

Development of Regions in the Context of Territorial Differentiation



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Abstract: *The goal of the study is determination of the spatial offset and geographical coordinates of the economic center in the North Caucasus for 2005 – 2015.*

The methodological base of the study is built on the centographic method. Results. The research in identifying new factors, mechanisms, and models of the national economy growth has intensified recently. The regional and spatial studies aimed at identifying "growth points", "development spaces", etc. that allow to "restart" the internal sources of growth development are an important area. The state of the economic center of the territory (from national to regional) is an important indicator in assessing the dynamics and structure of the growth development. The economic center of the territory can be a criterion; its behavior (offset to the North, South, West, East, as well as the pace and length of offset) can signal changes in factors, methods, and the mechanism of the existing economic growth in the national (regional) economy.

The geographical coordinates of the economic center in the North Caucasus for 2005 – 2015 have been defined in this article. New methodological provisions have been considered that allow defining the coordinates of the economic center of the microregion more correctly. The estimated data have been compared with similar data produced by other authors based on different methods; the advantage of the proposed technique has been demonstrated. Clarifications and methods of calculating and interpreting spatial offset and other centers of the national (regional) economy have been proposed.

Conclusion. *Certain provisions of the method for defining the location (coordinates) of the economic center, in accordance with which the economic center of the North Caucasus is found, have been provided in the article. The economic center of the North Caucasus is unstable and tends to offset.*

Keywords: *North Caucasus, spatial development, economic center, centographic method, territorial differentiation.*

I. INTRODUCTION

The research in identifying new factors, mechanisms, and

models of the national economy growth has intensified recently. The regional and spatial studies aimed at identifying "growth points", "development spaces", etc. that allow to "restart" the internal sources of growth development are an important area. The state of the economic center of the territory (from national to regional) is an important indicator in assessing the dynamics and structure of the growth development. The economic center of the territory can be a criterion; its behavior (offset to the North, South, West, East, as well as the pace and length of offset) can signal changes in factors, methods, and the mechanism of the existing economic growth in the national (regional) economy.

The search for an economic center has been considered in a number of publications in the economic and geographic studies [1-7]. This is due to, firstly, the search for new sources, factors, and conditions that influence the behavior of economies, secondly, the search for new methods and testing of new methods, as well as the development of the existing theoretical and methodological base for economic research, and thirdly, the search for criteria definitions and verification of economic phenomena, which are difficult or impossible to explain in the context of the existing mainstream. In this regard, the expansion of economic research into the inclusion of geography and a geographical factor in the context of territorial differentiation is an important aspect.

II. LITERATURE REVIEW

The development of methods for determining and assessing the behavior of the economic center of national, macroregional, and regional economies is an important aspect in the study of the modern problems of spatial development and location of production (as well as territorial organization). Various studies have been made into this aspect. However, most of the methods, such as J. Thunen, W. Launhardt, R. Cantillon, D. Stuart, D. Hume, D. Ricardo, A. Weber, and others [8], are based on a different scale adapted to national realities of a specific country (China, the US, etc.). The potential of such research is limited due to both territorial and methodological specifics.

There are works among Russian studies by D.I. Mendelev, B. Lavrov, B. Rodoman, and others that are related to the definition of the economic center of both the national economy and specific regions [5-7]. The value of these studies obliges to consider them specifically because they are "closer" to the topic of research in their goals, objectives, methods used, and the empirical basis.

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III. METHODS

A. General description

The key goal of the study was to determine the geographical coordinates of the economic center in the North Caucasus for 2005 – 2015.

The following tasks were implemented to achieve this goal: 1) presenting new methodological provisions that allowed to measure the coordinates of the economic center of the microregion more accurately; 2) comparing the estimated data with similar data proposed by other authors based on different methods; 3) determining the advantages of the proposed method; and 4) clarifying the interpretation of certain provisions of the theory and method of the research into the economic center of the territory. The subject of the study was the method for calculating (determining) the geographic location of the economic center in the macroregion (North Caucasus). The object of the study was the Russian Caucasus within the geographical boundaries of the North Caucasus.

The Russian Caucasus includes the northern part of the slope of the Greater Caucasus Mountain Range and Ciscaucasia, the western part of the southern slope up to the Psou River, along which the state border of Russia passes. The Russian Caucasus includes the republics of Adygea, Dagestan, Ingushetia, Karachay-Cherkessia, Kabardino-Balkaria, North Ossetia-Alania, and Chechnya, the Krasnodar and Stavropol regions, as well as the territory of Kalmykia and the Rostov region, lying south of Manych [9, 10].

The economic and geographical research and the works of economic geographers, regional specialists, and geographers made up a theoretical and methodological base of the study. It is based on the centographic method, which is adapted to the research into economic processes.

Geographical coordinates of the North Caucasus cities from reference books and corresponding websites of municipalities, as well as the data of the Federal State Statistics Service of Russia on the volume of GRP of the regions belonging to the North Caucasus and the size of their population served as an empirical base.

The centographic method was used as a methodological base, which had been first used by D.I. Mendeleev in Russia to solve the problem of determining the center of population in Russia [11]. It has been actively used by geographers (from various fields, including economic geographers) in solving problems related to geography to a certain degree since the imperial period [12-20]. The authors believe that the solution is not independent in terms of the methods and theory but acts as an instrument of a broader theoretical and methodological base: gravity methods and theory [16, 21].

B. Algorithm

In the framework of the study, the focus of the centographic method is made on finding a geographical point, relative to which the total moment of gravity acting on the system within the territorial unit is zero. The economic center of the territories is determined using the indicated position [22].

Several methodological provisions were proposed to find

the economic center of the North Caucasus. The first is to accept gross regional product (GRP) as the "economic mass of the territory" [23-25]. The conditional vector value, the scalar value of which is equal to GRP, is recognized as the force of the economy's gravity of the territory. The second is that the gravity vector of the economy of the territory is directed to the center of the Earth from a conditional point – the center of the territory, which is found as the center of gravity of a flat geometric figure expressing the geometry of the region. Moreover, the whole territory without a flaw is taken into account in this task, in contrast to the definition of other centers (population centers, in particular), in the calculation of which the territory of reservoirs, marshes, mountain ranges, and other places unsuitable for residence is eliminated.

Summarizing the available research and conducting a logical analysis of the problem, it can be concluded that the economic center of the North Caucasus can be defined by finding the economic centers of the regions included in the macroregion, and then the economic center of the macroregion can be found based on the obtained parameters.

As such, the proposal contains two stages: the so-called private or regional centers are found at the first stage, and macroregional centers are found on the second stage. This is apparently the classic way. It has its drawbacks associated with calculations by region and rests on a lack of statistical data. This contradiction can be circumvented by another direction, which consists in finding the economic center of the macroregion immediately and directly without first finding the centers of the region by taking into account the parameters of the main settlements (i.e., regional capitals and cities). However, both the geographical coordinates of these settlements and the volume of GRP (or GMP, gross municipal product), which is created in the settlements (cities) under study, should be known. This is a difficult task, given the state of the municipal statistics. This is why it is proposed to use indirect estimates by using the population of the Moscow region as a criterion. Of course, the population of the settlement is not an absolute indicator of the volume of manufactured products – GMP.

For example, there are settlements where the product (GMP) in GRP is higher than the share of the population of the settlement in the total population of the region. However, these discrepancies are usually eliminated, and the population can be taken as a fairly correct parameter for assessing the contribution of the settlement to the GRP.

The administrative capital of the region was taken as the economic center of the territory (region) in the study [5, 7]. The authors explain their choice by the fact that the major share of the GRP is being created in the capitals. However, according to the authors' estimates, although there is more GRP in regional capitals than in other cities and settlements, not all of GRP is created there. Moreover, the discrepancies are sometimes very significant. The estimates of the authors reveal that the share of regional capitals in the North Caucasus ranges from 15 % to 45 %.

If the population of the settlement is taken as a criterion, it will yield the same results. It turns out that regional capitals do not concentrate 100 % of the region's population, despite the concentration of the region's population and its dominance over the region's space.

For example, Vladikavkaz, the capital of the Republic of North Ossetia-Alania, has concentrated over 45 % of the republic's population, while Makhachkala in Dagestan accounts for just over 19 %, and Stavropol in the Stavropol region accounts for 15.5 %, etc. Therefore, other settlements (cities and towns) cannot be ignored even in the regions where the capitals really act as dominant and monopolists in the concentration of the population. As such, other settlements are also taken into account, in addition to the capitals. In this case, regional cities are used as such other settlements.

The absolute value of the GMP of the settlement should be found. To do this, a simple calculation can be made, where the GRP is multiplied by the share of the population of the Moscow region in the total population of the district. Formally, this operation looks as follows:

$$Q_i = GRP P_i / \sum P_i, (1)$$

where

Q_i is the GMP of the i -th settlement (city), mln rub.;

P_i is the population of the i -th settlement (city), thous. people; and

$\sum P_i$ is the entire population of the region, thous. people.

Of course, this value is not accurate. The value of the GMP of the Moscow region can be both less or greater than this estimated value. However, the authors assume that the accuracy obtained is quite enough to solve the problem. Once the value of the GMP has been obtained for all "significant" settlements of the macroregion, the coordinates of the economic center can be found. To do this, it is proposed to use the following expressions (they are presented both in the indicated source and in earlier ones referred to by the authors).

It is proposed to use the following expression to find the longitude (x) and latitude (y) coordinates. The east longitude is found as follows:

$$x_0 = \frac{\sum_{i=1}^n Q_i x_i}{\sum_{i=1}^n Q_i}, (2)$$

where

x_0 is the coordinates of the east longitude of the economic center, degree ($^{\circ}$);

x_i is the coordinates of the east longitude of the center of the i -th settlement (city), degree ($^{\circ}$);

Q_i is the GMP of the i -th settlement (city); mln rub.;

$i = 1 - n$ is the number of settlements (cities) taken into account in the calculation (taken in the calculations was 100 objects – cities of the North Caucasus).

The following expression is used to find the coordinates of the north latitude of the economic center:

$$y_0 = \frac{\sum_{i=1}^n Q_i y_i}{\sum_{i=1}^n Q_i}, (3)$$

where

y_0 is the coordinates of the north latitude of the economic center, degree ($^{\circ}$);

y_i is the coordinates of the north latitude of the center of the i -th settlement (city), degree ($^{\circ}$);

Q_i is the GMP of the i -th settlement (city); mln rub.;

$i = 1 - n$ is the number of settlements (cities) taken into account in the calculation (n in the calculations was 100 objects – cities of the North Caucasus).

IV. RESULTS

The geographical coordinates of the location of the economic center of the North Caucasus for 2005 – 2015 were determined during the study. New methodological provisions were considered, which allowed to measure the coordinates of the economic center of the microregion more correctly. The estimated data were compared with similar data produced by other authors based on different methods. The advantage of the proposed technique was shown. Clarifications and methods of calculating and interpreting spatial offset and other centers of the national (regional) economy were proposed.

Firstly, the proposed sample of settlements does not cover the entire macroregion. The selected objects in the Russian Caucasus accounted for 52 – 53 % of the total GRP. At the same time, the authors believe that the sample is quite representative for the description of the process under study, since other settlements – villages, auls and farms – are significantly smaller than the counted in terms of the number of people living in them, therefore, they do not compete with them. Secondly, all of the small settlements are located next to the counted large ones and are integrated with them in terms of creating a gross municipal product to some extent. Thirdly, the main thing is that the settlements adopted for the calculation act as certain points of concentration of the manufactured product, i.e., they act as economic centers in their local area, and the concentration zone of one economic center is formed outside the range of another economic center, i.e., local economic centers are concentrated in cities. The noted specifics have already been reflected at the level of sample settlements within the regions. In particular, the products of the counted settlements amounted to 52 – 54 % in the GRP in the Stavropol region, 66 – 67 % in the Rostov region, 50 – 52 % in the Krasnodar region, 38 – 40 % in Dagestan, 32 – 35 % in Chechnya, 52 – 57 % in Kabardino-Balkaria, 62 – 63 % in North Ossetia-Alania, 39 – 41 % in Karachay-Cherkessia, 35 – 38 % in Adygea, 44 – 45 % in Kalmykia, and 41 – 43 % in Ingushetia. The unaccounted (missing) volumes are concentrated around the counted ones.

In this regard, the identification of regional economic centers carried out according to the authors' method indicates that, with a rare exception (in particular, the exceptions in the North Caucasus were Adygea, Ingushetia, Kalmykia, and Karachay-Cherkessia, where the economic center coincided with the administrative center – the regional capital), the economic center of the territory does not coincide with the regional capital. The economic center of the Stavropol region is separated from the capital center by almost one degree to the North and by more than 1.2 degrees to the East from Stavropol.

The economic center of the Rostov region is separated from the capital center by more than 15 minutes to the South and 38 minutes to the East from Rostov-on-Don. The economic center of the Krasnodar region is separated from the capital

center by more than 10 minutes to the South and almost one degree and 20 minutes to the East from Krasnodar. The economic center of Dagestan is separated from the capital center by almost one degree to the South and about 10 minutes to the West from Makhachkala. The economic center of Chechnya is separated from the capital center by more than two minutes to the North and more than eight minutes to the East from Grozny. The economic center of Kabardino-Balkaria is separated from the capital center by more than four minutes to the South and more than 12 minutes to the East from Nalchik. Finally, the economic center of North Ossetia-Alania is separated from the capital center by almost six minutes to the South and more than four minutes to the North from Vladikavkaz.

Table 1. Comparison of the coordinates of the economic center of the Russian Caucasus, estimated by two methods.

Years/indicators		2005	2010	2015	Deviations in 2015 from 2005 in degrees	Deviations in 2015 from 2005 in km
The coordinates of the economic center, according to [7]	North latitude; $^{\circ}, ''$	45.2246	45.1807	45.1335	-0.0911	-16.9
	Change; +,-		-0.0439	-0.0512		
	East longitude (Greenwich); $^{\circ}, ''$	41.0109	41.0532	41.1337	0.1228	16.1
	Change; +,-		0.0423	0.0845		
The authors' economic center coordinates	North latitude; $^{\circ}, ''$	45.3639	45.3434	45.2934	-0.0705	-13.0
	Change; +,-		-0.0205	-0.05		
	East longitude (Greenwich); $^{\circ}, ''$	41.3831	41.3642	41.3847	0.0016	0.4
	Change; +,-		-0.0229	0.0205		
Deviations	North latitude; $^{\circ}, ''$	0.1433	0.1627	0.1639	0.0206	
	In terms of km	26.5	30.1	30.3		3.8
	East longitude (Greenwich); $^{\circ}, ''$	0.3722	0.311	0.251	-0.1572	
	In terms of km	48.9	40.9	33.0		-15.9

*The table has been compiled based on the data [7], as well as the calculations performed based on the data "Regions of Russia. Socioeconomic indicators of cities", as well as "Regions of Russia. Socioeconomic indicators" for the relevant years.

Comparison of the results of finding the economic center of the Russian Caucasus using the two methods revealed a discrepancy in both latitudinal and longitudinal measurements. Although the discrepancies do not exceed

minutes, they are noticeable. They also turned out to be higher in the longitudinal aspect than in the latitudinal. In particular, the difference in latitudinal aspect was 33'22" in 2005, 31'10" in 2010, and 25'10" in 2015 (Figure 1).

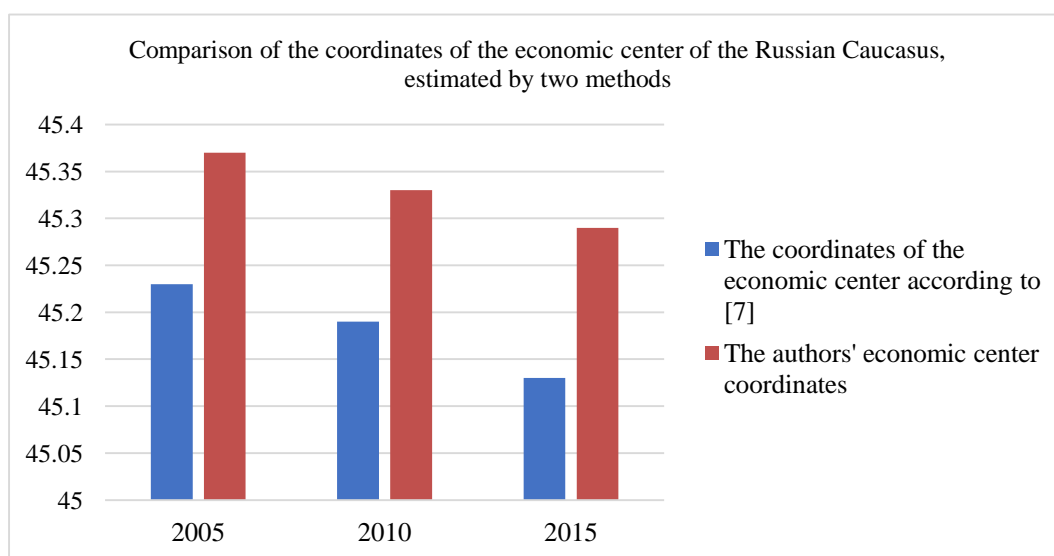


Fig. 1. North latitude; (Greenwich) o,

In terms of kilometers, the deviation was by 48.9, 40.9, and 33.0 km more eastwards, respectively, than in the calculations by the method of M. Gazaeva and her colleagues [7] (Figure 2).

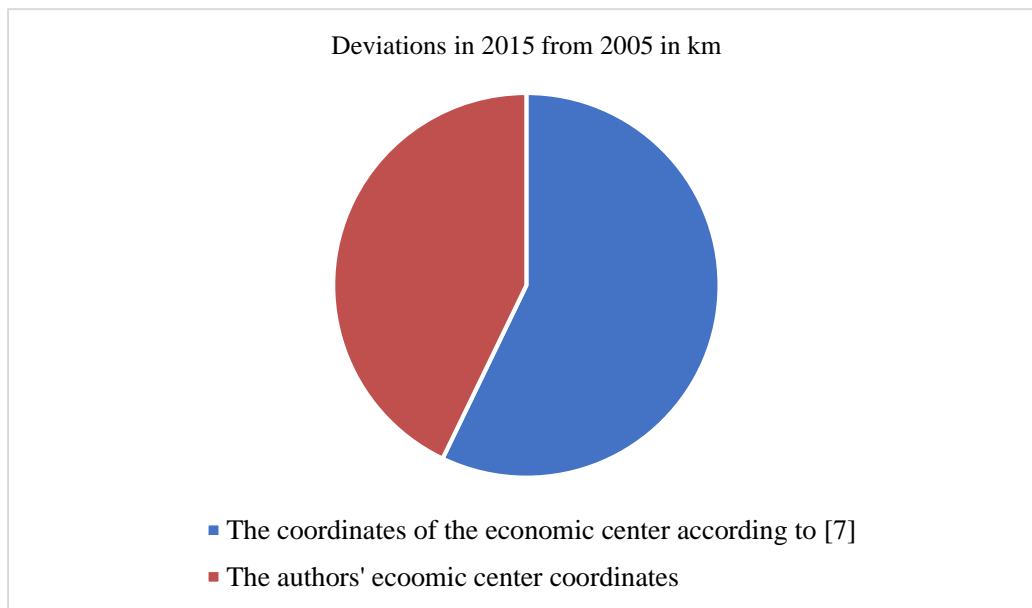


Fig. 2. North latitude in km.

In other words, the coordinates of the east longitude of the economic center of the Russian Caucasus according to the authors' method turn out to be to the East in comparison to the method of M. Gazaeva (Figure 3).

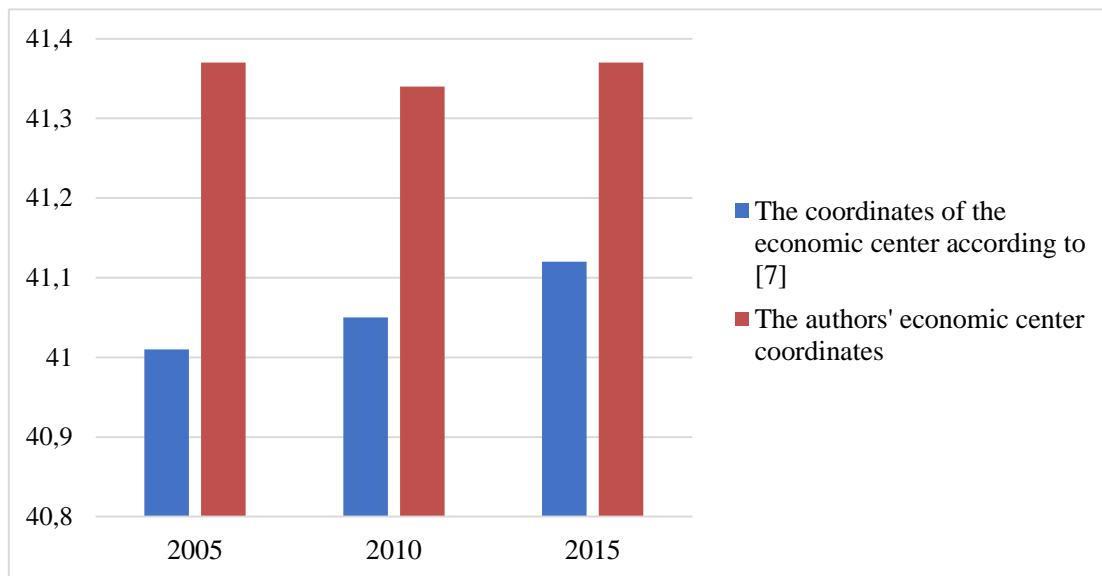


Fig. 3. East longitude (GMT); o,',"

There are less deviations in the latitudinal aspect. They amounted to 14'33" to the North in 2005, 16'27" in 2010, and 16'39" in 2015. In terms of the usual metric in km, the deviations were 26.5 km, 30.1 km and 30.3 km, respectively (Figure 4).

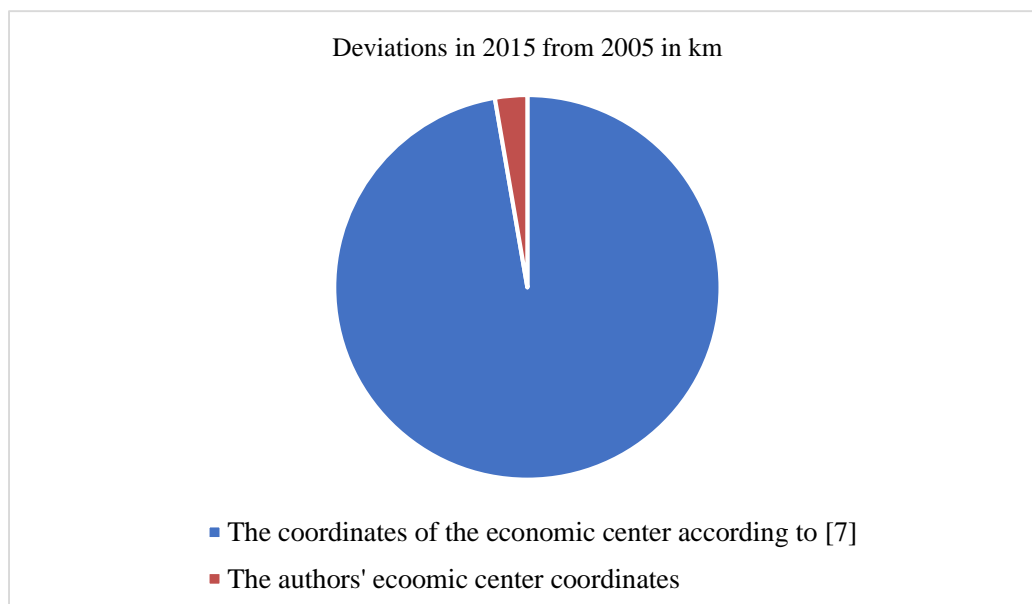


Fig. 4. East longitude, in km.

In general, the authors' economic center of the Russian Caucasus is located northeast of the economic center of the Caucasus. At the same time, according to the method of M. Gazaeva and her co-authors, it was located in the Stavropol region near Grigoropolisskaya closer to the border of the Krasnodar region in 2005 – 2015, while by the authors' estimations, the center is located in Tishenskoye, Stavropol region, northeast of the one determined by M. Gazaeva and her co-authors, which makes the Stavropol region even more Caucasian-centric.

V. CONCLUSION

As part of the study, the authors have presented certain provisions of the method for estimating the location (coordinates) of the economic center, in accordance with which the economic center of the North Caucasus is found. The economic center of the North Caucasus is unstable and tends to offset.

The existing methodological provisions related to the adoption of regional capitals as GRP concentration centers and taking into account the geographical coordinates of the administrative centers of regions for identification of the economic center distort the definition of a real economic center because the calculations have revealed that GRP of regions is not created exclusively in regional capitals. The share of regional capitals in the GRP of the regions of the North Caucasus ranges from 25 to 50 %. Therefore, it is incorrect to accept the geographical coordinates of regional capitals as economic centers of regions.

Two methodological directions for calculating the economic center of the macroregion have been proposed. The first is associated with the calculation of the averaged regional center with its subsequent use for calculating the economic center of the macroregion. The second one is related to the use of large settlements (the GMP of which is not 2/3 of GRP) and their geographical coordinates for finding the economic center of the macroregion.

It is proposed to use the share of the number of municipalities in the total population of the region to estimate the GMP of the settlement (cities, including regional capitals), which allows to convert the GRP into the GMP.

The economic center of the North Caucasus found by different methods is located in the Stavropol region on the border with the Krasnodar region.

As such, the Stavropol region acts as the economic center of the Russian Caucasus. A comparison of the coordinates of the economic center of the North Caucasus calculated by the authors' method from the ones calculated by other methods reveals the deviation in minutes (km). Moreover, the deviation in the longitudinal aspect is more significant than in the latitudinal one. However, there was a shift in the economic center of the North Caucasus to the South-East in both cases for the period from 2005 to 2015. Moreover, the shift to the East is more noticeable in the authors' calculations than in the calculations by another method.

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