The asymmetry of development of coastal cities of the Arctic zone of the Russian Federation

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Abstract. The development of coastal cities in the Arctic zone is characterized by a heterogeneous level. Some urban settlements have high rates of economic growth, while others have sustained stagnation. Differentiation can be caused by various reasons, one of which is location. Study of asymmetry of development of coastal cities of the Arctic zone, allows to estimate the impact of the factor geographical location on the level of economic development. In the study, the object is the coastal regions of the Arctic zone of Russia, and the subject is the process of regional heterogeneity of these territories. The heterogeneity study is based on the convergence tool. This mechanism will allow to assess the possibility of convergence of territories on certain economic and social indicators. In the study, the coefficient of variation is calculated and analysis is carried out for compliance with the conditions of $\sigma$-convergence. Rosstat's information base served as the main source of statistical data on coastal cities in the Arctic zone. The use of convergence allowed considering the coastal cities of the Arctic zone on separate economic and social indicators: population size, average monthly nominal accrued salary, investment in fixed capital. The built models of $\sigma$-convergence have shown that the process of reducing differences in these urban settlements is either not observed or economic prerequisites are needed to bring the territories closer together.

1. Introduction
In modern conditions for the development of the territory, the competitive advantages that it possesses are of special importance. Within the framework of a wide variety of territorial objects, coastal-type territories are of particular importance, the feature and advantage of which is the proximity of the territory to the sea area. The concept of "coastal zone" was most precisely defined by the European Commission: "The coastal zone is a space where human interaction with the environment is particularly intense. The coastal zone of the sea is the zone of contact of land with the sea, including natural complexes - both banks and adjacent marine areas within the boundaries, allowing to ensure ecologically balanced development of coastal territories, preservation of coastal and marine landscapes and ecosystems from pollution and destruction - territory with a regime of limited and regulated economic and other activities" [1].

A special format for interaction between economic activity and the environment is being formed within coastal cities.

The direction of economic development may have a positive aspect for the economy, which consists in the formation of specialization, which, in addition to the features of the Territory, may include the features of the coastal location. The economic directions of the coastal territory are industrial-commercial, recreational and tourist production, which are provided by the location factor.
Another area of coastal location is the existence of deficiencies that have an impact on development. It should be noted that these areas are areas of possible environmental problems.

As a result of the above, the aim of the study is to examine the economics of coastal cities and assess their level of development. The coastal cities of the Arctic zone of the Russian Federation - Arkhangelsk, Severodvinsk, Belomorsk, Kemh and Kandalaksha - were chosen as the objects of the study.

2. Literature review
The development of territorial entities is actively discussed in the scientific environment. Areas of research have a fairly wide range of issues, considering the economic and social characteristics of the object under study [2]. Unevenness in the majority of scientific articles is considered in the regional context, as a result the level of regional differentiation is determined [3].

An important importance is given to the economic and geographical location of territories [4]. The direction of economic and geographical location of territorial entities is important, in the context of the increasing role of the border. In determining the impact of the location of a territory, most researchers agree that the impact of a subject's location takes place, but it is not key in matters of territorial development [5].

In determining the importance of the geographical location of an area, several directions can be identified on the basis of which location is important [6]. First, the location is significant if the territory has proximity to the state border. In this case we are talking about competitive advantages of the territory, connected with great opportunities for foreign economic relations. Second, if the location of the Territory allows for access to the world's oceans. This advantage allows to intensify interaction with the world space, as well as to increase the cross-border function for the internal space. It should be noted that the considered processes are typical for increasing comparative advantages of regions. In the context of territorial entities, the position may be important in the presence of agglomeration effects, as well as the border location. Researchers pay special attention to the coastal location, which may be influenced by the infrastructure component, development of the production sector, and economic indicators.

Many interesting research papers have been devoted to the development of coastal areas, but the "starting point" is considered to be work B. I. Lymarev [7]. Of particular interest are the problems of these territories presented in the paper, which the author associates with the dynamics of the coastline and the impact of natural and anthropogenic factors on the territory.

The emerging interest in the scientific environment in coastal development has led to a wide variety of approaches and methodologies for marine and coastal area management. As a result, these areas are not always rational mechanisms for sustainable coastal development.

3. Methodology
The concept of a city has a rather blurred form, and researchers define this direction depending on scientific interests. A number of domestic studies present a generally accepted direction of urban settlement, which is that the majority of the population (more than 75%) should be employees of production and industrial enterprises. In a number of directions the status of the city is given to the territory on quantitative basis. In Russia, the Urban Planning Code uses a classification that is based on the number of people living in the city. [8].

The process of territorial development has a considerable number of preconditions, which have internal and external aspects. The internal aspect is to ensure the functioning and development of the urban settlement. The external aspect is formed as a result of the city's positioning and role in the formation and functioning of the economic system. Within the framework of the above, the urban settlement has various characteristics that determine the effectiveness of the internal and external aspects. One of the main directions is economic and geographical. "Thus, for example, the functional structure of the cities located near the water bodies consists mainly of such industries as cargo, fish and fish processing, recreation, etc.". [9].
Objects for study in this work are coastal cities of the Arctic zone - Arkhangelsk, Severodvinsk, Belomorsk, Kem, and Kandalaksha. The selected urban settlements have different level of economic development, different geographical location, population size and economic specialization, but these cities have a generalizing feature - coastal location.

The research of dynamics of the territorial research is carried out on the basis of statistical data of Rosstat. For the analysis of territorial heterogeneity the mechanism of estimation of territory walking is used on the basis of construction of convergence model, as a result of calculations $\beta$- and $\sigma$-convergence [13]. Using this tool, the coefficient of variation is calculated using the following formula:

$$\sigma_t = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - x_{cp})^2} / x_{cp}$$  

(1)

where $\sigma_t$ is a variation index in $t$, a time period, $x_i$ - regional development indicator $i$ territorial unit, $i = 1,...,n$ - number of economic subjects under consideration, $x_{cp}$ is an arithmetic mean indicator of regional development.

To assess the development of economic and social indicators of development, the data of Rosstat will be used to determine the dynamics and trends of economic growth of coastal cities.

4. The results

To carry out a comparative analysis of coastal cities in the Arctic zone of the Russian Federation, the main directions of development of these territories were analyzed. Within the constructed classification it is shown that the investigated coastal urban settlements have different functional directions of economic development. For example, Arkhangelsk is a port city with administrative functions.

| City         | Functions                            |
|--------------|--------------------------------------|
| Arkhangelsk  | Port function, administrative function|
| Severodvinsk | Port function, industrial function    |
| Belomorsk    | Administrative function, recreational function |
| Kemh         | Administrative function, fish processing function |
| Kandalaksha  | Administrative function, trade function |

*Source: compiled by the author

The study carried out on the functional purpose of coastal cities has a various of specifics. A large part of the cities under consideration are administratively oriented. The geographical location of urban settlements of this type allows the use of comparative advantage, expanding economic ties.

The obtained results allow to assume that economic development of coastal cities has the same vectors of economic development. The urban settlements under consideration in this study are characterized by different levels of development. Comparative analysis of a number of economic and social indicators will allow to assess the importance of the factor - geographical location.

| City          | 2010    | 2012    | 2014    | 2016    | 2018    |
|---------------|---------|---------|---------|---------|---------|
| Arkhangelsk   | 348 783 | 49 533  | 350 368 | 351 226 | 349 742 |
| Severodvinsk  | 191 353 | 190 083 | 187 284 | 185 075 | 183 255 |

Table 2. Comparative assessment of the development of Arctic coastal cities - population size.
A further direction of the study is to assess the level of heterogeneity of development of coastal cities of the Arctic zone of the Russian Federation.

Average monthly nominal accrued wages of the urban settlements studied do not have a significant gap. The exception is the town of Belomorsk, which has a comparatively lower figure throughout the whole period (Table 3).

Table 3: Average monthly nominal accrued salary, rubles

| Settlement   | 2014    | 2015    | 2016    | 2017    |
|--------------|---------|---------|---------|---------|
| Arkhangelsk  | 38288.6 | 40302.6 | 43177.7 | 45097.7 |
| Severodvinsk | 42843.9 | 47333.5 | 51110.5 | 54679.6 |
| Belomorsk    | 32056   | 32975   | 33839   | 35114   |
| Kemh         | 42435   | 42977   | 45257   | 48335   |
| Kandalaksha  | 39591   | 41177   | 44600   | 46616.5 |

*Source: compiled by the author.

On the basis of the calculation of the coefficient of variation, asymmetry of coastal cities of the Arctic zone of the Russian Federation was considered (Table 4).

Table 4: Coefficient of variation value by indicator average monthly nominal accrued salary by the coastal regions of the Arctic Zone

| years  | 2014 | 2015 | 2016 | 2017 |
|--------|------|------|------|------|
| variation coefficient | 0,10 | 0,11 | 0,13 | 0,14 |

*Source: compiled by the author.

Calculations of the coefficient of variation showed a reduction in regional differentiation within the study period from 2014 to 2017. The value of the coefficient of variation is steadily increasing. The analysis of the data in Table 4, as well as the absence of compliance with the condition of convergence, suggests an increase in the divergence between the territories.

The geographical interpretation of the coefficient of variation confirms the absence of a tendency towards convergence of the studied territories and allows to observe changes in the coefficient, comparing these changes with general economic changes in the economy.
Another area that is analyzed by the level of economic heterogeneity is the study of inequality of the regions under consideration by the indicator of investment in fixed capital (Table 5).

**Table 5:** Investments in fixed capital (in actual prices), million rubles

| Year | Arkhangelsk | Severodvinsk | Belomorsk | Kemh | Kandalaksha |
|------|-------------|--------------|-----------|------|-------------|
| 2012 | 17429,5     | 3891,8       | 680,7     | 81,3 | 953,5       |
| 2013 | 11754,4     | 4124,6       | 526,2     | 51,3 | 801,1       |
| 2014 | 15258,6     | 8412,5       | 804,4     | 35,5 | 1028,4      |
| 2015 | 10473,5     | 7774,9       | 119       | 232,4| 207,9       |
| 2016 | 12941       | 8487,2       | 193,07    | 220,08| 230,1       |
| 2017 | 17 277,10   | 9 295,70     | 199,682   | 92,619| 738,4       |

*Source: compiled by the author*

On the basis of the coefficient of variation calculation the following dynamics of regional differentiation by the indicator of investment in fixed assets is observed.

**Table 6.** Coefficient of variation by fixed investment by coastal regions of the Arctic zone

| Years | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|-------|------|------|------|------|------|------|
| Variation coefficient | 1,27 | 1,27 | 1,16 | 1,19 | 1,21 | 1,24 |

*Source: compiled by the author*

The dynamics of the coefficient of variation within the coastal cities of the Arctic zone has an unsustainable trend, which may be related to the period of economic instability – 2014. In the future, the situation will be leveled off and we can talk about the process of convergence.
5. Conclusions.
Studies of the regional asymmetry of coastal cities in the Arctic zone have revealed similar and distinctive features of these territories [10]. A positive aspect contributing to territorial development is the population dynamics of these urban settlements. The observed decline in numbers occurs evenly throughout the research period, leading to the conclusion that there are no significant migration outflows.

A study of the urban coastal area of the Arctic Zone for heterogeneity showed an unstable trend in various indicators. On the one hand, the increase in heterogeneity in the level of average monthly wages, which is the result of the development of the production and financial sector. On the other hand, the impact of crisis manifestations on the dynamics of fixed investment. Within the framework of the above, it is possible to speak about the continuation of general federal trends in the territorial development of coastal cities of the Arctic zone of the Russian Federation.

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