Approach to typologization of territories by the level of investment potential using methods of cluster analysis (on the example of the constituent entities of the Far Eastern macroregion)

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Abstract. The article deals with the problem of improving the sustainability of social and economic development of the Far Eastern Federal District (FEFD). The possibilities and limitations of the most well-known approaches and methodologies for assessing the investment climate are considered. It is argued that imperfect approaches to the assessment of investment potential of regions, as well as the shortcomings of strategic planning system for the development of Russian macro-regions, lead to the fact that the state applies the same management decisions to the constituent entities that differ significantly in social and economic potential. The results of the assessment of the investment potential of the FEFD are presented. The need to clarify the used assessment algorithms based on specific factors and conditions of development of certain groups of territories is substantiated. Using the methods of cluster analysis, the typology of the regions of the FEFD was carried out, and the peculiarities of realization of investment potential within 3 clusters of territories were highlighted. The article proposes a differentiated approach to the assessment of investment opportunities of regions, focused on the maximum use of accumulated socio-economic potential for developed regions and the development of priority measures of state support for regions with a limited resource of self-development.

Keywords: strategic planning, cluster analysis, macroregion, investment climate, Far East, investment potential.

1 Introduction

The President’s Address to the Federal Assembly in December 2013 declared the development of the Far Eastern macroregion as Russia's national priority for the entire 21st century. The government’s new macro-regional policy aims not just to implement individual, albeit large-scale, projects, but to develop the Far Eastern regions in a
qualitatively different way, which cannot be achieved without attracting a huge amount of investment. The formation of a favorable investment climate in the Far East and its constituent entities requires identifying and understanding the problems that hinder the creation of conditions for active investment activity in the macroregion, as well as developing measures to mitigate these problems, which is especially relevant in the current context of external sanctions and new geopolitical challenges. In methodological terms, imperfect approaches to determining the investment potential of regions and shortcomings of the system of strategic management of the development of Russian macroregions in general lead to the fact that the state applies the same management decisions in relation to constituent entities that differ significantly in social and economic potential, and that there are no tools to “fine-tune” measures of state regulation in the implementation of investment policy.

Thus, the purpose of the research is to develop a differentiated approach to the assessment of investment opportunities for regions, focused on the maximum use of accumulated potential for developed regions, and the development of measures of priority state support for the group of regions, which in the current conditions have a limited resource for self-development due to existing trends. In order to achieve the goal of the study, it seems advisable to conduct a typology of the regions of the Far Eastern Federal District by the level of investment potential using methods of cluster analysis and propose differentiated mechanisms to improve the investment climate for homogeneous groups of regions, justify an expanded methodology to assess their investment potential with regard to belonging to a particular cluster.

2 Materials and methods

Assessment of the investment climate of any spatial structure is a labor-intensive process that requires generalization of a large number of characteristics and development of special methods for their integration. At present there is a great variety of approaches and methods for evaluation of investment climate of territories. Description of the best-known approaches with highlighting of the main possibilities and limitations of their application within the framework of the problem to be solved, are presented in table 1.

Table 1. Approaches and methodologies for assessing the investment climate of territories.

<table>
<thead>
<tr>
<th>Author</th>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td>Rating agency “Expert RA”</td>
<td>Simplicity, clarity, comprehensiveness</td>
<td>Subjective nature of the assessment</td>
</tr>
<tr>
<td>Institute of Economics RAS</td>
<td>Complexity, use of statistics</td>
<td>Subjectivity of the assessment</td>
</tr>
<tr>
<td>National Rating Agency</td>
<td>Openness of the data and their use from different sources</td>
<td>Subjectivity of the assessment</td>
</tr>
<tr>
<td>“Moody’s”, “Fitch Ratings”, “Standart&amp;Poor’s” and others</td>
<td>Simplicity, clarity, provision of complex information for a certain group of investors</td>
<td>Subjectivity of the assessment</td>
</tr>
<tr>
<td>Y. A. Doroshenko</td>
<td>Only one criterion is taken into account</td>
<td>Difficulties of receiving data when forecasting incomes, subjectivity of assessment</td>
</tr>
<tr>
<td>V. P. Efimov</td>
<td>Use of big volumes of data, clarity, compactness</td>
<td>Time consuming nature of calculations</td>
</tr>
<tr>
<td>G. R. Ibragimova</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Factorial approach

<table>
<thead>
<tr>
<th>Approach</th>
<th>Characteristics</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-factor (Guseva K., Loguntsova I. V., Zulkarnaev I. U., etc.)</td>
<td>Simplicity, clarity</td>
<td>Inaccuracy of results, subjectivity of evaluation</td>
</tr>
<tr>
<td>Multifactor (Brodsky M. N., Knysh M. I., Perekatov B. A., Titikov Y. P., Harvard Business School methodology, etc.)</td>
<td>The use of many factors and indicators (qualitative and quantitative), differentiated approach to different levels of the economy when assessing the investment climate</td>
<td>Lack of precisely defined set of factors, subjectivity of assessment when assessing qualitative indicators</td>
</tr>
<tr>
<td>Risk-based approach</td>
<td>Possibility to assess perspectives and attractiveness of a territory or an industry for investment and compare them with possible risk level</td>
<td>Generalized characteristics of investment climate, does not have deep regional detailing, does not allow authorities to use them when developing strategies to improve investment attractiveness of territories</td>
</tr>
</tbody>
</table>

*Source:* Compiled by the authors based on [1-19].

Despite the extensive functionality of the methods and approaches described above, the main drawback of most of them is the lack of a differentiated approach to the assessment of the investment potential of territories heterogeneous in terms of development level. Within the framework of the solution of this problem the authors propose an extended methodology for assessing the investment potential of territories. At first, it involves the calculation at the initial stage of the complex indicator of investment potential based on the assessment of “sub-potentials” by 8 groups of indicators. At the next stage, the cluster analysis is carried out in order to typologize the regions and clarify the final value of the complex investment potential, taking into account the territory’s belonging to one of the selected clusters. This approach allows further application of differentiated measures of state regulation in relation to the constituent entities that have significantly different investment potential, including the ability of the regions to form a favorable investment climate in conditions of limited financial resources.

### 3 Results

According to the proposed two-step algorithm, it is necessary to analyze a set of social and economic indicators that characterize the level of development of the macrorregion’s constituent entities at first step. The solution to this problem involves:

1. Partitioning the set of used indicators for assessing the investment climate into homogeneous groups (potentials). In this case, only those indicators that have a high correlation with the indicators affecting investment activity in the macro-region are used.

2. To standardize the obtained indicators, the minimax method was applied according to the formula (1)

\[
x'_i = \frac{x_i - \bar{x}_i}{\bar{x}_i - \min(x_j)}
\]

where \(x'_i\) – is the normalized value of the indicator assessing the potential of the i-th region;
\( x_i \) – the initial value of the indicator;
\( \langle x_i \rangle, (x_i) \) – the highest and the lowest value of the indicator respectively for all the subjects included in the macroregion.

3) Carrying out the cluster analysis. The basic indicators of social and economic development of the constituent entities of the Far Eastern macroregion were the initial data for the analysis.

Based on the preliminary analysis of investment climate assessment indicators for the constituent entities of the Far East, 25 indicators were selected. Those were grouped into 8 homogeneous groups (potentials), the value of each block of indicators (potentials of macroregion) was determined as the average of the normalized values of used private indicators. The results of the obtained calculations according to the above algorithm are presented in Table 2.

**Table 2.** Results of the assessment of the investment potential of the regions of the Far Eastern Federal District.

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Republic of Sakha (Yakutia)</td>
<td>0.54</td>
<td>0.4 7</td>
<td>0.64</td>
<td>0.46</td>
<td>0.37</td>
<td>0.44</td>
</tr>
<tr>
<td>Kamchatka Territory</td>
<td>0.36</td>
<td>0.1 4</td>
<td>0.27</td>
<td>0.14</td>
<td>0.18</td>
<td>0.09</td>
</tr>
<tr>
<td>Primorye Territory</td>
<td>0.8</td>
<td>1</td>
<td>0.63</td>
<td>0.84</td>
<td>0.72</td>
<td>0.73</td>
</tr>
<tr>
<td>Khabarovsk Territory</td>
<td>0.74</td>
<td>0.7</td>
<td>0.49</td>
<td>0.73</td>
<td>0.51</td>
<td>0.66</td>
</tr>
<tr>
<td>Amur Region</td>
<td>0.63</td>
<td>0.3 8</td>
<td>0.26</td>
<td>0.66</td>
<td>0.2</td>
<td>0.24</td>
</tr>
<tr>
<td>Magadan Region</td>
<td>0.28</td>
<td>0.0 6</td>
<td>0.33</td>
<td>0.08</td>
<td>0.25</td>
<td>0.05</td>
</tr>
<tr>
<td>Sakhalin Region</td>
<td>0.71</td>
<td>0.2 5</td>
<td>0.59</td>
<td>0.27</td>
<td>0.48</td>
<td>0.11</td>
</tr>
<tr>
<td>Jewish Autonomous Region</td>
<td>0.33</td>
<td>0.0 3</td>
<td>0.01</td>
<td>0.1</td>
<td>0.04</td>
<td>0.03</td>
</tr>
</tbody>
</table>
At the second stage, taking into account the obtained assessments of potential values, a cluster analysis was carried out to highlight the same-type groups of regions (clusters). For this purpose, hierarchical agglomerative methods of clustering were used, and the results are presented as a dendrogram in Figure 1.

![Dendrogram of cluster analysis](image)

**Fig. 1.** Results of cluster analysis by regions of the Far Eastern macroregion. Source: Compiled by the authors.

According to the results of the analysis, three clusters were identified, uniting the constituent entities of the Far Eastern macroregion with similar investment potential, but differing in a set of other characteristics, which, among other things, should be considered both in the formation of strategic plans for the development of territories, and in the development of measures to create a favorable investment climate.

## Discussion

The selection of 3 clusters on the territory of the Far Eastern macroregion allows proposing a differentiated way of calculating the potential of the constituent entities of the
macroregion within each cluster as part of further research. The proposed algorithm consists of the following steps:

1) Assessment of the basic values of the potentials of each macroregion constituent entity in accordance with the methodology described above. Then the values of the indicators are brought to a standardized form.

2) Conducting a cluster analysis to identify regions with similar investment potential.

3) Assessment of the investment climate according to formula (2) using special correction factors $W_i \epsilon [0;1]$, calculated on the basis of methods of mathematical statistics and taking into account the belonging of the region to a certain cluster.

$$I = \sum_{i=1}^{N} \frac{W_i \times X_i}{m},$$

where $I$ is the total weighted assessment of the investment climate of the macroregion;

- $W_i$ – correction factor, taking into account the region’s belonging to a cluster;
- $X_i$ – value of the region’s potential;
- $m$ – number of regions in the cluster;
- $N$ – number of regions.

The basic level of the investment climate is assessed according to the quartile theory, for example considering the following scale:

- 0.00 to 0.25 – unfavorable;
- 0.26 to 0.50 – neutral;
- 0.51 to 0.75 – moderate;
- 0.76 to 1.00 – favorable.

At the next stage, the obtained estimates of the investment climate level were used to single out 3 homogeneous clusters uniting regions with similar conditions of the investment climate. Fig. 2 shows a cartographic representation of the obtained distribution of the regions of the Far Eastern macroregion by the investment climate level as of 2021.
Thus, the proposed assessment algorithm will make it possible to identify groups of regions that are similar in terms of the investment climate level and, accordingly, to form differentiated measures and mechanisms to improve the investment climate. Within each of the 3 selected clusters the following priority measures are proposed:

- **1st cluster:** using the advantages of territorial potential of the regions (development of agriculture, including increased competitiveness of local agricultural products in the domestic and foreign markets; development of all types of tourism; expansion of transport and logistics flows; rational use of natural resources and consolidation of added value in the cluster, etc.), which plays a crucial role in the investment attractiveness of the cluster.
- **2nd cluster:** development of the Northern Sea Route; development of industrial production through mining, creation of conditions for the development of hard-to-reach and remote areas; development of Arctic tourism, etc.
- **3rd cluster:** growth of throughput and carrying capacity of the region’s railway network; implementation of projects related to construction and modernization of seaport transshipment facilities; active participation in implementation of joint mutually beneficial projects with APR countries; development of all types of tourism (resort, cruise, cultural-historical, health, gastronomy), etc.
5 Conclusion

The article assesses the interrelation of a set of indicators for evaluating the investment potential of the FEFD constituent entities and proposes a differentiated approach to assessing the investment climate of spatial structures, consisting of several stages: assessing the potential of each constituent entity of the macroregion, conducting a cluster analysis to typologize the regions, assessing the investment climate of the macroregion, taking into account the cluster membership, developing recommendations to improve the investment climate for each highlighted cluster separately. In general, the proposed approach is universal and makes it possible to cluster regions according to the indicators that are of interest to specific investors. The results of the study can also be used by public authorities to analyze management decisions in the strategic planning of territories development.

Acknowledgments

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