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ANALYSIS AND MODELING OF TAX REVENUE DYNAMICS FOR UNITED TERRITORIAL COMMUNITIES

To date, the digitization of the economy has touched virtually every aspect of society life. This also applies to the activities of the united territorial communities (UTC). Due to the decentralization reform, since 2016, the annual increase of the revenues of the local budgets has been observed [1]. To the checking account of the territorial community, there are daily payments for the taxes and fees at the expense of which the UTC operates. Therefore, in order to plan their activities and ensure the functions of the UTC, it is an important question to study and analyze the dynamics of these revenues.

As a rule, each tax has different volume and a schedule of revenues (for example, the income tax is paid monthly, the land tax is paid once a year). Depending on the size and location of the community, the types of tax revenue may have several dozen items. Hence, modeling each individual tax is inappropriate, and the task of economists is to group taxes by the nature of their dynamics.
The authors have developed a mechanism for grouping taxes with similar dynamics (Figure 1) for further modeling and forecasting of tax revenues.

The proposed analysis and modeling mechanism was tested on the data of Veselivs'ka United Territorial Community (Zaporizhzhia region): retrospective monthly data on tax revenues for the period January 2016 - October 2018 were taken. The total revenue list includes 26 types of taxes.

In the first stage of the analysis, the share of each tax in the total tax revenues was calculated. The next step is to select the threshold percentage (integer) at which the tax group is formed, that in total account is more than 90% of the total amount of revenues. In this case, 11 budget-forming taxes were selected (Table 1) having more then a 2% specific weight (the main types of taxes are receipts in excess of 2% share of all tax receipts). Thus, the total share of budget-forming taxes is 93.6%.

Figure 1 - Analysis and modeling mechanism of tax revenues for united territorial communities

With the help of Statistica software, a dendrogram is built, which allows setting the optimal number of clusters (4 clusters). In order to
identify revenues with similar dynamics, a cluster analysis is performed using the k-means method. The results of the cluster analysis are shown in Table 1.

### Table 1

<table>
<thead>
<tr>
<th>№</th>
<th>Name of the tax</th>
<th>Specific weight, %</th>
<th>Cluster number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Employee income tax</td>
<td>37,1%</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Income tax of individuals - self-employed persons and independent professional activity</td>
<td>2,3%</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Fixed tax on personal income from engaging in business activities</td>
<td>4,8%</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Fuel</td>
<td>4,3%</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Excise tax on sales of excisable goods by retailers</td>
<td>5,7%</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Land tax on legal entities</td>
<td>2,2%</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Legal entity’s rents</td>
<td>6,4%</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Land tax on individuals</td>
<td>3,9%</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Individuals’ rent</td>
<td>2,9%</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Flat tax on individuals</td>
<td>7,9%</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>Flat tax on agricultural producers</td>
<td>16,0%</td>
<td>3</td>
</tr>
</tbody>
</table>

As a result of clustering, 4 clusters are obtained according to the nature of the dynamics. The first and third clusters consist of one tax each: Employee income tax - in the first cluster and Flat tax on agricultural producers - in the third. Two of these taxes are characterized by a significant amount of revenue, but the employee income tax is characterized by stable income and a positive trend. The flat tax on agricultural producers, by contrast, is characterized by a significant divergence in the amounts of monthly receipts (the main amounts of this tax are payable in October).

The second cluster consists of two taxes: Land tax on individuals and Individuals’ rent. These two taxes give insignificant payments during the year and main payments in July-August.

The fourth cluster is formed by all other tax revenues from Table 1, which are not included in clusters 1-3.

For the purposes of further forecasting, special attention should be
paid to the 15 types of tax revenue not included in Table 1, each with a share less than 1.6% (the total share of these 15 tax revenues is 6.4%).

Figure 2 shows the 5 tax revenue groups that are combined by the common nature of the dynamics.

![Figure 2 - Tax revenues for groups that share the same dynamics (4 clusters and a group of non-core taxes)](image)

It should be noted from Figure 2 that, despite combining a sufficiently broad set of different revenues in a cluster 4 and a non-core tax group, the aggregate dynamics of the cluster 4 and non-core taxes have fairly stable dynamics with little upward trend and fluctuations within certain bands, which makes the group's data easy to predict.

In general, the empirical studies conducted on the data of the Veselivs'ka UTC indicate the practical value of the proposed mechanism and the feasibility of its use in automated systems of analysis and forecasting of tax revenues.

References