METHODOLOGICAL APPROACHES TO DEFINING "DEMOGRAPHIC "FRAMEWORK" OF THE TERRITORIES INDUSTRIAL AND LOGISTIC DEVELOPMENT (CASE-STUDY FOR REGIONS IN THE VOLGA FEDERAL DISTRICT)

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ABSTRACT  
The industrial development and the spatial concentration of its corresponding economic activities are based and are in many respects caused by a demographic profile of regions, city population displacement type, positive and negative demographic trends taking place, an energy potential, as well as raw opportunities of the considered regions rent development. In article methodological approaches to discovering reasons for integrated indicator of demographic capacity development in the region are provided, its definition is given, the indicators included in its structure are theoretically proved and also the high level of influence of the demographic environment development on rates of social and economic growth in regions is theoretically proven and has found complex reflection in the model representing correlation dependence between the considered indicator.

Keywords: demographic framework, agglomerations competitiveness of regions, number of urban population, demographic priorities of productive forces development, industrial hubs of regions.

INTRODUCTION  
In regions the centers of industrial and industrial development are agglomerations. And here the hierarchy of industrial priorities and industrial development is created, not completely matching the regional.

It is reasonable to carry out methods of priorities determination in the methodological plan in the terms "number of urban population - city rank". It is known that the locus in the specified system of "phase" coordinates within a natural way of the created and developing city displacement system is described by Zipf's curve: $P_N = \frac{P_{MAX}}{N}$, where $P_N$ - the number of urban population with a rank N, and $P_{MAX}$ - the number of urban population in the largest ("capital") city of the considered regional system.

If "natural order" of city system forming of the region was broken for one reason or another, then the generalized analog of the Zipf's curve is recommended: $P_N = \frac{P_{MAX}}{N^\alpha}$, where $\alpha$ – the shifts parameter of actually developed structure of city displacement from the "natural" look to which $\alpha=1$ corresponds.
Having drawn up the logarithm for both parts in the equation of the generalized sedate Zipf's curve, we will receive \( \log p_N = \log \frac{P_{\text{MAX}}}{N^\alpha} \), or, expression equivalent to it \( \log p_N = \log P_{\text{MAX}} - a \log N \). Here \( N \) represents "rank" of the city settlement from 1 to 1537, \( \log p_N \) – function in which arguments are \( P_{\text{MAX}}, \alpha \) and \( N \). The main here are \( \alpha \) and \( N \), and \( P_{\text{MAX}} \) acts as mathematicians say, "an arbitrary parameter" as the fixed parameter depending on territorial borders for which Zipf's curve is being built.

Further we suggest to range the cities in the researched and estimated city agglomeration from the point of view of their "demographic priority" identification in the forthcoming industrial and industrial development by means of an indicator \( \log p_N \), which acts as mathematicians say, "an arbitrary parameter" as the fixed parameter depending on territorial borders for which Zipf's curve is being built.

Further we suggest locate the cities in the researched and expected city accumulation from the point of view of their "demographic priority" identification in the forthcoming industrial development by means of the indicator \( \log p_N \), which is the bigger, the bigger \( N \) is. Further observance of these priorities will allow to bring closer structure of city displacement to its "natural" look if \( \alpha=1 \).

Ranging of agglomerations, both in one region, and between regions, can be carried out at the same time as follows: \( R_K = \sum_{l=1}^{m_k} a_{ik} \log p_{ik} \), where \( a_{ik} \) - specific weight of \( i \) city settlement in the total number of the agglomerations population \( k \) \( (\sum_{l=1}^{m_k} a_{ik} = 1) \), \( m_k \) - the number of the city settlements allocated in \( k \) agglomeration \( P_{ik} \) - number of resident urban population of the city, settlement of city type. That is, \( R_K = \sum_{l=1}^{m_k} \frac{a_{ik} \log p_{ik}}{\sum_{l=1}^{m_k} p_{ik}} \).

METHODS

Approbation and verification of developed approach have been performed on the basis of determining the rank values of the agglomerations which are a part of the Volga Federal District of the Russian Federation regions [Safiullin et al., 2015].

Today three regions form "the core" of the "demographic framework" of future industrial development of the Volga Federal District – the Republic of Tatarstan, Samara and Nizhny Novgorod regions. And in this “core” the rating of the predicted demographic development in the Samara region is slightly higher, than in the Republic of Tatarstan, and in each of these regions is a little more preferable, than in Nizhny Novgorod Region.

The allocated “core” of "the demographic framework" is effectively supplemented by the Republic of Bashkortostan. Having promptly increased a share of the cities population from 3,6% in 1897 to 11,7% in 1989, the Republic of Bashkortostan gradually further raised this share: to 12,1% in 2002 and 12,4% in 2010. Such dynamics represents undoubted "asset" of the region and brings it closer to three regions considered above [Asian Social Science].

All above gives the grounds to provide "the core" of "the demographic framework" of regions industrial development for Volga Federal District taking into account "internal hierarchy" as follows:
Having determined "the core" of "the demographic framework" of Volga Federal District regions we will determine and make comparative dynamics analysis of their logarithmic ratings for estimated city agglomerations from the point of view of their "demographic priority" identification in the forthcoming industrial development.

We will determine and compare $R_k$ for the agglomerations allocated by us in "the core" regions of "the demographic framework" of the Volga Federal District. First of all, we will consider the largest of them.

Agglomeration of Samara includes, along with Samara itself, the cities of Novokuybyshevsk, Kinel, as well as city type settlements of Smyshlyaevk, Novosemeykino, Alekseyevka, Ust-Kinelsky, Mirny, Volga. 9 settlements total. The table of calculation of the demographic structure priority covering the specified agglomeration will look as follows.

**Table 1. Calculation of priority in the forthcoming industrial development of agglomeration of the cities of Samara and Novokuybyshevsk**

<table>
<thead>
<tr>
<th></th>
<th>N (1989)</th>
<th>$log P_{ik}$</th>
<th>$P_{ik}$ (th. peopl.)</th>
<th>$\alpha_{ik}$</th>
<th>$\alpha_{ik} log P_{ik}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Samara</td>
<td>5</td>
<td>3,099</td>
<td>1257,3</td>
<td>0,8653</td>
</tr>
<tr>
<td>2</td>
<td>Novokuybyshevsk</td>
<td>123</td>
<td>2,053</td>
<td>112,5</td>
<td>0,0774</td>
</tr>
<tr>
<td>3</td>
<td>Kinel</td>
<td>443</td>
<td>1,509</td>
<td>32,3</td>
<td>0,0222</td>
</tr>
<tr>
<td>4</td>
<td>Smyshlyaevk</td>
<td>889</td>
<td>1,134</td>
<td>13,6</td>
<td>0,0094</td>
</tr>
</tbody>
</table>
### Table 2. Calculation of priority in the forthcoming industrial development of city agglomeration of Nizhny Novgorod, Dzerzhinsk, Bor, Kstovo, Balakhna

<table>
<thead>
<tr>
<th></th>
<th>N (1989)</th>
<th>( \log P_{ik} ) ( k=2 )</th>
<th>( P_{ik} ) (th.peopl.) ( k=2, 1989 )</th>
<th>( \alpha_{ik} )</th>
<th>( \alpha_{ik} \log P_{ik} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Nizhny Novgorod</td>
<td>3</td>
<td>3,157</td>
<td>1434,7</td>
<td>0,7122</td>
<td>2,2485</td>
</tr>
<tr>
<td>2 Dzerzhinsk</td>
<td>61</td>
<td>2,463</td>
<td>285,4</td>
<td>0,1417</td>
<td>0,3490</td>
</tr>
<tr>
<td>3 Kstovo</td>
<td>224</td>
<td>1,811</td>
<td>64,5</td>
<td>0,0320</td>
<td>0,0580</td>
</tr>
<tr>
<td>4 Bor</td>
<td>226</td>
<td>1,809</td>
<td>64,4</td>
<td>0,032</td>
<td>0,0578</td>
</tr>
<tr>
<td>5 Zavolzhye</td>
<td>331</td>
<td>1,643</td>
<td>43,9</td>
<td>0,0218</td>
<td>0,0358</td>
</tr>
<tr>
<td>6 Balakhna</td>
<td>380</td>
<td>1,581</td>
<td>38,1</td>
<td>0,0189</td>
<td>0,0299</td>
</tr>
<tr>
<td>7 Bogorodsk</td>
<td>380</td>
<td>1,581</td>
<td>38,1</td>
<td>0,0189</td>
<td>0,0299</td>
</tr>
<tr>
<td>8 Gorodets</td>
<td>423</td>
<td>1,534</td>
<td>34,2</td>
<td>0,0170</td>
<td>0,0260</td>
</tr>
<tr>
<td>9 Volodarsk</td>
<td>1062</td>
<td>1,045</td>
<td>11,1</td>
<td>0,0055</td>
<td>0,0058</td>
</tr>
<tr>
<td>Total</td>
<td>x</td>
<td>x</td>
<td>2014,4</td>
<td>1,00</td>
<td>2,8407</td>
</tr>
</tbody>
</table>
As we see, agglomeration Samara in spite of the fact that Nizhny Novgorod in 1989 was 14% larger on the urban population number, being from the point of view of a demographic priority in the forthcoming industrial development of greater priority, than agglomeration of Nizhny Novgorod. Moreover, the assessment corrected on values of specific weight in agglomeration $\alpha_{ik} log P_{ik}$ actually, for was higher Samara, than for Nizhny Novgorod [World Applied Sciences Journal].

We will consider and will estimate agglomeration of Kazan now. Other than Kazan it also includes the cities of Zelenodolsk, Volzhsk (Republic of Mari El), city type settlements of Vasilyevo, Lower Vyazovye. We will notice that in Kazan 1085,3 thousand people lived in 1989. Insignificant feature of the Kazan agglomeration is that its borders cover not a really big city of 61,4 thousand people, but this city enters into territorial and administrative part of another region – the Republic of Mari El. And by the size Volzhsk is the second city of this republic. The table of the Kazan city agglomeration assessment looks as follows.

**Table 3.** Calculation of priority in the forthcoming industrial development of the Kazan city agglomeration

<table>
<thead>
<tr>
<th></th>
<th>N (1989)</th>
<th>$log P_{ik}$&lt;br&gt; k=3</th>
<th>$P_{ik}$ (th.peopl.)&lt;br&gt; (k=3, 1989)</th>
<th>$\alpha_{ik}$</th>
<th>$\alpha_{ik} log P_{ik}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Kazan</td>
<td>9</td>
<td>3,036</td>
<td>1085,3</td>
<td>0,8575</td>
<td>2,6033</td>
</tr>
<tr>
<td>2 Zelenodolsk</td>
<td>149</td>
<td>1,979</td>
<td>94,9</td>
<td>0,0750</td>
<td>0,1484</td>
</tr>
<tr>
<td>3 Volzhsk (Republic of Mari El)</td>
<td>239</td>
<td>1,789</td>
<td>61,4</td>
<td>0,0485</td>
<td>0,0868</td>
</tr>
<tr>
<td>4 cts Vasilyevo</td>
<td>714</td>
<td>1,255</td>
<td>18,0</td>
<td>0,0142</td>
<td>0,0178</td>
</tr>
<tr>
<td>5 cts Lower Vyazovye</td>
<td>1462</td>
<td>0,785</td>
<td>6,1</td>
<td>0,0048</td>
<td>0,0038</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>x</td>
<td>x</td>
<td>1265,7</td>
<td>1,00</td>
<td>2,8601</td>
</tr>
</tbody>
</table>

From the above it is visible that the Kazan city agglomeration has slightly better demographic priority in comparison with Nizhny Novgorod and very slightly yields to the Samara region. By and large all given values of "logarithmic ratings" on the leading agglomerations of "the core" of "the demographic framework" of Volga Federal District are comparable, and all above ranked agglomeration almost equally are high-priority [Scott and Peter, 2012]. In the specified regions "core" we allocated only agglomeration Ufa which also includes Blagoveschensk and settlement of city type Chishma can compete with these agglomerations. We will provide the table of Ufa agglomeration assessment.

**Table 4.** Calculation of priority in the forthcoming industrial development of the Ufa city agglomeration

<table>
<thead>
<tr>
<th></th>
<th>N (1989)</th>
<th>$log P_{ik}$&lt;br&gt; k=4</th>
<th>$P_{ik}$ (th.peopl.)&lt;br&gt; (k=4, 1989)</th>
<th>$\alpha_{ik}$</th>
<th>$\alpha_{ik} log P_{ik}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ufa</td>
<td>10</td>
<td>3,033</td>
<td>1079,8</td>
<td>0,9585</td>
<td>2,9073</td>
</tr>
<tr>
<td></td>
<td>Blagoveschensk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>----------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>497</td>
<td>1,444</td>
<td>27.7</td>
<td>0.0246</td>
</tr>
<tr>
<td>3</td>
<td>Chishma</td>
<td>648</td>
<td>1,2788</td>
<td>19</td>
<td>0.0169</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>x</td>
<td>x</td>
<td>1126.5</td>
<td>1.00</td>
</tr>
</tbody>
</table>

RESULTS

Results of the conducted research allow to build the considered largest agglomerations of "the demographic framework core" for regions of Volga Federal District in a kind of hierarchy. The priority of the head structure-forming city of agglomeration in noticeable degree depends on the specific weight of this city urban population number in the total number of all formed agglomerations urban population.

![Figure 2](image-url)

**Figure 2.** Demographic priorities of the forthcoming industrial development of the largest agglomerations of Volga Federal District in 1989

In 2010 structure of "the core" agglomerations of "the demographic framework" changed insignificantly:
Figure 3. Demographic priorities of the forthcoming industrial development of the largest agglomerations of Volga Federal District in 2010

If to take other indicator, - the amount of the cities and city type settlements population logarithms of the researched agglomeration which values reflect the capability of city agglomeration (or other city system) to reproduce the number of urban population, then the picture will look as follows: agglomeration Samara 12,152 in 1989 and 12,183 in 2010; agglomeration Kazan – 8,844 in 1989 and 8,927 in 2010, agglomeration Ufa – 5,755 in 1989 and 5,886 in 2010, agglomeration of Nizhny Novgorod – 16,624 in 1989 and 16,546 in 2010. That is, despite some insignificant decrease in "average demographic rating" in city agglomerations of Ufa, Samara, Nizhny Novgorod, from 1989 to 2010 demographic priorities in absolute expression of these agglomerations have increased.

On the basis of the received assessment using logarithms, it is possible to determine average "demographic rating" of each of the considered regions of Volga Federal District. Methods of calculation and results are reflected in Table 5.

From the table it is well visible that the Nizhny Novgorod Region from 1989 to 2010 at the same time has slightly lowered both average weighed and absolute values, the "demographic ratings" received proceeding from structure of the developed agglomerations. Very noticeable reducing from 89,7% to 88,61% of the urban population share for Nizhny Novgorod agglomeration became one of the basic reasons of it. At the same time, should we count "demographic capacity" of this agglomeration as the amount $\log P_{ik}$, the cities entering agglomeration, we will see that agglomeration of Nizhny Novgorod was and remains to the largest in the Volga Federal District. Received amount of logarithms on population of the cities equals to 16,624 in 1989 and 16,546 in 2010. In general on both agglomerations of the Nizhny Novgorod Region absolute "demographic capacity" of all Nizhny Novgorod Region made 23,768 in 1989 and 23,665 in 2010. And values of this last indicator much more exceeded the average weighed amount of averages on each agglomeration of the region.
Table 5. The structural and demographic characteristic of the Volga Federal District regions on the basis of the received averages of the weighed "demographic ratings" on the agglomerations and industrial hubs forming them.

<table>
<thead>
<tr>
<th>Region, agglomerations</th>
<th>Calculation of an average of the weighed &quot;demographic rating&quot; for regions of Volga Federal District</th>
<th>Absolute &quot;demographic rating&quot; of agglomerations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1989</td>
<td>2010</td>
</tr>
<tr>
<td></td>
<td>$\sum_{i=1}^{n_k} \alpha_{ik} = \Delta_k$</td>
<td>$\sum_{k=1}^{n_k} \Delta_k R_k$</td>
</tr>
<tr>
<td></td>
<td>$\sum_{i=1}^{n_k} \Delta_k \hat{R}_k$</td>
<td>$\sum_{k=1}^{n_k} \hat{R}_k$</td>
</tr>
<tr>
<td>I</td>
<td>Republic of Tatarstan</td>
<td>1,00</td>
</tr>
<tr>
<td></td>
<td>2,6318</td>
<td>1,00</td>
</tr>
<tr>
<td></td>
<td>7,3428</td>
<td>7,3863</td>
</tr>
<tr>
<td>Kazan city agglomeration</td>
<td>0,5444</td>
<td>1,5571</td>
</tr>
<tr>
<td></td>
<td>0,5349</td>
<td>1,5443</td>
</tr>
<tr>
<td></td>
<td>2,8601</td>
<td>2,8874</td>
</tr>
<tr>
<td>Agglomeration Naberezhnye Chelny</td>
<td>0,3312</td>
<td>0,8281</td>
</tr>
<tr>
<td></td>
<td>0,3399</td>
<td>0,8521</td>
</tr>
<tr>
<td></td>
<td>2,5004</td>
<td>2,5071</td>
</tr>
<tr>
<td>Microagglomerative industrial hub Almetyevsk</td>
<td>0,1244</td>
<td>0,2466</td>
</tr>
<tr>
<td></td>
<td>0,1253</td>
<td>0,2495</td>
</tr>
<tr>
<td></td>
<td>1,9823</td>
<td>1,9918</td>
</tr>
<tr>
<td>II</td>
<td>Republic of Bashkortostan</td>
<td>1,00</td>
</tr>
<tr>
<td></td>
<td>2,6205</td>
<td>1,00</td>
</tr>
<tr>
<td></td>
<td>8,9104</td>
<td>8,9777</td>
</tr>
<tr>
<td>Agglomeration Ufa</td>
<td>0,6009</td>
<td>1,7812</td>
</tr>
<tr>
<td></td>
<td>0,5839</td>
<td>1,7216</td>
</tr>
<tr>
<td></td>
<td>2,9644</td>
<td>2,9483</td>
</tr>
<tr>
<td>Agglomeration Sterlitamak</td>
<td>0,250</td>
<td>0,5613</td>
</tr>
<tr>
<td></td>
<td>0,2591</td>
<td>0,5901</td>
</tr>
<tr>
<td></td>
<td>2,2452</td>
<td>2,278</td>
</tr>
<tr>
<td>Microagglomerative industrial hub of Tuymazy, Octobersk</td>
<td>0,0869</td>
<td>0,1678</td>
</tr>
<tr>
<td></td>
<td>0,0921</td>
<td>0,1804</td>
</tr>
<tr>
<td></td>
<td>1,9311</td>
<td>1,9581</td>
</tr>
</tbody>
</table>
### Table

<table>
<thead>
<tr>
<th>Region</th>
<th>Microagglomerative industrial hub of Kumertau, Meleuz</th>
<th>Samara region</th>
<th>Agglomeration of Samara, Novokuybyshevsk</th>
<th>Tolyatti</th>
<th>Microagglomerative industrial hub Syzran</th>
<th>Nizhny Novgorod Region</th>
<th>Agglomeration of Nizhny Novgorod</th>
<th>Arzamas, Sarov</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0,0622</td>
<td>1,00</td>
<td>1,809</td>
<td>0,3313</td>
<td>0,0896</td>
<td>1,00</td>
<td>0,897</td>
<td>0,103</td>
</tr>
<tr>
<td></td>
<td>0,1102</td>
<td>2,7874</td>
<td>0,5807</td>
<td>0,9201</td>
<td>0,1928</td>
<td>2,7395</td>
<td>2,5481</td>
<td>0,1914</td>
</tr>
<tr>
<td></td>
<td>0,0649</td>
<td>1,00</td>
<td>1,6635</td>
<td>0,2122</td>
<td>0,088</td>
<td>1,00</td>
<td>2,4458</td>
<td>0,114</td>
</tr>
<tr>
<td></td>
<td>0,1164</td>
<td>2,7723</td>
<td>2,9089</td>
<td>2,7226</td>
<td>0,1887</td>
<td>2,658</td>
<td>2,8407</td>
<td>1,8578</td>
</tr>
<tr>
<td></td>
<td>1,7697</td>
<td>7,7841</td>
<td>2,8646</td>
<td>2,7773</td>
<td>2,1526</td>
<td>4,6985</td>
<td>2,7602</td>
<td>1,8611</td>
</tr>
<tr>
<td></td>
<td>1,7933</td>
<td>7,7861</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CONCLUSION

The amount of logarithms of the numerical population of all cities and city type settlements forming agglomerations of the Republic of Tatarstan region alone had absolute "demographic capacity", close to the Nizhny Novgorod Region, from four leading areas of Volga Federal District: 23,63 in 1989 and 24,1151 in 2010. For the Samara region values of absolute "demographic capacity" were estimated in 20,302 in 1989 and 20,4718 in 2010, for the Republic of Bashkortostan, respectively, - 19,5038 and 19,7889. At the same time the Republic of Tatarstan, Bashkortostan and the Samara region had much higher values of absolute "demographic rating". And, in the first two regions these values increased slightly quicker, than in the Samara region.

With their growth the average weighed "demographic rating" of the Republic of Tatarstan, as appears from Table 1.7, has grown from 2,6318 in 1989 to 2,6459 in 2010, the Samara region – has slightly decreased from 2,7874 to 2,7723, the Republic of Bashkortostan – from 2,6205 to 2,6085.

Thus, results of the conducted research allow to assume that on the current and perspective time-points the most priority regions of Volga Federal District, from the point of view of industrial industrial potential development, are the Republic of Tatarstan, the Samara and Nizhny Novgorod regions [Safiullin et al., 2013]. They, in fact, form "framework" of the Volga Federal District demographic profile generating the potential of productive forces development. At the same time it is necessary to notice that the prompt growth of demographic capacity "quality" of the Republic of Bashkortostan (growth of the population share in the cities to 12,4% in 2010) also predetermines entry of this region into so-called "framework" of demographic capacity of Volga Federal District.
ACKNOWLEDGMENTS

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

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