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Population Quality and Regional Economy: Direct and Indirect Correlation*

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Abstract. The article presents informative analysis of the place and role of population quality in the country's socio-economic development. The study has two major objectives: to determine the dependence of quality characteristics of the population on purely economic factors, and assess the extent and nature of the impact of the population quality on economic development. We present an extended author's description of the category "population quality" which includes the following aspects: economic activity, demographic processes, physical health, cultural potential, social health, educational potential, attitude to the environment. Ten statistical indicators out of 63 were selected and substantiated using correlation analysis within these aspects describing quality characteristics of the population. The information framework of the research includes data from the Federal State Statistics Service on 83 constituent entities of Russia for 2014. Based on selected indicators we conducted cluster analysis which helped classify elped the regions including and excluding economic factors. The obtained results of regions' grouping by quality characteristics of their population identified the impact of the following two factors on homogeneity of regions in clusters: economic development and geographical position. We provide a substantial analysis of the groups of regions; demonstrate their distinctive features and their strengths and weaknesses. In order to analyze the influence of population quality on the economic development we carried out regression analysis. The economic development was characterized by GRP per capita. The population's quality indicators serve as regressors. The significant factors are GRP per employee and the level of economic activity. The calculations confirmed the hypothesis about the weak influence of social indicators of population quality on the economic development. This result in no way diminishes the importance of improving population quality insignificant for the economy; it once again emphasizes that, in addition to economic, there are other goals of human development.

Key words: population quality, region, quality characteristics of the population, economic development, cluster analysis, regression analysis.

Introduction. The final goal of the research is to develop a system of measures to influence the region's socio-economic system contributing to the improvement of the quality of its population, the objective of the article is a separate, initial and mandatory stage of achieving the ultimate goal – fullest possible understanding of qualitative characteristics of the population in Russian regions and their correlation with the level and nature of the regional economy.

In the regional context this problem might not be relevant for countries with small populations and areas but in our country with 146.3 million people of more than 190 nationalities and ethnic groups and the area of 17.1 million km^2, not only individual differences between people, but also significant regional features are expected to take place.

Both foreign and domestic literature pays much attention to the populations' quality of life and its regional distinction. However, the goal of the state is not only to ensure the population's high quality of life; it is also responsible for its qualitative characteristics. At times, improving the quality of life causes negative processes in the population's behavior. For example, it is known that the increase in per capita income – an important indicator of the quality of life – from a certain point begins to negatively affect the qualitative characteristic of the population such as its natural increase. Without diminishing the importance of addressing the economic problem of improving

the quality of life we aim to demonstrate the importance of the surpa-economic goal of social development – improving the population quality.

In purely economic studies population appears in the form of human resources (ability to work) and human capital. If we want to assess the population more precisely than from the economic point of view, we turn to the concept of population quality, or human potential [1]. It should be noted that in recent years, the concepts of human capital and human potential are often equated, which in our view is wrong for two reasons. Human capital as a type of capital is aimed, firstly, to generate income; secondly, it is characterized by its main parameter – economic efficiency. Consequently, the concept of human capital can not express social goals of the state which involve the development of an individual beyond the scope of economic interests. On the contrary, human potential is the entire population realizing their abilities in all spheres of life, rather than just in the economy. The qualitative characteristics of human potential reflect the quality of the population itself.

In a vast range of issues related to human development, in this article we distinguish one aspect – analyze the correlation between population quality of the population, on the one hand, and the level and nature of economic development, on the other hand. This analysis is aimed at addressing two problems: first, determine the dependence of qualitative characteristics of the population on economic factors and, second, assess the degree and nature of the impact of population quality on economic development. The research is performed at the regional level.

Materials and methods. Since the set objectives involve quantitative comparisons, it raises the issue of numerical measurement of population quality and its qualitative characteristics [2–12]. The population quality is studied in seven ways: economic activity; demographic processes; physical health; cultural potential; social health; educational potential; population's attitude to the environment. We analyzed statistical books[1] and selected indicators related to qualitative characteristics of the population. There were 63 of such indicators, but as a result of the correlation analysis the following 10 indicators were left: GRP per 1 employed in the economy (labor productivity), (unit of measurement – thousand rubles/person); level of population's economic activity (%); innovation activity of organizations (%); natural decline/increase (per 1,000 people); life expectancy (years); share of the employed with higher and secondary vocational education (%); average number of viewers per 1,000 people, number of visits to museums per 1,000 people, number of newspaper issues per 1,000 people; share of reported crimes (number of crimes per 100,000 people); share of drug addicts (people per 100,000 people); number of air samples exceeding MAC, in % of the total number of studied samples. The last indicator at first glance evaluates environmental quality, but works [13; 14] demonstrate that it at the same time characterizes the population's environmental behavior.

In the future, when analyzing and interpreting the results we should remember that the population quality is only studied within the framework of the selected 10 indicators, and understand that they do not fully reflect this quality. Regional statistics impose significant

[1] *Healthcare in Russia. 2015: statistical book*. Rosstat. Moscow, 2015. 174 p.; *Environment protection in Russia. 2016: statistical book*. Rosstat. Moscow, 2016. 95 p.; *Russian regions. Socio-economic indicators. 2014: statistical book*. Rosstat. Moscow, 2014. 900 p.; *Russian regions. Socio-economic indicators*. 2016: *statistical book*. Rosstat. Moscow, 2016. 1326 p.

restrictions on the completeness of accounting all aspects of the population quality: the characteristics of the population quality which are difficult to measure such as, for example, moral and psychological differences, were excluded from analysis, as well as characteristics whose assessment approaches have already been developed but are missing in official statistics – for example, the quality of education.

It is difficult to visualize the real values of these indicators, their similarities and differences across 83 regions (in 2014). It is advisable to first divide the regions into homogeneous groups by population quality and then analyze the differences between these groups and its determining factors.

The fact that adequate convolution of 10 quality indicators of population quality with the aim of finding a single composite index is still unachievable was also taken into account. Although the weighting factors for the convolution are being designed, it is difficult to believe that it is possible to estimate the relative importance of indicators such as life expectancy and the share of drug addicts, natural increase and crime rate. In this regard, it seems appropriate to preserve the entire range of selected indicators in the analysis of population quality in the regions.

The preference among various methods of grouping was given to cluster analysis where the criteria clustering, i.e. selected indicators for analysis, are not aggregated and remain in the form of characteristics of the obtained groups of regions.

Cluster analysis is carried out using hierarchical agglomerative (unifying) methods which lead to the construction of a hierarchical structure of enclosed clusters [15–18]. At the same time, at the first (lower) level, all data are represented as separate clusters; at the last (upper) level – all data are combined into one cluster. In particular, we used the method of single link (nearest-neighbor method), either the usual Euclidean distance (clustering with ten characteristics) or Manhattan distance (clustering with seven parameters) served as a measure of proximity.

Reducing the dimension of the studied objects – from 83 regions to the number of clusters – will help address the first objective: identify factors affecting the qualitative characteristics of the population.

The initial results of cluster analysis are presented in [19; 20]. In this article, the study is continued through using information of 2014, as well as review of all 83 Russia's constituent entities, rather than 76 as it was done before. The time period under review is due to the fact that as of September 2017, information on GRP indicators was published by the Federal State Statistics Service (Rosstat) only for 2014, although GDP indicators are already available for 2016[2].

Research results. The results of regions' clustering according to ten mentioned characteristics of population quality according to data for 2014 are presented in *Table 1* (Federal districts are separated from each other by dimming). We formed 9 clusters from 83 constituent entities with different number of regions included in each cluster. The largest cluster is Cluster 1 consisting of 34 regions mainly in the Central and Volga Federal districts. The second largest cluster is Cluster 4 including 23 regions mainly in the Siberian and Far Eastern Federal districts. Clusters 3, 5, 6 and 9 are small, each consisting of 2–3 regions with strong specific features related to their economic development. Clusters 2 and 8 are primarily united on a territorial basis: the include neighboring regions.

[2] *Russian regions. Socio-economic indicators. 2016: statistical book*. Rosstat. Moscow, 2016. 1326 p.

Table 1. Results of regions’ clustering by 10 characteristics of population quality

1 – (34)	2 – (9)	3 – (2)	4 – (23)	5 – (3)	6 – (3)	7 – (1)	8 – (6)	9 – (2)
Belgorod Oblast Bryansk Oblast Vladimir Oblast Ivanovo Oblast Kaluga Oblast Kostroma Oblast Kursk Oblast Lipetsk Oblast Moscow Oblast Orel Oblast Ryazan Oblast Smolensk Oblast Tambov Oblast Tver Oblast Tula Oblast Yaroslavl Oblast Rep. of Karelia Arkhangelsk Oblast Kaliningrad Oblast Leningrad Oblast Pskov Oblast Astrakhan Oblast Volgograd Oblast Rep.of Bashkortostan Mari El Republic Rep. of Mordovia Rep. of Tatarstan Chuvash Republic Kirov Oblast Nizhny Novgorod Oblast Orenburg, Penza Oblast Saratov Oblast Ulyanovsk Oblast	Voronezh Oblast Rep. of Adygea Rep. of Kalmykia Krasnodar Krai Rostov Oblast Kabardino-Balkar Republic Karachay-Cherkess Republic Republic of North Ossetia-Alania Stavropol Krai	Moscow Saint Petersburg	Komi Republic Vologda Oblast Murmansk Oblast Novgorod Oblast Udmurt Republic Perm Krai Kurgan Oblast Sverdlovsk Oblast Chelyabinsk Oblast Republic of Khakassia Altai Krai Krasnoyarsk Krai Irkutsk Oblast Kemerovo Oblast Novosibirsk Oblast Omsk Oblast Tomsk Oblast Kamchatka Krai Primorsky Krai Khabarovsk Krai Amur Krai Sakhalin Oblast Jewish Autonomous Oblast	Nenets Autonomous Okrug Khanty-Mansi Autonomous Okrug (KhMAO) Yamalo-Nenets Autonomous Okrug (YaMAO)	Republic of Dagestan Republic of Ingushetia Chechen Republic	Samara Oblast	Tyumen Oblast (excluding AO) Altai Republic Republic of Buryatia Tyva Republic Zabaykalsky Krai Sakha (Yakutia) Republic	Magadan Oblast Chukotka Autonomous Okrug

Even with the simplest look at the clusters' composition demonstrates the influence of the territorial factor on regions' division into groups. If avoiding the influence of this factor of one or two regions in each Federal district is not considered a contradiction, then only regions of the Northwestern Federal district being in Clusters 1 and 4 is a significant region's' heterogeneity.

Table 2 presents cluster centers and highlights highest (in bold type) and lowest (underlined) center values for each indicator. At the same time, several clusters rather than one were distinguished as extreme values of indicators in cases where they were very close.

In the largest clusters – 1 and 4 – the centers do not demonstrate highest or lowest values (except the lowest natural increase in Cluster 1). This is natural as the more regions there are in a cluster, the more diverse it is.

The highest population quality in terms of four indicators – life expectancy, share of employees with higher and secondary vocational education, level of cultural development and environmental behavior – is in Cluster 3 consisting of Moscow and Saint Petersburg. This cluster ranks second in terms of GRP per one employed and level of innovation activity.

Cluster 9, consisting of the Magadan Oblast and Chukotka Autonomous Okrug, also leads in four indicators: it demonstrates highest values of the level of economic activity, innovation activity, natural increase and share of drug addicts. However, Cluster 9 is characterized by lowest life expectancy.

Cluster 6 consists of 3 regions – republics of Dagestan and Ingushetia and the Chechen Republic – and is the most controversial due to the fact that it has nine out of ten indicators characterized by extreme – from highest to lowest – values. In terms of population's natural increase, life expectancy, and crime rate, this cluster is the most prosperous. At the same time, it is the least prosperous in terms of three economic indicators, as well as in the share of employees with higher and secondary vocational education and environmental behavior.

Cluster 5 – Nenets, Yamalo-Nenets and Khanty-Mansi Autonomous okrugs – has the highest GRP per one employee many-fold higher than similar indicators in other clusters

Table 2. Cluster centers obtained by 10 indicators of human potential based on information for 2014

Indicator	Cluster								
	1	2	3	4	5	6	7	8	9
GRP per one employed	360.7	277.9	905.5	472.8	**2269.3**	275.8	470.4	429.2	704.6
Level of economic activity	52.8	49.0	56.2	53.4	56.7	45.7	54.4	47.5	**65.4**
Innovation activity	10.5	7.1	18.2	9.4	6.0	5.7	5.4	8.5	**24.8**
Natural increase	-6.1	-2.7	-2.9	2.5	0.4	**4.9**	-5.2	**4.4**	**4.4**
Life expectancy	70.2	72.5	**75.3**	68.6	69.7	**75.9**	69.4	67.2	64.6
Higher + secondary vocational education	54.9	56.8	**72.2**	52.5	55.7	43.3	65.8	55.2	52.4
Culture	745	344	**3411**	567	298	85	532	361	316
Crime rate	1313	1075	1269	2010	1490	**379**	1622	2218	1936
Drug addiction	136.6	191.3	227.2	260.9	196.1	132.2	646.6	135.2	**79.7**
Share of air samples	1.1	1.0	**0.2**	0.8	7.8	8.3	0.5	8.0	1.7
Note. Calculated by the authors.									

Table 3. Classification of constituent entities by 7 social characteristics of population quality

1 – (23)	2 – (16)	3 – (12)	4 – (2)	5 – (3)	6 – (3)	7 – (1)	8 – (8)	9 – (15)
Belgorod Oblast Bryansk Oblast Vladimir Oblast Ivanovo Oblast Kaluga Oblast Kostroma Oblast Kursk Oblast Lipetsk Oblast Orel Oblast Ryazan Oblast Tambov Oblast Tver Oblast Tula Oblast Leningrad Oblast Pskov Oblast Volgograd Oblast Rep.of Bashkortostan Rep. of Mordovia Chuvash Republic Kirov Oblast Orenburg, Penza Oblast Saratov Oblast	Voronezh Oblast Moscow Oblast Kaliningrad, Murmansk Oblast Rep. of Adygea Rep. of Kalmykia Krasnodar Krai Astrakhan Oblast Rostov Oblast Kabardino-Balkar Republic Karachay-Cherkess Republic Republic of North Ossetia-Alania Stavropol Krai Rep. of Tatarstan Ulyanovsk Oblast Sverdlovsk Oblast	Smolensk Oblast Yaroslavl Oblast Rep. of Karelia Komi Republic Arkhangelsk, Vologda Oblast Novgorod Oblast Mari El Republic Udmurt Republic. Perm Krai Nizhny Novgorod, Kurgan Oblast	Moscow Saint Petersburg	Nenets AO Jewish Autonomous Oblast Chukotka Autonomous Okrug	Republic of Dagestan Republic of Ingushetia Chechen Republic	Samara Oblast	Tyumen Oblast(excluding AO) Khanty-Mansi AO (KhMAO) Yamalo-Nenets AO (YaMAO) Altai Republic Republic of Buryatia Tyva Republic Zabaykalsky Krai Sakha (Yakutia) Republic	Chelyabinsk Oblast Republic of Khakassia Altai Krai Krasnoyarsk Krai Irkutsk, Kemerovo, Novosibirsk, Omsk, Tomsk oblasts Kamchatka, Primorskii, Khabarovsk krais Amur, Magadan, Sakhalin oblasts

and regions. However, this cluster is the worst in terms of innovation activity and environmental behavior.

The isolation of the Samara Oblast, which alone is included in Cluster 7, is associated with the unprecedented high share of drug addicts.

The value of innovation activity is minimal in clusters 5, 6 and 7. This is understandable in terms of clusters 6 and 5, where the modernization process of extractive sectors is slow. But the situation in the Samara Oblast is not very clear: this is probably the consequence of the shortcomings of the innovation activity indicator itself, which is estimated simply by the share of enterprises implementing any type of innovation.

Since the three economic indicators under review, though characterizing population quality, depend on other factors as well – natural resource reserves, sectoral structure, etc., of particular interest are the results of clustering carried out without considering these indicators. Cluster analysis has been conducted on 7 social indicators of population quality (*Tab. 3*).

Here, the regions of half of the federal districts were divided into a larger number if clusters than in the variant with 10 indicators. Thus, the regions of the Central, Volga and Ural federal districts were included in four clusters each (instead of three clusters before); the regions of the Northwestern Federal District – in five clusters (instead of four).

The clusters became more evenly filled: more than 10 regions are already included in four clusters, whereas previously they were included in only two clusters, containing in total almost 70% of the regions.

Three clusters remained unchanged: Cluster 3 (Moscow, Saint Petersburg); Cluster 6 (republics of Dagestan and Ingushetia, the Chechen Republic) and Cluster 7 (the Samara Oblast). During clustering without considering economic indicators, the Tyumen Oblast was joined by its autonomous districts – Khanty-Mansi-Yugra and Yamalo-Nenets. The Magadan Oblast and Chukotka Autonomous Okrug which were together earlier in Cluster 9, also became non-homogeneous in terms of 10 indicators.

When clustering on 7 indicators, both clusters' composition and their centers changed (*Tab. 4*). The "capital" cluster remained the most prosperous. It still has highest values of life expectancy, share of people with higher and secondary vocational education, level of cultural development and environmental behavior.

Table 4. Cluster centers obtained by 7 indicators of human potential based on information for 2014

Indicator	Cluster								
	1	2	3	4	5	6	7	8	9
Natural increase	-0.947	-0.283	-0.644	-0.243	1.004	**1.215**	-0.683	0.935	**1.404**
Life expectancy	0.071	0.689	-0.276	**2.070**	-2.195	**2.300**	-0.210	-0.624	-0.574
Higher + Secondary vocational education	-0.093	0.361	-0.261	**2.788**	-1.037	-1.788	1.781	0.266	-0.100
Culture	-0.132	-0.296	0.859	**4.842**	-0.594	-0.961	-0.182	-0.512	-0.218
Crime rate	-0.547	-0.525	0.433	-0.502	0.009	**-2.174**	0.161	1.009	1.004
Drug abuse	-0.606	0.170	-0.199	0.415	**-1.007**	-0.539	4.628	-0.161	0.939
Share of air samples	-0.290	-0.236	-0.383	**-0.574**	-0.381	2.027	-0.477	2.215	-0.400
Note. Calculated by the authors.									

Cluster 6 remained the leading one in natural increase, life expectancy and crime rate. At the same time, it is the worst, as in the pervious years, in terms of the share of the employed with higher and secondary vocational education, level of cultural development and environmental behavior.

It is natural to expect that the Samara Oblast would stand apart in this variant is an independent cluster due to a high share of drug addicts.

The Nenets and Chukotka autonomous okrugs and the Jewish Autonomous Oblast were united in Cluster 5 by the lowest indicator of life expectancy and, at the same time, the highest share of drug addicts.

Cluster 8, which was joined by two rich autonomous okrugs of the Tyumen Oblast excluding the economic indicators, still has the highest crime rate and the highest share of negative air samples, but it has lost its positive characteristics – leadership on natural increase (due to the joined autonomous districts).

In Cluster 9, which is completely new by composition and includes 15 regions instead of two as in previous calculations, the highest rate of natural increase and, conversely, its negative characteristic – the highest crime rate.

Clusters 1, 2, 4 large in the number of regions and federal districts included in it, have intermediate values of cluster centers by all indicators (except the lowest natural increase in Cluster 1).

Thus, analysis of results of clustering of regions by 10 and 7 qualitative characteristics of the population for 2014 carried out in 83 constituent entities, revealed common features of the regions united in each group, showed the advantages and disadvantages of each cluster and revealed the factors which caused their unification. The resulting grouping of regions according to qualitative characteristics of the population clearly demonstrated the impact of two factors on the uniformity of regions in clusters: economic development and geographical position.

The second objective set at the beginning of the article is to assess the role of population quality in economic development. To analyze the impact of population quality on economic development it is advisable to use regression analysis. Economic development as a dependent variable will traditionally be characterized by GRP per capita. All ten indicators of population quality and only seven social indicators are considered as independent, explanatory variables.

As a result of regression analysis carried out using the information for all regions separately for each year during 2008–2014, GRP per one employed and the level of economic activity measured as a share of economically active population in the whole population proved to be significant factors. The significance of these factors is undeniable and evident from analytical dependence: $y = x_1 x_2 l_{empl}$, where y – GRP per capita; x_1 – GRP per one employed; x_2 – level of economic activity of the population; l_{empl} – share of the employed in economically active population.

The remaining factors characterizing population quality are not among the most significant. Some of them – life expectancy, natural population increase/decrease, innovation activity – turned out to be significant (with a low level of significance) in one or two years of the entire six-year period under study. When analyzing the impact of only social indicators of population quality on the economic development, no significant factors were revealed at all.

Discussion. Initially, the authors imagined a more active influence of population quality on the economic development, especially its components such as educational and cultural level. Assuming that these factors turned out to be insignificant due to the strong influence on the economic development of the natural resource factor we distinguished only the processing regions from the whole set of regions. Among them were regions with the share of manufacturing industries in the economic structure exceeding 30%. There are 49 such entities. The regression analysis was repeated, but only for the selected processing regions.

As a result, the innovation activity factor was added to the list of significant factors when considering 10 indicators of population quality.

Expectations were met in regression analysis of processing regions only with social indicators of population quality – high impact on GRP was revealed with a high level of significance, as well as the share of the employed with secondary and higher education; with a lower level of significance – life expectancy. The cultural level was not included in the number of significant factors affecting the economic development, as well as crime rate, share of drug addicts, and population's environmental behavior.

The result does not reduce the importance of improving these indicators, which are insignificant for the economy; it is emphasized that, in addition to economic, there are other criteria for human development. The declaration of improving the population's quality of life as the primary state objective overshadow another equally important state objective – the development of an individual and improving population quality.

The proposed classification of regions by population quality is designed to attract the attention of the scientific community to the sometimes strong regional differentiation of the quality characteristics of the population. The feasibility of further research is seen in the importance of solving problems such as revealing the causes of the demonstrated differences and the search for possible mechanisms to improve population quality. The fact that improving the social characteristics of population quality does not provide direct economic dividends does not in any way diminish the paramount importance of this humane state goal and requires a special approach to the development and implementation of its social policy.

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