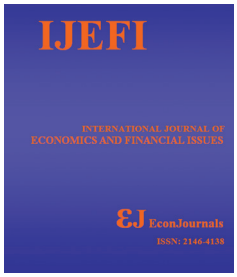

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System Diagnostics of the Social Comfort of Living in the Region: Methodological Approach and the Results of Assessment

Olga V. Bakanach[1]*, Natalya V. Proskurina[2], Yuri V. Sazhin[3], Marina A. Skvortsova[4]

[1]Samara State University of Economics, Department of Statistics, 141 Sovetskoi Armii, 443090 Samara, Russia, [2]Samara State University of Economics, Department of Statistics, 141 Sovetskoi Armii, 443090 Samara, Russia, [3]Mordovia State University Named after N.P. Ogarev, Department of Statistics, Econometrics and Information Technologies in Management, Saransk, Russia, [4]Mordovia State University Named after N.P. Ogarev, Department of Statistics, Econometrics and Information Technologies in Management, Saransk, Russia. *Email: bakanach@mail.ru

ABSTRACT

The article suggests methodological approach to determining the level of social comfort of living of the population in the regions of Povolzhskiy Federal District (PFD). In order to provide better perception of the analysis there was built the cardiogram of the differences in the level of social comfort for the regions of PFD on the basis of modern geographic information system-technologies. According to the described methodology the methodical apparatus was suggested which is based on indicative analysis using natural assessments of the object (indicators). The structure of the system of indicators modeling the state and development of social comfort of living in the region is given. On the example of the Republic of Mordovia there was performed multivariate modeling of social comfort of living of the population. The modeling was made in three ways: By constructing an integral index based on the subjective evaluation of the region's residents, by combining subjective and objective information into a single indicator of social comfort of living of the population. Finally, we analyzed the dynamics of the level of social comfort of living of the population of the Republic of Mordovia in 1994-2013.

Keywords: Anamorphosis, Discomfort, Indicator, Indicative Analysis, Modeling, Social Comfort
JEL Classifications: C19, C33

1. INTRODUCTION

1.1. Introduction of the Problem

The idea of increasing social comfort of living of the population in recent years the wider population in general. Social comfort of living of the population includes objective parameters caused by many different factors (political, social, economic, climatic, etc.) as well as subjective view of each person, so it is a kind of criteria of the country' development as a whole. Its assessment makes it possible to compare the regions and social groups, rank them, reveal negative trends and search for the ways and means to overcome them.

Today research of various rating agencies in measuring comfort of living in the cities and regions of the world is becoming more and more popular. Rating of the most comfortable cities is made, which is a very effective advertising tool to attract new residents and tourists.

Social comfort of living should be divided into two components: Objective-level of education, state of health service, social security, culture, sport, utility service, catering, passenger transport, communications, legal security and subjective - The view of each person on his/her conditions of living. Such division makes it possible to disclose the content of the concept. This implies a general idea of social comfort of living of the population as a set of interrelated characteristics, comprising a plurality of objective indicators characterizing the level and state of development of the social sphere (services) as well as indicators of subjective character reflecting the rational and emotional attitude of a person

to the comfort of his/her living, satisfaction with himself/herself and their life.

Social comfort of living is a kind of regulator of the process of development of a country because if there are any changes in the country which reduce the comfort of living it immediately affects the mood of its citizens, causes social tension, forms intolerant reaction of the population making governmental bodies correct its policy.

In modern conditions it is necessary to create optimal conditions of living and activities of people as these factors are the most important conditions of active, creative and full life of a person. Creation of comfort conditions for living contributes to widening the abilities of a person, increases motivation for professional activities and other kinds of social activities.

In assessing the level of social comfort of living of the population in the region there must be taken into account sufficiently large number of indicators, which in varying degrees can affect the studied socio-economic category. Multivariance of the initial set of indicators can bring you to ambiguous conclusions concerning the level of social comfort in the region, as some indicators demonstrate opposite trends and pace of development.

1.2. Background/Literature Review

In revealing the philosophical sense of the category "comfort," as well as in defining the role and place of "comfort" among other socio-economic categories there can be marked the works of Livraga (2003), Hachetsukov (2013), Mirgorodskaya and Sytnik (2012).

The works of Salyakin (2011), and Sidorenko (2001) are dedicated to different approaches to social comfort research and the works of Cochurov (2006) and Merinov (2001) are dedicated to ecological and social comfort of living in the region.

The works of many foreign scientists-economists such as Lane (1994), Layard and such Russian scientists as Aivazyan (2012) and Guriev are dedicated to the problems of measuring synthetic latent categories.

The works of Aivazyan, Eliseeva, Mhitryan, Sazhin were used as fundamental works in the sphere of applied statistics and multivariate analysis.

1.3. Hypotheses and Their Influence on Research Structure

The working hypothesis of this study is based on the assumption that by applying of econometric tools to the measurement and evaluation of the level of social comfort of living of the population, taking into account the use of both objective and subjective statistical data, will make it possible to model the picture of its condition and assess the prospects for inter-territorial comparisons.

2. METHODS

Multi-dimensional statistical methods such as principal component analysis, the methods of multi-criteria evaluation of integrated phenomena and processes, methods of econometric modeling, sociological methods, as well as tabular and graphical methods of presenting the results of research were used (Jessen and Chetyrkina, 1985).

The practical realization of the above-mentioned methods was made with the use of applied statistical programs Statistica 10.0 and electronic tables "Microsoft Excel."

Modeling of the state and development level of social comfort of living of the population is made with the use of 34 indicators in accordance with the objectives of the evaluation and interpretation of the results grouped into 10 modules: Housing, quality education, healthcare, leisure, social security, infrastructure facilities, social pathology of society, organization of labor, social and demographic conditions and social justice of society.

Such division helps to reveal the place of each indicator in the structure of the integral assessment of social comfort of living.

The proposed initial set of indicators has excess of information. Furthermore, it is characterized by multicollinearity of parameters. For the formation of the reduced set of partial indicators of level 2 it is necessary to select the most informative indicators - representatives of the modules, which play a crucial role in the formation of the corresponding integral indicator of social comfort of living of the population in the region.

For the selection of private indicators of Level 2 there was used the method of main components allowing to reduce the dimension of the initial set of indicators without significant loss of information content, as well as to eliminate the multicollinearity and small "variability" of indicators.

Before you proceed directly to the procedure of convolution of private indicators it is necessary to unify them, that is to apply to each of them a transformation as a result of which the scope of its possible values is limited to the interval [0, 10]. This zero value of the transformed indicator must correspond to the lowest quality and 10 - to the highest. To do this, we used the linear scaling which allows you to monitor the dynamics of real growth or reduction of each particular indicator in relation to stable maximum and minimum normative values - parameters. The particular choice of unifying transformation depends on which of the three types the analyzed indicator belongs.

1. If the private indicator x_j, t is connected with the analyzed integral feature of social comfort by monotonically-increasing dependency (i.e., the greater the value of x_j, t, the higher the social comfort is), the value of the corresponding unified variable is calculated by the formula:

$$\tilde{x}_{j,t} = \frac{x_{j,t} - x_{j\min}}{x_{j,t\max} - x_{j\min}} N, \quad (1)$$

Where $\tilde{x}_{j,t}$ is the unified value of the private indicator (j=1, 2,…, p; t=1994, 1995,…2013);

$x_{j,\max}$, $x_{j,\min}$ are maximum and minimum values of the private indicators;

$N = 10$ are scores.

2. If the private indicator x_j, t is connected with the analyzed integral feature of social comfort by monotonically-reducing dependency (i.e., the greater the value of x_j, t, the lower the social comfort is), the value of the corresponding unified variable is calculated by the formula:

$$\tilde{x}_{j,t} = \frac{x_{j\max} - x_{j,t}}{x_{j\max} - x_{j\min}} N \quad (2)$$

3. If the private indicator x_j, t is connected with the analyzed integral feature of social comfort by non-monotonic dependency (i.e., between x_{min} и x_{max} there is some optimal value x_{onm}, with which the best quality is reached) then the value of the corresponding unified variable $\tilde{x}_{j,t}$ is calculated by the formula:

$$\tilde{x}_{j,t} = (1 - \frac{\left|x_{j,t} - x_{jonm}\right|}{\max\left\{\left(x_{j\max} - x_{jonm}\right), \left(x_{jonm} - x_{j\min}\right)\right\}})N \quad (3)$$

Using the linear convolution N-point scale of measurement, we can represent the integral indicator of social comfort of living of the population in the region in the form of:

$$\hat{y}_t = \sum_{j=1}^{p} w_j \tilde{x}_{j,t} , \quad (4)$$

Where $\tilde{x}_{j,t}$ ($j = 1, 2,\ldots, p$) are unified private indicators per year t ($t = 1994, 1995,\ldots, 2013$);

w_j are some "weight coefficients" satisfying to the conditions: $w_j \geq 0$, $\sum_{j=1}^{p} w_j = 1$.

Thus the construction of integral characteristic of social comfort means determination of unknown vector of weights $W=(w_1,\ldots, w_p)$.

It is believed that the integral indicator built in the form of the first principal component of the reduced set of private criteria should explain at least 55% of the total dispersion of these criteria:

$$\frac{\lambda_1}{\sum_{j=1}^{p} \lambda_i} > 0,55, \quad (5)$$

Where $\lambda_1, \ldots, \lambda_p$ are the numbers of the correlation matrix of the private criteria $\tilde{x}_{1,t}, \ldots, \tilde{x}_{p,t}$, arranged in decreasing order.

Otherwise, there is no satisfactory solution to the problem of constructing a unified integral indicator in the form of the first principal component approximating the values of all the partial criteria of the reduced set.

Determination of the optimal number of integral indicators of available values of the normalized partial criteria and the construction of the composite or generalizing integral indicator includes the following steps:

1. Determination of the number of integral indicators (m_0) according to the values of the unified private indicators.
2. Division of the analyzed set of private indicators $\tilde{x}_{1,t}, \ldots, \tilde{x}_{p,t}$ in m_0 of relatively homogenous disjoint groups (blocks) $M_1,\ldots, M_{m0}$ where belonging to one particular group of indicators M_j is determined by the requirement that they should characterize some aspect of the analyzed category of social comfort.
3. Construction of modified first main components separately according to private indicators from each group $M_1,\ldots, M_{m0}$.

Integral indicator $y_{j,t}$ of each analyzed block M_j for t (1994,…,2013) on N-scale is determined by the ratio.

$$\tilde{y}_{j,t} = \frac{y_{j,t} - y_{t,\min}}{y_{t,\max} - y_{t,\min}} N , \quad (6)$$

Where $y_{t,min}$ and $y_{t\,max}$ are minimum and maximum values of the first main component among all the values of the first main component in t (1994,…,2013).

Then according to the values of block integral indicators $(\tilde{y}_{1,t}, \tilde{y}_{2,t}, \ldots, \tilde{y}_{m_0 t})$ we can calculate consolidated indicator $y_{t,\text{св}}$ according to the following scheme.

1. Calculate the weighted Euclidean distance p_t from observation per year t $(\tilde{y}_{1,t}, \tilde{y}_{2,t}, \ldots, \tilde{y}_{m_0 t})$ to standard (10; 10;…; 10) in the area of block integral indicators according to the formula:

$$p_t = \sqrt{\sum_{j=1}^{m_0} v_j \left(\tilde{y}_{j,t} - 10\right)^2} , \quad (7)$$

Where v_1, v_2, v_j ($\sum_{j=1}^{m_0} v_j = 1$, $v_j \geq 0$) are normalized non-negative weights. "The weights" of block integral indicators v_1, v_2, v_j ($j = 1,\ldots, m_0$)are determined by the share explained by common factors or blocks M_1, M_2, M_j ($j = 1,\ldots, m_0$), dispersion in the total dispersion of all unified private indicators $\tilde{x}_{1,t}, \ldots, \tilde{x}_{p,t}$ for these common factors:

$$v_j = \frac{sy_j{}^2}{\sum_{k=1}^{p} s^2 \tilde{x}_k} = \frac{s^2 y_j}{\sum_{k=1}^{p} \lambda_k}, \quad (8)$$

Where, $s^2 y_j = \frac{1}{n}\sum_{i=1}^{n} (y_{i,j} - \bar{y}_j)^2$, $\bar{y}_j = \frac{1}{n}\sum_{i=1}^{n} y_{i,j}$,

$$s^2 x_k = \frac{1}{n}\sum_{i=1}^{n} (\tilde{x}_{i,k} - \bar{\tilde{x}}_k)^2, \quad \bar{\tilde{x}}_k = \frac{1}{n}\sum_{i=1}^{n} \tilde{x}_{i,k},$$

λ_k ($k = 1,\ldots,p$) are the numbers of co variation matrix of private criteria $\tilde{x}_{1,t}, \ldots, \tilde{x}_{p,t}$. Onwards we will use the normalized values of weights v_j and $\tilde{v}_j$ calculated according to the formulas:

$$v_j = \frac{\tilde{v}_j}{\sum_{l=1}^{m0} \tilde{v}_l} = \frac{s^2 y_j}{\sum_{l=1}^{m0} s^2 y_l} , \quad (9)$$

It provides the fulfillment of condition $\sum_{j=1}^{m0} v_j = 1, \quad v_j \geq 0$, $j = 1,...,m_0$.

The higher the weight of the block integral indicator, the more its contribution in the consolidated integral indicator of social comfort of living of the population in the region.

2. The value of the consolidated integral indicator of social comfort for the year t is determined according to the formula:

$$y_{cв',t} = 10 - p_t \quad (10)$$

3. RESULTS

On the basis of the above-presented method there was made a selection of the most informative indicators for each module. The developed contracted set of private indicators (Table 1) was considered as the bases for the further integral assessment of social comfort of living of the population in the region.

Specific territorial differences of private indicators of social comfort of living of the population in the regions of the Povolzhskiy Federal District (PFD) can be displayed on separate cartograms. To demonstrate the distribution of values of the indicators in the classification most often there is used the principle of "natural boundaries" when the scale is based on the condition of the highest possible homogeneity of values within the intervals and the maximum difference between the values in different intervals. In addition, the modern geographic information system (GIS) packages have integrated method of automatic classification setting intervals based on the average value of the index XCP and standard deviation σ. Such a classification allows making some assessment compared with the average value of the index in the district for each selected group.

Table 1: Set of private indicators of social comfort of living of the population in the region

Basic modules	Private indicator
Living conditions	Living space per 1 person, on average, m^2
Quality of education	Specialists of higher educational institutions per 10,000 people
State of health service	The number of hospital beds per 10,000 people
Leisure	The number of spectators in the theaters per 1000 people
Infrastructure facilities	Density of public roads paved, km of roads per 1000 km^2 area
Social security	The number of reported murders and attempted murders per 100,000 people
Social pathology of society	The number of cases of alcoholism and alcoholic psychoses, taken under the supervision of newly established diagnosis per 100,000 people
Organization of labor	The number of victims of occupational accidents with disability 1 working day and more and the number of deaths per 1000 employees
Social justice of society	Coefficient of funds(coefficient of income differentiation)
Social and demographic conditions	The coefficient of migration increase of the population

On the basis of modern GIS-technologies in order to improve the perception and analysis of the initial information it is easy to modify the shape of its submission: To use scale without intervals, to build three-dimensional block diagram, to create conditional statistical surface, anamorphic images, etc. In our research for a logical meaningful interpretation of the phenomenon there was used anamorphosis as all indicators are relative, and the denominator in all indicators except for the density of roads is the population of a region or its part. Therefore, each individual region has been transformed automatically so that the density of the population proved aligned throughout the Federal District and the regions have become comparable in this parameter. The indicators related to the population present the real situation in comparison with the traditional cartogram. Let us note that the relative position of the territorial units, their size and configuration depend on how the density of the population differs from the neighbors and the average density of the district, as well as on the chosen algorithm for constructing anamorphic images.

When displaying the territorial distribution of the whole set of indicators of social comfort of living of the population in the regions of the PFD there was used a cartogram- diagram. It represents not the original values but their deviation (in percent) from the corresponding average values for the District as it is problematic to unite all parameters into a single scale. As a result, the same profile chart bars together are commensurate and the columns in different diagrams can be compared (first to first, second to second, etc.), i.e., deviation values of the same indicators. For ease of comparison of the charts the indexes are divided into two groups. The first group includes those the best estimation characteristics of which are the biggest numerical values of the corresponding index, the second - those the best estimation characteristics of which are the smallest numerical values. Zero height of the column of the cartogram-diagram means overlap of the indicator value in the region with the average for the district.

It is known that quantitative characteristics of phenomena are expressed either on an interval scale or on a scale of relationship. In the first case it is possible to determine whether this feature is presented more in one object in comparison with another, in the second - not only whether it is presented but the number of times this feature is more presented. In conducting research it is important to know what scales are used for the data as it determines the nature of the possible mathematical operations with them. Thus, the data of the observations submitted on an interval scale, cannot be divided one by another to find how many times the value of the object is greater than another object, etc. The migration rate of population growth was such a coefficient. Visual comparison of the profile charts combined with cartogram allows getting some qualitative and quantitative assessment of the social comfort of living of the population in the regions of the PFD.

According to the results of the modeling of the level of social comfort of living of the population in the regions of PFD in 2013 there were determined the values of the integral indicator.

Analyzing the chart (Figure 1) we can conclude that Saratov region is on the first place; the Republic of Tatarstan is on the second place; Nizhniy Novgorod Region is on the third place. The last is Perm Region. This can be explained by the social problems of the region where there are strong differences within the economy and the labor market typical to industrial regions with a predominance of mono-functional cities with industry of different competitiveness.

On the basis of the calculated integral evaluation the territorial units were ranked. In this case, the level of social comfort of living of the population was assessed on a scale, and classified as follows:

1. Comfort (from 6.5 to 10 scores);
2. Hyper comfort (from 3 to 6.5 scores);
3. Discomfort (from 0 to 3 scores).

Within the frame of the research there was built the final map on which the results of the modeling of situation of the regions of the Volga Federal District social comfort level of the population are shown on the background of cartograms demonstrating the distribution of gross regional product (GRP) per capita in each region.

It is worth noting that the rate of gross domestic product per capita and the level of social comfort of living of the population although directly dependent, however, do not increase the comfort of living of the population in the region. This is evidenced by the calculated coefficient of elasticity of growth of the social comfort of living of the population to growth rates of GRP for the Republic of Mordovia for 2012-2013 which indicates that for every one percent growth in GRP level of social comfort of living of the population increased by only 0.22%. Thus ensuring its own reproduction, the region in the long run should provide an adequate level of social comfort increase for the population as, in itself economic growth does not guarantee the growth of positive social dynamics.

The development of the social sphere and, consequently, the social comfort of living of the population is affected by many factors among which are there are social, economic, political, environmental, climatic, cultural and others.

On the example of the Republic of Mordovia we made an attempt to make multivariate modeling to assess the social comfort of living of the population in the region. Integral measurement of the studied category was conducted in three ways: By constructing an integral index, on the basis of a subjective assessment of the region inhabitants and by combining subjective and objective information into a single indicator of social comfort of living of the population.

Also the dynamics of the values of the integral indicator of the level of the social comfort of living in the Republic of Mordovia in 1994-2013 calculated by the above-described method was analyzed (Figure 2).

From 2002 there has been growth of the level of comfort of living of the population of Mordovia. This is due to the fact that since 2004 in the Russian Federation including Mordovia there was observed

Figure 1: The values of the integral indicator of the social comfort of living of the population in the regions of Povolzhskiy Federal District in 2013

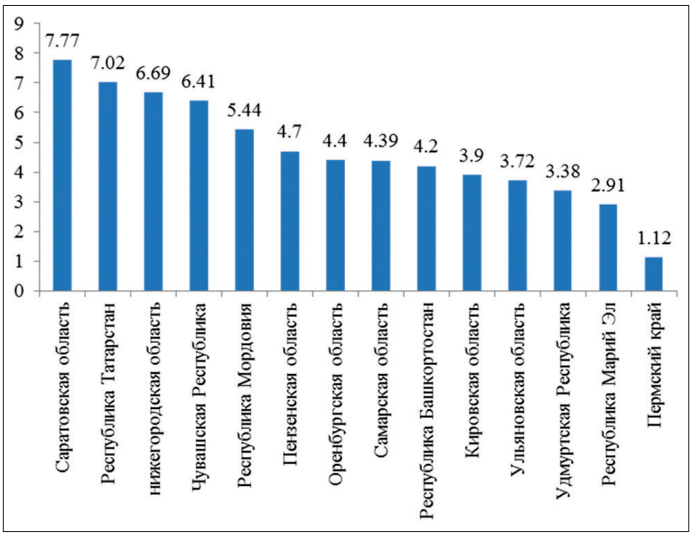
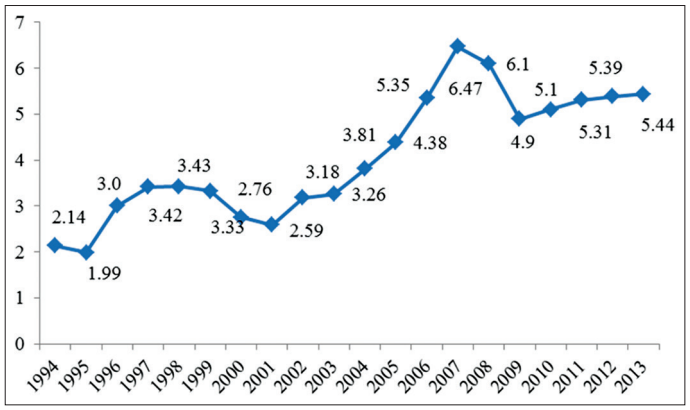


Figure 2: The dynamics of integral indicator of social comfort of living of the population of the republic Mordovia in 1994-2013



steady economic growth which immediately resulted in a balance of social policy and as a consequence - increased comfort of living of the population. Reduction in the index after 2007 can be explained by the deterioration of the socio-economic situation due to the global economic crisis in 2008. In 2010, once again the tendency of growth of social comfort of living of the population was observed.

4. DISCUSSIONS

Accumulation of subjective and objective information was based on the construction of another integral index of social comfort of living in the form of a weighted combination of the values of the modified first principal component of each block of indicators of social comfort. The importance of each factor determined in the course of sociological research served for the calculation of the index by weight coefficient. It should be noted that the rate of social comfort, combining the two approaches in measuring the studied category provides the most complete picture of the real state of social protection of the population in the Republic of Mordovia. It allows to identify its positive and negative dynamics for the region, to identify key areas for improvement of social

policy in the region, to build a forecast of the comfort of living of the population in the region, the results of which are not limited to be used for management decisions.

5. CONCLUSION

In conclusion, it should be noted that the social comfort of living of the population is a phenomenon that is characterized by a dual structure. It combines the subjective and objective outset which is the peculiarity of the assessment, so the use of multi-variant modeling can contribute to a more reliable determination of the level of social comfort in the region.

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