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ANALYSIS OF DEVELOPMENT TRENDS OF STANDARD OF LIVING FOR MEDIUM-SIZED CITIES IN POLAND

Summary: The standard of living and living conditions of the population of Poland are spatially highly diversified. The work attempts to conduct the analysis of spatial differentiation of the standard of living of residents in a dynamic model in the years 2002-2008, on the example of medium-sized cities (50-150 thousand inhabitants). 36 cities were selected for the study. In the first step, 19 variables from the set of 45 diagnostic features were selected to the final set of variables. The work presents the study conducted in the dynamic model in addition to the analysis of changes in the groups of cities with a similar standard of living.

Key words: spatial differentiation, standard of living, forecasting.

1. Introduction

It is practically impossible to define the notion of the quality of life in an appropriate, complex and unequivocal manner. The interdisciplinary nature of this term or just the possibility of examining the quality of life objectively or subjectively makes the task of measuring subjectively the perceived quality of life very difficult. The definitions used in reference books [*Ocena i analiza…* 2004; *Taksonomiczna analiza…* 2000; *Poziom życia…* 2004] emphasize the quality approach as frequently as the quantity approach to the used terminology.

The following terms are used among the quantity approach: economic welfare, living conditions, standard of living or affluence, whereas such terms as lifestyle, or even more frequently – quality of life, are characteristic of the other group.

Depending on the way of defining it is necessary to select appropriate methods of study: numeric in the case of quantity definitions or survey in the case of the definitions which emphasize the quality aspect. Due to complex relations between these categories, a complex estimation and analysis should assume conducting a dichotomous objective and subjective study. An improvement in objectively defined quality of life (standard of living) does not have to be directly translated into the improvement of individually perceived subjective quality [Campbell 1976]. The work assumes that the quality of life (defined subjectively) differs from the standard of living (defined objectively).

The spatial differentiation of the population's standard of living is linked to the general social and economic development of the object that is examined. The functioning and development of cities is among more and more commonly mentioned factors that can decisively condition the standard of living. The study of the development of big agglomerations has so far been an extensive subject in reference books [*Wrocław i sfera*... 2000; Berry 1981]. The publications focused on the study of the relationship between quality of life and the existing transport arrangements in large cities have a very important place. They come from such fields of study as city logistics, transport, sustainable development planning or sociology.

However, there is scant information on the spatial differentiation of the standard of living in smaller cities and towns. This work therefore attempts to analyze the spatial differentiation of the standard of living of the population of medium-sized towns in a dynamic approach, on the basis of the data from 2002-2008.

Thirty six medium-sized towns (with populations ranging from 50 thousand to 150 thousand inhabitants) with district rights were selected for the purpose of the study. The study of the spatial differentiation of the standard of living of the inhabitants of these towns forms a part of the project entitled: "The Reference Model of Civic Logistics and the Quality of Life of Inhabitants". The research project assumed that the highest potential of a low-cost improvement of the civic logistics system due to the implementation of organizational and functional rationalizations exists for these towns. The main reason of choosing cities of medium size (50 to 150 thousand. inhabitants), was the availability of statistical date including selected variables for as long-intervals as possible.

2. Material and methods

The study was based on the data from 2002-2008, gathered in the Bank of Regional Data of the Central Statistical Office. Statistical information encompassing 7 research areas was subject to the analysis. The created data bank included 45 diagnostic features, 19 variables were selected to the final set.

All variables included in the study were in the form of coefficients of intensity. Hellwig's parametric method was used for the purpose of the selection of the representatives of respective sets [Hellwig 1981].

After determining the matrix of coefficients of correlation among respective variables belonging to the selected areas, all variables were divided into sets which included central variables together with satellite variables and the so-called isolated variables.

The final set of variables was created by the features (both central and satellite) whose frequency of occurrence was the highest in the whole analyzed period. It was additionally assumed that the final set of features should include variables which represent all selected sets which are characterized by high spatial variability with

low correlation within the selected sets and asymmetric distribution [*Taksonomiczna analiza*… 2000]. Due to a very high variability (Vs > 100%) and indirect influence on the standard of living, statistical features which describe the degree of pollution of natural environment were further eliminated from the final set.

As was shown in the work [Ibidem], too high spatial differentiation of such coefficients and a relatively high share in the variability of a synthetic measure make the towns which belong to the areas for which this coefficient is the lowest (e.g. due to the low degree of industrialization) achieve a much higher value, e.g. of a taxonomic measure of development. Such high values of the taxonomic measure of development are not observed for these towns in the case of all other measures included in the study.

The following set of features qualified to the final set of diagnostic variables, which became the basis of further empirical studies:

1. Healthcare: x_1 – infant mortality per 1,000 live births, x_2 – death rate per 1,000 persons, x_3 – death rate in the age range of 1-59 years per 1,000 persons, x_4 – number of dentists per 10 thousand persons;

2. Labor market, working conditions and safety: x_5 – number of unemployed registered per one job offer, x_6 – number of injured in accidents at work per 1.000 employees, x_7 – number of employees working in hazardous conditions related to working in the so-called arduous conditions per 1,000 employees, x_8 – entities registered in the National Official Register of Business Entities (REGON) per 10,000 people;

3. Remuneration and income of population: x_9 – income of the city budget in total per 1 inhabitant in PLN, x_{10} – capital expenditure of enterprises per 1 inhabitant in PLN, x_{11} – sold industrial production per 1 inhabitant (number of work > 9);

4. Living conditions: x_{12} – average living area in m^2 per 1 person, x_{13} – apartments equipped with the central heating system as a percentage of total number of apartments occupied, x_{14} – apartments equipped with gas facilities as a percentage of total number of occupied apartments;

5. Education: x_{15} – number of children aged 3-6 per 100 places in nurseries and kindergartens, x_{16} – average number of pupils per 1 branch in primary schools;

6. Leisure and culture: x_{17} – public library readers per 1,000 persons;

7. Communication and transportation: x_{18} – percentage of total expenditure on transportation and communication; x_{19} – public roads of hard surface per 100 km^2 in km.

Selected variables became the basis enabling to compare and classify the selected spatial units (towns) into sets with a similar standard of living. For the study of spatial differentiation of the standard of living of inhabitants of medium-sized towns, z_i – a taxonomic measure of development was implemented, determined on the basis of standardized variables by transforming destimulants into stimulants on the basis of the following formula:

$$x_{ij}^{\{S\}} = 2\bar{x}_j - x_{ij}^{\{D\}} \qquad (i = 1,...,m \qquad j = 1,...,k) \tag{1}$$

where: $\bar{x}_j$ − average calculated for 36 analyzed towns in t year for j-variable,
S – stimulant variable,
D – destimulant variable.

The assumed transformation allows for maintaining an average level and variability of a variable in a time unit $t = 1$. An additional advantage of this manner of transformation is the possibility for negative values to appear, which in the case of stimulants will mean a very unfavorable situation for the studied object [*Ekonometria przestrzenna* 1991].

Moreover, the transformations of destimulants into stimulants in subsequent time units $t = 2,\ldots,7$, were carried out on the basis of average values, determined for a time unit $t = 1$, in order to conduct a dynamic analysis.

Taxonomic measures of development for each of the seven areas of the standard of living were determined on the basis of standardized values of diagnostic features, based on the formula [Nowak 1990]:

$$z_i = \frac{1}{K}\sum_{k=1}^{K} z_{ki} \tag{2}$$

where: z_i – value of a taxonomic measure of development for i-object,
z_{ki} – standardized value of k-feature in i-object,
K – number of examined features.

The arithmetic average of the measure determined in this way equals one. This enables to conduct comparisons of the development of objects with multiple features. If the following inequality appears for the object examined: $z_i > 1$, then the object examined reaches a higher level of development than the average in the whole set of objects. In the case when $z_i < 1$, then the object examined reaches a lower level of development than the average in the set of the compared units [Ibidem].

The study was conducted in the dynamic model for all analyzed years. Including time in the spatial differentiation of the standard of living enabled to select the towns in which the improvement in the standard of living is observable, the towns with a steady standard and those in which the standard of living is deteriorating, thanks to the possibility of using the methods of time series analysis [*Poziom życia*... 2004].

As a result of the used transformation manner, the analyzed variables are measured in the interval scale. The dynamic analysis was, therefore, conducted using methods which can be used in the case of this type of scales [Walesiak 1990].

The analysis of dynamics was conducted using the absolute chain increment on the basis of the formula: [*Taksonomiczna analiza* 2000]:

$\Delta_{qi(t+1,t)}$ − absolute chain increment of a Z_q synthetic variable for an object i calculated for t and t+1 time units.

Subsequently, the mean pace of change in time was determined on the basis of the formula:

$$G_{qi} = \frac{z_{qi7} - z_{qi1}}{6} \ (q = 1, \ldots,7; \ i = 1, \ldots, 36) \tag{4}$$

where: G_{qi} – mean pace of change in time of the Z_q synthetic variable for the object i.

3. Presentation and estimation of findings

Table 1 presents the descriptive characteristics of the mean pace of change for 36 medium-sized towns analyzed in the years 2002-2008, determined for synthetic variables encompassing 7 measure sets describing the standard of living of a population.

The mean pace of change in the years 2002-2008 in the healthcare group is characterized by a right-handed symmetry. The median value (0.0163), lower than the arithmetic average (0.0209) means that a bigger number of towns of this size (20) achieved a rate lower than the average in the analyzed period.

The following towns noted the highest increase in the synthetic variable in 2008 in relation to 2002: Zielona Góra (0.0896), Jelenia Góra (0.0815), Biała Podlaska (0.0806), Suwałki (0.0736), Chorzów (0.0730), Włocławek (0.0584), Przemyśl (0.0574).

A negative pace of change was noted in the case of 11 towns: Grudziądz (–0.0021), Jastrzębie Zdrój (–0.0033), Piekary Śląskie (–0.0067), Piotrków Trybunalski (–0.0094), Dąbrowa Górnicza (–0.0120), Leszno (–0.0137), Elbląg (–0.0194), Siemianowice Śląskie (–0.0220), Tychy (–0.0243), Jaworzno (–0.0276) and Słupsk (–0.0745). The positive value of the mean pace of change in this group was mostly influenced by changes in the last four years.

A right-half symmetry is also characteristic of the mean pace of change for synthetic variables describing the labour market, working conditions and safety, remuneration and income of population and living conditions.

Table 1. Descriptive characteristics of the mean pace of change in the years 2002-2008 for synthetic variables in the distribution of seven sets of measures of standard of living

Descriptive characteristics	The mean pace of change						
	G_{1i}	G_{2i}	G_{3i}	G_{4i}	G_{5i}	G_{6i}	G_{7i}
Arithmetic average	0.0209	0.0397	0.1579	0.0277	0.0091	–0.0294	0.0215
Standard deviation	0.0364	0.0809	0.1119	0.0288	0.0062	0.0259	0.0546
Median	0.0163	0.0180	0.1186	0.0227	0.0096	–0.0277	0.0196
Maximum	0.0896	0.4169	0.5663	0.1055	0.0226	0.0267	0.2199
Minimum	–0.0745	–0.0467	0.0572	–0.0266	–0.0088	–0.0891	–0.0904

Source: own calculations.

The negative dynamics of changes concerns 9 towns in the area of the labour market, working conditions and safety, 4 towns in the area of living conditions, 2 towns in the area of education, 11 in the area of communication and transportation and as many as 32 analyzed towns in the area of remuneration and income of population.

Synthetic distribution is characteristic of the mean pace of change for the areas of education as well as communication and transportation. This means that for half of the examined towns the mean pace of change was lower than 0.0091 in the area of education and lower than 0.0215 in the area of communication and transportation, whereas for the other half it was higher.

The group of towns whose increase in the synthetic variable in 2008 in relation to the year 2002 was the highest in the case of the area: labour market, working conditions and safety encompasses: Przemyśl (0.4169), Koszalin (0.1898), Żory (0.1640) and Jaworzno (0.1236).

The highest decrease in the value of the synthetic variable occurred in the case of such towns as: Biała Podlaska (0.0040), Suwałki (-0.0041), Siemianowice Śląskie (–0.00593), Tychy (–0.0062), Rybnik (–0.0065), Piotrków Trybunalski (–0.0189), Zielona Góra (–0.0249) and Dąbrowa Górnicza (–0.0467).

A reduction in the mean pace of change was mainly observable in 2004, when this tendency could be noticed in 28 towns. Two moments of the reduction in the arithmetic average of absolute increments were observed in 2004 and 2006. Since 2007, an increase in the arithmetic average of absolute increment has been observable, whereas the average determined for 2008 is lower than that from 2003. The biggest difference between the highest and the lowest value among all the analyzed areas also testifies to the quite extensive differentiation of the towns as to the mean pace of change in the analyzed period of time.

In the case of the third of the analyzed areas: remuneration and income of population, only 4 out of 36 analyzed towns witnessed the increase in the synthetic variable in 2008 compared to 2002. They are: Płock (0.5663), Dąbrowa Górnicza (0.46200, Tychy (0.3560) and Mysłowice (0.3306).

Mostly the years 2006-2007 influenced the positive dynamics of changes in this area. In 2008, a considerable fall in the mean pace of change was noted in the case of 11 towns. The arithmetic average of absolute increments in the case of medium-sized towns is lower in 2008 in comparison with 2007.

In the case of the next area which encompasses living conditions, the decrease in the mean pace of change of the synthetic variable can be observable only in 11% of towns. Almost a half of the towns had dynamics above average. The following 4 towns had the biggest negative mean pace of change of living conditions in the years 2002-2008. Detailed analysis of the arithmetic average of absolute increments in respective years makes it obvious that the upward trend was stopped in the years 2004-2006 and that the increase reappeared in 2007.

An even lower percentage of towns which noted the drop in the mean pace of change (approx. 6%) was observed in the case of the next set of coefficients relating to the area of education.

A negative pace of change in this group was characteristic of 2 towns: Siedlce (–0.0047) and Piekary Śląskie (–0.0088). The highest values were obtained by 4 towns: Koszalin (0.0226), Żory (0.0222), Łomża (0.0161) and Płock (0.0154).

The values of the mean pace of change of the synthetic variable for a subsequent set of measures describing culture and leisure are higher than zero only in the case of 4 towns, which are: Jaworzno (0.0267), Nowy Sącz (0.0032), Leszno (0.0032) and Płock (0.0013). The average level of the mean pace of change for this group is negative and amounts to –0,0294. In this area there was the highest percentage of towns (86%) for which the dynamics of the mean pace of change in this area of study was negative.

The values above zero in the case of the arithmetic averages of absolute chain increments for respective towns appeared only in 2003 and 2004. It is, therefore, possible to assume that this tendency will be maintained in the years to come, especially as there was only one measure in this area that described the number of public library readers per 1.000 persons.

The values of the mean pace of change in the last set of measures in the area of communications and transportation is highly variable. The negative pace of changes in this set is observable in the following towns: Jelenia Góra, Elbląg, Piekary Śląskie, Płock, Nowy Sącz, Piotrków Trybunalski, Opole, Tychy, Mysłowice, Jastrzębie-Zdrój and Gorzów Wlkp.

The next step in the study of standard of living of inhabitants of medium-sized towns was to estimate the trend function for each of seven emphasized sets of measures and for the standard of living of the population of towns in question on the basis of which it was then possible to prepare forecasts by the extrapolation of trends.

Table 2 presents z_{qt} values (q = 1, …, 7; t = 1,…7) and z_t (t = 1, …, 7) of Zq (q = 1, …, 7) and Z synthetic variables for all examined medium-sized towns in the years 2002-2007. The table also presents descriptive characteristics of the examined variables. The values above one indicate an improvement in the standard of living of a population in comparison to the average standard determined for towns with district rights with the population ranging between 50-150 thousand in relation to the level from 2002.

The determined values of the synthetic examined variables concerning seven examined sets of measures and the standard of living of the populations of 36 medium-sized towns were used to estimate the trend functions presented in Table 3.

In addition to t-Student statistics to be found under the parameter estimations, the table also presents the values of a coefficient of determination and coefficient of variability. Due to the fact that the trend equations for synthetic variables describing the sets of measures concerning healthcare and education had coefficients close to zero, it was assumed that the constants equaling the arithmetic average from the synthetic value for the given set of measures would be the trend describing these two

Table 2. The values of synthetic variables describing 7 sets of measures and the standard of living of the population of medium-sized towns with district rights in the years 2002-2007

Year	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z
2002	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2003	1.0900	1.2374	1.0879	**0.9896**	**0.9972**	1.0052	**0.9557**	1.0518
2004	**0.9951**	1.1368	1.1869	1.0346	1.0060	**0.9801**	**0.9621**	1.0431
2005	1.0890	1.1964	1.2853	1.0645	1.0804	**0.9437**	1.0867	1.1066
2006	1.0356	1.1620	1.5107	1.0668	1.0299	**0.8830**	1.2653	1.1362
2007	1.0846	1.2084	1.8250	1.1275	1.0450	**0.8409**	1.2360	1.1953
2008	1.1253	1.2381	1.9475	1.1660	1.0548	**0.8236**	1.1291	1.2121
Descriptive characteristics								
Arithmetic average	1.0599	1.1685	1.4062	1.0641	1.0305	0.9252	1.0907	1.1064
Standard deviation	0.0500	0.0831	0.3671	0.0645	0.0314	0.0759	0.1265	0.0799
Median	1.0846	1.1964	1.2853	1.0645	1.0299	0.9437	1.0867	1.1066
Minimum	0.9951	1.0000	1.0000	0.9896	0.9972	0.8236	0.9557	1.0000
Maxsimum	1.1253	1.2381	1.9475	1.1660	1.0804	1.0052	1.2653	1.2121

Source: own calculations.

Table 3. The trend functions for synthetic variables describing 7 examined sets of measures in the years 2002-2008

Synthetic variable	Trend function equation	Coefficient of determination	Coefficient of variability
Z_1	$\hat{z}_{1t} = 1,0599$	–	0.0472
Z_2	$\hat{z}_{2t} = \underset{(1,5495)}{0,0067t^3} - \underset{(-1,6473)}{0,0865t^2} + \underset{(1,8568)}{0,3466t} + \underset{(4,1021)}{0,7590}$	0.7057	0.0545
Z_3	$\ln \hat{z}_{3t} = \underset{(1,7383)}{0,0069t^2} + \underset{(1,9167)}{0,0620t} - \underset{(-1,2935)}{0,0730}$	0.9799	0.0258
Z_4	$\hat{z}_{4t} = \underset{(1,9646)}{0,0032t^2} + \underset{(0,2471)}{0,0033t} + \underset{(42,5907)}{0,9872}$	0.9468	0.0140
Z_5	$\hat{z}_{5t} = 1,0305$	–	0.0305
Z_6	$\hat{z}_{6t} = \underset{(7,1606)}{0,0024t^3} - \underset{(-7,8310)}{0,0312t^2} + \underset{(6,0666)}{0,0861t} + \underset{(66,9676)}{0,9415}$	0.9959	0.0205
Z_7	$\hat{z}_{7t} = \underset{(-5,0749)}{-0,0126t^3} + \underset{4,8785}{0,1469t^2} - \underset{(-4,0747)}{0,4363t} + \underset{(12,3595)}{1,3115}$	0.9165	0.0335
Z	$\hat{z}_t = \underset{(11,5540)}{0,0363t} + \underset{(68,4218)}{0,9613}$	0.9639	0.0150

Source: own calculations.

groups [*Taksonomiczna analiza*... 2000]. However, forecasts for these variables were estimated based on the average rate of change. In the case of three sets of measures (healthcare, leisure and culture, communication and transportation) the

third degree polynomials turned out to be the best adjusted trend functions.The average rate of change was also used to estimate projections for these variables, due to the high value of the residual variance for this class of models.

Moreover, in the case of communication and transportation, the value of parameter estimation at the highest power is negative, which makes it clear that the average standard of living measured by means of this set of measures starts to decrease at a certain point in relation to 2002. For the set of measures referring to remuneration and income of population as well as living conditions, the developmental tendency was determined in the form of the second degree polynomial. In this case, the values of parameter estimations at the highest power are positive, which can be interpreted as an increase in the standard of living for these sets from a certain moment in relation to the standard from 2002. However, in the case of the standard of living of population of medium-sized towns a simple increasing function turned out to be the best adjusted trend function, which indicates an upward trend in the standard of living of the population of these towns.

4. Conclusion

The considerations presented herein concerning the dynamic analysis of synthetic variables describing seven sets of measures and the standard of living of the populations of medium-sized towns can be the basis for determining the directions of the development of the standard of living of the populations of these towns for years to come, determined by the extrapolation of trends noted in the past or on the basis of the average rate of change. The values of the synthetic variable forecasts describing 7 sets of measures and the standard of living of the populations of medium-sized towns with district rights are presented in Table 4.

Table 4. The values of the synthetic variable forecasts describing 7 sets of measures and the standard of living of the populations of medium-sized towns with district rights (in comparison with 2002) for the years 2009-2011

The study area	2009	2010	2011
Healthcare*	1.1477	1.1705	1.1937
Labour market, working conditions and safety*	1.2830	1.3295	1.3776
Remunerations and income of population	2.3699	2.8340	3.4359
Living conditions	1.2176	1.2751	1.3389
Education*	1.0642	1.0737	1.0833
Leisure and culture*	0.7974	0.7720	0.7474
Communication and transportation*	1.1522	1.1757	1.1998
The standard of living of the populations of medium-sized towns	1.2517	1.2880	1.3243

*Forecasts were estimated based on the average rate of change.

Source: own calculations.

The forecasts of standard of living for the populations of medium-sized towns show upward trends, despite the deterioration which was forecast for the area of communication and transportation. This means that the improvement in the standard of living in relation to the situation from 2002 is very likely to take place in the years to come.

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ANALIZA TENDENCJI ROZWOJOWYCH POZIOMU ŻYCIA LUDNOŚCI MIAST ŚREDNIEJ WIELKOŚCI W POLSCE

Streszczenie: Poziom i warunki życia ludności w Polsce są silnie przestrzennie zróżnicowane. W artykule, na przykładzie miast średniej wielkości (od 50 do 150 tys. mieszkańców), podjęta została próba analizy przestrzennego zróżnicowania poziomu życia mieszkańców w ujęciu dynamicznym, w latach 2002-2008. Do badań wytypowano 36 miast. W ramach pierwszego etapu, ze zbioru 45 cech diagnostycznych do finalnego zbioru zmiennych wytypowano 19 zmiennych. W artykule, oprócz analizy zmian w grupach miast o podobnym poziomie życia ludności, przeprowadzono również badania w ujęciu dynamicznym.