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SIMILARITY OF REGIONS IN TERMS OF THE STRUCTURE OF THE ELDERLY POPULATION – PROPOSITION OF A MEASURE[1]

Summary

Purpose – The article presents a proposal for a measure of the similarity of regions in terms of the structure of the elderly population.

Research method – Using the proposed measure, the similarity of population structures aged 60 and above was assessed for the regions of Poland in 2017, where the age groups: 60-74, 75-84 and 85 plus were defined as components of the structure.

Results – The research results demonstrate that Poland's voivodeships differ with respect to the structure of people aged 60 and above. The spatial polarization of the country with respect to the components of the structure of an elderly population can be observed.

Originality/value – Identification of the regional differentiation of the situation in terms of the size and age structure of the elderly population can be helpful in planning activities within the silver economy policy adapted to the situation in each region.

Keywords: aging process, old age indexes, regional diversity of aging process, aging stages

JEL Classification: J11, C40

1. Introduction

For many years, the progressing process of population aging has been observed in Europe [Kowaleski, Majdzińska, 2012; *Sytuacja demograficzna Polski …,* 2017], including Poland [Roszkowska, 2018]. Some sociologists and gerontologists are openly talking about the "greying" population. Peterson [1999] refers to the process as the "grey dawn". According to predictions, over the next few decades, the populations of almost all developed countries are going to age. Concurrently, we can observe the process of old people "aging", which means that the population at the age of 75 and above increases more rapidly than the number of "younger senior

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citizens" [Pierzchalska, Klag, 2008]. According to a report published by the Office for National Statistics in Poland (GUS) [*Sytuacja demograficzna Polski …,* 2017], the majority of European countries are much further advanced in the process of population aging, however, there is a diversification of the dynamic of the aging process among those countries. The report also underlines that "Europe is the oldest continent in terms of demographics" [p. 14], however, "despite the aging process which has been observed for several years, the population of Poland is still relatively young, both in comparison with other EU countries and with the total population of Europe" [p. 15]. On the other hand, the GUS forecast predicts that the share of people who are aged 60 years plus in the total population of Poland, is going to increase from 25.9% in 2020 to 40.4% in 2050 [*Prognoza ludności …,* 2014]. The changes in the size and structure of the population according to the age groups are affected by the number of births and deaths, as well as the size and structure of migration. The aging process of the population of Poland is the resultant of the low birth rates, longer average lifespans related to the civilisation progress and improved standards of living, and also a negative migration balance [cf. Stańczak, Szałtys, 2016].

Numerous measures can be applied to assess the advancement of population aging. They are based on the population structure broken down by biological age groups (0-14, 15-64, 65 and more) or working age groups (0-14, 15-59, 60 and more), e.g. the demographic aging rate (DAR), the aging index, demographic dependency ratios, the young-age dependency ratio, the old-agee dependency ratio, and generational support ratios [Clarke, 1965; Kowaleski, 2011; Długosz, 1998]; statistical measures, such as median, deciles, quartiles, the Gini coefficient of concentration, the synthetic age structure index and the coefficient of skewness [Cieślak, 2004; Abramowska-Kmon, 2011; d'Albis, Collard, 2013]; the measure of a relative aging gap, the index of dissimilarity and the method of structure similarities [Podogrodzka, 2014]. Due to the complexity of the phenomenon, there is a constant search for fresh techniques and methods of measurement, as well as systems to analyse the aging process [cf. Abramowska-Kmon, 2011].

Demographic conditions, as well as the social and economic consequences of population aging are the subject of numerous analyses [cf. *Ekonomiczne konsekwencje…*, 2003, *Ludzie starsi w …,* 2007; *Demograficzne uwarunkowania …*, 2012; Sanderson, Scherbov, 2010; Murphy, 2017; Niewiadomska, Sobolewska-Poniedziałek, 2015; Zimnoch, 2013]. Researchers stress that the demographic properties of the population of a specific region have an impact on the population aging process, its intensity and characteristics, as well as the result represented by the population age structure [cf. Kowaleski, 2011; Kurek, 2008]. As a result of societies aging, there are changes affecting national economies and public finances, which impact transformations in the models of production, consumption, savings and investments, labour market, and efficiency, types of services, or the cost of budgetary expenses.

This paper examines the issue of measuring the aging process from the regional perspective, also in terms of the group structure of the elderly population. Due to various definitions of the "old-age thresholds" and the internal diversity of the

group of elderly people, attempts are made to develop new measures and concepts which would include, for example, the health condition or the functional and cognitive capacities of senior citizens, as well as their purchasing power or their position on the labour market. Identifying the regional diversification of the situation with respect to the size and structure of an elder population may be helpful to define the directions of development of the silver economy, and also to develop specific goals of the policy towards senior citizens adjusted to the situation of the region, including the needs of senior citizens representing specific age groups [cf. *Gospodarka senioralna ...,* 2018].

In the Polish subject literature, numerous studies can be found which concern the measurement and assessment of the territorial differentiation of population aging in Poland [e.g. Potrykowska, 2003; Błaczkowska, Grześkowiak, 2009; Wolańska, 2013; Podogrodzka, 2014, 2016a,b,c; Kowalewski, 2011; Stańczak-Szałtys, 2016; Wasilewska, 2017][2].

Potrykowska [2003] presents the evolution of the aging process of Poland's population, and describes the spatial diversification of the distribution of older people in the regions in 2000, with the application of the old age rate. Wolańska [2013] in her work presents an analysis of selected measures of the population aging process (e.g. old age coefficient, old age index) in individual voivodeships in urban and rural areas during the years 1995, 2005, 2010, and provides demographic forecasts for 2035. Similarly, Stańczak and Szałtys [2016] assessed a regional diversification of the aging process of Poland's population with the use of classical old age measures, i.e. age median, old age coefficient, old age index, demographic dependency ratios for 1990 and 2015, and they also presented the demographic forecast for 2040.

Błaczkowska, Grześkowiak [2009] in their work present the results of research concerning the comparative analysis of the population structure in urban and rural areas in Poland from the spatial perspective [voivodeships and voivodeship capital cities] with the use of taxonomy methods. The condition of age structures as of 2002 was compared with the structures forecasted for 2030. Also, the classification of voivodeship capital cities according to the hierarchical agglomeration procedures.

Wasilewska [2017] in her work provides an assessment of the spatial diversification of the demographic aging level and the dynamics of the aging process of the population in rural areas in the context of the course of this process in Polish cities during the years 2000-2015, with the application of classical old age measures, i.e. demographic old age coefficient and index in the static and dynamic perspective.

In her several works, Podogrodzka [2004, 2016 a, b, c] attempts to analyse the regional diversification of the aging process in Poland's regions during the years 1991-2011 with the application of various measures. Podogrodzka [2014], uses an analysis of a spatial diversification of the direction and intensity of population changes in the age groups: 0-24, 25-44, 45-64, 65 and more in Poland during the years

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[2] A review of works concerning measures and empirical research related to the assessment of the diversification of the aging process in the Polish regions before 2000 can be found in Kurek [2008].

1991-2010, and also the assessment of similarity of voivodeship population structures to the progressive age pyramid. The analysis of diversification of the aging process with the use of various aging coefficients as per voivodeship during the years 1991-2011 was presented in the study by Podogrodzka [2016a]. In the same work, the author also studies whether in the period in question, the groups of voivodeships with a similar value of the measure of demographic old age create spatially dense areas. In her supplementary research [2016c], the author applied the agglomerative method (Ward's method) to assess the spatial differentiation of the level of advancement of demographic old age and the assessment of differences occurring between the examined regions. The analysis was conducted for the years 1991, 2001 and 2011 per voivodeships, and conducted separately for the population of women and men. In her work [2016b], Podogrodzka utilised the old age index to analyse the aging process assuming various thresholds of old age. It confirmed the occurrence of polarisation of demographic old age of Poland's voivodeships during the years 1991-2011, sigma-convergence, i.e. decreasing differences in the value of old age index for the majority of voivodeships, gamma-convergence, i.e. the dependence of the spatial picture of demographic old age in the relation to the research time points, and the lack of spatial beta-convergence, i.e. lack of correlation between the high values of the old age index at the beginning of the examined period and their dynamics of changes. Furthermore, the impact of the manner of calculating the old age index on the results was analysed. In the work by Roszkowska and Wyszkowska [2020], an analysis was made of the direction and pace of changes of the share of people in the identified groups of old age in the total population of Poland's voivodeships during the years 2000-2016.

This study is part of the trend in Polish research literature dedicated to the analysis of spatial diversification of the demographic aging process in the methodological and application aspects. The main goal of the study was to present a proposal of a new measure of spatial measurement of differentiation in the structure of old people according to a measure of similarity of structures, which allows for an assessment of changes of structure for the population over 60 years old in a static perspective (i.e. in a specific year), and also in a dynamical perspective (i.e. for a specific period). As identified components of the structure of elder people, the study adopted the age groups of 60-74, 75-79, 85 and more, and the structure of the elderly population in Poland as the base for comparison.

According to the proposed measure of similarity of structures, an assessment was undertaken on spatial differentiation of the structure of old people at the age of 60 and more for regions in Poland in the static perspective in 2017[3]. For the purpose of the study, the data from the Local Data Bank were used. The adopted measure of similarity of structures helped to provide answers to the following questions:

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[3] In this study, the assessment of similarity of regions in terms of the structure of elderly population was conducted from the static perspective. At the time of writing this paper, the latest available data included 2017.

1. Were Poland's regions differentiated in terms of the structure of old people in 2017, and if so, to what degree?
2. Did the voivodeships of a similar structure of the elderly population create dense spatial areas, i.e. did they have at least one common border in 2017?
3. Did the eastern part of the country have a higher percentage of people older than 85 in the structure of the elderly population in comparison to western Poland in 2017?

It was shown that the process of aging is not significantly diversified regionally and there is a spatial polarisation in the country with respect to the components of the structure of old age population.

It is worth emphasising that the proposed measure may be also applied to assess similarity among regions with respect to the structure of older people in the dynamic perspective[4].

2. Demographic old age – threshold and stages

In the subject literature, various approaches may be encountered with respect to the definition of old age and its periodization, depending on the biological, psychological or social aspect [Szatur-Jaworska et al., 2006, pp. 45-48; Iwański, 2017]. We can distinguish biological, social, economic, psychological, legal and social, or demographic ages. The complexity of processes that determine the demographic old age incurs problems with defining old age thresholds which are not clear-cut, and the aging process occurs in stages. At first, the social aging process begins, which is followed by physical aging related to the lifestyle, living conditions, gender or place of living. Economic growth, a higher standard of living and improved life quality, progress and achievements in medicine have an impact on prolonging human life and reducing the mortality rate, which results in a larger group of old people.

Usually, it is assumed that old age begins at the age of 60 [www 1] or 65 [www 2]. According to various proposals, old age is divided into stages ranging from two to four. As it was noticed by Kowaleski [2008], "identification of the sub-population of 'younger' and 'older' old people in the research on the aging process is crucial due to the increasing number of the latter group ["double aging"], which brings additional qualitative elements to the presented phenomenon [such as an increasing number of people who require assistance in the performance of daily activities]".

In the psychological literature, there are usually two groups of old people differentiated: younger old people (60-75) and older old people (above the age of 75). The World Health Organisation [www 1] distinguishes the early old age (60-74), intermediate old age (75-89) and late old age, i.e. longevity (90 and more). The division into four stages of old age [Szatur-Jaworska et al., 2006] includes the period of initial aging (60-69), interim aging between the initial aging and the age of limited

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[4] The assessment of similarity among regions in terms of the structure of old people from the dynamic perspective is going to be the subject of a separate paper.

physical and mental efficiency (70-74), the advanced old age characterised with limited physical and mental efficiency (75-84) and the age of infirmity (85 and more).

For the purpose of this research, the old age threshold was adopted at 60 years old, and sub-groups of the elderly were identified taking into consideration three aging phases [Błędowski et al, 2012]:

– *the young old* – persons aged 60-74, who most often are still fully physically and mentally capable,
– *the old old* – persons aged 75-84, who usually require assistance with some daily activities, such as shopping, cleaning, making laundry, etc.
– *the oldest old* – persons aged 85 and more, who need continuous assistance with most of their activities; these are potential clients of institutionalised forms of assistance.

Further stages of old age are characterised with progressing symptoms of aging in terms of physiology and psychology, expressed with gradual limitation of psycho-physical efficiency, independence, possibilities of social adaptation and increased dependency on others. Activities of senior policy should be adjusted to individual old age groups. Particularly, in the case of the *young old,* greater emphasis should be made on measures related to professional activities of this age group.

3. Proposal of an index to show similarities of structures of old people

As old people do not constitute a uniform group, three sub-groups have been identified to present changes in the structure of the elderly population: young old, old old, and the oldest old. These groups include the phases of aging in the analysis of people at the age of 60 and more. The following criteria have been adopted as the principal measures:

– **index of the young old**, i.e. the relationship of the young old (60-74) to the elderly people (60 and more):

$$IMS_{it} = \frac{L_{it}(60-74)}{L_{it}(+60)} \tag{1}$$

– **index of the old old,** i.e. the relationship of the old old (75-84) to the elderly people (60 and more):

$$ISS_{it} = \frac{L_{it}(75-84)}{L_{it}(+60)} \tag{2}$$

– **index of the oldest old,** i.e. the relationship of the oldest old (85 and more) to the elderly people (60 and more):

$$INS_{it} = \frac{L_{it}(+85)}{L_{it}(+60)} \tag{3}$$

where:
$L_{it}(+60)$– number of people at the age of 60 and more for i –that region in the period of t,

$L_{it}(60-74)$– number of people at the age of 60-74 for i –that region in the period of t,

$L_{it}(75-84)$– number of people at the age of 75-84 for i – that region in the period of t,

$L_{it}(+85)$- number of people at the age of 85 and more for i – that region in the period of t,

i – region/Poland,

t – period of study.

And furthermore:

$$IMS_{it} + ISS_{it} + INS_{it} = 1 \tag{4}$$

The components of the old age structure, i.e. the structure of the elderly people (60 and more), in a region/in Poland in the t period create a column vector, where its components are the k-shares of this component of the old age structure [percentage share of *the young old, the old old,* and *the oldest old* in the structure of the elderly in total in a region/in Poland in the t period.]

Comparisons of regional structures of old age were conducted with the application of the measure of similarity of structures [Młodak, 2006]:

$$P_{ij,t} = \sum_{k=1}^{3} \min(w_{kit}, w_{kjt}) \tag{5}$$

where:

$i, j \in$ {voivodeship, Poland},

k – number of the component of the structure, where the identified components of the structure are age groups: 60-74, 75-84, 85 and more (k=1,2,3),

w_{ikt}, w_{jkt} – share of k- of this component in the structure in total respectively for $i, j \in$ {region, Poland} in the t period, t – period of study.

The following relationships occur: $0 \leq w_{kit} \leq 1$ oraz $\sum_{k=1}^{3} w_{kit} = 1$. The measure of similarities of structures is included within the range of [0,1]. In the case of totally different structures of old age, $P_{ij,t} = 0$, and in the case of identical structures – $P_{ij,t} = 1$. We can observe that according to the formulas (1)-(3), the following occurs:

$$P_{ij,t} = \min(IMS_{it}, IMS_{jt}) + \min(ISS_{it}, ISS_{jt}) + \min(ISS_{it}, INS_{jt}) \tag{6}$$

where: $i, j \in$ {voivodeship, Poland}. It can be easily verified that the obtained measure is symmetrical, i.e. $P_{ij,t} = P_{ji,t}$. And furthermore $P_{ii,t} = 1$.

According to the values of the measure of similarity of structures of the elderly population for regions with the elderly population structure for Poland, and also old age structures among regions, it is possible to identify clusters of regions which are the most similar inside the groups with respect to the structure of the elderly people at the age of 60 or more in the total population, as well as the most differentiated regions among the groups.

Notice. In the case of the assessment of the similarity of structures of age of elderly people each year (i.e. in static perspective), the t index in the formulas (1)-(6) may be omitted.

4. Similarity of structures of age of elderly population in total for Poland's regions in 2017

Using the measure of similarity of structures (formula (6)), an assessment was conducted in terms of the similarity of structures of age of the elderly people in total between pairs of regions in 2017. The values of the measure of the similarity of structure for pairs of regions have been presented in table 1. It can be observed that according to (6), the obtained matrix is symmetrical.

TABLE 1

Matrix of values of measures of similarities of structures of age of elderly people in total for pairs of regions in 2017

| 2017	DŚL	K-P	LBL	LBU	ŁDZ	MŁP	MAZ	OPO	PKR	PDL	POM	ŚL	ŚW	W-M	WLKP	ZPM	POLSKA
DŚL	1.00	0.99	0.97	0.98	0.99	0.96	0.97	0.96	0.97	0.94	0.99	0.97	0.97	1.00	0.99	0.98	0.98
K-P	0.99	1.00	0.97	0.98	0.99	0.96	0.97	0.96	0.97	0.94	1.00	0.98	0.97	1.00	0.99	0.98	0.98
LBL	0.97	0.97	1.00	0.95	0.98	0.99	1.00	0.98	0.99	0.97	0.97	0.98	1.00	0.97	0.96	0.95	0.98
LBU	0.98	0.98	0.95	1.00	0.97	0.95	0.95	0.94	0.95	0.92	0.98	0.96	0.96	0.98	0.99	1.00	0.97
ŁDZ	0.99	0.99	0.98	0.97	1.00	0.98	0.98	0.97	0.98	0.95	0.99	0.98	0.99	0.99	0.98	0.97	0.99
MŁP	0.96	0.96	0.99	0.95	0.98	1.00	0.99	0.99	1.00	0.98	0.97	0.98	0.99	0.96	0.95	0.95	0.98
MAZ	0.97	0.97	1.00	0.95	0.98	0.99	1.00	0.98	0.99	0.97	0.97	0.98	1.00	0.97	0.96	0.95	0.98
OPO	0.96	0.96	0.98	0.94	0.97	0.99	0.98	1.00	0.99	0.98	0.96	0.98	0.98	0.96	0.95	0.94	0.97
PKR	0.97	0.97	0.99	0.95	0.98	1.00	0.99	0.99	1.00	0.98	0.97	0.99	0.99	0.97	0.96	0.95	0.98
PDL	0.94	0.94	0.97	0.92	0.95	0.98	0.97	0.98	0.98	1.00	0.94	0.96	0.97	0.94	0.93	0.92	0.96
POM	0.99	1.00	0.97	0.98	0.99	0.97	0.97	0.96	0.97	0.94	1.00	0.98	0.98	0.99	0.99	0.98	0.99
ŚL	0.97	0.98	0.98	0.96	0.98	0.98	0.98	0.98	0.99	0.96	0.98	1.00	0.98	0.97	0.97	0.96	0.99
ŚW	0.97	0.97	1.00	0.96	0.99	0.99	1.00	0.98	0.99	0.97	0.98	0.98	1.00	0.97	0.96	0.96	0.99
W-M	1.00	1.00	0.97	0.98	0.99	0.96	0.97	0.96	0.97	0.94	0.99	0.97	0.97	1.00	0.99	0.98	0.98
WLKP	0.99	0.99	0.96	0.99	0.98	0.95	0.96	0.95	0.96	0.93	0.99	0.97	0.96	0.99	1.00	0.99	0.97
ZPM	0.98	0.98	0.95	1.00	0.97	0.95	0.95	0.94	0.95	0.92	0.98	0.96	0.96	0.98	0.99	1.00	0.97
POLSKA	0.98	0.98	0.98	0.97	0.99	0.98	0.98	0.97	0.98	0.96	0.99	0.99	0.99	0.98	0.97	0.97	1.00

Shades of grey indicate the smallest and the largest results.

Source: own elaboration according to: [*Rocznik Demograficzny…,* 2018].

The largest similarity of age structures of an elderly population was observed for pairs of voivodeships: dolnośląskie and warmińsko-mazurskie, kujawsko-pomorskie and pomorskie, kujawsko-pomorskie and warmińsko-mazurskie, lubelskie and ma-zowieckie, lubelskie and świętokrzyskie, lubuskie and zachodnio-pomorskie, mazo-wieckie and świętokrzyskie, podkarpackie and małopolskie. The largest difference was observed for the voivodeships: podlaskie and lubuskie (0.92) and podlaskie and

zachodniopomorskie (0.92). In the łódzkie voivodeship, the age structure of the elderly population was the most like the overall picture in Poland. Concurrently, the podlaskie voivodeship differed the most in comparison to other voivodeships in terms of the age structure of the elderly people. The measure of similarities of structures for the podlaskie voivodeship and others ranged from 0.92 to 0.98, while for all other voivodeships it is possible to find at least one voivodeship for which the measure of the similarity of structures amounted to not less than 0.99. Chart 1 presents the structure of ages of the elderly people in individual regions in 2017.

CHART 1

Age structure of elderly population in Poland's voivodeships in 2017
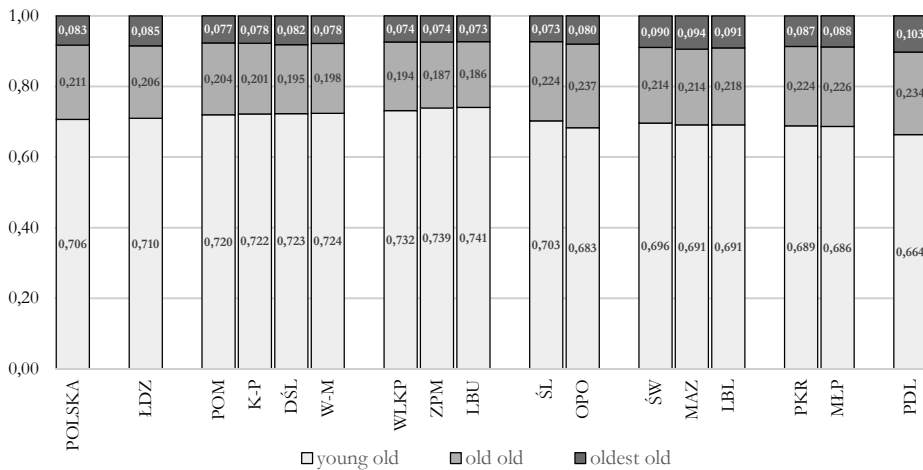
Source: own elaboration based on [*Rocznik Demograficzny…,* 2018].

According to the results presented in table and chart 1 it may be concluded that in 2017, Poland's regions were not much differentiated in terms of the structure of elderly people. In 2017, it was possible to distinguish the following groups of regions in terms of a similarity of the structure of age of the elderly people in the region to the structure of age of the elderly people in Poland [cf. table 1, chart 1]. The presented typology is a conceptual reference to the Osanna Triangle (triangular diagram) [Korycka-Skorupa, 2017], which can be applied to present phenomena of a threefold structure. The proposed typology additionally includes the differences in structure within the 'Osanna type'. The basic limitations of groups have been defined according to the share of people of respective age: 60-74, 75-84, 85 and more, in the structure of the elderly population (age of 65 and more) in Poland, i.e. A: the young old – 0.706; B: the old old – 0.211 and C: the oldest old – 0.083 (chart 1).

According to a classical Osanna typology, four groups of voivodeships were identified, and sub-groups were identified within certain groups, which included the differentiation of structure indexes and the measures of similarity of voivodeships' structures. The results of the classification are as follows:

Group I (*percentage of the young old in the region and the oldest old is higher, and the percentage of the old old in the region is lower than in Poland, i.e. A>0.706; B<0.211; C>0.083*): the łódzkie voivodeship (0.99), very high similarity of the structure of age of the elderly population in the voivodeship to the structure of the age of the elderly population in Poland; the similarity of age structure of the elderly population for this region to the age structures for other regions ranged from 0.95 to 0.99.

Group II (*percentage of the young old in the region is higher, of the old old and the oldest old is lower in the region than in Poland, i.e. A>0.706; B<0.211; C<0.083*) voivodeships: pomorskie, kujawsko-pomorskie, dolnośląskie, warmińsko-mazurskie, wielkopolskie, zachodniopomorskie, lubuskie.

Two sub-groups have been identified within Group II:

Group IIa (*percentage of the young old in the region is slightly higher, of the old old and the oldest old is slightly lower in the region than in Poland*) voivodeships: pomorskie (0.99), kujawsko-pomorskie (0.98), dolnośląskie (0.98), warmińsko-mazurskie (0.98); high or moderate similarity of age structures for the elderly population for the region and for Poland, similarity of structures among regions in the group is high (0.99) or very high (1.00).

Group IIb (*percentage of the young old in the region is significantly higher, of the old old and the oldest old is significantly lower than in Poland*) voivodeships: wielkopolskie (0.97)*,* zachodniopomorskie (0.97), lubuskie (0.97); low similarity of the age structure of the elderly population for the region and for Poland; in the lubuskie voivodeship the highest percentage of people at the age of 60-74 (0.741) and the lowest percentage of people at the age of 75-84 (0.186) in the population of the elderly in total; and the lowest percentage of people above 85 years of age (0.073) in the population of the elderly in total; high (0.99) or very high (1.00) similarity of structures among regions of this group.

Group III (*percentage of the young old in the region and the oldest old is lower, and the old old is higher in the region than in Poland, i.e. A<0.706; B>0.211; C<0.083*) voivodeships: śląskie (0.99), opolskie (0.97); similarity of age structure of elderly people for both regions equals to 0.98; similarity of age structure of the elderly for those regions to the age structures of other regions ranges from 0.94 to 0.99; in the opolskie voivodeship, the highest percentage of people at the age of 75-84 (0.237) in the elderly population in general.

Group IV (*percentage of the young old in the region is lower, of the old old and the oldest old is higher in the region than in Poland, i.e. A<0.706; B>0.211; C>0.083*) voivodeships: świętokrzyskie, mazowieckie, lubelskie, podkarpackie, małopolskie, podlaskie.

Three sub-groups have been identified within Group IV:

Group IVa (*percentage of the young old in the region is slightly lower; of the old old and the oldest old is slightly higher in the region than in Poland*) voivodeships: świętokrzyskie (0.99), mazowieckie (0.98*),* lubelskie (*0*98); high or moderate similarity of the age structure of the elderly population in the region and in Poland; high (0.99) or very high (1.00) similarity of structures among region within the group.

Group IVb (*percentage of the young old in the region is significantly lower; of the old old is significantly higher and of the oldest old is higher in the region than in Poland*) voivodeships:

podkarpackie (0.98), małopolskie (0.98); moderate or low similarity of age structure of the elderly population for the region and for Poland; high (0.99) or very high (1.00) similarity of structures among regions within the group.

Group IVc (*percentage of the young old is significantly lower; of the old old and the oldest old is significantly higher in the region than in Poland*) voivodeship: podlaskie (0.96); low similarity of the age structure of the elderly population in the region and in Poland; in this voivodeship, there is the highest percentage of people at the age of 85 and more (0.102) and the lowest percentage of people at the age of 60-74 (0.664) in the elderly population in total; the similarity of the structure of the elderly population for this region to the age structure for other regions ranges from 0.92 to 0.98.

The spatial differentiation of Poland's voivodeships in terms of the similarity of structures of the elderly population in 2017 is presented in chart 2.

CHART 2

Spatial differentiation of Poland's voivodeships in terms of the similarity of structures of the elderly population in 2017
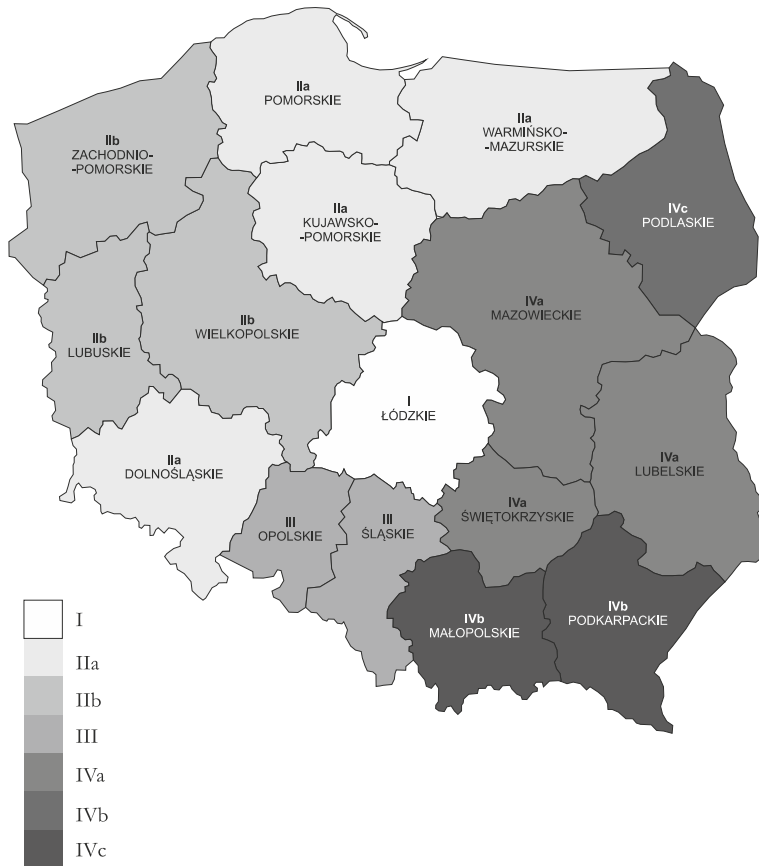
Source: own elaboration based on [*Rocznik Demograficzny…,* 2018].

It is possible to observe that in the regions of northern and north-western Poland (Group II) and partially of central Poland (Group I), the percentage of the young old in the region is higher, and the percentage of the old old is lower than in Poland. An opposite tendency can be observed in the regions of eastern and south-eastern Poland (Group IV), where the percentage of the young old in the region is lower and the percentage of the old old is higher in the regions than in Poland. In Group III, the percentage of the young old and the old old is lower in the regions than in Poland.

5. Conclusions

Research in the demographic processes in the spatial perspective have cognitive and practical significance. Social policy to address population aging challenges, undertaken by various entities, including the state, should take into consideration the age structure of the population resulting from the increased percentage of the old people, but also the changes of the structure of the elderly population.

This paper presents a proposal of a new spatial measurement of the diversification of demographic aging and the assessment of the changes of population structure at the age of 60 and more including the stages of the old age, according to the measure of the similarity of structures. An assessment was made to identify differences between the specific age groups of the elderly in terms of regions in 2017; as a result, answers were provided to questions 1-3 asked in the introductory part of this paper. In 2017, in the łódzkie voivodeship the age structure of the elderly population was the most similar to that of Poland, and in the podlaskie voivodeship, it was the least similar to that of Poland. In that year, Poland's regions were diversified in terms of the structure of people at the age of 60 and more. However, spatial polarization could be observed in the country with respect to the components of the structure of the elderly population. The structure of the elderly population in the northern, central-western and south-western parts of Poland was significantly different than its south-eastern and central-eastern parts.

It should be kept in mind that aging is a dynamic process, and the changes affecting aging take place at different paces and with different intensity in regions. As a result of such differentiated intensity of changes of population aging, there may be a change in the spatial picture of the percentage of people at the age of 60 and more, and also a change of the percentage of people in the analysed sub-groups of old age in individual voivodeships. Such observation may be a starting point to a more thorough analysis in that respect. The conducted static research should be complemented with an analysis of the structure of population at the age of 60 and more in the dynamic perspective, which would allow us to observe the diversity of regional internal structure, an identification of the quantitative character of changes of similarity of age structures of elderly population in the regions in a period of time; also the direction of such changes and their intensity. An analysis conducted according to the proposed measures may be also complemented with an assessment

conducted within voivodeships to assess the differentiation of the structure of the elderly population, for example in terms of gender or rural/urban areas.

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