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**Working Paper**

## The Analysis of Population Aging Phenomena in Poland in Spatial Perspective

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**Institute of Economic Research Working Papers**

**No. 5/2014**

**The Analysis of Population Aging Phenomena  
in Poland in Spatial Perspective**

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**Toruń, Poland 2014**

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## The Analysis of Population Aging Phenomena in Poland in Spatial Perspective

**JEL Classification:** C38, C51, J11

**Keywords:** *population aging, socio-economic development, spatial approach, taxonomic analysis, regression analysis*

**Abstract:** The processes of socio-economic development are continuously accompanied by the process of population aging. It is seen as a growing of the percentage share of people aged 65 and over in the general population. It covers the majority of European Union countries and also refers to Poland. The objective of the paper is to analyze the population aging phenomenon in spatial perspective. The study was carried out for 66 subregions (NUTS 3) and covered the period 1995-2012. Poland is characterized by a strong spatial diversification regarding the senior citizens share and its growth rate, and also determinants exerting impact on the demographic aging processes. The demographically youngest and slowest aging population lives in south-eastern and also central Poland. The most intensive population aging processes are seen in the selected subregions of south-western Poland. Here, we observe extremely low fertility, demographically old working-age population and also significant migration outflow of younger people.

### Introduction

The paper discusses the problem of demographic aging of the Polish population. Aging processes are defined as changes in the age structure of population where the percentage of older population against the total population number is increasing (Rosset 1959, Frątczak 1984, Uhlenberg 2009). They are accompanied by social, cultural and economic factors;

among others intentional delaying of procreation time and changing life priorities, leading more and more towards healthy life style, progress in medicine and wider access to medical services etc.

These processes are present in almost all European Union countries and also refer to Poland (see Kurkiewicz et. al. 2006, 2012, Muenz 2007, Giannakouris 2008, Kurek 2008, Strzelecki 2009, Lindh and Malmberg 2009, Kurkiewicz 2010, Dragan 2011, Hryniewicz 2012, Pocięcha 2003). The processes of demographic aging are affected by a slow, although often irreversible, change in time. From the perspective of the state policy it is observed as a major problem which strongly determines the situation in the country in terms of its financial, social and economic issues.

In the long-term prospect, without taking appropriate activities in the socio-economic sphere, population aging processes may lead to a gap in the labour market, disturbing the retirement system, decreasing the efficiency of social systems (e.g. health care, welfare). The growing share of the older population also imposes the need to adapt adequate social policy within the framework of which, indispensable care will be offered to people included in this age group (see Golimowska 2008, Jurek 2012, Magnus 2008, Prskawetz, Lindh 2011, Wilk, Bartłomowicz 2012).

There are significant regional disparities of socio-economic development processes in Poland. This affects the conditions of population aging processes. Therefore we can assume that the dynamics of population aging processes are also spatially diversified and their conditions are peculiar to particular regions of the country. The objective of the paper is to examine the level and rate of population aging processes in Poland and also reveal their demographic conditions in spatial perspective.

The analysis of the population aging phenomenon was carried out for 66 subregions (NUTS 3) and covered the period 1995-2012. In the first part of the paper the degrees and rates of population aging processes in subregions will be discussed. Therefore the subregions demonstrating significant progress of population aging processes will be revealed.

In the next part of the paper the econometric model will be constructed. The investigation will be carried out based on the synthetic measure values specified considering senior citizens share, as well as the growth rate of this share. Next, in the cases of the selected demographic factors (such as fertility, migrations etc.), the identification of their relations with population aging processes will be carried out. In the third part, the demographic conditions of population aging processes in Polish subregions will be indicated.

## Methodology of the research

The study examines the population aging processes in 66 Polish sub-regions and their demographical conditions. The age pyramids served to reveal the overall tendencies in changing of the age structure in Poland within the period 1975-2012. Than the shares of senior citizens (people aged 65 and over) in 2012 and also their increase rates in sub-regions in the period 1995-2012 were considered. This served to indicate the current state of population aging processes in sub-regions and the intensity of these processes.

In order to examine the advancement of population aging processes in Poland and their conditions the regression analysis was applied. The synthetic measure of the intensity of population aging processes served as the dependent variable while several significant demographic indicators formed a set of explanatory variables. The application of a synthetic measure in cause-effect models was proposed in Hellwig, Siedlecka and Siedlecki 1995.

The approach using a taxonomic measure of development (TMD) was applied to assess the spatial diversification of the population aging processes in Polish subregions. It allows us to cover a set of indicators at the same time and to provide the synthetic description of the situation regarding the analyzed phenomenon (see Grabiński, Wydymus, Zeliaś 1989, Nowak 1990, Młodak 2006).

The construction of TMD was based on two diagnostic variables: the share of senior citizens in 2012 and also the growth rate of the senior citizens share in the period 1995-2012. Both variables function as stimulants of population aging processes. Therefore the highest values of variables reached by Polish subregions served as the features of the pattern object. While the lowest values of variables determined the coordinates of the anti-pattern object. These two ideal objects (the pattern object and anti-pattern object) constituted referring points in the comparative analysis.

The variables' values were normalized, using the unitization with zero as minimum, to standardize their implementation intervals. For each subregion the distances to the pattern object and anti-pattern object were calculated using Euclidean distance. Applying the TOPSIS formula (see Hwang, Yoon 1981) resulted in determination of the value of TMD for each subregion. TMD takes values of  $[0, 1]$ . High values of TMD confirm the advancement of the population aging process in a subregion while its low values are seen as a moderate intensity of the phenomenon.

In the next step, the regression model of population aging phenomena was constructed. The TDM served as a dependent variable, while a set of demographical variables was used to explain the changes of TDM. Liability to procreation and the duration of life are seen as the basic determinants of population aging processes in a state perspective. A significant factor in regional perspective may also be the migration outflow of the young (working-age) population to other regions or abroad.

Population aging processes are also intensified by the aging of the working-age population (population aged between 18 years and retirement age). The higher the share of people aged 45 and over within this group, the bigger the “portion” of people who will supply the senior citizens population in the future. Population aging processes and their economic consequences are also determined by the share of oldest-old population (population aged 80 and over) in senior citizens population and also its growth rate. Table 1 presents the set of accepted explanatory variables.

**Table 1.** The set of explanatory variables

No	Variable name	Definition
1	Total fertility rate (person)	The mean number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years conforming to the fertility rates by age of a given year
2	Life expectancy of men at the age 65 (year)	The mean number of years still to be lived by a man who has reached the age 65, if subjected throughout the rest of his life to the current mortality conditions (age-specific probabilities of dying)
3	Net migration rate of population aged 20-59 (person)	Net migration of people between 20 and 59 years old, expressed per 10 000 inhabitants in this age group. Data covers registered migration inflows and outflows for permanent residence between subregions and abroad
4	Working-age population aging rate (%)	The percentage share of immobile-working-age people in the working-age population. Working-age population is defined as people from the age 18 to 59 (women) and from the age 18 to 64 (men). While a group of people aged 45 and over is seen as immobile working-age population
5	Oldest-old-age population rate (%)	The percentage share of people aged 80 and over in the total population aged 65 and over

Source: own compilation according to the definitions of Central Statistical Office of Poland.

The estimated values of structural parameters of the regression model, representing explanatory variables impacts, were estimated using least squares method. In this way the significance and the impact direction of the adopted variables on the phenomenon of population aging in Polish subregions was analyzed.

### **Population aging phenomena in Poland**

The overall tendencies in changing of the age structure are shown by the shape of age pyramid, which is a graphical illustration of the distribution of various age groups by sex in a population, and its changes in time. It forms the shape of a triangle when the young population is growing, whereas a diagram in the shape of an upside-down vase is characteristic for a demographically old population.

In 1975 the Polish population was relatively young demographically. There was a higher percentage share of young people than old people in the total population. The age pyramid formed a shape similar to a pyramid. In subsequent years the shape of the diagram changed; the middle of the pyramid extended while the lower part narrowed. The percentage share of young population had significantly decreased in the period before 2012 while the number of older people increased (see Figure 1).

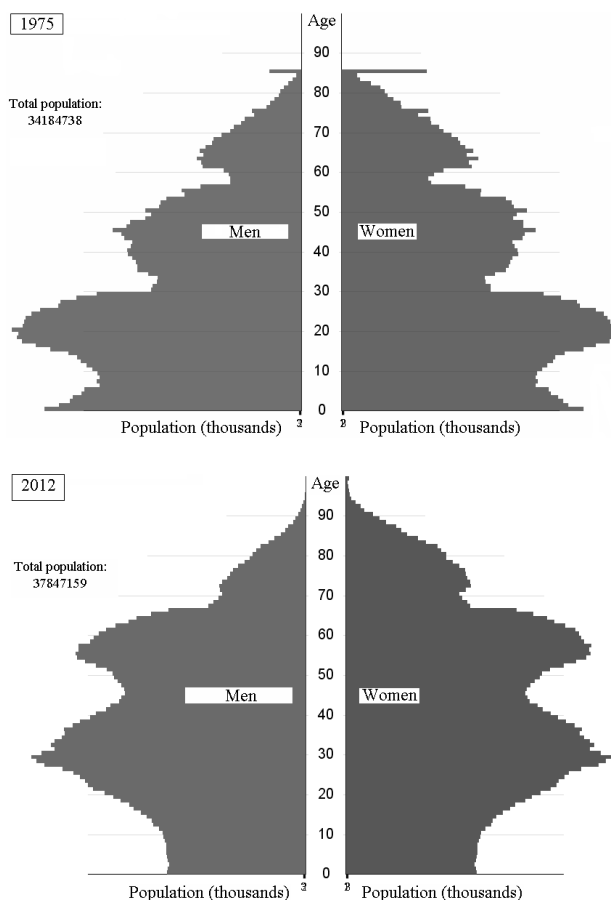
### **The senior citizens share and its growth rate in Polish subregions**

Population aging is demonstrated by a high share of senior citizens (people aged 65 and over) and also by the dynamics of this share. The share indicates the current state of population aging processes in a region (the saturation), while the growth rate indicates the direction of changes and their dynamics. Both variables function as stimulants of population aging processes. High values of these variables confirm the advancement (intensity) of population aging processes in a region.

In 2012 the senior citizens share of the total population of Poland reached 14.24% which was approximately 3.0 percentage points more than in 1995. This implies 1.41% yearly increases (see Table 2). Polish subregions demonstrated diversified senior citizens share, from approximately 10.0% in the Gdański subregion to approximately 19.0% in the city of Łódź. Positive increase rates of the share, to a greater or lesser degree, were noted in all subregions in the period 1995-2012. Values of the growth rate near to zero were observed in the Krakowski (0.23%) and

Sandomiersko-jędrzejowski (0,26%) subregions, while very high dynamics were demonstrated by the Rybnicki (3.44%) and Gliwicki (3.19%) subregions.

**Figure 1.** Age pyramids for Poland in 1975 and 2012



Source: see Central Statistical Office of Poland,  
[http://www.stat.gov.pl/PI\\_gus/ludnosc\\_piramida/struktura\\_ludnosci.svg](http://www.stat.gov.pl/PI_gus/ludnosc_piramida/struktura_ludnosci.svg).

Subregions were divided, on the basis of quartiles, into four classes representing very low, low, moderate and high senior citizens share. The same procedure was conducted in respect to the growth rate of senior citizens share. Figure 2 presents the results of this classification. Relatively high shares of senior citizens were exhibited by subregions located in



eastern, central and also a part of south Poland. In particular, this situation occurred in the biggest cities of Poland such as the cities of Warsaw, Łódź, Poznań, Wrocław, Szczecin, Tricity and Cracow.

**Table 2.** Basic statistics for the senior citizens share and its growth rate

Specification	The senior citizens (population aged 65 and over) share in 2012 (%)	The growth rate of senior citizens share in the period 1995-2012 (%)
POLAND	14.24	1.41
Minimum	9.9	0.23
Maximum	18.6	3.44
Coefficient of variation (%)	12.2	46.6
Pearson's correlation [-1, 1]	0.08	

Source: own estimation based on the data provided by the Local Data Bank of the Central Statistical Office of Poland.

Relatively high and moderate levels were recorded within Łódzkie, Śląskie, Lubelskie, Opolskie, Świętokrzyskie and Podlaskie voivodeships (NUTS 2). Conversely, very low shares of senior citizens were observed within the Zachodniopomorskie, Wielkopolskie, Pomorskie, Lubuskie and Warmińsko-Mazurskie voivodeships, and low shares within the Mazowieckie and Podkarpackie voivodeships.

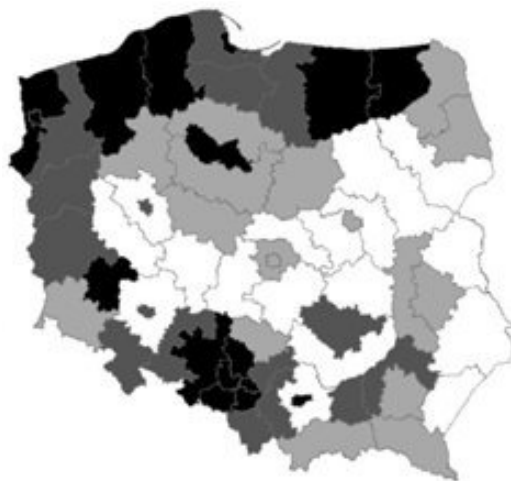
The situation is quite different regarding the growth rate of the share. Relatively high or moderately dynamics was characteristic for the subregions of Zachodniopomorskie, Pomorskie, Warmińsko-Mazurskie, Lubuskie, Opolskie and the Śląskie voivodeships. A very low or low growth rate was true for the Wielkopolskie, Łódzkie, Mazowieckie, Podlaskie, Lubelskie and Podkarpackie voivodeships. The highest dynamics were recorded in northern, western and south-western Poland, and also in selected bigger cities.

It is also interesting that discussed indicators are not statistically correlated (see Table 2). Therefore we cannot conclude that the higher the growth rate, the bigger (or lower) the share of senior citizens in Polish subregions. The exception is the Śląskie voivodeship, for which the values of both variables represent a relatively high percentage share. This is manifested in the intense advancement of population aging processes occurring in this subregion.





**Figure 2.** Spatial diversification of the senior citizens share and its growth rate



a) the share of senior citizens in the total population in 2012



b) the growth rate of senior citizens share in the period 1995-2012

Phenomena level	
	very low
	low
	moderate
	high

Source: own compilation based on data provided by the Local Data Bank of the Central Statistical Office of Poland.

### **Modeling population aging processes in Poland - a dependent variable**

Taxonomic measure, which indicates the intensities of population aging phenomena in Polish sub-regions, noted in Polish subregions values from approximately 0.20 to approximately 0.70, apart from Gdański which presented 0.91 (see Figure 3a). The situation in Poland is relatively highly diversified in spatial perspective; classical coefficient of variation took the value 32%. On the basis of the calculated TMD values the subregions were divided into four classes using quartiles. The obtained classes illustrate advanced (TMD took values above 0.52), progressive (between 0.42 and 0.51), intense (between 0.36 and 0.41) or moderate (up to 0.35) levels of the population aging processes advancement (see Figure 3b).

Advanced population aging processes are seen in south-western Poland. In particular the advanced and progressive situation is typical of the Śląskie and Opolskie voivodeships. Moderate or intense progresses relate to the Mazowieckie, Wielkopolskie, Lubuskie, Pomorskie and selected subregions of the Małopolskie voivodeship.

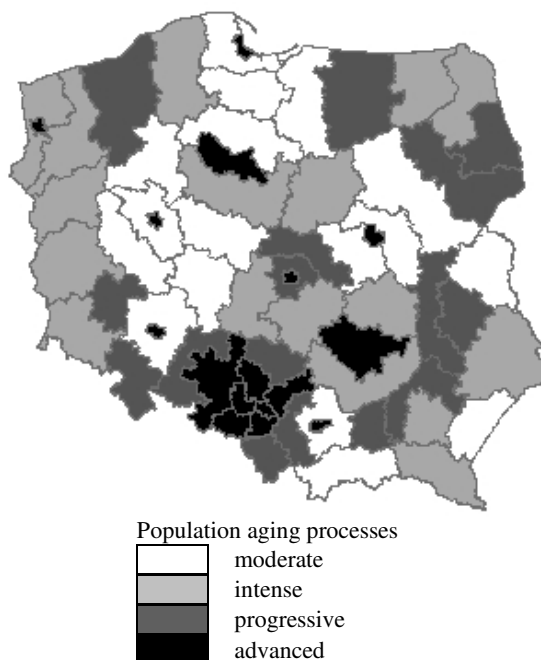
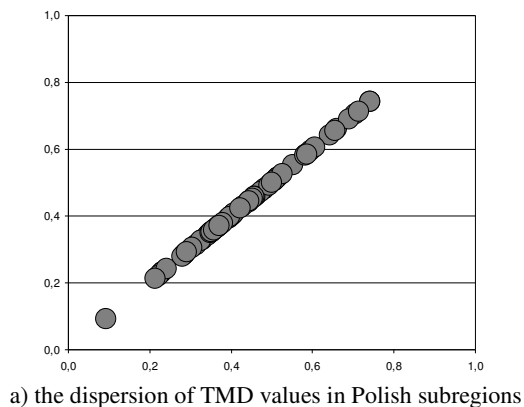
### **Modeling population aging processes in Poland – the set of explanatory variables**

High territorial disparities of population aging processes in Poland should be watched in the specificities of Polish subregions which differ in the social and cultural conditions; the dynamics of economic growth and socio-economic development and also in respect of the resources of the natural environment and its condition (see e.g. Müller-Frączek and Pietrzak, 2009a, 2009b; Bal-Domańska and Wilk, 2011; Pietrzak, 2012; Wilk and Bartłomowicz, 2012; Wilk, Pietrzak and Matusik, 2013). This affects the economic and financial situation of households, leading lifestyle and holding priorities, health condition of the society, the access to medical services etc. All these factors have a significant influence on demographic processes occurring in subregions; this is reflected in statistical data.

Extremely low fertility has been typical of Poland for many years and does not provide so-called simple generation substitutability which is seen as the level 2.1 of total fertility rate. Although a slight increase of the indicator value has been seen within the last 10 years, in 2012 the value reached only 1.3 in Poland (see Table 3). However, in the majority of Polish subregions (apart from Gdański) there were only 1.5 children per woman. In respect to the current socio-economic processes occurring in

Poland, we cannot expect rapid changes to this situation even in the long-term perspective. On the other hand, we notice a decrease of regional disparities regarding the fertility level within Poland.

**Figure 3.** Spatial diversification of population aging processes in Poland



Source: own compilation.

Low fertility is accompanied by extending life duration in Poland. According to statistical data, a man aged 65 is expected to live a further 15.4 years. It means that in average terms he would be up to a little more than 80 years old. The situation differs to Polish women who, on average, live 4.3 years longer than men. Statistical correlation between values of these two indicators (for men and women) is relatively high; Pearson's correlation took a value above 0.7, while territorial disparities are slightly higher for men.

In the period 2007-2012 yearly increases of life expectancy of men aged 65 were noted by all subregions. However their dynamics is territorially diversified; the difference between subregions reaches 2.7 years. The shortest expected life duration in 2012 was typical of men living in the Skierniewicki (79.2 years), Elbląski and Łódzki (79.3 years) and also Starogardzki (79.4 years) subregions. The longest life expectancy of men at the age 65 is noted in big agglomerations, such as the cities of Warsaw and Wrocław, where an average man is expected to live for 82 years.

In some regions of Poland population aging processes are significantly affected by migration outflows of young people. Approximately three in four subregions noted a negative balance of migration flows in 2012. The highest intensity of the phenomenon is typical in the Łomżyński subregion, where the net migration coefficient reached -55.2. A similar situation (negative net migration rate under 50.0) was demonstrated by the Puławski subregion which is, as Łomżyński, located in eastern Poland and also adjoins the Mazowieckie voivodeship.

Very high positive values (above 50.0) of net migration coefficient were presented by 7 subregions while extremely high value (100.2) was noted in the Poznański subregion which surrounds the city of Poznań. This means that many more young people settle down in this subregion than leave it. This results from the suburbanization processes (see Matusik, Pietrzak, Wilk 2012, Pietrzak, Drzewoszevska, Wilk 2012, Pietrzak et al. 2012, Pietrzak, Wilk 2013, Pietrzak, Wilk, Chrzanowska 2013, Pietrzak, Wilk, Matusik 2013a, 2013b, 2013c, Pietrzak, Wilk, Siekaniec 2013, Wilk, Pietrzak 2013, Wilk, Pietrzak, Matusik 2013, Pietrzak, Wilk 2014, Pietrzak et al. 2014).

In Poland we can observe a relatively high percentage share of old people within the working-age population. In 2009-2012 more than one in three people in the working age was 45 years old or over. The youngest working-age populations live in the Nowosądecki and Rzeszowski subregions (34.4% immobile-working-age people) while the oldest population lives in Sosnowiecki (41.1%).

Oldest-old population is also increasing in Poland; the growth rate of the oldest-old-age population coefficient is relatively high. The share of this

group in the senior citizens population has increased 6 percentage points within the last 7 years. Values of this indicator are spatially diversified; the differences reach over 10%. The highest share of oldest-old-age people is typical in the Łomżyński subregion, where one in three senior citizens represents an oldest-old-age person. Relatively high values of this indicator are also noted by the Sandomiersko-jędrzejowski (30.1%), the city of Warsaw (29.9%), Bialski (29.8%) and the Suwalski (29.7%) subregions.

**Table 3.** Basic statistics for explanatory variables

No	Variable name	Year*	POLAND	Minimum	Maximum	Coefficient of variation (%)
1	Total fertility rate (person)	2002	1.249	0.893 (Wrocław)	1.614 (Nowosądecki)	13.3
		2012	1.299	1.091 (Kraków)	1.632 (Gdański)	8.4
2	Life expectancy of men at the age 65 (year)	2007	14.6	13.6 (Włocławski)	16.4 (Warszawa)	4.1
		2012	15.4	14.2 (Skierniewicki)	16.9 (Warszawa)	4.0
3	Net migration rate of population aged 20-59 (person)	1995	x	x	x	x
		2012	x	-55.2 (Łomżyński)	100.2 (Poznański)	x
4	Working-age population aging rate (%)	2009	37.8	33.7 (Nowosądecki)	41.7 (Łódź)	4.4
		2012	37.4	34.4 (Nowosądecki, Rzeszowski)	41.1 (Sosnowiecki)	4.1
5	Oldest-old-age population rate (%)	2005	20.3	16.2 (Rybnicki)	24.2 (Sandomiersko-jędrzejowski)	8.3
		2012	26.3	19.5 (Rybnicki)	31.3 (Łomżyński)	8.4

\* according to the availability of statistical data.

Explanations: "x" – not applicable.

Source: own estimation based on data provided by Local Data Bank of Central Statistical Office of Poland.

## Demographic conditions of population aging processes within Poland

Table 4 presents the results of the estimation. They turned out statistically significant in case of all explanatory variables. This means that each of the examined factors exerts a significant impact on population aging processes within Poland. The resulting value of the determination coefficient confirms high adjustment of the model to the empirical data.

**Table 4.** Results of the estimation of the regression model's parameters

No	Variable name	Estimate	<i>p</i> -value*
1	Total fertility rate	-0,4013	0,0034
2	Life expectancy of men at the age 65	0,1539	0,0001
3	Net migration rate of population aged 20-59	-0,0071	0,0169
4	Working-age population aging rate	0,0492	0,0001
5	Oldest-old-age population rate	0,0259	0,0001
Determination coefficient		0,7356	

\* at 5% degree of significance.

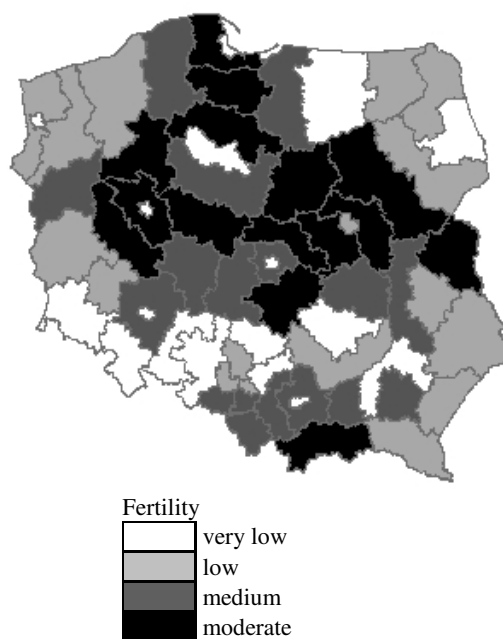
Source: own estimation based on data provided by Local Data Bank of Central Statistical Office of Poland in R-CRAN.

The highest estimate (considering absolute values) was determined for total fertility rate. A relatively high value of the structural parameter was also noted by the indicator representing life expectancy. The negative estimate was determined for total fertility rate, while the positive value is typical of the life expectancy. This indicates inversely proportional influence of fertility and directly proportional relations between life expectancy and the synthetic measure. Therefore the progress of population aging processes in Polish subregions is most significantly affected by low fertility and extending life duration.

The subregions were divided into four classes (according to quartiles), representing very low (the indicator takes values of [1.00, 1.22)), low [1.22, 1.30), medium [1.30, 1.37) and moderate [1.37, 1.65] level of fertility (see Figure 4). It is visible that moderate or medium level is present in the subregions of Pomorskie, Wielkopolskie, Mazowieckie, Łódzkie and Małopolskie voivodeships. Additionally, moderate intensity of births occurs in the cases of the following subregions: Grudziądzki (Kujawsko-pomorskie voivodeship), Skierniewicki and Piotrowski (Łódzkie voivodeship), Nowosądecki (Małopolskie voivodeship) and Bialski (Lubelskie voivodeship).

On the other hand, it is quite characteristic to observe the very low level of fertility in the cases of the largest Polish cities. Extremely low fertility was also noted within the Opolski region and also in Jeleniogórski and Wałbrzyski (Dolnośląskie voivodeship), Częstochowski and Sosnowiecki (Śląskie voivodeship), Kielecki (Świętokrzyskie voivodeship), Tarnobrzewski (Podkarpackie voivodeship), Białostocki (Podlaskie voivodeship) and Olsztyński (Warmińsko-mazurskie voivodeship) subregions.

**Figure 4.** Spatial diversification of the total fertility rate in 2012



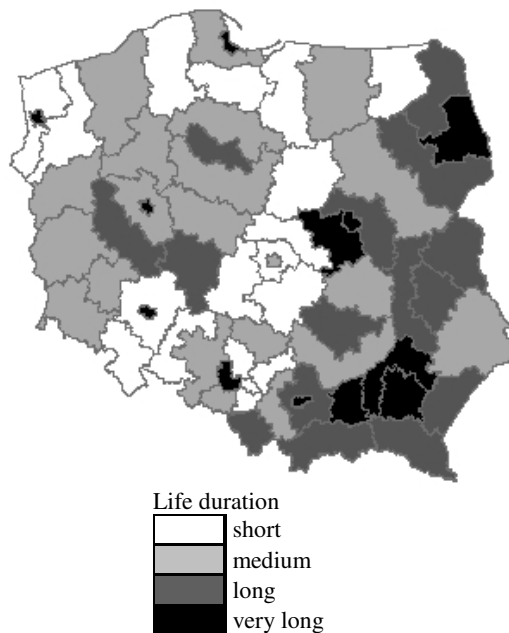
Source: own compilation based on data provided by Local Data Bank of Central Statistical Office of Poland.

The estimate of the regression parameter relating to life expectancy of men aged 65 was 0.1539 which is nearly three times less than in the case of fertility rate. According to the variables' values we can distinguish subregions noting short (the indicator takes values of [14.1, 14.8)), medium [14.8, 15.2), long [15.2, 15.6) and very long [15.6, 16.9) expected duration of life (see Figure 5). In this case, the very low life expectancy is characteristic for the subregions of the Łódzkie voivodeship and some subregions of Zachodniopomorskie, Pomorskie, Warmińsko-Mazurskie,



Dolnośląskie and Śląskie voivodeships. The relatively high values of the indicator were recorded in the subregions related to regional capital cities.

**Figure 5.** Spatial diversification of the life expectancy of men at the age 65 in 2012

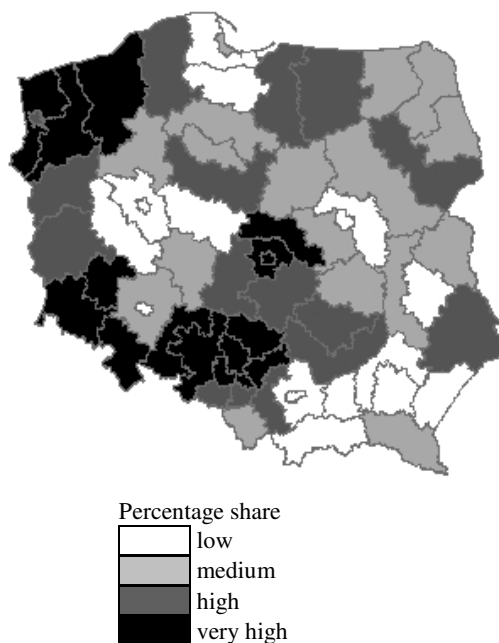


Source: own compilation based on data provided by Local Data Bank of Central Statistical Office of Poland.

Very low fertility and simultaneously long life expectancy are noted in Białostocki (Podlaskie voivodeship), Tarnobrzeski (Podkarpackie voivodeship) and Gliwicki (Śląskie voivodeship) subregions. A similar situation, resulting from different reasons (probably suburbanization processes) is seen in the following cities: Szczecin, Poznań, Tricity, Wrocław and Cracow.

The conducted regression analysis also allowed for observation of the substantial relations between working-age population aging rate and oldest-old-age population rate, and the intensity of population aging processes. A slightly higher impact is presented by the working-age population aging rate. The interval of indicator values was divided into four subintervals representing very high (the indicator takes values of [38.60, 41.10]), high [37.75, 38.60), medium [36.61, 37.75) and low [34.31, 36.61) percentage share of the immobile working-age population in the total working-age population (see Figure 6).

**Figure 6.** Spatial diversification of the working-age population aging rate in 2012

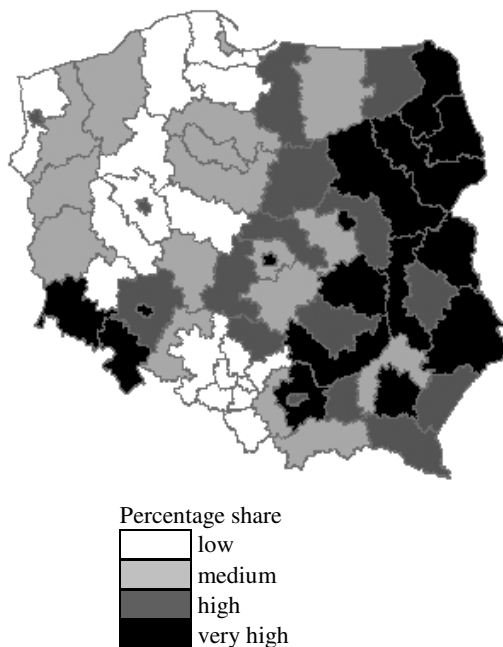


Source: own compilation based on data provided by Local Data Bank of Central Statistical Office of Poland.

The relatively high or very high level of this indicator is true for the Zachodniopomorskie, Opolskie and Śląskie voivodeships and some subregions from the Dolnośląskie and Łódzkie voivodeships. A relatively young working-age population lives in the biggest Polish cities (such as Poznań, Warsaw, Wrocław, Cracow and Lublin), as well as in subregions of the Podkarpackie voivodeship.

Figure 7 presents the classes of subregions in relation to the values of the oldest-old-age population rate which may be defined as very high (the indicator takes values of [26,97; 31,30]), high [26,33; 26,97), medium [25,04; 26,33) and low [19,51; 25,04) percentage share of the oldest-old population. Except for a few subregions, the relatively high or very high values of the oldest-old-age population rate were recorded in eastern voivodeships, such as: Warmińsko-Mazurskie, Podlaskie, Mazowieckie, Lubelskie, Świętokrzyskie, Małopolskie and Podkarpackie, while a low or medium percentage share of oldest-old seniors relates to the remaining part of the state, in particular western Poland.

**Figure 7.** Spatial diversification of the the oldest-old-age population rate in 2012



Source: own compilation based on data provided by Local Data Bank of Central Statistical Office of Poland.

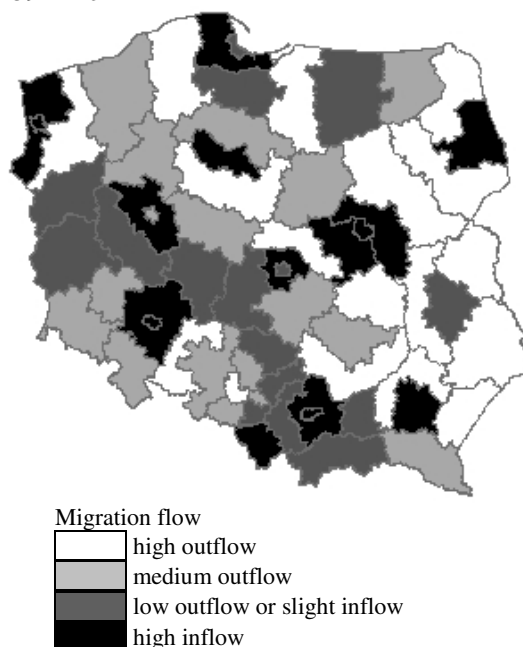
Statistically there are no significant relations between the working-age population aging rate and the oldest-old-age population rate; Pearson's correlation coefficient took a value near to zero (-0,142). However there exist subregions in which both indicators take relatively high values: subregions of the Świętokrzyskie voivodeship, Jeleniogórski and Wałbrzyski subregions (Dolnośląskie voivodeship), Sieradzki and the city of Łódź (Łódzkie voivodeship), Częstochowski (Śląskie voivodeship), Elbląski (Warmińsko-mazurskie voivodeship), Łomżyński (Podlaskie voivodeship) and Chełmsko-zamojski subregions (Lubelskie voivodeship).

The process of population aging in many Polish subregions is also deepened by migration outflow of young people (negative estimate). The higher the negative migration rate coefficient, the stronger the processes of population aging in a region. The values of quartiles served in defining four classes of subregions (see Figure 8):

- high outflow (the indicator took values of [-55,30; -29,40)), resulting from a much higher migration outflow than inflow of young people,

- medium outflow (the indicator took values of  $[-29,40; -20,62]$ ),
- low outflow or slight inflow; the coefficient took relatively low absolute values within the interval  $[-20,62; 4,21]$ ,
- high inflow (the indicator took values of  $[4,21; 100,30]$ ), resulting from a much higher migration inflow than outflow of young people.

**Figure 8.** Spatial diversification of the net migration rate values referring to population aged 20-59 in 2012



Source: own compilation based on data provided by Local Data Bank of Central Statistical Office of Poland.

High positive balance of migration flows occurs in the subregions related to big agglomerations and their neighbouring subregions (the city of Szczecin and szczeciński subregion, the city of Wrocław and wrocławski subregion, the city of Warsaw and Warszawski wschodni and Warszawski zachodni subregions, the city of Cracow and Krakowski subregion). A similar situation is observed in subregions which contain a bigger city inside, such as Bielski (Śląskie voivodeship), Rzeszowski (Podkarpackie voivodeship), Białostocki (Podlaskie voivodeship), Bydgosko-toruński (Kujawsko-pomorskie voivodeship), and also Szczeciński subregions.

This indicates progressing processes of concentrating population in the economically well developed areas and their surroundings and also depopulation of economically poor regions. An alarmingly high outflow of

young people is noticeable for the voivodeships of eastern Poland, such as Podlaskie, Lubelskie, Podkarpackie and also the selected sub-regions of Mazowieckie and Świętokrzyskie voivodeships. A similar situation is also presented by subregions (e.g. Stargardzki in the Zachodniopomorskie voivodeship), Słupski in the Pomorskie voivodeship etc.) which are located near to bigger cities and their nearest neighbours.

## **Conclusions**

Population aging processes result in long-term consequences in the socio-economic sphere relating to public finance, regional labour markets, increasing demand on selected goods and services, organizational problems etc. Therefore they affect socio-economic aspects of functioning of territorial units and formation of their policies of regional development. Results of the conducted empirical research allow for drawing of the following conclusions which may be significant support in these cases.

Population aging is usually a consequence of a few simultaneously occurring phenomena. The most significant factor of progressing population aging processes is extremely low fertility which is also supported by extension of life expectancy in Polish subregions. A significant role is also played by aging processes of the working-age population and increasing oldest-old people within the senior citizens population. The majority of subregions also struggle with a significant migration outflow of younger people which deepens population aging processes.

High territorial diversification of population aging processes, according to the senior citizens share and its growth rate, and also demographic conditions of these processes, occurs in Poland. The most advanced population aging processes are seen in south-western Polish subregions in which the most significant problems are very low fertility, relatively old working-age population and also a significant migration outflow of younger people. On the other hand, the youngest and slowest aging population lives in south-eastern and central Poland. It is characterized by higher fertility but shorter life expectancy and also a younger working-age population.

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