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## Spatial Typology of the Ageing Process in the European Union on the Level NUTS 2 Regions

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# Spatial Typology of the Ageing Process in the European Union on the Level NUTS 2 Regions

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**Abstract.** The article is deal with the spatial differences of the demographic events between European Union regions. We are research spatial diferencies of ageing process between 272 NUTS 2 regions today. The analyses on this spatial level are working with the creation of cartogram method for processing of the demographical data. We can use ArcGIS 10.2 and his version ArcMap 10.2 as a complete system for authoring, serving, and using geographic informations for better processing the spatial data by the help of cartogram method. Our principal main is to group the all 272 EU NUTS 2 regions on the basis children and elderly substitution in population and evaluation of the ageing process. Therefore we are using the basic measurement methods for examination of the age structure. The spatial typology is carried out on the basis of a series of values of the following three basic demographical indices: the children ration, the eledrely ratio, the ageing index (*IA*) and the dynamic ageing index (*DAI*). The world's current ageing index is about 30. And only in Europe is more than 100 and in European Union actually 117. This mean, that in Europe we have more elderly people than children. Only eight countries has ageing index less than 100 in European Union now. Ageing index 125 and more has six countries yet.

**Keywords:** ageing index, ageing process, cohesion regions, dynamic ageing index, elderly ratio, European Union, children ratio, NUTS 2

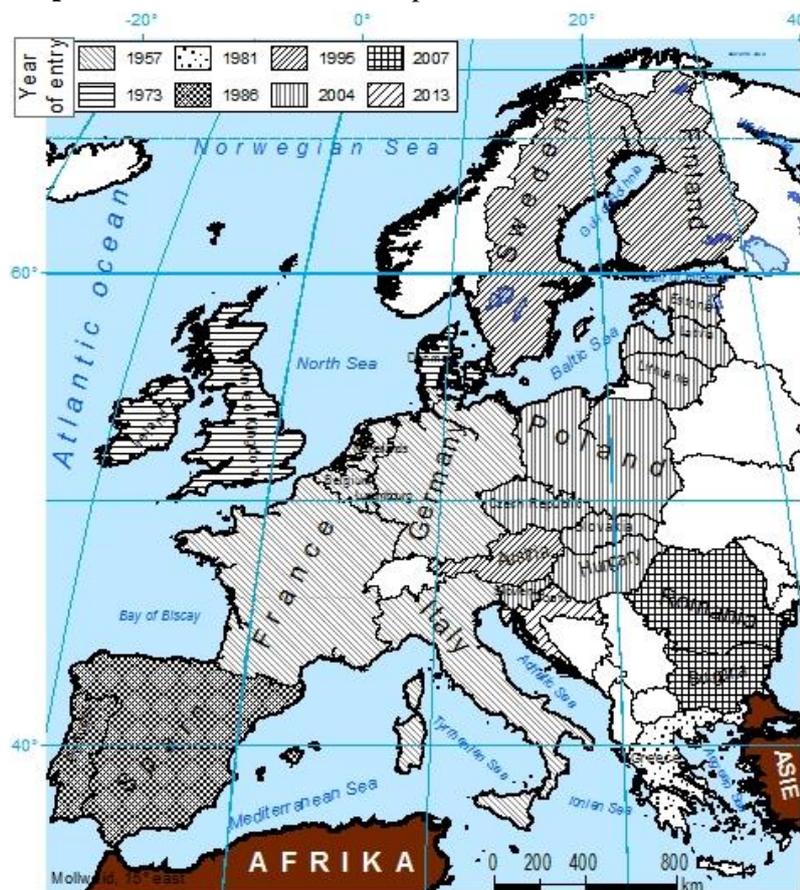
## 1 Introduction

It is very useful to anywhere when the population is unnoticed part of the science focus. Human resources are one of four the basic economic resources next to capital, soil and new technology. Economic behaviour is always affected by living phase. The population is playing the important rule in all basic economic activities as consumption, production and barter. The characters of these activities have a strong contexture on the age structure. The ageing process is one of the very prominent population structural matters. Age is basic structural characteristic on the field of demographic analysis. And we know that economic behaviour is always affected by living phase.

The main aim of this study is to compare differences of the ageing process 28 member countries of the European Union. We will analyses change of their age composition in the year 2012. We are using detailed statistics on the European Union which is prepared by their statistical office situated in Luxembourg (EUROSTAT). Its task is to provide the European Union with statistics at European level that enable comparisons between countries and regions. Eurostat was established in 1953 to meet the requirements of the Coal and Steel Community. Over the years its task has broadened and when the European Community was founded in 1957 it became a Directorate-General (DG) of the European Commission. As one of the Directorates-General of the European Commission, Eurostat is headed by a Director General and a Deputy Director General. As from 1 January 2014, the seven Directorates responsible for different sectors of Eurostat activities are organised as below:

- Cooperation in the European Statistical System; international cooperation; resources

**Map 1** Member states of the European Union



Source: Author

- Methodology; corporate statistical and IT services
  - National accounts, prices and key Indicators
  - Government finance statistics (GFS) and quality
  - Sectoral and regional statistics
  - Social statistics
- Global business statistics Eurostat does not collect data only. This is done in Member States by their statistical authorities which verify and analyse national data and send them to Eurostat.

We can see that the process of spreading the European Union was very dynamic for the last more than fifty years (Šotkovský, 2011). Nowadays nearly 73 % of the whole European population live there. And the area of that region represents 42 % of European continental territory.

The change of age composition of population depends on the many factors such as size of natural increase and migration, on the mortality characteristics. And in the European Union at present, migration is a greater cause of population growth than natural increase. Both population growth and migration can affect the age structure.

The global human population is projected to grow from 6.9 billion in 2010 to 9.15 billion in 2050. The population of what is now the European Union increased from 408 million in 1960 to nearly 504 million in 2013 (table 1). It is projected to go on increasing, reaching 521 million in 2035 and then begins to slowly decline to 506 million in 2060. This mean that will be the same number of EU population in the 2060 as was at 2013.

**Table 1** Basic characteristics of the EU

EU (year)	member states	area (sq km)	population (mil., 2012)	density (inh./sq km)
1957	6	1,365,961	188.892	138
1973	9	1,727,181	273.001	158
1981	10	1,859,138	287.943	155
1986	12	2,457,340	338.159	138
1995	15	3,318,227	370.658	112
2004	25	4,056,761	457.679	113
2007	27	4,406,051	493.153	112
2013	28	4,493,712	503.771	112

Source: Author, based on UNO and Eurostat data

The European Union was formally established when the Maastricht Treaty came into force on 1 November 1993. The European Union (EU) is an economic and political union of 28 member states (map 1). Today the EU generated an estimated 28% of the global economy (against global nominal GDP), or 21 % when adjusted in terms of purchasing power parity (global GDP). In 2002, euro notes and coins replaced national currencies in 12 of the

member states (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain). Since then, the **eurozone** (officially the **euro area**) has increased to encompass seventeen countries: Slovenia (2007), Cyprus (2008), Malta (2008), Slovakia (2009) and Estonia (2011).

We can see, that process of spreading the European Union was very dynamic for the last more than fifty five years (table 1). There lives nearly 73 % of the European population now. And the area of that region represents 43 % of European continental territory. Fifteen countries have less than ten million people and four countries have more than fifty million people (Germany, France, United Kingdom and Italy). Malta it's only 0.5 % of the Germany population and less than 0.1 % of the French metropolitan area.

## **2 Europa Union a their system of the territorial division**

The Nomenclature of Territorial Units for Statistics (NUTS) was established by Eurostat more than 25 years ago in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. The NUTS classification has been used since 1988 in Community legislation. However, it was not until 2003, after 3 years of preparation, that a Regulation of the European Parliament and of the Council on the NUTS was adopted. From 1 May 2004, the regions in the 10 new Member States and also from 1 January 2007, the regions the 2 last Member States, have been added to the NUTS. A particularly important goal of the Regulation is to manage the inevitable process of change in the administrative structures of Member States in the smoothest possible way, so as to minimise the impact of such changes on the availability and comparability of regional statistics. Enlargements of the Union will render this objective all the more vital.

The NUTS nomenclature was created and developed according to the following principles:

- The NUTS favours institutional breakdowns. Different criteria may be used in subdividing national territory into regions. These are normally split between normative and analytic criteria. Normative regions are the expression of a political will; their limits are fixed according to the tasks allocated to the territorial communities, according to the sizes of population necessary to carry out these tasks efficiently and economically, and according to historical, cultural and other factors. Analytical (or functional) regions are defined according to analytical requirements; they group together zones using geographical criteria (e.g., altitude or type of soil) or using socio-economic criteria (e.g., homogeneity, complementarity or polarity of regional economies). For practical reasons to do with data availability and the implementation of regional policies, the NUTS nomenclature is based primarily on the institutional divisions currently in force in the Member States (normative criteria).
- The NUTS favours regional units of a general character. Territorial units specific to certain fields of activity (mining regions, rail traffic regions, farming regions, labour-market regions, etc.) may sometimes be used in certain Member States. NUTS excludes specific territorial units and local units in favour of regional units of a general nature.
- The NUTS is a three-level hierarchical classification. Since this is a hierarchical classification, the NUTS subdivides each Member State into a whole number of NUTS 1 regions, each of which is in turn subdivided into a whole number of NUTS 2 regions and so on. At the regional level (without taking the municipalities into account), the administrative structure of the Member States generally comprises two main regional levels (Länder and Kreise in Germany, régions and départements in France, Comunidades autonomas and provincias in Spain, regioni and provincie in Italy, etc.).

The grouping together of comparable units at each NUTS level involves establishing, for each Member State, an additional regional level to the two main levels referred to above. This additional level therefore corresponds to a less important or even non-existent administrative structure, and its classification level varies within the first 3 levels of the NUTS, depending entirely on the Member State: NUTS 1 for France, Italy, Greece, and Spain, NUTS 2 for Germany, NUTS 3 for Belgium, etc.

**Table 2** Recommended thresholds of the population size of the NUTS regions and their delimitation.

EU (delimitation)	components of NUTS regions and the average size					
	NUTS 0	NUTS 1	NUTS 2	NUTS 3	LAU 1	LAU 2
EU - 15	15	72	213	1 091	2 453	95 152
EU - 25	25	89	254	1 214	3 334	112 119
<b>EU - 27</b>	27	98	270	1295	3 596	120 419
<b>EU - 28</b>	<b>28</b>	<b>99</b>	<b>272</b>	<b>1 316</b>	<b>...</b>	<b>120 975</b>
Minimum pop.		3 million	800 000	150 000		
Maximum pop.		7 million	3 million	800 000		

Source: author (EUROSTAT data)

At a more detailed level, there are the districts and municipalities. These are called "Local Administrative Units" (LAU) and are not subject of the NUTS Regulation. It is though foreseen in the Regulation that after two years the Commission will publish a report on the feasibility to extend the NUTS breakdown to a fourth level. At the local level, two levels of Local Administrative Units (LAU) have been defined (table 2). The upper LAU level (LAU level 1, formerly NUTS level 4) is defined only for the following countries: Finland, Greece, Ireland, Luxembourg, Portugal and the United Kingdom. The second LAU level (formerly NUTS level 5) consists of 120 975 municipalities or equivalent units in the 28 EU Member States.

Since several regions within Europe have the same name, a distinction has been made by adding to each of these the abbreviation for the country concerned. Some NUTS regions appear at several levels (example: Luxembourg appears as the country and at levels 1, 2 and 3). In this case, codes end in zero for the region with identical territory at the next lower level. The labels need not be identical at the different levels even if the territorial extent of the regions concerned is identical. Depending on the variable concerned, regional statistical data at one or more of the 3 NUTS levels is available in publications and databases. Many variables and time series for regional data in different domains are available on the Eurostat website.

### 3 Methodology and analytic approaches to study ageing process

Before more than one hundred years Swede A. G. Sundbärg distinguished three age groups: progressive (expansive), stationary and regressive (constrictive). We can say that population analyses are very useful more than one century. And during this long time arose a number of demographic analytic approaches which are part of demographic methodology. Specialized studies wanted to solve many problems linked to ageing process for the last several decades. We searched for the answers to the following fundamental investigative questions:

1. Is there a tendency to lower the degree of similarity in the age structures?
2. How has the process of changes in functional age groups of the population been proceeding?
3. What are spatial differences between European Union cohesion regions against ageing process in the year 2012?

4. How are the observed changes of children and elderly ratio in the context of comparisons between the cohesion regions?

Demographic changes in European Union countries after 1980, similarly to the whole EU, were characterized by a rapid decrease in demographic dynamics, which had mainly resulted from the decrease in the number of births, which reflected violently decreasing women's fertility and the number of children they had during their reproductive age. At the same time a significant improvement in mortality rate characteristics which brought distinct extension of expected lifespan was, observed. Those changes influenced the population structure by age and, as a consequence, also the relations between three basic age groups. The share of people at the pre-productive age decreased and the share of old age group of people increased in the total population. This caused intensification of the process.

The basic indicators (Šotkovský, 2010 and 2012) which can show share of very important age groups are children (equation 1) and elderly ratio (equation 2). Very often we can compute the percentage substitution subsequently:

$$\text{children ratio} = \frac{P_{0-14}}{P} \times 100, \quad (\text{equation 1})$$

$$\text{elderly ratio} = \frac{P_{65+}}{P} \times 100. \quad (\text{equation 2})$$

Their common weights we can compare by the help of the ageing index (**AI**). The ageing index (Dlugosz, Kurek, 2009) show us the relatively weight of the elderly to children (equation 3).

$$AI = \frac{P_{65+}}{P_{0-14}} \times 100. \quad (\text{equation 3})$$

Very special view of development trend ageing process presents indicator dynamic ageing index (**DAI**) in the case, when we want follow the time changes (equation 4).

$$DAI = \left( \frac{\tau_1 P_{0-14}}{\tau_2 P} - \frac{\tau_2 P_{0-14}}{\tau_1 P} \right) \times 100 + \left( \frac{\tau_2 P_{65+}}{\tau_2 P} - \frac{\tau_1 P_{65+}}{\tau_1 P} \right) \times 100. \quad (\text{equation 4})$$

For references territory diversity values of the children and elderly ratio and ageing index we will use cartogram method. All using data come from the statistical office of the European Union (EUROSTAT), their sector "Social statistics". The analyses on this spatial level are working with the creation of cartogram method for processing of the demographical data (Šotkovský, 2012).

We can divide the population again age to the many groups. But as major groups we can identify:

1. Young people or children (0 to 14 years old).
2. Old-age people or elderly people (65 years and more).
3. Working age population (15 to 64 years old).

The sum of the number of young and the number of elderly people are generally economically inactive. The develop countries have very accuracy statistical information and therefore they work with one year age structure. This statistical data come from censuses usually. And this demographic data we can use for planning actions too. The very special age model is population pyramid. **Population pyramids** show the distribution of the population by sex and by age groups (one-year, five-year or ten-year in general). Each bar corresponds to the share of the given sex and age group in the total (men and women combined) population. We can distinguish *three types of population pyramids*: expansive population (young population),

stationary population (adult population) and constrictive population (old population). The analysis of age structure it is not only major groups or types of population pyramids but average age, median age, life expectancy at birth. This compare shares of children and elderly people and some age dependency ratios as the every first analysis of the age structure.

#### 4 Regional disparities between European Union cohesion regions

The regional differences on behalf of children are very extreme on the world and they achieve more than thirty five per cent. Some African states (Niger, Uganda, Mali, Guinea-Bissau, Democratic Congo, Chad, Malawi etc.) have more than 40 % of the children. On the other side are countries where children are less than 15 %. There are Japan and Ukraine in the world or Bulgaria, Czech Republic, Germany, Greece, Croatia, Italy, Latvia, Lithuania, Hungary, Malta, Austria, Portugal and Slovenia in European Union. The regional differences are not so extreme between 28 EU countries, only 8.8 per cent in the year 2012. This number compares countries Ireland and Germany. The maximal regional differences between 272 cohesion regions (NUTS 2) of the European Union is 12.1 per cent in the year 2012 (without French overseas territories Guyane and Reunion). This number compares regions Ciudad Autonoma de Melilla in Spain and Principado de Asturias in Spain too.

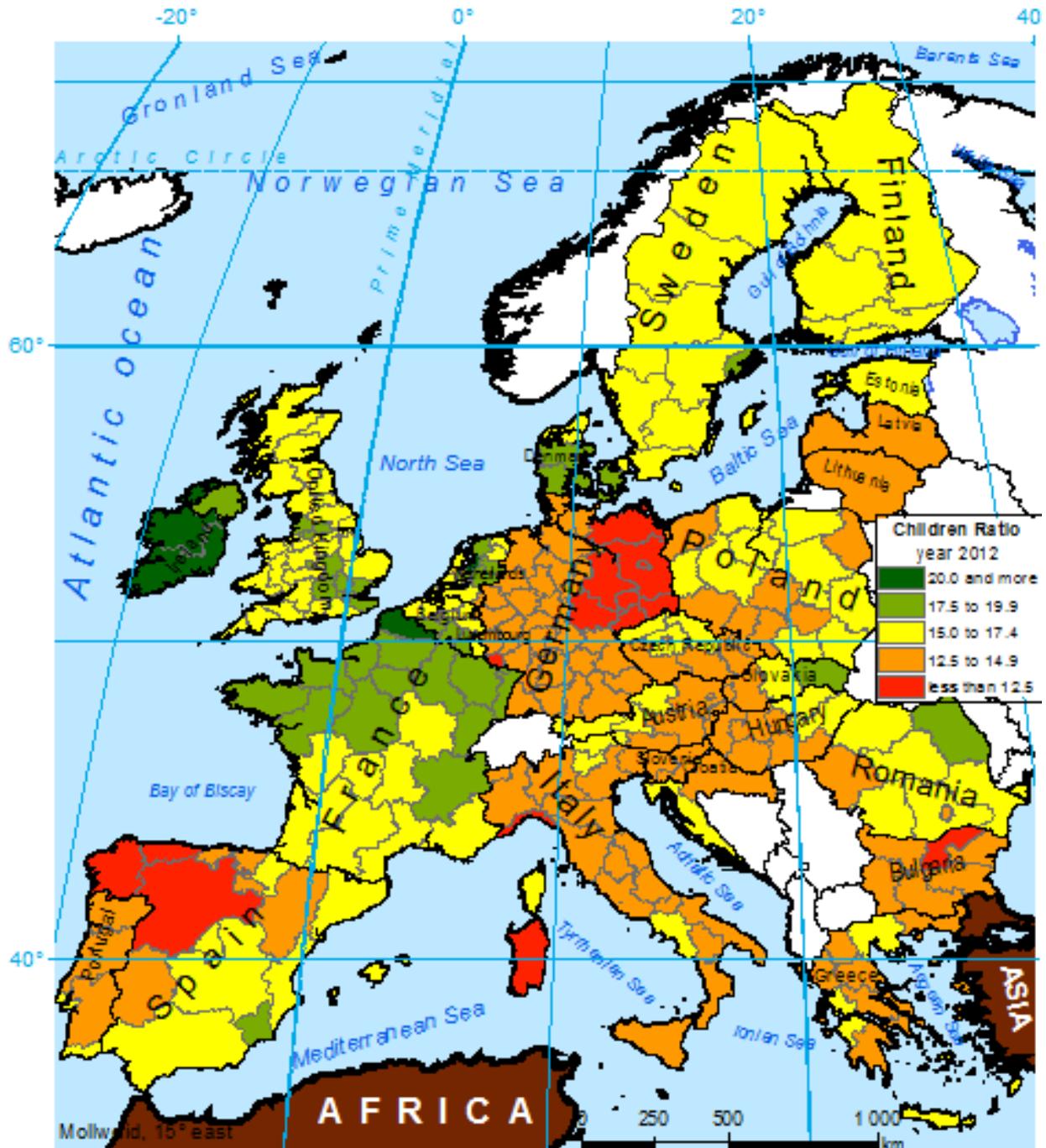
Today the youngest population has Ireland, Cyprus, Luxembourg and Slovakia. The countries as Poland, France, UK and Netherlands have a slight majority of children group. The others twenty countries of European Union has population with superiority of elerly people. The oldest population have Germany and Italy. There lives seniors about fifty percent more than children. Then the old population have countries as Bulgaria, Greece, Portugal, Latvia and Austria.

When we are analysed changes of the **children ratio** on the population (equation 1) we can name this situation as the ageing process (Šotkovský, 2009, 2010) from below. Our working model distinguishes the four phases in this case:

- **Gently ageing population**: the proportion of children is between 20.0 to 24.9 percent.
- **Ageing population**: the proportion of children is between 15.0 to 19.9 percent
- **Old population**: the proportion of children is between 12.5 to 14.9 percent.
- **Very old population**: the proportion of children is less than 12.5 percent.

Every countries of European Union have ageing population. This process started at the beginning of the eighties years of last century. The percentage of children group decreased below the 20 percent in Germany, Luxembourg, Sweden and Belgium at that time. We can say that very quickly grew old population in Latvia, Lithuania, Estonia, Romania, Bulgaria, Croatia and Poland for tha last twenty years according to dynamic ageing index (equation 4).

Very small children ratio have some cohesion regions on the territory of Germany (nine cohesion regions), Spain (three cohesion regions), Italy (two cohesion regions) and Bulgaria (one cohesion regions). There lives children less than 12.5 percent now. The cohesion regions with the amount of children above the twenty precent we can find on the territory of Ireland, France and Netherland (map 2).

**Map 2** Distribution of children at the European Union regions in the year 2012

Source: author (EUROSTAT data)

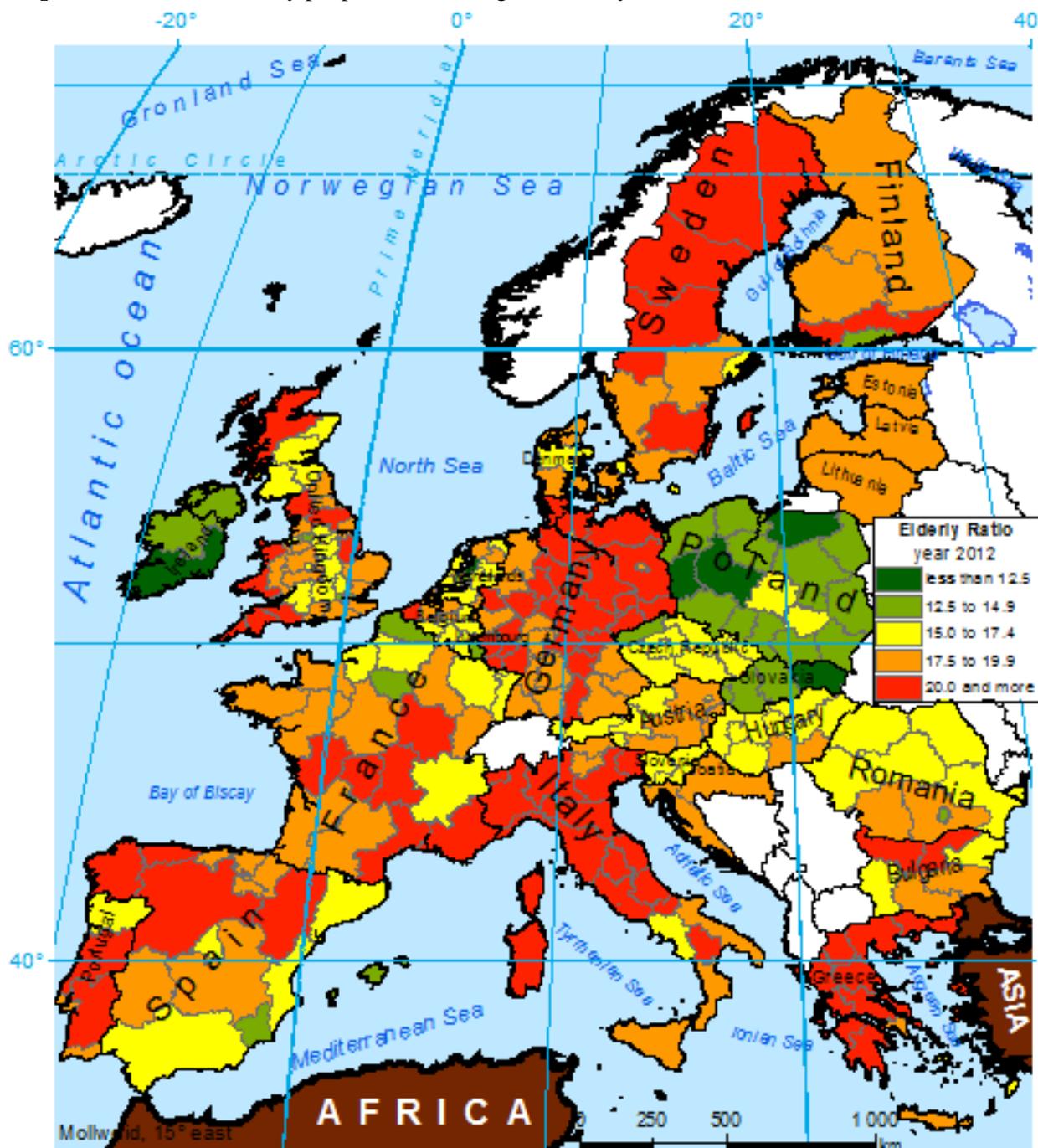
The indicator of the **elderly ratio** means how many people at the age of 65 and more are relatively (equation 2) in the population. Our second working model of the ageing process from above distinguishes the four phases:

- **Gently ageing population:** the proportion of elderly is less than 12.4 percent.
- **Ageing population:** the proportion of elderly is between 12.5 to 14.9 percent,
- **Old population:** the proportion of elderly is between 15.0 to 17.4 percent.
- **Very old population:** the proportion of elderly is 17.5 percent and more.

All cohesion regions on the territory of Germany (38 cohesion regions) and Greece (8 cohesion regions) have very old population when their percentage of elderly people is more than

17.5. This groups forms 158 cohesion regions in common for the whole European Union. There are only eleven cohesion regions with gently ageing population. We can find them on the territory of France, United Kingdom, Ireland, Netherland, Poland and Slovakia (map 3). Ageing population (proportion of elderly is between 12.5 to 14.9 percent) have 32 cohesion regions. One third of them are spread on the Poland territory.

**Map 3** Distribution of elderly people at the EU regions in the year 2012



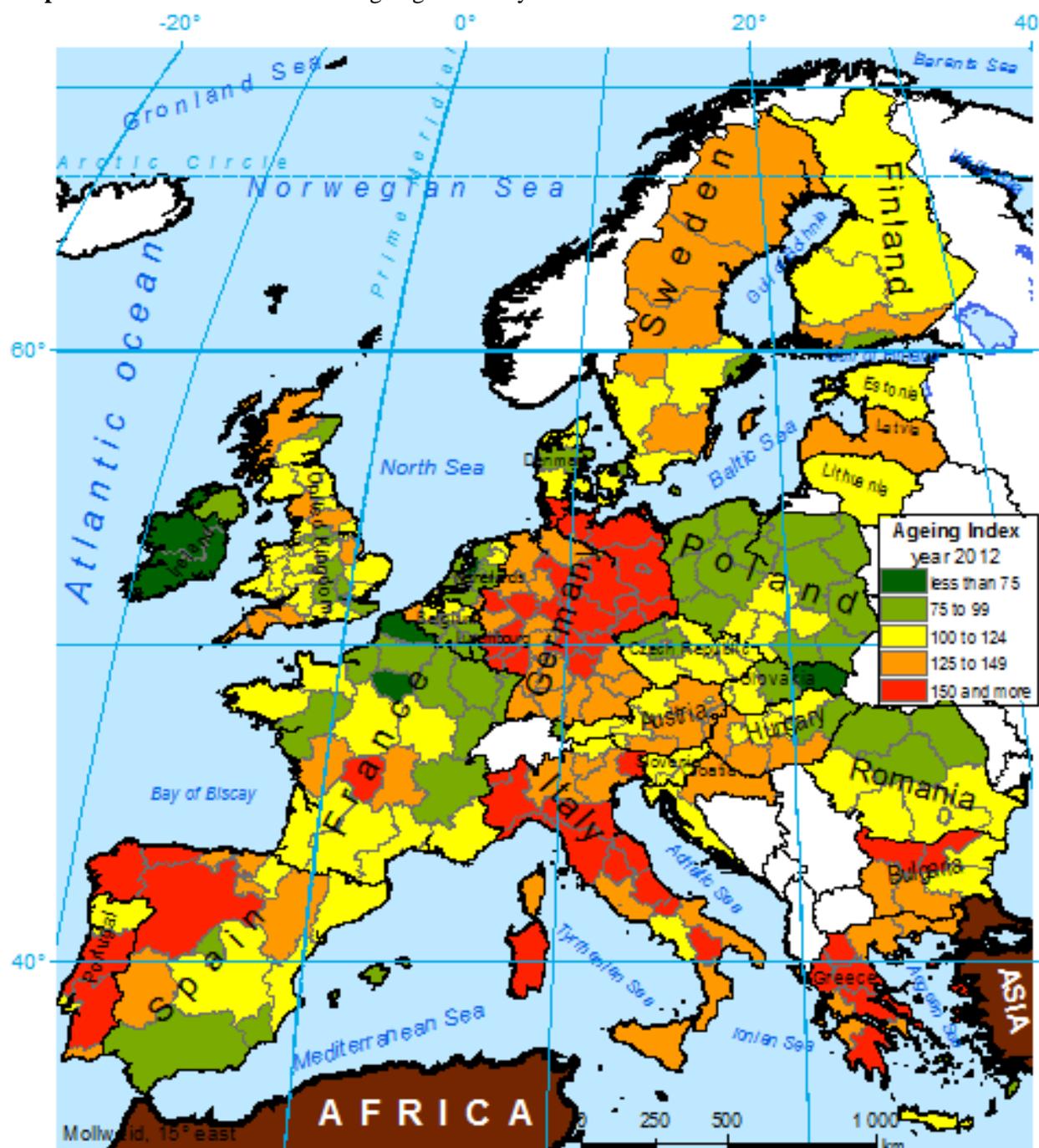
Source: author (EUROSTAT data)

Old population have 71 cohesion regions, which are especially situated on the territory of those countries: Romania, Czech Republic, Hungary, Austria, Slovenia, Belgium, Netherlands and Malta.

### 5 Territorial difference against the ageing index

The **ageing index** is calculated as the number of persons 65 years old (elderly group) or over per hundred persons under age 15 (children group). The ageing index is a composite demographic ratio, defined as the percentage between the old age population (over 65) and the young population (under 15). It is one of the several demographic indicators (e.g. old age dependency index, average age, turnover index) that can be used to measure the rate at which a population ages.

**Map 4** Territorial difference of the ageing index in year 2012



Source: author (EUROSTAT data)

According to the 2012 figures, Italy ranks second for the ageing index, as in recent years, falling just behind Germany (151 and 158 respectively). The average EU rate of 117 shows a greater balance between the elderly and the young. Overall, thirteen countries have a higher than EU-average ageing index: in addition to the two mentioned above, we find, among others, Spain, Malta, Slovenia, Hungary, Croatia, Lithuania, Austria, Latvia, Portugal, Greece and Bulgaria. By contrast, there are countries where the number of the younger age classes is greater. The most favourable ratio of all was detected in Ireland (53). The others are following countries are Cyprus, Luxembourg, Slovakia, Poland, France, United Kingdom and Netherland. The Czech Republic is country, where live more seniors at the age of 65 and more than children from year 2006 if in European Union it was year 2004. Nevertheless sixty years ago was ageing index only 35 in Czech Republic, in European Union probably around 38.

On a regional level (unit NUTS 2) the ageing index differencies are much greater (map 4). Even in five cohesion regions the ageing index exceeds value two hundred. Three of them are situated on the Germany territory (Sachsen-Anhalt, Chemnitz and Thuringen) and one in Italy (Liguria) and in Spain (Principado de Asturias). Fifty percent overbalance of eledrly people have nearly fifty EU cohesion regions now. We can say, that this regions have very old population. The population, where ageing index is between 100 and 149, we can specify as old population. The regions like this we have 122 in European Union (45 percent).

The relevancy majority of children have regions, where ageing index is less than 50. Today we have only fifteen cohesion regions with this value and three of them are French overseas territories (Guyane, Reunion and Guadeloupe) and two are Spanish cities on the on the north coast of Africa, sharing a border with Morocco (Ciudad Autonoma de Melilla, Ciudad Autonoma de Ceuta). So on the European countinent we have only ten regions from 168 units with relatively young age structure. Most of them are in this countries: Ireland, UK, France, Slovakia, Netherland and Spain.

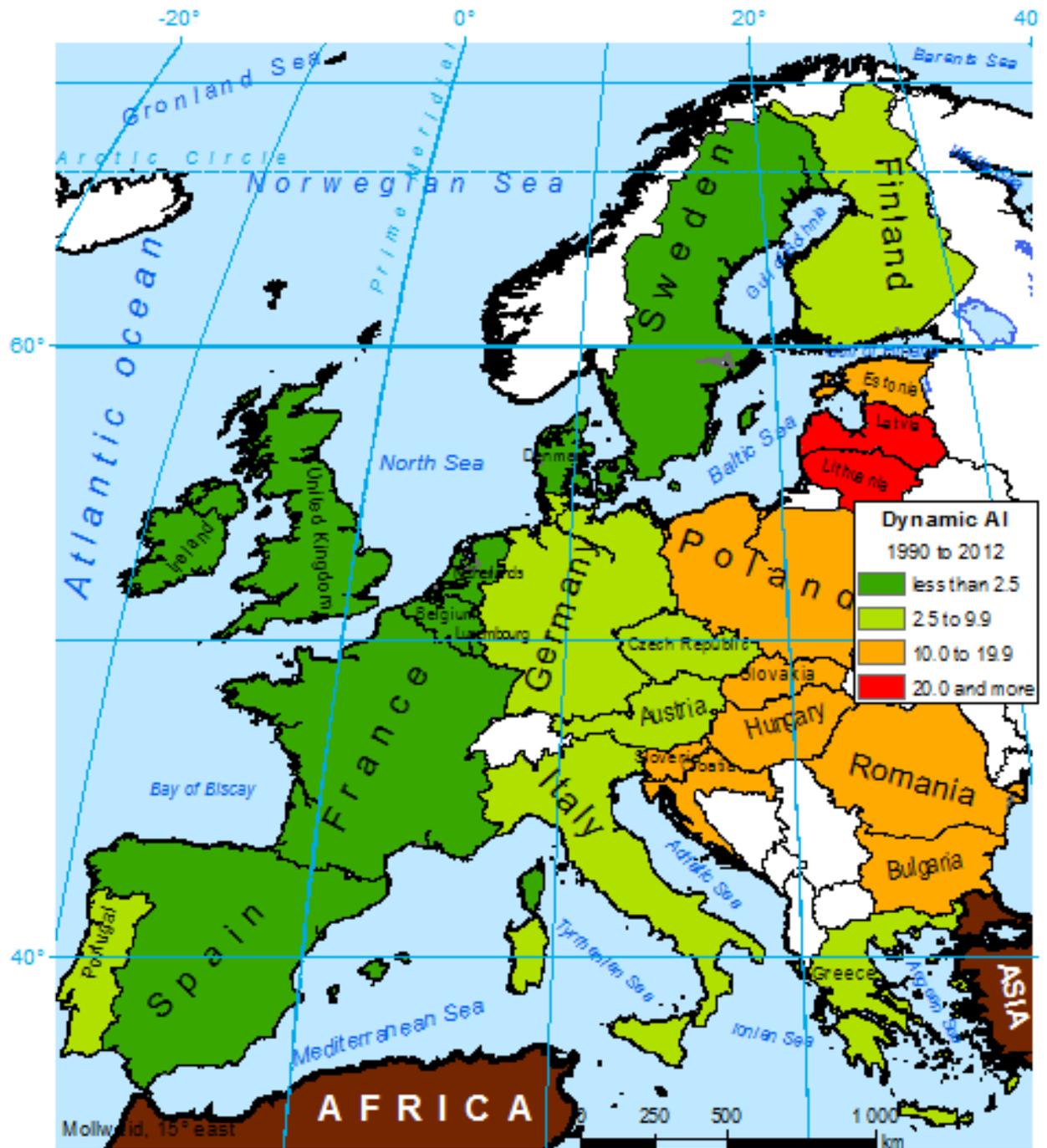
## 6 Conclusion

It is very interesting to compare ageing process on the European Union territory between 1990 and 2012 against dynamic ageing index (map 5). The EU index grew by nearly 70 percentage points from 70 to 117.

- The ageing process was **very quickly** in the regions in Latvia and Lithuania.
- The second group forms regions of the eight European Union countries, where ageing process was **quickly**: Estonia, Romania, Bulgaria, Croatia, Poland, Slovakia, Slovenia and Hungary.
- Ageing process in the cohesion regions of the countries Czech Republic, Portugal, Malta, Germany, Greece, Italy, Finland and Austria was **slowly**.
- The minimal changes from the point of ageing process were typical for this EU countries: Luxembourg, Ireland, Cyprus, Sweden, Denmark, United Kingdom, Belgium, France, Netherlands and Spain. Their ageing proces measured by the dynamic ageing index was **very slowly**. Their population growth was more than 5.0 ‰ by year at the same time. Only Netherlands and France were countries with more weight of the natural increase. This mean, that the others countries form this group grew due to net migration.
- Regions of European Union show quite a significant diversity with regard to the process of population ageing for the last twenty years. But it is true that differences between regions are decreasing.
- Transformations of the process of population reproduction during the last decades, that were taking place together with the processes of modernization, influenced the changes in the

population age structure during the period between 1990 and 2012. Therefore the demand for services related to care about elderly people is going to increase considerably.

**Map 5** Territorial difference of the dynamic ageing index between year 1990 and 2012



Source: author (EUROSTAT data)

The "median-variant" scenario of the U.N. Population Division remains a world with 9.2 billion people by mid-century. This means annual population growth at the level 3.4 % in 2050 and this is the same level as in European Union today. It is true that population growth is diminishing due to the demographic transition and the peak of the world population size will be probably achieved during the 21<sup>st</sup> century (around 2070). The peak of the European Union

population must be achieved much earlier (around 2030). But the big problem can be migration behaviour, namely international migration and just ageing process on the territory of European Union members.

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