Lodz Economics Working Papers

# Economic Development and the Spread of Diseases of Affluence in EU Regions

Agata Żółtaszek
Alicja Olejnik

4/2016

FACULTY OF ECONOMICS AND SOCIOLOGY
University of LODZ

Agata Żółtaszek, Alicja Olejnik

The Faculty of Economics and Sociology,
University of Lodz

# Economic Development and the Spread of Diseases of Affluence in EU Regions

**Abstract**

*Diseases of affluence* (*diseases of the* XXI c., *Western diseases)* by definition should have higher prevalence and/or mortality rates in richer and more developed countries than in poorer, underdeveloped states. Therefore, it has been indicated that it is the civilizational progress (directly or indirectly via changes in lifestyle, diet, physical activity, stress, etc.) that stimulates epidemic outbreaks of some illnesses (cancer, diseases of respiratory and cardiovascular systems, diabetes, mental disorders). On the other hand substantial financial resources, highly qualified medical personnel, and cutting-edge technology of richer states, should allow for effective preventions, diagnostics, and treatment of these diseases.

The European Union as a whole, as well as all its member states and their regions, may be considered "highly developed" in economic sense. Does it, however, mean that EU can be perceived as homogeneous in the sense of *diseases of affluence* epidemiology? Are the relatively small differences in economic regional development (compere to worldwide inequalities) significant factor in the spatial distribution of *diseases of affluence*? To evaluate the possible dispersion in the epidemiology of some of potential *Western diseases* and their relation with regional development tools of spatial statistics have been incorporated. The research covers 261 EU NUTS 2 regions for the years 2003-2010. These research may provide some answers to the existence and epidemiology of hypothetical *diseases of affluence* as well as in recognizing spatial patterns of prevalence and mortality rates for these illnesses.

**Key words**: diseases of affluence, health, socioeconomic development, spatial analysis
**JEL:** I14, I15, O18, O57

## 1. Introduction

In the modern world new and unexpected medical dangers constantly arise. It may mean new diseases, naturally mutated or bioengineered, but more and more often also changes in epidemiological patterns of existing disorders. The diseases of affluence, also known as the diseases of XXI c. or Western diseases, in last decades have become an alarming phenomena. Well known illnesses, like cardiovascular diseases, respiratory system diseases, cancer, diabetes, or mental disorders (including addictions) have re-appeared as a modern diseases and severe problem addressed in many WHO reports (WHO Report: ATLAS 2010…: pp.7-22; WHO Report: Global Report… 2016: pp.90-91; WHO Report: Global status…2011: pp.1-160). Statistics shows that almost half of deaths in most developed countries are caused by the cardiovascular problems, which is considered to be the flag example of the diseases of affluence. However, there is no unified definition or established list of the infamous XXI c. diseases. Nevertheless, it is generally believed that regions with higher economic indicators are more at risk, than the poorer ones. Though, there is no irrefutable evidence or methodology to state that any disease is influenced by regional socio-economic development. These illnesses are considered to be, direct or indirect, cost and by-product of social, cultural, technological, and economic progress in highly developed societies. (Kotarski 2013: 117-125; Link 2007: 75-76; Aue 2009: 175). Proving or disproving some of common notions may turn out to be very beneficial for the assessment and the development of regional, international, and global policies regarding the diseases of XXI c. For the purpose of this analysis the hypothesis of diseases of affluence can be statute as: *the more affluent (wealthy, developed etc.) the object (country, region, social group, household, person etc.), the more intense the prevalence (frequency of cases, severity of symptoms, mortality rate etc.) of the disease*.

The European Union as a whole, as well as all its member states and their regions, may be considered as "highly developed" region in an economic sense. Does it, however, mean that EU can be perceived as homogeneous in the sense of diseases of affluence epidemiology? Does economic diversity in EU (relatively small compared to worldwide inequalities) constitute a significant factor for the spatial distribution of diseases of affluence? To evaluate possible dispersion in the epidemiology of some of potential Western Diseases and their correlation with regional development, some tools of spatial statistics have been incorporated. Namely, uni- and bivariate local and global Moran's *I* statistics.

There are 3 specific aims of this paper: (1) verifying clustering of similar regions with high or low prevalence of each disease, (2) assessing the regional relation between economic

development and the prevalence of each disease, (3) verifying if this regional relation (proving or disproving the existence of diseases of affluence) is constant both over time and space. Therefore, these research may provide some answers to the questions concerning existence and epidemiology of potential diseases of affluence as well as it may allow for the recognition of the spatial patterns of prevalence and mortality rates for these illnesses.

## 2. Data

Data used in this statistical analysis represent death rates of the prevalence of each disease. Using mortality by the cause of death, as a measure of epidemiology is debatable, however in a way it does represent the prevalence. The death rates are in this case a result of combined effect of: the real prevalence or epidemiology (the number of people ill), the efficiency of diagnostics (the number of diagnosed cases of the illness), and health care efficiency (people living with the disease and possibly dying from different causes). It is difficult, if not impossible, to state which factor is decisive, and weather it is constant in time and space. However, there is very little data on prevalence, or even diagnosed prevalence available. It should be mentioned, that in the case of spatial statistics the dataset needs to be complete for all regions, to implement the spatial weight matrix. Therefore, the death rates analysis should be treated as a compromise between theory, speaking of prevalence or epidemiology, and the availability of data. In this analysis 5 potential diseases of affluence are considered: diabetes, diseases of the respiratory system, neoplasms (cancer), diseases of the circulatory system (cardiovascular diseases), and finally mental and behavioural disorders.

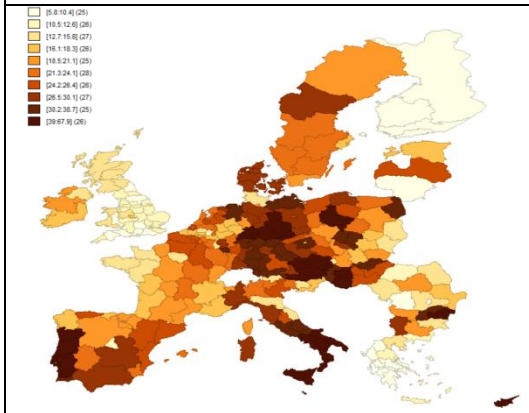
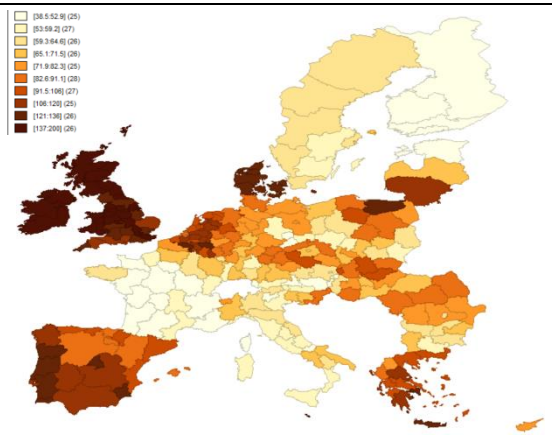
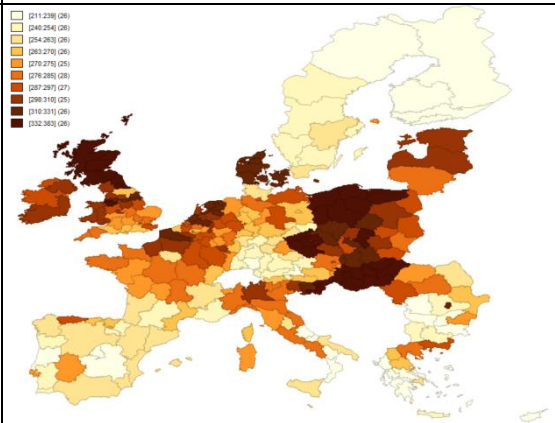
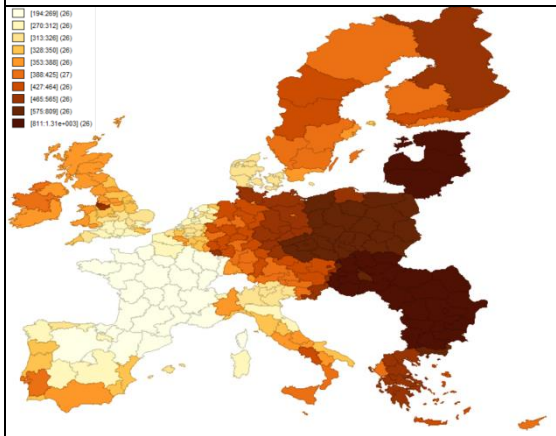
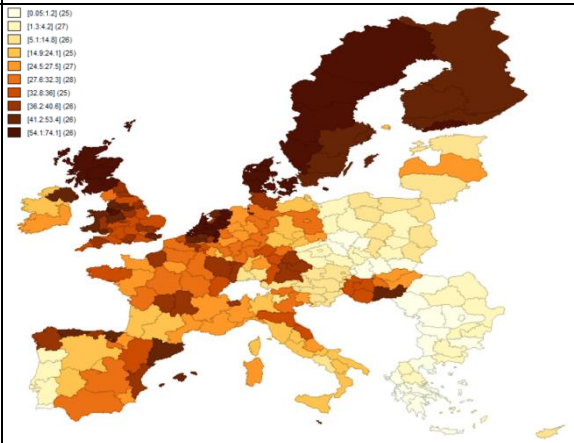
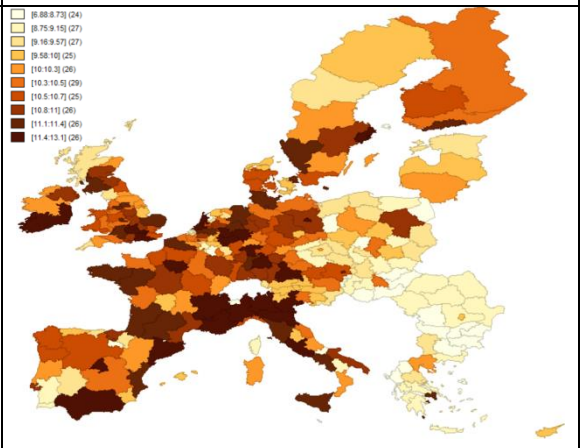
All the data used in the statistical analysis are taken from the Eurostat Database. They all cover for the period 2003-2010 and for 261 EU NUTS 2 regions. For each disease a three-year average of standardized death rates (per 100 000 inhabitants) are used. The age standardized death rates (SDRs) are calculated by Eurostat as weighted (weights are the age distribution of that population) average of the age-specific death rates of European Standard Population based on the EU27 and EFTA averaged over the projected period 2011-30. (http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Standardised_death_rate_(SDR); http://ec.europa.eu/eurostat/en/web/products-manuals-and-guidelines/-/KS-RA-13-028; Revision of the European Standard Population 2013:pp. 11-14) The regional affluence, or socio-economic development, is represented by Gross Domestic Product (GDP), expressed in Purchasing Power Standard per active population. In all comparisons between GDP and the prevalence, GDP is taken for the first year of each three-year average correspondingly to the

three-year average of causes of deaths. This GDP lag reflects two factors: (1) the time lag of economic effects on health and (2) the causality, where economic development influences the prevalence of each disease.

The spatial distribution of socio-economic status, measured by GDP per active population, clearly shows a division between Western-Northern regions and Eastern-Central Europe, with Balkans and Baltic states. This border separates rich and affluent provinces from poorer and less developed ones.

Analysing the spatial distributions of 5 potential diseases of affluence over EU regions it appears that there is no clear pattern, common for all the illnesses. The most deaths cause by diabetes are scattered across Germany, Slovakia, Czech Republic, Austria, Hungary, and a part of Balkans. The lowest values are noted in England (UK) and Finland. Diseases of the respiratory system seem to have the highest mortality rate in the whole British Islas, Denmark, and Iberian Peninsula, while the lowest in France and Italy. Cancer is most common in Central Europe, including Poland, Denmark, and Scotland (UK). The lowest death rates can be found in Scandinavia and Iberian Peninsula. On the other hand, cardiovascular diseases clearly divide Europe. The Eastern and Central Europe, with Balkans and Baltic states, constitutes highest death rates, unlike the Western parts, especially west of Germany, have very low mortality indicators. This distribution may preliminary point to a disease of poverty rather than affluence. Finally, mental and behavioural disorders cause most of the deaths in the Northern Europe (Scandinavia, Denmark, Scotland) and then in Western Europe. The lowest death rates appear in Central and Eastern Europe (with Balkans and Baltic states). This may indicate that mental disorders are diseases of affluence (see Fig.1). There is no clear or uniform patterning of these five diseases. Concluding, decile mapping alone does not give an answer weather any of these illnesses can be considered as a disease of affluence or diseases of poverty, or in general if there is any dependence between prevalence and socio-economic development. Therefore, a further and more detailed analysis needs to be carried out.

**Fig. 1 Standardized death rates of diseases of affluence, average 2008-2010, and GDP per active population, 2008, by region of residence, by deciles**

| Diabetes mellitus | Diseases of the respiratory system | Neoplasms |
|---|---|---|
|  |  |  |
| **Diseases of the circulatory system** | **Mental and behavioural disorders** | **GDP per inhabitant** |
|  |  |  |

Source: own compilation

## 3. Methodology

In the analysis of epidemiology of Western diseases and regional development two sets of spatial statistics measurements are used. Firstly, the (univariate) local and global Moran's *I* statistics allow for confirming any actual (statistically significant) grouping of similar regions, that is neighbouring NUTS 2 provinces with low-low, high-high, or mixed standardized mortality rates. Secondly, to verify grouping of regions with high or low mortality rates with high or low economic development (GDP per active population) bivariate local and global Moran's *I* statistics are introduced. The bivariate statistics measure the clustering of regions with high-low values of one variable (mortality rate of any disease) with high-low values of another variable (GDP) in bordering regions. These statistics do not reflect the affluence hypothesis *sensu stricto*, therefore three assumptions need to be made.

1. Direct and indirect, socioeconomic and medical, consequences of regional development are not limited by regional borders.
2. Prevalence of potential diseases of affluence is not limited by regional borders.
3. Regional correlation of:
   a) high GDP per capita with high mortality regions
   b) low GDP per capita with low mortality regions

   will confirm the affluence hypothesis, while mixed clusters (low-high) will prove otherwise.

Assumptions 1 and 2 reflect the common notion that regional borders do not limit any nonphysical phenomena, especially in the EU with common market and no-border policy. Assumption 3 allows for identification of diseases of affluence, and by association - diseases of poverty.

The classic or univariate Moran's *I* statistic (Moran, 1950; Cliff and Ord, 1981; Suchecki, 2010) is the most popular test of spatial association. The local Moran's $I_i$ shows whether the $i$-th location is surrounded by locations with similar or opposite values. The local Moran's $I_i$ statistic or Local Indicators of Spatial Association (LISA) takes the following form:

$$I_i = \frac{(x_i - \bar{x})}{\frac{1}{N}\sum_{j=1}^{N}(x_j - \bar{x})^2} \sum_{j=1}^{N} w_{ij}\left(x_j - \bar{x}\right). \quad (1)$$

The global Moran's *I* is a mean of local Moran's $I_i$ statistics and measures general regional similarity for all regions:

$$I = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{\frac{1}{N}\sum_{i=1}^{N}(x_i-\bar{x})^2}, \quad (2)$$

where $\bar{x}$ means mean of a given process and $w_{ij}$ elements of **W** matrix, which in this paper is based on queen contiguity spatial weight matrix, 1st order (Anselin, 1988). We assume positive spatial autocorrelation if: $I > -\frac{1}{N-1}$ and negative spatial autocorrelation otherwise.

Bivariate Moran's *I* measures are constructed in analogic manner. It measure local or global spatial correlation between x (death rate) and anther variable y (GDP per active population) in nearby areas. Bivariate LISA is defined as:

$$I_i^{bv} = \frac{(x_i-\bar{x})}{\frac{1}{N}\sum_{j=1}^{N}(x_j-\bar{x})^2}\sum_{j=1}^{N} w_{ij}(y_j-\bar{y}), \quad (3)$$

where $\bar{y}$ is a mean of the 2nd variable. The global equivalent Moran's *I* is:

$$I^{bv} = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(x_i-\bar{x})(y_j-\bar{y})}{\frac{1}{N}\sum_{i=1}^{N}(x_i-\bar{x})^2}. \quad (4)$$

All spatial analyses are based on queen contiguity spatial weight matrix, 1st order (Anselin, 1988).

## 4. Results and discussion

Analysing epidemic spatial clustering over NUTS 2 regions and time indicates unique patterning for each disease. Only statistically significant clustering is taken in to consideration (see fig.2).

Diabetes shows the smallest clusters among the 5 illnesses and little change over the period of 2003-5 to 2008-10. Low standardized death rates group in Finland, UK, and Greece. The highest mortality characterizes South-West Iberian Peninsula, South Italy, parts of Germany, Austria, Slovakia, and Czech Republic. There are almost no mixed clusters. The overall spatial autocorrelation for diabetes measured with global Moran's *I* was very high, 0.62 for 2003-5 and 0.61 for 2008-2010.

In the case of diseases of the respiratory system high mortality clusters form in the British Islas, Iberian Peninsula, and Benelux (Netherland, Belgium, Luxemburg), while the low ones group in Central and Western regions, especially France, Italy, and Germany. The main time difference is the disappearance of low values cluster for Scandinavia between 2003-5 and

2008-10. Mixed groupings are rare, if any. In general, the spatial autocorrelation for 2003-5 $I$=0.74 and for 2008-2010 $I$=0.79 was even higher than for diabetes.

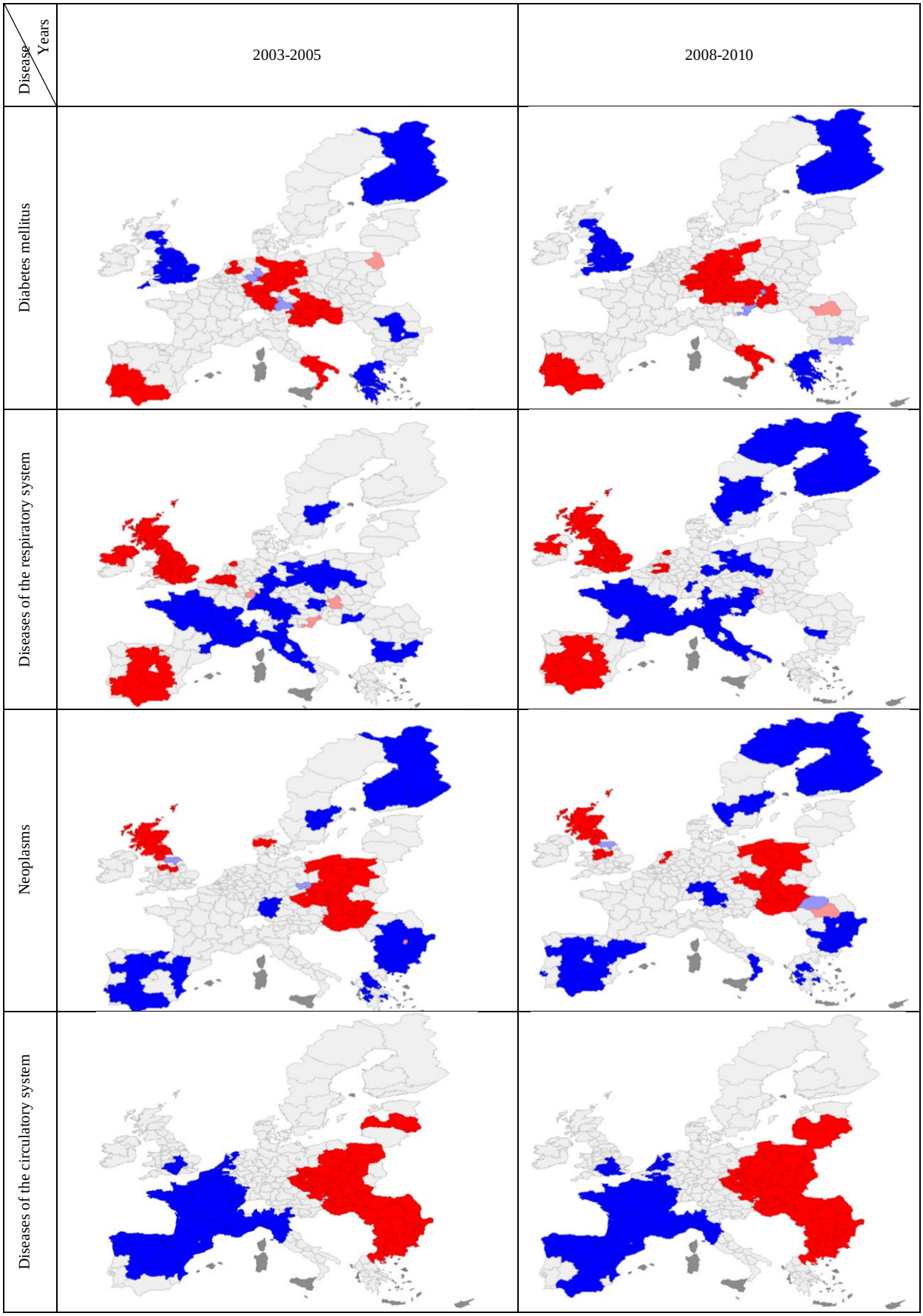
Neoplasms (cancer) have high mortality clusters in Northern UK and in Central Europe, including Poland, Slovakia, and Czech Republic, while low mortality groups in: Scandinavia, Iberian Peninsula, and Balkans. Very few high-low or low-high clusters are observed. The grouping is very similar for the years 2003-5 and 2009-10. The global Moran's $I$ for 2003-5 equalled 0.66 and for 2008-10 equalled 0.63.

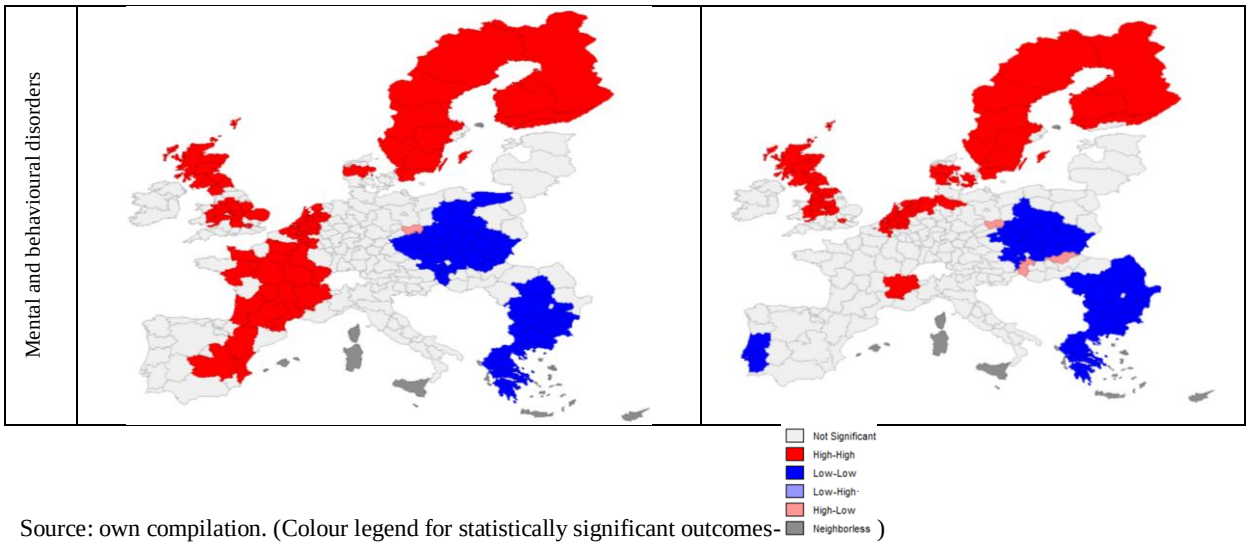
Diseases of the circulatory system or cardiovascular diseases created the largest of the 5 illnesses and stabile over time clusters. A low death rate cluster unites concentrate in Western regions (France, Iberian Peninsula, Benelux, parts of UK, and Italy) while high mortality clusters group in Central and Eastern Europe, including Poland, Balkans, and Baltic states. Overall Moran's statistic was extremely high with $I$=0.92 for both 2003-5 and 2008-10.

For mental and behavioural disorders clustering process has changed the most over time, compared to other 4 illnesses. Low mortality clusters in Central Europe, especially in Poland, and in Balkans decrease from 2003-5 to 2008-10. Four high death rate groups for 2003-5 formed in: Scandinavia, UK, France - Spain, and Benelux - Northern Germany - Denmark. In 2008-10 the large parts of clusters in France - Spain and Germany have disappeared. Out of very few high-low clusters in 2003-5, most in Central Europe, turned into low-low clusters in 2008-10. Global Moran's statistic for 2003-5 equalled 0.7 and for 2008-10 0.68, that is a very high autocorrelation.

Existence of large and positively correlated clusters, exceeding not only province but also state borders, supports the assumption concerning spilling over of Western diseases' prevalence and mortality. This also may be an indicator of dependence between regional economic development and epidemiology. However, this relationship needs further research.

**Fig. 2 Univariate LISA for diseases of affluence standardised death rates, averages for 2003-2005 and 2008-2010, by NUTS 2 EU regions**






Source: own compilation. (Colour legend for statistically significant outcomes- )

Analysing statistically significant clustering process between regions with high/low prevalence (defined as standardized mortality rates) of possible Western diseases in each region and high/low economic development (expressed by GDP per active population, PPS) in contiguous provinces gave some unexpected outcomes. The high-high or low-low grouping can be treated as an indicator of diseases of affluence, while mixed high-low and low-high regimes suggest the opposite, i.e. diseases of poverty (see fig.3).

For diabetes the Central and the Eastern Europe (with Balkans) is a mix of low mortality – low GDP and high mortality – low GDP clusters. In 2008-10 there were more clusters of high mortality and low GDP rates than in 2003-5. In Western Europe (UK, Germany, France, and Italy) we can observe small and dispersed clusters of high mortality – high GDP and low mortality – high GDP. Again, over the period of 2003-5 to 2008-10 the overall number of clusters decreases, however the mixed groups slowly grow in numbers. Generally, spatial autocorrelation measured by the global Moran's statistic equal to 0.08 in 2003-5 and -0.02 in 2008-10, turned out to be very small and with changing sign. Therefore, it is difficult to state weather diabetes is a disease of affluence or poverty. However, in the Central and Eastern Europe, especially Balkans, there are strong indicators that diabetes mortality rates' distribution has markings of Western diseases. Nevertheless the pattern changes over time of analysis, which means that mortality increases faster than economic development in these regions.

Diseases of the respiratory system clustering is very similar to diabetes – in the Central and Eastern Europe we observe large low mortality – low GDP and high mortality – low GDP groups, while in the Western Europe we recognise few high mortality – high GDP and low mortality – high GDP clusters. However, over the time number of high-high and low-low clusters increases, often taking place of the mixed ones. It may mean that respiratory diseases

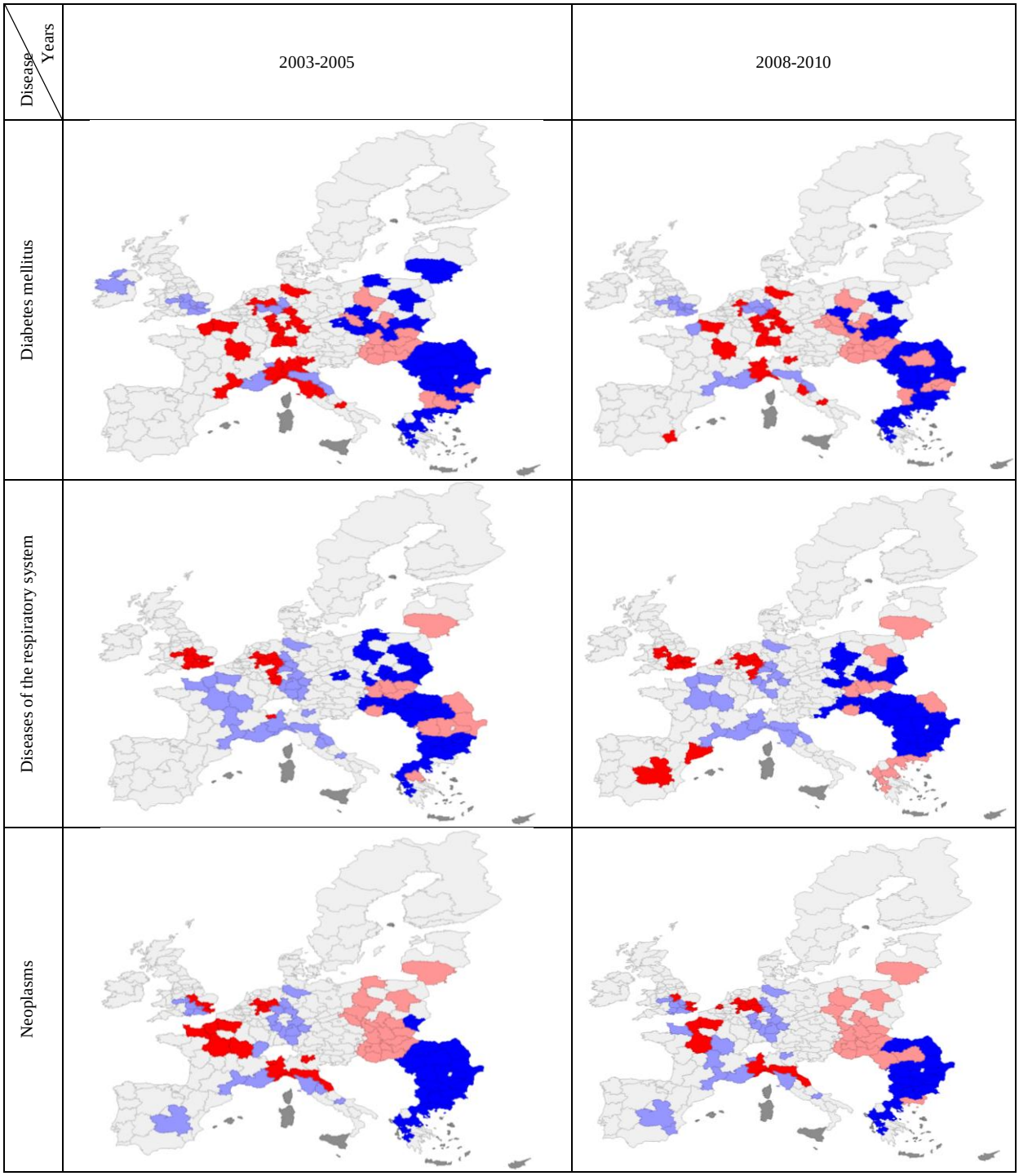
with time are becoming more and more a disease of affluence, but mostly in less affluent or poorer regions. Overall Moran's *I* was low and decreasing with time - for 2003-5 was *I*=0.13 and for 2008-2010 *I*=0.05.

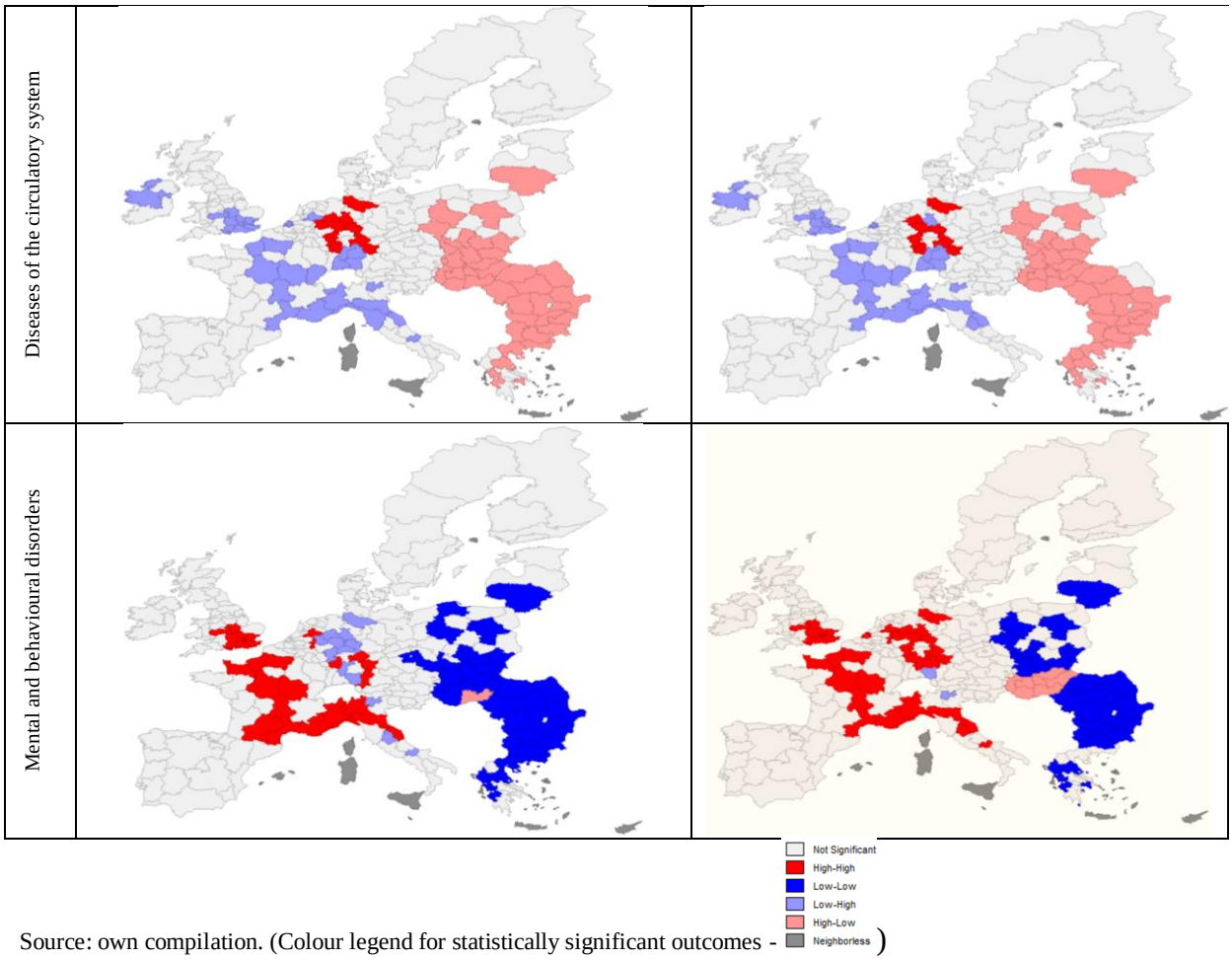
In the case of neoplasm (cancer) there are two major clusters, fairly stable over the period of analysis: high mortality – low GDP in Central-Eastern Europe and low mortality – low GDP in the Balkan region. This is a unique case among the 5 illnesses that Central - Eastern Europe and Balkans are divided and show opposite tendencies. In Western Europe, similarly as for diabetes and respiratory system diseases, some small mixed clusters of high mortality – high GDP and low mortality – low GDP can be spotted for both periods. The global spatial autocorrelation shows very weak and negative relation *I*=-0.01 for 2003-5 and *I*=-0.07 for 2008-2010, which has marginal effect.

Cardiovascular (or circulatory system) diseases indicate three separate and large clusters. Firstly, for Central and Eastern Europe (with Balkans) bivariate LISA indicates high mortality related to low GDP. Secondly, Western Europe (France, Italy, and British Islas) characterises low mortality with high GDP. In these two regions cardiovascular illnesses seem to be a disease of poverty, not affluence. Thirdly, in Germany there are some high mortality – high GDP clusters, where circulatory problems may be considered as a Western disease. The global Moran's *I* in 2003-5 was equal -0.57 and in 2008-2010 -0.54, which is high and negative.

Mental and behavioural disorders show strong indicators of being diseases of affluence. A large cluster of low mortality - low GDP has formed in Central and Eastern Europe, especially Balkans. It decreases from 2003-5 to 2008-10, mainly due to a large part of Hungry turning to high mortality – low GDP. On the other hand in Western Europe (France, UK, and Italy) a high mortality – high GDP clusters can be found. Moreover they increased over time by turning low mortality – high GDP in Germany into high mortality – high GDP. This together with relatively high global Moran's *I* of 0.42 for 2003-5 and 0.45 for 2008-10 is the strongest indicator of diseases of affluence among 5 illnesses in question.

**Fig. 3 Bivariate LISA for diseases of affluence standardised death rates (averages for 2003-2005 and 2008-2010) and GDP per active population (PPS; for 2003 and 2008, respectively) by NUTS 2 EU regions**






Source: own compilation. (Colour legend for statistically significant outcomes - )

## 5. Summary

While analysing, interpreting, and concluding some mixed and unexpected results rose for 4 out of 5 diseases in questions (excluding mental disorders). This may be attributed partly to two not strictly statistical factors. Firstly, it needs to be remember that the prevalence was measured by the death rates, i.e. mortality, it the total population. This could not be avoided due to lacking data. However, it fact we do not know if the prevalence *sesnu stricto*, that is the number of ill people or their fraction in the population, is spatially correlated to the level of economic development. Moreover, we do not know if the mortality among ill people is constant (over time and space) or if it maybe is spatially correlated to GDP level as well. It may be reasoned that the more developed region (due to better health care), the lower mortality (among the sick or in the population). If so, it can be observed by the mixed relations (high-low, low-high) and in fact be perceived as a symptom of diseases of poverty, where more people die in poorer and underdeveloped (socioeconomically and also medically) regions. Interloping of small low-low/high-high clusters with mixed groups and transforming one into the other over time proves that the "disease of affluence" is not a fixed distinction

forming a constant list of illnesses with constant and fixed distributions over time and space. Secondly, the analysed region of EU is fairly homogeneous in the sense of mortality and economic development, compared to the dispersion in the rest of the world. Therefore, the potential relations may be weaker thus more difficult to find and confirm statistically.

Diabetes, respiratory system diseases, and cancer can be perceived as diseases of affluence in some regions, mainly in poorer provinces of Central and Eastern Europe. There, lower mortality is the reflection of lower prevalence *senus stricto*. However, in some neighbouring regions the relation is inversed - low economic development correlates with high mortality. In these regions high death rates might be a result of higher prevalence and/or worse health care. Either way, more attention should be paid to these regions in creating health care policies, as they are in danger of socioeconomic inequality in access to medical aid.

Cardiovascular diseases are perceived as a flag example of diseases of affluence and yet the outcomes of this research indicate the exact opposite. In the sense of mortality caused by hart problems, it is a strong example of a disease of poverty. Clearly, more people die in poorer regions than in more developed ones. Again, we still cannot conclude if (1) the prevalence (number or fraction of ill in population) is positively or negatively correlated with GDP, (2) health care in richer states offers longer life with a diseases, but the fact is that people are more likely to die of cardiovascular diseases in Central and Eastern Europe than in the Western states.

Mental disorders measured by death rate surprisingly is strongly and positively correlated with economic development. While these illnesses are unique on their own and their mortality (suicides, addiction related deaths, etc.) is not as intuitive as with cancer or cardiovascular diseases, the spatial statistical approach clearly shows that they are a good example of Western diseases. Moreover since the relation is fairly clear in a homogenous region of EU, it can be concluded that in fact this mortality is very sensitive to small changes in economic development.

**Literature**


Anselin L., (1988), *Spatial Econometrics: Methods and Models*, Kluwer Academic Publications, Dordrecht

Aue, W. (2009*) Człowiek w środowisku: podręcznik. Cz. 1*, WSiP

Cliff A., Ord J. K., (1981), *Spatial Processes: Models and Applications*, Pion, London

Kotarski, H. (2013) *Kapitał ludzki i kapitał społeczny a rozwój województwa podkarpackiego*, Wydawnictwo Uniwersytetu Rzeszowskiego

Link, K. (2007) *Understanding New, Resurgent, and Resistant Diseases: How Man and Globalization Create and Spread Illness*, Greenwood Publishing Group

Moran P., (1950), Notes on Continuous Stochastic Phenomena, *Biometrika*, 37, 17–23

Report of Eurostat's task force: Revision of the European Standard Population 2013 (http://ec.europa.eu/eurostat/documents/3859598/5926869/KS-RA-13-028-EN.PDF/e713fa79-1add-44e8-b23d-5e8fa09b3f8f) (25.06.2016)

Suchecki, B. (ed.) (2010) *Ekonometria przestrzenna*, Wydawnictwo C.H. Beck Warszawa

WHO Report: ATLAS on Substance Use (2010) Chapter 1 Psychoactive substance use: epidemiology and burden of disease (http://www.who.int/substance_abuse/publications/treatment/en/)(25.06.2016)

WHO Report: Global Report on Urban Health (2016) (http://www.who.int/kobe_centre/publications/urban-global-report/en/) (25.06.2016)

WHO Report: Global status report on noncommunicable diseases 2010 (2011) (http://www.who.int/nmh/publications/ncd_report2010/en/)(25.06.2016)

http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Standardised_death_rate_(SDR) (25.06.2016)

http://ec.europa.eu/eurostat/en/web/products-manuals-and-guidelines/-/KS-RA-13-028 (25.06.2016)