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Spatial Disparities in Unit Labour Costs in Food Products Manufacturing Sector

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ABSTRACT

In case of agricultural economics, an economic growth is most generally understood as long-term process of increasing agricultural production. Especially in neoclassical theory, it is determined mainly by labour productivity. According to the producer's equilibrium theory the remuneration of labour factor should result from its productivity. If labour remuneration is greater than its productivity, the allocation can be considered as ineffective. Hence, the resulting difference should be financed from other sources. If such a situation occurs in a whole sector, then the producers benefit from the distribution of the value in the economy. The aim of this research is to examine spatial diversity of the ULC (unit labour costs) in EU's food products manufacturing sector. Defining the ULC as a ratio of the labour remuneration to its productivity, the paper used Moran's *I* statistic for identifying the spatial association. For 2008-2014 the study used information from EUROSTAT database.

Keywords: *microeconomics, unit labour costs, food products manufacturing sector*

Introduction

This article considers the issue of the producer's equilibrium. According to the neoclassical theory, the producer maximises its objective function, which is usually profit, with specific restrictive conditions. As noted by Sielska (2012), these conditions usually apply to the maximum level of costs resulting from the involvement of production factors, as permitted by the producer.

Assuming the existence of two production factors, i.e. capital and labour, the task of constrained optimization for the producer may be formulated as:

$$\Pi = \mathrm{Y} \cdot C_Y - (K \cdot C_K + L \cdot C_L) \rightarrow max$$

therefore:

$$\frac{\partial \Pi}{\partial Y} = 0$$

where:
Π – producer's income,
Y – production,
C_Y – price obtained,
K – capital input,
C_K – capital remuneration,
L – labour input,

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C_L – labour remuneration.

According to the Clark's theory (1891), for the producer maximising its profit, the price of production factors is equal to their marginal productivity (Rembisz, Sielska 2012), which may be formulated as:

$$C_Y \cdot \frac{\partial \mathrm{Y}}{\partial K} = C_K$$

and

$$C_Y \cdot \frac{\partial \mathrm{Y}}{\partial L} = C_L$$

with the designations as above.

Thus, the remuneration of the capital and labour factors should be compensated according to marginal productivities. However, "a standard, simple theory of aggregate production suggests that an increase in productivity of labour should lead to a proportional increase in labour compensation" (Willis, Wroblewski 2007, p. 6). Hence, although the remuneration of the production factor results from its marginal productivity, it is referred to the average productivity.

The basis of this study is, therefore, a ratio of the remuneration of the labour factor to its average productivity, referred to as the unit labour costs (ULC), in accordance with the following formula:

$$ULC = \frac{C_L}{\frac{Y}{L}}$$

with the designations as above.

The objective of the article is to analyse the spatial disparities of the remuneration of the labour factor in relation to its productivity in the food products manufacturing sector, but not trying to explain the causes of this differentiation. As noted by Rembisz, Sielska and Pawłowska (2016), this indicator informs whether the remuneration of the labour factor results from its productivity. This in turn may inform about the profitability of production and the competitiveness of the given system, e.g. sector, region and producer. However, it should be taken into account, as pointed out by Roszkowska, Wyszyński and Zienkowski (2010, p. 1), that "ULC should not be treated as an indicator of the overall competitiveness of the economy, but as a reflection of its cost competitiveness, which should be analysed in comparison with the capital acquisition cost". The advantages of unit labour costs cover also the ease of empirical identification and the possibility to directly compare countries (Ark, Stuivenwold, Ypma 2005).

Unit labour costs in the food products manufacturing sector

Firstly, the paper analyses the evolution of unit labour costs in the selected countries between 2008 and 2014. As shown in Fig. 1, unit labour costs in the food products manufacturing sector, referred to as a ratio of personnel costs per employee to gross value added per employee, show differentiation both among the individual countries as well as on year-on-year basis.

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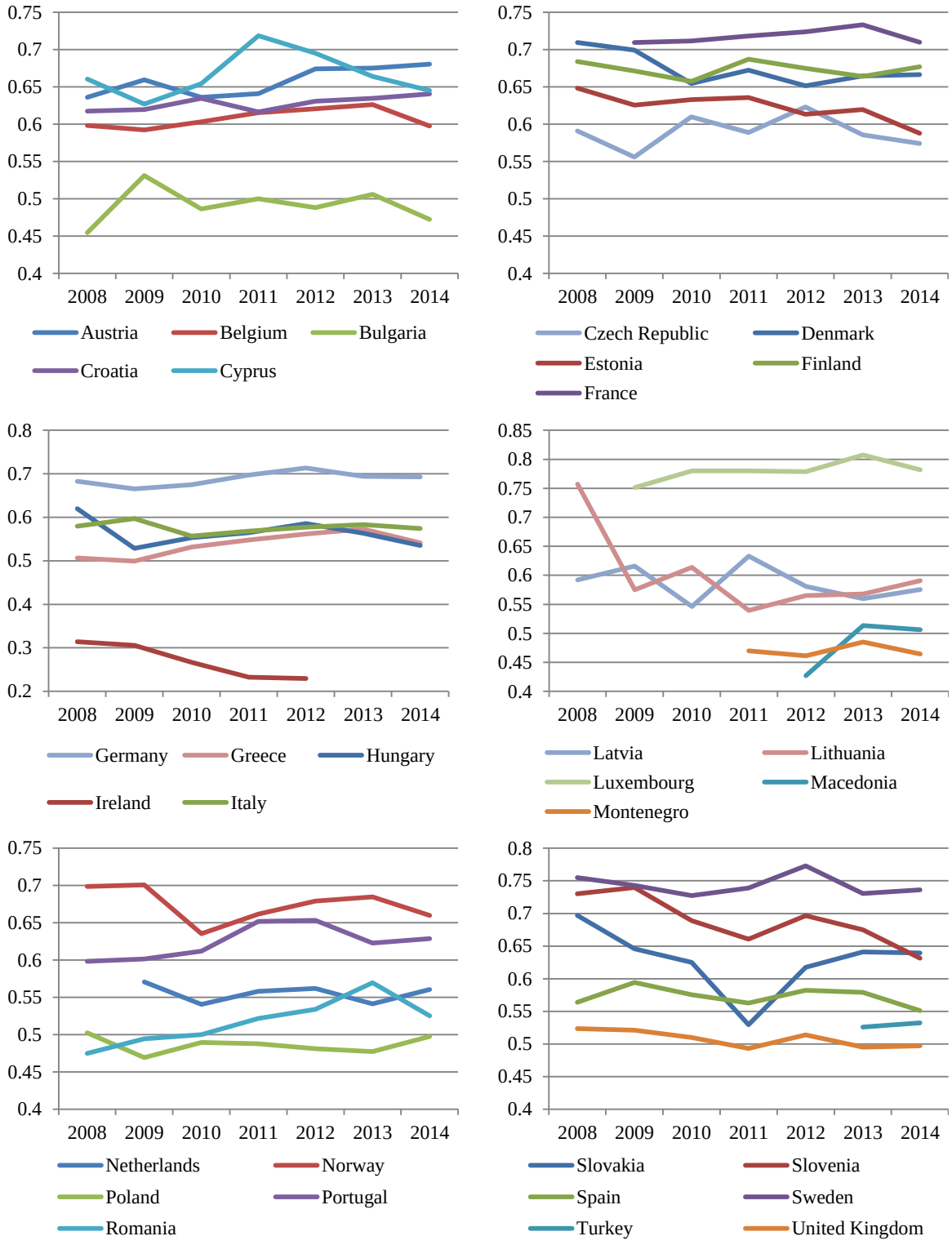
Figure 1. Unit labour costs in food products manufacturing sector in 2008-2014



Source: own elaboration based on EUROSTAT database.

When analysing the value of unit labour costs in 2008-2014 we can observe that in every country and in every year, unit labour costs were below 1. As it was mentioned before, if the productivity of labour factor is higher than its remuneration, the allocation can be considered as effective (Rembisz 2016). The highest level of unit labour costs (Fig. 1) occurred in Luxembourg (more than 0.75), Sweden (within 0.75) as well as in France

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(more than 0.7) and Germany (oscillating around 0.7). The relative high value of unit labour costs was observed also in Austria, Cyprus, Denmark, Finland, Norway and Slovenia.

The countries with the lowest unit labour costs include: Bulgaria, Montenegro, Macedonia, Ireland, Poland, the United Kingdom, and, in the early years of the analysed period, also Romania. The unit labour costs value in Romania increased over the years and in 2013 exceeded the level of 0.55. The relative low level of unit labour costs was observed also in Turkey and in Greece.

Some countries maintained a relatively stable level of unit labour costs, in other fluctuations were observed. A significant decline in 2009 was recorded by Lithuania which, despite an increase in the following years, did not reach the level of 2008. The situation resulted from decreasing personnel costs and increasing gross value added at the same time. In 2010, the indicator decreased in Norway and Latvia, and in 2011 in Slovakia. In Ireland, where the indicator was the lowest, a continuous decline was recorded in 2008-2012. Moreover, countries with the highest level of unit labour costs were characterised by their stable level in the analysed period.

Methodology

The spatial statistical methods were applied to examine the spatial disparities of unit labour costs in the selected countries. The spatial autocorrelation coefficients were calculated to examine whether the value of a variable in a given location determines the value of this variable in other locations (Kopczewska 2007, Suchecki 2010). The study includes both global and local relations, measured using relevant autocorrelation coefficients.

The global autocorrelation indicator measures the overall similarity of the regions. It allows to identify the spatial relationship between the values of the variable throughout the analysed area. The advantage of this measure is its syntheticity. However, it should be noted that this is the averaged indicator and, therefore, its value depends on the adopted division into areas.

To measure the global spatial autocorrelations the study used Global Moran's *I* statistic specified by the following formula (Moran 1948, Cliff, Ord 1981, as cited in Kopczewska 2007):

$$I = \frac{1}{\sum_{j=1}^{n}\sum_{j=1}^{n} w_{ij}} \cdot \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\,(x_i - \bar{x})\left(x_j - \bar{x}\right)}{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where:

x_i – value of the variable of interest in the i^{th} region,

n – number of the regions,

w_{ij} – elements of the spatial contiguity matrix ***W*** standardised by rows to 1.

As indicated by Suchecki (2010), Global Moran's *I* statistic is used to identify deviations in the random distribution of the analysed variable in the spatial sense. Therefore, it allows to determine whether the adjacent areas are more similar to each other than it would result from the stochastic nature of the analysed phenomenon. With an appropriate design of the matrix ***W***, Global Moran's *I* statistic is a weighted correlation coefficient, thus it is similarly interpreted, although its absolute value may exceed 1. In spatial statistics, test of significance of global statistics verifies the null hypothesis, stating the absence of correlation in the spatial sense. This means the randomness of the analysed phenomenon in the given area and the lack of relationships between locations. In case of rejection of the null hypothesis, we conclude that the value of the variable in one area is determined by the value of this variable in the adjacent areas, and *vice versa*. If the adjacent areas are characterised by a similar value of the analysed variable, we are dealing with a positive autocorrelation. In the opposite case, i.e. when the adjacent areas have different values of the given variable, there is a negative autocorrelation.

Local autocorrelation indicators allowed to show a more accurate picture of the structure of the spatial distribution of the analysed variable. In "individual" terms, the phenomenon of spatial autocorrelation may be measured by Local Moran's I_i statistic, defined as:

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$$I_i = \frac{(x_i - \bar{x}) \sum_{i=1}^{n} w_{ij} \left(x_j - \bar{x}\right)}{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2}$$

with the designations as above.

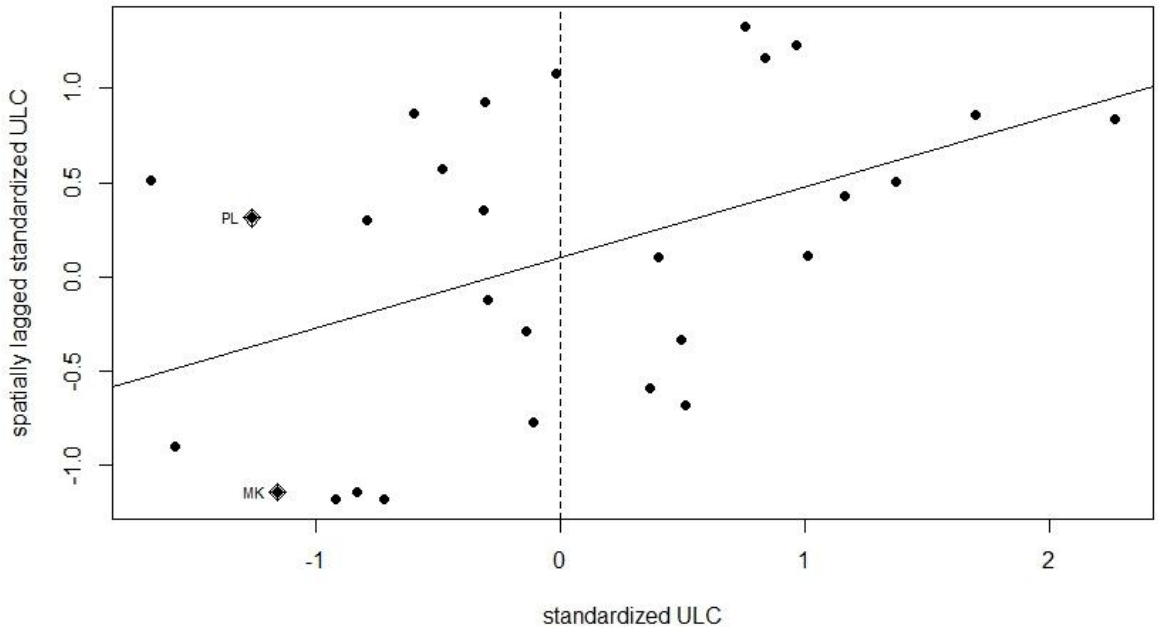
By identifying significant groups with a similar value of the analysed variable, local indicator of spatial autocorrelation allows to identify the so-called spatial regimes (Suchecki 2010). The study used standardised Local Moran's I_i statistic with the asymptotic normal distribution. This approach made it possible to verify the null hypothesis concerning the absence of groups of the similar value of the analysed variable in the vicinity of the i^{th} location.

Results

The obtained value of Global Moran's *I* statistic indicates the presence of the positive spatial autocorrelation for unit labour costs in the food products manufacturing sector in 2014 in the analysed countries. The spatial correlation coefficient is 0.35[1], therefore, the location explains the variability of unit labour costs in about 12.25%[2]. Statistically significant positive value of Global Moran's *I* statistic attests to the similarity of the analysed countries in terms of unit labour costs values.

The Moran's scatterplot allows to indicate the potentially influential observations, i.e. those characterised by a significantly higher or lower level of unit labour costs in comparison to the adjacent regions (Fig. 2). The horizontal axis contains standardised unit labour costs while the vertical axis – spatial lag of standardised unit labour costs.

Figure 2. Moran's scatterplot for unit labour costs in food products manufacturing sector in 2014



Source: own elaboration based on EUROSTAT database.

Poland and Macedonia were considered as outliers, but due to the location of the observations in relation to the regression line, Poland is the so-called "poor" region, while Macedonia – the "rich" one[3]. This

[1] With the level of significance equal to 0.05 calculated Global Moran's *I* statistic is statistically significant.
[2] $0.35^2 \cdot 100\% = 12.25\%$
[3] It should be highlighted that the "poor" (or "rich") region is a country where, comparing to the adjacent countries, the remuneration of the labour factor was respectively lower (or higher) in relation to the productivity of this factor.

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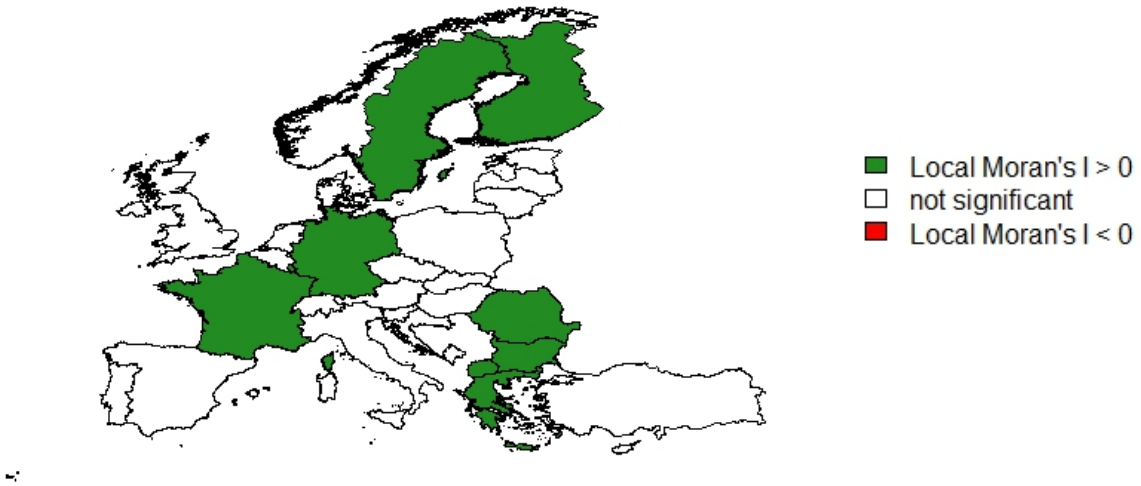
means that in the neighbouring countries of Poland, unit labour costs are higher than the average value. In addition, the value of the standardised variable below zero shows that Poland is the "poor" region not only in relation to its neighbours, but also to the entire analysed population. In Macedonia, in turn, unit labour costs exceed the values in the neighbouring countries much more than it would result from the general spatial pattern. It is therefore the "rich" region in relation to its neighbours.

By calculating Local Moran's I_i statistic, the patterns of local relations between the analysed countries were identified. On the basis of Local Moran's I_i statistic value, three spatial clusters with significantly high absolute values of local indicator of spatial autocorrelation were found (Fig. 3). These are the clusters with similar levels of unit labour costs in the food products manufacturing sector.

Figure 3. Unit labour costs clusters in 2014



Source: own elaboration based on EUROSTAT database.

The first cluster includes France, Germany and Luxembourg, the second – Sweden and Finland, while the third – Macedonia, Greece, Bulgaria and Romania. It should be noted that only in the previous year a similar distribution of the approximate ULC values of the clusters took place in the food products manufacturing sector (Fig. 4).

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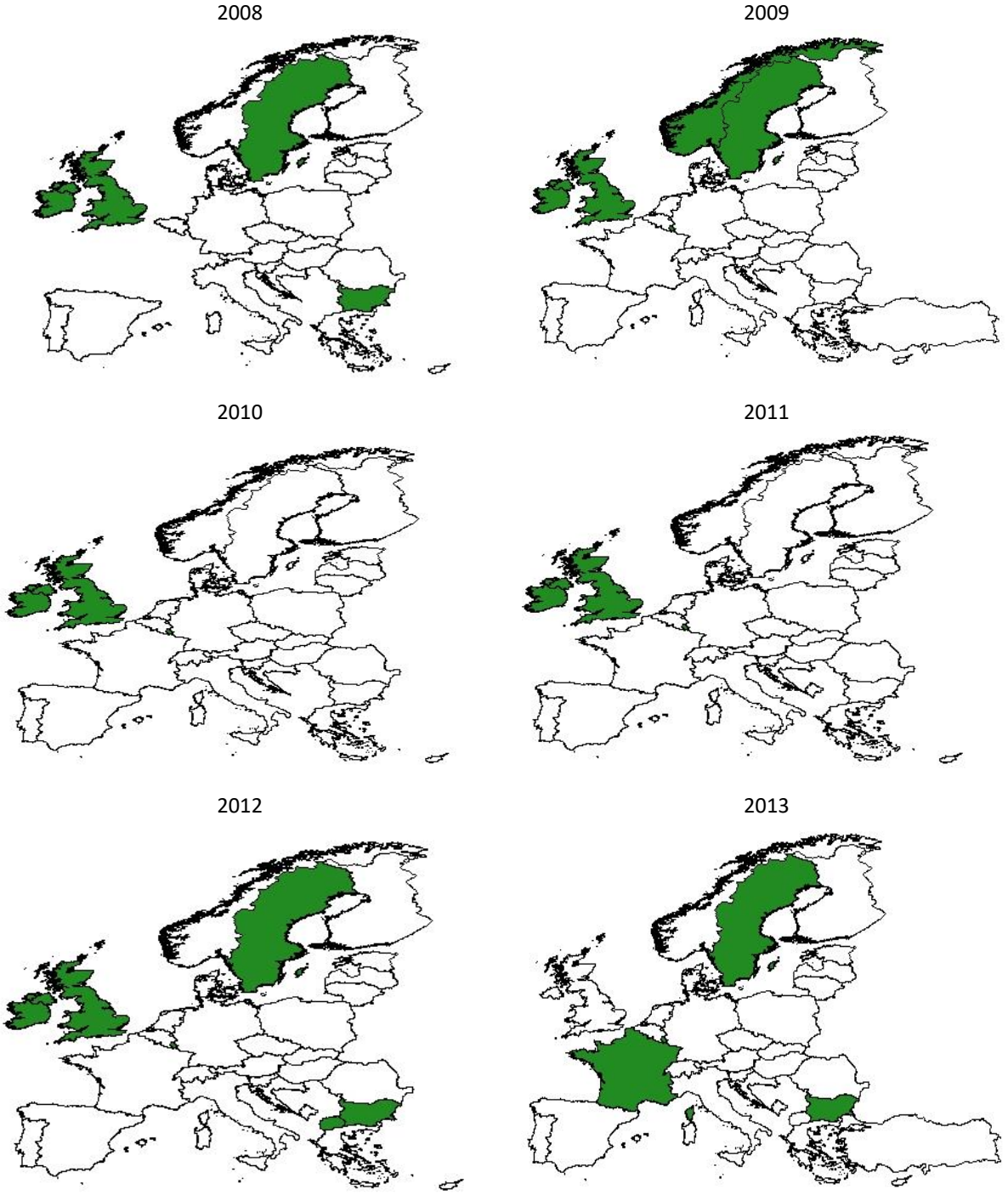
Figure 4. Evolution of clusters over the 2008-2013 period



Source: own elaboration based on EUROSTAT database.

The oldest seems to be the second cluster, the newest – the first one. In addition, it may be observed that the emergence of the first cluster was accompanied by the disappearance of the cluster including the United Kingdom and Ireland. Taking into account the relatively low unit labour costs values in these countries, this disappearance did not, however, result from the "shift" of the given cluster but most probably from the increased difference in the ULC values between the United Kingdom and Ireland and France, due to which France, compared to its neighbours, became the so-called "rich" region.

Table 1. Selected characteristics of clusters in 2014

Cluster	Number of	Unit labour	Personnel costs	Gross value	Investment per

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	countries in a cluster	costs	per employee	added per employee	person employed
1	3	0.72	34.4	47.2	6.03
2	2	0.71	46.1	65.1	9.95
3	4	0.51	8.7	16.5	3.33

Source: own elaboration based on EUROSTAT database.

As pointed out previously, the first and the second cluster are the so-called "rich" regions, i.e. with the significantly higher, when compared to their neighbours, unit labour costs values (Table 1). The third cluster, on the other hand, is the "poor" region in which the unit labour costs are relatively lower. In addition, differences in the share of the remuneration of the labour factor in its productivity are accompanied by differences in their levels. In the "rich" regions, the remuneration of the labour factor is by about four times higher, and the productivity of the labour factor is by about three times higher than in the "poor" regions. This is accompanied by the discrepancy between the clusters in the size of investments per employee, which in the first and the second cluster were in 2014 by about three times higher than in the third cluster.

Conclusions

Using producer's equilibrium as a theoretical background, this paper analyses spatial disparities of unit labour costs (ULC) in food products manufacturing sector in selected countries. The aim of the article was to examine the existence of spatial patterns over the years 2008-2014.

In 2014, the positive spatial autocorrelation of unit labour costs was observed across the analysed countries. Then, the location explains partially the variability of unit labour costs. Poland and Macedonia were considered here as outliers. The unit labour costs were lower in Poland than in neighbouring countries, while in Macedonia – higher.

Three spatial clusters were identified. Due to significantly higher unit labour costs, comparing to neighbours, two of these clusters were considered as the so-called "rich" regions. The first one included France, Germany and Luxemburg, while the second one consisted of Sweden and Finland. Third cluster, with Macedonia, Greece, Bulgaria and Romania, in turn, was identified as the so-called "poor" region.

Furthermore, differences in the share of the remuneration of the labour factor in its productivity were accompanied by differences in their levels. In the "rich" clusters, the remuneration of the labour factor was by about four times higher, and the productivity of the labour factor was by about three times higher than in the "poor" one. The reason for these trends in unit labour costs may be associated with producers' investments, which in the first and the second cluster were by about three times higher in 2014 than in the third cluster, which contributes to a better use of the available factors of production.

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