Nicola GALLUZZO

Association of Geographical and Economic Studies about Rural Areas, Rieti, Italy
asgear@libero.it

GROSS DOMESTIC PRODUCT AND RURAL DEPOPULATION IN ROMANIA: ANALYSIS OF CORRELATIONS USING A QUANTITATIVE APPROACH

ABSTRACT

The growth of Romanian Gross Domestic Product (GDP) has acted on the increase of food consumption, on the implementation of agri-food sector and on the level of farmer's income, even if one of the main negative bottleneck of this growth has been the emigration from the countryside, whose workforce has been partially re-employed in urban territories. The purpose of this research was to assess by a quantitative approach main nexus between the growth of Gross Domestic Product and the increase of agricultural GDP; besides, another aim has been focused on assessing the role of financial subsides allocated by the CAP in contrasting the emigration from the Romanian countryside. The Moran's index has been pivotal in estimating the spatial autocorrelation in all Romanian counties between the variable Gross Domestic Product, the level of agrarian GDP and rural emigration. Findings have pointed out a dichotomy between Romanian regions and a positive role of financial subsidies allocated by the CAP in alleviating depopulation in rural territories.

Key words: territorial specialization, Moran's index, Kohonen's maps, second pillar, rural development.

JEL Classification: Q12, Q18.

1. INTRODUCTION

Lots of authors have investigated by a quantitative approach the productive specialization using some indexes of concentration but very few researches have assessed in depth the correlation between agricultural specialization, in terms of agricultural GDP, and the level of Gross Domestic Product. Poor rural areas with modest plots of land and consequently low level of agrarian specialization are characterised by a significant rural emigration phenomenon; hence, agrarian productions satisfy only the needs of family farms. The dimension of farm is pivotal in reducing both the exodus from the countryside and also in using in an efficient way financial subsidies allocated by the Common Agricultural Policy (CAP). The objective of this paper was to investigate over 14 years, since 2000 to 2014, by a quantitative approach, the spatial autocorrelation between the arising

levels of GDP in every Romanian counties, the growth of agricultural productions, in terms of agrarian GDP, and the rural emigration, focusing the analysis on the impact of financial subsidies allocated by the second pillar of the CAP in reducing rural exodus.

2. LITERATURE REVIEW

In many European countries, which are new members of the European Union since 2004 and 2007, aftermath Berlin's wall fall there has been a significant transition from a centralized and planned agrarian productivist model of economy to a post communist one, which has implied some positive impacts to small scale farms influencing also decision processes of policy makers in order to face with this socio-economic transition and transformation (Kostov and Lingard, 2002). In the same time the European Union, as a consequence of international agreements in the framework of the Uruguay Round in the bosom of the General Agreement Tariffs and Trade (GATT), has changed its own paradigm of ag-commodities production and its own domestic subsidy scheme stimulating a post productivist model in the European countryside based on farm diversification activities, multifunctionality and an endogenous and shared rural development (Van der Ploeg and Van Dijk, 1995; Ilbery, 1998; Van der Ploeg et al., 2000; Van Der Ploeg and Renting, 2000; Van der Ploeg and Roep, 2003). As a consequence of this transition, farmer is singled out as the main dweller in the process of rural development able to contrast the rural socio-economic marginalization and emigration from the countryside.

The transition in a newly economic model of production was particularly demanding and ruinous in some disadvantaged rural territories, far away from the traditional urbanized areas, due to modest plots of land and to a poor level of investments in innovation both in terms of agrarian capital and assets and also as new technologies (Jordan, 2009). This author has argued as in declining rural areas of Romania there has been an increase of rural out emigration towards rich urban territories as a consequence of a significant change in the agrarian productive model which is marked out by poor opportunities for farmers in implementing the level of efficiency and investments.

The main downside of the rural emigration has been an increase of disparities and dualism between central and peripheral areas expanding the core-periphery dichotomy due to different level of income and economic growth (Benedek, 2015) more modest, in terms of Gross Domestic Product and income, in the countryside than in urban areas. Depopulated Romanian rural areas have affected on the level of productive specialization fossilizing and worsening rural poverty which has been partially dealt with specific financial subsidies allocated by the second pillar of the Common Agricultural Policy aimed at stimulating the rural development in stayed behind rural areas (Galluzzo, 2015a; 2016).

In Romania small farms are classified as subsistence farms and semi-subsistence farms with level of farm net income very poor and under the value of 1 European Size Unit (ESU) or rather 1,200 Euro. Subsistence and semi-subsistence farms are very important to protect the socio-economic rural fabric and they depict an important challange for the CAP which should compensate farmers for this ecosystem action and in order to alleviate the poorest demanding living conditions of these rural inhabitants (Hubbard et al., 2014; Davidova et al., 2009; Davidova, 2011; Petrovici and Gorton, 2005). Outcomes of these latter authors have corroborated the theoretical hypostasis according to which financial subsidies allocated by the Common Agricultural Policy are central in poor Romanian rural areas in halting partially the exodus from the countryside.

Romanian countryside is characterized by lots of small rural villages at risk of socio-economic marginalization consequence of out rural emigration which is also a negative prerogative typical of many European rural areas and in particular in new comers member states of the EU (Galluzzo, 2015a; 2014; 2013); in fact, more than 70% of Romanian farms has an agricultural area close to 1 hectare (Giurca, 2008). The main downside of small dimension in farms is correlated to an expansion of rural poverty with the consequence to foster the marginalization of Romanian rural space. Farms with small utilized agricultural areas, according to the latest data published by Eurostat, are predominately scattered in rural territories with small villages, poor in infrastructures at risks of rural depopulation and ageing of their local communities (Festuccia, 2013).

Assessing the allocation of financial subsides disbursed by the Common Agricultural Policy in the second and also in first pillar, some scholars have argued that direct and indirect payments and aids towards farmers have had a divergent impact on farm efficiency in several European countries (Zhu and Lansink, 2010). The Romanian National Rural Development Plan, both in the past seven year time 2007–2013 and also in the further period of time 2014–2020, was and it also is a good opportunity to reduce the out emigration from the countryside throughout an integrated economic development in rural territories which should necessary compensate, by the second pillar of the Common Agricultural Policy the role of farmers in protecting rural areas against socio-economic marginalization, acknowledging as well needs of rural inhabitants and an arising economic growth of Romanian people who live in rural spaces (Chiritescu, 2011).

In general, the aim of the European Union and national authorities is to implement the level of competitiveness of nations even if in Romania some socio-economic disparities among counties and regions are so widespread and they tend to arise over the time with a modest positive impact of financial subsidies allocated by the European Union in improving the level of Gross Domestic Product in the countryside and the crop specialization in different agrarian Romanian areas (Chilian et al., 2014; Bouayad-Agha et al., 2013). Lots of authors have pointed out in several Romanian counties as a poor level of Gross Domestic Product correlates to the highest levels of out emigration from rural territories (Pauna et al., 2015).

Several Romanian scholars have investigated by a quantitative approach territorial imbalances, focusing mainly their attention on the variables Gross Domestic Product, innovation-competitiveness and unemployment, both assessing time series of data and also comparing Romania to other European countries using also the Moran's index (Mare and Pop, 2011; Pauna et al., 2015; Chilian et al., 2014; Lincaru et al., 2014). In general, the field of study of these above mentioned authors has been tailored in order to assess by the Moran's index the spatial autocorrelation on territorial statistical units of investigation such as NUTS 2 and NUTS 3.

3. MATERIAL AND METHOD

In this research it has used two quantitative approaches in order to estimate the correlation among GDP, agrarian GDP and rural out emigration by the Moran's index (Moran, 1950); the further stage of this study has been focused in assessing main relationships among financial subsidies allocated by the second pillar of the CAP and rural depopulation by the Self Organizing Maps proposed by Kohonen in the 1980s (Kohonen, 2001).

The Moran's index is a quantitative methods aimed at assessing the spatial autocorrelation between two or more socio-economic variables (Moran, 1950). The main purpose of the spatial autocorrelation is to define a territorial cluster with similar values of assessed parameters (Anselin and Ray, 1991; Moran, 1950); hence, if values of parameters are spatially located they assume a positive value due to a direct and positive autocorrelation. By contrast, uneven values imply a spatial negative autocorrelation.

In mathematical term the index proposed by Moran in 1950 can be written as:

$$I = \frac{N\sum_i\sum_j W_{i,j}(X_i - \overline{X})(X_j - \overline{X})}{(\sum_i\sum_j W_{i,j})\sum_i(X_i - \overline{X})^2}$$

N is the number of geographical areas
X_i is the value of X variable in the i area
X_j is the value of X variable in the j area
W_{ij} is a weigh in connection to the distance between i-j areas
(X_i – $\overline{X}$) and (X_j – $\overline{X}$) are the standard deviation from the average value in investigated variables.

In general, W_{ij} is a matrix of weights like a binary matrix i,j where one uses weights inversely proportional to the spatial distance between the area i and the area j when i is different from j. According to Moran 1950, W_{ij} is an adjacent matrix if the i area is on the border to j area assuming a value close to 1 otherwise the value is 0 which presupposes the presence of a spatial pattern due to a random

effect. Usually the Moran's index has a nexus to the Moran's scatterplot which is a typology of chart which links the normalised variable x_i to the spatial lag of the analysed and normalized variable (Wx_i). In this case the Moran's index is defined as an angular coefficient of two variables put in relation in the Moran's scatterplot which are able to point out the main linear relationships in some assessed variables (Moran, 1950; Anselin and Ray, 1991). If the angular coefficient is 0 dots in the chart are dispersed in all quadrants which implies no correlation between investigated variable; otherwise, when the value is not close to zero, it is possible found different typologies of correlations. Summing up, the index proposed by Moran assumes a value from –1 to +1; the value equal to $\pm$ 1 implies a spatial clustering and a positive or negative spatial autocorrelation. In this paper all data have been assessed using the software GeoDa 1.8.14 in order to assess the Moran's index. The second stage of this paper has used the Self-Organizing Maps (SOMs) or Kohonen's maps with the purpose to assess if financial subsidies allocated by the second pillar of the CAP correlates to the variable rural depopulation in the Romanian countryside.

The SOM is based on a method of unsupervised learning in a space with a limited size provided that the topological properties of input space or stimulus that comes from the outside (Kohonen, 2001). The Self-Organizing Map is a neural network whose output neurons are arranged in grids based on a lower dimension (Haykin, 1999). Each input or stimulus is consequently connected to the others neurons part of the output that is a response of a stimulus. The weights assigned to the neurons are initialized either as random numbers or as small values sampled uniformly from a subspace crossed by the two wider eigenvectors main components hence, initial weights are a good approximation of the weights in the SOM (Kasky and Kohonen, 1996; Kohonen, 2001, Galluzzo, 2015b).

In our case study, using the free software Orange Canvas 2.7, the training model has used a competitive learning approach hence, its Euclidean distance has been assessed from all weight vectors (Kohonen, 2001). The neuron with a weight vector most similar to the input is called the Best Matching Unit (BMU) and the weights of the BMU and neurons close to it in the SOM hexagon are the closest to the input vector. The intensity of the approach process decreases over time and it is in function of the distance of neurons from the BMU. The formula used for updating the weights of a neuron Wv has been (Kohonen, 2001):

$$Wv\ (t+1) = Wv\ (t) + \Theta\ (v, t)\ \alpha\ (t)\ (D\ (t) – Wv\ (t)$$

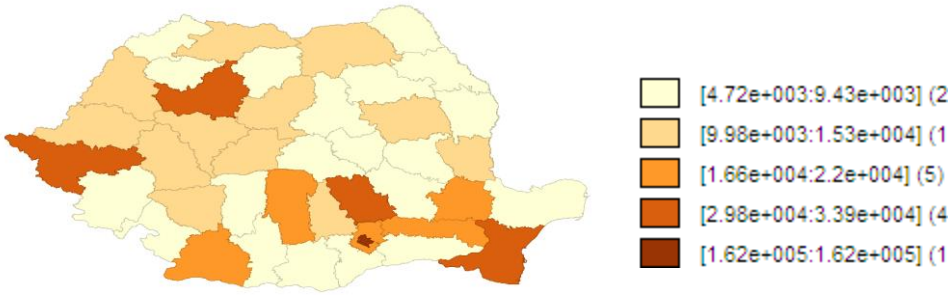
where α (t) is the monotonous descending learning coefficient
D (t) is the input vector.

The function that defines the neighbourhood Θ (v, t) depends on the distance in the hexagon between the BMU and the neuron v. The Kohonen's maps is a

network of relationships identified by a pattern shaped by two layers, connected to each other (Mehmood et al., 2011; Kohonen, 2001); one layer is made up by input and the other layer commonly called Kohonen's layer is constituted by the output (Kohonen, 2001). In the layer of output neurons there is a unique winner neuron close enough to the BMU, that is the winner neuron which takes all; hence, as a consequence of a system of interactions and lateral inhibitions and excitation, in function of the distance from the winner neuron, some neurons close to the winner are exited and other neurons far more from the winner neuron are inhibited generating a function similar to a Mexican hat (Kohonen, 2001).

4. RESULTS AND DISCUSSIONS

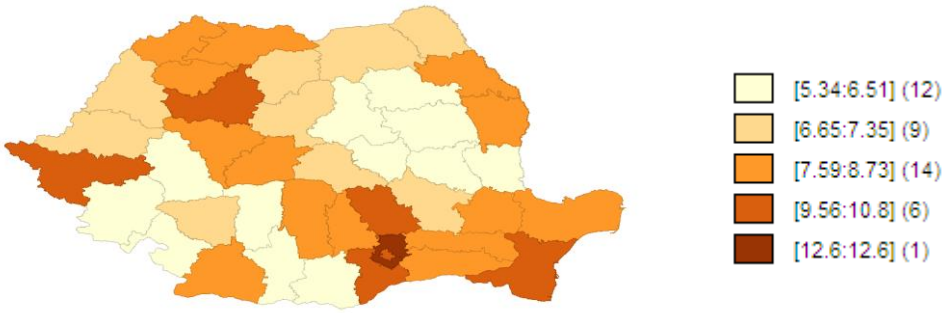
The Municipality of Bucharest has pointed out the highest level of Gross Domestic Product in 2014 such as the counties pinpointed close to the capital of Romania (Figure 1). In some Romanian counties located nearby to the border of Moldova, as Botosani, Iasi and Vaslui, and near to the Bulgarian frontier, such as Calarasi, Giurgiu, Olt and Teleorman, where agriculture is one of predominate economic activity, characterised by modest farms in terms of utilized agricultural areas, the level of GDP in 2014 has been very scarce and, with the exception of Iasi, under the average equal to 11.300 million of Lei national currency.



Source: Calculations using data from the Romanian National Institute of Statistics

Figure 1. GDP in Romanian counties in current value year 2014

In general, comparing the variation of GDP in 2014 over the baseline year 2000 in the Ilfov county there has been the highest increase of Gross Domestic Product equal to twelve times than the level of GDP assessed in 2000 and 12 Romanian counties out of 42 GDP arose by 5 times compared to 2000 (Figure 2).



Source: Calculations using data from the Romanian National Institute of Statistics

Figure 2. Variations of GDP year 2014 over the year 2000
in Romanian counties

Findings about the correlation between the GDP and agricultural areas, time series from 1990 to 2014, in all Romanian counties have pointed out the highest positive values in Buzau and Dolj (Table 1).

Table 1

Main correlations between emigration and agricultural area in Romanian counties

County	Correlation	County	Correlation
Bihor	0,195*	Galati	0,055
Bistrita-Nasaud	–0,390*	Tulcea	–0,114
Cluj	–0,353*	Vrancea	0,429*
Maramures	0,246*	Arges	–0,107
Satu Mare	0,005	Calarasi	0,210*
Salaj	–0,118	Dambovita	–0,134
Alba	–0,262*	Giurgiu	–0,625*
Brasov	0,320*	Ialomita	0,050
Covasna	0,374*	Prahova	0,071
Harghita	0,238*	Teleorman	0,204*
Mures	–0,367*	Ilfov	0,177*
Sibiu	0,358*	Bucharest	–0,138
Bacau	–0,685*	Dolj	0,451*
Botosani	0,357*	Gorj	–0,019
Iasi	0,372*	Mehedinti	–0,150*
Neamt	0,226*	Olt	–0,404*
Suceava	–0,467*	Valcea	–0,134
Vaslui	0,295*	Arad	0,151*
Braila	0,195*	Caras-Severin	0,177*
Buzau	0,731*	Hunedoara	0,406*
Constanta	-0,109	Timis	0,251*

* significance at 5%

Source: Author's calculations using data from the Romanian National Institute of Statistics

Outcomes correlating permanent emigration to the level of Gross Domestic Product in current value in all Romanian counties since 1990 to 2014 have pointed out a direct correlation equal to 0.310 with a level of significance at 5% with the lowest value found out in Bihor county instead the highest has been pointed out in the county of Vaslui (Table 2). Summing up, findings have pointed out in 2014 an increase of GDP in current value and a percentage incidence of agricultural GDP on the national GDP close to 21% with the lowest values assessed in Cluj and Bucharest and the highest estimated in Calarasi and Ialomita counties.

Table 2

Main correlations between permanent emigration and GDP current value in all Romanian counties

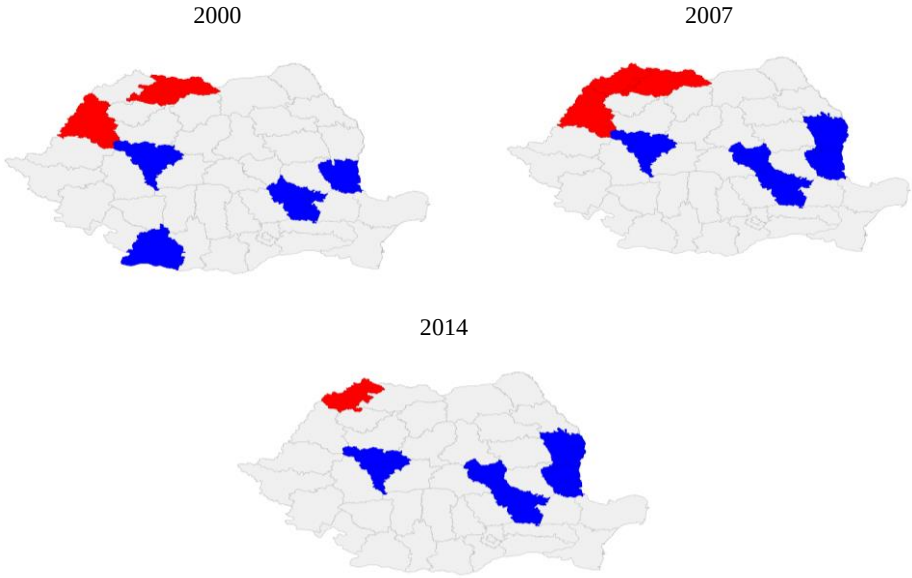
County	Correlation	County	Correlation
Bihor	–0.773*	Galati	0.724*
Bistrita-Nasaud	0.551*	Tulcea	0.680*
Cluj	–0.645*	Vrancea	–0.263*
Maramures	0.168	Arges	0.321*
Satu Mare	–0.580*	Calarasi	0.609*
Salaj	–0.571*	Dambovita	0.657*
Alba	0.391*	Giurgiu	0.590*
Brasov	–0.692*	Ialomita	0.448*
Covasna	–0.222	Prahova	0.311*
Harghita	–0.502*	Teleorman	0.628*
Mures	–0.676*	Ilfov	0.600*
Sibiu	–0.217	Bucharest	0.467*
Bacau	0.247	Dolj	0.197
Botosani	0.695*	Gorj	0.753*
Iasi	0.609*	Mehedinti	0.331*
Neamt	–0.126	Olt	0.701*
Suceava	0.203	Valcea	–0.324*
Vaslui	0.766*	Arad	0.056
Braila	0.640*	Caras-Severin	0.111
Buzau	0.589*	Hunedoara	0.645*
Constanta	0.517*	Timis	0.116

* significance at 5%

Source: Author's calculations using data from the Romanian National Institute of Statistics

Addressing the attention to the rural out emigration in Romania over the time of investigation (2000–2014), results have highlighted a consolidation of this downside which has involved predominantly Romanian counties marked out by the highest levels of incidence of agrarian GDP on the Gross Domestic Product (Figure 3). In particular, Romanian counties in the region of Maramures have shown the highest level of rural out emigration corroborating the financial and political efforts of the European Union in lessening and in contrasting rural exodus from the

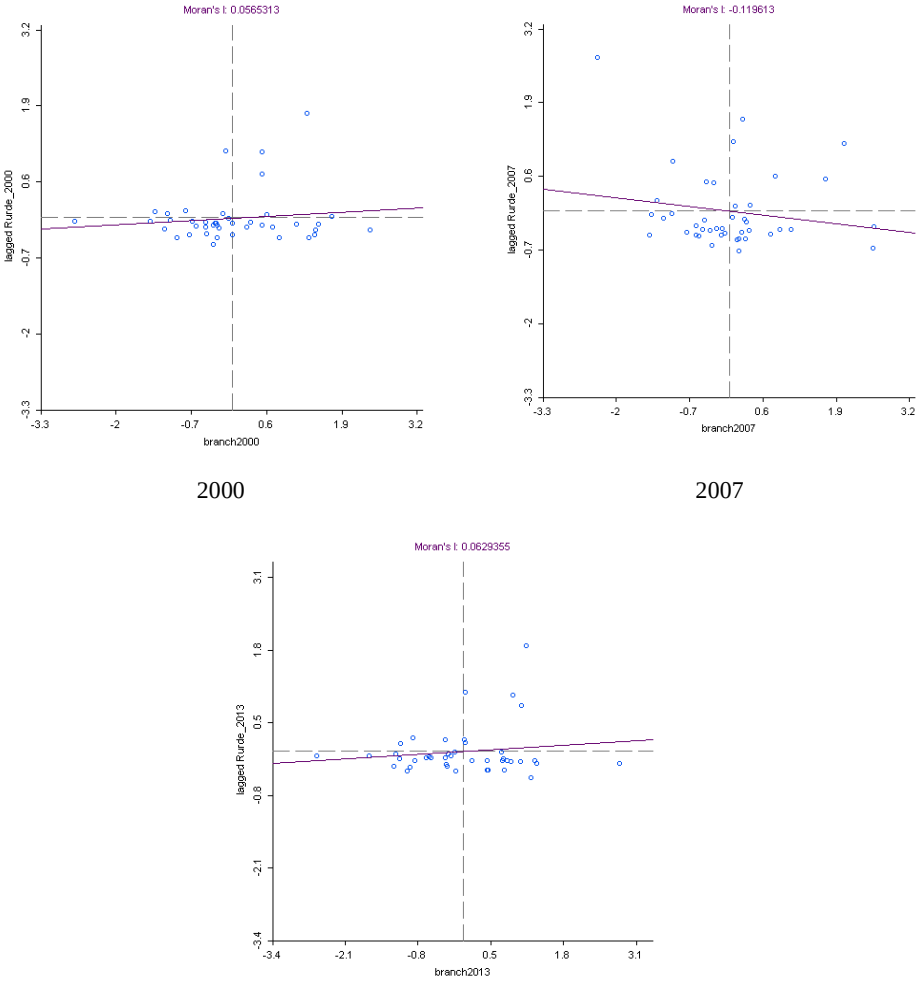
countryside by the allocation of specific financial subsidies paid by the Common Agricultural Policy with the purpose to promote an integrated rural development process, stimulating *in situ* agrarian enterprises, agritourism and other economic activities linked to the rural space. This is particularly true comparing the data of emigration in 2007 to the data in 2014; in fact, if in 2007 there was the highest level of rural emigration in three northern Romanian counties, in 2014 only in one Romanian counties out of 42 there has been the highest level of rural out emigration.



Source: Calculations using data from the Romanian National Institute of Statistics

Figure 3. Evolution of rural emigration from the Romanian countryside.
In red are regions with the highest value in blue the poorest one.

Spatial bivariate Moran's index analysis in 2000, considering the variables GDP in the primary sector and rural emigration in all Romanian counties, has pointed out a positive value of spatial autocorrelation with a statistic value equal to 0.056 higher than E[I] equal to –0.0244; hence, results in 2000 have been statistically significant corroborating a direct correlation between these two variable (Figure 4). Focusing the attention on the estimation of the spatial bivariate Moran's index in 2007, outcomes have highlighted a negative spatial autocorrelation between the variables agrarian GDP and rural depopulation with a statistics value equal to –0.119 higher than E[I] equal to –0.0244. In 2013 spatial bivariate Moran's index analysis has pointed out a positive spatial autocorrelation with statistic's value equal to 0.062 which has been statistically significant because its value is higher than E[I] equal to –0.0244 (Figure 4).



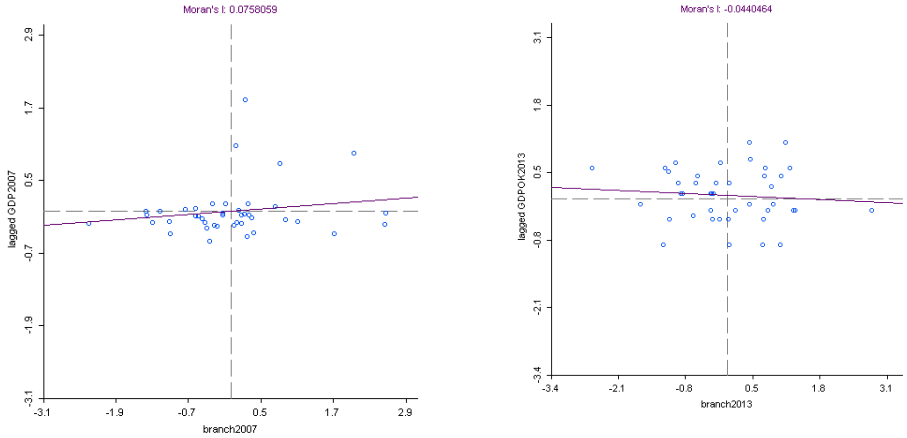
2000 2007

2014

Source: Calculations using data from the Romanian National Institute of Statistics

Figure 4. Agricultural GDP spatial auto correlation and rural emigration over the time 2000–2014 in Romanian counties.

Focusing the analysis on the variables GDP produced in the primary sector and the total Gross Domestic Product in Romanian counties, spatial bivariate Moran's index analysis in 2007 has pointed out a positive spatial autocorrelation with statistical value equal to 0.0758 higher than E[I] equal to –0.0244 (Figure 5). Findings in 2014 have instead underlined a negative spatial autocorrelation with statistical value close to –0.044.

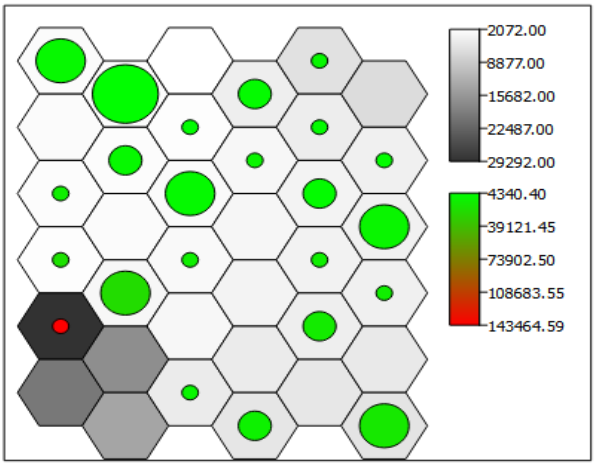


2007 2014

Source: Calculations using data from the Romanian National Institute of Statistics

Figure 5. GDP in the primary sector and total GDP in Romania in 2007 and 2014 spatial autocorrelation.

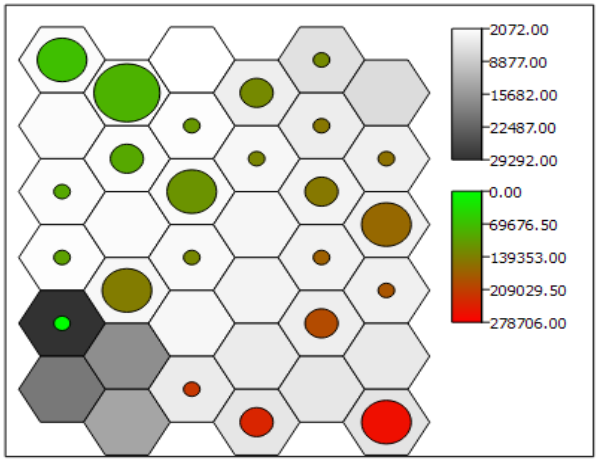
The Kohonen's map has pointed out a direct correlation between the permanent emigration and Gross Domestic Product (Figure 6); hence, the GDP is not a good deterrent in halting the emigration due to a different distribution among the counties and citizens. In fact, findings have particularly corroborated that in Romanian counties there is an uneven distribution of wealth, estimated as a dummy variable of GDP, which has been greatly unbalanced able to foster permanent emigration.



Source: Calculations using data from the Romanian National Institute of Statistics

Figure 6. SOM correlating total GDP (colored scale) in Romanian counties and permanent emigration (grey scale).

The role of financial subsidies allocated by the second pillar of the CAP are fundamental in halting permanent emigration (Figure 7); in fact, in Romanian counties receiving poor amount in payments for rural development have suffered of an intense phenomenon of permanent emigration.



Source: Calculations using data from the Romanian National Institute of Statistics and FADN

Figure 7. Kohonen's map correlating permanent emigration (grey scale) and financial subsidies allocated by the second pillar of the CAP (NRDP) in seven year time 2007–2013 (colored scale)

5. CONCLUSIONS

The Moran's index has been an useful method in order to estimate the evolution and the main correlations among GDP, Gross Domestic Product in the primary sector and the variable rural depopulation in all Romanian counties. Findings have pointed out a drop in permanent emigration, predominately concentrated in rural poor areas, as a consequence of an improvement in socio-economic conditions and in the productive fabric due to specific financial supports allocated by the European Union both before and afterward the enlargement of the European Union in 2007. Outcomes have pointed out an uneven distribution of wealth among Romanian counties and consequently in rural areas even if the Gross Domestic Product is not the unique variable able to contrast the emigration compared to the actions of economic support arranged by the European Union. These latter have carried out a more intense effect in reducing permanent emigration than the variables total GDP or agricultural Gross Domestic Product.

The European Union financial subsidies allocated by the Common Agricultural Policy have tried to reduce the out rural emigration from the Romanian countryside by a diversification in farms throughout agritourism, rural tourism and craftmade enterprises; main results in this paper have pointed out as higher is the emigration

from the countryside more intensive has been the allocation of financial subsidies finalised in lessening the rural depopulation. In general, Romanian counties located close to the border of other states member of the European Union have highlighted the highest level of rural depopulation due to an attractive effect of other states able to offer other job opportunities.

Summing up, financial aids and subsidies towards the rural development and job creation by local enterprises financed by the Common Agricultural Policy have to implement an agricultural and rural diversification throughout the agritourism and rural tourism in the countryside.

Main findings in this analysis have pointed out as far more than 90% of Romanian agricultural enterprises are characterized by a poor size in terms of agricultural areas which has a negative impact both on the level of investments and also on technical-economic efficiency.

Farms with a modest level of land capital receives limited financial supports allocated by the EU which are not able to implement farm's performances; hence, the National Rural Development Plan should put into practice actions aimed at promoting a farm's diversification and an improvement of infrastructures in particular in terms of skills and competence in farmers aimed at lessening the socio-economic divide and inequality among Romanian counties.

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