Social Resilience of Territorial Systems. A New Approach

PAUL-RĂZVAN ŞERBAN, Ioan IANOŞ
University of Bucharest, Faculty of Geography
1. N. Bălcescu Boulevard, Bucharest
Romania
paulrazvanserban@yahoo.co.uk

Abstract

Geography uses resilience to explain the mechanisms of the adaptation of components to change within the territorial system. In this study we aim to bring some clarifications of how the socio-economic system's components relate to each other and evolve, in order to become stronger against fluctuations and disturbances they are subjected to. Therefore, for the first time in geographical studies, we have decided to divide the two components, namely social and economic, to analyze them in their interaction, social resilience meaning social adaptation to the economic dynamics. For this we have chosen the Romania case. Apparent consistency is betrayed by the operation of the two components and the difficulty with which one responds to changes in the other. In our opinion, the unemployment rate is the most sensitive interface between the components of the social and economic systems, reacting almost instantly. In opposition, the response time of the other social components is much longer, resulting in a reduction of the impact of economic changes. We proceed to determining social resilience in Romania, at development region and county level, using the data grouped into 7 variables (three economic variables: employment by economic sector - primary, secondary, tertiary, and three social variables: settling of domicile, departures from the domicile, net settling of domicile, plus the unemployment rate), at each spatial level mentioned above, for the 1991-2012 period. At county or regional level, connections between components change at once the scale and decision makers at different spatial levels need to work together in applying economic development policies.

Key words: social resilience, social-economic systems, Romania

JEL Classification: J6, O52, R23

1 Introduction

Change is ubiquitous in social-economic systems where components not only adapt but involve voluntary action of the people (to anticipate or to meet changes emerged), unlike the ecologic systems, according to Futuyama (1979). Adaptation in natural systems usually require genetic evolution, while human action (in socio-economic systems) can anticipate change and can respond quickly to it (Smit, Wandel, 2006).

The idea we started from was the need for a different approach of resilience against existing geographical and ecological studies that consider only the links between human and environmental components. In contrast, dynamics dysfunction that occurs in socio-economic systems as a whole, requires a resilience approach based on economic and social components. Berkes and Seixas (2005) assessed that, at certain thresholds, switches in a system [community] make the system move from one state to another. This dimension has several important implications. First, the balance is not the goal, but rather persistence developed through adaptive renewal cycles stimulated by change (Gunderson & Holling, 2002). Second, community resilience requires self-organization experiment and learning capacity. Third, developing resilience increases community capacity to grow in dynamic environments that

are characterized by unpredictability and surprise (Walker, Holling, Carpenter, & Kinzig, 2004). Therefore, Folke, Colding and Berkes (2003) state that communities must accept that change is inevitable and must adapt to live with uncertainty and surprise. Resilience change perspective from the attempts to control changes in systems assumed to be stable to the management of socio-ecological systems capacity to cope with, adapt to and configure change (Berkes et al, 2003). To summarize, internal and external change is a constant in the community. Social scientists emphasized the capacity of communities to manage change, not to maintain the status quo (Donoghue, Sturtevant, 2007). However, local, state and federal government, has a responsibility to help minimize the negative effects of change or at least to assist citizens in preparing for these effects (Harris et al., 2000).

2 Materials and Methods

This study aims to understand the operating mechanisms of social-economic systems, determining the size of links and the effects of these connections between economic and social components (by correlation of dynamics when the system recovers following a disturbance in its ways of evolution) to obtain information on social resilience. In addition, differentiation of the two components of the social-economic system (the social and economic component) is necessary, given the different goals pursued by social and economic activities. Therefore, the analysis focuses on some points where resilience is going to emerge.

We started by delimiting milestones in the evolution of social-economic system, then we proceeded to determine the social resilience in Romania (at development region level and county level) by using data grouped into seven variables (three economic variables: employment by economic sectors - primary, secondary, tertiary, and three social variables: settling of domicile, departures from the domicile, net settling of domicile, plus the unemployment rate), at each spatial level mentioned above, for the 1991-2012 period.

As a methodology, we used Principal Component Analysis and Hierarchical Ascending Classification for grouping variables into principal components and classes using specific criteria analysis for each of them and highlighting spatial, temporal and causal links between them.

3 Results and discussions

As we mentioned above, we will start by delimiting the major stages which have reflected in changes at components level in Romanian social-economic system evolution. For delimiting purposes, we used unemployment rate in the period 1991-2012 (Figure 1).

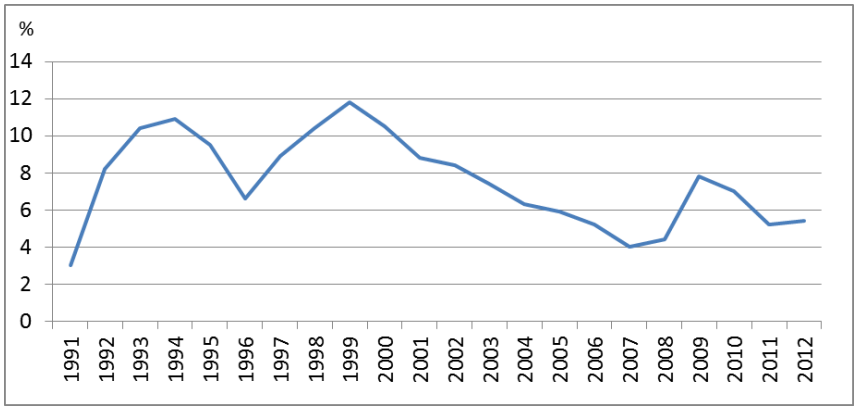

Fig. 1 Evolution of unemployment rate in Romania during 1991-2012
Source: National Institute of Statistics

The three stages where economic structure showed major changes were: first phase 1991-1997 was dominated by the economic downturn; the second stage overlaps largely growth period: 1997-2008; the third stage which began in 2008 is based on the economic and financial crisis, being currently felt in some economic sectors.

If the first stage meant a long process of deindustrialization and the rethinking of the primary sector, the next stage has been filling the void left by the secondary sector through the tertiary sector expansion, and the last stage meant restructuring of construction sector. Each stage starts by increasing unemployment. This increase was maintained as long as the causes that triggered it were kept (restructuring economic sector/sectors), after which there was a time when the unemployment rate dynamics has switched, the growth being replaced by reduction. Those moments are considered to be the onset of resilience, for Romania occuring in 1995, 2000 and 2010. However, we must make a statement regarding the evolution of the total number of employed in the three sectors. Although the unemployment rate has been declining for each of these three years as reported to the previous year, the employment decreased in 1995 compared to 1994 and was constant in 2010 compared to 2009, only in 2000 employment increased compared to 1999. The explanations are: in 1995 industry restructuring meant a workforce vacation that was retired early, not being framed unemployed; on the other hand, in 2010 the stagnation of employment meant a reduction in the unemployment rate since the reporting was done in a declining active population. We will return to these issues later, when analyzing the data.

Returning to our methodological approach, we divided the six variables into two categories, as follows: economic variables - employment by economic sectors: primary, secondary, and tertiary) and social variables (settling of domicile, departures from the domicile, net settling of domicile). If social variables refer to population movement during the year (1995, 2000, and 2010), economic variables were calculated as the difference between the variable in reference year and the one in previous year, to determine changes in the reference year (eg. for employment in the primary sector we have made the difference between the values in 1995 and 1994). Dividing variables into two aims comparing the spatial distribution of the evolution of the two types of components of the social-economic system, components that are interrelated and mutually determined through goals and decisions. Distributions and evolution of social variables are consequences of population decisions expressed in search of a job in another county or region (to avoid unemployment). On the other hand, entrepreneurship implies expansion, restriction or relocation of activities aimed to maximize profits, with both spatial and temporal differences in relation to social variables, differences highlighted by

differences in correlation. Spatial and temporal correlation of social and economic variables, when the unemployment rate began to fall, we called *social resilience*.

A first general information about social resilience we can get through the application of Principal Component Analysis (PCA). By grouping variables around the principal components we want to know the social affinities to the economic component and to what extent the spatial structure of the county can be reproduced, to create a self-similar regional structure. This can have great practical importance in creating national policies favorable to the development of effective economic profile in terms of resource consumption. This reduces the likelihood of spending money in ways less effective. Before running PCA, let's take a look on the evolution of variables over the three reference years. Economic variables were distinguished by a negative trend in 1995 (-500,000 employees), the highest contribution having primary sector and secondary sector with 400,000 respectively 200,000 diminution compared to the previous year. Only a small proportion of redundant have found a job in the tertiary sector (100,000). Population movements (departures or settlings of domicile) included 300,000 people each. In 2000 the primary sector played a positive role in the economy (+100,000 employees) alongside the tertiary sector (+150,000 employees). Secondary sector layoffs eased, being around 50,000. Departures or settlings of domicile dropped to 200,000. Finally, in 2010, there was not observed a significant change in the number of employees compared to the previous year. Population movements rose to about 500,000 people. These data will help us to better understand how variables are grouped in the PCA and gives us additional information for the interpretation of classes of variables in the Hierarchical Ascendant Classification based on calculating the mean and standard deviations.

Running ACP for the three reference years (1995, 2000, 2010), at the level of the 42 counties, we obtained the following results:

- For 1995 we see that most variables (except for employees in the primary sector and net settling of domicile) are grouped around the first principal component (settling the domicile). Thus, the departures and settling of domicile are correlated with entrepreneurial decisions in the secondary and tertiary sector and in these cases we speak about social resilience in the 42 counties as a whole. Regarding net settling of domicile, the explanation for correlation with the primary sector decisions must be based on the importance of this sector in the economic transformations produced in that year.
- For 2000 the situation was substantially similar. We see net settling of domicile migration from the second principal component to the first principal component and that occurred considering the reduction of importance of the primary sector in the economic transformations in that year.
- In 2010 the situation has changed substantially: departures and settling of domicile are presented in the first principal component with employees in the secondary sector; net settling of domicile form the second principal component with employees in the tertiary sector; the third principal component is employees in the primary sector. Thus, territorial movement of population was resilient only for secondary sector, while changes in the tertiary sector were "absorbed" by net settling of domicile.

Relating to regional level, PCA results for the three years were:

- In 1995 the evolutions of economic variables are grouped in the first principal component while social variables stood out in the second principal component; this lack of correlation between the two variables is interpreted as a failure of social resilience.

- In 2000 the departures and settling of domicile were in the first principal component with the evolution of the employees in the primary sector, the population being resilient to this sector. Resilience to the other economic sectors exist only with net settling of domicile.
- In 2010 the departures and settling of domicile were correlated with the employees in the secondary sector and net settling of domicile were correlated with the other two economic sectors.

As Harris et al. (2000) stated, community has degrees of resilience that change over time, depending on the community background, external factors that influence it and its ability to respond and develop. First, construction of community stability is disputed. Change, not equilibrium, is the constant.

If the above information are related to the Romanian counties as a whole, we used Hierarchical Ascendant Classification (HAC) in order to calculate the social resilience for each county or region. With HAC we group the variables into classes by reporting to the mean of variable with standard deviation. This way is much more conclusive than achieving analysis with raw data or transforming the data in percentages. Neither of these two modes of analysis are not reported in all regions of Romania but individually at territorial level at which data are available (county, region). So, using the standard deviation underlying the HAC, data are integrated in country level, thereby reducing the effect of regional relativity.

To highlight the territorial diversity in terms of social resilience existence and size, in HAC we preferred to keep as many classes as possible. In this way we can see the relationship between social and economic variables more accurately. We can speak about many degrees of resilience: very high, high, medium, low, very low (comparing mean distances of variables). We can also talk of resilience for one or more social variables related to one or more economic variables. The values of economic variables close to the mean cause a higher social resilience while sudden changes in economic components can not be followed by populations.

In the year 1995 the secondary sector influenced not too much social resilience, as most classes have shown an evolution close to mean at county level. It can be seen, on the other hand, that a pronounced negative trend of two economic sectors has reduced the resilience. To analyze the degree of social resilience in 1995, we considered the distribution of variables in groups of principal components: departures from the domicile and settling of domicile were compared with the changes in the number of employees in the two economical sectors from the first principal component (the secondary and tertiary sector), while net settling of domicile was compared with the evolution of employees in the primary sector.

Regarding the resilience degrees, it was observed the following situation (figure 2): counties with very high resilience: Class 4; high resilience: Class 3, Class 6, Class 7; average resilience: Class 1; low resilience: Class 5; very low resilience: Class 2.

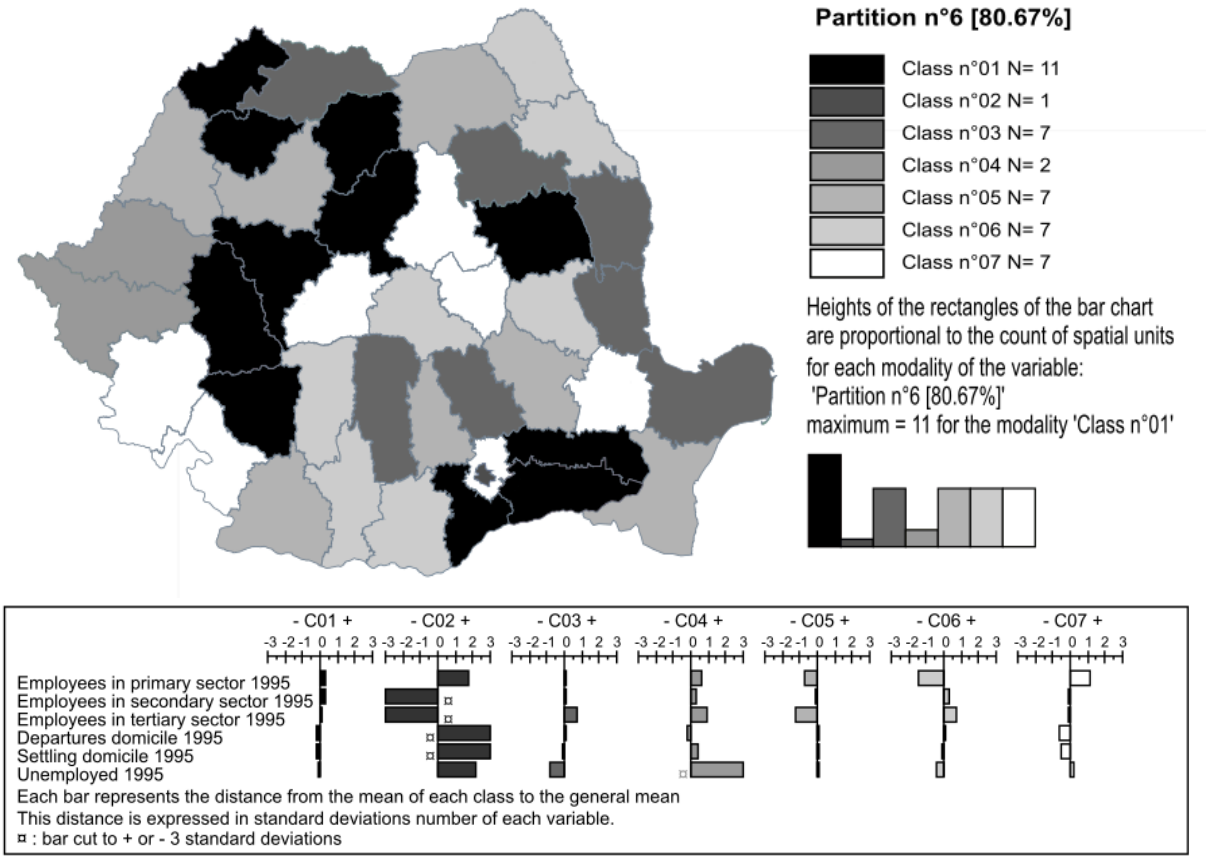

Fig. 2 HAC at county level in 1995
Source: National Institute of Statistics. Made with Philcarto (http://philcarto.free.fr)

Let us now remind that the primary and secondary sector were restructuring, losing an important part of the workforce. Low population resilience in relation to these sectors meant accepting early retirement instead of searching for a job in other county.

At development region level, employees number by economic sectors fluctuated much stronger than at the county level. The resilience of regions appear as follows, considering that, after applying PCA, social and economic variables were grouped into different principal components (figure 3): regions with very high resilience: no; high resilience: Class 2; average resilience: Class 1; low resilience: Class 4; very low resilience: Class 3.

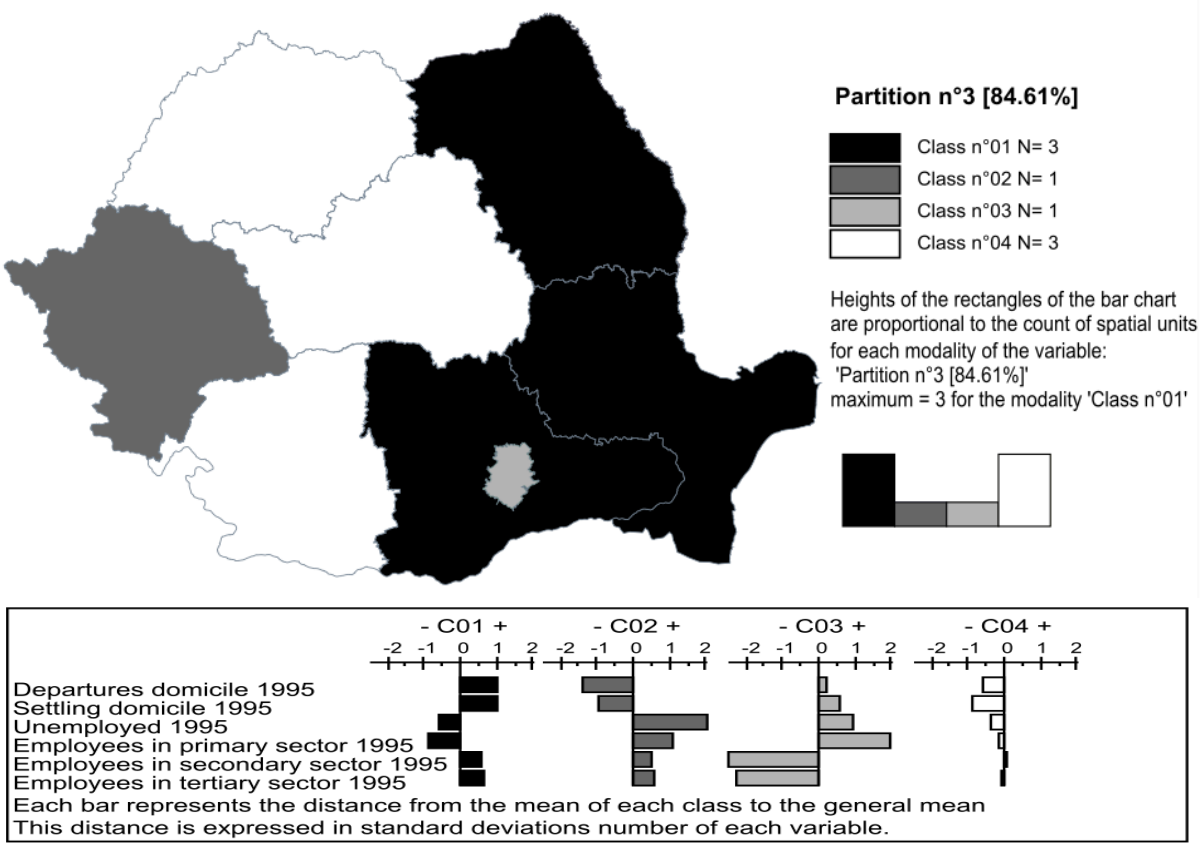

Fig. 3 HAC at regional level in 1995

Source: National Institute of Statistics. Made with Philcarto (http://philcarto.free.fr)

In 2000 the situation changed, the tertiary sector is present in almost all classes with evolutions close to mean, the other two sectors showed significant variations. In order to determine the degree of social resilience in 2000, departures from the domicile, settling of domicile and net settling of domicile were compared with changes in the number of employees in the two sectors of the economy from the first principal component: the secondary and tertiary sector.

Regarding the resilience degree, the following situation was observed (figure 4): counties with very high resilience: no; high resilience: Class 3; average resilience: Class 1, Class 4; low resilience: Class 5, Class 6, Class 7; very low resilience: Class 2.

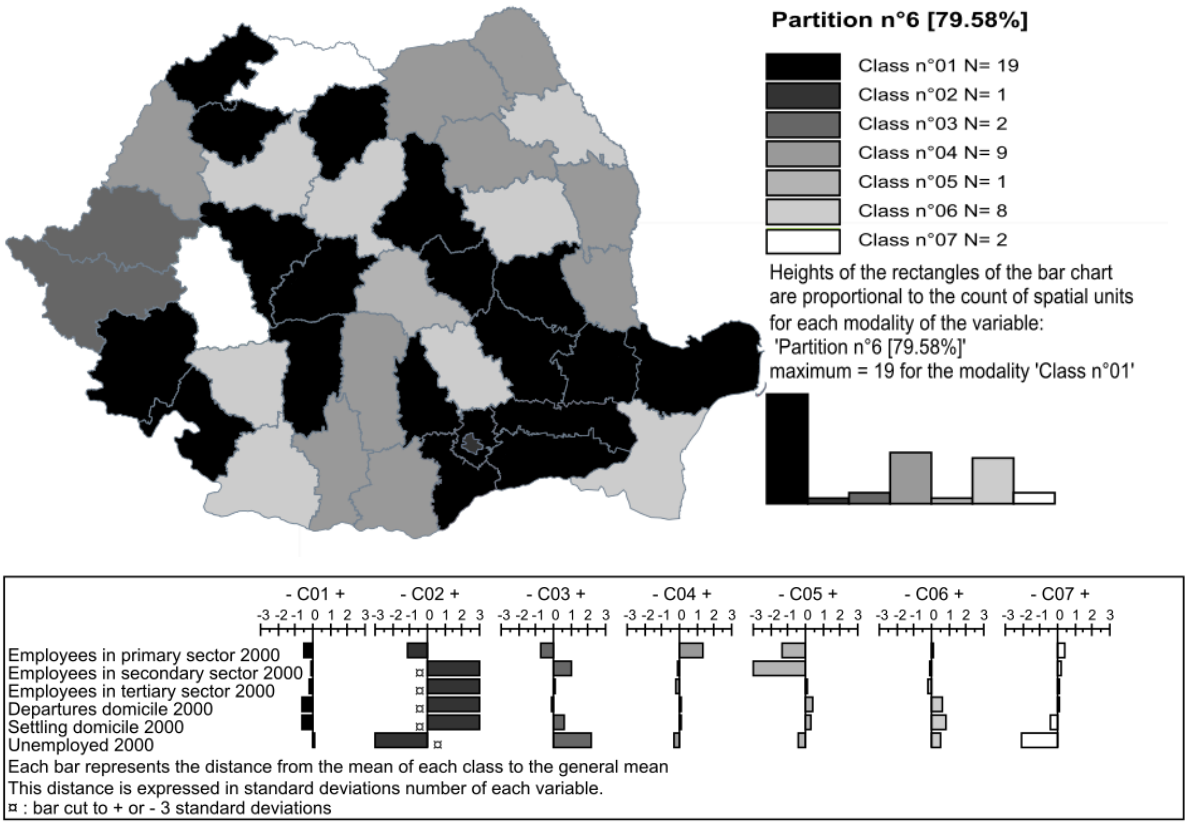

Fig. 4 HAC at county level in 2000
Source: National Institute of Statistics. Made with Philcarto (http://philcarto.free.fr)

At regional level, tertiary sector had also no significant deviations from the mean in the classes of variables, therefore, considered separately, not played an important role on social resilience. However, to determine the resilience we started by grouping variables into principal components: departures from the domicile and settling of domicile were in the first principal component, along with the evolution of the employees in the primary sector; net settling of domicile were in the second principal component along with the evolution of the employees in the secondary and tertiary sectors, resulting in the following (figure 5): regions with very high resilience: no; high resilience: Class 1; average resilience: Class 2; low resilience: Class 3, Class 4; very low resilience: no.

Although the evolutions of the three economic sectors were not significant for the 42 counties as whole in 2010, however, the tertiary sector suffered the biggest changes at the county level, taken individually, while the other economic sectors had less influence in this regard.

Determining the degree of social resilience in 2010 started from grouping of variables into principal components: departures from the domicile and settling of domicile were presented in the first principal component, along with the evolution of employees in the secondary sector; net settling of domicile formed the second principal component with the evolution of employees in the tertiary sector.

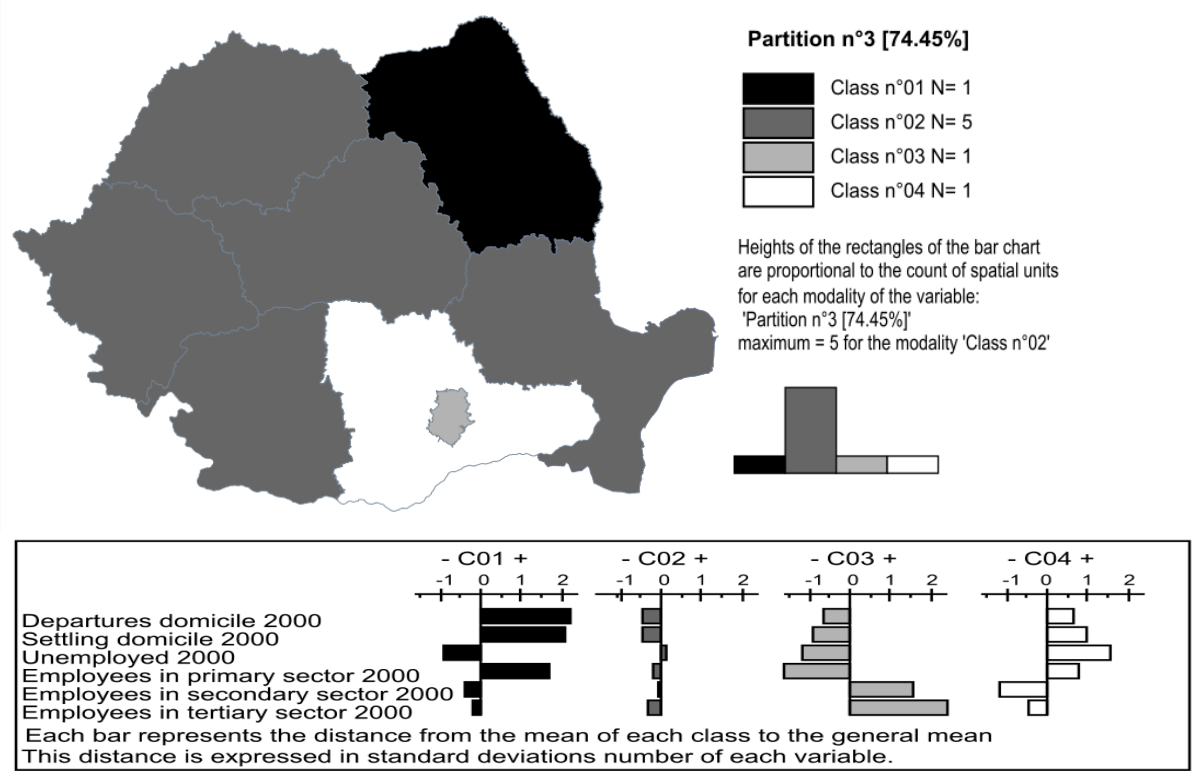

Fig. 5 HAC at regional level in 2000

Source: National Institute of Statistics. Made with Philcarto (http://philcarto.free.fr)

Regarding the resilience degree was the following situation (figure 6):

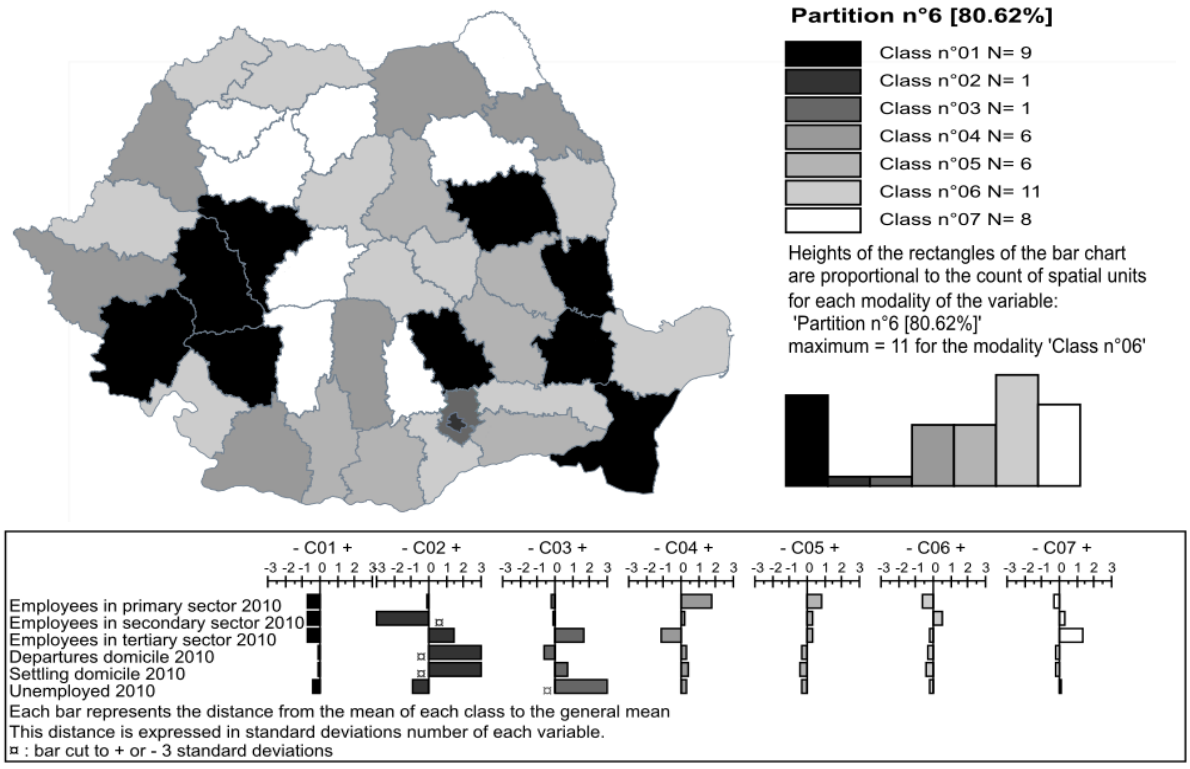

Fig. 6 HAC at county level in 2010

Source: National Institute of Statistics. Made with Philcarto (http://philcarto.free.fr)

counties with very high resilience: no; high resilience: Class 3, Class 2; average resilience: Class 1, Class 4, Class 6; low resilience: Class 7, Class 5; very low resilience: no.

At regions level, low fluctuations of tertiary sector remained. The resilience of regions appears as follows, given the grouping of variables into principal components (departures from the domicile and settling of domicile were correlated with the evolution of employees in the secondary sector and net settling of domicile was correlated with the evolution of employees in the other two sectors of the economy) (figure 7): regions with very high resilience: no; high resilience: Class 1, Class 3; average resilience: Class 4; low resilience: Class 2; very low resilience: no

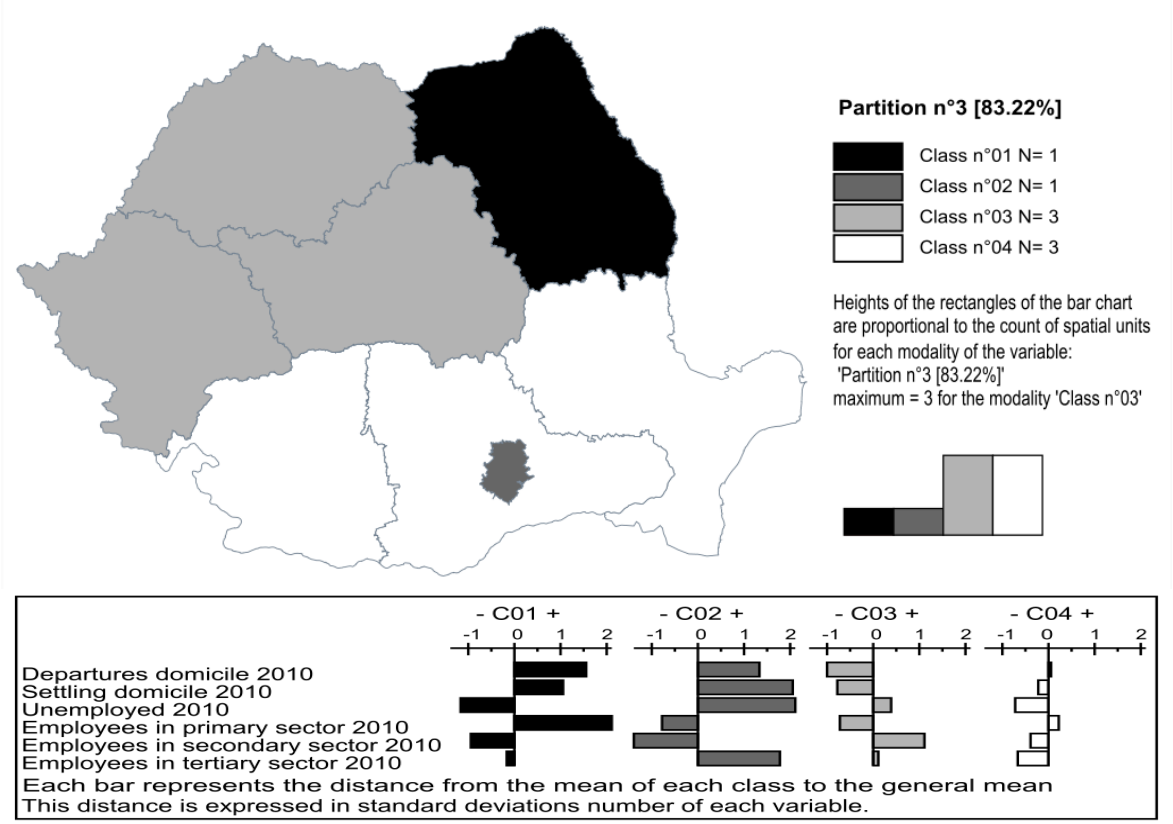

Fig. 7 HAC at regional level in 2010

Source: National Institute of Statistics. Made with Philcarto (http://philcarto.free.fr)

The components of the system can be analyzed at the micro level (territorial unit), while the structure representing the relationships and interactions between components can be analyzed only at the macro level (territorial units, as a whole). At the macro level there are no parts like at micro level, only the interactions between parts are preserved throughout. Self-organization in hierarchical systems means that a higher level process system is linked to a supersystem by emergence, thus new features emerge at higher level, that can not be reduced to the lower level. This type of emergence is accompanied by a low-level process, which is a kind of domination of superiority (Fuchs, 2003). This is also reflected on how resilience is achieved at two levels, which we can call the system and subsystem, national, regional. This type of emergence related to the connection between the micro and the macro was called by Fuchs et al. (2002) synchronous emergence. Phenomena, processes and structures work differently at different scales. Different scales are appropriate for different roles and different institutional policies (Wilbanks, 2006). Studies at one scale may be of little use in understanding the dynamics at other scales (Beckley, 1998).

4 Conclusions

We considered that determining how the variables interact should be reflected in the spatial distribution of their evolution. Concentration or dispersion of some of them can determine the spatial distribution of some others, for the variables which display causality relationships. Thus, we evaluated social resilience seen as bridging the spatial distribution and temporal evolution of social variables against economic variables at different levels of spatial aggregation: county, region. If social resilience means adapting social component to the dynamics of economic component, then capturing critical moments is essential. The disturbance in the dynamics of the system (beginning of each of the three stages) was considered to have occurred when the unemployment rate began to rise as a result of changes in the economy. The social component had to find ways to overcome this situation by seeking another job in another county or region in another sector. At county or regional level, connections between components are much closer than at national level and the regional specificities resulting from a particular composition in variables is responsible for the differentiated response to external shock. From the analysis of the size of links between social and economic components at regional and county level and from the ways of reaction of human groups (communities) in the two types of territorial scales, we extracted conclusions about the degree of social resilience. A non-resilient regional economy would probably be the one that fails to successfully transform and instead becomes locked in an outdated or obsolete structure, with a decrease accordingly, in the path of growth in equilibrium in the long term. However, according to Ramlogan and Metcalfe (2006), stability and self-organization is not the same thing to equilibrium. An interesting feature of socio-economic systems is the connection of the scales The resilience of economies depends on both the long-term regional processes, as well as short-term processes from microscale, and how they interact.

Aknowledgments

Invest in human resources!
This work was supported by the strategic grant POSDRU/159/1.5/S/133391, Project "*Doctoral and Post-doctoral programs of excellence for highly qualified human resources training for research in the field of Life sciences, Environment and Earth Science"* cofinanced by the European Social Fund within the Sectorial Operational Program Human Resources Development 2007 – 2013

Reference

BERKES, F., & SEIXAS, C. S. 2005. Building resilience in lagoon social–ecological systems: a local-level perspective. *Ecosystems*, *8*(8), 967-974.

BECKLEY, T. M. 1998. The nestedness of forest-dependence: A conceptual framework and empirical exploration. Society and Natural Resources, 11(2), 101-120.

DONOGHUE, E. M., & STURTEVANT, V. E. 2007. Social science constructs in ecosystem assessments: Revisiting community capacity and community resiliency. *Society & Natural Resources*, *20*(10), 899-912.

FOLKE, C., COLDING, J., & BERKES, F. 2003. Synthesis: building resilience and adaptive capacity in social-ecological systems. In B. F., C. J. & F. C. (Eds.), Navigating Social-

ecological Systems: Building Resilience for Complexity and Change (pp. 352-387). Cambridge: Cambridge University Press.

FUCHS, C., HOFKIRCHNER, W., & KLAUNINGER, B. 2002. The dialectic of bottom-up and top-down emergence in social systems. *INTAS Project" Human Strategies in Complexity" Research Paper*, (8).

FUCHS, C. 2003. Some implications of Pierre Bourdieu's works for a theory of social selforganization. *European Journal of Social Theory*, *6*(4), 387-408.

FUTUYAMA, D.J., 1979. Evolutionary Biology. Sinauer, Sunderland.

GUNDERSON. L.H. AND HOLLING, C.S. (eds) 2002. Panarchy: Understanding Transformation in Human and Natural Systems. Island Press, Washington, DC

HARRIS, C. C., MCLAUGHLIN, W., BROWN, G., & BECKER, D. R. 2000. Rural communities in the inland northwest: An assessment of small communities in the interior and upper Columbia River basins. In T. M. Quigley (Ed.), Interior Columbia Basin Ecosystem Management Project: Scientific Assessment, Gen. Tech. Rep. PNW-GTR-477 (pp. 120). Portland, Oregon: Department of Agriculture, Forest Service, Pacific N-W Research Station.

RAMLOGAN, R., & METCALFE, J. S. 2006. Restless capitalism: a complexity perspective on modern capitalist economies. *Complexity and co-evolution: Continuity and change in socio-economic systems*, 115-146.

SMIT, B., & WANDEL, J. 2006. Adaptation, adaptive capacity and vulnerability. Global Environmental Change 16(3), 282-292.

WALKER, B. H., HOLLING, C. S., CARPENTER, S. R., & KINZIG, A. P. 2004. Resilience, adaptability and transformability in social–ecological systems. Ecology and Society 9(2), 5.

WILBANKS, T. 2006. How scale matters: Some concepts and findings. In W. V. Reid, F. Berkes, T. Wilbanks & D. Capistrano (Eds.), Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment. Washington, DC: Island Press.