EVOLUTION OF SPATIAL COMPLEXITY IN ROMANIA: NETWORKING, DIFFERENTIATION

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Evolution of spatial complexity in Romania: networking, differentiation. The spatial complexity is negatively correlated with regional specialization. Demonstration of how regional specialization has been evolving has relevance in studying the dynamics of spatial complexity. The organization of phenomena has been studied starting with O. Onicescu' research of entropy measurement using Information Energy Index based on the sum of squared frequency of components. Entering this index data indicating the share of employment in key sectors of the economy we noticed that an important feature of complex systems is their tendency to increase their own complexity. It has been observed that processes of complex systems tend to develop complexity. Thus, complexity in nature is increasing. Many researchers are convinced that self-powering increasing complexity is an obvious fact, not without consequences - mainly because it sometimes leads to imbalances in the development of various system components that will not go unnoticed in the dynamics of the system as a whole.

1. INTRODUCTION

The space complicates once the notion of distribution is injected, said Thrift (1999). Spatial distribution, in itself, began to be taken into account to explain much of what happens in the world: from the beginning, the geographical world is one of disorder and inconsistency. O'Sullivan's remark (2004) on the low role assigned to geography by the first theorists of complexity science is fully justified. His argument is that geographical space over time configured and reconfigured the systems. Continuing the idea, one can bring evidence to show that geography is the determinant and support of the systems' evolution. The same dissatisfaction is fueled by how economists approach to the new economic geography (Krugman 1991a, 1991b, 1994, 1999; Arthur 1988; Berry 1994; Dymski 1996; Fujita *et al.* 2000; Isserman 1996; Martin 1999; Storper 1997), the issue of space being seen as a fixed frame for structuring interactions between economic entities, as opposed to geographers who, inspired by complexity theory ideas, lays interactions in a broader social, economic and political frame (O'Sullivan 2004).

The same intuition concerning the role to be played by geography has also Thrift (1999) who noted a core theory in complexity science theory which is spatially quite natural: it can be argued that complexity theory is about spatial ordering that arises from energy injection. Since previous scientific theory core were primarily interested in the temporal progression, complexity theory is equally interested in space. The overall structure depends on the emerging properties arising over time out of spatial order. First of all, the core theory questions about the instability, crisis, difference, disaster and impasses (Stengers 1997) in a way that suggests there is a clear affinity between "natural" and "human" sciences, a constant dream of geography. But geographers, continue Thrift (1999), have not utilized this opportunity a relatively long period of time, remaining on the field, mainly for reasons depending on conjecture.

The evolution far from equilibrium of complex systems derives from the second law of thermodynamics, discovered in mid-nineteenth century, which states that heat flows move from high to low temperatures, a kind of steam engine. This proves that the energy distribution is far from being

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in equilibrium and that the thermodynamic force acting spontaneously and minimizing potential or maximizing entropy, makes time to be considered irreversible. Entropy clarifies the order and disorder occurring in complex systems evolution due to the "uncertainty information" (Shannon, Weaver 1949).

2. MATERIALS AND METHODS

Complexity theorists Prigogine and Stengers (1984), Rössler (1986) and Casti (1994) Gell-Mann (1995), believe that understanding, knowledge interiorization using a mental model of the system depends on each observer, on whether he/she has a privileged relationship with the object observed, complexity is not an intrinsic property of an independent reality but is, at least partially, a feature of knowledge, a feature attributed by the observer.

To bring objectivity to our research, we used here a data set on employment in the main sectors of the economy at regional level NUTS III, spatial complexity being negatively correlated with regional specialization. Demonstrating how regional specialization evolving has relevance in studying the dynamics of spatial complexity.

The degree of organization of these phenomena has been studied by Octav Onicescu (1966), who changed Shannon's index (Shannon, Weaver 1949) for the measurement of entropy into Information Energy Index which can be summarized as the sum of the squared frequency of components.

In the Information Energy Index (IEI) formula by Onicescu we entered data on sectoral employment for two reference years: 1997 and 2002.

$$IEI = \sum_{i=1}^{n} I_i^2$$

where

$I_{i,\ i=1,\ 2\ldots n}$ represent the proportion of active population occupied in each main activity sector.

3. RESULTS AND DISCUSSION

The Information Energy Index was mapped for the analysis of spatial distribution in the years 1997 and 2002 and the evolutions recorded during the interval mentioned above.

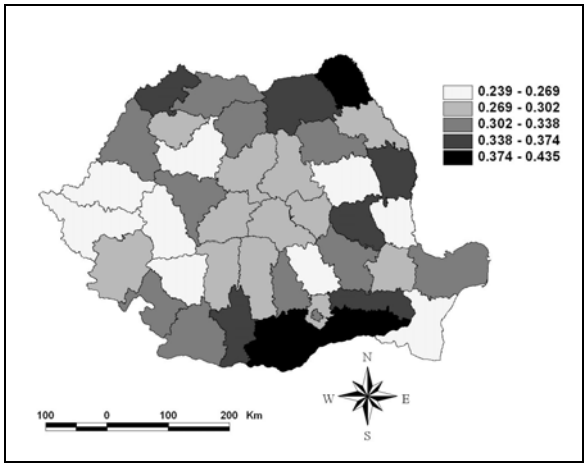

Fig. 1 – Information Energy Index, 1997.

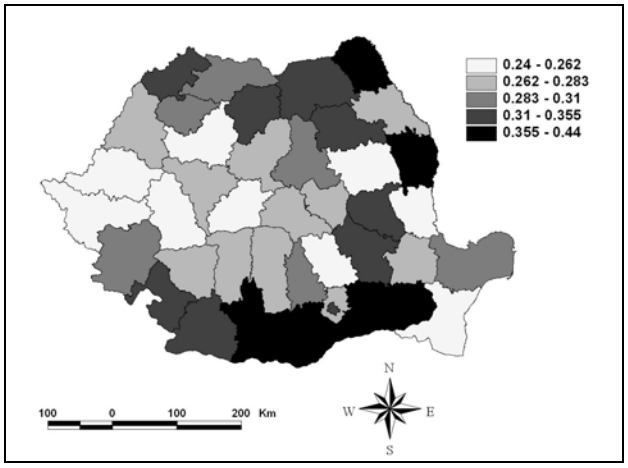

Fig. 2 – Information Energy Index, 2002.

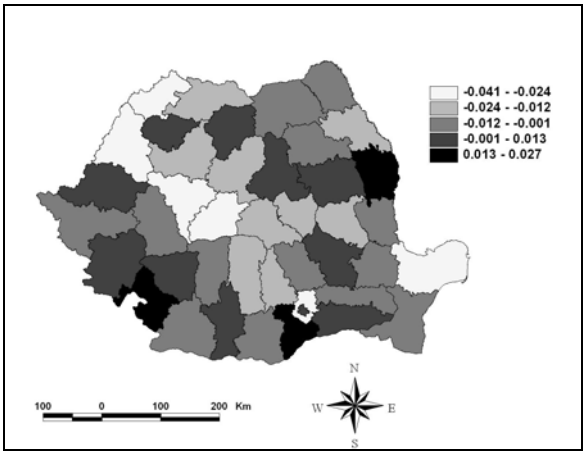

Fig. 3 – Evolution of Information Energy Index, 1997–2002.

High values of the Information Energy Index are translated into reduced spatial complexity due to the large share of employment in one of the branches of the economy and hence the concentration of economic activities in that branch. The highest values of the Information Energy Index were gathered in the south and northeast of the country where the share of employment in agriculture and industry is about 60% and 15%, respectively while low values are specific to counties in the western part of Romania, where the share of the population employed in agriculture and industry is about 30% and 25–35%, respectively.

The positive trends in the Information Energy Index from the 1997–2002 period meant a specialization of economic activities, namely the reduction of employment in some economic activities and its redistribution to other dominant economic activities. For example, in the Vaslui, Giurgiu, and Mehedinți counties, which were characterized by augmented Information Energy Index, increased the share of the dominant economic branch - agriculture or the next branch in importance – the services sector. Decreases were recorded in the share of employment in the industry and construction sectors. In two-thirds of the counties of Romania, the evolution of the Information Energy Index was negative, leading to a diversification of economic activities by increasing employment in activities such as trade and other services and decreasing the share of employment in agriculture and industry – the dominant economic activities.

These changes are aimed primarily at the rural space. As noted by Rusu (2009), the rural space is more complex than we used to think, considering it to be dominated by agriculture. Actually, countryside dynamics is entailed, also, in the evolution of other economic functions. According to Rusu (2009), in the transition period the main source of partial failure that had some rural areas - the illusion of mono-functionality and transition strategies focused solely on agriculture.

Rural economies based on non-agricultural activities are the sign of a counter-urbanization phenomenon. Its causes are in the links between center and periphery. The relationship between the urban center and its area of influence depends primarily on urbanization level and economic development, generally (Popescu 2011). On the other hand, when we analyze the relations between the rural and the urban areas one must start from economic specialization, which is the main source of stimulation for these relations through the complementarities and functional dependencies they create (Popescu 2011).

Fixed links between urban and rural areas are due to lack of forces of the city required to bring important changes, urban influence being visible in a limited space. This occurs in the case of small and medium towns in Romania, leaving room for unpolarized areas among which are disadvantaged areas. The city provides a range of services for the rural area (commercial, educational, medical, cultural) and jobs (Stoica *et al.* 2011).

As Tacoli (1998) pointed out (quoted in Stoica *et al.* 2011) spatial development policies that have attempted to integrate rural and urban dimensions have often failed because they were based on incorrect generalizations of relations between the two.

One of the reasons for not accepting the period of collectivization in the communist era and, at the same time, eulogy of the decollectivization process that followed the 1989 revolution is the theory of "reversible history" which claims that spatial, economic and social structures affected by communism muster the pre-war positions (Rusu 2009). Béatrice von Hirschhaussen (1997) is one of the supporters of this theory, saying: "More than in neighboring countries, Romanian decollectivization was interpreted as a return, validating the belief in the reversibility of history and making collectivization episode appear as aberrant phase that can be removed from history" (quoted in Rusu 2009). We believe that the evolution of the socio-economic system is dependent on initial conditions and this is one of the examples when deviations occur in a particular evolution trend which is corrected by means of the self-organizing system that learns and adapts.

Complex spatial socio-economic systems are in a continuous transformation, the effects of many small independent shocks in different sectors of the economy are not canceled as a whole, due to lack of the kind of shock linear aggregation needed for the law of large numbers application. Conventional reasoning fails as a result of strong localized significant nonlinear interactions between different parts of the economy argue Bak, Chen, Scheinkman & Woodford (1993). The type of macroscopic instability that may result has been studied in various contexts earlier as "self-organizing criticality".

The self-organizing internal structure determines the response of the socio-economic component interacting with the environment and the fact that the internal organization is robust to external changes (requiring a certain intensity of external stimuli to change the internal structure) gives a different response from that of linear determinism as said Şerban, Ianoş 2012.

Creating a mental system of reality on which to expand the economic potential of a territory through positive feedback loops that feeds complexity dynamics is what is intended by decision-makers either at political or economic level. But things are not so. The increasing spatial complexity has also negative effects that are related to the state of environment that is heavily transformed by human pressure. The woods are converted into crop land or agricultural land are being used for industrial or residential construction. The primary state of the environment, the resources that it entails have been equated with the term eco-energy (Ianoş *et al.* 2011).

The divergence between the stock of eco-energy and the degree of connectivity

As pointed by Ianoş (2000) and then by Braghină *et al.* (2010), the largest primary eco-energies are located in heavily wooded areas where human activity is present only at the periphery, very punctual or along the axis of penetration, while the lowest amount of eco-energy is in the highly urbanized areas, those with intensive surface mining or natural areas that were completely degraded by vegetation clearing and soil removal.

Reduction of eco-energies in big cities determines their search by the population in rural areas, thus taking place an eco-energy transfer from rural to urban areas. The regularity with which the movement of urban populations is conducted to the rural areas determines the "transfer of development" and thus rural destination change. This transformation is sometimes so radical that some environmental component representing attractiveness diminishes the quality. Through eco-energy consumption there is an increase of spatial complexity by anthropogenic subsystems diversification (Ianoş *et al.* 2011), in this case the components of the rural anthropogenic system. The rate at which the eco-energy consumption happens, makes their regeneration impossible, slowing down the increase or even the inversion of spatial dynamics, where imbalances between the components of the environment are irreversible.

If during the development period conservation is not taken into account, as much as possible, the environmental elements (by harmonious integration of architecture into the environment, etc.) namely eco-energy, the decline will come soon and will be irreversible.

4. CONCLUSIONS

Economic evolution is linked to differences in the geographical space, both in terms of natural resources and their exploitation. The spatial complexity study takes into account the analysis of economic activities in terms of their diversity, to ensure several development paths making economic evolution less vulnerable to internal fluctuations and especially to external shocks that occur with a certain periodicity.

The initial preference for location of economic activities in a specific area, against other areas, forming and developing human agglomerations, areas of economic activity and a high population density, through a process of circular causality. This creates a human settlement system in which privileged locations more than others grow into cities having around a polarization area consisting of villages and towns. These interdependences created between different locations explains how the economic situation of a region has consequences not only on locations within it but also on other near and far regions.

Finally, we would like to note the misuse of the term development in place of evolution, the two are not equivalent. Path dependence, explaining cumulative economic evolution had strong influences on evolutionary economics using concepts of complexity theory. Inspired by evolutionary biology, evolutionary economics deals with economic systems as evolutionary systems. What is new in evolutionary economics is, according to Witt (2008) not taking choice or decision object features as settled. Also, the analysis of non-equilibrium processes (transforming the economy from the inside) and its implications is a bold approach to classical economics of equilibrium. Processes, in turn, arise from the actions of different agents with limited rationality that can learn from experience and interactions and whose differences contribute to change. The subject is based on Charles Darwin's evolutionary method and the principle of non-equilibrium economy of circular and cumulative causation. In this sense it is natural to consider the economy as a "evolving" and not "developing" process, the latter referring rather to bringing something to a fixed state, instead of a process that can go anywhere.

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