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Using fractal analysis in modeling trends in the national economy

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Abstract

The study aims to develop a methodology for analyzing the trend of concentration of economic activities in the main core of national polycentric network. A spatial projection has been realized in ArcGIS platform, for the period 2000-2012, containing the number of companies, number of employees, turnover and profit. The original images were converted to images created 8-bit grayscale (using open-source software ImageJ) are then analyzed by Higuchi 1D Fractal Dimension algorithm using open-source software IQM. Higuchi fractal dimension provided us very useful information about more or less chaotic disposed in space by the number of companies, the profit, the number of employees and the turnover. From data analysis we observed a increase of Higuchi dimension with the growing economic influence of the main centers of development for all the four parameters. We observed that Higuchi analysis could help in identifying of the increasing of the influence of the main centers on the neighbouring territories, in periods of economic development, or decreasing of influence in the periods of the economic crises. For testing and confirmation of the veracity of Higuchi analysis the results obtained were confirmed by gray box-counting analysis using Fractal Analysis System and Fraclac/ ImageJ. Hence, the Higuchi's fractal dimension is a very good, fast and versatile method for modeling evolution of concentration trends in the national economy.

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Keywords: Fractal dimension, concentration trends, complexity, territorial management;

1. Introduction

Spectacular dynamics of emerging economies require specific approaches, more complex to highlight structural changes and evolution trends [1, 2, 3, 4] .The complex analysis in territorial profile of economic dynamics can allow the identification of trends of clustering at development poles levels of polycentric networks. The development of

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these economic clusters contributing in developing of polarization capacity of settlements; the changes in the entrepreneurship sector are felt at the settlements levels from subordinate network [5, 6, 7]. Also, the analyze of concentration trends has an important role in the studies of human activities pressure on the natural subsystem [8, 9, 10]. Fractal dimension is a measure of complexity, providing a measure of the degree an object "fills" space. The fractal dimension quantifies the degree of irregularity and fragmentation of a geometrical structure or of an object in nature. The degree of irregularity is derived from the properties of the fractal object which is a fragmented or broken geometric figure that if divided into parts, each part is approximately a smaller copy of the whole. In nature these copies are not exact representations but are nevertheless scale invariant [11].

Fractal methods can be very useful for quantitative assessment and classification of images. For these tasks, determining the fractal dimensions of 2D digital images has been very successful in recent years [12, 13, 14, 15, 16]. The methods involved include the well known Box counting method or the Minkowski dilation method. It is also possible to use gray value statistics, differential box counting, a variation method, a blanket method or frequency analysis. In situation of gray images with spatial projection of turnover, companies number, profit, employees number, could be use 2D and but also 1D fractal analysis techniques. The purpose of this article is to develop a robust research method addressing the analyze concentration trends in the economy, based on fractal analysis that can use in sustainable development and management. To be applicable a method should preferably be really simple and easily understandable to non-specialists in the field. We used in this paper a very simple and fast method (1D Higuchi dimension) which can be adapted very easily to actual problems and which can be used in multidisciplinary applications.

2. Material and methods

We analyzed 52 images, annual spatializations of turnover, companies number, profit and employees number, for the period 2000-2012, to the whole country (fig. 1-4). The images were obtained by GIS modeling. Cartographic models were made in the ArcGIS platform, where each territorial administrative unit was assigned values of turnover. For each individual year, values were represented respecting the principle of selection the same number of intervals and the same minimum and maximum values for each of them to be able to observe differences arising from year to year.

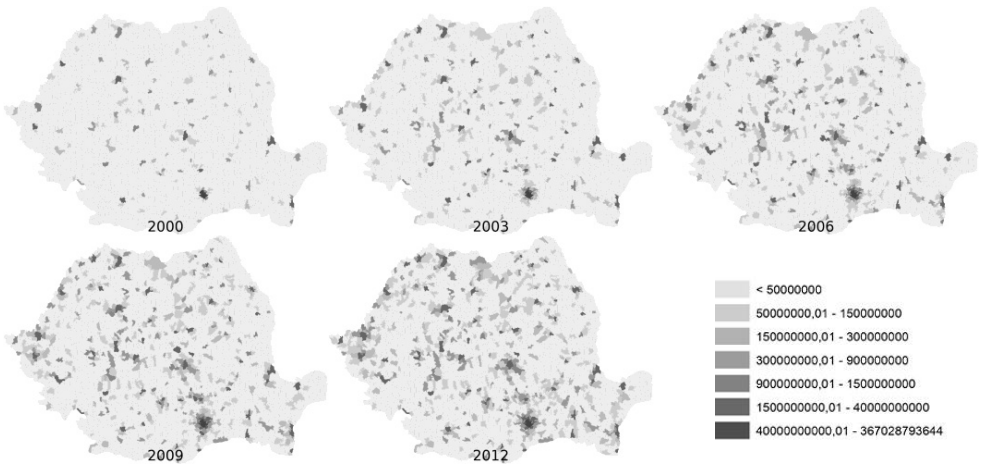

Fig.1. The spatial projection of concentration trends of turnover (lei)