

THE APPLICATION OF THE FRACTAL APPROACH IN THE MODELING OF ECONOMIC AND EDUCATIONAL PROCESSES

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Annotation

Due to the fact that recently an objective necessity to develop adequate models for the development of the modern economic farming has been formed, this article provides a thesis as for the possibility of fractal modeling of economic processes, one part of which is the educational form. It is shown that fractal economic systems are cyclically developing in time and space. The computer experiment of applying fractal modeling was carried out.

Keywords: economic processes, education, fractal, fractal dimension.

Introduction

In the modern transcription of the theory of economic development there is no universally recognized paradigm of understanding the past, present and future. The objective necessity to develop adequate models for the development of the modern economic farming has been formed. A great amount of new knowledge, accumulated by mankind, requires rethinking of certain traditional definitions, filling them with a different meaning, expanding the conceptual apparatus.

The human economy is developing in a variety of different forms, which can be reduced to three basic forms: militaristic, religious and educational.

Chapter 1

The educational form of economic management and control of development arose not at all because of the desire of the human masses to learn, but because of the fact that capitalism required literate workers of all levels. Public schools, universities, public theaters and other institutional attributes of the expanded reproduction of capital came up. The educational form quickly became independent, because it had the knowledge and it learned how to use it. All the processes of origin, development of these forms are fractal and repeat the previous fractals. Militarism, religion, education have always been and are in constant interaction, complementing each other in constant development. It is interesting that the spiritual development of the economy and society determines the overall trend of the development of the fractal and it is estimated by the level of education, culture and religiosity in society. Moreover, with increase of the education level, culture increases and religiousness decreases, and with decrease of education level, culture declines and religiousness and fanaticism increase. The consequence of this practice is the centers of instability. From these arguments, the fractal economic model of the human economy is logically formed, which is developing cyclically. First of all, fractals of the current level are laminarily formed. The potential is accumulated and another bifurcation (revolution) occurs. After that turbulent processes occur and a new fractal cron is created that sets the general trend, but at the same time each local fractal forms its own local cron, and its vector does not always coincide with common trend. Externally, this model looks like a tree. The development background of the fractal economic system is based on the relations of production and consumption, which are in continuous creative contradiction. When contradictions reach the maximum permissible values,

revolutions take place, which give new directions for the development of all existing fractals, but at the same time all fractals, like branches of the tree, continue their development. Fractals, in which bifurcations cease, begin to stagnate, cease to develop and die (like branches of a tree).

Application of fractals theory in modeling socio-economic processes makes it possible to predict the behavior alternative variants of different economic processes. For example, the classical financial models, which are used in modeling the behavior of financial flows, predict that the very sharp fluctuations in the exchange rate or stock prices are impossible and will never happen. These models assume that these fluctuations are independent from each other and they do not occur predictably or improbably.

However, as practice shows, graphics of shares or currency are changing over time, which let us see the constant background of fluctuations and price movements up and down. That is, they are invariant in time (Figure 1). This property determines the charts as fractal fluctuations.

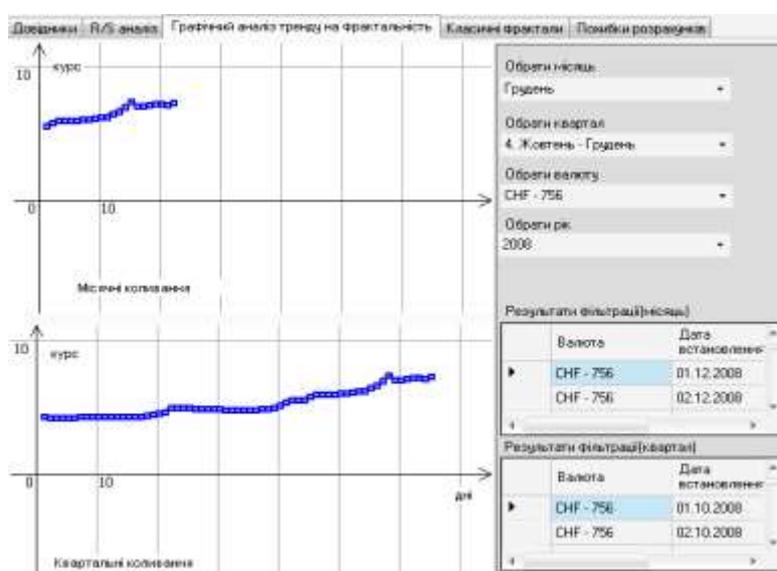


Figure 1. An example of invariance of exchange rate fluctuations chart

The classic arsenal of mathematical modeling, which is used by analysts, based on the so-called linear paradigm (small fluctuations of the system input data change its trajectory in small extent), in many cases is not enough to build adequate mathematical models. This fact has identified the necessity of a fundamental review of the linear concepts and transfer to the so-called nonlinear mathematical modeling paradigm (small fluctuations of the input data or the variables values of the dynamic system can, in a catastrophically large degree, change its trajectory due to the complexity of the system itself and the its chaotic behavior). The practical value of the described paradigm is that on its basis it is possible to reflect more adequately the specific characteristics of hierarchy, specific dynamics and high degree of uncertainty, which are inherent to real social, economic, financial, physical and other processes and systems. The transition to the new concept has caused the necessity of creating fundamentally new tools of mathematical modeling, in particular such as fractal geometry and fractal analysis.

Therefore for building predictive model the new approach was proposed, which is based on the use of methods of fractal analysis.

Chapter 2

Thus, the thesis is constituted as to the effect that nature, natural economy, elements, processes, which occur in nature and the natural economy, are fractal [2]. All natural fractals act as independent and self-developing systems that enter the fractal of a higher level: the Earth in the Solar System, Solar System in the Galaxy, etc., and it is assumed that human economy and management are also fractal. Then, by analogy, all the economic systems used to represent economic processes and phenomena can be regarded as fractal and, developing such an assumption, it can be assumed that the human natural and economy have fractal nature.

Any chaotically developing system of economy tends to take the form of a fractal; the development of a fractal economic system represents its cyclical complication with a change in the periods of accumulation and bifurcation. Bifurcations are always replaced by accumulation, accumulation is always replaced by a bifurcation in a developing fractal; production always outstrips consumption; the human economy constantly increases its significance in three basic forms; development is always accompanied by the growth of the economic system; all subsequent fractals are holographic to the previous ones, but at a new level; the development of fractal systems of economy is manageable under the influence of internal and external factors. Understanding the significance of the adopted regularities and the meaning of the factors, it is quite realistic to build adequate models for the development of human economy [3].

Formation of sociological methods and involving mathematical tools have made it possible to build models of such processes, which enable to explore and explain the regularities of various changes of indicators, to create forecasts and develop practical recommendations of any social and economic processes, particularly educational ones.

For an example of applying fractals in modeling of economic processes, fractal dimension of chart of fluctuations in the exchange rate was studied (Fig. 2). It amounted to 1.333, revealing that the system is affected by one or more forces that move the system in one direction. Therefore, the use of fractal techniques for modeling and predicting the dynamics of economic processes is appropriate.

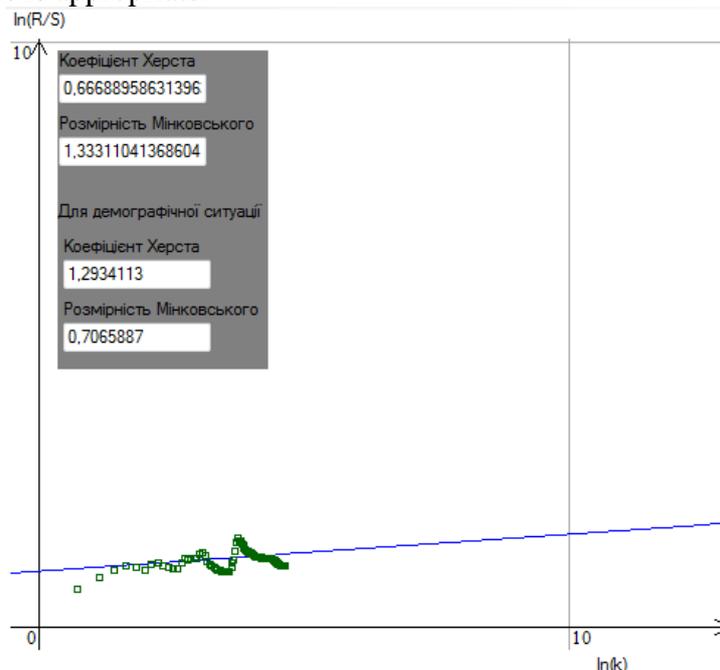


Figure 2. An example of calculation of fractal dimension by the classical R/S -method for socio-economic processes

Conclusion

According to the facts just cited, it is possible to model the trend of development of the economic system with a high probability as a sum of vectors of all fractals at all levels. In certain periods of time, the potential accumulates and the germ grows, at the beginning of the next period of time a revolution occurs and fractals are formed-new sprouts grow that gradually gain strength until the next bifurcation. Bifurcations occur both on the vertical trunk of the tree and on the lateral branches, it is all repeated and the fractal organism model of a tree of a human economy is built, which has both fractals of subsistence economy, and fractals of the economic farming, in particular, fractals of educational forms. This kind of model is easily amenable to programming and lets us understand and evaluate the dynamics of past fractals, assess the state of the economy in the current time intervals and calculate the potential for future development.

References

1. S. V. Bozhonkin. Fractals and multifractals/ S. V. Bozhonkyn, D. O. Parshin – Izhevsk: SRC “Regular and chaotic dynamics”, 2001. – 128 p. [in Russian]
2. Y. M. Osipov. Economic civilization and scientific economy./ Economic theory at the turn of XXI c. edit. by Y. M. Osipov. – M., Yurist, 2000. [in Russian]
3. O. M. Roi. Research of social, economic and political processes/ O. M. Roi. – St. P.: Piter, 2004. - P. 22. [in Russian]
4. O. V. Zhulikova, P. P. Zhulikov. Strange metamorphoses of human economy, property and capital in current time intervals. – Novosibirsk, OOO “TRNS”, 2014. [in Russian]

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