

ANALYSIS OF SPATIAL-TEMPORAL DYNAMICS IN THE SYSTEM OF ECONOMIC SECURITY OF DIFFERENT SUBJECTS OF ECONOMIC MANAGEMENT

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Abstract: The importance to solve the problem of spatial-temporal dynamics analysis in the system of economic security of different subjects of economic management is substantiated. Various methods and approaches for carrying out analysis of spatial-temporal dynamics in the system of economic security are considered. The basis of the generalized analysis of spatial-temporal dynamics in economic systems is offered.

Keywords: data interpretation, regression analysis, economic dynamics, mathematical model, economic security.

Introduction

Development of various subjects of management (beginning with separate enterprises and ending with regions, the country as a whole) is objectively interdependent with variations taking place in the exterior medium where such processes function. In this case fleetness of economic processes, which in separate cases verges on unpredictability and errors in forecasts in reference to the following economic development, prevailing of globalization tendencies and the necessity to prevent economic crisis and decays motivate the importance of considering the problems concerning economic security of such objects.

At the same time the problem of agreeing various characteristics and indices of economic management functioning processes becomes rather urgent for making adequate decision in the system of their economic security, this determines the necessity of considering, first of all, such statistical data which describe their spatial-temporal dynamics.

Substantiation of the aim and problems of the investigation. Complexity of different problems solution in the frameworks of the chosen investigation direction is associated with the necessity to process rather great body of statistical information which as a whole can be presented in the form multidimensional matrix structures. In this case traditionally the problems of the indicated line of investigation are solved in the context of the definite problems of the specific subject of economic management taking into account the economic situation development temporal factor being an important component when building up any economic security system. So one of the abundant tools for solving the economic security analysis problem is application of methods and approaches of the simulation modeling [1], this makes it possible to link them with visualization and significance interpretation of movement of the data being studied. In this case recognizing that specific characteristics of the analysis of activity of economic management subjects are interconnected, as a rule, with the temporal factor, the use of the apparatus of the temporal series analysis and prediction theory [2, 3] is of no small importance. Nevertheless, both in the first and in the second cases, as a rule, the problem of the obtained data agreement remains beyond field of vision in the course of analysis of available statistical data which reflect dynamics of different components of economic activity for making adequate decisions.

An economic managing subject faces constantly with the problem of making an acceptable decision in the process of functioning; this eventually defines the importance of analysis of the spatial-temporal dynamics when creating a corresponding economic security system. Directly the given conclusion emerges from the fact that a definite economic managing subject progresses through widening living resource space, based on resolving contradictions between external and internal environment which are an integral component in any decision making and require a definite coordination.

Moreover, one should take into account that decision being made must be weighted and substantiated on the basis of statistically significant conclusions which make it possible to reveal, first of all, available tendencies of economic development. Consequently, rather complicated problem emerges interdependent both on justification and building of an adequate model explaining interconnection between the data being studied, and the following analysis using the built model of the available set of the statistical data. In the general terms the adequacy of the corresponding analysis model should be consistent with the problem of interconnection dynamics analysis of some economic process (or phenomenon) being investigated between different subjects of the market in the

definite temporal interval. Solution of the given problem, on the one hand, encounters insufficient quantity economic process (or phenomenon) being investigated and on the other hand it encounters the necessity to process a set of data of different dimensionality. Specificity of the statistical data describing some object being investigated leaves a definite imprint on the formulated problem solution. That is why the problem of agreement of various characteristics and indices of economic managing subjects functioning processes for making adequate decisions in the system of their economic security is so significant.

Thus, as the prime objective of the investigation one should set off, first of all, examination of the available approaches to the investigation of the spatial-temporal dynamics of different economic managing subjects. At the same time the problem of such approaches critical analysis performance with revealing features of the corresponding analysis together with the problem of consideration of the feasible generalization in the spatial-temporal dynamics analysis of different economic managing subjects are important.

Spatial-temporal dynamics in the system of economic security and methods of its analysis. The most simple and abundant example of the spatial-temporal dynamics in the economic systems may be considered a set of the data characterizing development of some process (phenomenon) in time having regard to variety of available economic managing subjects. By description of such processes (phenomena), in particular, is meant dynamics of different indices of the socioeconomic development of the country in connection of its separate regions or development of some sector of the economy taking into account functioning of its separate economic components. Dynamics of the banking sector of economy development both taking into account regional features of separate administrative territorial units of the country and presence of a definite number of economic managing subjects defining the corresponding activity in this or that region can exemplify such a description. The analysis of the priorities justification, while choosing some variety of stocks based on some set of stock exchange indices dynamics investigation, should be indicated as an example of more complicated example of the spatial-temporal dynamics. Complex description of some economic managing subject behavior with regard to plurality both of indices of such description, the presence of a definite system of limitations on the system of such indices and consideration of the temporal factor of the analyzed indices factor system is rather sophisticated spatial-temporal dynamics process.

At the same time, as a rule, the spatial-temporal dynamics analysis in the economic systems amounts either to the cross-section regression, or to the temporal series regression [4]. The first type of regression makes it possible to estimate the interconnection between different data being analyzed at a definite moment of time; the second type is the interconnection between the data of one (or several) parameter during some interval of time. In this case application of the first type of regression, as a rule, doesn't take into account the dynamics of data being analyzed, application of the second type of regression doesn't take into account the presence of interdependent influence between the studied parameters with respect to different economic managing subjects. In the total the generalized model of analysis can assume the structured form:

$$Y = F(X_1, X_2, \dots, X_n) \Leftrightarrow \begin{cases} y^1 = f^1(X_1), \\ y^2 = f^1(X_2), \\ \dots \\ y^n = f^n(X_n), \end{cases} \quad (1)$$

or

$$Y = F(X_1, X_2, \dots, X_n) \Leftrightarrow \begin{cases} y^1 = f^1(x_1^1, x_2^1, \dots, x_n^1), \\ y^2 = f^2(x_1^2, x_2^2, \dots, x_n^2), \\ \dots \\ y^i = f^i(x_1^i, x_2^i, \dots, x_n^i), \end{cases} \quad (2)$$

where

Y – dependent variable characterizing some generalized its value;

$\{X_n\}$ – set of independent variables characterizing some generalized their values;

$F(\dots)$ – function representing the kind of regression dependence between the generalized values of variables being investigated;

y^n and y^i – dependent variables with regard to the analysis of the action of one independent variable X_n on the whole interval of time being investigated or taking into account analysis of the action of all independent variables $\{x_n^i\}$ for some definite interval of time;

$f^n(\dots)$ and $f^i(\dots)$ – function representing the kind of regression dependence between the dependent and independent variables represented with non-generalized values.

Variation of interconnection in the growth of general bank segment assets of the international bond market can serve as a concrete example of such spatial-temporal dynamics analysis. This is related to that in the given case the accounting of temporal unevenness of bank segment assets of the international bond market growth is obligatory. As a result the given feature can be represented through adequacy of the corresponding regression dependence equation for a longer period of time to the regression equations system defining the time interval being investigated in shorter intervals:

$$A_y = 0,697 * VB_y + 0,357 * NF_y \Leftrightarrow \begin{cases} A_{Q1} = 0,664 * VB_{Q1} + 0,346 * NF_{Q1} \\ A_{Q2} = 0,782 * VB_{Q2} + 0,245 * NF_{Q2} \\ A_{Q3} = 0,672 * VB_{Q3} + 0,399 * NF_{Q3} \\ A_{Q4} = 0,476 * VB_{Q4} + 0,660 * NF_{Q4} \end{cases}, \quad (3)$$

where

A_y – variations in general bank segment assets of the international bond market in annual estimation during 2000–2006,

VB_y – variations in requirements on banks in annual estimation during 2000–2006,

NF_y – variations in requirements on non-banking sector in annual estimation during 2000–2006,

$A_{Q1}, A_{Q2}, A_{Q3}, A_{Q4}$ – variations in general bank segment assets of the international bond market in quarterly estimation during 2000–2006,

$VB_{Q1}, VB_{Q2}, VB_{Q3}, VB_{Q4}$ – variations in requirements on banks in quarterly estimation during 2000–2006,

$NF_{Q1}, NF_{Q2}, NF_{Q3}, NF_{Q4}$ – variations in requirements on non-banking sector in quarterly estimation during 2000–2006.

Such a representation of spatial-temporal dynamics in the form of the regression dependence makes it possible to present the interconnections existing between the data being analyzed in the combined-structured form and to investigate them in greater detail. Nevertheless, the given approach doesn't explain in full measure the degrees of the interaction between different economic entities.

The following approach used for analysis of spatial-temporal dynamics in the economic systems can be introduction of the coefficients leveling asymmetry of the information influence between the variables been analyzed into the regression equation [5, 6]; this, as a result, makes it possible to eliminate the action of the variety being investigated both of the economic entities and separate features of their territorial distribution. The disadvantage of such approach one may consider the lack of a unified methodological base for such coefficients construction, this hampers the analysis unified method construction. Moreover, the given approach is unlikely to be applied to the information asymmetry elimination when solving the problems of securities version choice for investment on the basis of the stock exchange index analysis. This is associated with that in the given case one should, first of all, pay attention to the complexity of carrying out the corresponding analysis owing to the uncertainty of the stock exchange indices dynamics of developing countries [7]. Consequently, to solve such a problem associated, first of all, with attainment of sufficiently stable and high profit on financial investments one should use the fuzzy set theory approaches having considered fuzzy intersection operations for membership functions by every of the stock exchange index being investigated [8].

The concept of the main components method [9] should be indicated as one more approach making it possible to analyze of spatial-temporal analysis dynamics in the economic systems. The essence of such a concept for the spatial-temporal dynamics analysis can be reduced to the definition of the most significant action of one or other economic entity whose data are used for further investigations. But in such an event, as in the case of the regression equations structured system building, possible interaction between different economic entities is not taken into account.

The question of estimating the mutual influence of the financial flow on the part of different economic agents on the activity of each other is no less important in the context of the considered problems [7]. One of the approaches making it possible to give an answer to this question consists in the mutual analysis of the corresponding temporal series of such flows. Then, if there is a mutual subordination between two series (stability of correlation interconnection taking into account a definite lag and group of series transform being its manifestation) one should say about mutual action of one series on another one. Here two cases are possible:

- economy entity with a dominating series acts negatively on the financial flows movement of the other economy entity with a co-subordinated series if there is a stable correlation interconnection on the positive lags of the series being investigated;
- economy entity with a dominating series acts positively on the financial flows movement of the other economy entity with a co-subordinated series if there is a stable correlation interconnection on the negative lags of the series.

At the same time, when investigating the mutual dynamics of development of such economy entities, it is expedient to use the "fuzzy set levels" concept making it possible to build adequate procedures of mutual analysis of such economy entities spatial-temporal dynamics [10].

Basis of the generalized analysis of spatial-temporal dynamics based on applied registration analysis.

Considering foundations of the regression models feasibility for spatial-temporal dynamics analysis it should be noted, first of all, that it is expedient to consider just the regression equation set as the description model of spatial-temporal dynamics of some economic process (phenomenon). In this case transition to such a description comprises the regression equations system built on the standardized transformation scales in the variables space. This is associated with that the regression parameters estimates turn out to be measured in the units of the variables mean square deviation from their mean values and they become comparable to themselves and other regressions parameters. Thus, considering some system of such equations for different sets of data Y^* and X^* , describing dynamics of functioning of some definite number of economic entities (k), it is possible to speak about that it is completely described with a set of the standardized coefficients $\{\eta_k\}$

representing correlation interconnection between dependent and independent variables of the economic entities under investigation.

Then in three-dimensional space the graphical interpretation of the regression equations described with the standardized coefficients (Fig.1) can be presented as a projection on the plane $Y^{**}\eta^X$ of the cone which represents the essence of the spatial-temporal interconnection of the parameters being analyzed; in the simplest case one should single out among them the following:

- the variable being investigated represented with its weighted-mean values Y^{**} ;
- the standardized coefficients of the interconnection regression of variables represented in the three-dimensional space in the form of their generalized weighted-mean values of the variable not represented by η^X ;

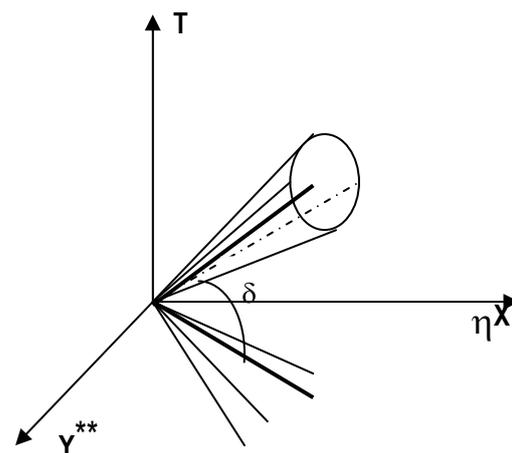


Fig.1. Three-dimensional graphical representation of the spatial-temporal dynamics analysis generalized characteristics

- the time factor T . In this case the generators of the considered cone (Fig.1) represent the investigated parameters interconnection dynamics by every of the economic entity being analyzed.

Thus, the regression coefficient δ value may represent the spatial-temporal dynamics generalized characteristics of the process (phenomenon) being analyzed among weighted-mean values of the value chosen for further investigation and standardized regression coefficients among the main investigated variables in their mutual temporal dynamics:

$$Y^{**}(T) = \delta \cdot \eta^X(T). \quad (4)$$

It is possible to interpret such coefficient δ as the angle of slope of the cone, representing the interconnection essence of the spatial-temporal dynamics analyzed parameters of the economic process (phenomenon) being investigated, to the plane $Y^{**}\eta^X$. From economic standpoint such an interpretation can denote the quality of development (functioning) of the process (phenomenon) being investigated. As this takes place, insignificant value of such coefficient is indicative of non-uniqueness and insufficiency of the process (phenomenon) being investigated, while its significant value, that corresponds to remoteness of the cone from the plane $Y^{**}\eta^X$, is indicative of dynamic development of the considered process (phenomenon). Then the essence of the spatial-temporal dynamics analysis of the process (phenomenon) being investigated in the system of economic security of different economic entities reduces to:

- first, to the control of the considered regression coefficient in the equation 4;
- second, to the prevention of the possible values leaving the definite limits defining efficiency of the security system control over some economic entity.

Conclusions

Thus, interconnection between spatial-temporal dynamics analysis of the process (phenomenon) of some economic entity and efficiency of security system management is considered in this work. The given interconnection is based on consideration of the spatial-temporal dynamics generalized characteristics basis which makes it possible to introduce the generalized management efficiency characteristics of the corresponding security system into consideration. While more detailed formalization of such characteristics is the subject of further investigations.

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