FUZZY SET THEORY APPROACH AS THE BASIS OF ANALYSIS OF FINANCIAL FLOWS IN THE ECONOMICAL SECURITY SYSTEM

Alexander Kuzemin, Vyacheslav Lyashenko

Abstract: The problems of formalization of the process of matching different management subjects' functioning characteristics obtained on the financial flows analysis basis is considered. Formal generalizations for gaining economical security system knowledge bases elements are presented. One of feedback directions establishment between knowledge base of the system of economical security and financial flows database analysis is substantiated.

Keywords: financial flows, economical security, knowledge database, fuzzy sets.

ACM Classification Keywords: K.4.4 Electronic Commerce - Security; I.5.1 Pattern recognition Models – Fuzzy set

Introduction

Objective laws of economical development assume constant interaction of a managing subject (economical agent) with different manifestations of the external medium. At the same time variations of the external medium stipulate rebuilding of the economical agent internal structure. It is connected with the fact that the given process promotes preservation of the management subject stability, overcoming of crisis-forming external factors; those as a whole can be regarded as a result of purposeful response of the corresponding system of economical security. At the same time coordination and efficiency of the economical security system can be increased at the cost of introduction of financial flows analysis subsystem both of the managing subject itself and the flows connected with economics functioning as a whole. It can be explained by the fact that the direction and velocity of financial flows' movements in many respects reflects transient nature of economical processes and changes taking place in the external medium of managing subject functioning. In this case, the range of the indicated problems becomes apparent in the period of transformations which in fact permanently embrace all without exceptions institutional formations both in the developed and developing countries due to evaluation process of economical relations' development. Such a situation emerges because just at the period of transformation changes the possibility of the rupture between the flows of the real and financial sectors of economics increases.

That is why the problems of various management subjects financial and goods flows control are constantly in view of researches.

At the same time, the effectiveness of financial flows' analysis depends in many instances on the existing systems of their estimate and the system of conclusion concerning any decision-making. This is already directly associated with the stage of formalization and analysis of different characteristics of financial flows in the system of any management subject economical security.

Substantiation of Investigation Aims and Problems

Traditionally designation of investigations' direction is solved in the context of definite problems of the managing subject taking into account the temporal factor of the economical situation development. Nevertheless, one of the widespread tooling of the set problem is the use of the methods and approaches of simulation modeling [1], this makes it possible to link them with visualization and semantic interpretation of movement of the flows under investigation. In this case recognizing that definite characteristics of financial flows' analysis are interrelated

as a rule to the temporal factor, the use of the apparatus of the analysis theory and time sequence prediction [2,3] turns out to be rather important.

But in the first and in the second cases the problem of matching the data obtained in the course of financial flows analysis which reflect dynamics of different components of economical activity for adequate decision-making as a rule remains beyond the field of vision.

Yet, a managing subject constantly comes up against the problem on some decision-making in the process of his functioning, this makes his system of economical security an integral part of the general management system. The reason is that a definite managing subject is developing through widening of his vital resource space on the basis of solving conflicts with internal and external media which are an integral part in any decision-making and which require a distinct agreement. That is why the problem of agreement of different characteristics and indices of the managing subjects functioning processes obtained on the financial flows analysis basis for adequate decision-making in the system of their economical security is presented as the main problem of investigation.

The Problems of Financial Flows' Analysis in the Social-economical Systems of the Transition Period. The Decision-making Formalization Apparatus Choice.

But before proceeding directly to the preset problem treatment it is necessary to note that for the modern managing subject the problem of the economical security system creation, development and control of this security assumes solution of the complicated and multi-aspect problems complex. At the same time one should take into account that the economical security of development of some economical agent is defined not only through widening a set of elements of its resource space but the degree of protection against internal and external threats. Their activation can significantly decrease or even destroy this space. That is why the choice of economical security system functioning criteria, creation of data bases and knowledge bases serving the foundation of adequate economical security system creation, matching different characteristics of the processes for objective and appropriate decision-making are among the problems of paramount importance in the given direction.

In this case, it is also important to realize that there are objective reasons for the limited application of the decision-making models in the social-economical systems [4].

At the same time, the preset problem solution complexity is enhanced with the presence of different estimates of the same processes taking place during the transformation period of economical relations development. Several of the problems connected with estimation of tendencies in development of the funds market can be shown as the most striking example. This funds market on one side is rather little predicted for the countries with c transient economy, and on the other side it is very important component for decision-making in the system of economical security as it reflects the processes of redistribution of free monetary and financial resources.

Fig.1 shows the profitableness distribution density of some fund indices of the Ukrainian securities' market (KAC-20 (a), SOKRAT (b), Sofia Bondar Priadka Ukraine (c), TEKT-KKOC Price Bonds (d), PFTS (e), KINDEX (f) calculated for the period which covers a year and a half from 01.06.03 based on the sites of the corresponding companies).

As can be seen from Fig.1 the analysis and proper conclusion is hampered with a distinct uncertainty of fund indices' dynamics. Significant dissimilarity of statistical characteristics of indices under consideration both from the standard meanings and from each other can be considered as its manifestation.

The problem of estimation of financial flows mutual influence on the side of different economical agents on the activity of each other is also no less important in the context of the considered problems. This also manifests itself both on the micro- and macro level [5].

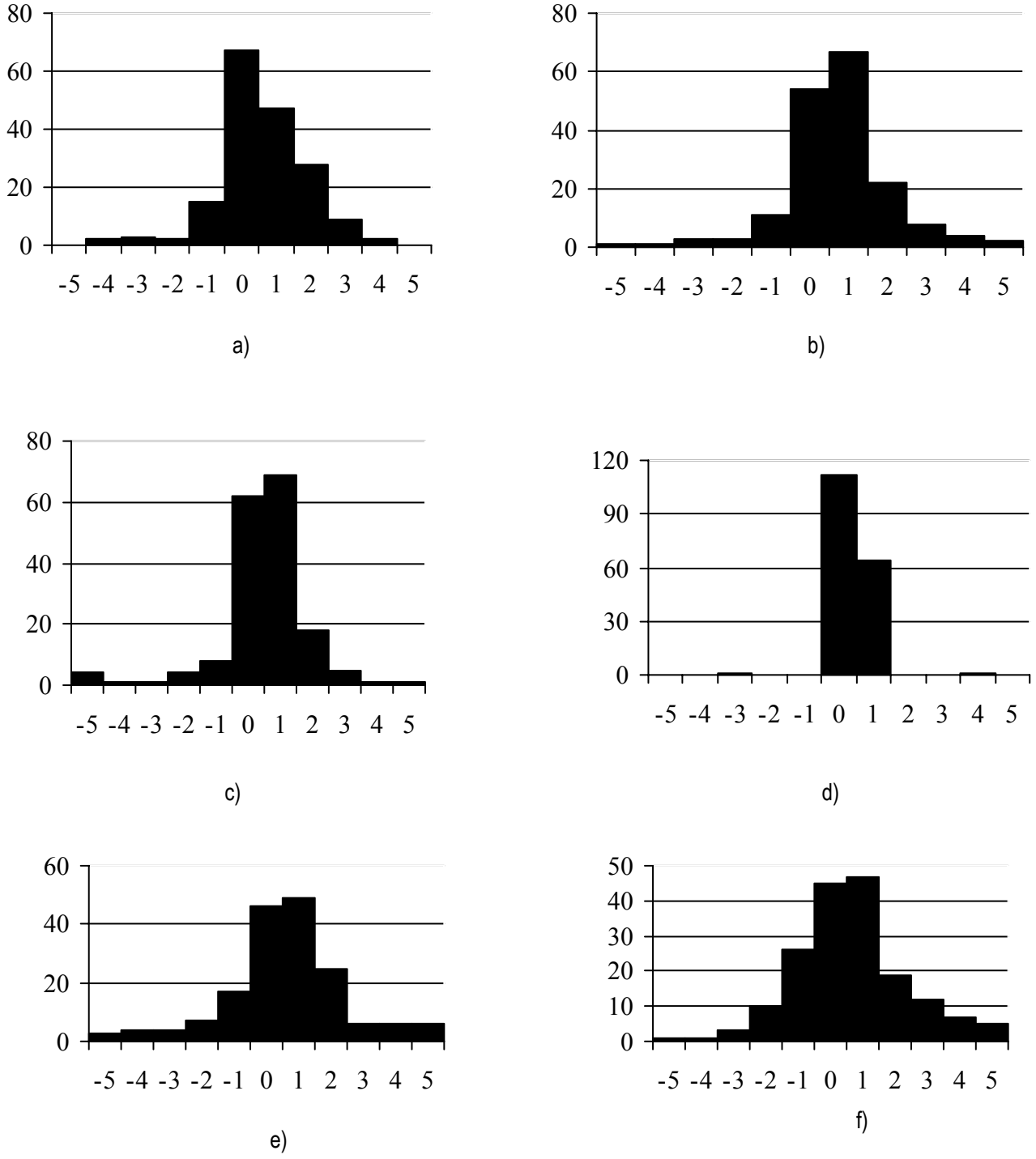

Fig.1. Profitableness distribution density of some Ukrainian fund indices

Thus, in the process of analysis of different financial flows we obtain the database, which represents in the general case some dissimilar database and which should be transformed into the knowledge base of full value later on. In this case considering the structure of the given process (Fig.2) it can be characterized in the most

general terms as the procedure of obtaining information images which in the following suffer a definite grouping and analysis.

That is to say, from the formal point of view the structure of the knowledge base formation process for decision-

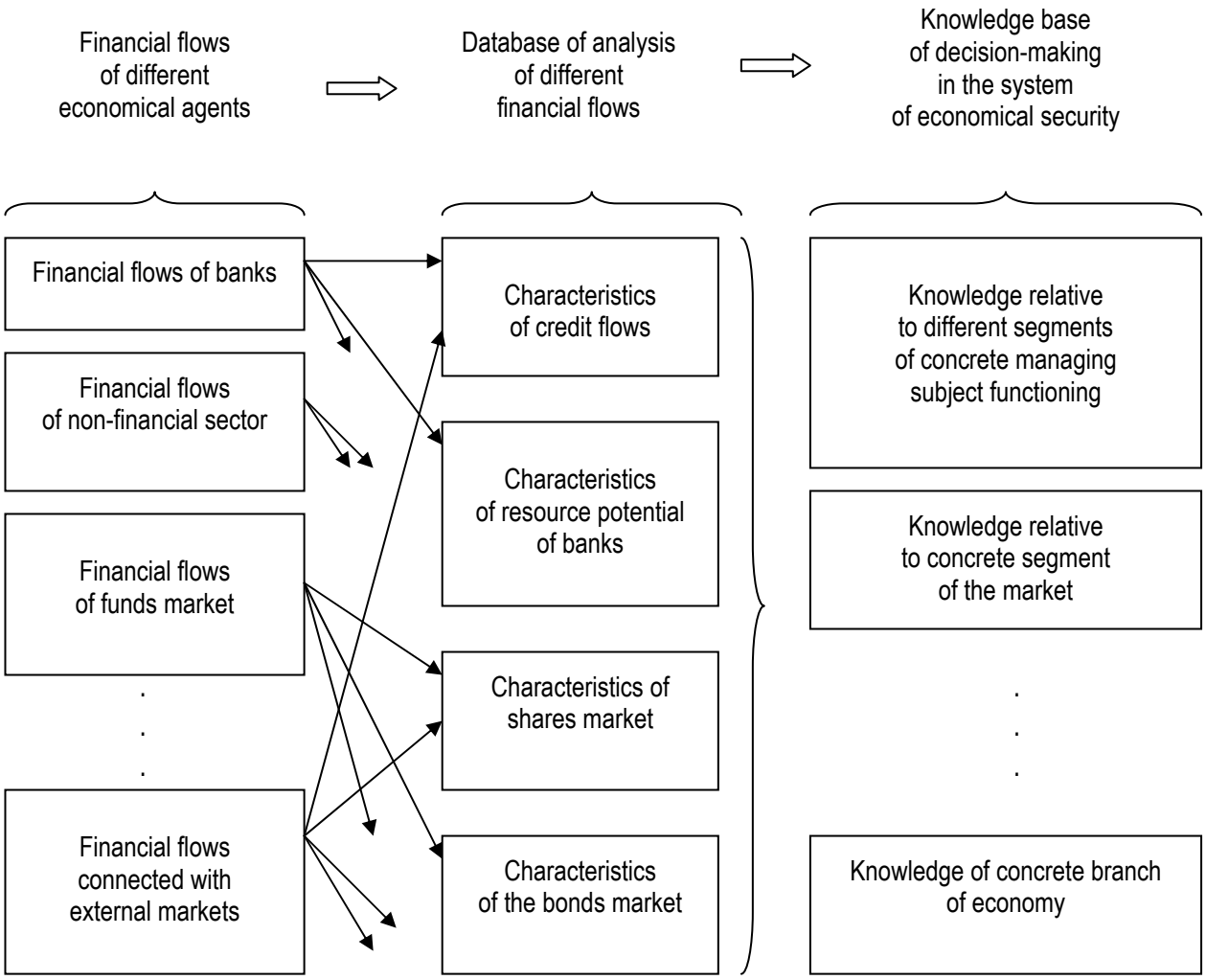

Fig.2. Generalized structure of the knowledge base formation process for decision-making in the system of economical security on the basis of different financial flows analysis

making in the system of economical security based on different financial flows analysis can be presented in the form of image recognition theory procedures. However, taking into account the fact that all economical and financial processes carry the randomness treats and inertia properties of the objects under investigations (though they give a high degree of conditionality of the future behavior of the previous ones) do not guarantee their complete execution. This fact determines to consider the theory of fuzzy set as an additional mathematical apparatus.

The utility of such a union of the indicated theories is connected, first of all, to the fact that to establish links between elements of the database and knowledge base, to clarify which of them should be or shouldn't be considered linked with some relation, one is forced to solve the problems of interaction between enterprises which sometimes do not correlate well. At the same time, it is necessary to take into account the difference in transitions for gaining knowledge between different characteristics of financial flows for the same economical

processes. In other words, the case in point is only a degree of belonging of the concrete characteristics of financial flows required for gaining one or other knowledge. Then, the higher is degree of the alternative belonging to fuzzy set the greater is degree of attaining this aim when choosing the given alternative as a solution.

Matching of Different Characteristics of Financial Flows in the Economical Security System

Along with the discussed above one should note that the standard operations with fuzzy sets could be used as the simplest procedures for knowledge base elements' derivation. As an example the inference concerning the use of a definite set of the fund indices combinations existing on the market for gaining the criterion of the enterprise assets maximal diversification into different securities can be considered. Let us assume that we have belonging functions $\mu_F(P)$ which represent profitableness of investments (P) based on the analysis of three different fund indices of some their fuzzy set (F) (Fig. 3),

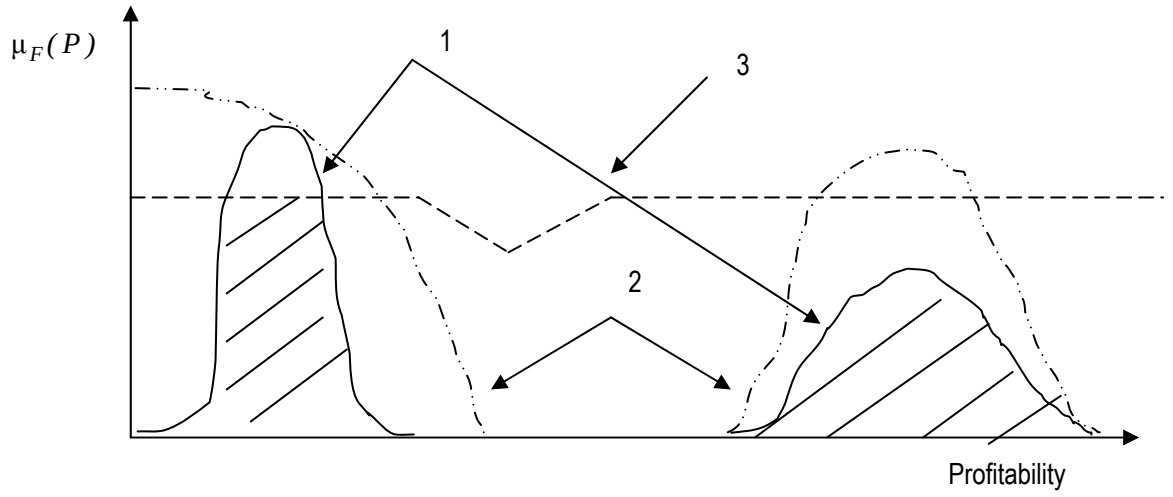

Fig.3. Fuzzy setting of profitability function on the basis of different fund indices analysis and knowledge base element formation results

where

curve 1 – represents insufficiently high and stable profitability degree by investments into securities according to the values of the first of the fund indices under investigation;

curve 2 – represents sufficiently high and not very stable profitability degree by investments into securities according to the values of the second of the fund indices under investigation;

curve 3 – represents sufficiently mean and sufficiently stable profitability degree by investments into securities according to the values of the third of the fund indices under investigation.

Then to attain sufficiently stable and high profitability by the investments into securities it is necessary to consider the fuzzy crossing operation for the obtained belonging function by every of the fund indices under investigation (the shaded region in Fig.3).

Nevertheless, for more adequate solution of the problems emerging when choosing different managing subjects functioning processes' characteristics being formed on the basis of the existing financial flows analysis it is expedient to consider their generalized matching to obtain the knowledge base elements. Such solution can be obtained starting from the fact that the corresponding crossing of the considered sets which represent the

concrete characteristics of the managing subjects functioning processes should be the maximal one and the symmetric difference approaches zero.

In the formalized form this can be written as follows: so the crossing maximization condition assumes the following form:

$$\mu_{A1\cap A2\cap...\cap An}(x) = min(\mu_{A1}(x),\mu_{A2}(x),...,\mu_{An}(x)),$$

and the condition for the symmetrical difference has the form:

$$\mu_{A1\oplus A2\oplus...\oplus An}(x) = max(\mu_{A1}(x),\mu_{A2}(x),...,\mu_{An}(x)) - min(\mu_{A1}(x),\mu_{A2}(x),...,\mu_{An}(x)),$$

where $\mu_{A1\cap A2\cap...\cap An}(x)$ and $\mu_{A1\oplus A2\oplus...\oplus An}(x)$ – belonging function of some knowledge base element which is defined from the concrete belonging functions $\mu_{An}(x)$ data base X. Characterizing corresponding fuzzy sets of different analyzed financial flows' indices.

In this case, the condition of the fuzzy sets' matched join for knowledge base elements' formation is also a good tool:

$$\frac{\mu_{A1\cap A2\cap...\cap An}(x)}{\mu_{A1\oplus A2\oplus...\oplus An}(x)} = \frac{min(\mu_{A1}(x),\mu_{A2}(x),...,\mu_{An}(x))}{max(\mu_{A1}(x),...,\mu_{An}(x)) - min(\mu_{A1}(x),...,\mu_{An}(x))},$$

as can be seen from the above formulae the symmetrical difference approach to zero can point to maximization of joining the considered fuzzy subsets and, as a result, characterize in some way the degree of matching of the obtained corresponding characteristics of financial flows when deriving the concrete element of the knowledge base.

It is precisely the given approach was used as a basis for building the developed economical security system; their main components are:

- subsystems for analysis of external factors acting on the financial flows movement on the basis of the indices system characterizing the position of a country in the external financial markets;
- subsystems for analysis of the degree and direction of action on financial flows on the side of other countries and organization;
- subsystems for analysis of financial flows movement on the basis of economy bank sector indices taking into account researches of the possibility of emerging crises situations with a mutual movement of flows of the real and financial sectors of economy, influence of the external bank capital;
- subsystems for analysis of efficiency of monetary and financial resources redistribution through the securities market.

Conclusion

Here it should be noted that the considered approaches to matching of different managing subjects functioning characteristics obtained on the basis of the financial flows analysis mustn't be regarded as the unique ones. For example, the problem of account of the possible range of financial flows' indices quantity variation when deriving different knowledge elements is rather significant. As a whole, it can result in correction of the corresponding belonging functions. Nevertheless, despite the given remark it should be noted that its elimination is possible through widening functional subsystems of the general economical security system. In this case, it should be spoken about correction of the knowledge base; establishment of the feedback with database, which will control the process of gaining, needed indices of financial flows' analysis. At the same time, it is also expedient to use the theories of fuzzy sets as formal apparatus for such problem solution.

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DYNAMICAL SYSTEMS IN DESCRIPTION OF NONLINEAR RECURSIVE REGRESSION TRANSFORMERS

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Abstract: The task of approximation-forecasting for a function, represented by empirical data was investigated. Certain class of the functions as forecasting tools: so called RFT-transformers, – was proposed. Least Square Method and superposition are the principal composing means for the function generating. Besides, the special classes of beam dynamics with delay were introduced and investigated to get classical results regarding gradients. These results were applied to optimize the RFT-transformers. The effectiveness of the forecast was demonstrated on the empirical data from the Forex market.

Keywords: empirical functions, learning samples, beam dynamics with delay, recursive nonlinear regressive transformer, Generalized Inverse, Least Square Method.

ACM Classification Keywords: G.1.2 Approximation, G.1.3 Numerical Linear Algebra, G.1.6 Optimization

Introduction

Approximation of the function represented by its values is classical direction of researches for mathematics both in the deterministic statement, and in statistical variant (see, [4,5], and also [1-3]). Classical results in this area are full enough represented in the specified works. They show importance of superposition-recurrence as means of generation of a class of approximating functions.

Natural way of use of approximation in applied researches is the forecast of values of researched function. Means of forecasting have special importance in the modern unified systems of automation of management of firm: in so-called Business Intelligence systems and, in particular, in their structural elements as DSS.