



Methodology for Analysis of Financial and Economic Security: Management of Capital Flows

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Abstract

A methodology which is based on the theory of equilibrium random processes based on the evolutionary-simulation model and Decision instrumental system is proposed. The main stages of capital flow modeling are proposed. This is an analysis of the situation in which it can be interpreted. The structure of the flow of water and the market mechanism were determined. The main stages of capital flow modeling are proposed.

Keywords: financial-economical security management, the theory of equilibrium stochastic processes, the evolutionary simulation methodology, the instrumental system "Decision".

1. Introduction

From the analysis of scientific sources [1-7, 10-12] it becomes clear that there is no shortage of quantity and variety of indicators. The problem is that any financial or economic indicator has a large, often unacceptably large information error. Among the sources of error, an important role belongs to financial bubbles and money laundering. At the same time, in each specific case, it is too difficult or even impossible to estimate the size of the error of an indicator. Therefore, the real, practically significant and, at the same time, rather complex in scientific and methodological terms, task is to find ways to reduce the errors of the estimates of indicators [7,10].

The formal formulation of the problem of managing capital flows considers the situation and conditions of capital flow from class j to class j' , introduces the concepts F_{aj} - the expected demand for capital of class j ; PL_j is the equilibrium amount of capital of class j ; C_j is the income per ruble of investments (price) of capital of class j ; S_j is the charge for using sources of financing when using capital of class j (cost price); β_j - the probability that the supply will be greater than the demand; $\beta_j / \beta_{j'}$ - the ratio of the risk of overvaluation to the risk of understating.

2. Research Method

To understand the essence of the phenomenon of the flow of capital, it is important to compare it with similar phenomena that have, of course, fundamental differences. Identification of similar and distinctive features allows you to specifically and fully identify the specifics of the flow of capital and formulate the principles of mathematical modeling of this phenomenon. The flow in the volume V_j , j' will only occur if 3 conditions are fulfilled simultaneously:

- capital is absolutely liquid;
- capital j' is able to instantly absorb this volume;
- the transfer of capital from j to j' is not associated with losses.

Considering that capital j is not completely liquid and the possibility of capital j' to accept investments is limited (for example, by the capacity of the building complex, if j is production capital), it can be argued that there is a limit amount of capital R_j in which j' can

flow from j to j' per unit of time. This means that each movement of capital changes the capacity of both source j and receiver j' . Therefore, at each instant of the discrete time $t = 0, 1, 2, 3, \dots$ after each movement, it is necessary to recalculate the characteristics $\{PL_j, \beta_j / \beta_{j'}\}$ for each j by solving the ECM.

Losses from the flow of capital from class j to class j' appear in the form of a fraction W_j, j' of transferred capital, which is used for transfer and insurance.

Capital classes can be allocated with any degree of detail and in unlimited quantities. In principle, it is possible to consider the capital of a separate physical and legal person and all possible associations, and the intersection of all capitals. The accuracy and reliability of the prediction of capital movements can be increased by increasing the number of classes of capital allocated. There are reasonable limits, which, however, have not yet been formally defined.

3. Results and Analysis

Prediction and management of capital movements are tied to the interests and competencies of certain government bodies or certain categories of business entities. For example, the Government of Russia is interested in capital inflows into the real economy, or capital outflows from the country, or capital inflows into agricultural production. Toy manufacturers are interested in the incomes of families with children. The bank is interested in the flows passing through it, because the forecast of flows helps formulate the tactics and strategy of the bank's behavior, by means of transfer pricing in management accounting, etc.

If J capital classes are allocated, an ESM is developed for each capital class, then at each time t , the main characteristics $\{PL_j, \beta_j / \beta_{j'}, t\}$ can be calculated. For any pair $j \neq j'$ you can build a simulation model for calculating the flow force. When building this model, it is necessary to take into account another important feature of the flow of capital, which has no analogies. This is about the psychology of capital owners. On the exchanges, the role of psychology is especially vivid. Sometimes it is enough to say one

statement by an employee of the Central Bank, the Ministry of Finance, a manager of a large company, or simply a “duck” launched by some trader to make a powerful flow from one class of capital to another. This overflow occurs in the form of panic purchases or sales of shares, currencies, and changes in securities quotations.

With this in mind, any prediction of the movement of capital, or, especially, management of capital, may seem impossible and senseless. However, this impression is superficial. The fact is that the significance of the statements, and indeed of any information, depends on the situation on the exchange. Often there are also situations where no informational stuffing does produce any impression. However, if informational stuffing is impossible to predict, then the forecast of situations in which they acquire meaning can be reliable and accurate. It is in the forecasting of situations that the main task of modeling the movement of capital is.

It is fundamentally important that the $S/3$ indicator, on the one hand, quantitatively expresses psychology, namely the ratio of subjective assessments of the risk of overstatement and the risk of underreporting, and, on the other hand, uniquely determines the influence of psychology on reliability, capital PL_j , tension U_j, j and current I_j, j' . Considering, moreover, that at the current time the $S/3j, t$ can be found by solving the ESM on the basis of actual data implementing the well-known principle “The market knows everything”, the task of taking into account the psychological factor appears as a problem of forecasting $3/3j, t+1$ for a given $3/3j, t$. The presence of a psychological factor leads to the fact that the amount of capital flowing through the connection (j, j') , that is, the current strength I_j, j' , is an undetermined quantity that is uniquely determined by the values of the quantities U_j, j', R_j, j' and w_j, j' , but a random variable. At the same time, $U_j, j', R_j, j', W_j, j'$ determine the form of the law of probability distribution I_j, j' and the parameters of this law.

To predict $3/3j, t+1$, it is necessary to estimate the probabilities of the emergence of information of various types (on the actions of monetary authorities, political events, natural and man-made disasters) and the expected degree of its influence on subjective risk assessments. This technology has long been successfully used in the international financial market Forex. This experience can be used to develop methods and algorithms for predicting $3/3j, t+1$. Taking this into account, we will assume that the simulation model allows in statistical tests to obtain realizations of the flow force I_j, j' in accordance with the law of probability distribution of the quantity I_j, j', t .

As noted above, for complex modeling of capital movements, a graph G is constructed, in which each class of capital j is assigned a vertex [8]. In graph theory, the momentum at the vertex at the moment is commonly understood as the change in the parameter at that vertex at the moment. A pulse process is a change in the parameters at the vertices that occurs as a result of impulse transmission along arcs (oriented links) of a graph. A simple impulse process is a process that begins with an external impulse applied to one of the vertices and is not accompanied by other external impulses.

Further, by impulse we shall mean the realization of the flow force I_j, j', t , obtained in the statistical test, which we denote. Between the vertices j and j' , we establish a connection (j, j') between the classes j and j' if the expected magnitude of the pulse and the probability of the pulse passing between them are not negligible. Since the flow is possible both from j to j' and vice versa, the connection between capital classes should not be represented by an arc (which has a direction), but by an edge. That is, the graph G is not oriented, connected, not having loops. Each edge of the graph (j, j') will be characterized by a set of values $\{U_j, j', R_j, j', W_j, j'\}$. The order of traversing vertices during the passage of pulses is important. If a pulse has passed from j to j' , then, as already noted, both $\{PL_j, 3/3j, t\}$, and $\{PL_{j'}, 3/3j', t\}$ will change. This means that after the passage of a pulse, the voltages and pulses will change in all other connections where j or j' and, further, in all

other connections of the graph are present. At the same time, there are no criteria by which the order of traversal of vertices could be determined uniquely. This leads to the conclusion that the order of traversing the vertices of the graph G is random, and the greater the voltage U_j, j', t and the current strength I_j, j', t , the greater the probability of the pulse passing.

4. Conclusion

With the help of integral characteristics, it is possible to compare forecasts and control measures with which the forecast corresponds. In other words, the possibility of forecasting, at the same time, means the possibility of choosing a management option based on the study of scenarios [9]. Summarizing the above, we can determine the following main stages of modeling the flow of capital:

- Set the prediction horizon T and the discrete time.
- Select classes of capital, the movement of which affects the interests of the government body; determine the operations characteristic of each class of capital; identify ways to collect and update data.
- For each class of capital j , develop an ESM for calculating the basic characteristics of capital classes, as well as voltages and flow forces between classes of capital.
- Develop ways of calculating resistances and losses when capital is moved from class j to class j' .
- Develop simulation models for calculating impulses between classes of capital, taking into account psychology.
- Create a graph G of the movement of capital, assuming that the edge exists if the average value of the impulse and the probability of its passage are not negligible.
- Establish the rules for traversing vertices of a graph G , taking into account that the traversal sequence is random and the probability of passage of a pulse along an edge is the greater, the greater the voltage and momentum.
- Develop a mockup of the software implementation of the ESM capital classes and flows on the G column for the implementation of the modeling computing process.

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