Dr. N. VIŞINOIU
Department of Economic Cybernetics
Academy of Economic Studies

Analysis of the System of Socio-economic Statistics

The theoretical and methodological prospects provided by the examination of the functioning and development of science as a system explains the spectacular development of this sort of studies. Equal interest is shown for the specific forms of knowledge owed to the sciences about science, such as the philosophy of science, the sociology of science, the economy and the history of science. The complexity of this problem is very well suggested by the multitude of determinations of the concept of science: a system of knowledge, production of knowledge, a specific form of labour division, an element of selfadjustment of social development, etc.

The development of science in general and of statistics in particular takes place under the influence of two simultaneous processes, one of differentiation and autonomization of disciplines and another of their integration. A similar evolution will be manifested also in the future following the changes to take place in the structure of the economy and society and as a result of the progress of education.

The differentiation process caused by the growing complexity of the economic phenomena, by the deepening of labour division and the intensification of study has engendered within socio-economic statistics the appearance of autonomous disciplines such as the Statistics of industry, the Statistics of Constructions, the Statistics of Transports, the Statistics of agriculture, the Statistics of circulation, the Statistics of population, etc. Resulting from this enumeration is the isomorphism of statistical disciplines reflecting the structure of the systems in the economy and in society just as natural science reflects the structure of the systems in nature.

In the context of the general theory of systems and of the information theory statistics just like any other science can be defined as a complex, dynamic system of information with its own laws of functioning and develop-

ment created for obtaining new truths and applications offering its "products" to economic practice and the educational process [8].

Based on the universality of the concept of system we can consider in a synthetic formulation that the set of statistical disciplines and of their connexions forms the system of socio-economic statistics. The elements of the afore mentioned system are in close interdependence and in an endless exchange of information and methods. Just like in the case of other sciences, the statistical disciplines are borrowing their methods, their separation taking place according to the examined economic space. Considering the particularities of the reference domain it can be said that the system of affiliated statistics is an open system interacting with the environment made up of other economic disciplines from which it cannot be entirely isolated in point of information.

Following the introduction of negentropy, the system develops improving its organization and complexity in order to achieve a dynamic state of balance with environment.

The attitude towards one or other of the disciplines must take into account the fact that the whole set is in a state of balance if and only if each part is in a state of equilibrium in the conditions provided by the other parts. Consequently, we can consider that each part has the right of veto on the state of balance of the whole set.

The existence of this system of disciplines is fully evinced by the systemic character of their object of study, the national economy. It must be said that the definition of statistics as a system is correlated with the traditional definition which referring to the object of study considers that statistics has in view the quantitative aspect of the mass socio-economic phenomena in specific conditions of time and space.

The attempt to apply to the systemic method aims at outlining new aspects regarding the place and role of statistical disciplines and at investigating their dynamic interconditioning. In the same sense, the systemic concept is useful in solving some possible controversies as concerns the delimitation of disciplines and their interconnexions.

The structure of the system of statistical disciplines may have a series of significances beginning with the defined structure as a collection of relations among disciplines and ending by considering the structure as a specific representation of the observer as to the composition of the system. In another order of ideas, the examination of the structure as an expression of labour division may lead to the identification and acceptance of the objective character of certain interfaces among the disciplines. To create an image of the structure a graph can be built having as tops the elements of the system and as arces the connexions between them.

The dialectical unity of intensive structure (in time) and of the extensive structure (in space) is a result of the organization of the system of statistical disciplines within an uninterrupted process for improving the relations between parts and the whole.

The organizing structure of statistical knowledge, an attribute of the system is indispensable, without it knowledge being an amalgan of contradictory observations and experiments. That is why, the optimizing of the teaching of statistics implies, among other things, the logical ordering of

the subject by taking into account the isomorphism of its structure with the structure of the economy. Consequently, each discipline esablishes its frontiers where it considers it suits its aims, based on a thorough knowledge of the characteristics of the branches studied. The frontier once established the area of the phenomena belonging to a discipline is delimited and its placement in its environment is achieved.

As regards the notion of structure, it is worth pointing out that the economy can be divided endlessly by establishing still more analytical frontiers and by reducing the area of a group of processes up to a point-moment of time and space. By covering the road inversely we can note that the whole is never equal to the sum of its various parts if we opt for the systemic outlook. In our case this hypothesis is verified through the fact that the "Socio-economic Statistics" whole alone has all the attributes of a science.

For a dialectical approach of the structure one must take into account N. Georgescu-Roegen's affirmation in [7]: "The borders of any science about facts are half-lights in motion. Physics is superposed with chemistry, chemistry with biology, economics with the political science and sociology a.s.o.".

The consequence of these interfaces was the creation of physical chemistry, of bio-chemistry, of political economy and appearing in connection with statistics were economic statistics, mathematical statistics, linguistic statistics, statistical physics, etc. The previous examples are an expression of the tendency of integrating disciplines coexisting with that of their autonomization.

To specify the significance of the "half-light" zone separating a notion from its opposite, we mention the existence of the virus crystals forming a "half-light" between the living and the dead matter. Similarly, but in another order of ideas we can speak about half-lights in motion on the borders between the economic branches, implicitely, on the borders between their statistics. An expression of these are the difficulties of a methodological character caused by the permanent, complex and dynamic character of the economy. To exemplify, we mention the activities taking place on the borders of the branches and the activities belonging to different branches simultaneously carried out by the same unit. The exceptions and modifications in the methodology of delimiting the activity of branches prove the existence of the half-light zones in statistics.

The difficulties of statistics related to the delimiting and measuring of the phenomena in time and space are due to the fact that no length is discretely distinct from the preceding and following one just as no event can be completely isolated from the others.

The possibility of constantly improving statistical research is also explained by the fact that the decision of quantifying the economic phenomena and the preceding operations are human deeds and the results of these actions depend on human beings just like the results of all human actions. This remark is in keeping with the philosophical thezis of critical realism which maintains that the thing itself is gradually cognizable, with a certain distorsion, therefore knowledge is corrigible and not final [4].

As regards the concern for quantification it should be pointed out that each set of data is not a goal in itself but a means to suggest or activate theory and for the knowing-perfection of socio-economic activities. Although

we shall not review all exigencies formulated in connection with statistical research we shall nevertheless mention the need of a concordance between the type of data searched and the techniques or resources at our disposal. Similarly, in the process of knowing, special attention should be paid to the "noisy" data (affected by random variations) and to the data with an equivocal significance.

The application of the systemic method in analysing the components of socio-economic statistics implies the emphasis of the multiple connexions inside and outside the system. The complex of connexions represents the essential feature of the system conferring a unitary and homogeneous character on socio-economic statistics. This is explained by the fact that the unity and homogeneity of the system in motion result from the interconditioning of the individual movements belonging to the component elements. In the conditions of a traditional treatment of the relationships between the autonomous statistical disciplines and their whole, socio-economic statistics, the unitary character of this science was also emphasized.

The interconnexions of the analysed elements in a system have as attributes their complementary character and the transfer of methods and concepts. The complementary character of knowledge is present both in the connexions between the statistical disciplines and in their relations with the other economic and mathematical disciplines. In this sense, the importance of organizing the inter and intradisciplinary connexions is well known, for the efficiency of the scientific information flows at "the beneficiaries".

The economic and informational particularities of the branches make the statistical disciplines to adapt general methods, to elaborate their own techniques of computation and analysis and to establish the methodology of indicators in keeping with the nature of the investigated phenomena and rocesses. There is in the analysed system a multitude of reaction loops having in view the whole or some of its parts, as is the case of interaction between the branch statistics and theoretical statistics. As there is a circularity of action between the parts of the dynamic system, socio-economic statistics, we can say we have to do with a feed-back connexion. Since the branch statistics contributes to amplifying the fund of concepts and methods, we can consider the existence of a positive feedback between the respective elements.

The outlining of the flows of knowledge depends on a correct delimitation of borders. If a discipline is not delimited by the whole universe of science in order to create an isolated system, it is difficult to know whether the respective domain is developing or is a frozen conglomerate. The development of statistics implies a change which can be conceived only as a relation between the considered science and its environment.

The relations between statistical practice and statistical disciplines hold a special place within the external connexions of the system. Apart from isomorphism we should mention the existence, in general, of a justified advance of practice in the field of the methodology of indicators and of an advance of education as regards the mathematical-statistical methods of data processing.

The set of flows received from other sciences or from economic practice represents the vector of inputs into the statistics system. The results of the

activity of the statistical disciplines system are materialized in flows directed along the teaching process, along other sciences or along statistical practice forming the output vector. If the flows of concepts, methods, data and of other scientific information unfold in a time interval, the stocks of knowledge are determined for a point in time and have a tendency of growing. In this connection, the rate of flows per time unit can be established in order to characterize the intensity of activity and of statistics exchanges. The particularity exists of not diminishing the stock of science as a result of the flows crossing the border outside, whereas the inputs most often bring about an increase in accumulations. Besides the interconnexions of disciplines in the system of socio-economic statistics, there are its connexions with other systems of disciplines forming its environment in education. Through the input and output, the statistical disciplines system makes a constant exchange of information with the branch economy, mathematics, informatics, cybernetics, etc.

In this sense, we can consider as an example the influence exerted on statistics (operand) by the information theory (operator) and the product of the change in the operand represented by informational statistics (transformed).

A transfer of concepts and methods may sometimes take place between statistics and other apparantly distant sciences. For example, the tendency of shifting along production processes of shorter duration and higher frequency may be interpreted in terms of radiations physics with a displacement towards blue. This is equivalent to the displacement of spectral lines towards shorter wavelengths as a result of the Doppler effect caused by an approaching source [16].

Another essential feature of the statistical disciplines system is its capacity of actively interacting with the socio-economic environment through statistical practice. The socio-economic activities determine a "demand" for statistics and through feed-back statistics conditions the knowing, organization and stepping up of socio-economic life.

The whole evolution of statistics is a result of the interaction of its heredity with the scientific and socio-economic environment, an interaction which exemplifies very well, for instance, the appearance in the 17th and 18 th centuries of the German descriptive school and of the British political arithmetics.

In the process of interaction with environment, statistics has improved its methodology and concepts, however maintaining constant some internal structures ensuring the continuity of the existence of the system.

The process of osmosis and interface between the sciences of nature and of society has engendered the appearance of the bordering disciplines situated in the vicinity of statistics. Their category includes sociometrics, econometrics, psychometrics, marketing and demography. Another characteristic of our time is the impact of informatics which by revolutionizing the data processing methods has generated a new concept on the role and facilities of statistics. The automation of statistical data processing also facilities a thorough knowledge of reality by improving the quality of the informational content of indices. On the other hand, automatic processing was required by the need of processing a still greater volume of statistical data, by more laborious methods of analysis, by the new exigences of economic practice.

As can be seen, a systemic analysis implies the handling of an interdisciplinary methodology and the operation of a simplification, abstractization and overture towards the investigated systems. If we look at the time intervals we can try an overture by indentifying at an extremity the existence of an evidence of forecasts which might be called "futurostatistics". At the other extremity we can speak about a "paleostatistics" of the distant periods in the past which must reconstitute the series of data or operate with nonquantitative methods. On the other hand, another overture is possible based on the impact of biology with statistics, on the field of measuring human activity within a biologization of economic sciences.

In conclusion, the system of statistical disciplines just like other systems of disciplines is constantly developing, is amplifying its stock of knowledge and is changing its structure to adapt itself most adequately to the requirements of education and of economic practice.

THE BLOCK SCHEME OF THE SUBSYSTEMS OF STATISTICAL DISCIPLINES

If we consider that the activity of integration of education with research is similar to the functioning of the systems of interconnected actions in technics and biology we can try to apply the general principles and the theoretical schemes on the functioning of living mechanisms and bodies to the investigated field.

Based on the formulas and general principles of adjustment and management substantiated by Oskar Lange in "Introduction to Economic Cybernetics" we can study the functioning of the adjustment subsystems "Theoretical and Economic Statistics" and "Statistics of Branches". The adjusted subsystems S_1 and S_2 achieve through research the development-systematization of the stock of scientific information in the field of statistics and the adaptation-integration of knowledge resulting from environment. In other words, the subsystems transform inputs X_1 and X_2 into outputs Y_1 and Y_2 and regulators R_{11} and R_{22} correct the deviations from the command values Z_1 and Z_2. The corrections take place through a selective development and reorganization of the stock of knowledge or through the elimination of repetitions and of obsolete data, in keeping with the progress of sciences and the requirements of didactic activity and of economic practice.

The transfer of concepts and methods between the subsystems is achieved according to the investigated economic space pursuing the amplification of statistical knowledge and the avoidance of unjustified repetitions with the aid of regulators R_{12} and R_{21}.

The input dimensions X_1 and X_2 or the exterior state to which the subsystems react are constituted by information flows resulting from the environment made up of other sciences and on the other hand, of the didactic activity and the statistical-economic practice. The outputs Y_1 and Y_2 acting on the afore mentioned environment are made up of laws, concepts, tests, principles, methods, rules, methodologies, norms, relations, analyses, classifications, data, graphs, etc. organized in courses and collections in keeping with the curricula.

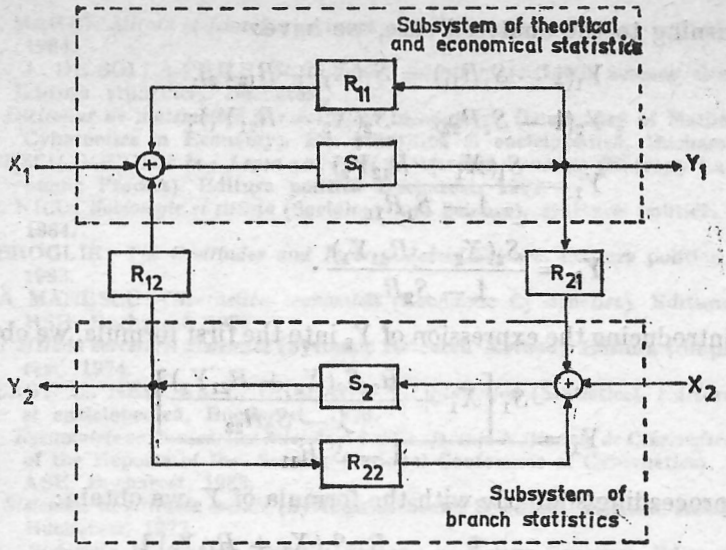

Fig. 1

The interdependence relations between the analysed systems are graphically illustrated by their direct and feedback connexions within the block scheme.

To calculate the numerical results of the connexions of the two (sub)-systems we shall determine the formulas of the output dimensions based on the fundamental formula of the adjustment theory $Y = \dfrac{S}{1 - SR} X$. We consider that in the adjusted subsystems proportional transformations take place by multiplying the input dimension (the volume of scientific information expressed in hours) by a real number S expressing the transfer capacity of the subsystem. Proportional transformations take place in the regulators, with a transfer capacity R so that $S_1R_{11} < 1$ and $S_2R_{22} < 1$. Based on the configuration of the scheme we can write:

$$Y_1 = S_1(X_1 + \Delta X_1) = S_1(X_1 + R_{11}Y_1 + R_{12}Y_2),$$
$$Y_2 = S_2(X_2 + \Delta X_2) = S_2(X_2 + R_{22}Y_2 + R_{21}Y_1).$$

If we generalize, considering n (sub)systems, it results:

$$Y_1 = S_1\left(X_1 + \sum_{i=1}^{n} R_{1i}Y_i\right).$$

$$Y_2 = S_2\left(X_2 + \sum_{i=1}^{n} R_{2i} - Y_i\right).$$

.....

$$Y_n = S_n\left(X_n + \sum_{i=1}^{n} R_{ni}Y_i\right).$$

Returning to the analysed case, we have:

$$Y_1(1 - S_1R_{11}) = S_1(X_1 + R_{12}Y_2),$$

$$Y_2(1 - S_2R_{22}) = S_2(X_2 + R_{21}Y_1);$$

$$Y_1 = \frac{S_1(X_1 + R_{12}Y_2)}{1 - S_1R_{11}}$$

$$Y_2 = \frac{S_2(X_2 + R_{21}Y_1)}{1 - S_2R_{22}}.$$

By introducing the expression of Y_2 into the first formula, we obtain:

$$Y_1 = \frac{S_1\left[X_1 + \dfrac{R_{12}S_2(X_2 + R_{21}Y_1)}{1 - S_2R_{22}}\right]}{1 - S_1R_{11}}.$$

By proceeding similarly with the formula of Y_2 we obtain:

$$Y_2 = \frac{S_2\left[X_2 + \dfrac{R_{21}S_1(X_1 + R_{12}Y_2)}{1 - S_1R_{11}}\right]}{1 - S_2R_{22}}.$$

As a result of computation, we obtain the final formulas of the output dimension for the 2 (sub) systems.

$$Y_1 = \frac{S_1X_1 - S_1S_2R_{22}X_1 + S_1R_{12}S_2X_2}{1 - S_1R_{11} - S_2R_{22} + S_1R_{11}S_2R_{22} - S_1R_{12}S_2R_{21}}$$

$$Y_2 = \frac{S_2X_2 - S_1S_2R_{11}X_2 + S_2R_{21}S_1X_1}{1 - S_1R_{11} - S_2R_{22} + S_1R_{11}S_2R_{22} - S_1R_{12}S_2R_{21}}.$$

To obtain an output dimension equal to the command value the number of hours in the plan of each subsystem, we introduce into the formulas $Y_i = Z_i$ and calculate the input dimension X_i or the transmittance R_{ni}.

Obviously, the application of cybernetics in statistical education serves in the knowledge, planning and management of teaching, based on the adjustment mechanisms of the (sub)systems of interconnected disciplines.

The systemic analysis is the most promising way of approaching the science "Socio-economic Statistics". The systemic approach of the statistical disciplines as a whole allows for a thorough knowledge of the internal and external connexions of the system and the motivation of the interdisciplinary flow of concepts and methods.

REFERENCES

1. ASHBY W. ROSE: *Introduction to Cybernetics*. Editura Tehnică, Bucharest, 1972.
2. BERNAL, J.: *Science in the History of Society*. Editura politică, Bucharest, 1964.
3. BIJI E., TÖVISSI L.: *Statistica teoretică* (Theoretical Statistics), Lithography, ASE, 1984.

4. BUNGE MARIO: *Ştiinţă şi filozofie* (Science and Philosophy). Editura politică, Bucharest, 1984.
5. DOROK, J., DE SOLLA PRICE: *Ştiinţa mică, Ştiinţa mare* (Little Science, Great Science). Editura ştiinţifică, Bucharest, 1971.
6. * * * : *Dicţionar de matematică şi cibernetică în economie* (Dictionary of Mathematics and Cybernetics in Economy). Ed. ştiinţifică şi enciclopedică, Bucharest, 1979.
7. GEORGESCU-ROEGEN N.: *Legea entropiei şi procesul economic* (Entropy Law and Economic Process). Editura politică Bucharest, 1972.
8. IAHIEL NICO: *Sociologie şi ştiinţă* (Sociology and Science). Editura politică, Bucharest, 1984.
9. L. DE BROGLIE: *The Certitudes and Incertitudes of Science*. Editura politică, Bucharest, 1983.
10. MANEA MĂNESCU: *Cibernetica economică* (Economic Cybernetics). Editura Academiei RSR, Bucharest, 1979.
11. * * * : *Metoda cercetării sistemice* (Systemic Research Method). Editura ştiinţifică, Bucharest, 1974.
12. MOINEAGU C., NEGURA I., URSEANU V.: *Statistica* (Statistics), Editura ştiinţifică şi enciclopedică, Bucharest, 1976.
13. * * * : *Rezumatele comunicărilor celei de a 2-a Conferinţe Naţionale de Cibernetică* (Abstracts of the Reports of the Second National Conference of Cybernetics), Litography, ASE, Bucharest, 1983.
14. * * *: *Sistemele în ştiinţele sociale* (Systems in Social Sciences). Editura Academiei RSR, Bucharest, 1977.
15. * * * : *Sistemele în ştiinţele naturii* (Systems in Nature Sciences). Editura Academiei RSR, Bucharest, 1979.
16 WEINBERG STEVEN: *The First Three Minutes of the Universe*. Editura politică, Bucharest, 1984.