Professor MANEA MĂNESCU
Member of Romanian Academy

"Nowadays cybernetics has an increasing importance in the management of industrial and economical processes, in reducing the special productivity of man's work, in the overall progress of mankind."

NICOLAE CEAUȘESCU

from the Message addressed by the President of the Socialist Republic of Romania to the Third International Congress of Cybernetics and Systems.

The Financial And Price System. Cybernetic-Economic Models of the System

In the complex mechanism of directing all components of national economy system on the optimal trajectory growth, a major part is played by the financial and price system — a synthesis system — penetrating in all cells of economic body.

Under the conditions of managing on the base of the single national plan, country's whole economic-social life, the financial and price system has to face very important tasks for fulfilling the objectives resulted from the general policy of economic-social development.

The economic practice outlines the important role of *financial levers* in directing, controlling and adjusting the phenomena and processes taking place within the national economy space, with a view to efficiently fulfill the settled economic objectives. At the same time, the financial and price system has to meet many targets for ensuring the continuous connections between macro and microeconomy, for maintaining all systems and subsystems within the national economy space *on the dynamic equilibrium trajectory.*

By means of financial and price system, the efficiency and profitableness of all activities taking place within the national economy space is measured, thus ensuring the mobilization and distribution of the assets necessary to the development of goods production, services, systematic increase of nation's welfare, *the strengthen of economic administration and rational management of financial and material resources,* for a strict economic policy (Fig. 1).

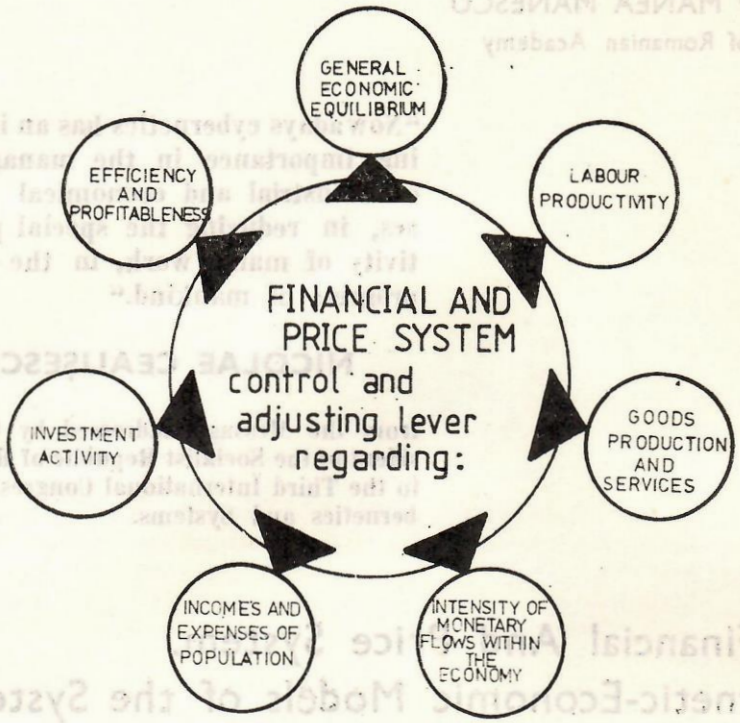

Fig. 1

The financial and price system is also very important for achieving the *general record of national wealth*, for knowing the situation of all production goods the society disposes of, and the other elements of the national wealth systems, in such a way as to achieve the best management under the conditions of strengthening the order and financial discipline for managing the public patrimony.

By using more and more improved methods and computing technique, the price and financial system together with the economic information system, assures by means of patrimonial and bank accounts, by the budget and balancesheet, the records of monetary flows movement and of the financial fund balances, of the financial-economic results of the units, as well as of the patrimony administration manner.

The financial and price system by its functional subsystems — state budget, credits subsystem, price subsystem, organised economies subsystem, insurance subsystem — assures the maintenance *of optimal intensity concerning all financial flows in economy*, sine qua non condition of efficient working of national economy system. By working out the financial and balanceshet plans at all organizational levels, it is ensured within the financial and price system, the concentration and controlling of financial resources with a view to perform the fundamental objectives of social-economic development set

up by the management command control regulation system. At the same time, by its levers and by the mechanisms specific to financial and price system, the functional independence of each economic units and the most efficient utilization of that share of the nation's general wealth are ensured

Within the financial plans worked out by the components of the system of goods production and services (enterprises, centrals, assimilated units and co-operative organizations), it is quantified the financial indicators level, financial connections formed with other components of national economy space, as well as the resources to be received with a view to fulfill the respective tasks. The financial plans over territory mirrors the financial potential of the territory units, the forward and feedback connections which are formed on the base of financial flows with the other components of the national economy's general cybernetic system.

The totality of financial flows formed within the national economy space are synthesised into the *centralized financial plan* — a very important instrument by which it is ensured the financial equilibrium at the level of general cybernetic system ensemble. The main input flows of the centralized financial plan proceed from the system of goods production and services, they quantifying the monetary accumulations under the form of benefits and tax on goods circulation, the amortization of fixed assets, a.o.

At the same time, the flows proceeding from the international economic relations system, the incomes and payments from the foreign trade activity and other foreign activities, respectively, are directed towards the centralized financial plan.

The output flows within the centralized financial plan are directed towards all the components of the general cybernetic system of national economy, they quantifying the magnitude of investments from state assetss the resources meant to covering the growth of stocks and mineral reserves, the expenses for foreign activity, for social-cultural activities, a.o.

Strong connections are formed between the input and output flows, thus being performed the equilibrium of incomes and expenses in the planning process. This is done on one hand by mobilizing all income resources and on the other hand by settling the options and priorities as regards the expenses. We have to mention that, during the operation, the connection is maintained and the expenses are made only to the extent to which the necessary resources have been created. Thus, we deal with a *cybernetic regulation* of expenses level depending on the incomes volume to be performed.

The centralized financial plan is one of the main instruments of checking the state of *dynamic equilibrium* of the projected growth trajectories

An important part is played by the procise knowledge of monetary intensity flows which are formed with the population and labour force system, in ensuring the continuous increase of nation's wealth. This important task is performed by the financial and price system by means of *population's expenses and incomes balance*. This has to ensure an optimal proportionality between population's incomes and expenses.

Population's incomes and expenses balance quantifies the financial intensity flows directed towards the population and labour force system, and the output ones, i.e. their distribution manner to several components representing population's expenses.

Input flows, within the population's incomes and expenses balance, mainly proceed from the effectory systems, i.e. from the performed work payment, from sales of agricultural products through goods circulation subsystem, as well as from the incomes of social funds consumption obtained by population under several forms as: retired pays, scholarships, social assistance, expenses for public education, health protection, a.s.o.

The main directions of output flows within the population incomes and expenses balance are referring to the purchasing of goods and services which are fulfilled by means of goods circulation subsystem, dwellings buying, as well as the deposition at savings bank under the form of population savings.

Thus, it is outlined the fact that the monetary expenses and incomes balance of population reflects the coupling between the moment of distribution and that of consumption within the complex process of extended reproduction. In this way, the synchronization of phenomena and processes taking place within the financial and price system is ensured to those within the subsystems of distribution and final utilization of the national income, as well as to those within the nation's wealth system.

Important connections exist between several financial macroflows taking place within the financial and proce system, i.e. between several types of funds, this fact generating a mechanism similar to that one formed between the communicating vessels.

Thus, on the base of financial and political policy decisions adopted by the macroeconomic decision element with respect to the demands of each development stage, the financing tasks of certain actions can be transmitted from state budget to bank credit or upon the funds, the necessary resources being moved in a corresponding manner. Obviously, the flows can take place to inverse direction.

The tight connections formed between several types of financial funds are performed on the base of monetary forward and feedback flows between them. Thus for example, the state budget ensures the long-range crediting resources, while the surplus of budgetary execution becomes short-range crediting resource. At the same time, the budgetary surpluses accumulated as crediting resources can be withdrawn, rebecoming budgetary incomes and the funds of temporarly available units become crediting resources etc. Thus, it is outlined the strong connection between several categories of funds within the financial and price systems, the mechanism of communicating vessels formed among them (Fig. 2).

Between the financial and price system and other components of national economy's general cybernetic systems, multiple forward and feedback connections are formed, especially performed by means of monetary flows quantifications, in fact, the intensity of goods and services flows between the systems and subsystem evoluating within the national economy space, in this way contributing to ensure the dynamic equilibrium state and therefore the general economic equilibrium. This underlines once more the important part played by the financial and price system as lever of the management command control regulation system, for coordination and synchronizing the growth process of all components of national economy system.

The forward and feedback connections which are performed between the system of management command control regulation and the financial

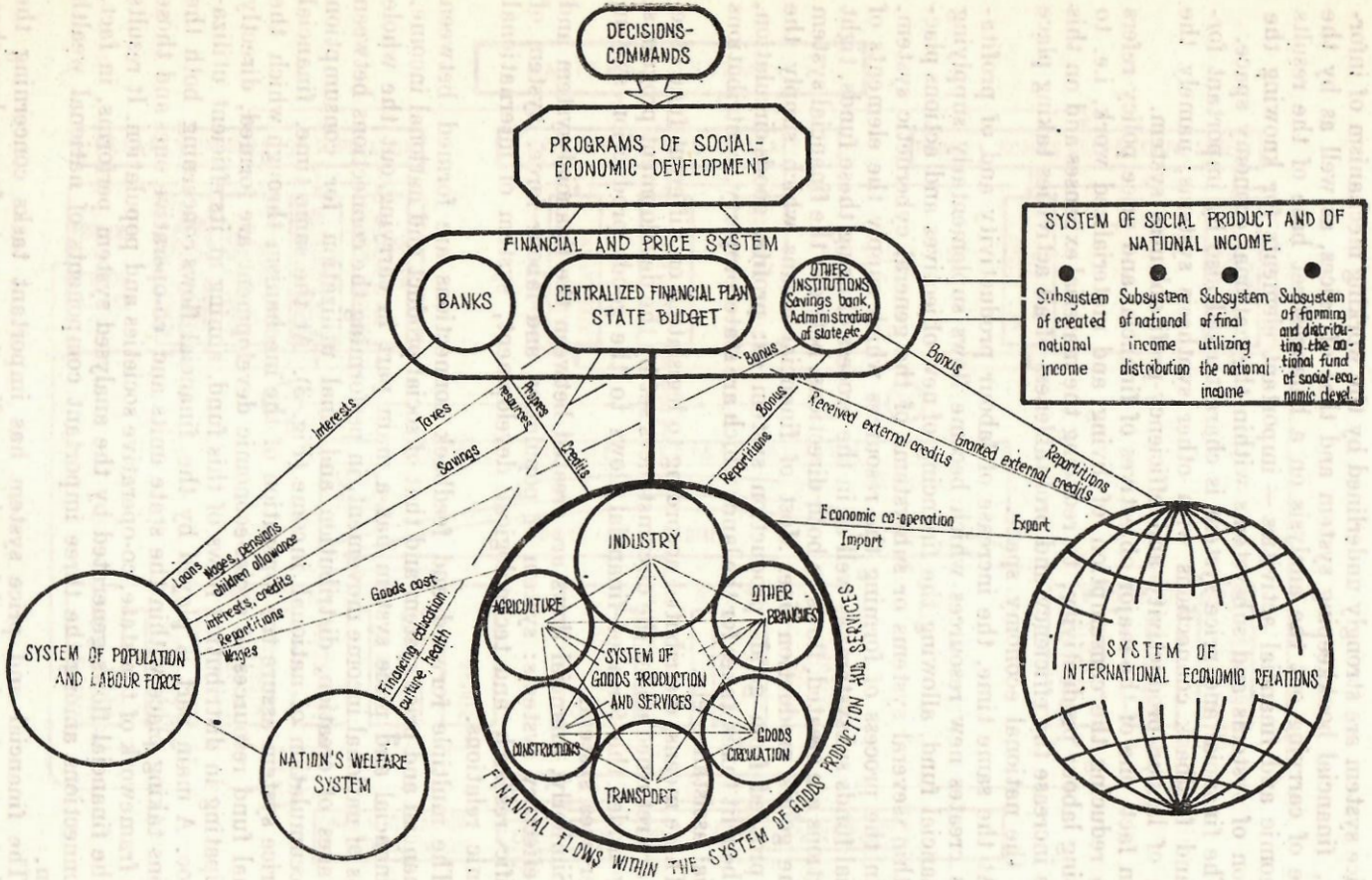
DECISIONS-COMMANDS
PROGRAMS OF SOCIAL-ECONOMIC DEVELOPMENT
FINANCIAL AND PRICE SYSTEM
BANKS
CENTRALIZED FINANCIAL PLAN STATE BUDGET
OTHER INSTITUTIONS Savings bank, Administration of state, etc
SYSTEM OF SOCIAL PRODUCT AND OF NATIONAL INCOME
Subsystem of created national income
Subsystem of national income distribution
Subsystem of final utilizing the national income
Subsystem of forming and distributing the additional fund of social-economic devel.
Bonus
Interests
Taxes
Payments
Resources
Savings
Credits
Loans
Wages, pensions children allowance
Interests, credits
Repartitions
Wages
Goods cost
Financing education culture, health
Repartitions
Received external credits
Granted external credits
Economic co-operation
Import
Export
SYSTEM OF POPULATION AND LABOUR FORCE
NATION'S WELFARE SYSTEM
INDUSTRY
AGRICULTURE
OTHER BRANCHES
SYSTEM OF GOODS PRODUCTION AND SERVICES
CONSTRUCTIONS
GOODS CIRCULATION
TRANSPORT
FINANCIAL FLOWS WITHIN THE SYSTEM OF GOODS PRODUCTION AND SERVICES
SYSTEM OF INTERNATIONAL ECONOMIC RELATIONS

Fig. 2

and price system are strongly underlined by the working mechanism of information, financial bookkeeping system and that of prices, as well as by the practice of carrying out the analysis on a balancesheet base of the results of economic and financial activities — important elements for knowing the evolution of systems and subsystems within the national economy space.

The financial and price system is characterized also by important forward and feedback connections with other synthesis systems, namely the system of labour productivity and efficiency-profitableness system.

In fact, one of the major objectives of financial and price policy refers just to reducing the consumption of living and materialized work, i.e. to increasing labour productivity, to reducing the material expenses and on this base to increase the efficiency and profitableness of all activities taking place within the national economy space.

At the same time, the increase of labour productivity and of profitableness creates new resources which become flows suplementarly supplying the financial fund, allowing the financing of new objectives and actions placed within several systems or subsystems of the general cybernetic system.

In the process of forming the resources which supply the elements of financial funds subsystem, as well as in the process of using these funds, tight connections are created, flows to both directions, between the financial system and the goods production one. Most of financial means which supply the funds proceed from goods production system as: profits, goods circulation, taxes, benefit taxes, taxes for the lands which are state property, contributions to social assistance etc.

These means, distributed according to legislation on different fund categories are returned under the circumstances set by the development programs, mostly under the form of financial flows to the goods production system and services system.

Similarly, financial flows are created between the financial system and other effectory systems: system of population and labour force, system of scientific research and technological development, system of international economic relations.

The multiple forward and feedback connections are formed between the financial and price system and that of social product and national income. The financial and price system has a main part in carrying out the whole process of national income movement, in performing the connections between the stages of creation, distribution and final utilization for consumption and accumulation of national income (Fig. 3). At the same time, financial and price system assure the operation of the mechanism through which the national fund resources of social-economic development are formed, directly participating in distribution flows of this fund, aiming at its efficient utilization too. A main part is played by the financial flows concerning both the relations taking place within the state units and co-operative ones and those in the framework of the state, co-operative societies and population. It results that the financial flows generated by the analysed system performs, in fact, the connections among the three important components of national wealth system.

The financial and price system has important tasks concerning the record of accumulated material goods according to property forms, branches,

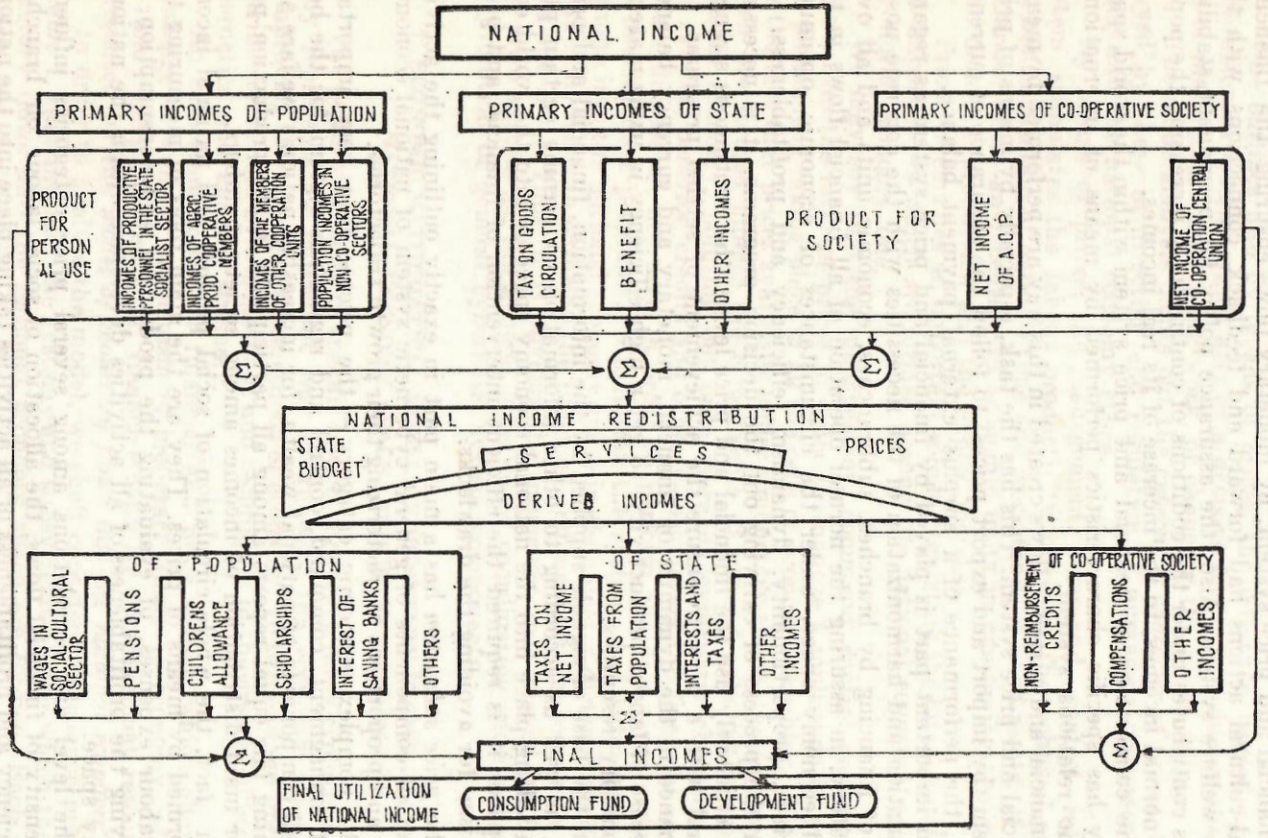
NATIONAL INCOME
PRIMARY INCOMES OF POPULATION
PRIMARY INCOMES OF STATE
PRIMARY INCOMES OF CO-OPERATIVE SOCIETY
PRODUCT FOR PERSONAL USE
INCOMES OF PRODUCTIVE PERSONNEL IN THE STATE SOCIALIST SECTOR
INCOMES OF AGRIC. PROD. COOPERATIVE MEMBERS
INCOMES OF THE MEMBERS OF OTHER COOPERATION UNITS
POPULATION INCOMES IN NON CO-OPERATIVE SECTORS
TAX ON GOODS CIRCULATION
BENEFIT
OTHER INCOMES
PRODUCT FOR SOCIETY
NET INCOME OF A.C.P.
NET INCOME OF CO-OPERATION CENTRAL UNION
Σ
NATIONAL INCOME REDISTRIBUTION
STATE BUDGET
SERVICES
PRICES
DERIVED INCOMES
OF POPULATION
WAGES IN SOCIAL-CULTURAL SECTOR
PENSIONS
CHILDRENS ALLOWANCE
SCHOLARSHIPS
INTEREST OF SAVING BANKS
OTHERS
OF STATE
TAXES ON NET INCOME
TAXES FROM POPULATION
INTERESTS AND TAXES
OTHER INCOMES
OF CO-OPERATIVE SOCIETY
NON-REIMBURSEMENT CREDITS
COMPENSATIONS
OTHER INCOMES
FINAL INCOMES
FINAL UTILIZATION OF NATIONAL INCOME
CONSUMPTION FUND
DEVELOPMENT FUND

Fig. 3

organizational structures and to the ensemble of national economy, quantification of natural resources etc.

Financial and price system, by monetary flows ensuring the financing of social-cultural actions had forward and feedback connections with the nation's welfare system. Also, the assurance policy for permanent stability of prices contributes under the coditions of continuously increasing the population's normal incomes, to the incerase of its real incomes.

The connections of financial and price system within the world space economy has specific characteristics performed by means of international economic relations system.

Financial and currency flows created in this way are performed by means of financial and price system. This has the task, especially by means of price subsystem (by import and export prices) to follow the ensurance of currency balance, the performance of a surplus external payment balance.

An important part is played by financial and price system as regards the regulation and harmonization of the necessities with the concrete possibilities of financing by branches, subbranches, economic units and all over the territory, in assuring the normal operation of all financial flows in the national economy space, under the circumstances of economic optimum, equilibrium, proportionality, dynamism, efficiency and profitableness.

In the process of carrying out the decision programs, it is necessary to most efficiently use the financial and price levers, the continuous strength of control with a view to ensure the achievement of settled programs, the maintenance in the dynamics of financial, monetary and currency balance, the increase of labour productivity to get a high efficiency in using material and monetary resources.

On the base of signals supplied by the information, financial and price system, as well as according to other information concerning certain phenomena taking place into the national economy space or into the world economy space, it is required the efficient intervention of financial and price mechanism for avoiding the drawlacks.

The *price subsystem* has a main part in exactly outlining the activity results of all components of general cybernetic system of national economy, of rates and proportions characterizing their growth trajectories.

The complex economic category — the price — is a very important lever of managment, command, control and regulation system for the best use of all components of national wealth, for increasing nation's welfare and performing fair equal reports among all participants in the production process, for main distribution of incomes among society members.

In fact, the whole circulation of social product and national income is performed by means of prices. They are the main tools of measuring the social labour expenses, of evaluating the production and consumption, of quantifying the profitableness of all activities developed within the national economy space.

The level and correlations among several price categories influence the intensity of financial flows, the allocation of social labour on branches, the efficiency and profitableness of all activities taking place into the national economy space. Under price incidence there are also flows which are formed between the components of goods production and services. We refer to the

flows intensity among the subsystems of industry and that of agriculture, depending on a certain extent on the correlation between the prices of industrial produces and prices of agricultural products.

One outlines also by means of prices, the influence caused by labour profitableness system, which acts as a decisive factor to reducing the expenses of materialized and living work, of changing the goods value.

The made analysis points out the *cybernetic character of prices*, the role played by these in directing and regulation of numerous processes taking place into the national economy space.

By means of prices, the management, command, control, regulation system stimulates the labour productivity increase, the technical progress, the best utilization of nation's time and work fund, of fixed assets, of natural resources, offers an incentive to economic units in consuming the products from domestic production and the export increase.

Price systems has an important role in regulating the intensity of export and import flows which are formed among the national economy space and the world economy one.

We may say that the management, command control and regulation system uses the lever of prices in order to manage a multitude of processes and phenomena taking place in all the cells of economic organism. This outlines the fact that prices synthesise under a monetary shape, the complex links which are formed among the components of general cybernetic system of national economy, pointing out once more its cybernetic character.

Prices, benefits, credits and other valoric levers the financial and price system dispose of, are used in order to perform the objectives included in the development programs, to maintain the systems and subsystems which evoluate into the national economy space in *their state of dynamic equilibrium.* This finally leads to ensuring the financial and monetary balance at a macroeconomic level. Thus, it is obvious the important part played by financial and price system in the general logistics of coordinating and synchronizing the evolution of general cybernetic system components.

1. ECONOMIC MATHEMATICAL MODEL OF MONETARY FLOWS IN THE NATIONAL ECONOMY SPACE. BUDGET EQUATION

The performed study of specific laws of monetary flows evolution in economy represents an important way of knowing the economic mechanism, of improving the management methods of economy. To this end, an important contribution is held by the methods and techniques in the arsenal of economic cybernetics and cuantic economy.

An important model of financial and price system which allows the knowledge of working mechanism of monetary flows in economy, of forming and using the incomes, financial capacity, the financial resources is represented by the *model of monetary flows into the national economy space.*

In order to analyse the model, we shall consider the balance presented in table 1, that includes the systems and subsystems among which the main monetary flows into the national economy space are formed. Each of the elements of table's lines and columns are detailed, with respect to the analysis requires, in a corresponding number of components.

BALANCE OF MONETARY FLOWS WITHIN THE NATIONAL ECONOMY SPACE

INPUTS \ OUTPUS		SYSTEM OF GOODS PRODUCTION AND SERVICES						FINANCIAL AND PRICE SYSTEM				SYSTEM OF POPULATION AND LABOUR FORCE	SYSTEM OF ECONOMIC INTERNATIONAL RELATION	BALANCE	TOTAL
		INDUSTRY	AGRICULTURE	CONSTRUCTIONS	TRANSPORTS	GOODS PRODUCTION	OTHER BRANCHES	STATE BUDGET	BANKS	BANKS	ASSURANCE				
1 SYSTEM OF GOODS PRODUCTION AND SERVICES	INDUSTRY														
	AGRICULTURE														
	CONSTRUCTIONS			A_{11}					A_{12}			A_{13}	A_{14}	δ_1	Y_1
	TRANSPORTS														
	GOODS CIRCULATION														
	OTHER BRANCHES														
2 FINANCIAL AND PRICE SYSTEM	STATE BUDGET														
	BANKS			A_{21}					A_{22}			A_{23}	A_{24}	δ_2	Y_2
	BANKS														
	ASSURANCE														
3 SYSTEM OF POPULATION AND LABOUR FORCE				A_{31}					A_{32}			A_{33}	A_{34}	δ_3	Y_3
4 SYSTEM OF ECONOMIC INTERNATIONAL RELATIONS				A_{41}					A_{42}			A_{43}	A_{44}	δ_4	Y_4
BALANCE				Δ_1					Δ_2			Δ_3	Δ_4		
TOTAL				X_1					X_2			X_3	X_4		

In dial A_{11} of balance there are included the monetary flows which are formed between the components of material production system and that of services. Firstly, it is outlined the monetary flows which are formed within the subsystems of industry, agriculture, transports, goods circulation as well as the monetary flows among these subsystems, i.e. among the industrial transport and agricultural units.

In dial A_{12} there are outlined the monetary flows which are formed between the components of goods production system and of services and that of financial and price system.

These refer to the taxes upon goods circulation, credits reimborsement, contribution to social assistance, goods assurance, etc.

Dial A_{13} reflects the monetary flows directed by goods production system and of services by the system of population and labour force: wages payment, payment of contracts for agricultural products etc.

The flows reflected in dial A_{14} refer to the payments of financial system, toward foreign countries by means of international economic relations system.

Similarly, on the base of analysing the monetary flows taking place in economy, one may infer the content of other dials included into the balance presented in the table.

In case of a detailed analysis concerning the mechanism of forming the monetary flows in economy, one may introduce also within the balance, the other components of general cybernetic system of national economy: system of social product and of national income, system of nation wealth, a.s.o.

In order to present under an equation form the monetary flows which are formed into the national economy space, the following notations will be used:

φ_{ij} — intensity of monetary flow directed from component i to component j of national economy space ($i, j = 1, 2, ..., n$)

X_j — the inputs sum of monetary flows within the component $j (j = 1, 2, ..., n)$;

Y_i — outputs sum of monetary flows within component i ($i = 1, 2, ..., n$)

The following equilibrium equations can be written according to the introduced relations;

$$\sum_{i=1}^{n} \varphi_{ij} = x_j (j = 1, 2, ..., n)$$

$$\sum_{j=1}^{n} \varphi_{ij} = y_i (i = 1, 2, ..., n)$$

For a first step of analysis, one may assume that rations:

$$\frac{\varphi_{ij}}{Xj} = \lambda_{ij}$$

are constant. In this case, one gets the following equation system of monetary flows:

$$\sum_{j=1}^{n} \lambda_{ij} x_j = y_i (i = 1,2, ..., n)$$

The above system can be written as follows under a matrix form:

$$\Lambda X = Y$$

the following matrix notations have been used:

$$\Lambda = || \lambda_{jj} ||_{n \times n}$$

$$X = || x_j ||_{n \times 1}$$

$$Y = || y_i ||_{n \times 1}$$

when $x_i = y_i$, i.e. the inputs sum within a component is equal to outputs sum, the above matrix equation can also be written:

$$(E - \Lambda) X = \varnothing$$

where $\varnothing$ denotes the vector having all the components null.

On the base of matrix equation utilization presented above, we can analyse the direct influences, as well as those of propagation effect, generated by the intensity change of certain flows which are formed into the national economy space. Thus, for instance, it is possible to be analysed the direct influences and those ones of the propagation effect, generated by increase of work payment in certain sectors of economy, by changes occured in the level of enterprises benefits, a.s.o. In order to deeper study the evolution of monetary flows into the national economy space, the worked out analysis on the base of presented linear model, has to be improved by the results obtained by solving certain non linear models better underlining the particularity of financial connexions.

In case of cybernetic economic models of financial and price system, an important part is played by *budget equation.* The following relations will be used in order to write this equation:

- X — vector whose components quantify the material production and services;
- σ — vector — line of taxes share upon goods circulation;
- β — vector whose components quantify the benefit;
- $\hat{\beta}$ — share of payment from benefits;
- γ — vector whose components underline the taxes upon incomes of co-operative farms and enterprises;
- δ — vector whose components underline the share from other incomes performed by the budget, from the system of goods production and services;
- Y — budget incomes of state social assistance;
- Z — incomes from foreign trade and from other activities with foreign contries;

$\hat{Z}$ — inputs of received external credits and cashing the due instalements for the granted external credits;
C — the increase of deposition balance at saving banks;
α — coeffiecient of taking over from the increase of permanent balance at saving banks;
φ — other budget incomes.

Denoting by V — the general total of budget income, we can write:

$$V = (\sigma + \hat{\beta}\beta + \gamma + \delta)\ X + Y + Z + \hat{Z} + \alpha C + \xi$$

Each of the elements presented above are in their turn, functions having an important number of variables underlining the specific mechanisms of performing the budget income.

For the equation distribution of state expenses budget the following notations will be used:

I — expenses for investments;
H — other expenses for financing the objectives and actions performed from the national fund of social-economic development;
S — expenses related to the operation of scientific research system;
B — expenses for financing the actions related to the nation welfare system, the education, culture and art, public health, etc.
E — expenses for external granted credits and payment of due instalements of received external credits;
G — expenses of budget for other actions;
m — budgetary reserve fund;
e — surplus budget.

Budget equation on the base of introduced notations is:

$$(\sigma + \hat{\beta}\beta + \gamma + \delta)\ X + Y + \hat{Z} + Z + \alpha C + \xi =$$
$$= I + H + S + B + E + G + m + e$$

For operational reasons, elements of budget equation are detailed on components, underlining for each component the parameters they belong to.

In order to perform the tasks which to underline the activity results of all components of national economy's general cybernetic system to be the main instrument of measuring the social labour expenses, of evaluating the production and the rentability and efficiennoy of activities taking place within the national economy space, the financial and price system uses a series of cybernetic-economic models of prices, among which the most important are the followings:

a) macromodel of prices general rearrangement;

b) model of determining the influence of price changes of the raw materials;

c) model of determining the influence of specific consumption change in materials, remunerations, indirect expenses and net income.

Taking into account that the national economy disposes, at every moment, of a determined volume of human and material resources, the opti-

mal allocation of these on activity branches, the reducing of material expenditures and the permanent increase in the labour productivity, are objective laws and decisive conditions of the national economy development.

The necessity of the price system elasticity arises, on one side, from the compulsory condition of the national economy development — reducing the material expenditures and increasing the labour productivity — and on the other side, from the correlation between the internal and external prices, as result of the growing participation to the international labour division.

The influence of these factors means, in fact, the reflecting inside prices of the reducing in the social labour expenses as result of labour productivity growth.

From this the necessity results of using economic-cybernetic models, by means of which the system under analysis could adopt effective measures depending on the endogenous or exogenous influences under the national economy space.

In writting the prices equation the following notations will be used:

P — row vector of prices;
A — direct expenses matrix;
R — retribution vector;
V — net income vector.

The vectors R and V are also row vectors.

On the basis of the mentioned notations one can write:

$$P = P \cdot A + R + V$$

From the above mentioned relation the following *prices equation, written vectorially* follows:

$$P = (R + V) \cdot (E - A)^{-1}$$

On the basis of the prices equantion it is possible by using specific algorithms, to complete the influences generated by the involving and the propagating effect under the national economy space, as result of price changes of some raw material from import, of specific consumption reduction-a.c. At the same time, the model may be used in the activity of prices rearangement.

* * *

The carried out analysis, the mentioned economic-cybernetic models, have emphasized the part played by the finance and price system into the topology of the general cybernetic system of the national economy; in assuring the economic optimal, balanced and proportional growth, for all the components of the national economy space.