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Aspects of the Characteristics of Territorial Economic-Cybernetic Modelling

The study presents some of the characteristics of economic-cybernetic modelling of territorial development in our country starting from the qualitative aspects of the territorial development.

Within the characteristics of territorial development modelling, ample space is devoted to the rectilinear distance and to the concept of growth territorial centre. In this context, some models of territorial growth using the concept of growth territorial centre are presented.

The territorial economic development is an important component of the economic policy of the Romanian Communist Party, a basic guide-line in building the multilaterally developed socialist society, a guide-line comprised in the Party's Programme. The constant presence of this problem in the development plans of Socialist Romania is a consequence of the Party's preoccupations to improve the territorial structures inherited from the past, structures characterized by disproportions in locating the productive potential, by a lagging behind as regards the socio-economic development of important regions of the country.

The Twelfth Party Congress has adopted a comprehensive guide-programme for Romania's socio-economic development from the territorial point of view, in the 1981—1985 period, whose basic orientations and tasks express the full turning to account of resources in each region, the harmonious development of the branches within the economy of the counties, the judicious location of the economic units and implicitely of work placed, the more intensive development of agriculture in all counties, the furthering of the programmes for the lay out of hydrographic basins, for the development of forests and environment protection [2]. Within this framework, special stress is laid

on the qualitative sides of the territorial growth: a higher increase in the efficiency of economic activity by firmly promoting scientific research, technological development and the introduction of technical progress; the increase in the level of the occupation of labour, ; the furthering of the actions for the systematization of the territory with a view to creating a modern network of localities harmoniously distributed throughout the country and, the raising of the living standards of the population in all the counties of Romania [2].

The main characteristic of the economic-cybernetic modelling of territorial development in our country is the existence as regards elaboration and application — of a *unitary long-range strategy for ensuring the multilateral progress of all regions and localities.* The establishment of the evolution trajectories within the national economy still more requires such long-range strategies, the substantiation of economic policy decisions inclusively by forecasting the dynamic character of the economic phenomena and processes on the basis of economic-cybernetic models [3].

Another important characteristic of this modelling is that the territorial development is intrinsically comprised in the national development programmes through the *location* component.

The solving of the problems of location is mainly tackled through optimal models which, in the conditions of the Romanian economy have led to interesting results both within the economic-cybernetic modelling of branch development [4], [5] and within the economic-cybernetic modelling of territorial development [6]. As regards the latter aspect, there is a proposal tested in France [7] for the use of an index to characterize the distance — "the rectilinear distance" (Fig. 1) equal to the sum of distances on the abscis and on the ordinate between two points in a bidimensional space.

According to adnotations in Fig. 1 the rectilinear distance between points A_1 and A_2 is

$$D(A_1, A_2) = |X_2 - X_1| + |Y_2 - Y_1|.$$

The advantage of considering this index in the optimal problems is that the length of the distance between two points can be considered to be the same regardless of the chosen trajectory; in other words, $A_1BCDEFA_2 = A_1GHI$

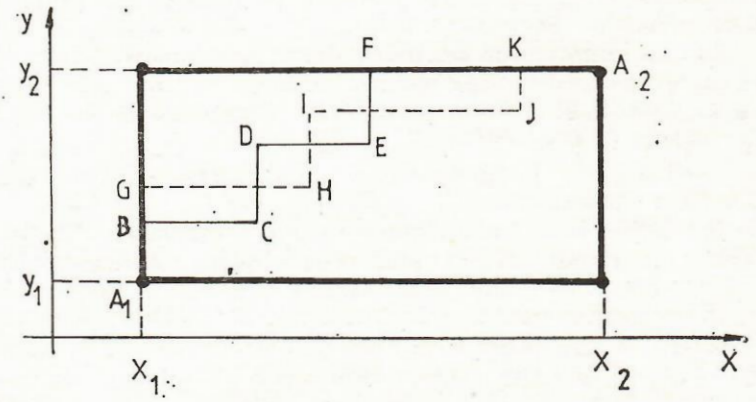

Fig. 1. Rectilinear Distance

JKA_2 and equal to any trajectory of this type chosen between A_1 and A_2. In the optimal solutions for the location of new units, in which the transport expenses are also taken into account, these expenditures can be established for each pair (location point + consumption point) as a constant size regardless of the trajectory followed between the two points, by observing the conditions resulting from Fig. 1: the strict integration of the path in the rectangle generated by the two points (firm condition) and the obtaining of linearity on portions of the chosen path (approximation condition [1]).

Another important characteristic of the economic-cybernetic modelling of territorial development is *to consider regional peculiarities* and those expressing the nature and aim pursued in solving a territorial problem. In this respect, it is absolutely necessary to conceive regional development only as part of national development, as a component of a national policy of territorial development specific to each state, sovereignly and independently worked out in keeping with the interests of the respective nation.

The concept of *growth territorial centre* [2], meaning the creation in various regions (territorial-administrative units, historical-geographical zones, hydrographic basins, etc.) of points of industrial, agricultural, a.s.o. and, generally of production accumulations has become wide-spread in the specialized literature, in the study and analysis of territorial socio-economic development. These centres can be organized on new or on existent platforms, ensuring the polarization of production, of the staff and investments for a gradual development of the entire region, for creating new territorial production structures, for a better turning to account of the resources of the region.

In the People's Republic of Bulgaria, they aim to create on the objective basis of the distribution of productive forces, territorial production complexes, as subsystems of the national economy [8]. The territorial distribution of the productive forces is conceived as a form of social division of labour and through its primary character it is considered to have a value equivalent to the distribution of the productive forces on branches. Its meaning is the relatively equal distribution of the productive forces throughout the territory, the tendency of a gradual disappearance of the essential differences between the productive territorial complexes, their marked specialization and their complex development.

The standard of development is measured through the national revenue growth index and the measure of the level of approach between the productive territorial units by an index expressing per capita the level of covering the consumption needs from primary incomes:

$$g = \frac{V}{C_m}$$

[1] The condition must be understood to the effect that if the trajectory portions are not linear the paths are no longer equal. The authors show that in practical problems the deviations have no significant influence on the results since the deviation marge does not surpass 5—8%.

[2] This concept is found under different names in the economic literature of various countries.

where: g = grade of coverage
V = level of primary incomes per capita in the plan period
C_m = the value of the corresponding needs of consumer goods and services of type m characterizing the consumption budget in various compartments.

The system of planning models achieves the integration of the global economic growth models with the territorial ones (Fig. 2).

In the Hungarian People's Republic, a characteristic of the general development of the economy from the territorial point of view is the development of the provincial centres as a problem whose development must be tackled in a period of several decades [9]. In many regions (north, central, north-east), the wide-scale development of industry has taken place on the basis of the favourable natural and economic conditions. The industrial centres have gradually been turned into industrial zones, thus ensuring the

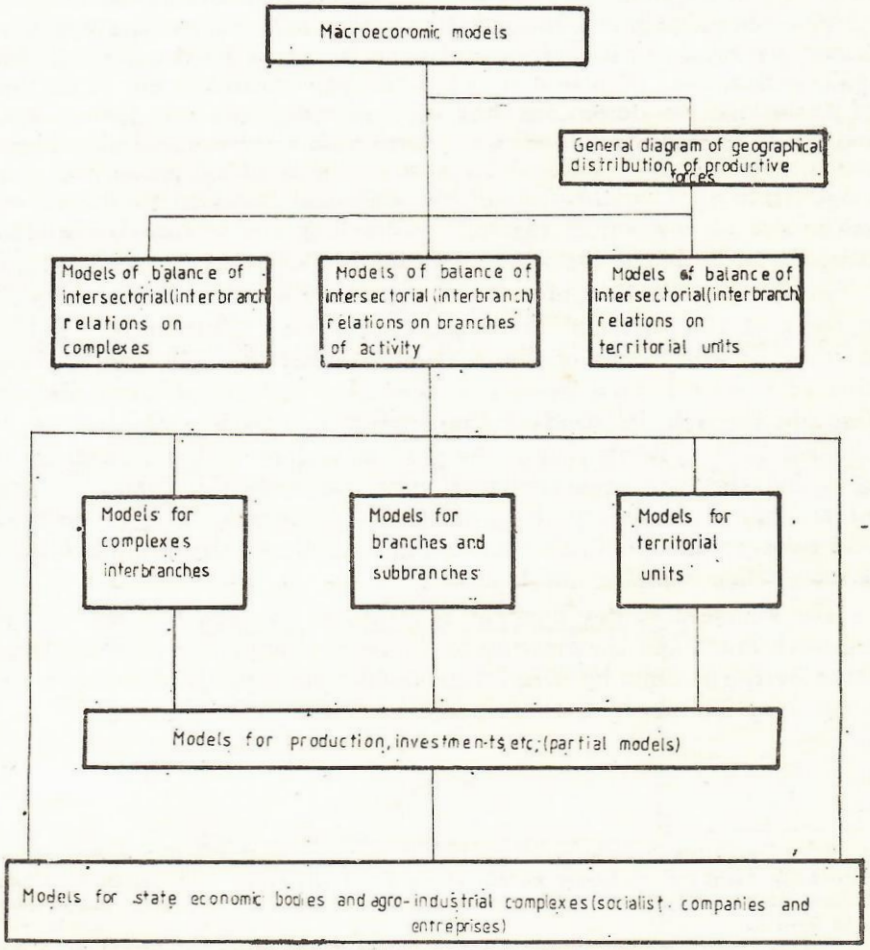

Fig. 2. Integrating models of territorial economic development in global models

improvement of the socio-economic structures of the territorial-administrative units. For the industrially under-developed regions, production centres of manufactured goods have been created and a substructure was built. Worth mentioning as an element specific to the economic policy of territorial development is the creation in each region, regardless of its standard of development, of recreation and tourist centres by developing the existent ones, by creating new ones and by building a special, high quality substructure.

In the German Democratic Republic, specific to the regional economic growth is the setting up of zones with a high denseness of production and population [10]. It is estimated that local and regional agglomeration is one of the main problems of territorial structure development. The agglomerated zone represents a powerful territorial organization both as regards the entire social life of the territory and as regards its production, science and substructure. The local and territorial agglomeration of production, inhabitants, of the basic factors and territorial structure is expressed in the concentration on 10 per cent of the country's surface of about 33% of inhabitants, of about 50% of industrial workers and of 50% of the entire industrial production. As far as the level of concentration is concerned, three categories of zones are distinguished: nuclei of town agglomerations, field of agglomerations and agglomerated territories. Although the agglomeration process is estimated to have attained only average values, it is considered that specific structural features can be outlined for the agglomerated regions: the local and regional concentration of the information, educational and training systems; the high training and educational standard of the population; the local and regional concentration of the factors and networks of the material basis structure; the high regional availability and mobility of the population, production and services.

The consideration of the factor of urban or regional agglomeration as an element of territorial development also appears in some economic-cybernetic models of regional development in Sweden. Thus, the model worked out by the Faculty of Political Economy of the Stockholm University [11] defines a production function for each region

$$Q_i(t) = R_i \cdot e^{\varepsilon t} \cdot K_i^{\alpha}(t) \cdot L_i^{1-\alpha}(t)$$

and an agglomeration function

$$R_i = A \cdot F_i^{\gamma} \cdot B_i^{\beta}$$

where:

i	= the regional index
$Q(t)$	= industrial production in year t
$K(t)$	= capital in year t
$L(t)$	= labour force in year t
R	= technological standard
F	= territorial dimension
B	= denseness of population
α, $1 - \alpha$, γ, β	= flexibilities of the auxiliary factors
ε	= technological growth rate.

The content of the agglomeration function is represented by the standard of technology explained by factors pertaining to the dimension of the region and to the denseness of population. This standard is supposed to be constant within a plan period.

Beside the two above mentioned functions (the production and agglomeration ones) three conditions of equilibrium are comprised in the model:

a) the first for assets

$$\sum_i Q_i(t) = \eta K(t) + \Delta K(t) + S(t)$$

where: η = the wear coefficient of the capital asset, a coefficient constant in time
$\Delta K(t)$ = the increase of the capital asset in year t
$S(t)$ = production surplus in year t above the size of raw investments

b) the second for capital

$$\sum_i K_i(t) = K(t)$$

c) the third for labour

$$\sum_i L_i(t) = L(t) = L_0 e^{nt}$$

where: L_0 = manpower in the basic year
n = labour growth rate.

In the Soviet Union [12], the combination of the sectorial with the territorial principle is defined as an essential characteristic of the planning and management system. The higher bodies (the first two levels) have the function of coordinating the branch options at an all-country level. The lower level bodies (the next two levels) are autonomous financially and are included into the plan options worked out by the higher bodies. The pairs of agents linked on a vertical line are called chains, so that a three-chain management body is created (Fig. 3).

An important practical problem of territorial planning is to establish the location of units within the production territorial complexes, especially of the new ones. The dimensioning of these complex units, the location of enterprises within them or within other regions, the setting up of industrial centres are problems connected with the location ot the production territorial complexes. The instruments used in working out solutions to these problems are the inter-territorial and intersectorial economic-cybernetic models, of optimum, dynamic character, etc. (Fig. 4).

In Holland, the approach of territorial problems is made in close connection with the national whole, the so-called economic regions being defined. [13]. The territorial development modelling must answer two questions: the impact of the development of each region on the national economy, on the one hand and the effects of the measures of economic policy taken by the goverment on the development trajectories of various regions, on the other hand. The Dutch RM 73 model of simulating territorial development com-

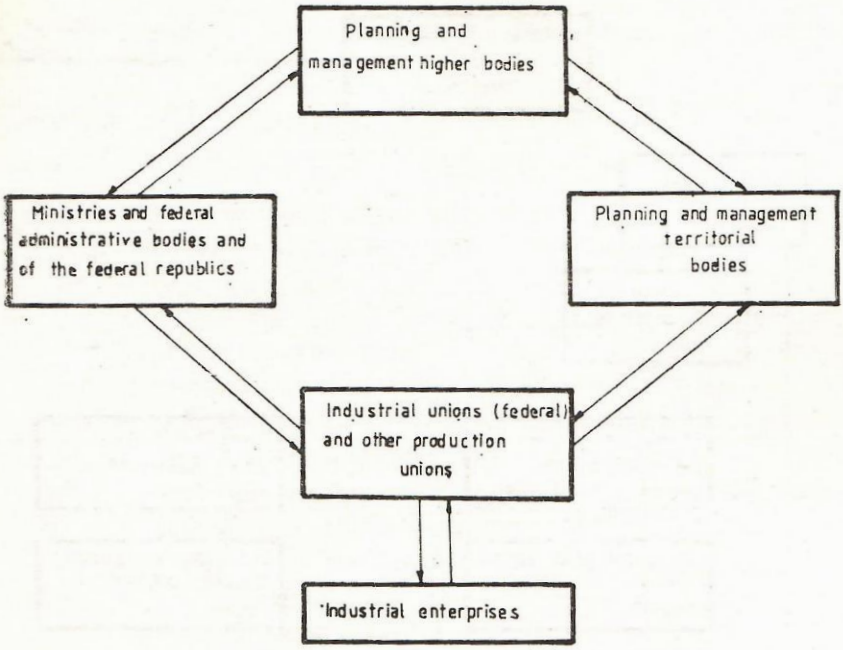

Fig. 3. "Chains of agents" in the Soviet planning and management system

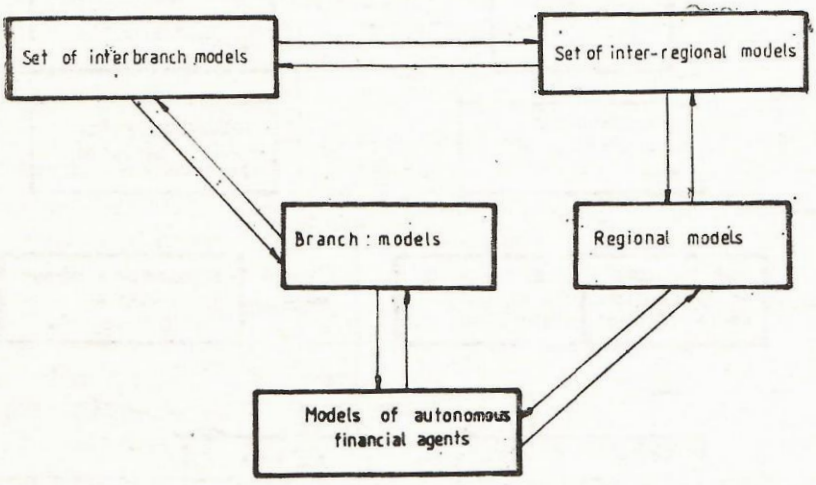

Fig. 4. System of models to solve problems of territorial economic development

prises a regional and a national block, the link between them being achieved through the national product and through the use of labour, the feed-back element being represented by the investments. Worth mentioning as a drawback of the model is the lack of direct connections between regions, of horizontal connections. (Fig. 5).

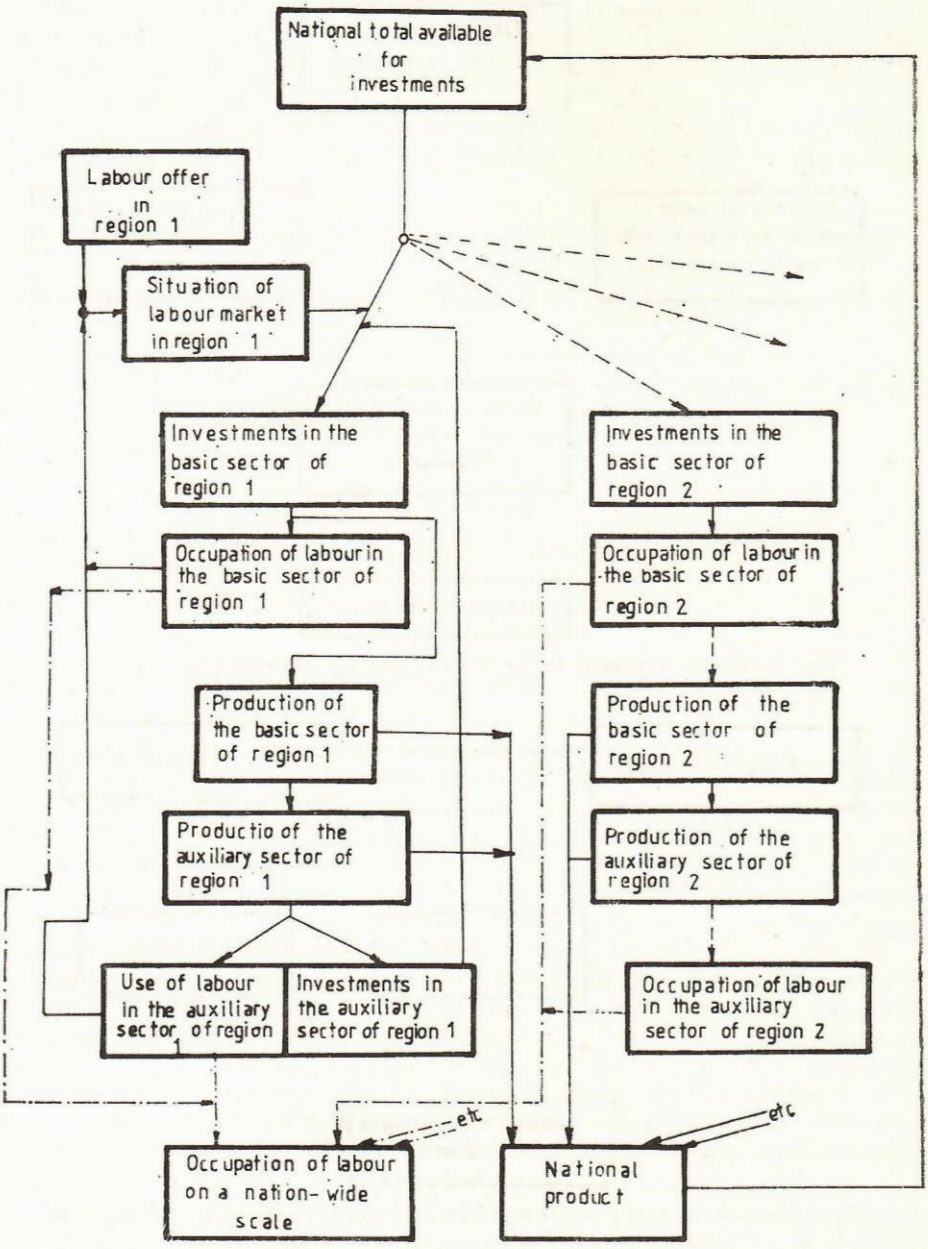

Fig. 5. Regional block of a multiregional economic model for Holland

In this model, the production functions are based on a Cobb Douglas type function and are established on branches of activity in each region. Four branches of activity are defined: the manufacturing industry, trans-

ports, other services, constructions and public works. For industry, the production function is of the form:

$$y^r_{in} = y^r_{in-5}\{1 + \alpha^r_{in}[(1 + \hat{d}^r_{in})^{1/5} - 1] + \beta^r_{in}[(1 + \hat{k}^r_{in})^{1/5} - 1] +$$
$$+ \gamma^r_{in}[(1 + \hat{d}t)^{1/5} - 1] + \lambda^r_{in} + 0.009\ PD^r1\}$$

where the cap (^) means the relative variation of the index in five year time and, the other adnotations represent:

r = regional index
y_{in} = production of the manufacturing industry in the final year of the five-year plan
y_{in} = idem in the annual plan of the five-year plan
$\hat{d}_{in5}$ = degree of labour employment in the manufacturing industry
$\hat{k}_{in}$ = capital stock of the manufacturing industry
$\hat{d}t$ = work time (in hours) in the final year of the five-year plan
$PD1$ = denseness of the population
α = flexibility of production in relation to manpower
β = idem to capital
γ = idem to work time
λ = impact of the technical progress on production.

In the United States, the regional problems are outlined in connection with the "development areas" more largely delimited in "economic development districts", within which localizations are made selectively under the name of "economic development centres". Thus, the regional development strategy is included into the type of polarized development strategy [14].

Certain characteristics are taken into account in the economic-cybernetic modelling of territorial development in the USA: the high level of financial autonomy of enterprises and of local bodies towards the local and federal government (for example, only 10% of the incomes of local budgets are directed to support the enterprises); the way out of the vicious circle defined by urban renewal and blank removal; the turning to account of natural resources including geographical resources and quality of environment. Thus, for example, the problem of water resources is estimated to be solved within a pluri-regional framework. In this context, the water resource system can be considered temporally, physically-geographically, politically-geographically and as purpose or functionality [15]. The modelling of the utilization of these resources is achieved in a double hierarchical structure: a) the first — in connection with the planning and management of the agricultural system (Fig. 6);

b) the second in connection with the organization and management of water resources correlated with those on pollution control (Fig. 7).

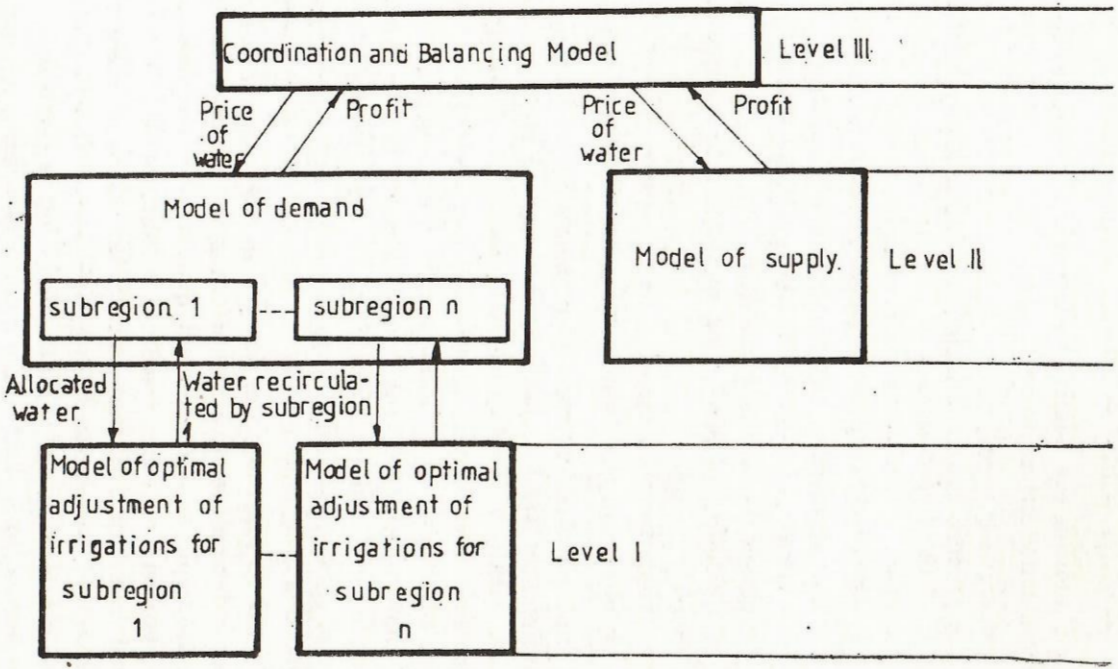
Coordination and Balancing Model
Level III
Price of water
Profit
Price of water
Profit
Model of demand
subregion 1
subregion n
Model of supply
Level II
Allocated water
Water recirculated by subregion 1
Model of optimal adjustment of irrigations for subregion 1
Model of optimal adjustment of irrigations for subregion n
Level I

Fig. 6

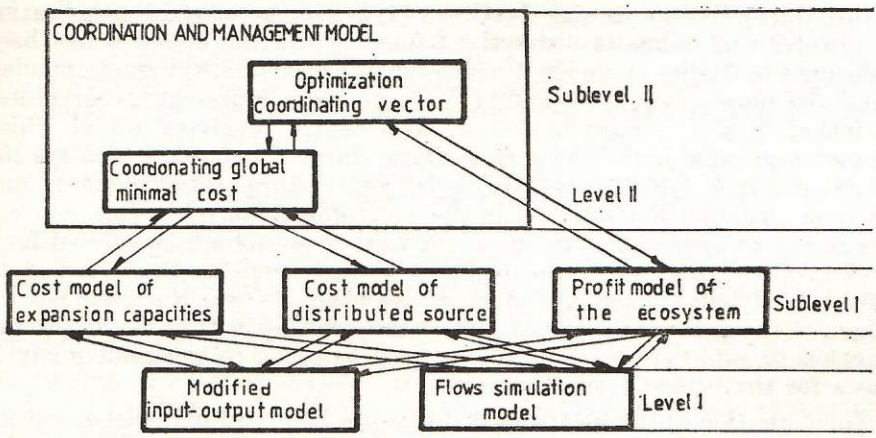

Fig. 7

The policy of growth centres is promoted on rather widescale also in the economy of countries like France, Spain, Holland, Portugal and Italy, as regards regional economic development [16]. As a rule, the point in question is about industrial agglomerations in a certain region characterized by several groups of industries and by the nature of viable complexes. Such programs are practised for the economically underdeveloped regions of the Common Market countries and are given by the total volume of investments to be made in a certain period of time, at least 5—10 years. The programmes are governmental and aim at the efficient economic growth of the underdeveloped or stationary regions, at the same time counting on dynamic effects of subsequent development at an enterprise or local body level.

The essential condition of the economic-cybernetic modelling is the existence of a number of n intercorrelated industrial branches selected as parts of a regional complex. The data about investments, production and labour, about prices and the relations with the foreign market are supposed to be known. The investments and manpower functions are given by relations:

Where

$$\frac{I_i}{I_0} = \left(\frac{P_i}{P_0}\right)^{\alpha_i} \text{ and } \frac{L_i}{L_0} = \left(\frac{P_i}{P_0}\right)^{\beta_i}$$

I_i = investments for production in branch i
P_i = production of branch i
L_i = manpower corresponding to level P_i of production in branch i.

Index "0" means the minimal technical level for the variable to which it was attached and, α_i and β_i are the positive subunitary parameters.

An ample application at the level of a geographical area the upper Mureș hydrographic basin — as regards territorial development has been achieved in our country, as part of the Laboratories of the Economic Cybernetics Department — the Bucharest Academy of Economic Studies in cooperation

with the Mureș County Desing Institute [17]. The premise of polarization areas as territorial subunits distinctly defined within the counties has been used during the studies made for working out the economic-cybernetic models of territorial development [18] and [19]. These zones represent geographical areas including a developed urban or rural centre revolving round which is the socio-economic life of the surroundings, directed towards which are the flows of labour, in which there are social and cultural establishments and which form an important junction in the communication network.

The main objectives of the research were to establisch the global forecasts of synthetic indices for the basin as a whole and for the counties, to establish the dynamic character of structure elements which should outline the place of the polarization areas and of the counties within the basin and of branches or subbranches of its economy as a whole, to work out analytic forecasts for the polarization areas.

The definition of the polarization areas has led to a territorial structure on three levels: macro-economic, county and polarization area. The correlation of the decisions on the updating of the plan targets and on the distribution of resources is taking place at two levels: macroeconomic — county; county-polarization area; at the same time, for the polarization areas of paramount importance data (ouput parameters) are transmitted both at a county and at a macro-economic level.

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ASPECTS CONCERNANT LES PARTICULARITES DE LA MODELISATION CYBERNETIQUE ECONOMIQUE EN PROFIL TERRITORIAL

L'auteur présente certaines particularités de la modélisation cybernétique économique du développement en profil territorial, en Roumanie ayant pour point de départ les aspects d'ordre qualitatif du développement du territoire.

L'auteur traite amplement de la distance rectilinéaire et du concept de centre territorial de croissance du point de vue des particularités de la modélisation du développement territorial. Y sont présentés aussi certains modèles de croissance territoriale qui utilisent le concept de centre territorial de croissance.

АСПЕКТЫ, КАСАЮЩИЕСЯ ОСОБЕНОСТЕЙ ЭКОНОМИКО-КИБЕРНЕТИЧЕСКОГО МОДЕЛИРОВАНИЯ В ТЕРРИТОРИАЛЬНОМ РАЗРЕЗЕ

В работе приводятся некоторые особености экономико-кибернетического моделирования развития экономики нашей страны в территориальном разрезе, изходия из качественных аспектов развития территории.

В рамках особеностей моделирования территории особое место выделено для ортоскопического расстояния и для понятия территориального центра. Вэтом контексте представляются некоторые модели территориального развития, использующие понятие территориального центра развития.

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