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Considerations on the Elaboration of Territorial Forecast Models

The study comprises a model for determining the share of the industrial subbranches in the economy of the counties by substantiating the objective function. A system of models is also presented for forecasting the dynamics of the industrial production throughout the territory. In this context, an analysis is made of the dynamics of the parameters of several production functions elaborated for the industry of several counties of the Socialist Republic of Romania.

The socio-economic development of the territory represents a component of major importance of our state's economic policy, the homogenization of territorial development being one of the main trends in building up the multilaterally developed socialist society. The adoption of optimal solutions for the territorial development as part of definite strategies of economic policy becomes an objective necessity at present, following the powerful and complex connections between the territorial and administrative units, between each of them and the national economy.

The establishment of the global strategy of development within the national economy includes the determination of the means and ways for placing and maintaining on the line of general progress the entire general cybernetic system of the national economy, its structure including also the zonal subsystems: counties, municipalities, towns, villages with a view to attaining the final goal — the increase of the nation's welfare. This implies the carrying out of an ample and thorough analysis of the future trends of development of each system and subsystem taken separately and of the general system as a whole.

An important role within this strategy is played by the decisions on the judicious distribution of the productive forces throughout the

territory, with a view to ensuring favourable conditions for the development of all counties, for a rational organization and territorial systematization of the socio-economic development, for the setting up of new urban centres and for a reduction of the essential differences between towns and villages.

The main objectives pursued to this end concern — as the President of the Socialist Republic of Romania, Nicolae Ceaușescu pointed out — the achievement of a dynamic territorial equilibrium by "increasing the standard of civilization of all localities, the elimination of the population's migration to big towns, the harmonious transformation of the entire social structure and life, the achievement of full equality as regards working and living conditions, the territorial homogenizations and the levelling of disparities between counties" [4].

As part of the Party's conception of the gradual homogenization of the national economy from the territorial point of view, Academician, prof. Manea Mănescu [18], [19] approaches with the means of cybernetics, of quantic economy and economic logistics, the territorial development, underlining the particular role incumbent on the distribution of the productive forces, and he considers that: "The adoption of strategies in connection with the intensification of the process of territorial homogenization affects the cross structure of most of the components of the general cybernetic system of the national economy ..."

In the studies as well as in the practical activity of drawing up the forecasts of economic development throughout the territory, the problems representing a solution to the models used can be divided, in principle, into two categories:

a) determining the global forecasts for all investigated zones, mainly concerning synthetic indices, such as the volume of production, the volume of fixed assets, the dynamics of manpower, etc.:

b) determining the dynamics of structural elements concerning shares of the territorial subunits for the entire zone, of the economic branches and subbranches in the economy of the zone or in the national economy, etc.

1. A MODEL FOR OPTIMIZING THE STRUCTURE OF INDUSTRY THROUGHOUT THE TERRITORY

Such a model can be set up on the basis of share a_{ij} to be held in the total national industrial production by each industrial subbranch of each territorial unit. One of the hypotheses lieing at the basis of such a model is the knowing of the total volume of industrial production. For this we consider the following equation and inequation system:

$$\sum_{\substack{i \in J' \\ j \in J''}} a_{ij} = 1. \tag{1}$$

$$m_i \leqslant \sum_{j \in J''} a_{ij} \leqslant M_i; \quad i \in J' \tag{2}$$

$$m_j \leqslant \sum_{j \in J'} a_{ij} \leqslant M_j; \quad j \in J'' \tag{3}$$

$$e_j \cdot P \cdot \sum_{j \in J''} a_{ij} \leqslant I_j; \quad i \in J' \tag{4}$$

$$e_i \cdot P \cdot \sum_{i \in J'} a_{ij} \leqslant I_i; \quad j \in J'' \tag{5}$$

$$\sum_{j \in J''} И_{ij}^k \cdot a_{ij} \geqslant И_i^k; \quad i \in J'; \quad k \in K' \tag{6}$$

$$\sum_{i \in J'} И_{ij}^k \cdot a_{ij} \geqslant И_j^k; \quad j \in J''; \quad k \in K'' \tag{7}$$

$$\sum_{j \in J''} И_j^k \left(\sum_{i \in J'} a_{ij} \right) \geqslant И^k; \quad k \in K'' \tag{8}$$

$$\sum_{i \in J'} И_i^k \left(\sum_{j \in J''} a_{ij} \right) \geqslant И^k; \; k \in K' \tag{9}$$

$$a_{ij} \geqslant 0; \quad i \in J'; \quad j \in J'' \tag{10}$$

and the aim function:

$$\begin{matrix} \text{maximum} \\ \text{or} \\ \text{minimum} \end{matrix} \qquad F = \begin{matrix} max \\ \text{or} \\ min \end{matrix} \sum_{\substack{i \in J' \\ j \in J''}} f_{ij} a_{ij} \tag{11}$$

where:

a_{ij} — represents the share of production of industrial branch i of the territorial unit j in the total national industrial production
J' — the set of industrial branches $(1, 2, ..., J_1)$
J_1 — the number of industrial branches
J'' — the set of territorial units $(J_1 + 1, J_1 + 2, ..., J_1 + J_2)$
J_2 — the number of territorial units
m_i — the minimum share of the production of industrial branch i in the total national industrial production
M_i — idem maximum
m_j — the minimum share of the industrial production of territorial unit j in the total national industrial production
M_j — idem maximum
P — the value of industrial production in the plan year t for which optimization is made
e_i — the economic efficiency of investments in branch i in relation to production
e_j — idem in the territorial unit j
I_i — the planned volume of investments in branch i
I_j — idem in the territorial unit j
$И_{ij}^k$ — the growth index (the reduction task) in the plan year t in relation to the basic year of the plan index k in industrial branch i of the territorial unit j
K' — the set of plan indices for industrial branches $(1, 2, ..., K_1)$
K'' — idem for territorial units $(K_1 + 1, K_1 + 2, ..., K_1 + K_2)$
K_1 — the number of plan indices for industrial branches

K_2 — idem for territorial units
$И_i^k$ — the growth index (the reduction task) in the plan year t in relation to the basic year of the plan index k in branch i
$И_j^k$ — idem in the territorial unit j
$И^k$ — idem for the total industry
F — efficiency function
f_{ij} — "aim" index in branch i in the territorial unit j.

In this way, the problem on the structure of the national economy from the department, branch and territorial points of view is at least partly tackled, and its solution provides useful data on the territorial and on the branch proportions and on the harmonization and correlation of the forecast and plan variants in the stage of drawing up their drafts. The model presented approaches the industrial branch, as a decisive branch of the national economy. However, we consider that the general problem of the national economy can be approached in a similar way.

The model comprises three big groups of constraints:

a) Constraints on the field of definition of variables: the fact that they are shares of a whole (1) and (10); the variation interval of the share of industrial branches (2) and of the territorial units (3) of the national economy as a whole.

The minimum (m) and maximum (M) levels for both the industrial branches and for the territorial units are exogeneously established on the basis of the registered evolution trends. The margin defined by them and their effective value may represent important decision-making elements for the managerial body in view of imprinting a certain evolution trend in the future on the structure of industry, in keeping with the economic policy strategies.

b) Constraints in the non-implementation of the investment fund distributed in the plan year on branches (4) and territorial units (5). The expression of the required investments with the aid of shares a_{ij} is made by applying on the corresponding industrial production coefficients of the type of "investment consumption" on branches (e_i) and territorial units (e_j). This requirement is thus determined as a product between the planned volume of the total industrial production — P and the share of the branch, of the territorial unit respectively, calculated by totaling variables a_{ij} according to the territorial index j and the branch index i respectively. The volume of the planned investments for branch $i(I_i)$ and for the territorial unit $j(I_j)$ respectively are considered to be known.

The "investment consumption" coefficient is defined as the relation between the volume of investments and that of production in the respective branch or territorial unit:

$$e = \frac{I}{P}. \tag{12}$$

Values of a "standardized" type are used in the model for this coefficient both on branch and for the territorial units. As the special determination of some corresponding values is necessary for such coefficients, we propose to use the values for this five year plan period:

$$e_{j(i)} = \frac{\sum_{\tau=1}^{5} I^{\tau}_{j(i)}}{\sum_{\tau=1}^{5} P^{\tau}_{j(i)}} \tag{13}$$

where $e_{j(i)}$ represents the "standardized" coefficient of investment consumption in industry, in the territorial unit j (in branch i respectively).

$I^{\tau}_{j(i)}$ — the volume of investments in industry in the territorial unit j (in branch i respectively) in the year τ

$P^{\tau}_{j(i)}$ — the volume of industrial production of the territorial unit j (in branch i respectively) in year τ.

We consider that the 5 year reference period is the most adequate because in comparison to the short periods it has the advantage of ensuring a compensation of the influences of "investments" maturation, that is of the "delays" in their materialization and the advantage (in comparison with the longer periods) of not catching the extinguishing influence of the technical and technological level of the past.

c) Constraints on the fulfilment of the growth indices or of the reduction targets in the plan year t in relation to the basic year of plan indices (6)—(9). The plan indices as well as their number may differ for the territorial units and branches. Thus, for branches we may have: the growth index of industrial production and of labour productivity, the target of diminishing production expenditure, etc. For the territorial units we may have: the growth index of industrial production and of labour productivity, the degree of employment of manpower in industry, the degree of drawing female labour into industry, etc. The planned level of these indices per total and per structure is considered as known.

The aim function of the model — F expresses optimization (maximization or minimization, according to case) of the structure of industry from the point of view of an efficiency index we shall generically call an "aim" index — f_{ij}, which is supposed to be calculated on branch within each territorial unit.

Within the increase of the economic efficiency of the fixed assets, the f_{ij} index is going to be this very efficiency calculated as the ratio between the average annual value of the fixed assets and the value of the annual production:

$$f_{ij} = \frac{FFI_{ij}}{P_{ij}} \tag{14}$$

where f_{ij} represents the efficiency of the fixed assets in the industrial branch i in the territorial unit j;

FFI_{ij} — the value of the industrial fixed assets in branch i in the territorial unit j;

P_{ij} — the value of the industrial production in branch i in the territorial unit j.

In increasing the economic efficiency of investments index f_{ij} can be considered as an efficiency index. As in the current practice no such indices

are formulated at the disintegration level required by the model we suggest the calculus of f_{ij} as the sum of efficiencies e_i and e_j formulated above:

$$f_{ij} = \frac{\sum_{\tau=1}^{5} I_j^{\tau}}{\sum_{\tau=1}^{5} P_j^{\tau}} + \frac{\sum_{\tau=1}^{5} I_i^{\tau}}{\sum_{\tau=1}^{5} P_i^{\tau}}.$$

In this way, the index loses somehow its economic content but allows for a good scheduling, in our opinion, of the "binomial" branch-territorial unit from the point of view of the efficiency of investments.

In the efficiency of investments, the expression of index f_{ij} can also be used as an efficiency in relation to the increase of the production in each branch and territorial unit respectively.
In this case, we have:

$$f_i = \frac{I_i}{\Delta P_i}, \tag{15}$$

respectively

$$f_i = \frac{I_j}{\Delta P_j}, \tag{16}$$

where f_i represents the efficiency of investments in the industrial branch i in relation to the production increase;

I_i — the volume of investments in the industrial branch i;
I_j — idem in the territorial unit j;
ΔP_i — the industrial production increase in branch i;
ΔP_j — idem in the territorial unit j.

These indices are exogeneous to the model. Their value is of a "standardized" type, that it is calculated on the achievement of the basic period and are considered constant. The leading body may obviously decide on their dynamics in keeping with the economic policy targets.

The coefficients thus formulated, the aim function will have the formula:

$$min\ F = min \sum_{i \in J'} \left(f_i \cdot \sum_{j \in J''} a_{ij} \right) \tag{17}$$

for case (15) and

$$min\ F = min \sum_{j \in J''} \left(f_j \cdot \sum_{i \in J'} a_{ij} \right) \tag{18}$$

for case (16) wehre J' represents the set of branches and J'' the set of the considered territorial units.

At the same time, indices f_{ij} can be defined in relation to the percentage increase of production in which case, in relations (15) and (16) the denominators become $\frac{\Delta P_i}{P_i}$ and $\frac{\Delta P_j}{P_j}$ respectively. Of course, various points of view can be formulated in connection with the content of the aim function and the way of quantification through its indices. In our presentation, we dealt especially with those which, in our practice, have resulted to be more used in the analyses of the efficiency of the economic activity in general.

As regards the size of the model, it depends on four parameters: the number of industrial branches (J_1), the number of territorial units (J_2), the number of plan indices for the industrial branches (K_1) and the number of plan indices for the territorial units (K_2). For a higher degree of disintegration of industry and of the territorial structure, the model is less interesting because the higher the degree of disintegration, the bigger is the number of the liberty degrees, thus as many shares a_{ij} are assumed zero. A disintegration of industry into 10 subbranches, allowing for a good turning to account of the possibilities of the model, is suggested in table 1. Considering the territorial structure on counties and the number of plan indices 3 — for branches and 3 — for counties, we come to a model 400 × 348 which can be considered to be adequate to the proposed aim.

Table 1

Subbranches of industry

Subbranch in the statistical classification	Subbranch in the classification used in the model
Electric and thermal power	Electric and thermal power
Fuel	Fuel
Ferrous metallurgy Nonferrous metallurgy	Metallurgy
Machine building and metal processing	Machine building
Chemistry	Chemistry
Construction materials	Construction materials
Wood working and processing Pulp and paper	Timber
Glassware, porcelain, faiance Textiles Garments Leather goods, furs, footwear,	Light industry
Food industry	Food industry
Nonmetaliferrous ores extraction and abrasive products Printing Other branches	Other branches

2. A SYSTEM OF MODELS FOR FORECASTING THE DYNAMICS OF THE TERRITORIAL INDUSTRIAL PRODUCTION

The system of models which has been suggested aims at working out a territorial forecast of the industrial production and it is based on a number of previous results concerning the utilization of the production functions in the study of territorial development [26], [27], [28], [29], [30]. The system comprises models — of the class of trend functions and of the production functions with the aid of which a chain forecast of the production factors and of industrial production could be worked out. The forecast refers to a county territorial structure in which five counties have been considered: Alba, Cluj, Harghita, Mureș and Sibiu. For comparison, a forecast of the industrial production for the whole of the Socialist Republic of Romania has also been worked out. Some of these studies have been worked out as part of a larger cooperation [21], [22], [23], [24], [25] between the Laboratories of the Department of Economic Cybernetics and the Mureș County Design Institute for the Mureș Project on the socio-economic development in the basin of upper Mureș, including parts of the above mentioned counties.

The fixed assets, manpower and technical progress have been considered as production factors. As regards labour force, the average number on the staff of all the working personell in industry and the average number on the staff of workers in industry have been taken into consideration. 10-year statistical series [35], were at the basis of the estimation of the parameters of the models used, statistical series including dynamics indices with a fixed basis (1965) for the 1966—1975 period.

18 types of trend functions, among which: linear, exponential, parabolic, logistic, quadratic logistic, logarithmic, semilogarithmic, log-parabolic, log-log-inverse, etc. have been tested for forecasting the dynamics of the production factors. The testing was made with the aid of the REMUS routine of the program library of the Laboratory of the Department of Economic Cybernetics which allows to establish the parameters of functions, the calculus of the representativity statistical indices and the working out of a long-range forecast.

The selection of the forecast functions for each case taken separately was made on the basis of the following filter categories:

a) econometric filters — regarding the observance of conditions for the parameters of functions;

b) statistical filters — comprising the coefficient of multiple correlation, the multiple determination, the standard error, the variation coefficient the calculus of which is made by the program used;

c) "reliability" filters comprising the relative deviation of the calculated values from those noticed as well as the proximity of the forecast values to the envisaged level of the respective indices [2], [34].

As regards the proximity of the forecast values to those envisaged by the Eleventh Congress of the Romanian Communist Party, the orientations concerning the overall industrial output have been taken into account [1],

[2], [3], [34]. In this way, the overall industrial production will increase by 62 — 70% until 1980 as against 1975 and in 1990 it will be 6.5—7.5 times bigger than in 1970, which related to the year 1965, means dynamics indices of 520—550 and 1140—1320 respectively.

The functions which have corresponded to the thresholds imposed by these filters are presented in annexes 1—3, for the fixed assets. The best results were given by the exponential and parabolic functions and for labour force by the logistic and parabolic functions.

For amplifying the possibilities of comparing the production forecasts, a variant based on the trend has also been drawn up, by using the same functions as for the production factors. The selection of the functions was made on the basis of the above criteria: the characteristics of the kept functions are presented in annex 4. The exponential and parabolic functions and in isolated cases the log-log-inverse function could be maintained in particular. The production indices for the whole of industry are somewhat higher (550—570 and 1250—1850 respectively) both for the year 1980 and for 1990. A differentiated situation appears for the counties: thus, the indices of Cluj and Sibiu counties are placed within the limits forecast for the national economy, whereas Harghita county registers a more marked dvnamics and Alba and Mureș counties a slower dynamics than the national industry as a whole. This reflects the trend of homogenization which started being felt more and more especially during the last few years and whose extent will be intensified in the future.

In the forecast of the industrial output, the production functions of the counties' industry and of the industry of the Socialist Republic of Romania have been elaborated on the basis of the production factors forecast (see Annex 5). Functions of a Cobb-Douglas, CES, Allen and Sato type have been taken into account. The introduction of technical progress was made both as a temporal trend and through technical tooling, as follows:

$$PGI = f(FFI, NPI) \cdot exp\, g(t) \tag{19}$$

$$PGI = f(FFI, NPI) \cdot exp\, h(k) \tag{20}$$

where PGI represents the overall industrial production;
FFI — fixed assets for industry;
NPI — the total working staff in industry;
t — time;
k — FFI/NPI = technical tooling.

In order to bring some data with a more general character about the possibilities of considering these types of production functions in the growth, simulation and forecast models, tables 2, 3 and annex 6 comprise the characteristics of the functions corresponding to the demands of the considered filters.

Table 2

Characteristics of the Cobb-Douglas functions which can be taken into consideration in the industrial production forecast

County	Function parameters				Representativity statistical indices				Relative deviations interval	
	A	α	β	γ	CCM	DM	ES	CV	Lower limit %	Upper Limit %
Alba	0.929214	0,819454	0,209048	—	0.997	99.485	0.022	0.424	−4.1	3.3
	3.822786	0.581487	0.131877	0.031929	0.998	99.693	0.017	0.327	−3.2	2.2
	1.061156	0.851737	0.148263	—	0.985	97.038	0.021	9.17	−3.5	4.1
	1.048549	0.726437	0.273563	0.006845	0.987	97.424	0.02	8.551	−2.5	3.8
Cluj	8.47212	0.493976	0.047686	0.053179	1.000	99.93	0.009	0.164	−1.2	1.2
	1.01005	0.939056	0.060944	—	0.998	99.576	0.014	3.368	−1.8	2.4
	1.009165	0.82532	0.17468	0.009015	0.998	99.59	0.014	3.31	−1.5	2.8
Harghita	1.073736	0.721859	0.273852	—	0.998	99.58	0.023	0.442	−2.2	3.9
	4.977012	0.566264	0.082224	0.035389	0.999	99.867	0.013	0.249	−2.4	2.2
	1.052408	0.719314	0.280686	—	0.992	98.36	0.022	8.62	−3.9	2.2
	1.039651	0.666598	0.333402	0.004974	0.993	98.509	0.021	8.22	−3.5	3.0
Mureș	0.633029	0.403171	0.714377	—	0.992	98.456	0.033	0.628	−6.2	4.9
	1.06982	0.501966	0.498034	—	0.928	86.042	0.035	10.526	−4.5	6.9
	1.095507	0.334768	0.665232	0.011779	0.946	89.484	0.03	9.136	−4.9	5.4
Sibiu	0.080634	0.916328	0.631441	—	0.997	99.317	0.027	0.508	−4.6	4.6
	3,830158	0.198213	0.512208	0.073832	0.998	99.52	0.022	0.425	−4.2	3.3
	1.006999	0.388824	0.611176	0.051873	0.994	98.897	0.023	5.441	−3.5	4.3
S.R.R.	0.12537	0.590138	0.865529	—	0.999	99.825	0.014	0.269	−1.8	2.7
	0.991197	0.921945	0.078055	—	0.996	99.102	0.018	4.614	−2.7	2.7
	1.019279	0.185268	0.814732	0.052224	0.998	99.633	0.011	2.951	−1.8	1.6

NOTE: $PGI = A \cdot FFI^{\alpha} \cdot NPI^{\beta} \cdot e^{\gamma t}$ has been considered the form of the Cobb-Douglas function.

Table 3

Characteristics of the CES functions which can be taken into consideration in the industrial production forecast

County	Function parameters					Representativity statistical indices				Relative deviations interval	
	A	δ	ρ	h	γ	CCM	DM	ES	CV	Lower limit %	Upper limit %
Alba	0,929197	0.789362	−0.177866	1.028625	—	0.997	99.485	0.022	0.424	−3.3	4.1
	1.060294	0.86255	0.376896	1.0	—	0.985	97.039	0.021	9.168	−3.5	4.1
	1.051526	6.671827	−0.883768	1.0	0.007252	0.987	97.443	0.02	8.52	−2.4	3.7
Cluj	8.498873	0.905049	−0.170328	0.541098	0.053266	1.000	99.93	0.009	0.164	−1.2	1.2
	1.00336	0.875396	0.791283	1.0	0.008011	0.998	99.599	0.013	3.276	−1.5	2.9
Mureş	0.643093	0.323168	−0.387644	1.115931	—	0.992	98.46	0.033	0.627	−4.9	6.1
	1.085033	0.429403	−0.63896	1.0	—	0.928	86.135	0.035	10.49	−4.5	6.8
	1.091278	0.354185	0.198984	1.0	0.011897	0.946	89.492	0.03	9.133	−4.8	5.4
Sibiu	0.924821	0.533949	−0.967974	1.521144	—	0.997	99.345	0.026	0.497	−4.8	4.1
S.R.R.	0.071076	0.376942	0.606248	1.5775	—	0.999	99.833	0.014	0.263	−2.5	1.6
	1.016613	0.179294	0.389873	1.0	0.054334	0.998	99.635	0.011	2.941	−1.7	1.5

NOTE: has been considered the form $PGI = A \cdot (\delta FFI^{-\rho} + (1-\delta)\, NPI^{-\rho})^{\frac{-h}{\rho}} \cdot e^{\gamma \cdot t}$, of the CES function.

In comparison with some results which were previously obtained [26], [29] we note that the SATO type functions did not correspond and therefore we estimate that they are more adequate to estimations for smaller series and to forecasts for closer time periods. The ALLEN type functions continue to be inadequate in estimating the industrial production.

Good results have been obtained with the aid of the COBB-DOUGLAS and CES functions. As regards the Cobb-Douglas type function (Table 2) good estimates have been obtained for all counties and for the total industry of the Socialist Republic of Romania in three or even all of the four tested forms: homothetic ($h = \alpha + \beta = 1$), homogeneous ($h = \alpha + \beta \neq 1$), with and without technical progress (where the degree of homogeneity was denoted with h). The analysis of the contribution of the production factors to the increase of production expressed by the elasticity of production in relation to them allows for interesting conclusions, the more so as a dynamic analysis can be made on the basis of some previous results [30]. The problem is dealt with on the variants with and without technical progress, separately for the homothetic functions and separately for the homogenous ones of a certain h degree. (Table 4).

Table 4

Elasticities of production in relation to the factors

Function Variant	Counties	Production Factors				Sum of Elasticities
		Fixed Assets		Working Staff		
		Elasticity	Share (%)	Elasticity	Share (%)	
0	1	2	3 = (2:6) × 100	4	5 = (4:6) × 100	6 = 2 + 4
1. homothetic without technical progress	Alba	0.851737	85.2	0.148263	14.8	1.0
	Cluj	0,939056	93.9	0,060944	6.1	1.0
	Harghita	0.719314	71.9	0.280686	28.1	1.0
	Mureș	0.501966	50.2	0.498034	49.8	1.0
	Total SRR	0.921945	92.2	0.078055	7.8	1.0
2. homogeneous without technical progress	Alba	0.819454	79.7	0.209048	20.3	1.028502
	Harghita	0.721854	72.5	0.273852	27.5	0.995706
	Mureș	0.403171	36.1	0.714377	63.9	1.117548
	Sibiu	0.916328	59.2	0.631441	40.8	1.547769
	Total SRR	0.590138	40.5	0.865529	59.5	1.455667
3. homothetic with technical progress	Alba	0.726437	72.6	0.273563	27.4	1.0
	Cluj	0.82532	82.5	0.17468	17.5	1.0
	Harghita	0.666598	66.7	0.333402	33.3	1.0
	Mureș	0.334768	33.5	0.665232	66.5	1.0
	Sibiu	0.388824	38.9	0.611176	61.1	1.0
	Total SRR	0.185268	18.5	0.814732	81.5	1.0
4. homogeneous with technical progress	Alba	0.581487	81.5	0.131877	18.5	0.713364
	Cluj	0.493976	91.2	0.047686	8.8	0.541662
	Harghita	0.566264	87.3	0.082224	12.7	0.648488
	Sibiu	0.198213	27.9	0.512208	72.1	0.710421

The resulting estimates generally outline the big contribution of the fixed assets; the introduction of technical progress determines in the case of the homogeneous type a marked contribution in comparison with the homothetic type, where the contribution is smaller, the relation, in some cases, being overturned (Mureş county and the total—Socialist Republic of Romania), in favour of the labour force factor, It is interesting to note that in the case of Harghita and Mureş counties, the relation between the two factors has the tendency of being approximately the same in this estimation just in that emphasized by us in 1974 [30]. Thus, the relation was 84.1:15.9 as against 72.5:.27.5 for Harghita county and 33.3:66.7 as against 36.1:63.9 for Mureş county.

As regards the CES type function (table 3) satisfactory forms have been obtained for four out of the five counties (except for Harghita county) and for the total industry of the Socialist Republic of Romania. The coefficient of the elasticity standard of the substitution of factors is estimated with positive values for the homothetic case with technical progress and with negative values in the homogeneous case without technical progress. The influence of the technical progress and of the degree of homogeneity is thus decisive on this index specific of the production functions.

It results from the estimations made that the degree of homogeneity also influences the size of the technical progress rate (Table 5). Thus, the rate is exclusively higher for the degree of homogeneity $h \neq 1$. It is also worth mentioning that the value of this rate is sensibly equal for both types of functions in the case of the same degree of homogeneity. It is also noted (for example, in the case of the degree of homogeneity $h = 1$) that in four out of five counties, Alba, Cluj, Harghita, Mureş, the value of the technical progress rate is much lower to that of the total national economy.

Table 5

The technical progress rate (%) in the production functions used in elaborating the forecast of the overall industrial production

County	Degree of homogeneity $h = 1$		Degree of homogeneity $h \neq 1$	
	Cobb-Douglas	CES	Cobb-Douglas	CES
Alba	0.68	0.73	3.19	—
Cluj	0.9	0.8	5.31	5.33
Harghita	0.5	—	3.54	—
Mureş	1.18	1.19	—	—
Sibiu	5.19	—	7.38	—
Total SRR	5.22	5.43	—	—

Based on the above mentioned selection criteria, a single production function has been maintained for each county (Annex 5) with the aid of which the dynamics in indices with a fixed basis of the overall industrial output can be calculated.

For a deeper analysis, we propose further to study on the basis of these results the dynamics in time of the parameters of the production functions.

Starting from this dynamics, from the characteristics of the parameters variation, we propose to try and estimate certain production functions specific of the counties.

Naturally, we are convinced that these results should be regarded with reserve considering any attempts at a forecast which, through these methods, remain in fact extrapolations of some past situations in the development of which imprevisible changes may appear. We consider however that the production functions remain a useful instrument in prospecting the rate and level of the economic growth, from the territorial point of view inclusively, and as its analysis, an instrument we consider to be indispensible in the methodological arsenal of the theoretician and practioner of modern economy.

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Annex 1

Trend functions in forecasting the dynamics of the number of workers in industry (MI)

Alba county

1. $MI = \dfrac{2236.232391}{1 + 23.031541 \exp(-0.068789\ t)}$

(0.975 94.974 5.57 4.245 2.086)

2. $MI = 0.36778\ t^2 + 4.615044\ t + 95.917679$

(0.975 95.157 5.644 4.167)

Cluj county

1. $MI = \exp(4.642927 + 0.045729\ t)$

(0.972 94.464 0.032 0.65)

2. $MI = 0.215108\ t^2 + 3.787207\ t + 105.658615$

(0.973 94.585 4.245 3.15)

Harghita county

$MI = 0.552223\ t^2 + 3.199542\ t + 92.541824$

(0.98 95.982 5.512 4.195)

Mureş county

$MI = \dfrac{819.783693}{(1 + 1.970605 \exp(-0.05993\ t))^2}$

(0.992 98.345 3.673 2.584 1.267)

Sibiu county

$$MI = 0.298821\ t^2 + 2.106954\ t + 104.447067$$

(0.983 96.667 2.905 2.278)

Total of the Socialist Republic of Romania

$$MI = 0.510189\ t^2 + 2.253411\ t + 100.9039$$

(0.999 99.761 1.12 0.843)

Annex 2

Trend functions in forecasting the dynamics of the total number of working staff in industry (NPI)

Alba county

1. $$NPI = \frac{2236.232391}{1 + 23.031541\ \exp\ (-0{,}068789\ t)}$$

(0.975 94.974 5.75 4.245 2.086)

2. $$NPI = 0.36778\ t^2 + 4.615044\ t + 95.917679$$

(0.975 95.157 5.644 0.167)

Cluj county

$$NPI = \frac{468993.081047}{1 + 4507.516118\ \exp\ (-0.039628\ t)}$$

(0.971 94.251 3.65 2.002 1.392)

Harghita county

$$NPI = \exp\ (4.488379 + 0.065515\ t)$$

(0.955 91.123 0.059 1.221)

Mureş county

$$NPI = \frac{549.193882}{(1 + 1.418519\ \exp\ (-0.062653\ t))^2}$$

(0.99 98.053 3.458 2.51 1.236)

Sibiu county

$$NPI = 0.224592\ t^2 + 2.071353\ t + 104.040649$$

(0.98 96.064 2.661 2.145)

Total of the Socialist Republic of Romania

$$NPI = 0.376852\ t^2 + 2.594691\ t + 100.310287$$

(0.999 99.787 0.902 0.699)

Annex 3

Trend functions in forecasting the dynamics of the fixed assets in industry (FFI)

Alba county

$$FFI = 1.968844\ t^2 - 2.415445\ t + 109.61441$$

(0.998 99.68 3.234 1.879)

Cluj county

$$FFI = 1.668669\ t^2 + 6.037998\ t + 112.777222$$

(0.996 99.273 6.086 2.895)

Harghita county

$$FFI = 2.006713\ t^2 - 8.6432115\ t + 63.2142485 +$$

$$+ 0.5 \exp\left(2.596269 + 2.125121\ \frac{1}{t}\right) \cdot\ t\,1.26953$$

Mureș county

$$FFI = 0.3\ \exp(4.80852 + 0.114502\ t) + 1006.04 \cdot 0.073039^{\,0,929284\ t}$$

Sibiu county

$$FFI = \exp\ (4.612642 + 0.09283\ t)$$

(0.998 99.514 0.019 0.376)

Total of the Socialist Republic of Romania

$FFI = 1.594465\ t^2 + 7.327562\ t + 106.411484$

(0.999 99.751 3.613 1.736)

Annex 4

Trend functions in elaborating the forecast of the territorial industrial production (PGI)

Alba county

1. $PGI = \exp(4.549582 + 0.104545\ t)$

(0.993 98.589 0.036 0.71) (−3,7%; 6.4%)

2. $PGI = 1.674115\ t^2 + 0.124144\ t + 110.963776$

(0.999 99.742 2.776 1.576) (−4.2%; 3.5%)

Cluj county

1. $PGI = \exp(4.650893 + 0.113408\ t)$

(0.999 99.764 0.016 0.301) (−2.2%; 2.5%)

2. $PGI = 1.420222\ t^2 + 7.304841\ t + 110.044815$

(0.998 99.675 3.807 1.849) (−2.8%; 4.1%)

Harghita county

1. $PGI = \exp(4.449096 + 0.119552\ t)$

(0.987 97.493 0.055 1.078) (−9.9%; 8.0%)

2. $PGI = 2.408942\ t^2 - 5.146828\ t + 111.263275$

(1.000 99.948 1.461 0.831) (−1.2%; 1.4%)

Mureş county

1. $PGI = \exp(4.737022 + 0.091836\ t)$

(0.996 99.147 0.024 0.467) (−3.5%; 6%)

Sibiu county

1. $PGI = 122.018173t + 76.59991$

(0.976 95.333 13.993 7.078) (−14.2%; 8.5%)

2. $PGI = 1.825627\,t^2 + 1.936295\,t + 116.763718$

(0.998 99.527 4.452 2.252) (−3.5%; 4.8%)

3. $PGI = \exp\left(3.610034 + 1.165465\,\frac{1}{t}\right) \times t^{0.849547}$

(0.984 96.778 0.058 1.103) (−8.2%; 7.1%)

Total of the Socialist Republic of Romania

1. $PGI = 22.94545\,t + 72.399979$

(0.984 96.785 12.011 6.048) (−14.1%; 7.2%)

2. $PGI = \exp(4.590363 + 0.117157\,t)$

(0.999 99.852 0.013 0.247) (−1.9%; 2.2%)

3. $PGI = 1.617188\,t^2 + 5.156398\,t + 107.978058$

(0.999 99.862 2.485 1.251) (−2.1%; 3.4%)

4. $PGI = \exp\left(3.570419 + 1.167123 \times \frac{1}{t}\right) \times t^{0.875546}$

(0.989 97.888 0.049 0.935) (−8.0%; 5.7%)

Annex 5

Production functions in forecasting the industrial production until the year 2000

Alba county

$$PGI = 3.822786 \times FFI^{\,0.581487} \times NPI^{\,0,131877} \times \exp\, 0.031929\,t$$

(0.998 99.693 0.017 0.327)

Cluj county

$$PGI = 1.00336\,(0.875396 \times FFI^{\,-0,791283} + 0.124604 \times NPI^{-0,791283})^{-\frac{1}{0.791238}} \times \exp\, 0.008011\,t$$

(0.998 99.599 0.013 3.276)

Harghita county

$$PGI = NPI \cdot \exp\,(0.477872\,k - 0.398684)$$

(0.981 96.275 0.034 12.99)

Mureş county

$$PGI = 0.633029 \cdot FFI^{0.403171} \cdot NPI^{0.714377}$$

(0.992 98.456 0.033 0.628)

Sibiu county

$$PGI = 0.080634 \cdot FFI^{0.916328} \cdot NPI^{0.631441}$$

(0.997 99.317 0.027 0.508)

Total of the Socialist Republic of Romania

$$PGI = 0.12537 \cdot FFI^{0.590138} \cdot NPI^{0.865529}$$

(0.999 99.825 0.014 0.269)

Annex 6

Characteristics of other production function categories which may be taken into account in the industrial production forecast

Alba county

$$PGI = NPI \cdot \exp\ (0.661901\ k - 0.587218)$$

(0.983 96.67 0.023 9.725) (−3.4%; 5.4%)

Cluj county

$$PGI = NPI \cdot \exp\ (0.592541\ k - 0.520742)$$

(0.991 98.3 0.028 6.745) (−4.1%; 4.7%)

Harghita county

1. $PGI = \sqrt{1.92406\ FFI \cdot NPI - 0.01289\ FFI^2 - 0.832652\ NPI^2}$

(0.994 98.806 0.074 4.135) (−3.4%; 3.3%)

2. $PGI = NPI \cdot \exp\ (0.477872\ k - 0.398684)$

(0.981 96.275 0.034 12.99) (−5.4%; 4.9%)

Mureş county

$$PGI = NPI\ \exp(0.309384\ k - 0.019969)$$

(0.926 85.807 0.035 10.614) (−4.7%; 6.3%)

Total of the Socialist Republic of Romania

$$PGI = NPI \cdot \exp\ (0.59785\ k - 0.550271)$$

(0.994 98.838 0.02 5.25) (−2.9%; 3.5%)

Note: The figures grouped in the first parenthesis in the annexes 1—6 represent the representativity statistical indices, as follows: multiple correlation coefficient (*MCC*), multiple determination (*MD*), standard error (*SE*), variation coefficient (*VC*). For the logistic functions the fifth figure represents the Theile coefficient. The figures grouped in the second parenthesis in the annexes 4 and 6 represent the interval in which the percentage deviations are grouped of the values calculated with the trend function in relation to the statistical values.

CONSIDERATIONS CONCERNANT L'ELABORATION DE MODELES DE PREVISION EN PROFIL TERRITORIAL

On présente un modèle pour déterminer l'importance relative des sous-branches industrielles dans l'économie des départements en définissant la fonction objectif. On présente aussi, un système de modèles pour la prévision de la dynamique de la production industrielle en profil territorial. Dans ce contexte on fait l'analyse de la dynamique des paramètres de certaines fonctions de production élaborées pour l'industrie de quelques uns des départements de la République Socialiste de Roumanie.

СООБРАЖЕНИЯ ПО ПОВОДУ РАЗРАБОТКИ МОДЕЛЕЙ ПРОГНОЗИРОВАНИЯ В ТЕРРИТОРИАЛЬНОМ РАЗРЕЗЕ

Работа содержит модель определения удельного веса промышленных подотраслей в экономике уездов, с обоснованием целевой функции. Показана также система моделей прогнозирования динамики промышленной продукции в территориальном разрезе. В этом контексте анализируется динамика параметров производственных функций, разработанных для промышленности некоторых уездов Социалистической Республики Румынии.

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