DECISION MODELS FOR PLANNING AGAINST STAGNATION

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1. Introduction

From the beginning of the seventies onwards the Western economies showed the first signs of a recession which developed into a full-fledged stagnation from the middle of the seventies onwards. The rapid rise in investments, national product and exports which characterized the Western countries in the sixties came to an end and a process of stagnation emerged. Especially the unemployment demonstrated a rapid and hardly uncontrollable increase.

Some illustrative figures are included in Table 1 which shows some values of main economic variables in the Netherlands during the period 1973-1975.

Table 1. Values of key variables of the Dutch economy, 1973-1975.
(measured in percentage changes)

	1973	1974	1975	1976	1977
Gross national product	4.5	2.5	-2.0	5.0	3.0
Private consumption	4.1	3.1	3.9	2.7	4.0
Gross private investment (excluding residential construction)	11.4	-0.4	-7.4	-3.0	1.6
Exports	14.0	3.0	-4.6	12.5	-2.0
Imports	11.9	-0.9	-4.8	11.7	1.5
Product of business sector	6.5	4.5	-1.7	4.9	2.5
Price index private consumption	9.0	10.0	10.2	8.8	6.4
Unemployed persons (x 10^3)	117	143	206	224	218

Source: Central Planning Bureau, The Hague.

The figures in Table 1 are not an exception on the main trends of the Western industrialized countries. In this respect the Dutch economy did not but follow these trends. For example, the average gross domestic product in the industrialized countries decreased by 0.5 per cent in 1974 and 1.5 per cent in 1975 (see also Mennes and Nijkamp [1977]). Several forecasts made for the period until 1980 suggest a continuation of the abovementioned trend, given at least the expected development of world trade, the price level of imports, the price level of competing exports, the international exchange rates and the average wage rates.

A crucial role in many forecasting models for the advanced countries is played by public expenditures (i.e., government and social security expenditures). An on-going rise in public expenditures will lead to an increase in inflation and to a decrease in gross national product and employment. Consequently, public policy plays a key role in the stagnation process of Western countries. On the other hand, a reduced growth in public expenditures requires among others a policy of wage restraint. Given the resistance of trade unions, such a policy is also very hard to implement.

The debate on the desired direction of public expenditures during a stagnation period focusses especially on the impact of labour costs. Increases in taxes and social security premiums (to be paid by entrepreneurs) in order to finance the rise in public expenditures affect the level of profits. Then an additional increase in labour costs will certainly lead to a substitution of capital for labour, apart from a rise in the price level. In addition to this traditional view of the causes of unemployment some other important factors for the stagnating development of Western countries may be mentioned, such as the influence of the rapid rise of foreign prices, the influence of autonomous rises in consumer prices, the competition of Third World countries, and a certain saturation trend in the demand for products from the primary and secondary sector.[1)]

To analyse the intricate relationships between these phenomena, a comprehensive model is necessary which is based on a complete set of interrelationships for the abovementioned variables.

A second prerequisite for an satisfactory analysis of stagnation phenomena is the introduction of the spatial element. Stagnation phenomena are not spread uniformly through space, but show significant differences in different regions depending on the locational qualities, growth potentials, sectoral specializations and demographic and professional structures of these regions. This implies that the sectoral labour demand, the supply structure of labour, and the interregional linkages (input-output structure and migration processes, e.g.) should be analyzed at an appropriate spatial scale (cf. Paelinck and Nijkamp [1976]). The same holds true for the impacts of public controls and regional economic policies.

Furthermore, it appears that urban agglomerations tend to reflect a socio-economic pattern which differs significantly from the average regional pattern. Inequalities in terms of both income and unemployment of urban inhabitants show sometimes a rather alarming picture, especially in the urban agglomerations of the industrial heartland. There is some evidence that a further stagnation process will reinforce the inequality problems at the urban level.

In the framework of a policy analysis much attention should also be devoted to regional economic objectives. For example, the dilemma "efficiency-equity" is a glaring example of public policy conflicts at the regional level (cf. Stilwell [1972]). This implies that the trade-off problems concerning the constituents

1) Especially in the Netherlands, the discovery of natural gas has led to a strong position of the Dutch Guilder which has affected the international competitive capacity of the Netherlands.

of regional welfare may not be neglected, so that adjusted decisions models for optimal decision strategies for stagnating regions have to be developed.

The introduction given thus far makes clear that the present paper about decision models for planning against stagnation should include the following ingredients:

- a quantitative and operational model which reflects the functional and causal relationships of an integrated economic system that is suffering from a stagnating development.
- a spatial and sectoral differentiation of such an economic system, so that the spatial and distributive impacts of stagnation processes and public policies can be spelt out.
- a further analysis of spatial inequalities within each regional system, especially at the urban scale, so that socio-economic frictions and discrepancies at the core of industrial regions can be identified.
- the construction of an appropriate decision model for public policy which is capable to take into account divergent options and policy issues related to both a wide variety of incommensurable objectives and a hierarchical decision structure of the country at hand.

After the presentation of these ingredients the paper will conclude with an evaluation and an outlook of further research.

2. A Simple Interregional Model

During the last decade a wide variety of multiregional and interregional models of many countries have been developed (for example, Czamanski [1969], Courbis [1972], Van Delft and Van Hamel [1978], Glickman [1977], Harris and Hopkins [1972], Nijkamp and Paelinck [1974], and Rembold [1975].

The model used in the present paper is based on an extension of a model developed for the Rhine-delta region (see ESSOR [1977] and Van der Werf [1977]; see also Hafkamp and Nijkamp [1978]).

The model in its most simple form can be represented for 2 regions by means of the following linkage structure:

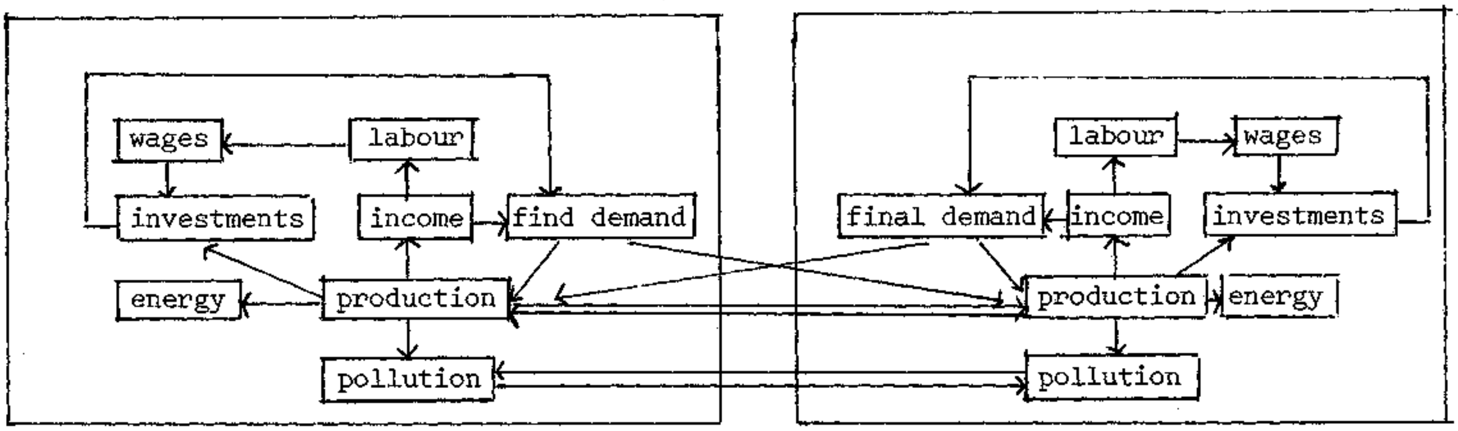

Fig. 1. A linkage structure for a two-region model

The mathematical structure of the interregional model presented here is based on a ful information input-output table, so that all spatial patterns of (intermediate and final) commodities are known (see also Paelinck and Nijkamp [1976]). Consequently, the following input-output model may be created for each region r (r=1,...,R):

(2.1.) $$\underline{q}_r = \sum_{r'=1}^{R} A_{rr'} \underline{q}_{r'} + \sum_{r'=1}^{R} \underline{f}_{rr'} ,$$

where: $A_{rr'}$ = matrix of input-output coefficients for intermediate deliveries between region r and r' of order IxI

$\underline{q}_r$ = vector of sector production levels of order Ix1

$\underline{f}_{rr'}$ = vector of final demand flows from region r to r' of order Ix1

The total interregional input-output structure can be represented in a comprehensive way as:

(2.2.) $$\underline{q} = A\underline{q} + \underline{f}$$

The final demand vector $\underline{f}$ is composed of consumption $\underline{c}$ (both private consumption $\underline{c}^{pr}$ and public consumption $\underline{c}^{pu}$), investments $\underline{i}$ (both private investments $\underline{i}^{pr}$ and public investment $\underline{i}^{pu}$), exports abroad $\underline{e}$ and stock formation $\underline{s}$. Therefore, $\underline{f}$ may be decomposed as follows:

(2.3.) $$\underline{f} = \underline{c} + \underline{i} + \underline{e} + \underline{s}$$

$$= \underline{c}^{pr} + \underline{c}^{pu} + \underline{i}^{pr} + \underline{i}^{pu} + \underline{e} + \underline{s}$$

Assuming fixed regional value added coefficients v_{ir} (for each sector i in region r), regional sectoral value added y_{ir} can be calculated as:

(2.4.) $y_{ir} = v_{ir}\, q_{ir}$

The elements y_{ir} can be incorporated in an (IRx1)vector $\underline{y}$. Consequently, total value added y is equal to:

(2.5.) $$y = \underline{\iota}'\,\underline{y}$$
$$= \underline{v}'\,\underline{q},$$

where $\underline{v}$ is an IRx1 vector with regional and sectoral value added coefficients. Similarly, total regional or sectoral value added can be calculated.

The sectoral and regional requirements l^d_{ir} can be assessed by means of fixed employment coefficients g_{ir} between labour demand l^d_{ir} and value added v_{ir}:

(2.6.) $$l^d_{ir} = g_{ir}\, y_{ir},$$

so that the total demand for labour l^d is equal to:

(2.7.) $$l^d = \underline{g}'\,\underline{y}$$

It is clear that the demand for labour over a series of periods is influenced by the rise in labour productivity h_{ir}:

(2.8.) $$l^d_{ir} = h^{-1}_{ir}\, g_{ir}\, y_{ir}\ ,$$

where h_{ir} is a perunage representing the average sectoral-regional rise in labour productivity. This implies that total demand for labour is equal to:

(2.9.) $$l^d = (\underline{h}^{-1})'\,\hat{g}\,\underline{y},$$

where $\underline{h}^{-1}$ = an (IRx1)vector with h^{-1}_{ir} as elements
$\hat{g}$ = an (IRx1) diagonal matrix with g_{ir} as main diagonal elements.

Assuming a fixed average sectoral wage rate u_{ir}, the sectoral-regional wage sum w_{ir} can easily be determined as:

(2.10.) $$w_{ir} = u_{ir}\, l^d_{ir},$$

so that the total wage sum w of the system concerned is:

(2.11.) $w = \underline{u}' \, \underline{l}^d$

Given the assumption that total value added can be divided into wages w and remaining incomes p (especially profits), the following identity holds true:

(2.12.) $y = w + p$

The annual determination of the wage rates is either the result of a bargaining process between unions of employees and employers or the outcome of a centrally controlled wage policy. In a free market system the rise in annual wage rates may be assumed to be equal to the rise in labour productivity, given the usual efficiency criteria for entrepreneurs. When the rise in wage rates exceeds structurally the rise in labour productivity, a substitution process between capital and labour will take place. This implies that the demand for investment goods should also be incorporated as an endogenous variable. It schould be noted, however, that a distinction has to be made between investments produced by the sector of origin and those implemented by the sector of destination. When the latter type of investments is denoted by $\underline{z}$, a distribution matrix T is required to link $\underline{i}$ to $\underline{z}$:

(2.13.) $\underline{i} = T \, \underline{z}$

For the moment, the assumption will be made that the demand for investments is based on a mixed accellerator - substitution principle. The accellerator principle relates investments to the rise in income, while the substitution principle reflects a positive relationship between the rise in wage costs and the demand for investments. Thus, the following model may be assumed:

(2.14.) $$\underline{z} = \hat{\kappa}_1 \, \underline{\Delta v} + \hat{\kappa}_2 \, \underline{\Delta w} \, ,$$

$$= \hat{\kappa}_1(\underline{v}-\underline{v}_{-1})+\hat{\kappa}_2(\underline{w}-\underline{w}_{-1})$$

where $\hat{\kappa}_1$ and $\hat{\kappa}_2$ are diagonal matrices with marginal capital-output ratios and marginal capital-wage cost ratios on the main diagonal.[1] The lower index -1 refers to the value of a variable in a preceding period. Discussions and presentations of alternative investment equations are contained <u>inter alia</u> in Bitter and Nijkamp [1978], Van Delft and Van Hamel [1978], and Guccione and Gillen [1972]. It is obvious that the coefficients of an investment equation are co-determined by the locational qualities of the region at hand and its growth potentials.

1) It should be noted that (2.9.) is consistent with (2.14.), if the marginal labour productivity is equal to the rise in wage rates. Otherwise, (2.9.) has to be extended with an additional term for wage costs.

The imports $\underline{m}$ can be included as endogenous variables by means of the following import relationship:

(2.15.) $\underline{m} = M_1\underline{q} + M_2\underline{i}$,

where M_1 and M_2 are matrices with import coefficients for intermediate goods and investments, respectively.

The foregoing model constitutes the basic structure of a descriptive interregional model. In the next section, several extensions and generalizations will be proposed in order to make the model more appropriate as a policy model.

3. Extensions of the Basic Model

The model described in section 2 has a fairly simple structure. A comprehensive policy model, however, should reflect a higher degree of completeness for various relevant policy variables, such as environmental quality, employment situation, etc.

First, the pollution sector may be incorporated by means of an emission model (see also Muller [1978] and Nijkamp[1977]).

$$(3.1.) \qquad \underline{p}_r = B^1_r \, \underline{q}_r + B^2_r \, \underline{f}_r$$

where $\underline{p}_r$ is a J x 1 vector with pollution levels p_{jr}, and where B^1_r and B^2_r are J x I emission matrices which incorporate all direct and indirect emission effects of production and final demand, respectively. For the moment, these emission coefficients will be assumed to be constant, but this assumption will be relaxed later.

It should be noted, however, that in an open interregional system a distinction has to be made between final deliveries by origin and by destination (see also the investment relationship). This implies that the vector $\underline{f}$ with final deliveries from regions of origin has to be linked to the final demand in regions of destination by means of a distribution matrix N (see also Paelinck and Nijkamp [1976]):

$$(3.2.) \qquad \underline{f} = N\underline{f}^*$$

where $\underline{f}$ is the fector of realized final demand in all regions of destination. In fact, the realized final demand $\underline{f}^*$ gives rise to pollution from final demand, so that $\underline{f}_r$ in relationship (3.1.) has to be replaced by $\underline{f}^*_r$.

It is clear that N may be also be split up according to the components of final deliveries (see (2.3.)), including the investment transformation matrix T. In this case, a more deep-going analysis of final consumption is also possible by specifying a demand model for consumption (see also Coupé [1976]):

$$(3.3.) \qquad c^{pr}_{ir} = \bar{c}^{pr}_{ir} + \eta_{ir} \left(y^{pr}_{ir} - \sum_{i=1}^{I} \bar{c}^{pr}_{ir} \right) ,$$

where:

c^{pr}_{ir} = consumption of private goods of sector i in region r

$\bar{c}^{pr}_{ir}$ = minimum (indispensable) consumption of the same good

y^{pr}_{ir} = regional expenditure budget for private goods

η_{ir} = regional allocation parameter of descretionary income

It is clear that, in case of a saturation trend of the demand for consumption goods of a certain sector, the corresponding allocation parameter will tend toward zero.

It should also be noted that, in case of important interregional commuting flows and flows of profits p, regional income should also be adjusted for the difference between income generated in regions of origin and income earned (and received) in regions of destination. This can also be done by means of a distribution matrix, so that ultimately the multiregional emission structure can be assessed on the basis of information on regional production and income accounts.

The interregional transmission of pollution can be represented by means of a diffusion matrix H, so that the immission (and concentration) of pollution $\underline{g}$ in all regions of destination can be calculated as:

$$\underline{g} = H\underline{p} \quad , \tag{3.4.}$$

where $\underline{g}$ and $\underline{p}$ are JR x 1 vectors with immission and emission levels of all pollutants in all regions and where the elements of H represent the average diffusion coefficients.

In a similar way, the energy structure may be included (see also Lesuis et al [1978]). The demand for various energy components $\underline{k}$ can be related to production and consumption as:

$$\underline{k} = C^1 \underline{q} + C^2 \underline{f}^* \quad , \tag{3.5.}$$

where C^1 and C^2 are matrices reflecting the energy requirements of the production sector and the consumption sector, respectively. Substitution of (2.2.) and (3.2.) into (3.5.) gives the following result:

$$\underline{k} = \{C^1 (I-A)^{-1} N + C^2\} \underline{f}^* \tag{3.6.}$$

For the moment, the energy coefficients are assumed to be fixed in the short run. This assumption will also be relaxed later.

In addition to environmental variables, more attention has to be paid to the employment variables. In the first place, the perunage rise in wage rates $\tilde{u}_{ir}$ may be related to the rise in labour productivity h_{ir} as well as to the discrepancy between demand and supply of labour:

$$\tilde{u}_{ir} = \alpha_1 h_{ir} + \alpha_2 (l^d_{ir} - l^s_{ir}) \quad , \tag{3.7.}$$

where l_{ir}^{s} is the supply of labour. It should be added, that the supply of labour is not a homogeneous category, but rather a diversified set of labour categories characterized by differences in professional skill, age, sex etc. This implies that the supply of labour in region $r(l_r^s)$ should be split up according to several categories $m(m=1,\ldots,M)$, i.e.,

$$l_{ir}^{s} = \sum_{m=1}^{M} l_{irm}^{s} \qquad (3.8.)$$

This relationship reflects the fact that the labour supply pool is co-determined by the regional demographic and professional structure (see Herrmann [1978], Rogers [1978] and Willekens [1978]). Apart from commuting flows, l_r^s should be equal to $\sum_{i=1}^{I} l_{ir}^{s}$. A further analysis of this supply-demand pool analysis is contained among others in Bartels [1977] and Tinbergen [1975].

A shift in the regional supply of labour for each category may occur due to migration flows. The net migration t_r to region r can be assessed by means of a migration relationship of the following type (cf. Nijkamp [1977] and Cebula and Vedder [1973]):

$$t_r = \beta_1 (l_r^d - l_r^s) + \beta_2 y_r + \beta_3 s_r + \beta_4 p_r + \beta_5 d_r \quad , \qquad (3.9.)$$

where s_r represents the excess supply on the housing market, p_r the average regional pollution (as an indicator of environmental quality), and d_r the average regional accessibility (for example, measured via the average distance with respect to the heartland of the country). It is clear that the latter equation may also be subdivided according to sectors and professional classes.

The foregoing model can be extended in several alternative ways, but for the moment the structure of this interregional model is sufficient for an analysis of regional economic policy in which key variables such as employment, income, environmental quality and energy play a dominant role. So far no explicit attention has been paid to the dynamic aspects of this model. It is clear that many relationships have a dynamic structure. Apart from the estimation problems of dynamic interregional models (see Cliff and Ord [1973] and Hordijk and Nijkamp [1977]), it is important to pay attention to the dynamic development of an interregional system, especially because there is no quarantee for a harmonious and balanced interregional equilibrium. The dynamic disequilibrium analysis was initiated by Myrdal [1957], who presented in his theory of cumulative causation the foundation stones for a study of interregional growth processes based on an interplay of new investments, labour market adjustments, migration movements, income growth, and resulting regional welfare impacts. This cumulative process implies a structural process of permanent interregional discrepances, particularly due to the existence of backwash effects and spread effects. Myrdal's theory is especially important in the case of a stagnating economic development in which regional disparities tend to become more manifest. A further analysis, however, of differential regional growth and stagnation processes requires the construction of a comprehensive dynamic model incorporating all dynamic spatial spill-over effects. An illustrative mathematical presentation of such interregional growth processes is contained in Paelinck and Nijkamp [1976]. The analysis in this paper, however, will be limited to a comparative static approach to regional economic policies during a stagnation process. Before the various aspects of these policies will be studied in more detail, the attention will be focussed on intraregional disparities.

4. Intraregional Disparities in an Interregional Framework

The orthodox (neo-classical) view of economic life tries to explain regional developments on the basis of marginal productivity theory: given assumptions of perfect competition and market equilibrium, the distribution of marginal products is identical with the distribution of earned incomes (cf. Thurow [1969]). Evidently, neo-classical economists admit that a dynamic economy is normally not in an equilibrium state and that the market displays many discrepances with respect to a situation of perfect competition, but they still believe that the actual market processes incorporate sufficiently competitive forces and equilibrating adjustments to justify a reliance on the traditional income/marginal productivity hypothesis (cf. Richardson [1973]).

Especially the assumption of a free mobility of production factors has been criticized due to the existence of distance friction. These distance frictions may be caused by spatial barriers (cf. Isard [1956]), but also by socio-psychological barriers. This phenomenon implies that even a regional labour market may show significant disparities. The dual labour market theory attempts to explain this situation by postulating the presence of a dichotomization of local labour markets, a primary and a secondary one. The rules of behaviour on these labour markets tend to be completely different, so that even equal rates of productivity in these markets might lead to completely different employment prospects of large numbers of urban employees (see among others Doeringer and Piore [1971], Gordon [1972], and Harrison [1972]). Ethnic conditions and residential quality appeared to be more important driving forces in the evolution of urban labour markets than traditional productivity measures. The resulting differences in poverty and underemployment among the various social groups of the urban community show that even within a regional system significant disparities may exist. There is much empirical ecidence that the income inequality at the intraregional scale is even much higher than at the interregional scale (cf. Bartels and Nijkamp [1976] and Stöhr and Tödtling [1977]).

In many industrialized countries a simple duality on the labour market does not exist, but rather a certain degree of segmentation according to levels of skill, age, profession and so forth. For example, the presence of modern office buildings (with a large demand for skilled personnel) at the fringe of older residential areas in the city (mainly inhabited by lower skilled people) may cause many disturbances at the local labour market (cf. Pahl [1971]). The fact that especially at the local scale significant disparities may occur indicates that a global regional policy runs the risk to neglect structural imbalances and frictions within the region (cf. Button [1976]). Consequently, it is extremely important to orient regional policies toward the diversified aspects and developments of the regional and local labour markets (cf. Gleave and Palmer [1977]).

This implies also that in an operational policy model a clear reason exists to disaggregate the supply categories of labour also according to the various local levels (see also (3.8.)).

In this respect the well-known dilemma 'efficiency-equity' becomes manifest at the regional level (see also Stilwell [1972]). The achievement of a maximum overall regional efficiency (for example, measured in terms of income) does not necessarily imply an equity with respect to all social groups (for example, measured in terms of employment rates), mainly caused by lack of mobility and discrepancies between the urban labour market segments.

Consequently, regional economic policy should also try to incorporate inter-local disparities within the regional system itself. Therefore, regional economic policy should necessarily be implemented in a hierarchical or stepwise fashion (either as a bottom-up or as a top-down policy). The further elements of regional decision-making in a period of stagnation will be discussed in the next section.

5. Decision-Making and Stagnation

As set out in the beginning of this paper, the present-day stagnation has to be placed in a broader development of our western societies, in which energy frictions, environmental deterioration, Third World problems, power conflicts and land use problems cause an attack on the post-war growth process. Consequently, any decision model for planning against stagnation should incorporate two elements: (i) a set of policy objectives which should be strived for in national, regional and local policy-making and (ii) a set of instruments and institutional measures which should be implemented in order to achieve the policy objectives (cf. Kuklinski [1975]).

A basic problem in the specification of regional economic objectives is the fact that traditional growth ideals do no longer hold in our era of energy shortages, environmental frictions and Third World problems. Therefore, it is plausible to assume more modest regional targets, based on so-called 'satisficer-principles' (cf. Simon [1958]). This implies that certain achievement levels for policy variables are to be specified (at the regional or urban level). Next, a set of instruments and institutional measures has to be established to guarantee the achievement of the pre-specified targets.

Without lack of generality the following 4 policy objectives will be assumed: demand for labour (l^d), investments (i), environmental quality (p) and moderate use of energy resources (k)[1)]. Suppose that for each region the following achievement levels can be specified: l^*, i^*, p^* and k^*. Then the following objective function can be assumed:

$$(5.1.)\quad \begin{cases} \min \phi = l^- - l^+ + i^- - i^+ - p^- + p^+ - k^- + k^+ \\ \text{subject to} \\ l + l^- - l^+ = l^* \\ i + i^- - i^+ = i^* \\ p + p^- - p^+ = p^* \\ k + k^- - k^+ = k^* \end{cases}$$

where the upper symbols - and + reflect an underachievement and an overachievement of the variable at hand, respectively.

1) It should be noted that p and k are essentially cost criteria, so that their achievement levels should be established at a low level.

The latter model can easily be written as a multi-objective goal programming model (see for a general introduction to multi-objective programming theory inter alia Van Delft and Nijkamp [1977] and Nijkamp [1977] and to goal-programming theory Nijkamp and Spronk [1977]). To that end the variables of the model presented in section 2 and 3 will be divided into goal variables $\underline{x}_1$ (including l, i, p and k), remaining endogenous variables $\underline{x}_2$, instrumental variables $\underline{x}_3$ (such as public investments and tax rates) and exogenous variables $\underline{x}_4$. In formal terms these variables are linked to each other by means of the following general model:

$$(5.2.) \qquad \underline{f}\ (\underline{x}_1, \underline{x}_2, \underline{x}_3, \underline{x}_4) = \underline{0}$$

Clearly, in addition to a set of structural equations one may impose a set of constraints on the system at hand, for example, capacity constraints in capital equipments, availability of labour, standards of environmental quality, etc.

Then the goal programming formulation of the multiple objective decision model (5.1.) and (5.2.) is:

$$(5.3.) \qquad \begin{cases} \min \varphi \\ \text{subject to} \\ \underline{x}_1 + \underline{x}_1^- - \underline{x}_1^+ = \underline{x}_1^* \\ \underline{f}\ (\underline{x}_1, \underline{x}_2, \underline{x}_3, \underline{x}_4) = \underline{0} \end{cases}$$

This model can be solved by means of standard solution techniques (see the end of this section for a discussion of the trade-off problem).

It should be noted that the latter model incorporates all levels of planning and policy-making (national, regional and local). This integrated framework can also be represented by means of the following hierarchical scheme (which may be extended with feed-back relationships):

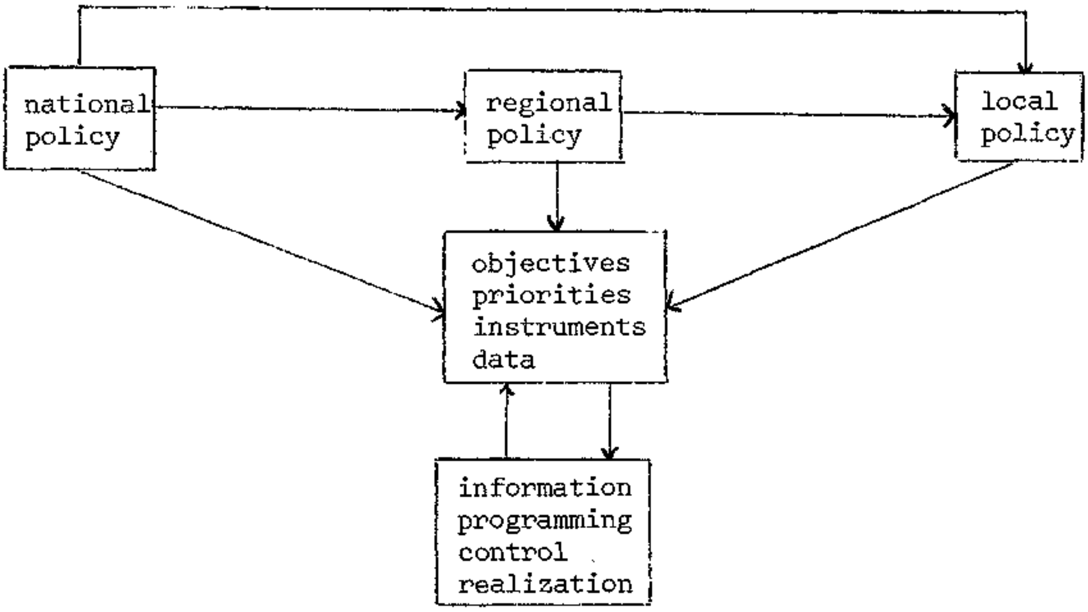

Fig. 1. An integrated control scheme for decision-making.

So far little attention has been paid to the use of the foregoing model in a stagnating economy. This model incorporates the impacts of changes in world trade prices, energy prices, exports etc. All these variables are outside the control space of regional or national policies, so that the use of this model as a projection or policy model is necessarily conditional. By making alternative <u>ceteris paribus</u> assumptions about the external developments of the system at hand, a set of external scenario's may be created (such as a further decrease of the world trade, a sharp rise in energy prices, a continued growth etc.). Each of these scenario's $s_1 \ldots, s_k$ gives rise to a certain outcome of the goal programming model represented in (5.3.). This gives rise to the following picture with alternative outcomes:

	goal variables at national level	goal variables at level of region 1	- - - - - - - - - -	goal variables at level of region R	goal variables at local levels
s_1					
⋮					
s_k					

Fig. 2. Results of diverse scenario's at different institutional levels.

Next the instrumental aspects have to be considered somewhat more closely. Since the present-day stagnation is assumed to be caused by an intricate set of driving forces, the policy instruments should be rather diversified. These public controls may include inter alia: investment subsidies, wage cost subsidies, public investments, spatial reallocations, infrastructural improvements, migration subsidies, charges upon pollution and energy resources, etc. The impacts of these instruments on the structural coefficients of model (5.2.) should be taken into account, for example, by means of a sensitivity analysis or a simulation model. For instance, a pollution tax will affect the emission coefficients, charges on energy resources will affect the energy demand, etc. Examples of the letter type of analyses can be found in Muller [1978] and Lesuis et al [1978] among others. These instruments should be differentiated according to the specific needs of regions in order to arrive at a selective multiregional policy. It is clear, however, that a selective regional policy against stagnation necessarily includes a compromise between the various conflicting regional objectives represented in (5.1.).

This compromise view of regional policy-making brings us back to the problem of policy objectives. As indicated before, the goal programming model gives rise to a solution for each external scenario s_k, but this solution emerges from an unweighted goal programming technique (see (5.3.)). A more adequate compromise procedure would be to specify weights for the successive overachievements and underachievements of the goal variables, but this approach is hardly operational in planning practice. Therefore, a better approach is to use an interactive learning procedure (see for an extensive exposition of interactive multi-objective goal programming theory Nijkamp and Spronk [1978]).

This interactive approach incorporates the following steps: determine an initial solution according to (5.3.), present this solution to the responsible decision-maker or public authority and ask which goal variables are not satisfactory in the initial solution, modify the goal programming accordingly and determine a new trial solution, etc. This procedure is repeated until a certain 'satisficing' compromise solution has been attained.

Sometimes it may be rather difficult to identify a unique compromise solution out of a set of conflicting priorities. In that case it is more plausible to create a set of alternative policy scenario's characterized by different priorities regarding the goal variables (for example, a energy savings policy, an environmental protection policy, an economic growth policy, etc.). For each of these scenario's $s_1,\ldots,s_M$ a certain compromise solution may be identified. By combining these policy scenario's with the above mentioned external scenario's, a new set of composite scenario's may be constructed (see Fig. 3).

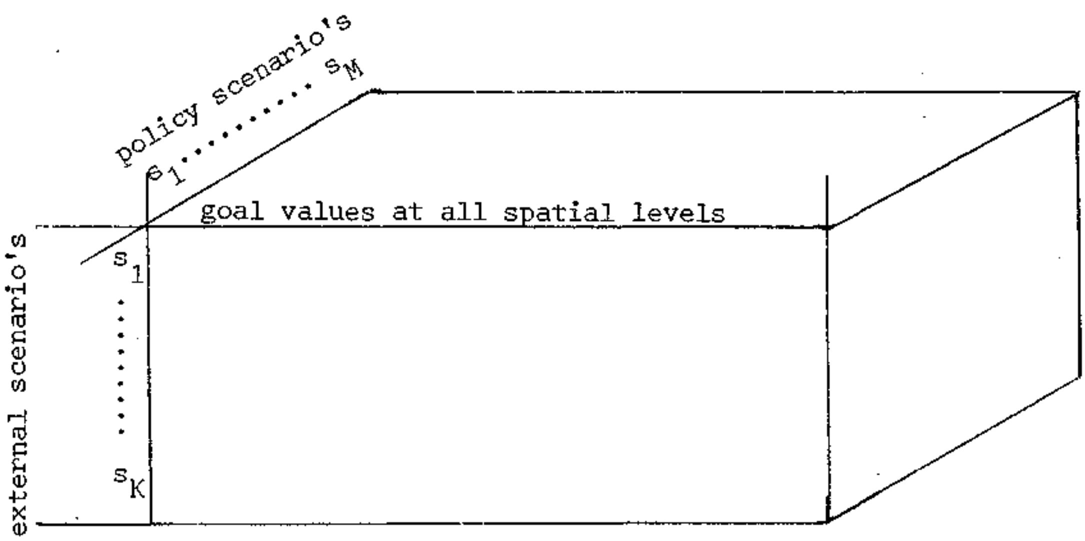

Fig. 3. Composite scenario's

In this way, all relevant information about the effectiveness of instruments and the impacts of external developments upon all goal variables can be represented in a concise way. The advantage of this approach is that the political priorities regarding conflicting policy issues can be dealt with in a systematic and operational manner.

6. Conclusion

Regional development and planning covers a wide variety of subjects ranging from theory, models and data needs, to specific spatial problems, policy issues and the implementation of regional policies. The present-day stagnation problems once more emphasize the necessity of an integrated approach to spatial development problems and of comprehensive decision models to guide policy-makers and planners. It is a fundamental notion to take into account the fact that, in the developed part of the world, regional and national policy objectives must go beyond traditional efficiency principles such as maximizing income or production. Instead, a balanced development has to be strived for, so that a compromise has to be found between a maximum economic efficiency, social and regional equity, a good quality of life, and protection of energy resources.

The present paper is an attempt to provide a methodological and operational framework to cover the above mentioned issues. Interregional input-output models extended with a large set of behavioural and technical relationships appear to provide a useful formal framework for a policy analysis of a stagnating economy. An integrated hierarchical spatial systems approach can be regarded as an extremely important representation of complicated spatial interactions. The policy framework itself, based on 'satisficer' principles, can be further analyzed by means of a compromise approach from multi-objective goal programming theory. By means of an integration of external and policy scenario's, extended with a learning (interactive) approach, a useful frame of reference for decision-making and planning for balance in a situation of a stagnating economy can be created.

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