STRATEGIC REGIONAL POLICY

A. STRASZAK AND J.W. OWSIŃSKI
EDITORS

PART I
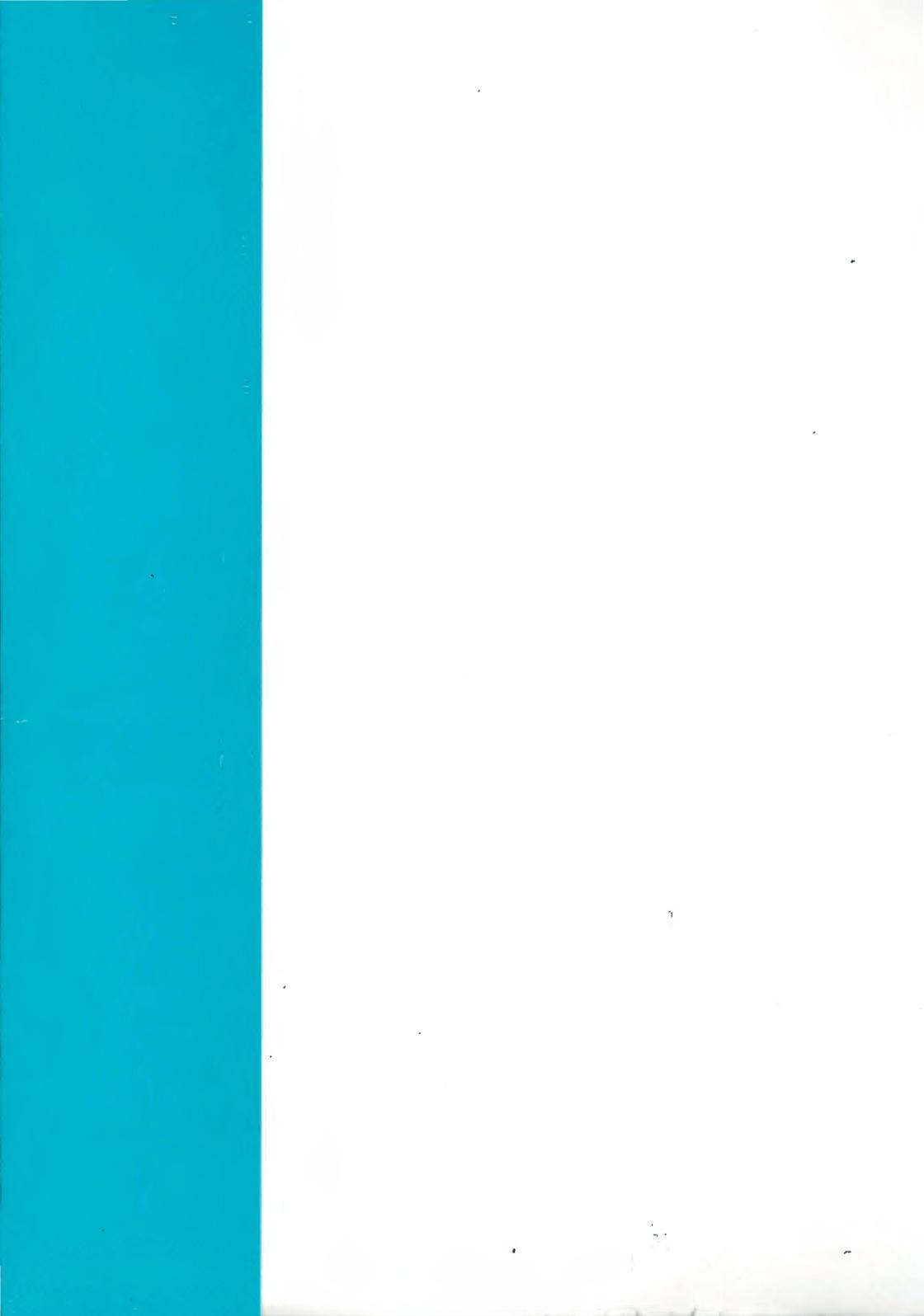
STRATEGIC REGIONAL POLICY

Paradigms,Methods, Issues and Case Studies

A. Straszak and J.W. Owsiński
editors

Documentation of the workshop on "Strategic
Regional Policy", December 10 - 14, 1984,
Warsaw, organized by the Systems Research
Institute, Polish Academy of Sciences and
the International Institute for Applied
Systems Analysis

PART I

II. REGIONAL POLICIES
IN A SYSTEMS CONTEXT

FEASIBILITY OF REGIONAL INVESTMENT POLICY
- INTRODUCTORY STUDY

Krzysztof Cichocki

Systems Research Institute
Polish Academy of Sciences

1. Introduction

One of the major questions in regional planning is how much
investment one should make in each sector and region and where
to add to capacity. The allocation of investment, and the power
of decision making in this respect, by the upper management le-
vel, for instance the Central Planner (C.P.) was the major fac-
tor influencing the decisions at branch level in the 70-ies in
Poland.

The centralized procedure of investment allocation by the C.P.
can be applied to regions or otherwise one can delegate the
authority to a macroregional level in order to neutralize do-
mination of branch aggregation over the regional aggregation.
The C.P. will still have the possibilities of parametric inter-
vention at the regional level due to suitable tax policy, in-
fluencing the formation of the average wage and of the prices
of exported goods. However, designing a decentralized alloca-
tion mechanism requires construction of a disaggregated regio-
nal model, which, in turn, requires a very large data collec-
tion and substantial statistical services. For instance, the
regional model requires one intermediate input matrix for each
region. Also, data on shipment of goods between regions are
required. These difficulties encourage the use of models with
less realistic economic assumptions or with more aggregation.

One can use models for multiple regions or locations and a single
industry, thus treating sectoral interdependences either through
iterative solution of the model or ignoring them.

One can also convert economy-wide models to regional ones by adding the spatial dimension to sectoral or national models. This approach results in much more complicated solution methods but due to the lack of special regional structure (e.g. lack of intermediate input matrices) it does not help the planner in exact determination of locations of new production facilities.

Also, in most regional models time is aggregated to a simple period, in spite of the fact that investment considerations which are dynamic in nature are usually included. There are some less traditional approaches to treating regional production of a given branch in a synamic context. The paper of Sosnowski and Tołwiński [7] compares the results of game theoretic and optimal control approaches applied to investigation of regional stock production.

Decisions, pertaining to investments distributed over time will always remain important in regional analysis. Therefore, some studies of difficult environment of investment and fixed assets, their relation to consumption and production levels in various sectors of the economy, each having different profitability might be useful.

Some investments might not be feasible due to the lack of imported goods, lack of labour force or because of too high requirements for production capacities in the region.

In modelling analysis selection of the time interval over which the investment processes are investigated plays a crucial role, especially when some terminal conditions are imposed on investment or fixed assets which ensure that the fixed assets do not decapitalize over time.

The investment delay considered should not exceed the investigation period. Valuable observations can be obtained when the analysis is carried out over the period not shorter than the doubles investment lag.

2. Analysis of Investment Processes

2.1. Traditional Description of Fixed Assets Formation

The process of accumulation of capital stock in a given production branch is considered, where capital stock K is represented by the gross value of fixed assets, accumulated over the period $[t_0, T]$. The fixed assets at time t+1 depend on the depreciated value of fixed assets at time t (with included liquidated fixed assets) and newly formed fixed assets due to investments from the period (t_0, t) and to investments committed prior to time t_0.

The accumulation equation assumes the form

$$K_{t+1,j} = (1-d_{jj})K_{t_j} + \sum_{\tau=0}^{t} \phi_{\tau_j} V_{t-\tau,j} + \Delta_{tj} \quad \text{for} \quad t < N_j, \quad (1)$$

$$K_{t+1,j} = (1-d_{jj})K_{t_j} + \sum_{\tau=0}^{N_j-1} \phi_{\tau_j} V_{t-\tau,j} \quad \text{for} \quad t \geqslant N_j, \quad (2)$$

$$\Delta_{t_j} = \sum_{\tau=t+1}^{N_j-1} \phi_{\tau_j} \tilde{V}_{t-\tau,j}, \quad t=0,\ldots,T-1 \quad (3)$$

where N_j is the average investment delay in the j-th branch $j=1,\ldots,m$, ϕ_{τ_j} denote coefficients of lagged investment and represent the effect of current ($\tau=0$) and lagger ($\tau=1,\ldots,N_j-1$) investments on fixed assets formation in the j-th branch, $0 \leqslant \phi_{\tau_j} \leqslant 1$, $V_{t,j}$ is the investment level at time t in the j-th branch. A parameter d_{jj} is the j-th element of the diagonal matrix and denotes depreciation rate.

The expression Δ_{t_j} specifies changing over time fixed assets which are due to investments committed in the past prior to the planning period, starting from $t=t_0-N_j+1$ till $t=t_0-1$.

The initial conditions on the fixed assets are assumed given:

$$K_{oj} = \bar{K}_{oj}, \quad j=1,\ldots,m \quad (4)$$

The above traditional description of fixed assets accumulation, slightly modified due to the addition of the expression Δ_{t_j},

does not protect the fixed assets from decapitalization in value shortly after the investigated period $[t_0,T]$ is over.

In real life, investments are committed during the period $[t_0,T]$ and contribute to the fixed assets formation after the time T, thus allowing for maintaining a given or sufficient level of fixed assets and production capacities. It might even happen that for some categories of fixed assets which decapitalize fast over time, some investments are needed at time succeeding the time instant T, i.e. after the investigated time period.

There are of course many ways of tackling the problem of avoiding the decapitalization of fixed assets in the future. Two approaches are presented and discussed in the paper based on analysis of numerical computations and official statistical data $[8]$.

2.2. Explicit Conditions on Future Investments

The first approach utilizes explicit formulation of terminal conditions on fixed assets. They constitute, together with the relations (1)-(4) the set of constraints which provide for feasible values of investments satisfying the relations (1)-(6). The addition of an objective function and solution of this constructed model yields an explicit relation between fixed assets and investments which is optimal in the sense of the formulated optimization problem.

The terminal conditions imply investments which are commited over the investigated period and contribute to the formation of fixed assets in the future. They assume the form

$$K^P_{T+1,j} - (1-d_{jj})K_{T_j} - \phi_{oj}V^P_{T_j} \leq \sum_{\tau=0}^{N_j-1} \phi_{\tau_j}V_{T-\tau,j}, \tag{5}$$

$$K^P_{t+1,j} - (1-d_{jj})K^P_{t_j} - \sum_{\tau=0}^{t-T}\phi_{\tau_j}V^P_{t-,j} \leq \sum_{\tau=t-N_j+1}^{N_j-1}\phi_{\tau_j}V_{t-\tau,j}, \tag{6}$$

for $t=T+1,\ldots,T+N_j-2;$ $j=1,\ldots,m.$

For exmaple, the relation (5) assumes that the investments committed up to the year T-1 must ensure investment expenditures associated with the depreciation of fixed assets at time T, and with an increase of fixed assets $K_{T+1}^p - K_T$. Thus, the decapitalization of fixed assets can be avoided. The superscript p, which appears with fixed assets K^p, and investments V^p denotes evaluated exogeneously prognoses of these variables. Both these prognoses have to be rationally correlated one with another. It is assumed in the paper that the investments at time t, contribute to the fixed assets in the year t+1 and in the following years.

In order to investigate the dynamic changes in production of a branch j, the production is defined with the aid of a distribution equation:

$$Y_{tj} + (\overline{B}_t V_t)_j + M_{tj} = (A_t Y_t)_j + (B_t V_t)_j + C_{tj} + E_{tj} \tag{7}$$

The global production of the j-th branch cannot exceed its production possibility level (production capacity), which is approximated by the two-factor CES production function.

$$Y_{tj} = \{(I-A)^{-1} [(B-\overline{B})V_t + C_t + E_t - M_t]\}_j \leqslant f_{tj}^{CES}(K_{tj}, L_{tj}) \tag{8}$$

A is a matrix of input-output coefficients, $0 \leqslant A_{ij} \leqslant 1$, $i,j=1,..$
.,m and includes imported production goods.
The matrix $(I-A)^{-1}$ exists and its elements are nonnegative. B and $\overline{B}$ are the total and imported capital coefficient investment matrices, $B_{ij} - \overline{B}_{ij} \geqslant 0$, $i,j=1,...,m$. $\overline{B}_{ij} V_{tj}$ denotes a flow of the i-th investment good to branch j. H_j is a diagonal matrix of total imported investment coefficients in the j-th branch, $0 \leqslant H_j \leqslant 1$, $j=1,...,m$. $H_j V_{tj}$ denotes investment goods imported by the j-th branch at time t. E_{tj} is a real export, $j=1,...,m$, $t=0,...,T-1$, M_{tj} is a consumption import at time $t=0,...,T-1$ in branch j, $j=1,...,m$. L_{tj} denotes labour (employment level) in the j-th branch which can be determined from a simple relation

$$\sum_{j=1}^{m} L_{tj} = \overline{L}_t \tag{9}$$

where $\overline{L}_t$ is the total amount of labour in the economy, and m

denotes the number of branches.

One could carry out various computer experiments analysing interdependences between investments, fixed assets, consumption and labor based on relations (1)-(9). For simplicity, we assume that exports do not significantly contribute to the investment and fixed assets, and are given exogeneously.

However, it is evident that although the conditions (5), (6) ensure that the fixed assets do not decapitalize over time they can be satisfied for any, sufficiently large values of investments. Thus, it might happen that for some inconsistent (irrational) forecasts of fixed assets K^p, and of investments V^p the investments at a given time t, $t \in (t_0, T]$ can assume very large values.

For very large investments, especially when consumption tends to increase monotonically, the production capacity constraint (8), might not be satisfied unless imported consumption M_{tj} grows sufficiently fast.

One could expect that the increase of fixed assets K_{tj} and of labor L_{tj} would increase the value of the CES production function and help to satisfy the inequality (8). However, for given values of labor $0 \leqslant L_t \leqslant \tilde{L}_t$, $t=0,\ldots,T-1$ the value of the function $f_t^{CES}(K_t, L_t)$ is limited since

$$\lim_{k \to \infty} F(K,L) = \alpha(1-\delta)^{-\upsilon/\rho} L^\upsilon \qquad (10a)$$

Additionally, the marginal value of the derivative

$$\lim_{k \to \infty} \frac{\partial F(K,L)}{\partial K} = 0 \qquad (10b)$$

indicates that for large values of K_{tj} (and thus for large values of V_{tj}) the change (an increase) of investment V_{tj} will rather imply changes of variables on the left hand side of the inequality (8), i.e. consumption C_{tj} and imported consumption M_{tj}. In case these changes are inefficient in satisfying (8), an immediate change in labor value might occur.

The tendency of increasing the labor L_{tj} in some branches might be very inconvenient. Too high level of employment $\sum_{j=1}^{m} L_{tj}$ might imply non satisfaction of the relation (9), describing labor distribution over branches. This, in turn, will result in the decrease of employment L_{tj} in some branches $j \in \{1,...,m\}$ and will force the consumption and investment to decrease again or the M_{tj} to raise.

The above process is distributed over time and branch. The most rapid changes of V, M'and L are observed at the end of the investigated period.

In Figs. 1,2,...,8 examples are presented, which depict the above described phenomena in case of assumed irrational progno-sis of investments V_{tj}^P and of fixed assets K_{tj}^P in the termi-nal conditions (5) and (6). The numbers in the figures denote various simulation runs.

In the metal machinery industry the investments are higher than the actual ones even at the beginning of the investigated period 1982-1985. Starting in 1984 they grow rapidly due to very high anticipated values of K^P and V^P in that industry (Figure 1). Therefore the inequality describing production possibility (8) is not satisfied. The consumption decreases starting with 1984 (Fig.7) and employment (Fig.6) and fixed assets (not shown here) grow very fast, exceeding actual values.

In food and agriculature the initial values of investments (Fig.2) and of fixed assets (Fig.8) are close to actual. Howe-ver, due to the fast increase of consumption, which follows the desired path, the inequality (8) is not satisfied. In the re-sult, the investments decrease rapidly over the years 1984, 1985, (Fig.2), the imported consumption M_{tj} grows steadily (Fig.3) as do the fixed assets. The employment (Fig.5) decreases fast in 1984 because the constraint (9) is not satisfied.

There are various simulation runs in the presented graphs. They correspond to various parameters of the model: alternative pro-gnoses of investment V_{tj}^P and of fixed assets K_{tj}^P and various desired reference trajectories.
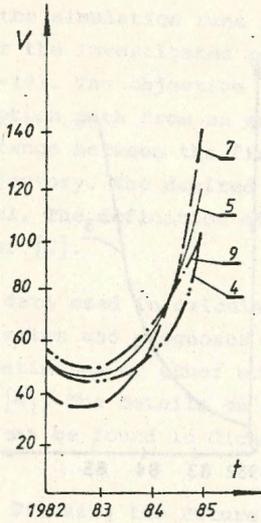
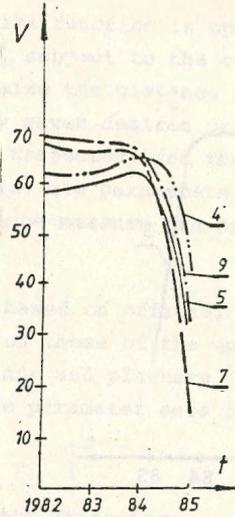Figure 1. Invextment in
the metal-machinery industry

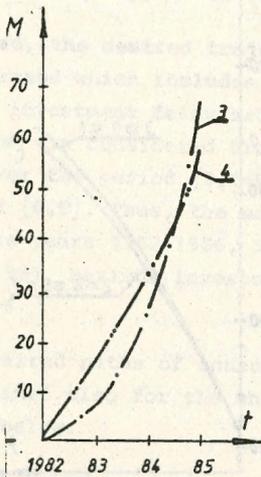Figure 2. Investment in
food and agriculture

Fugure 3. Imported consump-
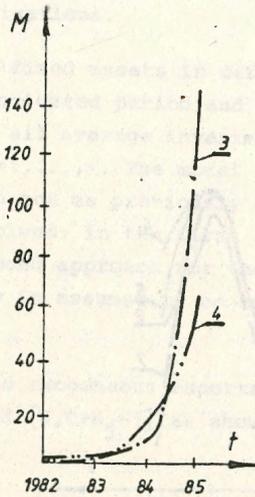tion in food and agriculture

Figure 4. Imported consump-
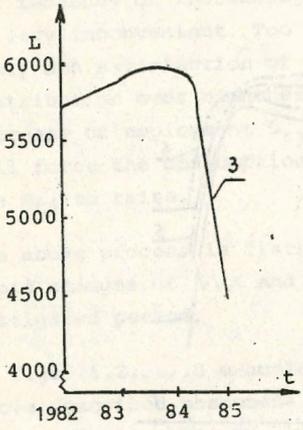tion in construction sector

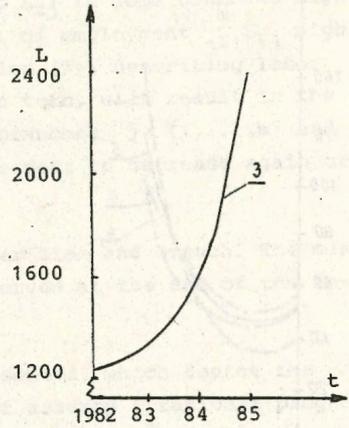Figure 5. Employment in
food and agriculture

Figure 6. Employment in the
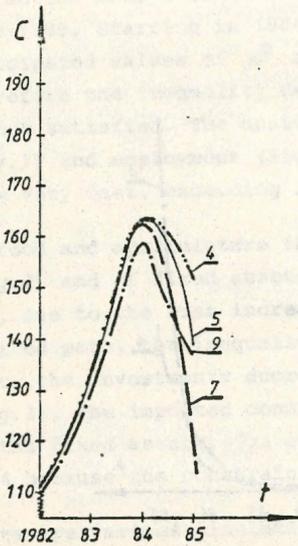matal-machinery industry

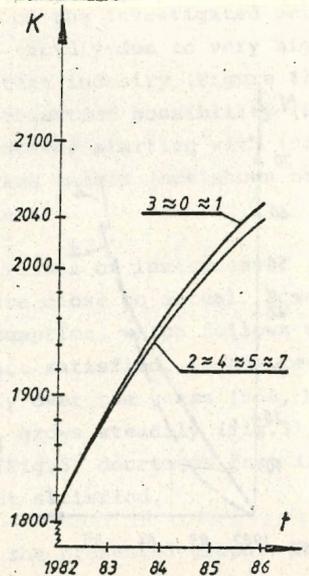

Figure 7. Consumption in the
metal-machinery industry

Figure 8. Fixed assets in
food and agriculture

In the simulation runs the objective function is optimized
over the investigated period $[0,T]$ subject to the constraints
(1)-(9). The objective is to minimize the distance of the con-
sumption path from an exogeneously given desired path and the
distance between the fixed assets trajectory and the desired
trajectory. The desired trajectories are parameters of the
model. The definition of the distance measure can be found in
paper [2].

The data used in calculations are based on official statistics.
Estimates and prognoses are based on those of the author, and
on estimates of other econometricians and planners [1], [5],
[6],[8]. The details on alternative parameter sets of the mo-
del can be found in Cichocki, [4].

2.3. Tracking the Future Fixed Assets Trajectory

The second approach to the problem of decapitalization of fixed
assets in the future does not explicitly apply prognoses of
investment V_{tj}^p and of fixed assets K_{tj}^p. The relations (5)
and (6), which formulate the terminal conditions for the fixed
assets do not appear in the investigations.

Instead, the desired trajectory of fixed assets is defined for
the period which includes the investigated period and the ma-
ximum investment delay selected of all average investment de-
lays N_j in considered branches $j=1,\ldots,m$. The model is sol-
ved over the period $[0,T+N_j-1]$, and not as previously over the
period $[0,T]$. Thus, the model is solved: in the first approach
for the years 1982-1986, in the second approach for the years
1982-1991. Maximum investment delay is assumed to be six years,
$N_{j\,max}=6$.

The desired paths of consumption and exogeneous exports have to
be defined also for the whole period $[0,T+N_j-1]$ as shown in the
graph below.

Past investments $\tilde{V}_{t_0-\tau}$ committed over the years 1977-1981 con-
tribute to the fixed assets in the investigated period consis-
tently with the equation (3).

Optimal solutions

$$\hat{K}_{tj}$$

$$\bar{L}_{tj} \; , \; \hat{V}_{tj} \; , \; \hat{C}_{tj} \; , \; \hat{M}_{tj}$$

1977 78 79 80 81 82 83 84 85 86 87 88 89 90 1991 $t(years)$

t_0-N_j+1 t_0-1 $t_0=0$ t_k $t_k+1=T+N_j-1$

$\tilde{V}_{t_0-\tau_j}$ $\bar{C}_{tj}$

             $\bar{K}_{tj}$
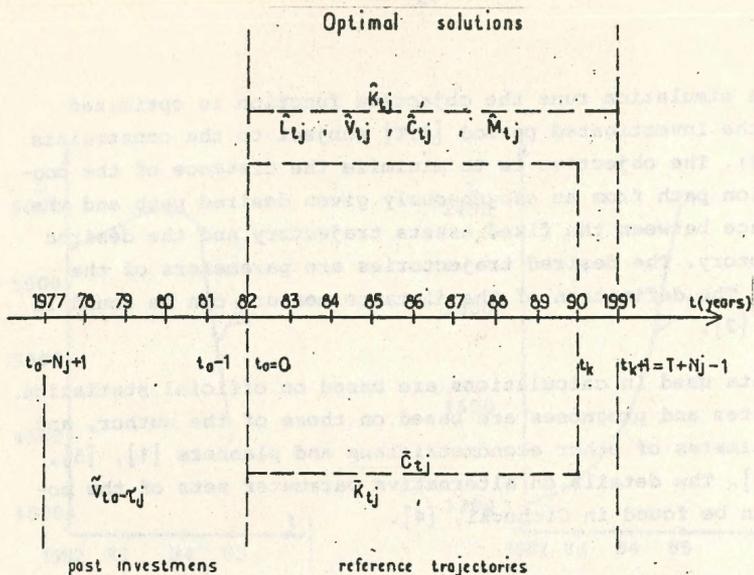
post investmens   reference trajectories

Fig. 9

Given past investments, desired trajectories (and in the first
approach prognoses of investment and fixed assets) the solution
of the model yields optimal values of investment, consumption,
labor and fixed assets for all branches j=1,...,m, which mini-
mize the objective function and satisfy the constraints (1)-(4),
(7)-(9)(in the first approach additionally (5) and (6)).

The model is solved many times, every time assuming different
reference trajectories (and various prognoses of investment and
fixed assets), representing various utilization of production
capacity [6] in the economy and alternative development paths
of Polish economy [1], [4].

The second approach yields solution of the model for the whole
period [0,T+N_j-1] i.e. for the years 1982-1991 but one can in-
vestigate thoroughly the period of interest, for instance 1982
-1985 and still have an idea what happens with the fixed assets
trajectory, investment and consumption paths after this period,
until the year 1991.

The graphs depicted in Figs. 10-15 present investment, fixed
assets and consumption in the food and agriculture sector and
in the metal-machinery industry.

The investments in the food and agriculture (Fig.11) do not
decrease in the year 1985 as in the Fig.2. They grow slowly
till 1991 with the exception of the path 102 which attains ma-
ximum in the year 1985. The increasing investments results from
increasing fixed assets (Fig.10) which for all alternative si-
mulations do not decapitalize over time. The highest investments
yield the highest fixed assets and the lowest investments imply
the lowest fixed assets trajectory (compare corresponding simu-
lation runs denoted by numbers, for instance in Fig. 5, 10 and
12).

The investments over the period 1982-1985 are slightly lower in
Fig.11 as compared with those presented in Fig.2.

The investment paths 101-106 obtained as solution of the model
constructed consistently with the second approach grow slower
than the prognosis of investment elaborated by other econome-
tricians [1], [5], [6] and applied in the first approach.

The investment path denoted by 4 results from the solution of
the model over 1982-1985 consistently with the first approach
and its parameters are very close to the parameters of the mo-
del for which the investment path 101 is obtained.

The level of fixed assets in Fig.10 is close to that of fixed
assets obtained in Fig.8.

There is also a straightforeward relation between investments
and consumption depicted in Fig.12. The highest investments
imply the lowest consumption and vice versa, for the lowest
investments the highest consumption is obtained.

The simulation runs 103 and 101 in Figs. 10 and 11 are very
similar, only the desired trajectory of fixed assets $\bar{K}_{t7}$ is
slightly higher for the simulation 103 starting from the year
1987. One would expect, that higher desired trajectory $\bar{K}$ will
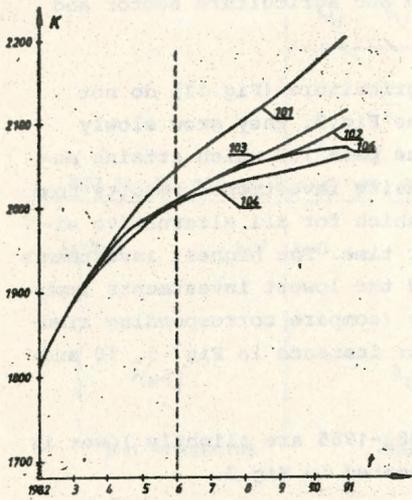result in higher investments and higher fixed assets, while

Figure 10. Fixed assets in food and agriculture
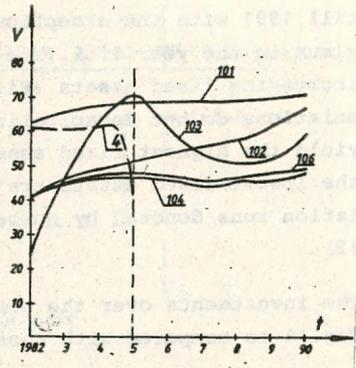

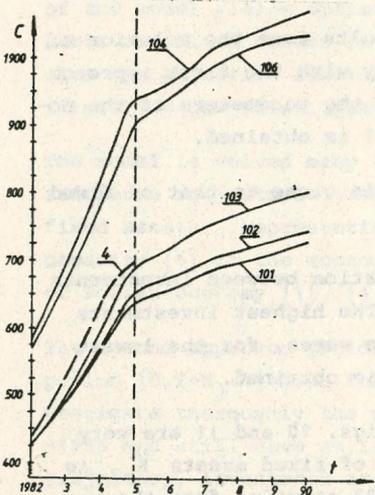Figure 11. Investment in food and agriculture

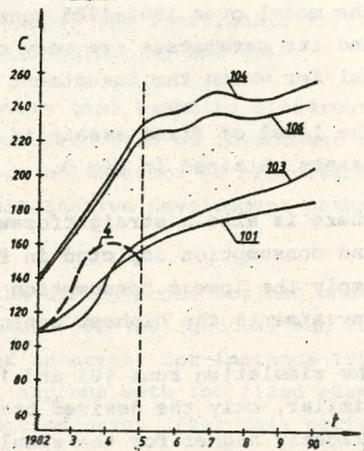Figure 12. Consumption in food and agriculture

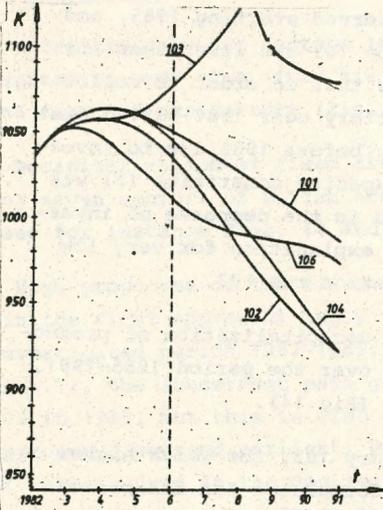Figure 13. Consumption in the metal-machinery industry

Figure 14. Fixed assets in
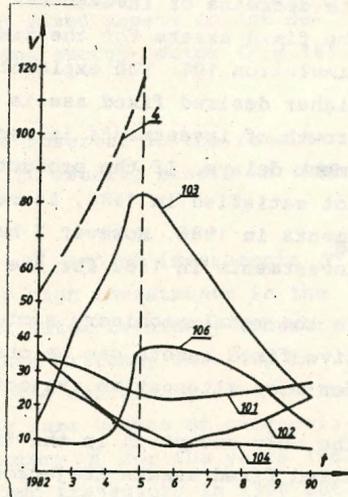the metal-machinery industry

Figure 15. Investments in
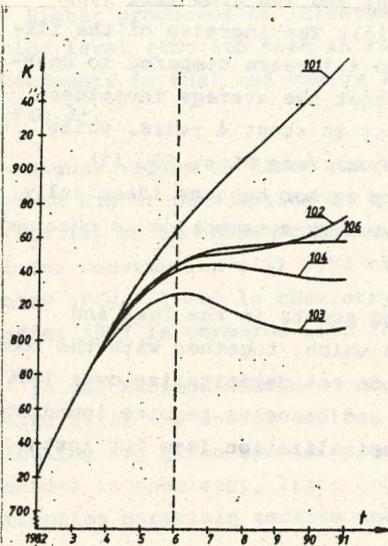the metal-machinery industry

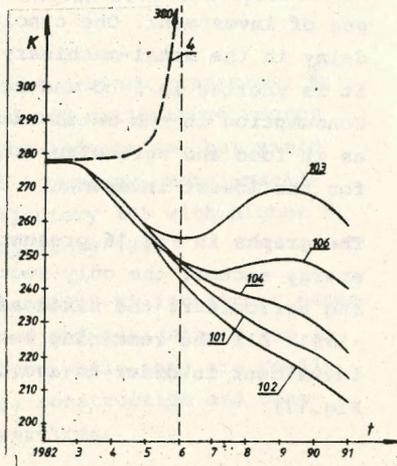Figure 16. Fixed assets in
the fuel and energy

Figure 17. Fixed assets in
the construction sector

the decrease of investments is observed starting 1985, and
the fixed assets for the simulation 103 are lower than for
simulation 101. The explanation is that in order to follow
higher desired fixed assets trajectory over 1987-1991 a fast
growth of investments is necessary before 1985 due to inves-
tment delays. If the production capacity constraint (8) was
not satisfied in 1985, it resulted in the decrease of inves-
tments in 1986. However I have no explanation for very low
investments in 1982 for the simulation run 103.

In the metal-machinery sector the decapitalization of produc-
tive fixed assets can be observed over the period 1985-1991,
for most alternative trajectories (Fig.14).

The only exception is the trajectory 103, for which higher de-
sired fixed assets trajectory is formulated for the period
1987-1991 as compared for instance with the desired trajectory
$\bar{K}$ when solving for 101. Most investment paths decrease until
the year 1986 by as much as 40%-50% and then grow up to the
year 1990. The investment paths 103 and 106 grow till 1985
and then decrease over time (Fig.15). The increase of the fix-
ed assets is shifted about 4 up to 4.5 years compared to chan-
ges of investment. One concludes that the average investment
delay in the metal-machinery sector is about 4 years, while
it is shorter in food and agriculture (see Figs. 10, 11).
Consumption in the metal-machinery sector behaves identically
as in food and agriculture, the highest consumption is obtained
for the lowest investments.

The graphs in Fig.16 present fixed assets in the fuel and
energy sector, the only sector in which, together with the food
and agriculture the fixed assets do not decapitalize over 1986
-1991. All the remaining sectors and branches require immediate
investment in order to avoid decapitalization (see for instance
Fig.17).

3. Conclusions

- There are only two sectors in which fixed assets do not de-
capitalize over time. They are fuel and energy sector (Fig.16),
and food and agriculture (Fig.10).

- Decapitalization of fixed assets in observed is the remain-
ing seven sectors of Polish economy. It usually starts in 1985
(see for instance Figs. 14 and 16).

- High prognoses of the fixed assets K^P and of investments V^P
(in the first approach) imply usually high investments in the
investigated period 1982-1985. In the metal-machinery industry
(Fig.1), the investment path grows then extremly fast (up to
500 in 1985, but this is also due to the deficiency of the first
approach discussed earlier). When the same values of prognosis
K^P are assumed in the desired trajectory $\bar{K}$ for the years 1987
-91, we then have a jump in the desired trajectory in 1986 but
the same phenomenon is observed in the second approach. For in-
stance in Fig.15 the investment path 103 grows fast until 1985.

- Higher prognoses of investment yield slightly higher consump-
tion level (the 4th path in Fig.7) and a little bit higher in-
vestments in fuel and energy sector and in food and agriculture
(Fig.2).

- Higher values of fixed assets in the desired trajectory $\bar{K}$,
yield higher consumption in the food and agriculture sector
(Fig.12) an in construction and light industries, but yield
lower consumption till 1984 or 1985 in energy, metal-machi-
nery (Fig.13) and in chemistry. Trajectory 103 with higher $\bar{K}$
after 1987 is compared with the trajectory 101.

- In the National Socio-Economic Plan 1983-85 investment expen-
ditures in the energy sector, in food and agriculture and in
housing are given special preferences, while they are really
needed in chemistry, light industry, construction and cons-
truction materials sectors and in services.

The concluding remark is that the three years period is too
short for studying dynamics of investments and its contribu-

tion to the formation of fixed assets, especially in the case
when the average investment delay is six years. In this respect
one should carry out further tests with the first approach for
longer investigation periods.

Adding the regional dimension to the described investment in-
vestigations would definitely complicate the analysis. The
foreign credits and imports are incorporated in the analysis.
However, results pertaining to the foreign debt and import
policy are not reported for the sake of clarity of presenta-
tion.

References

Alternatives of the National Socio-Economic Plan 1986-90 (in
    Polish), State Planning Commission, Warsaw (April 1985).
Chmielarz, L., Cichocki, K., Stachurski, A.: Experiments with
    the Penalty Scalarizing Function for Nonlinear Multiobjec-
    tive Optimization Problem, Control a Cybernetics, (1982),
    (11), pp. 57-72.
Cichocki, K.: Optimal Techniques in Modelling of Economic Policy.
    In J.M.L. Janssen, L.F. Pau, A. Straszak (Eds.) - Dynamic
    Modelling and Control of National Economies, Pergamon Press
    (1981), pp. 105-116.
Cichocki, K.: Analysis of Relations Between Investments, Fixed
    Assets, Consumption and Foreign Debt in Sectors of the
    Polish Economy (in Polish) ZTS, 27-1/MR-I-30: Systems Re-
    search Institute Report, Polish Academy of Sciences, War-
    saw (1984).
Juszczak, W., Welfe, W.: Medium-Term Prognosis of Economic De-
    velopment for Poland 1984-1988 (in Polish), 47 (D 25) ;
    Institute of Econometrics and Statistics, Łódź University
    (1984).
The National Socio-Economic Plan 1983-85 (in Polish), End. 1
    and 6, State Planning Commission (1983).
Sosnowski, J., Tołwiński, B.: Planning Model with Decentralized
    Structure of Decision Making. In: J.M.L. Janssen, L.F. Pau,
    A. Straszak (Eds.) - Dynamic Modelling and Control of Natio-

nal Economies, Pergamon Press (1981).

Statistical Yearbooks (1978)-(1984), (in Polish), Main Statistical Office.

DISCUSSIONS

Paper by A. Straszak

Discussion participants: K. Polenske, S. Ikeda, R. Espejo,
A. Straszak.

Main point of discussion was the question of influence exerted
by introduction of new technologies ("intelligent production
systems emerging from combination of robotics, automation, ar-
tificial intelligence and specialized computer applications")
on the society in general and on the labour force and its struc-
ture in particular. Notwithstanding some analyses which suggest
that the net result would be decrease of the higher skill jobs'
share, it was indicated that obvious historical trends still
point towards more of intellectual work and less of the physi-
cal one in the future. This was also the main factor behind
the move towards the "information society", as witrassed in
the Japanese national/regional plans and schemes, where it is
combined with a broader quality-of-life view of regional pro-
blems.

Paper by L. Lacko

Discussion participants: R. Bolton, K. Polenske, L. Lacko.

Two questions were taken up, mainly for clarification: the
contents of "background activities", which are those not nee-
ding big factories or sophisticated equipment and therefore
only small input capital, and the notion of responsibility,
which refers to local organizations, able to carry greater
responsibility, having at their disposal greater financial
resources.

Paper by G. Gavrilov and O. Panov

Discussion participants: K. Polenske, R. Espejo, R. Bolton,
L. Lacko, S. Ikeda, G. Gavrilov.

The first question touched concerned the notion of "private
strategy" used in the paper. This notion refers to these stra-
tegies (substrategies) which are worked out by and for the
individual organisms and which could only afterwards be inte-

grated into an overall strategy. Such strategies were said to
be the leading ones on the present stage of development in
Bulgaria.

Another question concerned participation of local bodies in the
planning process. Thus, it turned out that local authorities
are interacting in Bulgaria with the central, national level
ones through the strategically-oriented dialoque with sectoral
organisms, mainly ministries. Formal planning is more concen-
trated on elaboration of one-year and 5-year plans.

A clarification point was also raised connected with the envi-
ronmental issues and resources accounted for. Thus, it was sta-
ted that over a given territory all strategically important re-
sources are taken into consideration.

The last question concerned similarities and dissimilarities
between Hungary and Bulgaria and was answered by L. Lacko.
Thus, among similarities in planning for regional dimensions
were quoted: care for infrastructure, environment, and recrea-
tion and tourism facilities. Dissimilarities were said to main-
ly reside in planning and management system. For Hungary the
double approach of socio-economic and physical planning was
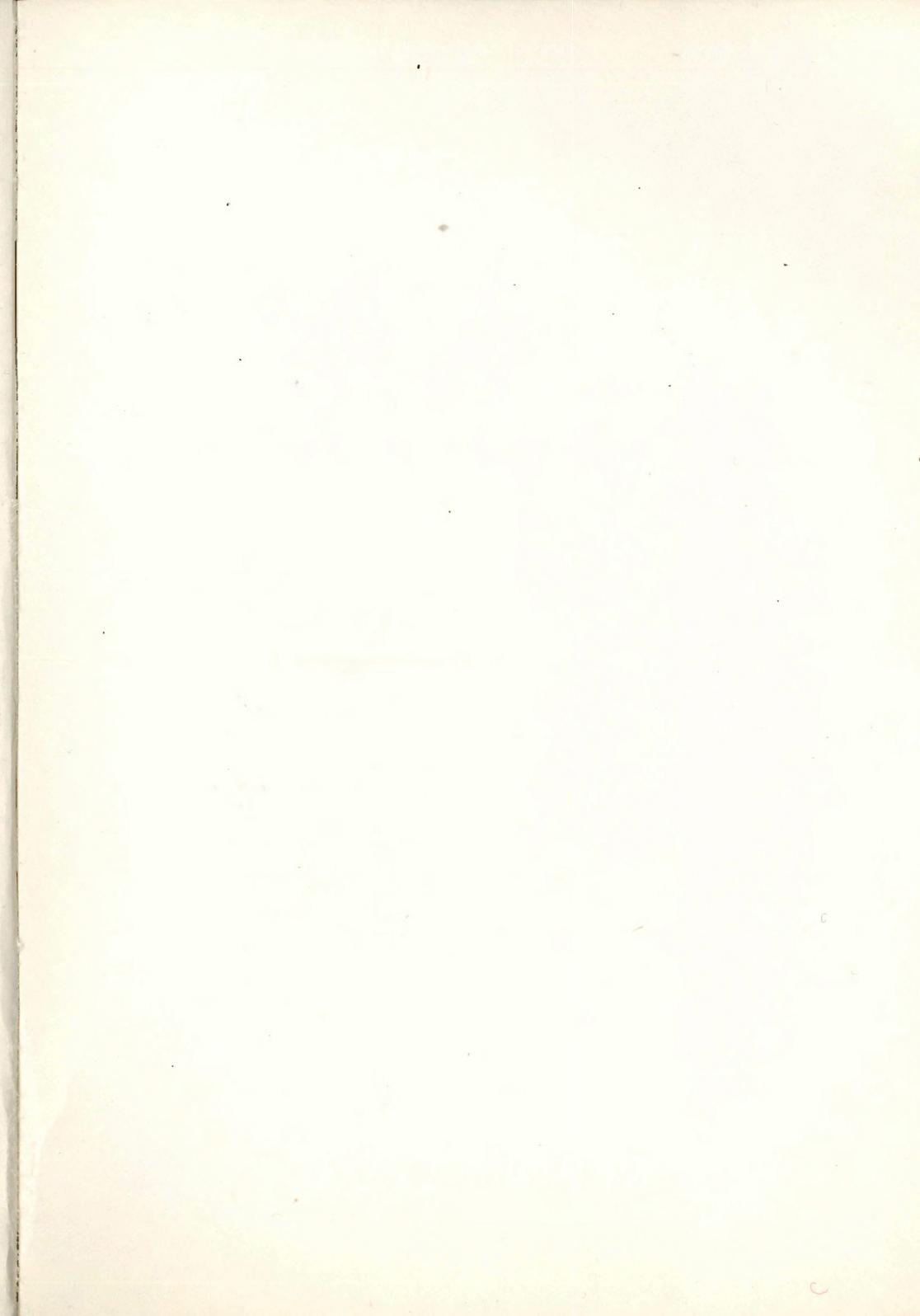quoted.

Paper by R. Domański

Discussion participants: L. Kajriukstis, U. Loeser, R. Domański.

Two questions were addressed: first, how can such activities as
recreation or forestry be incorporated into the model, and se-
cond, whether this model can be applied to developing countries,
mainly in the Third World, where large urban inmigrations are
often occurring. The first question was answered by stating that
currently the model recognizes such spatial entities as points,
lines and circles, and whichever activity can in its spatial
aspect be expressed in their terms, can be incorporated in the
model. As far as application of the model in developing coun-
tries is concerned, it was deemed possible to formulate appro-
priate mathematical structures in which problems of creation
of verylarge urban centers and local agricultural decline could
be accomodated, quite satisfactorily.

Paper by K. Cichocki

Discussion participants: S. Dresch, K. Cichocki.

Discussion cetered around the role of consumption in models
considered, insofar as consumption is related to the main object
of these models, namely investments. It has turned out that in
several runs of the models consumption was used as an element
of the vector objective function. A variant envisaged takes mo-
notonic growth of consumption as reference to objective func-
tion, with the monotonic growth based both upon official state-
ments and on the estimates provided by analyses made by other
research centers in Poland.