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REGIONAL MODEL OF EUROPEAN CMEA ECONOMIES

1. Minimodel of National Economy - Basic Conceptions

There are two mainstreams leading to a full scale model of
the national economy. The first one leads through the construc-
tion and next expansion of a m i n i m o d e l of the economy.
The second one[1] starts with already built models of sectors of
the economy and integrates them into one large model. In the
second case a minimodel is still very useful since it allows for
carrying out simulation of several integrated sectoral models with
the rest of the economy represented by it. In such a case the
integration of sectors can be made sector by sector.

By a m i n i m o d e l we understand an econometric model
in which each equation describes a separate sector of the natio-
nal economy. Hence in the minimodel we have each of the basic
variables: investments, fixed assets, employment, wages, incomes,
consumption, exports, imports, and finally both - produced and
distributed national income represented by a separate equation.
Jointly these constitute a simple model of the national economy.
We tend to describe the economy in real terms although the natio-
nal income deflator is a desirable feature of a minimodel. In the
case of foreign trade real variables are useful as long as the
description of material processes is concerned. The nominal ver-
sions of these equations are of importance as well since the dif-

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[1] See for example chapter: Subnational Models, in K l e i n
1982.

ference of nominal exports and imports determines the need of the country for foreign credits.

A deep belief in the existence of an economic mechanism operating autonomously and not fully controlled, is the cornerstone of any econometric modelling. We stress this assumption since the notion of central planning is sometimes understood quite voluntaristically as the possibility of almost total control over main economic processes. The acceptance of such an interpretation would cause the model to describe the central planner's activity rather than the activity of the economy.

Hence we start the description of the system of minimodels of the national economies of CMEA countries stressing the main assumptions lying behind our modelling activity:

A. There exists an economic mechanism deeply anchored in objective economic laws. The degree of the similarity of these mechanisms in CMEA countries has been partly tested through the attempt to estimate unified equations for all seven European CMEA countries[2].

B. The central planner's[3] influence on the economic processes is constrained by the following circumstances: the first restriction results from channels of his influence. The planner makes mainly investment decisions, secondary (since not as efficiently controllable) are the decisions about prices and wages. We left out the fact that plans are based on the national balances of labour force, raw materials and fuels as well as the most important semi-finished goods, these balances represent another channel of the influence, which can by exerted by the central planner.

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[2] Let us remind here that the European members of the Council for Mutual Economic Assistance are: Bulgaria (1), Czechoslovakia (2), the German Democratic Republic (3), Poland (4), Romania (5), Hungary (6) and the Soviet Union (7), where in brackets we show numbers chosen to represent the data about a given country in our data-bank.

[3] We shall stress the difference between the notions of the central planner and the administration, as the difference between the process of the formulating desirable and feasible economic targets, and the process of the operative decision-making during the period of the plan implementation. In the economic practice these two processes (and notions) are frequently mixed together and the above assumption has somewhat idealizing character; basically all our assumptions have this character.

The second restriction is connected with the first assumption — the planner's influence is bound by the objective economic laws governing the behaviour of the economy, among them a special role is played by the possibilities of the economy to invest.

The difficult situation of Poland in the late seventies exemplifies the adverse effects of a voluntaristic activity of the planner and administration. On the other hand, it is mostly the dimension of the foreign trade debt of Poland, that can be attributed to the mismanagement of the economy. Except for the Soviet Union, all the other CMEA countries have accumulated foreign debts in the late seventies (in 1978, the last year of our sample, the accumulated foreign trade balance, measured in million US dollars was: for Bulgaria - 1898, for Czechoslovakia - 1961, for GDR - 6130, for Poland - 14 954, for Romania - 1486, for Hungary - 4978, and for the Soviet Union - 11 289), reflecting the troubles with such a control of the national economies as to match the imports with the exports in the world of rapidly changing prices, especially of oil. Strong changes in the economic mechanisms are to be expected before a new balance of foreign trade and internal growth will be reached.

C. The main target of the economic system is to obtain the possibly highest increase of its output, while the main source of the increase is formed through the investment process. Although the welfare is usually understood as the true target of the socialist system, the well-known troubles with the measurements of the welfare and some general correlation of the welfare and the output of the economy brought the above transformation of the original target. After all, the output forms a material background for the welfare increase. Perhaps the most probable suggestion is that the increase of the output of the economy along with some constraints in the form of a minimum, yet admissible, rate of growth of social and individual consumption, form the operative target of the socialist system.

The above, along with a very popular opinion that the production of the investment goods should increase faster than the production of the consumer goods, are the probable reasons why the socialist economy tries to increase the share of investment, as a "spiritus movens" of the whole economy. The reverse, i.e. the decrease of the investment share, can be expected mainly when the

constraints (the rate of growth of the consumption) fall below
the acceptable level.

D. Employment is determined by the increase of labour force
as a result of the full employment policy. Accordingly, the ex-
pected increase of the labour force influences also the level and
character of investments. It strengthens the tendency towards
higher investment rate in a country with not fully utilized
labour force. However, the full employment policy imposes serious
restrictions on the available measures towards the increase of
labour productivity, especially in the field of negative stimuli
such as dismissal.

E. Imports serve needs of the production process, exports earn
money for imports. Imports bring mostly fuels, raw materials and
some investment goods - all that is not available inside a given
country. The imports of consumer goods have a complementary charac-
ter and are frequently activated as an intervention. In the case
of exports we should expect that it is not the relation of
domestic to foreign production costs that determines what goods
are exported, it is rather the acceptability of the goods from
the point of view of a foreign customer. Hence, in models of the
CMEA countries we frequently accept demand functions for exports,
although it is obvious that with the increase of the activity
level of the economy exports increase as the supply of goods in-
creases. The question of the efficiency of exports reduces some-
times to the minimum a requirement that the export prices should
exceed domestic costs. The CMEA economies seek for the export in-
crease mostly when they need finances for imports, in the other
case prices of respective goods are kept low enough to allow the
population to consume all products. Lack of properly defined me-
chanisms allowing to compare foreign and domestic costs prevents
these countries from more extensive application of the policy of
efficient foreign trade in the sense of exporting these goods
which can be produced efficiently in the country, and importing
those which can be also produced but inefficiently.

2. Specification of Basic Relations
in the Minimodel[4] Investments J

$$J = J\left(\overset{+}{X}, \overset{+}{J_{-1}}, \overset{\pm}{r}\right), \tag{1}$$

depends mainly on the growing possibilities of the national economy, represented here by the produced national income X, the inertia of the process is considerable and we reflect it introducing a lagged endogenous variable J_{-1}, finally we introduce the investment intensity rate r that reflects the central planner's influence. What we really want here is the p l a n n e d intensity of investments, however such a variable is published in different versions and we have no possibility to construct long enough, internally consistent series of the planned intensity. In practice we replace it with a proxy in the form of the r e a- l i z e d intensity of investments. This gives a very rough estimate of the influence of the planner; the variable is considered to be exogenous.

By the i n v e s t m e n t i n t e n s i t y, we understand the ratio of gross investment J to the distributed net national income XD.

J/XD.

This peculiar definition not only reflects the unavailability of necessary data (for example gross national income), it also tends to characterize how strongly the investment activity – the new JNET and the renovatory JREN investment weights down the distributed national income. We have:

J/XD = JNET/XD + JREN/XD,

the investment intensity as the sum of two ratios – the regular net investment rate JNET/XD measuring the speed of expansion of the capital stock, and the 'rate of renovation' JREN/XD measuring the intensity of consumption and renovation of the existing capital stock. We prefer the intensity of investment to the net in-

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[4] We show the expected sign of the related coefficient using "+" or "-" above the variable's name.

vestment rate, since the value of JREN is calculated through purely
bookkeeping operations without direct relation to the real 'con-
sumption' of the capital. A slight change in the rules of calcula-
tion of JREN can change its value dramatically. On the other hand,
it is a measure of the share of t o t a l J investment activity
that is interesting for us.

Fixed assets (or shortly capital) K obey the following basic
identity:

$$K = K_{-1} + I - s_k, \tag{2}$$

i.e. the current value of the capital equals to the previous
year's capital K_{-1} increased by realized investments I minus its
decrease (consumption) in the production process s_k.

The main problem is posed by the fact that the information
about I and s_k is usually unavailable, simplifications in the
process of calculation of amortization and capital replacement
make the information doubtful if available. Hence we make two
simplifying assumptions:

a) the realized investments I is some disturbed lag function
of the investment outlays J:

$$I = f\left(\overset{+}{J}, \overset{+}{J}_{-1}, \overset{+}{J}_{-2}, \dots\right),$$

b) the capital replacement is proportional to the value of
the capital in the previous year:

$$s_k = r_k \cdot K_{-1},$$

with the coefficient of replacement r_k. Substituting these into
(2) we get stochastic version of the capital equation

$$K = f\left(\overset{+}{J}, \overset{+}{J}_{-1}, \overset{+}{J}_{-2}, \dots\right) + \left(1 - \overset{+}{r_k}\right) \cdot K_{-1}. \tag{2'}$$

Due to low variability of the J and K series and strong trends in
both statistical quality of estimates of (2') it happens to be
quite poor in the case of the CMEA countries. Sometimes we are
forced to reduce the number of lags of J or to fix a priori their
coefficients.

Employment N

$$N = N(\overset{+}{L}, \overset{+}{N}_{-1}, \overset{+}{X}),$$ - (3)

is determined by the two most important factors: the full employment policy on the one hand, and labour force supply L on the other. For a long time the danger of the barrier posed by the second factor was considered a theoretical one, except in say the GDR. Then Czechoslovakia and Hungary, next the Soviet Union and Poland met this problem. Now only Romania, and possibly Bulgaria can be considered free from this problem.

Basically, employment depends on the stock of labour force L (frequently represented by a simple trend L = f(T), or even directly substituted by trend T). The economy is not, however, confined to the supply offered by the natural processes, it can also generate changes in the labour force by a proper employment policy, stimulation of women's participation or propagation of two-job work. Hence, on the longer term movements of employment caused by changes in labour force, there are imposed shorter term oscillations correlated with the movements of the national economy (represented here by X). The process of changes, once initiated, is not easy to stop, hence lagged endogenous variable reflects the inertia of the employment changes.

The problem of the proper representation of the factors reflected by X is quite difficult, so we have the so called p r o d u c t i v i t y version of the employment function (used more frequently in disaggregated macromodels to describe employment in sectors, branches and industries):

$$N = N\left(\overset{+}{L}, \frac{\overline{X}_{-1}}{N_{-1}}, \overset{+}{X}\right),$$ (3')

where we intend to catch the following phenomenon: given the production plan X and labour force L we expect that the increase of employment will be retarded whenever in the last year the productivity of labour increased allowing production of the same amount using fewer workers.

Production X (in the minimodel it is just the national income) used to be generally described by two factors

$$X = X\left(\overset{+}{N}, \overset{+}{K}\right). \tag{4}$$

Such an approach, typical in the case of mezo- or micro-
-economic considerations has to be modified in at least two ways:

a) by the weather (index of IOWA type),

b) by the imports (or broader - materials and fules supply)
influence.

The influence of imports can be divided into:

1. Imports of machinery (investment imports) influencing the
capital-labour ratio, productivity and hence production. It is
widely accepted that imported investment goods have higher pro-
ductivity and this is the way they influence the growth of the
economy. Some authors tried to measure the difference in produc-
tivities of machinery of domestic origin or imported. Such an
approach is too much simplified since the investment import need
not only be a more productive substitute of domestic production.
It can be complementary as well, especially if some kinds of ma-
chinery are not produced domestically,or produced in insufficient
amounts. Such a machinery need not be of better quality or tech-
nologically more advanced, since its most important effect is the
reduction of the bottlenecks of the economy. Hence although the
attempt at measuring the effects of machinery imports on the
domestic output is a reasonable excercise,its results interpreted
in terms of differences in productivities of machinery of domestic
and imported origin are likely to lead to exaggerated results.

2. Import of raw materials and fuels MF is directly linked to
the global production of the economy.Since we import mainly goods
unavailable from domestic sources, available in insufficient
amount or of worse quality, the reduction of such imports exerts
strong influence on the productivity; some production is either
stopped, or reduced, or is continued using less efficient or more
expensive domestic materials bringing higher costs.

All what has been said above along with some effects in esti-
mation process (connected with multicollinearity due to strong
trends in variables) brings us to the conclusion that it is rather
the productivity function that should be used as indirect produc-
tion function:

$$X/N = X/N\overset{+}{(}K/N, \overset{+}{M}/X, \overset{+}{IOWA}, \overset{+}{T}),$$ (4')

where the productivity X/N depends on the capital-labour ratio K/N, imports to production ratio M/X, weather index IOWA and neutral technical progress represented by time trend T coefficient. The technical gains from estimation of such an equation arise from the fact that usually T, K, N and M are very strongly correlated in time, especially in quite stable economies, as the socialist ones have been in the sixties and the early seventies, the multicollinearity effects frequently prevent us from proper statistical identification of separate influences of the variables in the following equation: X = X(K, N, M, T, IOWA). In the productivity equation, we have also described the influence of the same variables but estimated one coefficient less. The price is the homogeneity of the first degree with respect to capital and employment in the case of using power version of productivity function, along with a stronger nonlinear character of the entire model.

From the considerations about the influence of import we arrive at the first suggestion with regard to expansion of the initial proposition of the minimodel - to replace the propensity to import M/X by two separate variables - describing machinery imports and raw materials - fuels separately. The second suggestion calls for a two-sectoral minimodel with agriculture separated from the rest of the economy.

Wages Z

$$Z = Z\overset{+}{(}X/N, \overset{+}{J}/XD, \overset{+}{T} \text{ or } \overset{+}{Z}_{-1}),$$ (5)

are generally determined by the productivity X/N. The investment intensity enters this equation not as a direct cause, but rather as an i n d i c a t o r o f t h e s t a t e o f t h e e c o n o m y. The increase of it leads to the increase of the share of sectors and branches participating in the investment process, with wages relatively higher than the others. Also, especially in building and construction, the increased demand for labour force, associated with the increase in J/XD, leads to an increase of wages. These industries can utilize relatively low qualified labour force, taken for example from agriculture. Hence the wage

stimulation is more popular there. An alternative is the increase of the productivity in these industries, which require usually additional investment. The last one can be obtained either from imports (which does not influence wages directly) or through additional production in investment-goods producing industries, with the same final result - an increase in wages.

The mechanisms determining wages have a considerable inertia, and once accelerated cannot be stopped easily. However, the lagged endogenous variable Z_{-1} supposed to reflect the inertia of the process is frequently too highly correlated with the productivity which makes us omit it in many cases.

Personal incomes Y, described in a simplified version

$$Y = Y\left(\overset{+}{Z}, \overset{+}{N}, \overline{PY}\right),\tag{6}$$

will be rather introduced indirectly through the identity

$$Y_{apr} = \frac{Z \cdot N}{PY}\tag{6'}$$

and in the case of necessity an additional linking equation will be used:

$$Y = Y\left(\overset{+}{Y}_{apr}\right).\tag{6''}$$

The above proposition reflects the tendency to use as few variables as possible, simultaneously avoiding oversimplifications introduced by the linearity of the relation between PY and Y in equation (6). Another reason is that usually N and Z are calculated in different classifications, also wages are not the only source of incomes - hence (6'') adjusts the magnitudes of Y_{apr} and Y; what we really expect is that the v a r i a b i l i t y of Y_{apr} reflects the most important determinants of incomes, preserving simultaneously some important nonlinearity in the model.

To a large extent, personal incomes are not necessary in the minimodel, if we tend to reduce its dimensions, since we may formulate

Consumption C as

$$C = C\left(\overset{+}{C}_{-1}, \overset{+}{X}\right),\tag{7}$$

as an alternative for more proper formula

$$C = C\left(\overset{+}{C_{-1}}, \overset{+}{Y}\right).$$ (7')

Theoretically, the version (7') is more admissible, but troubles with data may prevent us from this approach.

The importance of (6') increases especially when the minimodel incorporates also

Personal income deflator PY

$$PY = PY\left(\frac{\overset{+}{E - M}}{X}, \frac{\overset{+}{Z * N}}{X}, \overset{+}{PY_{-1}}, \overset{-}{IOWA}\right).$$ (8)

The specification of the equation for the deflator depends crucially on the strength of the government control over prices. This is perhaps the most speculative equation in the model. In it we can see the main factors influencing prices:

$(E - M)/X$ - the weight of the foreign trade balance per unit of production,

$(Z * N)/X$ - the weight of the domestic incomes per unit of production, (basically we prefer version Y/X, but not in all the CMEA countries we have good data concerning Y, hence the above version serves as a proxy).

As, long as the foreign trade balance stays unchanged near zero, the connection between world and domestic prices can be very loose, in the case of positive foreign trade balance we may even expect decreases of prices inside the economy, since it is strong enough to pay for its imports. In our economic reality it is however, quite an unusual case. A negative balance of foreign trade, if prolonged, leads to the necessity of an internal price increase, since the existing prices apparently prevent imports from a decrease sufficient to restore a reasonable balance. The variable $(E - M)/X$ represents therefore, an i n d i c a t o r of the state of economic relation- s h i p s with the w o r l d, and its coefficient reflects the signals received by the central planner, as well as some of the actions not described by the model, but having place in the reality.

The weight of domestic payments per unit of production (the relationship between the buying power of population and selling power of the economy)[5] possibly cannot be fully adequately reflected by the variable $(Z + N)/X$ and the last one has to be considered as a crude approximation. As long as changes in wages and productivity match each other and they are smooth in time, the influence of this weight cannot be statistically identified - the common problem of the econometric modelling based on the inference from observed changes and reactions.

If enormous investment activity or wage increase without accompanying productivity increase brings strong imbalance between buying power and selling power in the economy, one may expect that one of the three situations will occur:

1) a decrease of n o m i n a l wages,

2) a decrease of r e a l wages,

3) acceptance of the imbalance for p r o l o n g e d period.

The case 1) is especially painful for workers, and causes their strongest opposition; after all there i s the m o n e y i l l u s i o n in the human behaviour. In the economic practice of socialist countries solution 1) is rather rare, especially when one considers the economy as a whole.

The case 2) is quite unpopular as well, but it is easier to accept. The money illusion acts especially efficiently when we realize 2) through simultaneous raises of prices and wages, with wages growing slower. Such a solution allows also for some reallocation of the buying power between groups of population - quite a frequent task in the socialist economy. It has, however, some unfavourable effects due to a low value of money. Under too low interest rate on saved money this stimulates current consumption against the future one, i.e. against saving, bringing additional imbalance to the economy.

The case 3) requires least activity of the central planner, in fact no activity towards balancing the economy is needed. This case destimulates the productivity increase, but its most dangerous effects accumulate in the field of the expectations of econo-

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[5] Here we should repeat the arguments close to the case of variable Y_{apr}; we limit ourselves to the comment that it is the variability of the indicator that counts.

mic agents. Under accepted prolonged imbalance in the economy, the sensitivity of the planner decreases and sometimes he does not receive n o t i c e a b l y strong signals before a catastrophe[6]. In fact the main assumption of the economic policy is the reversibility of such a situation, and its removal is seen as one of the main tasks of the planner.

Equation (8) reflects the assumption that in the case of imbalances it is the case 2) that seems most probable. It must be stressed once again, that the equation describes perhaps tendencies rather than a real process, since prices of the most important goods are changed once in every several years, when the influence of foreign and domestic factors has accumulated clearly. We shall see the performance of this assumptions in the context of the estimated equations.

The inertia (even in the statistical sense - the increase of the price of alcohol say in the third quarter of a year will be reflected in the statistical data only in $1/2$-$1/4$ of its influence, since in the first half of the year there was no price change effect; the full influence will be recorded in data for the next year) of the price increase is the reason for introducing Y_{-1}, the weather index IOWA is to be responsible for a short-term reaction of prices for agricultural goods.

The tendency to reduce the amount of variables in the mini-model may lead to the following reformulation of the consumption function:

$$C = C\left(\overset{+}{C}_{-1}, \ \overset{+}{Y}_{apr}\right).$$ (7″)

i.e.

$$C = C\left(\overset{+}{C}_{-1}, \ \overset{+}{Z} * N\right),$$

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[6] All the economy relies on social e x p e c t a t i o n s: the worker works expecting an income the same drives the behaviour of peasant, banker and so on. It is the s t a b i l i t y and r e a s o n a b i l i t y of the expectations that keep the economy going on. But continuity of the accumulation of adverse effects for a long time prevents the signals from being "noticeably" different from the previous ones, and hence "strong" enough to convince the planner. Sometimes it is the catastrophe that constitutes the signal "strong" enough.

where wages Z are originally described in current terms, but enter
this equation deflated by PY.

National income

produced: $X = X/N * N$ (9)
and

distributed: $XD = C + A$,   (10)
are reconciled by the item U

$U = X - XD$,   (11)

covering statistical discrepancies, losses but mostly foreign
trade balance expressed in domestic prices. Since we resigned
from JNET as the book-keeping quantity, we enter accumulation A,
described by a separate equation:

$$A = A\left(\overset{+}{J}, \overset{-}{E} \ M\right).$$ (12)

The accumulation covers net investments plus inventory in-
vestments, the first one correlates with the first variable, the
second one with the second variable, hence the minus sign above
it.

We pay attention to the behaviour of U as the representative
of global balance of the economy, the difference between the
supply X and demand XD expressed in the most aggregated terms.
The difference has to be filled up by the foreign trade. One of
the main balancing mechanisms is realized through this variable,
as we shall show further on.

Imports M

$$M = M\left(\overset{+}{X}, \overset{-}{U}, \overset{+}{SE}, MP\right),$$ (13)

are assumed to satisfy the needs of the production process, hence
their magnitude depends on the magnitude of the national income[7].
The gross imbalance forcing some additional imports, or allowing

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[7] Perhaps it should be rather the relation between imports
and gross production, however, we limited ourselves to the natio-
nal income and had to accept the first approximation. The second
approximation arrives from the interpretation of the role of U.

to reduce imports is represented by U. The third term was first proposed in the minimodel of the Polish economy W4 in 1979, and next extended to the entire system of the CMEA models. It is the accumulated foreign trade balance, treated as a proxy for the foreign debt, since official information about the debt of the CMEA countries is not published in yearbooks. We assume that the worse situation in foreign trade, the stronger the measures to reverse it - first through the reduction of imports, next by an increase of exports. Perhaps the current foreign trade balance, used on different occasions in other models reflects rather a short-term phenomenon, so we prefer the accumulated one as an expression of the dimension of accumulated tensions in foreign trade.

The presence of U in the import equation reflects the following balancing mechanism.

In fact the initial discrepancy between X and XD was to be larger, only a part of it has been fulfilled through foreign trade. The higher the 'ex post' imbalance U, the larger 'ex ante' imbalance was supposed, and the larger was the increase of M caused by it. The increase in M is assumed proportional to the 'ex ante' one.

To clear the idea of the balancing mechanism let us consider very short units of time:

period 1 - excess demand $X_1 < XD_1$ (additional imports have been asked for, mostly to increase X_1 by DX_1, partly directly to the market),

period 2 - balance $X_2 = XD_2$ (effects of additional imports make $X_1 = XD_1$),

period 3 - excess supply $X_1 > XD_3$ (additional exports have been offered export increases by $DE_3 = X_3 - XD_3$).

We have at our disposal only aggregated data. Let us denote:

$$\hat{M} = \sum_i \hat{M}_i \text{ - the originally planned imports,}$$

$$DM = \sum_i DM_i \text{ - the additional imports,}$$

$$\hat{E} = \sum_i \hat{E}_i \text{ - the originally planned exports,}$$

$$DE = \sum_i DE_i \text{ - the additional exports.}$$

The final aggregated value of U equals to $\hat{E} - \hat{M} + DE - DM$. Assuming that, additional imports first are supposed to increase domestic output by, say, DX_1, and only afterwards we import directly to the market (it seems to be the most popular practice in the CMEA countries), we find that the final aggregated value of X is equal to $X + \sum_i DX_i$. Denoting the additional imports of materials for DX by DM_x, additional imports for the market by DM_m, we have

$$M = \hat{M} + DM_x + DM_m.$$

The first two elements $\hat{M} + DM_x$ correlate with $\hat{X} + DX$ explaining their magnitude, the third one is correlated with the global imbalance U. Aggregated X and XD can be balanced even when in the subperiods situation need not be balanced; if $U > 0$ we have $X > XD$ and total imports will be smaller than one can infere looking at the national income alone, when $U < 0$ we have $X < XD$ and total imports will exceed its value - expected from the inspection of relevant X figures alone.

Now we impose friction on our mechanism, friction that makes it possible to have non-zero U. First - the realization of additional requirements needs time, second - we never know for sure the exact value of the imbalance $X_1 - XD_1$, third - we try to make the additional requirements possibly small, hoping that in the following period the situation will improve. Only when the imbalance is considerable do we really increase imports, hence only a part of it has been fulfilled.

The above adds to our model, already containing accelerator-type feedback: J - X - J, new feedback, resembling multiplier: C - XD - U - M - X - C.

Exports E

$$E = E\left(\overset{+}{EHS}, \overset{-}{SE} - MP\right), \tag{14}$$

are described from the demand side EHS - world trade volume represents the demand for the exports of a given country, in the case of exports in current prices we add PEHS - world price index, or switch to the world exports in current prices EHSP. As we assumed - one of the main functions of exports is to earn money for im-

ports. Hence, we assume that there exists an additional mechanism in the CMEA countries - when the foreign trade balance worsens, governments take measures towards the export increase. Basically only prolonged unfavourable conditions can activate these measures, an indicator of the situation - SE-MP is used to reflect it. Typical for the CMEA economies, very tense, ambitious plans make exports a kind of sacrifice, so we expect a quite strong reverse relationship - improvement of the balance relaxes the pro-export activities. We still need some conception linking exports with the production potential of the country as well, but in such an aggregated model solution is not obvious.

List of variables

Variables have been named according to the following rules:
The first letter:

A - accumulation

C - consumption

D - stands for the first difference of the variable, example DKM
    - first difference of KM

E - exports (real ED, nominal EP)

M - imports (real MD, nominal MP)

J - investments

K - capital stock (KM - in productive sector, KMK - as KM, measured
    at the year end)

L - population, labour force

N - employment, NA - professionally active

P - deflator, PX - of national income, PZ - of wages, PED, PMD of
    exports, imports, respectively

X - national income

Z - wages

U - dummy variable, U72 - with 1 in 1972
    The second letter - after D or P - as above

M - material production sector
    The last letter P stands for current prices.
    Combined symbols:

J/X   - the investment intensity rate

JM/X - JN : X

WM   - X : N
K/N   - KM : N
MM/N - machinery imports per employee
MF/X - raw materials and fuels imports per unit of production
E-MD - ED - MD
E-MP - EP - MP
SE-MP - accumulated EP - MP, since 1960
JM+-1 - JM + JM_{-1}
EMP/X - EP - MP : X
ZN   - Z * NM
ZN/X - Z * NM/X
UD   - difference X - XD

Other comments. Bulgaria: all variables in current prices, except ED, MD, Z, GDR and Romania: no distributed national income, accumulation, Romania: no consumption.

Last number indicates country: 1 - Bulgaria, 2 - Czechoslovakia, 3 - GDR, 4 - Poland, 5 - Romania, 6 - Hungary, 7 - Soviet Union. In the case of two digit number (except for U) the second digit 1 indicates lagged variable by 1 year.

A detailed analysis of the performance of the minimodels of the CMEA countries is to be shown in the next publication. We would like, however, to give a very general information in the Tab. 1 where MAPE (mean absolute percentage errors) of the most crucial variables of the system are shown, as obtained in the dynamic simulation of the entire system.

As we can see the ex-post errors are very reasonable, the most difficult problem concerns the foreign trade of Hungary. After these calculations have been made, Hungary published revised versions of foreign trade statistics, with the last years revised dramatically. Since the old series do not look reasonably, we think that troubles with Hungary are caused by data quality, at least partly. Also due to mismanagement, imports of Poland rose in the late seventies drastically, and the simulation of the system does not catch it (or rather does not find good reasons for such large imports) bringing some 8.3 per cent error. Generally exports and imports are harder to simulate than the other variables of the model.
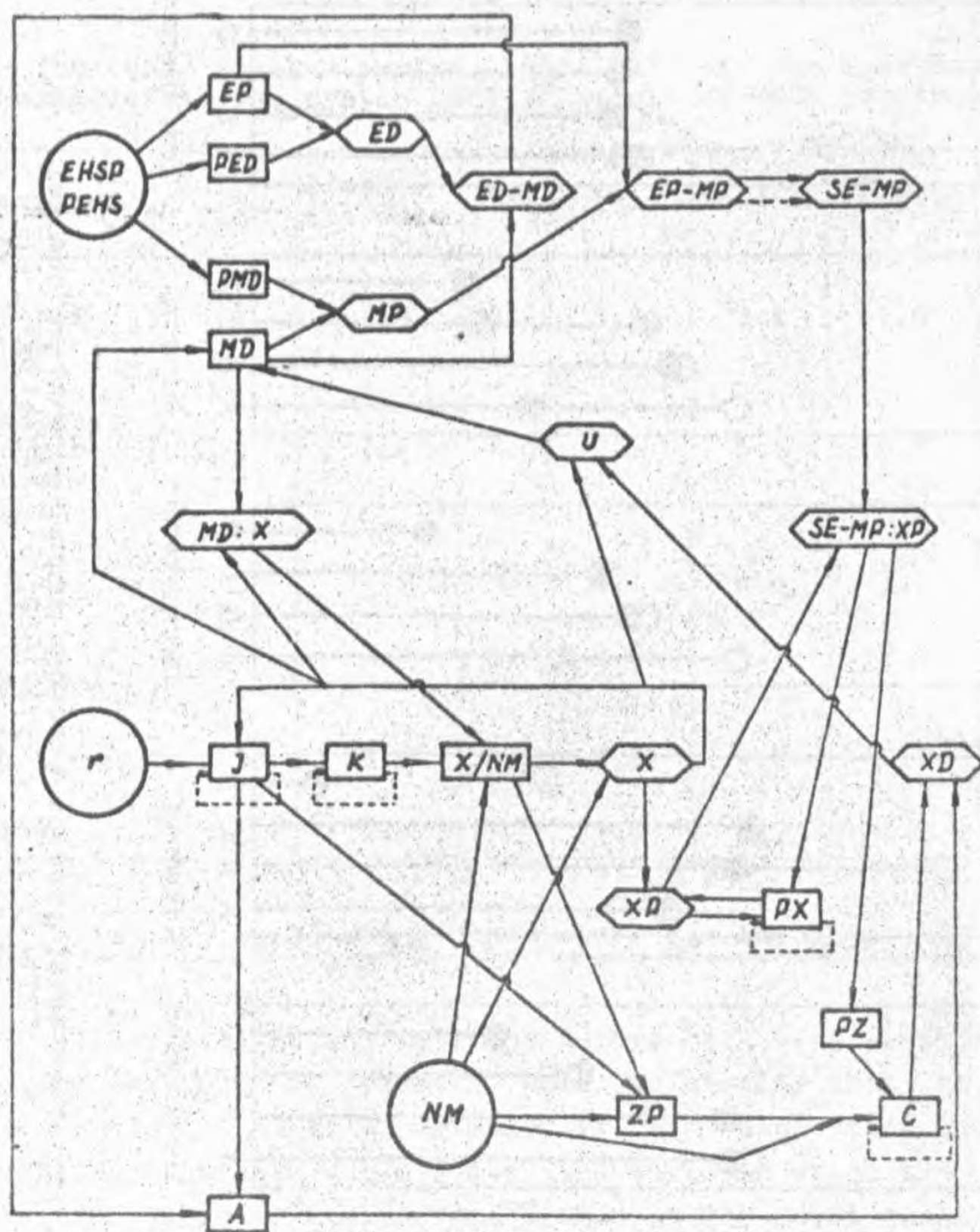
Fig. 1. Scheme of a typical structure of a minimodel of CMEA country variables:

ⓡ exogenous, X/NM endo-stochastic eq-n, ⟨ x ⟩ endo-from identity, ──► most important lags

P as the first letter denotes deflators, P as the last letter denotes variable in current prices (Export EP, import MP, income XP, wage ZP, accumulated foreign trade balance SE-MP-are in current prices, PX - national income deflator, PED, PMD, PZ - exports, imports, wages deflators, respectively)
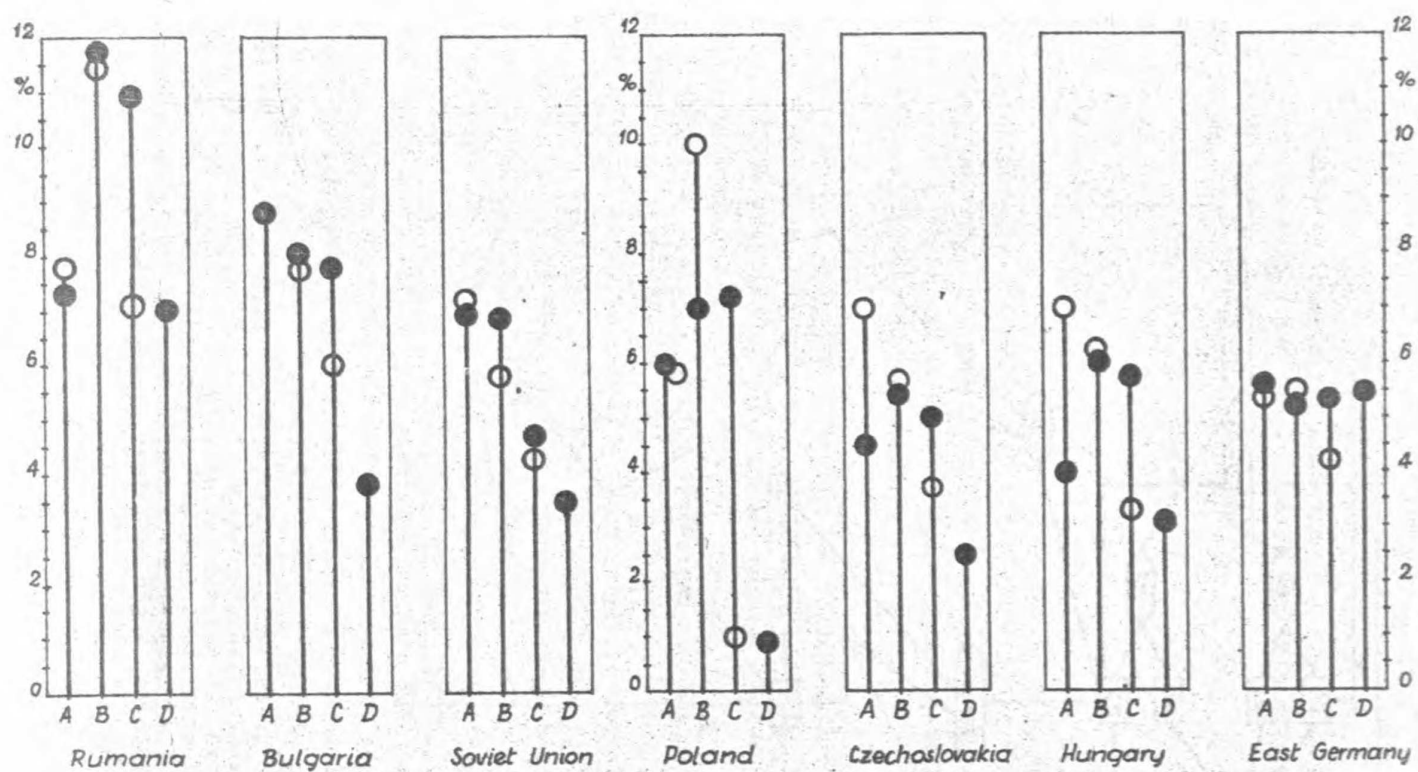
Fig. 2. Growth of net material product (average annual percentage change)
A - 1966-1970, B - 1971-1975, C - 1976-1980, D - 1981-1985
● plan, O - actual

Mape for the sample period 1963-1978 of the most important
    variables of the system IES2 of models of CMEA countries

Categories	Bulga-ria	Czecho-slovakia	GDR	Poland	Romania	Hungary	USSR
X National income	1.1	2.2	0.8	3.0	2.9	1.5	2.0
JM Investment in pro-ductive sphere	2.5	1.2	1.0	2.6	5.1	6.5	1.7
C Consumption	1.3	1.3	1.1	2.1	n.a	1.6	2.2
MD Real imports	6.3	3.2	4.0	8.3	5.1	12.7	5.8
ED Real exports	4.3	2.4	2.9	4.9	4.2	11.0	5.5
Z Real wages	3.6	1.6	1.1	1.6	2.7	1.8	2.5

3. Preliminary Forecasting Experiments for the Years 1981-1990

Our first projections into the future have been performed in
two versions, but the results were so similar that we shall
report mainly the first experiment. It has been made under the
assumption of 'frozen world', i.e. the world in which the values
of the ednogenous variables were frozen at the level realized in
1978, the last period available for forecasts. Since in the mini-
models there are no time trend variables, the solution shows
the existence of some mechanism of internal growth of the econo-
mies. Obviously, such an experiment is reasonable only for a
limited period since the freezing at a constant level shall lead
to the increasing difficulties in exports and imports, with the
repercussions in the field of the growth rates of the CMEA count-
ries.

Let us observe the CMEA economies in the frozen world. We
shall stress that as the investment activity r we used the follow-

ing proxy: J/X the share of the gross investment J in the net national income X.

Below, we shall reproduce the behaviour of these ratios in the past (Tab. 2).

T a b l e 2

The investment intensity proxies J/X

Year	Bul-garia	Czecho-slovakia	GDR	Poland	Romania	Hungary	USSR
1965	0.40	0.31	0.24	0.25	0.32	0.31	0.29
1970	0.34	0.33	0.29	0.27	0.38	0.39	0.28
1975	0.38	0.37	0.29	0.41	0.38	0.38	0.30
1978	0.38	0.36	0.30	0.38	0.42	0.42	0.29

We can see that some countries realize quite stable intensity of investment, as for example the Soviet Union or GDR. Bulgaria, Romania and Hungary have tendencies to keep the intensities quite high, with Czechoslovakia somewhat in-between. The Polish economy is characterized by the highest variability of the intensity[8].

T a b l e 3

The expected rates of growth of the national incomes under assumption of the frozen (at 1978 level) values of exogenous variables

Year	Bul-garia	Czecho-slovakia	GDR	Poland	Romania	Hungary	USSR
1981	4.3	4.6	4.1	5.1	8.6	4.9	5.5
1985	3.9	4.1	4.4	5.1	8.1	4.4	4.2
1990	3.6	3.6	4.3	4.9	7.7	4.2	4.4

As other exogenous variables we have EHSP - the world trade in current prices, PEHS - the deflator of the world trade. Also

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[8] We look at the dynamics of the series rather than at their levels, since one may expect quite large distortions introduced by not fully comparable prices in different countries, and their relationships in the case of investment and consumption goods.

the employment (NM - in material production sector) has been assumed exogenous to reflect the restrictions on the side of supply of the labour force.

In the frozen world the CMEA economies have tendencies to continue their growth at decreasing rates (Tab. 3).

These rates are similar to a direct projection of the growth observed in the seventies, but with the impact of the late seventies not enough pronounced. Having the information about the realization of some variables we shall use special proce-dures to detect the probable directions and magnitudes of changes in some chosen parameters of the system.

The forecast for consumption changes for Bulgaria from 5.1% in 1981 to 3.4% in 1990, and accordingly, for Czechoslovakia 3.6--4.1%, for the GDR 5.1-4.3%, for Poland 3.3-4.3%, for Hungary from 5.9% through 7.0% (!) to 6.4%, and for the Soviet Union 6.3--5.2%.

This very optimistic picture changes dramatically when we inspect the variables describing the foreign trade. It turns out that such a stable growth is financed by the foreign trade debt! Interesting enough, it is only the nominal debt, since in real terms the foreign trade balance is for almost all the CMEA count-ries positive, at least through the part of the ten-year period. The adverse trends in the import and export prices are responsible for most of the debt. Nevertheless, the nominal trade balance is what counts. We may expect that further, improved version of the forecasts will be more favourable at least for the GDR and the Soviet Union, since both countries have unjustified jumps in their import forecasts. However, the identification of the foreign debt, even if in the real terms the CMEA countries are losing exchanging more labour embodied in exports for less work incor-porated in imports (!), as the source of the stable, quite fast growth of the economy, suggests that large changes in the behaviour of CMEA countries are to be expected.

Although the 'frozen' solution suggests the necessity of some changes in the model parameters, we made the first, preliminary forecast without any changes in the model. The assumptions have been as follows: EHSP increases by 18% in 1980, and further at a decreasing rate to 6.5% in 1990, PEHS, respectively, from 14

T a b l e 4

Assumptions of the world trade path

Year	World trade		
	nominal EHSP	deflator PEHS	real EHS
1980	18.2	14.8	2.8
1981	12.2	8.0	3.1
1982	13.1	7.9	3.9
1983	12.8	7.8	4.8
1984	12.4	7.5	4.6
1985	11.9	7.1	4.4

to 5.6%, which brings moderate increase of the volume of the world trade from 4 to 2%. The investment intensity in all the socialist countries was reduced by 20% in 1979, and kept at that level until the end of the forecast period. The employment NM in the productive sector was assumed to increase each year by 2.5% of the percentage point (1978 - the base) for Bulgaria, 1% for Czechoslovakia, 0.5% for the GDR, 1.5% for Poland, 3% for Romania, 0.5% for Hungary, and 1.5% for the Soviet Union.

Surprisingly enough, except for Czechoslovakia, the forecasts were quite close to the 'frozen' case for Bulgaria and the GDR, while the other countries reveal some decrease of the growth rates by almost 1 point.

The reported experiments were supposed to reveal the forecasting behaviour of our system. The observed growth mechanism is very plausible, but the relationships with the rest of the world cannot be accepted. We do not treat the deterioration of the foreign trade balance as a drawback of the model, just the opposite - it seems to be a reasonable signal that the further existence of the economies needs strong measures towards the improvements of the foreign trade balance. Hence, the growth rates should be treated rather as possibly over-estimated, upper bounds for the possibilities of the socialist system. The next series of experiments will be devoted to the investigation of possible measures towards the growth of the economies simultaneously with the improvement of their foreign trade balance. Since any measure

needs time to be realized, the growth of the CMEA economies in the next two years can be extremely slow. More realistic forecasts for these years will be available after the incorporation into the model parameters of the information about the state of economies in 1979 and 1980.

4. Some Further Forecasting Experiments (January 1981)

The reported results have been obtained with the previous version of the system(the presented printout contains the'81 version of the system with improved EP and MD equations).

Guided by L. R. Klein Nobel Prize Lecture we assumed the following path for the world trade.

The assumptions about the investment intensity rate as well as CA in productivity and export-import equations have been determined using 1979-1980 realizations and planned figures. The investment intensities have been reduced considerably (Tab. 5).

T a b l e   5

Assumptions of the investment intensity rate

Year	Bul-garia	Czecho-slovakia	GDR	Poland	Romania	Hungary	USSR
1978[a]	.38	.36	.30	.38	.42	.42	.29
1979	.36	.35	.29	.36	.41	.41	.29
1980-1985	.34	.33	.26	.29	.35	.30	.27

[a] Actual.

We stress that in the case of Poland the resultant forecasts only partly reflect its current situation, although we reduced its propensity to import by 10% in the import equation. At the moment of calculations the economic situation was still very difficult. Perhaps after the economic policy of the prime minister Jaruzelski is announced, we shall be able to make more precise projections.

T a b l e 6

The expected rates of growth of national income X (NMP), consumption C, exports E and imports M (years 1981-1985)

Year	Bulgaria	Czechoslovakia	GDR	Poland	Romania	Hungary	USSR
X							
1981	4.2	3.5	4.3	-1.6	8.7	3.5	4.9
1982	4.1	3.3	4.1	3.6	8.6	4.0	4.9
1983	4.0	3.1	4.0	3.6	8.4	4.4	4.8
1984	3.9	3.0	3.9	4.5	8.3	4.1	4.8
1985	3.0	2.9	3.9	4.0	8.2	4.0	4.8
C							
1981	4.7	3.2	4.3	-1.8		3.9	4.3
1982	4.5	2.8	4.2	0.0		3.8	4.8
1983	4.2	2.4	4.1	1.2	N.A.	3.6	4.8
1984	3.9	2.1	4.1	2.3		3.4	4.8
1985	3.6	1.9	4.0	2.8		3.3	4.8
EP							
1981	14.4	13.7	12.2	7.2	14.2	10.3	13.5
1982	12.7	11.1	9.2	4.3	8.3	10.3	8.4
1983	12.9	11.1	9.4	5.3	8.4	12.0	9.1
1984	12.3	10.5	9.0	6.1	8.2	12.3	9.4
1985	11.6	10.0	8.6	6.9	8.0	12,3	9.7
MP							
1981	17.6	15.1	14.9	3.6	18.4	13.3	19.5
1982	14.8	12.3	11.0	6.0	14.1	16.5	17.0
1983	13.1	10.9	9.3	8.0	12.0	14.4	15.5
1984	12.1	10.1	8.5	9.0	10.7	13.5	14.5
1985	11.3	9.7	8.1	10.0	9.7	13.9	13.8
Value forecasted for 1985 as % of the value reached in 1978							
JM	27	15	25	0	65	10	37 investment
ZP	35	9	25	26	41	83	28 wages
X	36	28	34	22	73	39	40 N-income
A	45	22	N.A.	0	N.A.	10	33 accumulation
C	35	20	36	9	N.A.	31	40 consumption
X/NM	29	20	30	12	46	40	26 productivity
KM/NM	45	22	35	36	60	48	39 capital-labour ratio

Table 6 shows the expected rates of growth of national income X (net material product), consumption from national income C, exports E and imports M.

Once again it happened that the real foreign trade balance was positive,while in the nominal terms it was negative, suggesting the accumulated foreign trade balance would reach by 1985 the value - 17 billions dollars for Bulgaria,33 - for Czechoslovakia, 16 - for the GDR, 41 - for Poland,16 - for Romania, 35 - for Hungary and 28 - for the Soviet Union.

Some of these numbers are to be changed when the improved IES2 system will give its forecasts based on the additional feedbacks between foreign trade and national income. Even if we take into consideration the expected inflation - we do not expect the CMEA countries to be willing to afford such a foreign trade burden. Some measures to decrease imports and increase exports are to be expected, the problem is - how efficiently they can be excercised. In the CMEA's imports, raw materials and fuels play an important role and the possible reductions are to be expected rather in the field of imports of machinery and consumer goods. On the other hand, any increase in exports will perhaps require additional machinery imports, and - for sure - will prevent the raw material imports from falling down.

We see that during the nearest five years Poland will be able only to regain the 1978 level of accumulation, the capital-labour ratio will increase considerably(due to completion of the started investment projects), but the social productivity - measured in global terms - will increase by less than one third of it. The reliability of these numbers depends on two factors - first - the possible import shortages can even lower it - second - efficiently executed reform of the economy may increase it quite rapidly,even as soon as in 1982. Accumulated human and capital resources allow to expect the possibility of an even faster recovery than forecast. Quite stable forecast for the Soviet Union seems reasonable, except for exports behaviour. The last one has to be attributed to reducing impact of SE-MP variable.

5. Extension of Foreign Trade Sector Model - the IES3 Model

The IES3[9] model of European CMEA countries has the foreign
trade sector divided into two directions - intra CMEA and trade
with the rest of the world, and into four groups: machinery and
equipment (M), fuel and raw materials (F), agricultural goods (R)
and other consumer goods (C) with separate deflators for each of
the eight (2 directions x 4 groups) variables. The equations are
built on the basis of the "joint pool" conceptions, when we assume
that each country trades with the CMEA as a whole (and with the
world as a whole).

This brings some additional 150 equations in foreign trade
sector only, plus additional equations in the production, invest-
ment and capital stock formation, so we restrain ourselves to a
general information. Foreign trade is modelled in real terms, it
depends on three main groups of variables:

1) domestic activity (industrial and agricultural production,
along with IOWA index),

2) world trade activity,

3) prices of competitive directions (i.e. world prices for
CMEA trade equations and the reverse) or relative prices.

On several occasions, we use also investment propensity and/or
investment itself. As a starting point we assumed the Vanous
supposition that the intra CMEA market of raw materials, fuels
and agricultural goods is supply-determined, and market of machi-
nery and other consumption goods is governed by demand. The main
drawback of the above specification is that we have to secure the
balance of the imports and exports proposed through the joint
pool. In the model IES1 special share equations have been applied
by A. B. Czyżewski and P. Tomczyk. We feel, however, that the
intra CMEA trade can as well be described by input-output type
model.

This approach is not free of troubles. The flows of trade
inside the CMEA are widely obtainable only in an aggregated vers-
ion (see the paper by P. Tomczyk presented along with this one),

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[9] Built as M. A. papers by students: Mariola Porczyńska, Zo-
fia Majdzińska, Danuta Piotrowska, under Dr. Gajda's supervision.

more detailed data are available only to the government agencies. Hence, we invented some additional procedure that allows to recover the matrix of coefficients of I-O model using country marginal exports and imports in a given group and more detailed information about rows and columns describing foreign trade of Poland and Soviet Union. With some additional assumptions this procedure allows us to recover the missing elements of the matrix. Since it is being monited in a computer programme we have only "hand-made" results, suggesting that the precision of this procedure is quite reasonable.

The next step will be a test of Vanous' assumption about supply and demand-driven markets. We simply plug into IES3 the two versions of the I-O system and compare the performance of the model under each version.

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REGIONALNY MODEL GOSPODARKI KRAJÓW RWPG

Cechą charakterystyczną prezentowanego w referacie modelu jest jego dwupoziomowa budowa. Na poziom pierwszy składają się makromodele narodowe, opisujące gospodarkę każdego z krajów oddzielnie. Poziomem drugim jest submodel wymiany handlowej z zagranicą. W submodelu tym handel zagraniczny rozbity jest na dwa kierunki - do innych krajów RWPG oraz poza RWPG.

Modele narodowe oparte są na dość zunifikowanych założeniach i hipotezach odnośnie do przebiegu procesów gospodarczych w poszczególnych krajach. Założenia te w trakcie empirycznych weryfikacji modeli zostały odpowiednio zmodyfikowane i zindywidualizowane, stosownie do właściwości gospodarek poszczególnych krajów.

Autorzy zwrócili uwagę na fakt, iż w specyfikacji równań szczególną rolę odegrały dwie okoliczności: pierwsza związana

jest z koniecznością odwzorowania wpływu ograniczeń importowych na społeczną wydajność pracy, druga z wpływem procesu produkcji na tworzenie potrzeb importowych i oferty eksportowej.

Specyfikując model szczególną uwagę poświęcono także zagadnieniu odwzorowania ograniczeń, jakie na wzrost importu i eksportu narzuca zadłużenie wobec zagranicy.