A C T A U N I V E R S I T A T I S L O D Z I E N S I S
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• CMEA ECONOMIES - MODELS AND FORECASTS BASED ON IES SYSTEMS**

1. Introduction

Entire series of systems of models[1] of the seven European members of CMEA (Bulgaria, Czechoslovakia, GDR, Hungary, Poland, Romania and Soviet Union) was based on the assumption that the similarities in the economic systems, trends in historic developments, geographic location, etc. allow for similar specification of equations of the country models, while special, individual features of some economies induce modifications of the prototype model equations (G a j d a [4]).

The system consists of two subsystems. The first one contains models of national economies, the second one - submodel of foreign trade understood as the main link between the national models. In the prototype version, links between national models are of very limited scope, as the main stress is put on the interconnections between the main economic variables of a country and the impact of

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**An earlier version has been presented to the V World Congress of Econometric Society; see G a j d a, T o m c z y k [6]. The first author's contribution covers predominantly model specification, while the second author's - the forecasts.

[1] On various stages of research and model building the following members of the research team made their increments: A. B. Czyżewski, J. B. Gajda, E. Górska-Haładaj, G. Juszczak, W. Juszczak, D. Miszczyńska, M. Potargowicz, J. J. Sztaudynger, P. Tomczyk as well as students: D. Kaźmierczak, Z. Łęczycka, M. Porczyńska, The general supervision of prof. W. Welfe is gratefully acknowledged.

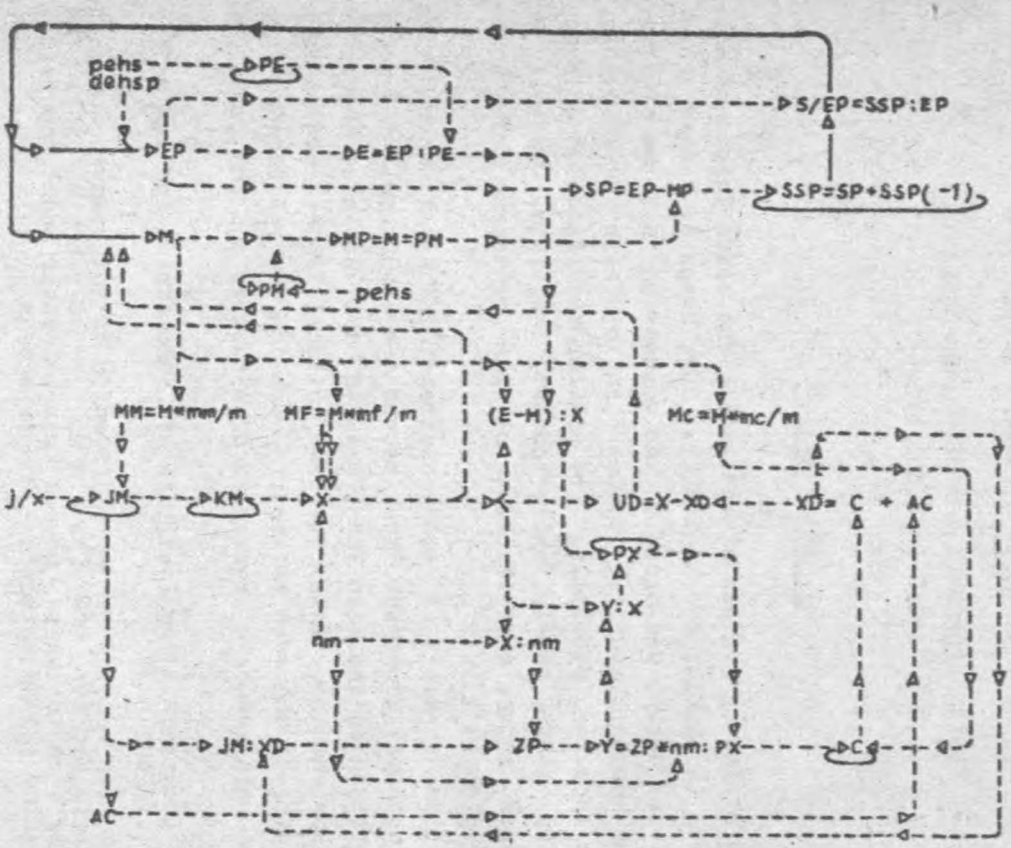

Fig. 1. Schematic representation of basic relationships in prototype model of CMEA economy ----> nonlagged; ⟶ or ⊂▷ lagged influence; exogenous variables - small letters (j/x, peh, ehs, mm/m mf/m, mc/m, nm); endogenous variables - capital letters

foreign trade and especially debt burden on the domestic activity. Only then the submodel of foreign trade enters, with its separation of the intra-CMEA trade from the trade with the rest of the world.

The largest systems - IES2 and IES4 are the most disaggregated ones, with foreign trade divided into four groups of commodities: fuels and mineral raw materials (roughly equivalent to groups 2 and 3), machinery and transport equipment (investment goods, close to SITC7), food and organic raw materials (close to SITC0 + 1 + + 4 and some of 2 (oils, fats), and other (mostly consumer)goods. The foreign trade flows are further disaggregated into two directions - the intra-CMEA trade and the trade with the rest of the world, and expressed in both - current as well as constant prices, in US dollars. The national economy is disaggregated into five production sectors: manufacturing and mining, construction, transportation, agriculture, domestic trade and the rest; with the following endogenous variables: gross investment, capital stock, net material product (roughly equivalent to the net domestic product of SNA statistics with services excluded). In some variants submodel of employment is incorporated.

The system is closed by the equations explaining consumption, net material product (national income) distributed, net and inventory investment and national income deflator.

The general structure of relationships of the prototype model is demonstrated on the Figure 1 (symbols have been described in Appendix).

2. Theses

(i) We assume that the main target of the centrally planned economy is to obtaind possibly highest output, as to fulfil maximally the needs of society. Usualy the welfare increase is understood as the proper target of CP society. The measurement problems forced the substitution of welfare by output as the operative target. This brings, however, some delicate change having powerful potential impact. One may be tempted to maximize output of investment goods as it would lead to further expansion of capacities and

faster further growth, temptation quite natural for countries severely destroyed in the last war. There are risks associated with this approach. First is the risk of stagnation or even decrease of the nation wealth as measured by, say, consumption per capita. In longer run one can expect the self-corrective mechanisms to revert the situation, as lack of increase of consumption tends to decrease labour motivation and increases social tensions. The other is the risk of "overheating" - the economy may not be able to assimilate properly the new capacities, or - sometimes - even to finish the investment projects already started. Thus we have net waste of some of the goods produced and frozen in the unfinished projects. Thus, part of the output does not increment to the growth of wealth, rather the reverse is true since the imported input as well as the labour input must be payed increasing the tensions at domestic market and foreign debt burden. Nevertheless the output of the economy grows at high rate, formally.

(ii) Another basic assumption says that the central planner has only a limited influence at the course of economic processes of his own country. We shall stress the difference between the central planner and the administration - the first one sets targets in the form of plan to be fulfilled, the second one is responsible for operative decisions leading to the realization of the plan; in practice of CMEAs the two functions used to be mixed together. The influence of the planner is obviously more limited at the short distance (when the supply restrictions are tight) than at the long run; even in the last case.

(iii) The elements best controllable by the planners seem to be associated with decisions about investment, wages and prices. However, some investment decisions are forced over the planner by the requirement due to the necessity to continue unfinished investment projects in the past; wage control is limited to wage increase and/or wage structure decisions - as it is extremely unpopular to decrease wages. The increase of prices is unpopular, too, but can be realized easier.

The central balancing and distribution of crucial raw materials and manufactured goods seems to be the last of the most powerful tools of the planner's influence. To be made properly - this distribution requires perfect knowledge of the existing needs and possible gains, what restricts seriously the efficiency of such a tool.

(iv) Virtually all plans assume some measures toward efficient use of resources. In practice it seems to be easier to set and achieve growth goals through such extensive measures as the increase of capacities through investment, than through organization conditions stimulating technical and organizational progress, resulting in more efficient use of already existing capacities and resources. It is thus assumed in the model that the main source of growth is formed by investment activity.

(v) Currently one may safely assume that the labour force is (at least formally) fully employed in CMEAs (as a result many simulations are made with employment set exogenously according to the growth of labour force; the employment submodel used to be activated only for special analysis, structural analysis). The assurance of job is one of the best pronounced attributes of centrally planned economies. Socially highly favourable - it may pose problems with efficient use of the labour force, as it happens to relax the working discipline. We do not analyze this problem any further.

(vi) One of the very important assumptions is that the imports serve mostly the needs of the production process,while the exports earn money for imports. The chances that the exchange is based on calculus of efficiency and comparative costs are thus seriously limited. There exist at least two main reasons for it. First - attempts to defeat centrally planned economies in economic "cold war", restrictions and embargos frequently introduced by the West and hence the risk of being cut short of some important commodities forces CMEAs to pursue cautious export-import policy with resulting autarchic tendencies. The other reason results from petrification of the policy of fast industrialization realized after introduction of central planning in the post-war period (heavily destroyed economies had to buy investment goods abroad, and the central control over scarce amount of foreign currency available enhanced the achievement of such crucial goals as economic recovery and expansion).

Additional hindrance is posed by the system of domestic prices, being insulated from the world ones. The structure of domestic prices as well as their level only remotely reflect either costs or utility of goods available on the market - so remotely that it is hard to compare them even between two centrally planned economies. This obviously influences heavily the proper calcula-

tion of efficiency of the foreign exchange obscuring the gains from the international division of labour.

(vii) Thus, basically, import brings fuels, raw materials and investment goods. The import of consumer goods has mostly complementary character and is likely to be activated when a special intervention on the market is necessary. Those are the reasons for imports of consumer goods to be included into the consumption function, while imports of investment goods enters investment function, imports of raw materials and fuels - production function.

(viii) In the models of the CP economies, export equations are frequently demand determined with, say, world exports serving as a proxy for world demand. This reflects the hypothesis that due unsufficient quality, the CMEA products are present on the world marked in relative abundance. However, it is clear that as the economy grows, the amount of high quality goods offered for export increases even if the share of such goods in total production does not increase. Our export equations are supply driven ones, with world exports serving as a shift variable, a modificator of supply realization function. Another modification of supply is achieved by the pressure of administration - we assume that the higher debt/export ratio, the higher the pressure of administration is, to force production of goods for exports and, simultaneously, to reduce the imports of goods. Hence in both - export and import equations we put a measure of the debt pressure[2].

(ix) For the intra-CMEA trade we assume that each country trades with all the rest of the CMEA as a whole (Figure 2). This "common-pool" concept obscures somewhat the dominating role of the Soviet Union and in more detailed models of foreign exchange is sometimes modified as to account for the latter (see discussion in T o m c z y k [8]).

(x) When disaggregating the foreign trade we assume that the CMEA market for raw materials and fuels is supply driven, as these

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[2] In 1977/1978 no data of foreign debt of the CMEA was available, thus we introduced the accumulated foreign trade balance as a proxy for the debt (observe that it has negative sign whenever the debt is positive). When debt estimates became available the accumulated foreign trade balance was found to have explanatory power (as measured by the determination coefficient, significance of estimates or correctness of their signs) higher than the debt estimates.

Fig. 2. Foreign exchange schema of CMEA countries in IES system

goods seem to be easy to sell at the non-CMEA markets as well. The opposite is assumed for the CMEA market of investment and consumer goods. The fact that after the second world war CMEAs have developed economies with similar structures (especially the smaller six European CMEAs) increases supply of products of the last two groups of goods, frequently of quality comparable within the CMEA, but lower than quality of the same goods offered at the world market (especially by the fast developing countries of, say, Pacific Basin), where the direct influence of world market prices made the competition very though[3]

3. Prototype Model

Below, we present a short review of the prototype model (see Appendix for the list of basic symbols). The basic structure shown refers to the unisectoral minimodel. It serves as well as the basic for the specification of equations of disaggregated models.

PRODUCTION X (net output) is explained by the classical two-factor production function modified additionally by the import restrictions:

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[3]Actually, sometimes "lower quality" means at the world market "Made in CMEA", due to political rather than economic or true quality factors, tarriffs and barriers restricting imports from CMEAs.

$$X = f(\overset{+}{KM}, \overset{+}{nm}, \overset{+}{MF}, \overset{+}{T}), \text{ where } MF = M \times mf/m$$

or as productivity function

$$X/N = f(\overset{+}{K/N}, (MF/N + \overset{+}{MF/N(-1)}):2, \overset{+}{T})$$

where K/N = KM : nm, MF/N = MF : nm, and we use two period moving average of the last variable to cancel out some of the short--term fluctuations buffered by stocks[4].

INVESTMENT JM (in production sphere, gross) is explained basically by factors determining supply: growing possibilities of the economy to invest (X represents the possibilities as well as the increasing supply of investment goods), MM - supply of imported investment goods (this variable represents import restrictions having form of the technology-import-bottleneck; changes of exogenously set share mm/m of imported investment goods in total imports make the bottleneck wider or narrower; on the other hand, reduction of total imports due to debt burden may bring another bottleneck-type impact), j/x is the planner influence proxy, defined as investment intensity rate (see G a j d a [2] for discussion)

$$JM = f(\overset{+}{X}, \overset{+}{MM}, \overset{+}{j/x}, \overset{+}{JM(-1)}), \text{ where } MM = M \times mm/m.$$

The presence of lagged JM obscures somewhat the supply orientation of the equation, this is, however, understood as a variable shifting the supply realization function, the shift being due to the investment project started in the past.

FIXED ASSETS KM (in production sphere) follow the standard identity

$$KM = KM(-1) + IM - d$$

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[4] This supply-driven description is in accordance with our assumption about the target of the centrally planned economy, in which there is no need to bother about demand being too small; as the profit maximization is not the driving force of the economy there always exists a possibility to expand demand by simple reduction of prices. Sixties and seventies gave examples of such reductions.

stating that the current value of fixed assets equals the past value, expanded by IM - material effects of investment expenditure having the form of new assets entering the production, and reduced by the amount of assets depreciation d due to capital use in production. Data limitations forced us to restrain to some stochastic proxy:

$$KM = f(JM, \overset{+}{JM}(-1), \overset{+}{JM}(-2), \ldots,) + (1 - \overset{+}{r}) \times KM(-1)$$

where we assumed the depreciation being proportional to the amount of fixed assets at the end of last period (r - the depreciation rate), and the new fixed assets being a distributed lag of the current and past investment expenditures[5].

WAGES ZP (nominal, in production sphere) generally depend on the labour productivity X/N, reveal their own inertion (reflected by the lagged value of ZP), and react to the investment share in the national income

$$ZP = f(\overset{+}{X/N}, \overset{+}{J/XD}, \overset{+}{Z(-1)}).$$

As there is basically full employment - in the periods of investment expansion there must act some other mechanisms bringing additional labour force to the heavy industry and building; these are assumed to have the form of attractive wages offered there, the wage inertia reflecting the process of non-investment industries stressing afterwards to close the gap in wages.

PERSONAL INCOME Y (real) depends on nominal wages ZP, employment nm and personal income deflator PY (or alternatively national income deflator PX, whatever is available). Due to data limitations we choose a proxy variable defined as follows:

$$Y = ZP * nm : PY.$$

PRICE DEFLATOR (say PX) depends on foreign trade (and its prices) pressure, as measured by the current foreign trade balance

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[5] In extreme cases the equation has the following form: $KM = a_0 + a_1 \times (0.167 \times JM + 0.0.333 \times (JM(-1)+JM(-2)) + 0.167 \times JM(-3)) + (1 - 0.04) \times KM$, where we were forced to assume a priori values of coefficients, due to extremely smooth time series of JM and multicollinearity problems; also some data on JM and KM are not directly compatible, thus the equation has reconcilliatory character as we sometimes get the estimate of a_1 greater than one.

(sometimes the debt proxy - the accumulated balance - was assumed) per unit of domestic net output (EP - MP) : X, the ratio of income to net output Y:X, situation in agriculture (measured by the weather index IOWA, assuming 100 for normal years, exceeding it in years with good crops, and the reverse when crops are bad):

$$PX = f(\overset{+}{EP - MP}:X, \overset{+}{Y : X}, \overset{-}{IOWA}, \overset{+}{PX(-1)}).$$

The equation suggests price decrease when the balance is positive hence some modification of (EP - MP) : X seems necessary to cover the problem; as all CMEAs have negative accumulated foreign trade balance the variant with this variable works (locally) better.

Thus the main forces bringing inflation into the CMEAs are identified as the world inflation, the foreign trade debt (and resulting need for import reduction) and disproportion between domestic output and incomes.

The main problem arises from the fact that inflation in CMEAs has different character than in market-type economies with nonregulated prices. As the prices are basically controlled and changed by a central decision - the CMEA equivalent of non-step-wise price increase typical for the market economy, has the form of supply shortage and hidden tensions. This cannot be easily reflected in the equation like the one quoted above. This part of the prototype model especially needs further elaboration[6].

CONSUMPTION C (real) has, similarily to the production function, classical form with lagged consumption and income as explanatory variables, modified by the imports of consumer goods MC:

$$C = f(\overset{+}{C(-1)}, \overset{+}{Y}, \overset{+}{MC}), \text{ where } MC = M \times mc/m$$

or in more supply oriented version - with Y substituted by X. However, we do not assume that supply of consumer goods is unlimited and thus the personal income determines the consumption. In our specification real income is supposed to be adjusted appro-

[6] A very interesting concept based on the velocity of money circulation was suggested in a private conversation by prof. Wilhelm Krelle, director Bonn-IIASA Research Group. Further results may be expected from this group research.

priately by the price movement before it enters the market. This seems to become the case of last years, at least in Hungary or Poland. Nevertheless the above specification seems a bit too normative, still.

To evaluate the discrepancy UD between the national income produced X (net output) and distributed XD we need the accumulation item AC equal to net investment and inventory investment (the consumption from social funds - distant cousin of government consumption in market-type economy models, is included into C).

$$AC = f\ (\overset{+}{JM},\ E - M,\ \overset{+}{X})$$

The equation has auxiliary character, the gross investment JM is supposed to deliver the main body of accumulation, the E - M term reflects the change in inventories due to excess of exports or imports, and the last term X reflects the increase in inventories as the net output increases (the inventories serve here as the production/circulation buffer).

DISCREPANCY UD = X - XD reflects in most general terms the gross imbalance of the economy. Assumed to reflect the need for extra imports (see G a j d a [2], G a j d a et al. [5] for discussion), it enters the equation of imports, closing thus the main loop of the country model.

EXPORTS E (in constant prices) are described by the identity

$$E = EP : PE.$$

EXPORTS EP (in current prices) are explained by the general supply of goods, represented by net output X and two shift variables, one (DEHSP) - first difference of world exports in current prices, reflecting shifts in supply realization due to the changes in the world activity and the second one (SSP:EP) - debt (proxy) per unit of export, reflecting shifts due to extra activity of administration, oriented on export expansion in cases of high debt:

$$EP = f\ (\overset{+}{X},\ \overset{-}{S/EP(-1)},\ \overset{+}{DEHSP}),\ \text{where } S/EP = SSP : EP,$$

(as SSP is negative when debt is possitive, the sign of S/EP is negative).

IMPORTS M (in constant prices) are explained by the production process requirements represented by a gross variable - net output X (in disaggregated versions the gross investment enters,respectively) the same as in export equation shift variable representing the pressure of administration to reduce imports as debt grows, and the gross imbalance variable UD (it is assumed that the initial difference between X and XD was larger, it was, however, partialy filled up with increased imports; since the authorities as well as the foreign trade companies that have the foreign trade monopoly react with delay and "resistance", only a part of the difference was filled up, the ratio of the two parts assumed stable).

$$M = f(\overset{+}{X},\ \overset{+}{S/EP(-1)},\ \overset{-}{UD})$$

(as SSP is negative when the debt is positive, the sign of SSP/EP is positive).

IMPORTS MP (in current prices) are defined by the identity:

$$MP = M \times PM.$$

DEFLATORS PE and PM of foreign trade are linked to the world prices with some inertia:

$$PE = f(\overset{+}{PEHS},\ \overset{+}{PE(-1)} \text{ and } PM = f(\overset{+}{PEHS},\ \overset{+}{PM(-1)}).$$

As the deflators reflect the price generating process of the intra-CMEA exchange, too, where prices are formed on the basis of moving average of the last 3-5 years, the inertia element introduced by lagged endogenous variable is related to the Koyck distributed lag. More advanced specification takes indices of world prices for the four commodity groups (PF, PM, PR and PC) instead of the single index PEHS[7].

[7] It is interesting to find in the estimation that the introduction of these four indices make the lagged endogenous varia-

4. Disaggregated Model

As we mentioned in the paragraph 3 the equations of the country models preserved basically their specification in disaggregated model. The main difference is in the functions describing the output of transportation, domestic trade and the other, where the explained variables are linked to the net output of manufacturing and mining, building and agriculture rather than described directly by production function, the import of investment equations for agriculture and the above mentioned sectors, also investment intensity disappeared from some investment equations.

The most important changes were introduced in foreign trade sector, since the trade was described in disaggregation into two directions - CMEA and the rest of the world, and into four groups.

Describing the functioning of the CMEA market one has to take into account the crucial factor mentioned above: the levels as well as structure of prices on the intra-CMEA market differ significantly from those of the world market. The most striking example is oil. Until midseventies its price (set by the Soviet Union as the main supplier of oil to Poland, and almost exclusive supplier to Czechoslovakia, GDR and Bulgaria) was kept at the level of last five-years world average, later moving average was taken instead. As a result, in late seventies the price was approximately some 30% below the world price, while in 1984 it was a b o v e it, as the latter decreased significantly in the eighties.

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ble absolute (as judged by determination coefficient or significance test). Does it mean that the prices charged in intra-CMEA trade, although different in level from the world ones, tend to reflect the most current changes in the world prices and thus imitate the dynamics of the latter? Another interesting observation made on aggregate level (i.e. when PEHS was used) was that the autoregression coefficient of export equation was for all seven CMEAs smaller than the same coefficient in import equation of the same country. The institutions excercising monopoly of foreign trade seem not to be able to make full advantages of an increase of world prices (and respectively increase prices for their exports), while suppliers of CMEA imports demand the new prices much more succesfully. One has to keep in mind that at least half of the exchange is made inside CMEA market, where prices are much more stable.

Another factor strongly influencing the intra-CMEA exchange results from unchangeability of CMEAs currencies and their isolation from the world prices. The structure of prices was different in different countries, system of direct or indirect subsidies were different as well. Hence, direct comparison of costs of exchanged goods was extremely difficult, with resulting tendence to b a l a n c e b i l a t e r a l e x c h a n g e within each of the four about mentioned groups (i.e. raw materials and fuels for raw materials and fuels, etc.) the strongest was this tendency in exchange within the six smaller CMEAs and for the two deficit grodps - agricultural and fuels and raw materials. As multilateral accounting was never implemented on full scale - the excess of exports in some bilateral trade actually meant giving credit with unusually low interest rate (in the seventies 2% was not an usual rate).

Finally, the debt accumulated in the seventies, started to influence the exchange in early eighties. In the seventies, when the post-oil-shock recession stagnated the western economies, the credits were readily given to CMEAs. As they were realized in the form of imports from the West - they expanded the demand at otherwise strinking international market considerably softening the recession effects. The debt repayment schedule was strongly influenced by the hardening conditions of exports to the West, resulting from the recession, and unusually high interest rate in the USA, spreading over the whole international credit market.

According to our theses exports of raw materials and fuels (ESF) and food (ESR) to the other CMEAs are determined by supply, while the two other groups of exported commodities (ESM - machinery, ENC - other, mostly consumer goods of industrial origin) are treated in quantites determined by the demand.

Country's export to the CMEA of raw materials and fuels is explained as follows:

$$ESF = F\ (\overset{+}{XQ},\ \overset{+}{MSF}(-1),\ \overset{+}{SSNP/ENP - SSNP/ENP\ (-1)})$$

where XQ - net output of manufacturing and mining, assumed to represent the supply (the last one was assumed being proportional to the output XQ) the tendency towards bilateral balancing of ex-

change of this commodity group is reflected by the country's imports MSF of these goods from rest of CMEA (data on bilateral flows are not published, hence we assume the "bilateral" balancing of the given country with the rest of CMEA), finally the impact of debt to the West (approximated by the foreign trade balance, accumulated with the non-CMEA countries - SSNP) per unit of exports to this area (ENP) is introduced as

$$SSNP/ENP - \overline{SSNP/ENP},$$ where $\overline{SSNP/ENP}$ is some

"safe" debt/export ratio[8].

Observe the plus sign expected in association with this variable, different from the one of similar variable in the equations for exports in the prototype model (there the variable reflects the pressure to increase exports, here - the pressure to increase exports to the West, to decrease the debt, with simultaneous reduction of supply for intra-CMEA use). The Soviet Union and Bulgaria seem not to be under the debt pressure, thus we do not introduce the "debt-pressure" variable into equations explaining exports of these countries; Soviet Union export equations contain as well total imports from the CMEA rather than imports of the given groups as this country seems to employ the policy of total balancing with CMEA rather than commodity one.

Export to CMEA is explained as follows:

$$ESR = f(\overset{+}{XR}, \overset{+}{MS(-1)})$$

where the main supply steems from XR - the net output of agriculture modified by the total imports from the CMEA of the previous year. For the Soviet Union the equation contains additionally import MNR of food from outside of the CMEA (with expected negative sign as one has to expect some reduction of the Soviet export to

[8] The variable is actually built in such a way, that it assumes nonzero value for the periods when the debt (accumulated balance per unit of exports) exceeds the "safe" level (in our case - is smaller than the level as our debt proxy is negative when debt is positive). The "safe" ratio was found empirically between -0.8 and -1.6. The approach repeats that of W e l f e [9].

CMEAs when it has to increase import of the same commodity group from the West).

The related import equations allocate total available supply among customers:

$$MSF = f(ESFW - ESF, ESF(-1))$$

$$MSR = f(ESRW - ESR, ESR(-1))$$

where ESFW and ESRW are total intra-CMEA exports of the given commodity group. Obviously we exclude the country's own export from it; on the other hand, the lagged value of this export is associated with the tendency mentioned above to balance "bilaterally" exchange inside each commodity group.

The situation in the other commodity groups: M - machinery and C - consumer goods is modelled in the reverse order: first, the demand of the countries is determined, and then some allocation equations "allocate" this demand between potential suppliers.

The demand equations are thus as follows:

$$MSM = f(\overset{+}{JM}, \overset{-}{MNM}, \overset{+}{ES(-1)}, \overset{+}{MSM(-1)})$$

$$MSC = f(\overset{+}{C}, \overset{-}{MNC}, \overset{+}{ES(-1)}, \overset{+}{MSC(-1)})$$

Import of machinery is determined by the investment activity of the importer JM, while consumption C (in more disaggregated version this is the consumption of non-food goods) is the determinant of imports. The ES variable reflects the "bilateral" balancing tendency in much the same way as in the previously discussed equations; the imports from outside the CMEA (MNM and MNC) are assumed as the competitors for MSM and MSC, respectively and thus have negative signs of coefficients expected. Trade agreements signed inside the CMEA for multiyears periods add inertion to the exchange, reflected by introduction of lagged endogenous variable. The allocation of demand is realized by simple allocation equations, similar to the allocation equations for the previous two groups:

$$ESM = f(\overset{+}{MSMW} - MSM, \overset{+}{ESM(-1)})$$

$$ESC = f(\overset{+}{MSCW} - MSC, \overset{+}{ESC}(-1))$$

where MSMW and MSCW are total intra-CMEA imports of machinery and consumer goods, respectively.

Equations for price deflators of commodity groups in intra--CMEA trade have been assumed the same for all countries and have the form discussed in the prototype model, with world trade deflators of related commodities (rather than total world trade deflator) serving as explaining variables. The "common pool" approach is demonstrated on the Figure 3.

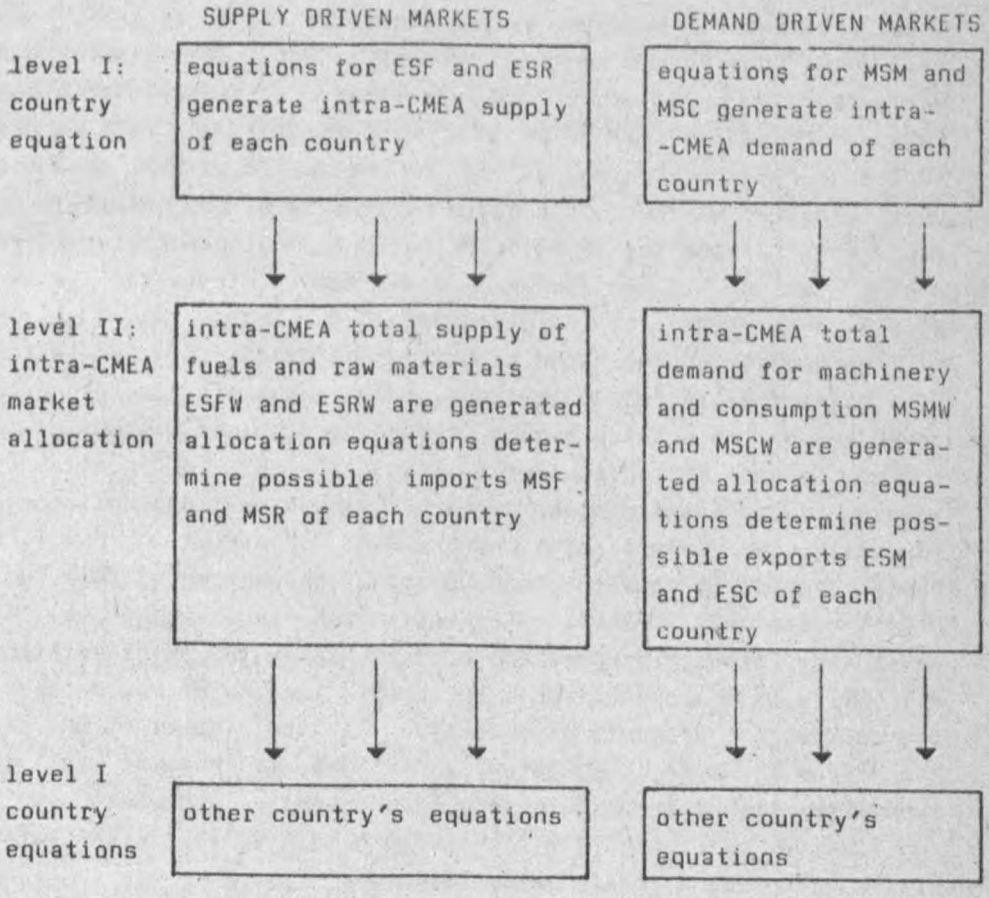

Fig. 3. The "common pool" approach in disaggregated model

Export to countries outside the CMEA determined by the world demand represented by the world exports (minus the CMEA exports) of commodities of the given group. The export equations contain as well shift variable in the form of ratio of price offered by CMEA on the world market to the world prices, the higher the ratio, the smaller the world demand for the CMEA products. Finally supply limitations, present in some of the last years, are introduced in the form similar to the combined variable shown in the equation ESF above:

$$ENi = f\ (\overset{+}{ENiW},\ \underset{-}{PHSi} : PNSWi,\ MNF/XQ - \underset{-}{\overline{MNF/XQ}}\ (-1),\ \overset{+}{ENi}(-1)),$$

where i stands for symbols of raw materials and fuels F, machinery M, food R and non-food consumer goods C, ENiW is the world (outside CMEA) exports of commodities of the related group, PHSi and PNSWi - deflators of prices charged in the CMEA exports to the non-CMEA region and at the non-CMEA world market, respectively. Finally, MNF/XQ is the ratio of imports of raw materials and fuels from outside the CMEA to the net output of manufacturing and mining - which - if one assume too low value, indicates actual supply restrictions for the given group.

The import is considered as being generated in two steps. First, the initial (unconstrained) import value is determined, as depending on the country demand (represented by net output of the economy, except for agricultural output, X - XR, in equation for imports of raw materials and fuels MNF; investment expenditures JM in equation for imports of machinery MNM, consumption CNR - of non-food goods in equation for MNC, and consumption of food CR in equation for MNR). Significant modification is brought to the demand for imports from outside of the CMEA by the price relationship (like in the export equations ENi); import of raw materials and agriculture products depends also on the import of the same goods from the CMEA, the weather index IOWA is present in the import equation for agricultural goods (shortly food, although it contains raw materials of agricultural origin as well; IOWA variable is not present in the below formula):

$$\widetilde{MNi} = f(\overset{+}{Ai}, \overset{-}{PHSi/PRGi}, \overset{-}{MSi}),$$

where i stands for F, C, M or R, Ai denotes one of the demand generating variables described above, PHS and PRG are the price indices of import from outside the CMEA and intra-CMEA, respectively, MSi - related imports from the CMEA region and tilda denotes the initial, unrestricted demand[9].

Imports from the outside of the CMEA are restricted globally by the available means to pay for them. It was assumed to have the following form:

$$MNP = ENP - SNP,$$

where SNP is the current balance of foreign trade that is to be realized outside the CMEA region (thus SNP is negative if some credits rare expected, or positive, if some payments are to be realized, the value being set exogenously). Using import price deflator PMN we calculate the affordable imports in constant prices:

$$MN = MNP : PMN$$

and then adjust the initial imports (only if their total exceeds the affordable one) as follows:

$$MNi = MNi \times (MN : (MNF + MNR + MNC + MNM)).$$

The world prices are assumed exogenous, the deflators calculated from the known structure and levels of imports in constant prices and deflators of trade inside the CMEA and outside it.

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[9] See note 9 for comments on the construction of variables alike, in the equation for consumption - domestic consumption to domestic production of agricultural sector was taken in such a variable: C/XR - $\bar{C}/\bar{XR}$, in more disaggregated models consumption of agricultural goods was taken instead.

B.U.E.

5. Forecast

Consecutive version of IES system were used for forecasting experiments since the beginning of eighties. The period was especially challenging and unfavourable as well. On one hand, the world economy as well as the CMEA economies underwent quite rapid changes of trends of growth and structure of performance, on the other hand, in such moments one is especially interested in the possibility of foreseeing the future[10].

Below we present a consecutive variant of forecast up to the year 1990. The economic situation in the starting moment of our forecast was not bad. The rate of growth of the world trade increased from 1.6% in 1983 to 8.9% in 1984, mostly due to the increase in the activity of the American and Japaneese economies. As a result, the raw material and fuel trade increased at a similar rate, the other commodities were also trade in increased quantities, while the prices of the world trade revealed further decline (Figure 4).

Hence the world economy seems to overcome the stagnation or even decline of the early eighties, although it is not obvious for how long, the negative trends have been reverted. Generally we assume that the world trade outside the CMEA will show further increase:

i) exports of raw materials and fuels will grow by 5% in 1985, and by 2-3% yearly, afterwards,

ii) the machinery exports as well as the non-food consumer goods will grow by 4% in 1985, and by 3-1.5% yearly, afterwards,

iii) exports of agricultural products will grow yearly by 3-4%, until 1988, and by 2% afterwards.

World prices area expected to:

i) drop by 2% in 1985, and then grow by 1-2% yearly in the case of raw materials and fuels,

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[10] See for example G a j d a [3]; G a j d a, S z t a u d y n g e r [7]. The current forecast is an improved version of: G a j d a, T o m c z y k [6]. The submodel of foreign trade was first outlined in: C z y ż e w s k i, T o m c z y k [1], a more detailed version can be found in T o m c z y k [8].

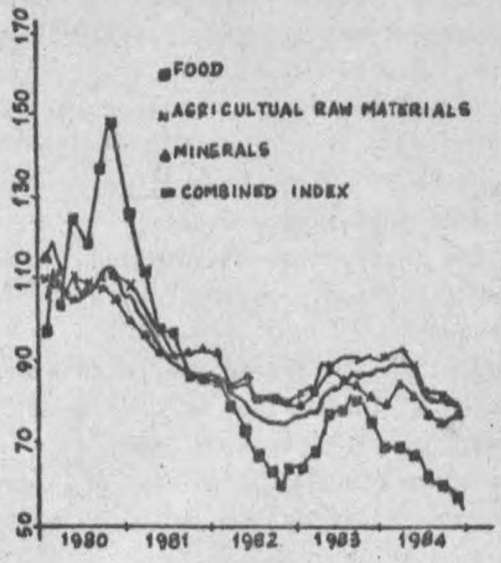

Fig. 4. Prices in the world trade 1980-1984 (after UNCTAD, Monthly Commodity Price Bulletin)

ii) increase by 1-2% yearly in the case of machinery and non-food consumer goods,

iii) increase by 1% in 1985, and by 2-3% yearly afterwards in the case of agricultural products.

Hence our assumptions assume the explosion of world prices of the second half of seventies and early eighties is now over. The CMEA prices are expected to follow the same pattern. As the direct result of moving average basis prices of fuels and raw materials will increase by 16% in 1985, and then by 2-3% in 1986, only in 1987-1988 it will show some 2% decrease, to stabilize in the final years. Agricultural exports are to be priced at level increased by 6% in 1986, yearly, and grow by 1% yearly afterwards. The other two groups will show the same pattern and grow by 2-3% yearly in 1985-1986, and by 1% yearly afterwards.

The situation of the European CMEAs deteriorated in the early eighties considerably, although the degree of deterioration differs in different countries. If we exclude Poland for a moment, as the depth of its crisis had stronger social than economic back-

ground, the net output of the other CMEAs experienced decline in the rates of growth but not the absolute level. Consumption, however, decreased not only in Poland.

Among the main sources of the CMEAs troubles one may name the following:

i) the exhaustion of extensive sources of economic growth, like free labour force or (relatively easily) available investment goods; actually the last source disappeared in some cases because investment projects started required too large expenditures and imports to be finished;

ii) debt burden and changes in the international credit market;

iii) stagnation of the western economy with resulting restrictions of the export possibilities of CMEAs;

iv) increase of tensions between East and West with further, politically based restrictions imposed on both exports and imports of the CMEA.

Since 1983 we observe signs of recovery in the CMEA economy. To be correct one must stress that the real recovery refers to Poland and Romania, while in the case of the other CMEAs we shall speak rather of the slow-down of the rates of growth being over. Table 1 illustrates the performance of these countries in 1982--1984. The difficult situation of Poland and Romania can be easily seen, on the other hand Bulgaria and GDR sustain quite reasonable growth. While Bulgaria luckily avoided the debt-trap and never accumulated too large debt to the West, the spectacular advances of the GDR economy may be partially attributed to the robust, well organized economy, partially to the special terms of intra-Germany trade, with West Germany, giving easier access to potential importers of goods produced in the GDR. The Soviet Union seems quite robust, especially in the field of foreign trade.

One should not be misled by the Hungarian rates of growth oscillating slightly above zero. This economy is succesfully struggling for the preservation of fragile balance on domestic market, being probably in the best position with the respect among the all east European CMEAs. Its low growth rates may be attributed to very cautious foreign trade and investment policies directed on the preservation of balanced market.

T a b l e 1

Basic indicators of economic development of CMEAs in 1982-1984

Specification	National income	Investments	Exports		Imports		Debt to West[d]
			total	outside CMEA	total	outside CMEA	
Bulgaria[a]							
1982	4.0	3.6	14.3	-6.7	3.1	-8.2	3 300
1983	3.0	0.8	4.4	8.6	5.2	-13.8	2 900
1984	4.6	1.2	8.1[b]	-	-	-	2 700
Czecho-slovakia							
1982	0.1	-1.6	5.8	-1.5	2.8	-6.5	3 800
1983	2.5	0.3	5.9	5.7	2.1	-2.4	3 700
1984	3.2	4.1	8.0[b]	4.6[b]	8.0[b]	-	3 200[c]
GDR							
1982	2.6	5.2	6.0	20.5	-5.0	-3.6	10 100
1983	4.4	0.0	11.0	7.0	5.0[b]	14.3[c]	11 500
1984	5.5	-5.5	5.0	-	-	-	11 200[c]
Poland							
1982	-5.5	-12.1	8.7	5.5	-13.7	-22.1	27 300
1983	6.0	9.4	10.3	10.5	5.2	9.8	27 800
1984	5.6	8.8	9.0[b]	-	9.0[b]	-	28 200[c]
Romania							
1982	2.8	-3.1	-9.5	-14.4	-24.2	-45.3	11 300
1983	4.0	2.4	6.0	-3.4	-4.3	-31.3	9 300
1984	7.7	6.1	-	-	-	-	8 800[c]
Hungary							
1982	2.6	-2.2	7.2	9.1	0.0	-2.6	7 300
1983	0.5	-2.7	9.5	16.9	4.0	15.0	7 500
1984	3.0	-6.0	6.5[b]	5.0[b]	0.9	0.0[b]	7 200[c]
USSR							
1982	4.0	3.6	5.0	9.3	0.0	6.0	16 800
1983	4.2	5.7	3.0	1.4	4.0	1.4	19 000
1984	3.2	2.0	-	-	-	-	17 800[c]

N o t e: a - current prices, b - plan, c - estimate, d - mln US $.

S o u r c e: G a j d a, T o m c z y k [6].

Table 2

Trade balance with countries outside CMEA and debt to the West assumed in forecast, mln US $

Specification	1985	1986	1987	1988	1989	1990
Trade balance:						
Bulgaria	600	500	400	400	400	400
Czechoslovakia	600	550	500	500	500	500
GDR	700	500	500	400	400	400
Hungary	400	500	400	400	400	400
Poland	1 500	1 500	1 500	1 500	1 500	1 500
USSR	3 300	2 800	2 800	2 500	2 500	2 500
Debt (gross):						
Czechoslovakia	3 200	3 200	3 000	3 000	3 000	3 000
GDR	10 600	10 600	10 600	10 600	10 600	10 600
Hungary	6 900	6 900	6 900	6 900	6 900	6 900
Poland	30 200	31 500	33 000	33 000	33 000	33 000
Romania	8 100	7 700	7 700	6 800	6 300	6 000

Table 2 shows the values of exogenous variables associated with indebtness to the West. Generally, there was assumed positive foreign trade balance and reduction of the size of debt. One must admit that the assumptions about the debt of Poland and Romania are the most doubtful ones, as simultaneously with reduction of it there exists positive and quite significant growth of output. The assumed figures mean in fact that the actual debt will be reduced slightly, but the debt service payments are to be fulfilled. As it was told by prof. Pajestka, member of the Polish delegation for talks in Viena - countries that have largest debt cannot repay it even if they starve themselves to death to generate the necessary export excess; Poland, however, will dutifully pay its debt service payments, since in other case it would have been punished as an example for the others. We may stress that the two-three year moratorium on debt payments would pay more to the creditors as the economy, strengthened by the years with less restricted raw

Table 3

Basic forecast for the years 1985-1990
of the economic performance of European CMEAs
(% rates of growth)

Specification	1985	1986	1987	1988	1989	1990
1	2	3	4	5	6	7
Bulgaria						
X	5.5	5.9	5.9	5.6	4.4	4.3
JM_p	6.0	7.1	7.3	7.4	7.4	7.3
C_p	4.3	5.2	5.6	5.0	4.6	4.7
EP	14.3	7.3	6.6	6.3	6.3	6.0
ENP	3.6	4.9	4.6	5.3	5.2	4.3
MP	10.3	8.0	6.6	6.2	5.9	6.3
MNP	4.5	12.1	10.8	10.7	5.4	4.5
Czechoslo-vakia						
X	3.2	3.5	3.7	3.2	3.2	3.2
JM	4.8	4.6	5.1	4.4	4.5	4.4
C	2.9	2.4	3.2	3.4	3.1	2.9
EP	11.6	6.7	5.1	4.9	5.0	5.3
ENP	3.6	3.7	3.1	3.5	3.6	2.5
MP	13.6	7.5	5.8	4.3	4.6	5.1
MNP	4.1	7.1	5.0	3.5	2.7	2.7
GDR						
X	4.8	4.6	4.8	4.6	4.7	4.7
JM	5.7	5.6	5.5	5.4	5.5	5.4
C	3.6	3.7	3.7	3.8	3.7	3.6
EP	10.9	6.4	5.8	5.0	5.1	5.0
ENP	2.9	3.3	3.2	3.2	3.0	2.6
MP	12.6	9.2	5.4	4.5	5.0	5.0
MNP	1.0	6.5	3.4	3.4	5.7	2.2
Hungary						
X	2.7	2.6	2.3	2.1	2.1	2.0
JM	5.2	3.3	6.6	4.5	4.1	4.0
C	2.8	1.9	2.8	2.9	3.0	3.0
EP	12.1	8.6	4.6	4.9	4.4	4.6
ENP	4.4	4.0	4.7	3.8	3.3	2.4
MP	16.1	3.5	6.8	3.7	4.4	4.6
MNP	2.8	1.2	8.6	4.3	3.7	2.6
Poland						
X	4.2	3.5	3.6	3.8	4.3	3.7
JM	5.2	5.8	5.9	5.1	4.4	4.4
C	2.3	1.4	2.0	2.1	2.2	2.7
EP	12.0	8.0	5.7	5.9	5.7	6.0
ENP	4.1	4.3	2.6	4.4	3.2	2.9
MP	12.8	4.0	5.3	5.0	5.2	5.5
MNP	4.5	5.5	4.6	5.9	4.6	3.7

Table 3 (contd.)

1	2	3	4	5	6	7
Romania						
X	5.0	4.1	4.8	4.7	4.6	4.7
JM	6.1	4.3	6.8	5.7	5.5	6.1
C	2.9	3.9	3.4	3.4	3.5	3.5
EP	7.4	5.2	5.0	4.2	4.9	5.2
ENP	4.3	4.7	4.6	4.8	4.5	3.4
MP	12.3	6.8	8.0	7.6	7.6	7.1
MNP	6.1	5.6	8.1	8.6	8.6	6.7
USSR						
X	2.2	3.2	3.0	3.1	3.2	3.1
JM	2.8	3.5	3.0	3.2	3.2	3.3
C	2.6	3.1	2.9	2.8	2.7	2.6
EP	12.0	4.7	3.8	3.4	4.0	4.0
ENP	3.1	2.4	3.0	3.6	3.6	2.1
MP	9.2	6.2	4.2	4.8	4.5	4.0
MNP	5.3	4.1	3.2	4.7	3.8	2.2

material and fuel imports would be able to pay more and faster; these are, however, political rather than econometric forecasts.

The other exogenous variables of the model were assumed almost stable. The most important of them is employment, assumed to stabilize in Poland, Hungary, GDR and Czechoslovakia, or to grow by 0.5% to 1.5% in the USSR, Bulgaria and Romania. The resulting forecast is presented in Table 3.

Looking at the more detailed versions of the forecast than the one presented here (G a j d a, T o m c z y k [6]) one can clearly see that the growth of CMEA economy is strongly based on the growth of the intra-CMEA trade, the last one incrementing dominating portion of the total foreign trade growth. Stabilization of prices growth, present especially in the second half of the forecasting period smooths growth, while the echo of the world price changes of early eighties, due to the moving average price generation process of the intra-CMEA trade, can be seen in the first years of the forecasted period.

Generally the forecast is quite an optimistic one, although we have an inclination to attribute higher probability of realization to the less optimistic fragments of it (i.e. to cases of the USSR, Hungary or somewhat lesser extent to Czechoslovakia and GDR). Bulgaria may have good reasons for such a high growth, the data available are, however, expressed in current prices, thus asessment of impact of prices (considerably changed in early eighties)

on the rates presented is not possible without additional information. The cases of Poland and Romania - countries recovering from deep recess are the most dependent on succesfullness of further restructuralization of economy, stimulation of technical (or perhaps, in the case of these countries one should write - socio-economic progress, as there seems to be j u n c t i m between the two) progress, labour productivity and above other - reduction of material costs per unit of output, being the necessary condition for increase of output with simultaneous restrictions on imports.

Final remarks needs to be written about consumption growth. As we assumed at the beginning of the paper - this growth seems to reflect the main target of centrally planned economy better than net output, say. In all cases not only decreases in consumption are not forecasted, just the opposite is true. One may, however, expect that the first impact of any serious troubles CMEAs encounter in the future will be directed against consumption increase. Even in such over-invested in the past economy as the Polish one - further investments are necessary for any restructuralization and energy saving policy. Since in current times the success of the latter can happen "to be or not to be" of these economies - one can say that slow-down of the investment growth is possible, but their reduction - rather not. Thus consumption may happen to be the only available "scapegoat"in the case of economic turbulences; this is quite opposite to the typical planners behaviour in the early eighties, when consumption was usually assumed the preferred target to be sustained.

Appendix

List of basic symbols

(basic units: mln of local currency)

A - accumulation (AC - net investment + inventory investment)
C - consumption
D - stands for increase (first difference) of the following variable

E - exports, EP - current prices, E - constant prices, US $ EHS--world exports, constant prices, US $

J - investment (expenditures), JM - productive sphere

K - fixed assets, KM - in productive sphere

M - imports, MP - current prices, M - constant prices, US $

N - employment, NM - in productive sphere, in thousand persons

P - price deflator, PX, PE, PM, PEHS - of X,E, M, EHS respectively P as the last letter indicates measurement in current prices

S - SP-balance of foreign trade, SP = EP - MP
SSP-accumulated balance of foreign trade, a proxy for foreign debt S/EP=SSP:EP - a measure of foreign debt pressure on the economy

U - UD - discrepancy between X and XD

X - national income produced, X/N = X : NM (net) output-labour ratio XD-national income distributed

Symbols are further extended with letters indicating commodity group (F - fuels, minerals and metals, M - machinery and equipment, C - other, mostly consumer goods) in foreign trade, direction of this trade (ESP - exports to socialist countries, current prices, total, MNF - import from nonsocialist countries, constant prices, fuels), or a sector (B - building, H - domestic trade, Q - manufacturing and mining, R - agriculture, T - transportation, O - other sectors) etc.

References

[1] Czyżewski A. B., Tomczyk P. (1979), Foreign Trade in Econometric Macromodels, "Studia Prawno-Ekonomiczne", nr 22 (Łódź).

[2] Gajda J. (1982), Minimodel W4/79 gospodarki Polski W4/79 (Minimodel of Polish Economy), [in:] Opisowe modele ekonometryczne (Descriptive Econometric Models) ed. N. Łapińska-Sobczak, University of Łódź Print.

[3] Gajda J. (1983), The Economic Development of European CMEA Countries in 1983-1985: A Econometric Model Forecast, "Prevision at Analyse Economique", Vol. 4 (Paris).

[4] Gajda J. (1986), The System IES2 of Minimodels of European Centrally Planned Economies. A New Version, [in:] Macro-

models and Forecasts of National Economy, Polish Scientific Editors, Warszawa-Łódź.

[5] Gajda J., Czyżewski A. B., Górska-Haładaj E., Juszczak G., Miszczyńska D., Potargowicz M., Sztaudynger J. J., Tomczyk P. (1986), Regional Model of European CMEA Economies, Acta Universitatis Lodziensis, Folia oeconomica 54.

[6] Gajda J., Tomczyk P. (1985), Econometric Model of CMEA Countries - Simulation, Analysis and Forecasts, presented to the V World Congress of Econometric Society, Boston.

[7] Gajda J., Sztaudynger J. J. (1984), Prognozy rozwoju i zadłużenia krajów RWPG (Forecast of Development and Debt of CMEA Countries), Biuletyn Pracowni Prognoz, nr 3, IEiS UŁ, Łódź.

[8] Tomczyk P. (1985), Ekonometryczny model wymiany handlowej krajów RWPG (Econometric Model of Foreign Exchange of the CMEA Countries, Ph. D. Thesis, University of Łódź.

[9] Welfe W. (1983), Model W5 of the Polish Economy. General Assumptions and First Empirical Results, presented to the Econometric Society European Meeting, Pisa.

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GOSPODARKI KRAJÓW RWPG - MODELE I PROGNOZY OPARTE NA SYSTEMIE IES

W artykule przedstawiono założenia i strukturę modeli gospodarki krajów RWPG, zbudowanych w Instytucie Ekonometrii i Statystyki Uniwersytetu Łódzkiego. Modele te, mające kilka wersji, zaprezentowano w postaci systemu składającego się z dwóch podmodeli - opisującego sferę gospodarki narodowej poszczególnych krajów oraz handlu zagranicznego, stanowiącego jednocześnie ogniwo łączące poszczególne modele w jeden spójny system.

W konstrukcji modelu krajów RWPG przyjęto hipotezy o podobnej specyfikacji równań w modelach poszczególnych krajów na podstawie istniejących podobieństw mechanizmów ekonomicznych, trendów w rozwoju historycznym itp. Założenia specyfikacji równań zostały przedstawione w artykule w postaci schematu wraz z uwzględnieniem najważniejszych powiązań występujących między podstawowymi kategoriami ekonomicznymi opisywanymi w modelu.

W końcowej części artykułu zaprezentowano prognozę rozwoju podstawowych wskaźników ekonomicznych krajów RWPG w latach 1985-1990, poprzedzoną omówieniem założeń o zmiennych egzogenicznych modelu.

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