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I. MODELS OF SOCIALIST ECONOMIES

Vladimir Dlouhý*

ON THE PROBLEM OF MACROECONOMIC MODELLING IN CENTRALY PLANNED ECONOMIES

1. Introduction

Macroeconomic and macroeconometric modelling is a well established research activity in centrally planned economies (CPE's) nowadays. In recent years, quite a lot of macroeconometric models have been constructed for CPE's and the purpose of constructing of these models was, in general, to investigate the nature of short-run macroeconomic fluctuations, and to forecast the magnitude of main macroeconomic aggregates.

However, many of these models failed to reach the mentioned aims and the whole area of modelling is now under rather strong criticism from both theoretical and practical economists in CPE's. The reason for this criticism stems mainly from the failure of the models to become an useful tool in everyday economic practice; nevertheless, many theoreticians pointed out a lack of theoretical background in constructing econometric models of CPE's.

We believe that the crucial problem is in the purpose which stands behind the modelling activity and, namely, in the interpretation of the results. In CPE's, the introduction of formalized approaches and methods to the economic thoughts and practice wasn't gaining the ground in an easy way. Therefore, after the acceptance of "the mathematics in economics" at the beginning of

* Dr., Institute for Forecasting, Czechoslovak Academy of Sciences, Prague, Czechoslovakia.

the 60´s, a lot of emphasis was put to the formal models and with a lot of expectations economists waited for the results. However, the mainstream of the economic theory, in spite of the wide use of the mathematical tools, didn´t provide the modellers withe the well-established theory in a utilizable form.

Economic models, nevertheless, appeared in all CPE´s and their number continued to grow significantly. Many attemps failed. Many serious attempts, on the other hand, led into the whole series of models: this is the case of the activity of W. Welfe in Poland, I. Šujan in Czechoslovakia and, to some extent, of M. Wolfling in the GDR. Apart from this, there is a great number of centers of theoretical or applied research, where the econometric models were specified, estimated and used both for analytic and forecasting purposes. Serious results appeared outside the CPE´s; SOVMOD is probably one of the most important examples.

Where, then, is the source of the problem with the macroeconomic models in CPE´s? First of all, the critics themself, very often, are not able to distinguish the most elementary facts. Many times the modellers are asked to solve the problems which their models are not designed for. The difference between the short-run issues on one side and medium- and long-run problems on the other side serves as the best illustration[1].

Short-run issues, that can be covered under the broad heading of stabilization policy, should be carefully distinguished from the medium and long-term problems, which might be called development strategy. In the central focus of stabilization policy stand the main macroeconomic variables as the level of economic activity, the level of employment, nominal wage and profit etc. The analytic framework of stabilization policy is that of macroeconomic models in the "Keynesian" tradition - this, broadly speaking, is true for the models of market economies and for the ones of CPE´s as well. Econometric models of this type experienced the most active development and brought the most significant and important results.

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[1] This part is adopted from K. D e r v i s, J. de M e l o and S. R o b i n s o n (1982).

On the other hand, development strategy focus on such variables as the growth and structure of production in the broad sense, and the analytic framework is that of economy-wide, multisectoral model (usually with the input-output model as a core). The underlying theory is essentially microeconomic in spirit and this is again true for CPE´s as well - with one, almost fatal qualification: there is no appropriate microeconomic theory for the functioning of the CPE´s.

The two approaches can be complementary, are certainly not independent, but they are nonetheless distinct. This is a fact, which is very often overlooked by the potential users of the models. Rather long discussion (in which author himself was involved) about the low strenght of the econometric models in the long-term forecasting process, emphasizing the "problem" of the parameters´ stability, fixed structure, autocorrelated nature of the data generating process etc. can be, to a certaing extent, labeled as useless. Econometric models never were and never will be designed for modelling of structural changes or, more generally, for the long-term forecasting of development strategies at all; all in all, they are designed for the contitioned forecasts of the performance of the existing structure given the assumptions about the development of exogenous factors.

In this framework several types of existing macromodels are discussed. We start with the most developed ones, with existing large macroeconometric models and we try to find certain common features in specifying the equations for production, consumption, investments, foreign trade etc. Macroeconomic models with quantity rationing represent another type, which is examined in our paper; the theory behind these models deals with the formalization of planners´and households´ behaviour, but the applications are severly limited by the technical problems (coherency conditions, estimation etc.). Recently, Kornai´s macroeconomic attempt, based on the notion of shortage as a central phenomena in the functioning of CPE´s, opened new problems and questions to discuss. Finally, we try to present an outline of the multisector model of CPE.

2. Large Econometric Models

Large econometric models of CPE´s exist in spite of the fact that their authors didn´t have any macroeconomic theory as a basic guide for the specifications. Yet one can draw a conclusion that these models brought reasonable results: significant and from the view of economic interpretation plausible parameters estimates, well-behaved functions, rather accurate ex-post simulation performance and acceptable short-term forecasts. Given the lack of the background theory, it is clear that various models were constructed in various ways, reflecting namely the specific economic situation of the country of the origin. However, because of many common features which can be found in the functioning of CPE´s, there are many similarities in the models´ specifications as well. In this section, we intend to trace the main common lines, the main common short-term forecasting results, and to set a general theoretical framework for macroeconomics of CPE´s; this can be considered as a transparent feedback from the model building to the theory.

On a very aggregate level, macroeconomic institutional characteristics of CPE´s are rather simple. There are no complex monetary flows and institutions, the basic role plays the central plan and the planning hierarchy. Prices and wages are fixed by the centre, the resources are distributed in the physical units and money plays only a passive role. Foreign trade flows are virtually separated from the internal economy as the foreign trade prices are not linked with the internal prices. The basic equilibrating mechanism consists of short-term adjustments on the consumption goods market and, mainly, of the planners´ reactions and adjustments in pursuing the main economic targets (steady growth rate, full employment, internal and external balance etc.). The whole idea of modelling in CPE´s is heavily based on the assumption that there exist regularities in these economies, both behavioural and technological; this assumption we consider as being proved already long time ago. On the other hand, we must admitt that many of the existing characteristics of the functioning of CPE´s create many new, system specific problems: prices fixed by the centre obviously don´t clear the market, but, mo-

reover, bring distorted information about the scarce resources, about the cost structure etc.

In dynamics, the main barriers consist of consumption, labour force, and foreign trade. This, together with the assumption of full employment determines the model; problems of full capacity utilization, however, require its adequate solution.

There are several important blocks which exist more or less in all large econometric models of CPE´s as well as of market economies: production functions, determining the level of gross or net output, aggregate consumption function, investment function, export and import functions, the chain from investment outlays to gross capital formation, increase in capacities and increase in output, inflationary feedback etc. Given the system specific features of CPE´s, there are also specific blocks of at least equations. Following the taxonomy of W. W e l f e (1985) one can specify closed loop, bottleneck multiplier, describing the spread of scarcities in supplies in certain industries to the whole economy; the existence of shortages and disequilibria calls for the construction of disequilibria indicators, taking into account excess demand or supply etc. In foreign trade the separation to the trade with socialist and non-socialist countries is inevitable, as well as the separation among the most important commodity groups. Let´s have a look at some problems closer.

Modelling the production sector leads, in general, to the use of Cobb-Douglas production function, either with or without the technical progress. The relation generates gross or net output and usually the alternative aggregate is determined by the given exogenous parameter, reflecting the share of net output on gross output or vice versa. Occasionally, the imported machinery equipment is introduced as explanatory variable.

In the framework of our general discussion here we mention only two broad problems, namely the type of production function and capacity underutilization. The wide-spread use of Cobb-Douglas production function with constant returns to scale is usually explained by its relative simplicity, especially in the context of handling with large models. However, substantially growing number of studies has shown that rather restrictive assumptions behind C-D function are often contradictory with the reality of

CPE´s: there were no constant returns to scale, elsticity of substitution between capital and labour wasn´t equall to one, more generally, using the concept of translog function, one can reject the global separability and, consequently reject the idea of introducing other explanatory variables. More sophisticated types of production functions, like CES or VES functions, are much less both analytically and numerically tractable. It seems that a reasonable trade-off among various types of production functions and experienced adjustments represent the best way-out from this complex problem.

In foreign trade, the models of the trade flows with capitalist countries are relativelly well-established. On the import side, the small East-European CPE´s are considered as price takers and only the demand for import is specified; explanatory variables usually include the proxy for overall economic activity, import price and restrictions stemming from the limited foreign currency reserves. On the export side, both supply of and demand for exports must be specified, the supply being constructed symmetrically with demand for imports. The demand for exports (hence the demand of the non-socialist world) depends on the index of economic activity in the developed economies and on the general price level; this equation is usually normalized with respect to price (for more general discussion see V. D l o u h ý and K. D y b a (1985a, 1985b). As concerns the trade among the socialist countries, here the regularities are sometimes much less transparent. Given the situation of the last decade, the separation of at least four commodity groups is necessary, as well as the separation of "hard" and "soft" goods (see J. V a ň o u s (1978a), resp. (1978b).

Specification of consumption function is much dependent on the country for which the model is constructed. Accepting the assumption about the global equilibrium on the consumption goods market, Houthakker-Taylor type of function seems to fit best the reality of CPE´s. This, however is applicable for countries like Czechoslovakia or Hungary while for Poland, e.g., other types of consumption function should be investigated.

The main, model dynamizing link is the chain from the investment outlays to capital formation and increase in capacites.

At the same, this is the source of much controversies, because the formation of investments, its structure, time lags between the outlays and their "materialization" in gross capital, depreciation rates and price structure of various investment projects and of capital, this all is by many economists seen as a large complex of entirelly open questions. There is a common wisdom indicating that actually all information carried in the aggregate data at our disposal can be completelly misleading and wrong. We don't share this view believing that there are very strong regularities at the macrolevel and that data contain a substantial part of information about that. Here, however, from the very beginning is necessary to see the difference between demand and supply oriented specification. In the demand oriented models, the specification follows, in general, the well-known acceleration principle. From the anticipated level of general economic activity the desired stock of capital is derived; from here, the "desired" investment (mostly as a proxy for planned investment) follows. Realized investment outlays are then, moreover, influenced by other variables namely balance of trade, import of investment goods etc.

In the supply oriented models we sometimes speak about inverse or supply accelerator (W. W e l f e (1983, 1985)). Here the investment process is primarily dependent on the capacity of industries producing investment goods. Increase in production in these industries induces (with some time-lag) increase in capacities with further increase in production etc. Obviously, in both types of specifications, particular models include several modifications or even the combination of both chains.

Illustration 2.1. SOVMOD (see D. G r e e n and Ch. H i g g i n s (1977)). In its rudimentary form SOVMOD can be expressed as follows[2]:

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[2] We attempt to introduce general notation and "fit" all the models into this notation: X - gross output; Y - net output; A - gross capital formation; I - investment outlays; K - capital stock; C - personal consumption; G - social consumption, CG = C + + G; W - nominal wage; SK - scrapping; Z - material input; DP - depreciation; YD - disposable income; P - price level; PG - gross profit; M - imports, MK imports from non-socialist countries (NSC), MS imports from socialist countries (SC); E - exports, XK export

$N = N\ [(W/P)_L, Y_L, N, D]$ employment

$I = I\ [Y_L, PG, BD, IF, D]$ investment

$K = K\ [K_L, I_L, D]$ capital stocks

$Y = Y\ [N, K, D]$ output

$W = W\ [Y/N] \cdot P$ nominal wage

$P = P\ [W.N/Y]$ price level

$YD = (W.N - TX)/P$ disposable income

$PG = Z\ [Y]$ gross profits

$CG = c\ [YD, Y]$ consumption

$R = Y - I - CG - BD$ residual

Alternatively, consumption may be determined as residual

$CG = Y - I - BD$

Here IF is state budget finance for investment, TX are personal taxes and BD defense expenditures; consequently, CG is personal plus government consumption less BD.

This is a typicall supply-determined model: investment depend on the past output and profits, with appropriate lags materialize in capital stocks, which in turn enter the production function. Employment is given essentially by demographic factors, with a lagged link to real wage. Consumption, as is specified above, follows the line of "supply constrained demand function" or is considered as residual. In general, SOVMOD is essentially the long-run model, short-run deviations are induced by changes in exogenous variables and there is no equilibrating mechanism to ensure the return of the model to the growth path (R. P o r t e s (1977)). There is virtually no foreign trade in the model; notice that SOVMOD is constructed for the USSR.

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to NSC, XS exports to SC; PM, PX, PMK, PMS, PXK, PXS - imports and exports prices; N - employment; J - inventories. D - represents appropriate dummy, T - time trend. Superscripts: + denotes anticipated values, p - planned values, T - trend values, d - demand, s - supply; subscript L - denotes lagged values. In particular cases, some other symbols are used and they are explained in the text. In should be clear that we don't pretend to present complete models, but only their relevant parts.

Illustration 2.2. CEM 2-1 (I. Šujan et al. (1983)).

A^+	$= \mathcal{A}[X^+]$	anticipated gross capital formation
I^+	$= \mathcal{I}[A^+, (E/M)_L]$	planned investments
I	$= I[I^+, X^T, MI^T, J]$	investment outlays
A	$= A[I_L]$	gross capital formation
K	$= K_{-1} + A - SK$	capital stock
X^+	$= \mathcal{X}[K, N, T, R]$	planned gross output
X	$= X[X^+, X_L, M, Z, D]$	gross output
Z	$= X.\ QZ/100$	material input
Y	$= X - Z - DP$	net output (material product)
YD	$= Y.\ QD/100$	disposable income
C	$= C\ [YD_{-1}, YD, C_{-1}]$	personal consumption
EK	$= EK\ [MW, PEK/PW, X$	exports to NSC
ES	$= ES\ [MS, (Y - EK), J_L, MS^+, X^+]$	exports to SC
MK	$= MK\ [X, PMK, (EK - MK)_L]$	imports from NSC
MS	$= MS\ [X, ES/PMS, ((ES - MS)/MS)_L]$	imports from SC

Here MI represents imports of investment goods, R denotes variable expressing the degree of capacity utilization; QZ and QD are exogenous parameters. The four equations for foreign trade are presented only for the sake of completness and the real specification is desaggregated substantially and particular equations differ considerably. For our "skeleton presentation" however, the detailed description is not desireble.

Once again, this is a supply-determined model of the socialist economy, suited much more for the small open CPE. Anticipated values of particular variables are generated through the weighted averages of past values. In this sense, there is here a certain demand factor, nevertheles, the main loop from investments to capacity, output and back to investments ("supply accelerator") is essentially preserved. Production function generates gross output, material inputs seem (implicitelly) to be substi-

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tutable with other factors (in the long-run) and don't represent any fixed constraint in the production process. Consumption is specified from the demand side (assuming global equilibrium on the Czechoslovak consumption goods market) and foreign trade has a substantial role in influencing the formation of planned investments and gross output. There is no link between real (or nominal) wage and employment, nor any block devoted to the monetary flows.

Illustration 2. 3. W-5 (W. W e l f e (1983, 1985)). It is not an easy matter to write down the redimentary form of this model because of its size and complexity. Hence, the following presentation should reflect only these aspects, which are relevant for our purpose here, and obviously don't reflect the whole model.

I	$= I\,[X^{+} - C^{+} - G]$	investment outlays
A	$= A\,[I_{L}]$	gross capital formation
K	$= K_{-1} + A - SK$	capital stock
Y	$= Y\,[K.WZ,\ N^{H},\ TK,\ (MI/II),\ DY]$	net output
X	$= X/(1 - QX)$	gross output
C^{d}	$= C^{d}\,[(Y + FS),\ P]$	demand for consumption goods
C^{s}	$= C^{s}\,[Y,\ (E - M)]$	supply of consumption goods
CE	$= C^{d} - C^{s}$	excess demand for con. goods
EK	$= EK\,[MW,\ PEK,\ DEK]$	export to NSC
ES	$= ES\,[MR,\ PES,\ DES]$	export to SC
MK^{d}	$= MK\,[X,\ I,\ C^{d},\ PMK]$	demand for imports from NSC
MK	$= MK^{d}.\ DMK$	imports from NSC
MS^{d}	$= MS\,[X,\ I,\ C^{d},\ PMS]$	demand for imports from SC
MS	$= MS^{d}.\ DMS$	imports from SC

Here WZ represents average number of shifts worked, N^{H} hours worked, TK dummy for technical progress and DY is indicator of shortage of material inputs, QX is exogenously given parameter,

FS are forced savings. Once again, it´s necessery to notice that this not full model W-5; there are several important blocks, namelly blocks of price determination, wages, state budget and balance of payments. This is a rather distinctive feature of W-5 in comparison with other large econometric models of CPE´s; this enables the authors to specify the inflationary loop, but doesn´t have any influence on the equilibrating process in the model.

It should be clear that W-5 is long-run, supply driven growth model, where short-run contingencies are modelled through sophisticated system of various shortage indicators, capacity utilization indexes etc. The main dynamizing chain, supply accelerator, is modified to the extent that potential output of industries producing investment goods does not determine the total level of investment activities. The adjustment is supposed to be in hands of the centre, indicating that the total level of the investments is a result of a "dialogue" between the centre and the enterprises. The corrections of capacity utilization and hours worked are given by parameters. In foreign trade, imports are generated in two stages; demand for imports is primarily specified as a "traditional" function and then, actuall imports are obtain using dummy reflecting foreign exachenge shortage (DMK, DMS). Similarly, exports are demand driven, but possible problems with the allocation on the foreign markets are introduced through dummies (DEK, DES). In spite of the supply or demand determination of particular block, model W-5 specifies always the "long" side of the market as well; this enables to determine excess demand for particular cases. This obviously creates plenty of open problems; their detailed discussion is not out aim here.

From our illustrations above should be clear, that in all three large macroeconomic models of CPE´s (each of them was constructed having in mind another country) we can trace several common features, common blocks and chain of thoughts; the should be clearly seen now: supply accelerator, bottleneck multipliers, adjustment for shortages, capacity utilization and foreign exchange constraints. The growth is - in the long-run - driven primarily by increasing the capacities, there is no clear idea how to model technological change and the shortages in material

inputs are taken into account only indirectly, what (implicitelly) reflects our possibilities in modelling the structural changes with these tools.

This in no case can be considered as a criticism; we believe that out statement reflects the current knowledge, or - in other words - current state of the art of modelling of CPE´s. On the other hand, these models in an important way contributed (or even proved) not only the existence of some regularities in the functioning of CPE´s, but enlarged our knowledge about particular regularities both in a qualitative and quantitative sense. All above mentioned loops, multipliers and accelaroters were actually estimated for independent set of data, for various countries and one can draw a conclussion that we have a general idea about the macroeconomics of CPE´s, at least about the macroeconomics for a rather turbulent period of the end of 70´s and the beginning of 80´s. Consequently, there should be only a small step to postulating only the most relevant aspects influencing the long-term growth in the present situation.

Illustration 2.4. The "naive" model (V. D l o u h ý and K. D y b a (1985a, 1985b)) and forecasts. The "naive" model overlooks the existence of any type of the accelerator; given the experiences of the last decade and the accumulation of a certain amnount of debt (this amount differs significantly for various CPE´s) the model takes into account only one limit of growth, namelly imports. Long-term rate of growth of imports determines the long-term rate of growth of net output. The priorities of the centre in assuring certain level of consumption (both personal and governmental) and the necessary level of exports determines gross investments as a residual.

$Y = Y_{-1}\ (1 - \varepsilon_{YM}) + \varepsilon_{YM}(Y/M)_{-1} \cdot M$		net output
$XK = XK_{-1}\ (1 - \varepsilon_{XM}) + \varepsilon_{XM}(XK/MW)_{-1} \cdot MW$		exports to NSC
$BK = a \cdot XK_{-1}$		given balance of trade with NSC
$MK = (PXK/PMK) \cdot XK - (BK/PMK)$		imports from NSC.
$BS = b \cdot XS_{-1}$		given balance of trade with SC

XS = (BS/PXS) + (PMS/PXS)·MS esports to SC

M = MK + MS total imports

E = EK + ES total exports

Y = Y - CG (BK + BS) investments

It can be seen that exports to NSC are demand determined, where ε_{XM} is the elasticity of exports vis a vis "world" activity. Trade balance target is given as a fraction of lagged exports and imports become to be a residual from the identity that defines the trade balance. Imports from socialist countries are predetermined, trade balance is again a target that's desirable to achive and required volume of export may be derived. Total imports than enter to he "production" function and ε_{YM} represents elasticity of net output with respect to imports. Finally, investments are given as residual, when consumption is exogenously given.

Now should be clear why this model is labeled as "naive". Yet it is our believe that its structure reflects a good deal of reality of today's functioning of small open CPE; looking at the Czechoslovak data one can confirm the specification. It is a matter of fact that given the preferences in repaying the foreign debt and in retainning the level of consumption, the centre had to cut in investments (which is the same as saying that investments became a residual). Moreover, at least in the short-run, this is a strong argument for the claim, that imports are the only valid constraint; wheather in the long-run we can expect increasing effect of past investments is a open question which we don't answer in the model. However, this depends on many factors bearing upon the problems that can be solved only partially by econometric models (structure of the economy etc.).

We don't intend to compare naive model with large, sophisticated and carefully specified and estimated econometric macromodel. Nevertheless, some forecasting results is instructive to compare. Under the modest expectations about the growth of export and import prices and world economic activity, about the repayment of foreign debt and providing that real level of consumption will grow at the rate 2% by year, naive model forecasts

long-term anual growth rate of net output in the range 2.2-2.9%, of absorption in 1.5-2.2% and investment in 1.7-2.9%. Large simulation results with CEM 2-1 (unpublished) gives obviously much broader picture about the future development, but as concerns the main aggregates, the figures are not much different: material product with higher rates (around 3.4%), absorbtion almost in the range as in the naive model (around 2.4%) and investments approximatelly in the same range.

To conclude this part, we intend to stress that large econometric models constitute an important tool both for analytical and forecasting exercises. The system specific features of the performance of CPE´s and the macroeconomic reality of past years led to the "common wisdom" in constructing the models. The framework of the macroeconomic functioning or, in other words, the skeleton of the models, is rather simple; this is given by limited choices the planners have at their disposal in the present situation. Under these circumstances, one observes a certain degree of rigidity in forecasting results, even under substantially different assumptions about the behaviour of exogenous conditions. This in turn reflects the reality; given the present structure and present functioning, small open CPE´s don´t face other choice than slow growth. Other options depend then on the changes that probably call for other type of models.

3. Models with quantity rationing

The general structure of large macroeconometric models, as has been presented in the previous part, doesn´t contain any endogenous, explicitelly built-in equilibrating mechanism. At the same time, all existing models tend to stress the dominance of the supply side and growth is driven essentially by (sometimes modified) supply accelerator. Several years ago, this led Portes for the conclusion that: "a better basis for a structural model will be the more symmetrical quantity rationing framework, appropriately adapted to the CPE context" (R. P o r t e s (1977)). Since then, the macroeconomic models with quantity rationing of CPE´s have been on their way.

In this framework, there exists better possibility for explicit specification of the equilibrating mechanism in the model: the feedback from excess demand or supply to planners' behaviour and endogenous quantity adjustment. The theoretical model is much more simple: it has only two markets (for consumption goods and labour) and two agents, households and planners. Both subjects maximize their utility function; preferences of the households are defined on consumption and leisure and intertemporal maximization of the appropriate utility functions gives the constrained and unconstrained demands for goods and supplies of labour. The preferences of planners are defined on consumption and government expenditures. During the period of plan construction they maximize their utility function subject to several contraints determined by technology, expectations about the behaviour of households, by desired end-period inventories and by foreign trade conditions. In the current period, planners realize possible errors in expectations about the technology and households' behaviour and adjust the magnitude of relevant variables, namely supply of consumption goods and supply of exports.

This approach allows for explicit treatment of spillovers between the two markets and the whole specification of the model leads to the standard classification of the short-run outcomes: Keynesian unemployment, repressed inflation, classical unemployment and underconsumption.

Illustration 3.1. Macromodel with quantity rationing (V. D l o u h ý (1985).

$$Y = C + G + I + J + E - M \qquad \text{net output identity}$$

$$Y = Y\,[M/N]\cdot N \qquad \text{net output}$$

$$C^d = \begin{cases} C^d\,[W^p, R] & N = N^s \leqq N^d \\ C^d\,[W^p, R, N] & N = N^d < N^s \end{cases} \qquad \text{demand for consumption goods}$$

$$C^s = C^s\,[Y, R, J] \qquad \text{supply of consumption goods}$$

$$C = \min\,[C^d, C^s] \qquad \text{observed consumption}$$

$$N^d = N^p \qquad \text{demand for labour}$$

$$N^S = \begin{cases} N^S\,[W^P,\ R] & C = C^d \leqq C^s \\ N^S\,[W^P,\ R,\ C] & C = C^s < C^d \end{cases}$$ supply of labour

$N = \min\,[N^d,\ N^S]$ observed employment

$J = \beta \cdot Y$ end-period inventories

$M = M\,[PM,\ PE,\ B^P] \cdot N$ demand for imports

$E = E^S\,[Y,\ PM,\ PE,\ B^P]$ supply of exports

$E = E^d\,[MW,\ PE,\ PW]$ demand for exports

This is essentially a short-run model with explicit endogenous equilibrating mechanism; the emphasis here is put on the description of planners behaviour. It has been stressed by several authors namely by E. H e w e t t (1976). J. C. B r a d a (1980) and others, that planners play an important equilibrating role in the functioning of CPE´s. In the model above, the plan formation is not fully endogenous and the equilibrating role of the planners is realized in the current period, when planners react to the deviations from their expectations from reality. Adjustment, then, runs through the supply of consumption and supply of exports, which, naturally, is a great simplification.

Endogenous quantity adjustment on the side of households is expressed by the supply multiplier (originally see R. J. B a r r o and H. J. G r o s s m a n (1974): the excess demand for consumption goods has a spillover effect in reducing effective labour supply and consequently output as well. This is a rather controversial issue because of the lack of empirical evidence; see P. W i l e s and G. R o s t o w s k i (1979) and Kornai´s comments on this subject (J. K o r n a i (1980, 1982)).

The positive effects of this approach are straightforward: apart form the above mentioned specification of equilibrating mechanism, "disequilibrium" models significantly clarified our understanding of households´and planners´ behaviour and their interaction on the very aggregated level. At least in the theore-

tical framework, we have a general equilibrium, non-Walrasian model for CPE, with, in Kornai´s words, "real" and "control" spheres, built-in adjustment towards equilibrium and with the representation of plan construction, assuming that the planners are rational in their behaviour.

There is a lot of problems with this approach as well. Often cited empirical ones, when the lack of appropriate methods for estimation of the multimarket model with quantity rationing is stressed, don´t have to be the most crucial ones. They certainly prevent us from using this model more actively and to measure the relevant and highly important magnitudes as the parameters of supply multiplier, excess demand on both markets, etc. However, there are more important objections from the theoretical point of view; they come primarily from Kornai (J. K o r n a i (1980, 1982)), but from the theory and practice of large econometric models as well; for the more detailed discussion see R. P o r t e s (1984) and V. D l o u h ý (1984). Kornai explicitelly refuses the short side rule claiming that when dealling with the data on the macrolevel, usully shortage and slack are presented simultaneously. This, obviously, is of microeconomic origin and the whole problem is the one of aggregation. In the "disequilibrium" literature this has already been recognized since J. M u e l l b a u e r (1978) and the theoretical solution was presented by Ch. G o u r i e r o u x and G. L a r o q u e (1983).

There are naturally, objections from the econometricians. W. W e l f e (1985) finds the classifications of the economic regimes of CPE´s developed by these models (see above) inferior when compared with the typology based on the constraints in material-input. This is legitimate point, especially for the practisizing economists - it is not easy to imagine today´s CPE to be in a demand constrained regime of Keynesian unemployment with demand-driven growth. It should be stressed, however, that there are widely spread doubts about the strict prevalence of repressed inflation - see several empirical confirmation of the global equilibrium on the consumption goods market in at least some CPE´s (R. P o r t e s and D. W i n t e r (1980), and others).

But there is no other way for testing the hypothesis of repressed inflation or of Keynesian unemployment than to specify the model that allows for disequilibria of either signs. The whole system of indicators of shortage, capacity utilization, number of shifts ets. doesn't represent anything else than a way out from not uniquelly defined regime; the "supply-demand" types of consumption function may serve as another example.

Numerical intractability of the whole model and the obvious interest in measuring the disequilibria on the particular markets caused the increasing interest in specifying the quantity rationed models for consumption goods market. W. C h a r e m z a and R. Q u a n d t (1982) supplemented classical "one-market" model by the fourth equation for the planned value of transaction, which in turn enters demand and supply equations. The plan formation is made endogenous and given the specification of equations the model has a built-in adjustment towards market clearing which can be compared with that of price adjustment in others "disequilibrium" models.

Illustration 3.2. Four-equation DSQ model (see P o r t e s et al. (1983).

$$C^d = \alpha_1 HS_{-1} + \alpha_2 \Delta YD + \alpha_3 YD_{-1} + u_1 \qquad \text{demand}$$

$$C^s = \beta_1 C^p + \beta_2 C^pZ + \beta_3 RHS_{-1} + \beta_4 BDZ + \beta_5 IZ + u_2 \qquad \text{supply}$$

$$C = \min [C^d, C^s] \qquad \text{actuall transaction}$$

$$C^p = \delta_1 C^p_{-1} + \delta_2 C_{-1} + \delta_3 C_{-2} + \gamma(C^d - C^s) + \delta_4 RHS_{-2} + u_4 \qquad \text{plan-adjustment aquation}$$

Here, HS are household savings, RHS are deviation from the trend values and BDZ, C^pZ, resp. IZ are defined as

$$C^pZ = (C^p/Y^p).(Y-Y^p),$$

$$BDZ = [(BD/Y) - (BD^p/Y^p)].Y,$$

$$IZ = [(I/Y) - (I^p/Y^p)].Y.$$

There is a theory behind the equation for plan-adjustment. Planners' loss function is specified with a steady growth objective and with implicit trade-off between current and future deviations from the planned magnitudes of consumption, resp. current and future excess demand. Several alternatives of the model brought very promising results for the Polish data; there is no space to discuss them in detail. However, the usefulness of the plan data in models for plan construction and for adjustment proceses was demonstrated. The "disequilibrium" framework provides insight into the behaviour of central planners an certainly represents a substantial step forward.

Two illustrations, presented above, don't exhaust the whole area of application of disequilibrium framework for modelling CPE's. Substantial contribution is represented in the works of W. Charemza (see W. C h a r e m z a (1981, 1984), W. C h a r e m z a, M. G r o t n i c k i (1983, 1984)). All these contributions laid down a clear basis for rather autonomous look at the functioning of CPE; in spite of all the difficulties this basis turned out to be very usefull and contributed to clarify the most controversial issues. "We may be getting closer" R. P o r t e s (1984)).

4. Kornai's model

Recently, in his last book, Kornai presented his own version of macroeconomic model for the "traditional" CPE (see J. K o r n a i (1982)); this book represents certain kind of generalization of his massive theoretical work devoted to microeconomic performance of the socialist economy (see J. K o r n a i (1980)). The importance of this alternative approach, which in many aspects substantially differs from the usual way of theoretical thinking in CPE's, obviously calls for attention and for critical judgment as well. It is not our task to present a profound discussion of Kornai's contribution to the economic theory (but see V. D l o u h ý and V. K l a u s (1985)), but we find usefull to include at least a telegraphic description of his model.

Kornai´s macromodel is based on his description of the performance of CPE´s and, especially, on the facts he considers as the most relevant. Having in mind the very wide scope of Kornai´s innovations, we restrict our attention to two important questions. First, there is the notion of shortage as a basic phenomenon influencing actually all socio-economic events in CPE´s. However, in all Kornai´s work we find no clear definition of this notion, only becomes obvious that shortage represents not only the notion of disequilibrium (in its classical understanding), but several of its consequencies (forced substitution etc.) as well. Kornai literally "pushes" shortage to the real center of the analysis, both at the microeconomic and macroeconomic level; the aggregation of the essentially microeconomic phenomena is overcome very easy and macroindex of shortage is supposed to be a well-defined function of partial indexes from the lower level of aggregation, and we are able to measure it.

Second, the "counterpart" of equilibrium is in Kornai´s approach represented by the notion of normal value. The whole theory is based on the idea of the exogenously determined "normal value" of the variables and on the existence of the adjustment mechanism that react to short-run contingencies and bring the variables of the system back to the normal values; similarly, in dynamics the normal trajectory is defined (see J. K o r n a i (1983)). Normal value falls as manna from the heaven and the whole approach is strictly descriptive. There is no sign of behavioural or technological regularities the economy, only the subjects (households, firms, planners) are expected to react to the deviations from the normal values. In this way, the decisive point is the normal value of shortage; this magnitude is considered to be inherent for the functioning of the socialist economy; at the same time, Kornai very strongly refuses to press his analysis into the repressed inflation regime of the "disequilibrium" framework, arguing that his approach is much broader and involves the possibility of simultaneity of both slacks and shortages.

Illustration 4.1. Kornai´s model (see J. K o r n a i (1982)). This model doesn´t fit to our notation and it is not

possible to reproduce here all the equations; let's present the most important features. In the control sphere, five variables are determined: volume of the investment vintage, production, firms' purchases, household purchases and real wage fund. In general, the equations have the following form:

$$Q(t) = Q^{*}(t) + \alpha_1[P_1(t) - P_1^{*}(t)] + \ldots + \alpha_k[P_k(t) - P_k^{*}(t)]$$

where $Q(t)$ is the real value of control variable and $P_1, \ldots, P_k$ are explanatory variables; asterisk represents the normal value of the variables. Production, e.g., is determined as follows:

$$X(t) = X^{*}(t) + \xi_U[U(t) - U^{*}(t)] + \xi_Z[Z(t) - Z^{*}(t)],$$

where $U(t)$ represents output stocks and $Z(t)$ is the aggregate index of shortage. Household purchases depend only on their normal value and on the deviations from the normal degree of shortage:

$$H(t) = H^{*}(t) - \chi_Z[Z(t) - Z^{*}(t)]$$

In the real sphere we have the stock equations, where output and input stocks are determined, and input-output relations, where current inputs are specified in the same form as the relations above. Further, the investment block belongs to this group of equations: volume of investment vintage $M(t)$ is determined as an ex-ante estimate of the total investment expenditures. Gestation period G is assumed to be constant and structure of investments in period t is given by the expediture shares $\beta_i(\theta)$. Ex-ante estimate of investment expenditure is given as

$$\tilde{B}(t) = \sum_{\theta=0}^{G-1} \beta_M(\theta+1) \cdot M(t-\theta)$$

and investment commitment is specified as follows:

$$K(t) = \sum_{\theta=1}^{G-1} \sum_{\tau=\theta+1}^{G} \beta_M(\tau) \cdot M(t-\theta).$$

Volume of the investment vintage is then determined by

$$M(t) = M^*(t) + \mu_H[H(t-1) - H^*(t-1)] - \mu_K[K(t) - K^*(t)] - \mu_Z[Z(t) - Z^*(t)]$$

and investment input is given by

$$B(t) = \tilde{B}(t) + \beta_Z[Z(t) - Z^*(t)]$$

Normal values are usually determined by the growth factor, e.g.

$$M^*(t) = \Gamma_M^t \cdot M(0).$$

This is a long-term growth model, essentially driven by growth factors for the normal values. Investments are driven autonomously, only the volume of investment vintage dependes on the short-run fluctuation. The same is true for households´ and firms´ purchases as well as for other variables in the model. In its simplicity one could compare this specifications to our "naive" model presented in illustration 2.4. with one important difference: there is no foreign trade here and growth is determined by the development of normal values; we have no feedback of the accelerator type. In the naive model, foreign trade has a leading role, and investments are residual; neither in this case an accelerator was specified. To conclude, in spite of rather wide theoretical backgroud of Kornai´s model, it structure is surprisingly simple; we believe that this is in accord with our previous conclusion about the simple macroeconomic framework of the today´s performance of CPE´s.

5. Multisectoral models

More than twenty-five years ago, Johansen laid down the basic ideas of a multisectoral general equilibrium growth model (L. J o h a n s e n (1959)). However, only recent years have witnessed the development of more complex models, specified in this line, and simultaneously being applicable in the economic practice. These models are now usually called general equilibrium models; large, nonlinear models turned out computationally feasible only recently (H. S c a r f and T. H a n s e n (1973)), but the number of applications is growing substantially.

Following our discussion in the first part of this paper, there is no doubt that in the context of medium - and long-term growth strategies these models should be in a center of the attention. Indeed, there appeared already the first attempts to develop a computable general equilibrium model for CPE and "to investigate the possibilities and expected benefits of incorporating nonlinear and multisectoral models of the general equilibrium type into the planning methodology of socialist (centrally planned) economies" (E. Z a l a i (1980)). It has been demonstrated that multisectoral general equilibrium models represent an useful tool in the process of search of various development strategies; their relation to the optimal planning models was clarified (E. Z a l a i (1982)) and the questions of their solutions were investigated (J. S i v a k, A. T i h a n y i and E. Z a l a i (1984)).

Illustration 5.1. Multisectoral model (E. Z a l a i (1980)). Balancing equations:

$$X_i + M_i = \sum_{j=1}^{n+1} Z_{ij} + C_i + G_i + E_i \qquad i = 1, 2, \ldots, n$$

$$X_{n+1} = \sum_{j=1}^{n} \delta_j K_j + \delta_g K_g + I$$

$$\bar{M}_i = \sum_{j=1}^{n+1} M_{ij} + C_i + G_i \qquad i = 1, 2, \ldots, n$$

$$K = \sum_{j=1}^{n} K_j + K_G$$

$$N = \sum_{j=1}^{n} N_j + N_G$$

Technological choice

$$Y_j = Y_j [N_j, K_j] \qquad j = 1, 2, \ldots, n$$

$$Z_{ij} = a_{ij} X_j \qquad \begin{matrix} i = 1, 2, \ldots, n \\ j = 1, 2, \ldots, n \\ n + 1 \end{matrix}$$

$$\bar{M}_{ij} = \bar{m}_{ij} X_j$$

$$S_j \frac{\partial F_j}{\partial N_j} = W_j \qquad j = 1, 2, \ldots, n$$

$$S_j \frac{\partial F_j}{\partial N_j} = Q_j$$

Import and export functions

$$M_i = m_i [X_i - E_i], \qquad m_i = m_i^0 \left(\frac{PM_i}{PW_i}\right)^{\mu_i} \qquad i = 1, 2, \ldots, n$$

$$E_i = E_i^0 \left(\frac{PE_i}{PW_i}\right)^{\eta_i}$$

Here we have an economy with n sectors producing homogenous commodities; commodity n + 1 represents composite capital good and δ_j are the depreciation rates. Imports are divided to noncompetitive and competitive ($\bar{M}_i$, resp. M_i), S_j is user cost of capital and labour per unit of output in sector j, W_j is user cost of labour, Q_j is user cost of capital. For the sake of simplicity we disregard here the separation of trade flows with rubble area and dollar area. As concerns the production technology, this is based on the original Johansens specification; there are two primary factors of production and linear homogenous production function Y_j (.). Minimization of the total cost of the primary factor subject to the production function condition yields the necessary first order conditions for W_j and Q_j. We have omitted from our description not only the group of final demand equations, but the equations for prices and costs as well; the latter omission is unhappy, but the description would require much more profound discussion of the whole model. The price and cost block is in a sense crucial in general equilibrium model, but for our purpose the above part of model is sufficient.

Short inspection of the equations of the model shows that we are still far away from the satisfactory model for the development strategy. As it stands, the model is not much different form the general skeleton of the (econometric) models from the previous parts. Yet these models should be different: econometric specification is very often heavily based on lagged endogenous variables and reduced-form equations (especially in the situations when there is no background economic theory); multisectoral models, on the other hand, should be able to capture the mechanism driving the development of the economy. Here we are still hardly in the half of the way: the intersectoral allocation of the primary factors of the production is determined within the model, while their available quantity is assumed to be exogenously given. The allocation problem is solved in the context of minimization of producers' costs, the dual side of the model yields the price structure, but from the point of view of the long-term growth there is no link from investment decisions to capacity increase and allocation of factors of production.

It is desirable to conclude the paper with a positive statement. The large econometric models proved to be an useful tool

for analysis of past development and short-term forecasts; in the longer run, however, we encounter several problems whose solution seems to be behind the possibilities of these models. Multisectoral models are essentially constructed as a planning device and several crucial variables are left exogenous, possibly as an instrument of the planners. This brings us to the idea of linking the two approaches; for the models of market economies this idea is not entirelly new, but for CPE´s we find this link to be a substantial step forward. We may be getting closer ..., but there is still a lot of work to do.

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Vladimir Dlouhý

O PROBLEMIE MAKROEKONOMICZNEGO MODELOWANIA GOSPODAREK CENTRALNIE PLANOWANYCH

W artykule podjęto próbę prezentacji różnych podejść do procesu modelowania gospodarki w krajach socjalistycznych. Wyróżniono dwie dziedziny ze względu na typy modeli - stabilizację polityki ekonomicznej oraz strategię rozwoju. Przedstawiono kilka typów istniejących makromodeli w kontekście specyfikacji podstawowych sektorów: produkcji, konsumpcji, inwestycji, handlu zagranicznego itp.

Teoria modeli z ograniczeniami ilościowymi opiera się na formalizacji zachowań planisty i gospodarstw domowych, lecz ich zastosowania są ograniczone przez problemy techniczne (warunki spójności, estymacja etc.). Podejście J. Kornaia, oparte na akcentowaniu zjawisk niedoborów jako podstawowego zjawiska w funkcjonowaniu gospodarki socjalistycznej, otwiera nowe możliwości dyskusji i rozwiązania tych zagadnień. W końcowej części zaprezentowano koncepcję wielosektorowego modelu gospodarki socjalistycznej.