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MAIN FEATURES OF THE MACROECONOMETRIC MODEL

OF CZECHOSLOVAK ECONOMY (VERSION CEM-3.2)

1. Introduction

Since 1978 the second generation of macroeconometric models
of Czechoslovakia has been developed in the Computing Research
Centre (since 1984 the VUSEI-AR), Bratislava. The first member
of this series of models, the CEM-1 model[1], was presented by I.
Š u j a n (1980) at the 5th conference "Models and Forecasts"
in Esztergom (Hungary). In this paper the main features of the
last version of these models, the CEM-3.2 model, are described.

The structure and specification of the CEM-3.2 model is di-
rectly linked up with the preceding versions (CEM-1 up to CEM-3)
which have been constructed, verified and successfully utilized
in different simulation and prognostic applications (see I.
Š u j a n (1985)).

The model expresses causal relations among the main macro-
economic indicators. It has been constructed on the basis of
yearly statistical data and is designed for medium-term analyses
and prognoses of the development of the Czechoslovak economy.

The CEM-3.2 model implicitly reflects the mutual interaction
of three basic types of economic agents:

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[1] CEM - central econometric model, i.e. the central part of
the system of models for macroeconomic analyses (SMMA), see A.
K l a s (1985), Simulačná... (1985).

a) central planners,

b) enterprises,

c) households.

The structure of the model folows from a system approach to
the functioning of the socialist economy (which has been outli-
ned e.g. in Dynamizácia... (1981) an from the assumed orien-
tations of the applications of this model.

At the present stage of research a further improvement of the
model has taken place, especially the efforts in a more precise
specification of some regression equations in the sense of eco-
nomic theory. The structure of the model has been specially ar-
ranged in such a way that it could be interconnected with the
matrix model of mutual flows of foreign trade of the   European
member countries of the Council of Mutual Economic Assistance
(see I. Š u j a n   (1984)).

The CEM-3.2 model consists of 192 equations (26 of them are
regression equations) which express the relations among 298 va-
riables (106 of them are exogenous). For the estimation of the
parametrs of the regression equations there were used time series
of macroeconomic indicators and derived variables for the years
1960-1983 (in the case of lagged variables data from 1955 were
also used).

The great majority of the value indicators of the model is
expressed in the constant 1977 prices[2].

The model expresses the relations among all essential indi-
cators characterizing development of the Czechoslovak economy.
In some cases there are the fully aggregated indicators, in other
ones the corresponding variables are expressed in a certain degree
of disaggregation. Within the framework of the model the stocha-
stic, nonlinear and dynamic character of the corresponding re-
lations of the modelled variables are fully taken into conside-
ration. At the same time, for practical reasons, the   recursive
form of the model has been retained[3].

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[2] Some simulation variants of the development in the 8th five
years plan (1986-1990) were additionally converted into constant
1984 prices so as to be comparable with data of the State Plan-
ning Commission.

[3] In addition to a suitable arragement of the individual
blocks and equations the recursivenessof the CEM-3.2 model has

2. The Structure of the Model

The "basic axis" of the CEM-3.2 model is a balance identity expressing an equality of the sources and the utilization of the created gross social product in constant prices. On the side of the sources there is (in the extended form of this balance) the gross social product X and the imports in domestic constant prices M_X, on the side of utilization - personal consumption C, social consumption G, investments I, inventory investments J, losses and balance differences H, exports in domestic constant prices E_X and intermediate product N.

The model also contains all the main components of a balance of the formation and utilization of the gross (including depreciations, Y_G) and the net (Y) national income. From the variables expressing the utilization of the sources created, the inventory investments J are considered to be a residual variable. The development of all the above mentioned and related variables is (in a different manner, taken into account their importance) explained in the individual blocks of the model (Figure 1):

1. Expected values of selected indicators.
2. Fixed capital stocks.
3. Approximative indicators of technical progress.
4. Capital-labour ratios.
5. Production functions.
6. Intermediate product.
7. Exports.
8. Sales.
9. National income and disposable income of the population.
10. Personal and social consumption.
11. Imports.
12. Foreign trade balances, terms of trade and other indicators of external economic relations.
13. Investments.

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also been achieved by the utilization of special types of "proxy" variables: so called "expectations" (expected values 1,4 of the corresponding indicators).
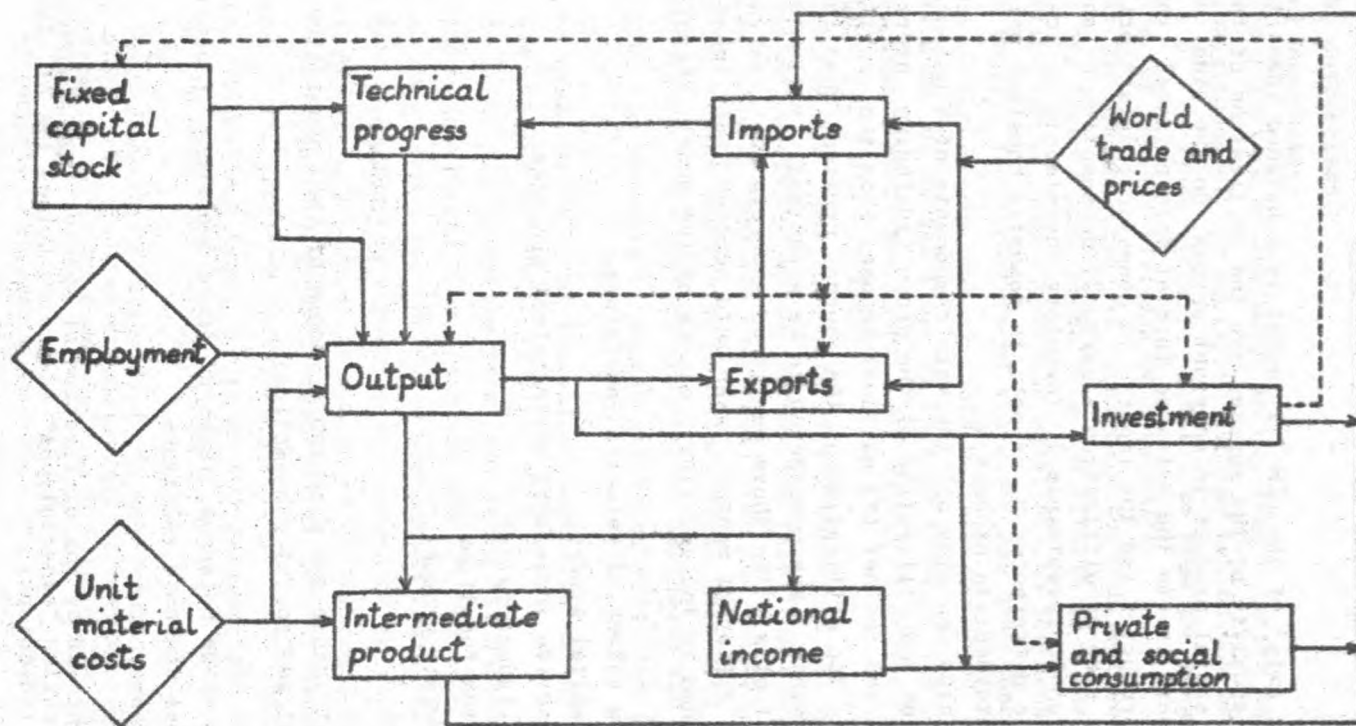
Fig. 1. Condensed flow diagram of the CEM-3.2 model

□ - blocks of endogenous variables, ◇ - important exogenous
factors in the model

14. Domestic utilization of national income, losses, inventory investments and accumulation.

15. Aggregate labour productivity and efficiency   of fixed capital stock.

16. Investment-output ratios and relative indicators of unfinished construction.

17. Aggregate indicators of overall efficiency.

The equations expressing the behaviour of economic agents (behaviouristic regression relations) are parts of the blocks 2, 5, 7, 10, 11 and 13. The regression equations in the blocks 2 and 5 express the behaviour of enterprises: in 2 the fixed capital formation determined by investments, and in 5 the volumes of output as functions of production factors.

The blocks 7, 11 and 13, on the other hand, may be in general considered to be a realization of the decisions of central planners, influencing directly foreign trade and investments in a close interaction with the sphere of enterprises.

Block 10 expresses the behaviour of the household sector (consumer market - formation of the volume of personal consumption) in an interaction with the planning centre which determines the development of the monetary incomes of the population and the retail prices. The planning centre, in addition to this, influences the development of the material social consumption[4].

It should be pointed out, that in the model only a   certain part of the decisions of central planners is supposed to be stable and is expressed by regression equations, while another part may be changing in different situations and is expressed by exogenous variables (including dummies).

3. The Specification of Economic Relations in the Model

The CEM-3.2 model expresses the following basic theoretical knowledge and hypotheses about the functioning of the Czechoslovak economy:

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[4] The material social consumption in the CEM-3.2 model is indirectly determined on the basis of a regression equation (a "quasi production function" explaining the activity of the non-material sector of the economy).

1. The core of the model is represented by production functions. They express the creation of the gross social product in a disaggregation into four branches of the material sphere:

a) agriculture including forestry,

b) industry,

c) building industry,

d) an aggregate of the other branches of the material sphere.

The creation of the gross social product is expressed from the supply side, with slight modifications by certain correction factors (e.g. the index of weather R_W) and some demand factors.

The production functions (see D. Š t r a u c h (1984)) express, first of all, the potential product X^* depending upon labour, fixed capital stock and technical progress (the usual expression of the disembodied technical progress and the approximative indicators of the technical progress embodied in the fixed capital). In the production functions the variable (decreasing) elasticity of substitution of labour by fixed assets is taken into consideration. The actual product X is expressed then as depending upon the potential product X^* (with distributed lags), while the impact of the time utilization of the basic production factors (labour and fixed assets) is also taken into account. The volume of the actual product is also influenced by the changes in the unit material costs (in addition to the two types of technical progress this is another factor expressing the intensification of production) and other factors specific for individual branches. In industry, for instance, it is the influence of the imports of raw materials and fuels M_{NX} and the deliveries of electric energy for productive consumption (N_{E2}). These limiting factors are expressed as ratios to the potential product.

2. The formation of the basic production factors is expressed in the CEM-3.2 model partly in a simplified manner: the development of the number of employees in a division into four branches of the productive sphere ($L_1, \ldots, L_4$) and the non-productive sphere (L_N) is given exogenously (the existence of a "labour market" is thus not assumed). The gross increase in the value of fixed assets is determined by investments from the preceding periods with distributed lags. The liquidation of

fixed assets is expressed by means of exogenously given shares in the gross capital stocks in the preceding year.

3. The CEM-3.2 model expresses (in a similar way as the preceding versions of the CEM model) assumptions about an important interaction between the internal sector of the Czechoslovak economy and the sector of external economic relations - foreign trade.

The imports M and the exports E are disaggregated territorially (into socialist (S) and non-socialist (K) countries - a different character of the formation of their volumes is assumed) and, at the same time, they are disaggregated also into four main commodity groups:

a) machinery and equipment - M_{IS}, M_{IK}, E_{IS}, E_{IK};

b) raw materials, fuels and materials - M_{NS}, M_{NK}, E_{NS}, E_{NK};

c) foodstuffs and raw materials for foodstuffs - M_{FS}, M_{FK}, E_{FS}, E_{FK};

d) industrial consumer goods - M_{CS}, M_{CK}, E_{CS}, E_{CK}.

The import and export equations with regard to foreign trade monopoly reflect the decision-making of the planning centre (see I. Š u j a n (1984)) (with the exception of the equations of exports of machinery and consumer goods into non-socialist countries[5], the volume of which is, according to the hypothesis accepted, determined by the demand of the customer countries). In a decision-making of the planning centre about the corresponding volumes of imports and exports the development of relevant internal macroeconomic indicators is taken into account, as well as the relations between the price indexes of imports and exports, the foreign trade balances from the preceding period, etc.

All the import equations and some of the export equations are specified as demand functions. The equations for exports of raw

[5] The structure of the CEM-3.2 model has been linked with a matrix model of foreign trade of the European CMEA countries (MMZO-3). Therefore in the CEM-3.2 model there are no equations for determining the volume of exports of machinery and consumer goods into and the imports of raw materials and foodstuffs from the socialist countries. These volumes are determined in the matrix model and in the CEM-3.2 model they are treated as exogenous variables.

materials and foodstuffs are specified as supply functions   of
the planning centre, i.e. depending especially upon the domestic
production of these commodities.

Foreign trade disaggregated into the four main commodity groups
exerts its influence on production, sales, consumtion and   inve-
stments and, vice versa: the development of these variables   in-
fluences the decision-making of the planning centre, e.g.   about
the realized import volumes.

4. The personal consumption (in a division into   consumption
of foodstuffs and non-foodstuffs) is modelled predominantly   from
the demand side. For the consumtion of foodstuffs the market with
a certain general equlibrium is assumed. On the other hand,   the
demand equation for the consumption of non-foodstuffs has   been
extended with the influences of supply restrictions. These   are
approximatively expressed by the sales of industrial   production
for internal trade and the imports of consumer goods, namely   as
deviations of these variables from their long-term trends.   The
negative deviations express an insufficient supply which reduced
actual consumption under the level of demand, which is   determi-
ned first of all by the available incomes of the population. The
positive deviations express a relatively higher supply   in   the
corresponding period which makes it possible to realize not only
the current demand, but partly also the unsatisfied demand   from
the preceding periods[6]. The current level of demand is expressed
in the equations of the consumption of foodstuffs and   non-food-
stuffs by means of the Houthakker-Taylor consumption model, which
has been in the CEM-3.2   model extended with the relative   price
indexes of the corresponding commodity groups (their development
is determined by the planning centre); in the case of consumption
of non-foodstuffs a part of the fluctuations is explained by the
changes in the savings-income ratio.

5. In the CEM-3.2 model investments are modelled   from   the
supply side with the assumption about the source restriction   of
their total volume. The investments are divided into the   machi-
nery investments (I_S) and building investments (I_B).

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[6] To a   certain extent a higher supply (especially of imported
commodities) may also stimulate an increase in the current   de-
mand above the "normal" level in the corresponding period.

The machinery investments depend upon the sales of industry for investments (X_I) and upon the imports of machinery in domestic constant prices (M_{IX}), while the building investments depend upon the production of the building industry X_3.

4. Possibilities of Applications of the Model

The CEM-3.2 model may be used, as well as the previous versions of the CEM models, for ex-post and ex-ante simulation analyses according to different scenarios (see I. Š u j a n (1985)).

In ex-post simulations the contributions of various direct and indirect factors to the development of selected macroeconomic indicators during a given period may be computed. A typical example is the simulation analysis of the factor contributions to the deceleration in the growth rate of the gross national income in the period 1975-1980 (see I. Š u j a n (1982 b)).

Ex-ante simulations may be oriented to investigate:

a) what would be the complex consequences of certain macroeconomic decisions on the selected indicators,

b) what alternative changes in the policy of planning centre would be necessary for reaching certain objectives,

c) what is the feasibility and consistency of the selected variants of medium-term plans.

A typical examples of the simulations of type (b) and (c) are the simulations of possibilities to reach the external economic eguilibrium (see. I. Š u j a n (1982a)) and the simulation analysis of several variants of the five-years plan for 1986-1990. These last simulations have been elaborated this year using the CEM-3.2 model.

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PODSTAWOWE WŁASNOŚCI MAKROEKONOMETRYCZNEGO
MODELU GOSPODARKI CZECHOSŁOWACKIEJ
(WERSJA CEM-3.2)

Przedstawiony w artykule model wyraża związki przyczynowe
między głównymi wskaźnikami makroekonomicznymi. Został on skon-
struowany dla potrzeb analizy i prognozowania gospodarki czecho-
słowackiej. Odzwierciedlono w nim współzależności między trzema

rodzajami podmiotów gospodarczych: centralnym planistą, przed-
siębiorstwami i gospodarstwami domowymi. Konstrukcja modelu po-
zwala na bezpośrednie powiązanie z modelem handlu zagranicznego
krajów RWPG.

Model składa się ze 192 równań przedstawiających 17 bloków
gospodarki. Podobnie jak wersje wcześniejsze jest on używany do
analiz symulacyjnych, głównie w zakresie możliwości osiągania rów-
nowagi gospodarki w zależności od czynników zewnętrznych oraz do
analiz wariantów planów pięcioletnich.