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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MULTIPLIERS ANALYSIS BASED ON THE W3S79 MODEL

Since 1971 in the Institute of Econometrics and Statistics, University of Łódź continuous research on modelling the national economy has been carried out. The W3S79 model is a subsequent supply version of the W-3 medium-term model of the Polish economy. This version has been constructed mainly to reflect the phenomena accompanying the economic crisis of the late seventies and the eighties. The model consists of 353 equations, with 153 of them being stochastic and 200 identities.

The following blocks can be distinguished in the model those describing investments, capital formation and fixed assets, labour supply, employment and working time in industry, net and gross output, market supplies and consumption, inventory investments, exports and imports, wages and personal income, financial accumulation and prices. Interrelationships between blocks of the model are presented in Fig. 1. The level of aggregation is the same as that introduced in the earlier versions of the W-3 model[1], namely the national economy is divided into the material product-sector including industry, construction, agriculture, forestry, trade and transport, and non-material services sector (housing and communal services).

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[1] Cf. C z y ż e w s k i, D ę b s k i, W e l f e 1976; W e l f e 1973; W e l f e 1975.

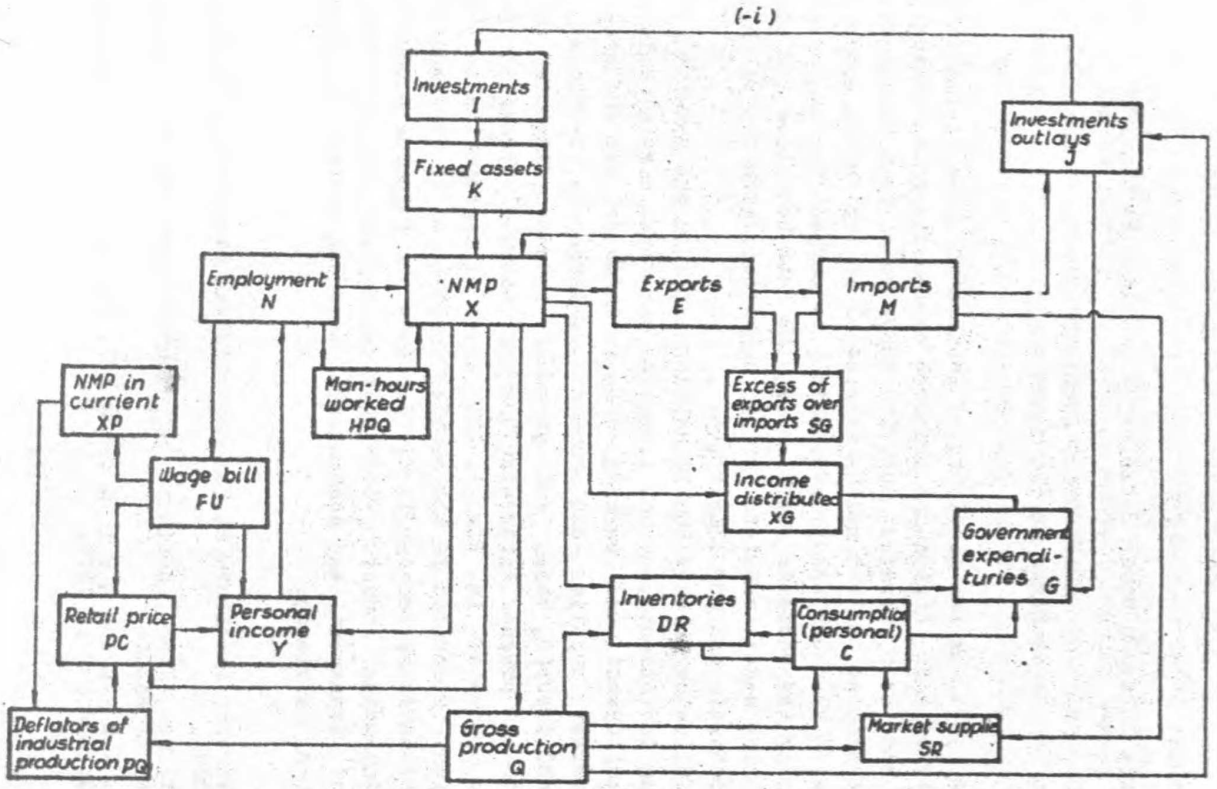

Fig. 1. Scheme of interrelationships among blocks of the model W3S79

Industry is divided into 6 groups of branches. Investment outlays, consumption goods and imports and exports are divided into 3-9-5 groups, respectively. Variables are given in constant prices of 1 st January 1977, and in current prices.

Structural parameters and those of stochastic structure of the model have been estimated using the ordinary least squares method on the basis of annual statistical data for the years 1961--1979[2]. Computations were made on an ODRA 1305 computer using the program # EWI 9[3].

1. Description of the W3S79 Model

This is a consistently supply-oriented model. The existing production capacities given input constraints determine the volume of output, i.e. the originated and distributed net and gross material product. It contains, however, the most important feedback defining a long-term supply-type accelerator. The feedback is expressed by the fact that the production of investment goods determines investment outlays, and in turn, taking into account lag distribution - capital formation, fixed assets and production capacities are determined. The interrelationships between investment outlays and production are presented in a scheme of investment and production sectors (Fig. 2)[4].

The above feedback is strengthened by additional simultaneous relationship involving the foreign trade. Namely, the production determines exports which in turn determine imports, including machinery and equipment, and thus lead to the increase of production capacities.

Finally, the model attempts to present the feedback operating through production functions bottle-necks in the production process because of constraints in imports of raw materials, semi--finished products caused by export limitations depending, among

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[2] These data are included in the data bank of =W-3-SKA-79= and they result from the research work of the group directed by Dr. W. Juszczak.

[3] The author of all computer programs used in the presented calculations, if not stated otherwise, is Dr. J. B. Gajda.

[4] Cf. also Fig. 1.

others, on the declining production levels. It is not able, however, to explain the economic crisis as the total impact of import constraints on the underutilization of capacities has not been captured through the production functions (it occurred in the period 1980-1982 not covered by the sample period).

The investment outlays (for buildings and construction JBUS, machinery and equipment - JMUS and other - JPRS) are the function of gross output of construction industry - QB, electro-engineering industry - QQE, and imports of machinery and equipment - M7. The allocation of investment outlays among the distinguished industries (branches) depends on predetermined coefficients - being instruments of the investment policy[5].

$$J_i = J_i/J \cdot J, \tag{1}$$

where: J = JBUS + JMUS + JPRS, i = M, N, Q, B, T, R, L, H.

The investments put into operation IK_i have been determined assuming Almon lag distribution of investment outlays, according to the general formula:

$$IK_i = f\Big(\sum_{j=0}^{m_1} w_{ij} J_{i,-j}\Big), \tag{2}$$

where: m_1 - the length of investment cycle.

The gross value of fixed assets K_i has been determined using three systems of equations generating scrappings of fixed assets (KD_i), the stocks of fixed assets at the end of the period (K_iK) and the average stock of fixed assets (K_i), respectively

$$\begin{aligned} KD_i &= f(IK_i, K_iK_{-1}), \\ K_iK &= K_iK_{-1} + IK_i - KD_i, \\ K_i &= (K_iK_{-1} + K_iK)/2. \end{aligned} \tag{3}$$

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5 "i" is a symbol of an industry (branch). Cf. Appendix 1 including the description of symbols of the variables.

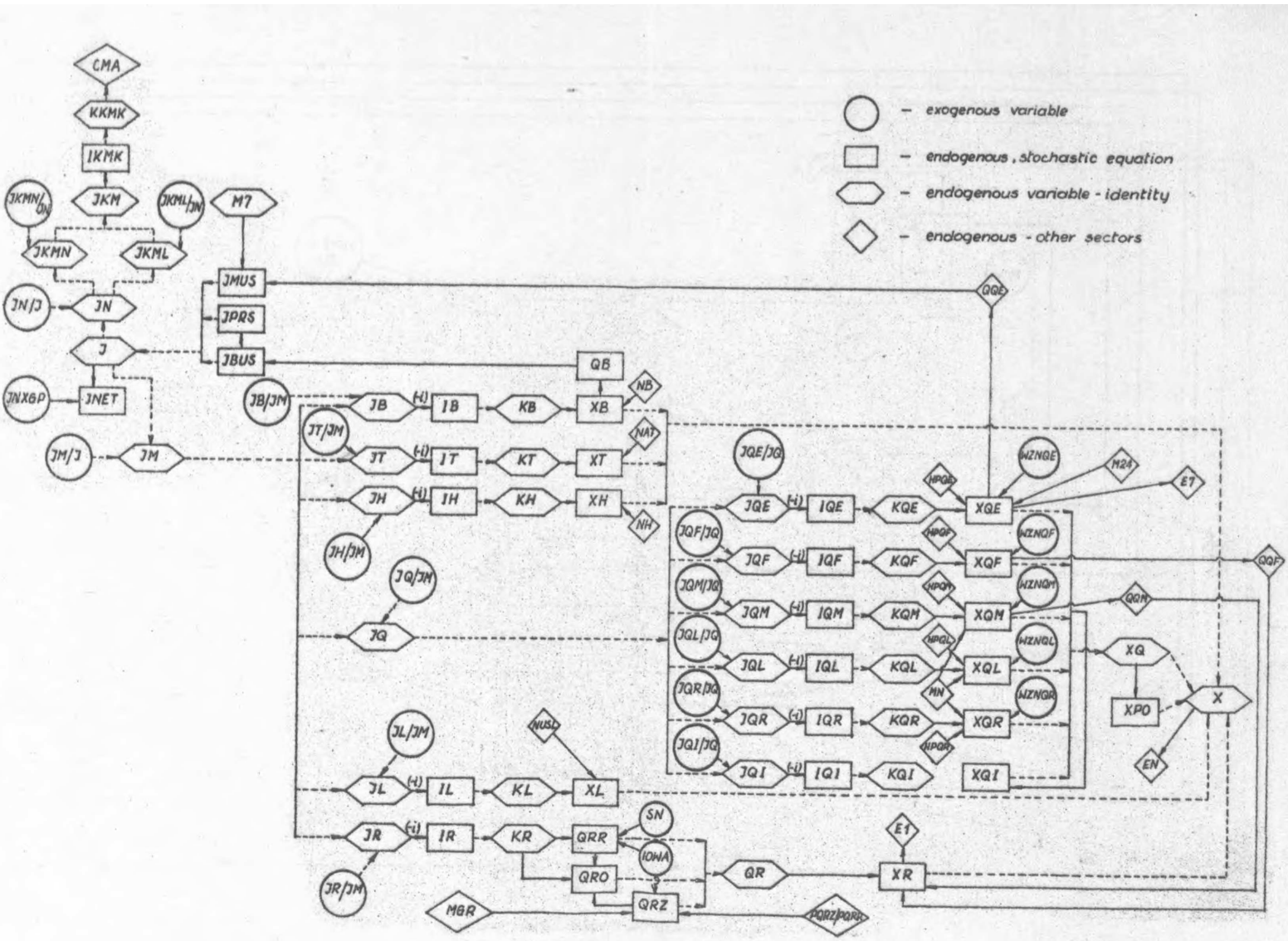


Fig. 2. Scheme of investment and net production sector

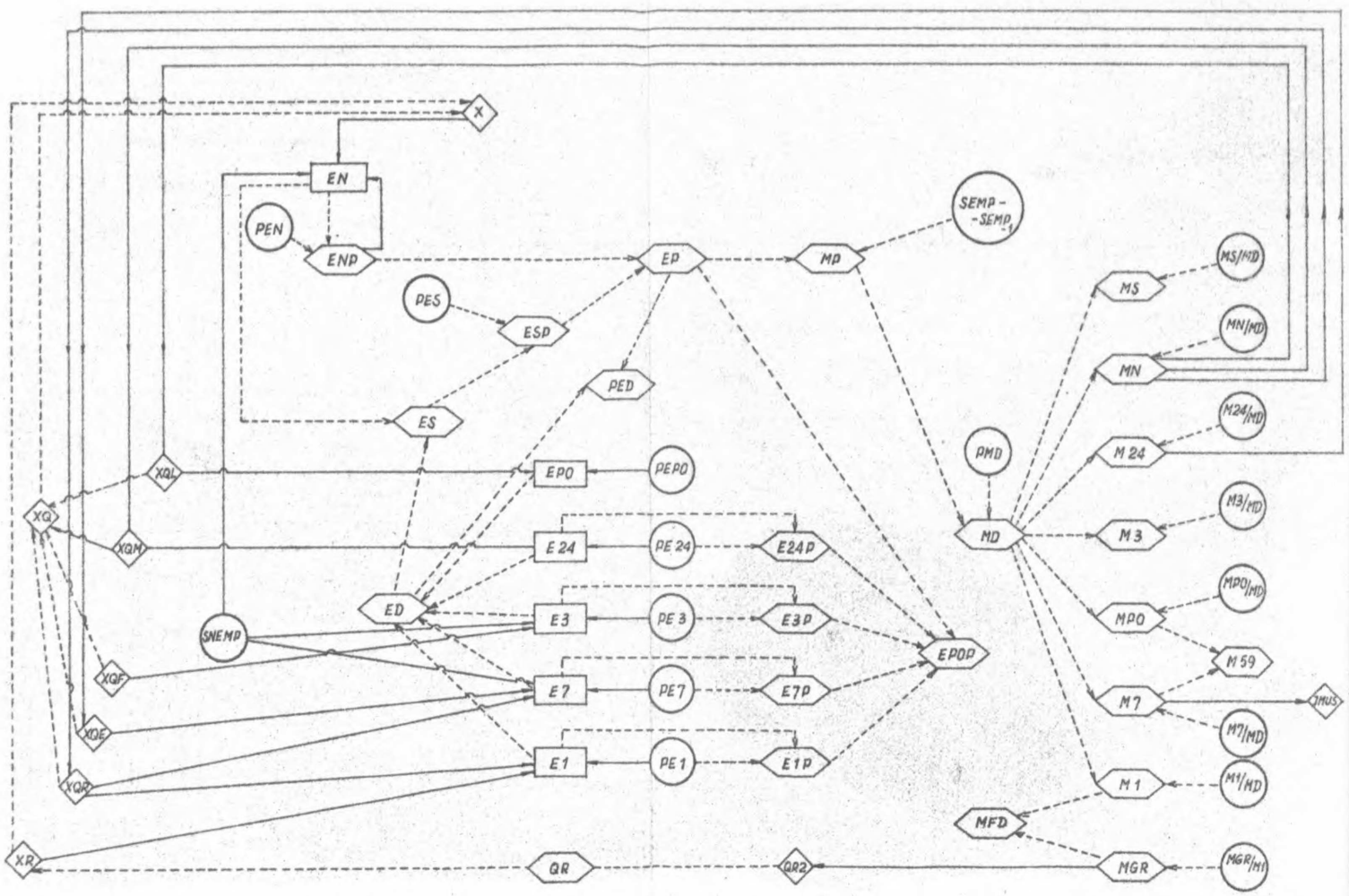


Fig. 3. Scheme of foreign trade sector

Labour supply outside private agriculture NANSR has been assumed exogenous. The sectoral (branch) structure of employment is determined by the autoregressive process and relative wages. It should be noted that - except for wages in agriculture, forestry and non-material sector - average wages are exogenous.

Man-hours worked in particular branches of industry (HPQ_i) depend on the level of employment in a given branch (NUQ_i). Changes in an average working week or day length are introduced in the form of parameter changes (among others, of the intercept), by introducing appropriate dummy variables.

Net output depends, first of all, on the primary factors inputs, i.e. fixed assets, employment (or working time) determining the capacity output. Besides, in industry the factors determining the utilization of production capacities, such as the number of shifts worked and imports volume (for constraints of raw materials) were used.Thus,the production functions explaining net output (at constant prices) in industrial branches (XQ_i) have the form:

$$XQ_i = f(KQ_i, WZNQ_i, HPQ_i, M_k), \tag{4}$$

while in construction, trade, transport and forestry:

$$X_i = f(K_i, N_i, XQ). \tag{5}$$

Gross production (Q_i) is obtained by transforming net output (X_i).

A different approach was used in relation to agriculture, where in the first stage the gross production was explained:

- plant production:

$$QRR = f(KR, SN, IOWA), \tag{6}$$

- animal production:

$$QRZ = f(QRR, MGR, PQRZ/PQRR, IOWA), \tag{7}$$

- other production:

$$QRO = f(QRR + QRZ, KR) \tag{8}$$

and in the second stage - the net output (XR) as a difference between gross production and material inputs:

$$XR = QR - f(IOWA, QQF, QQM), \tag{9}$$

where: $QR = QRR + QRZ + QRO$.

The gross production and imports (in the case of fuel and power industry also exports) of a given industry determine the level of market supplies of respective consumers' goods which in turn, affect the level of personal consumption. Possible changes in the volume of supplies or consumption can be introduced by changing respective coefficients of production allocation(jointly with symmetric changes in allocation coefficients for other final recipients).

The sector covering wages and personal income includes, among others, the equations describing

- incomes from employment as a function of wage bill

$$YPRP = f(FUSP), \tag{10}$$

where: $FUSP = \sum_i FUS_iP$ and $FUS_iP = ZUS_iP * NUS_i$, i.e. wage bill is obtained by multiplying employment by mostly exogenous wages:

- incomes from agricultural activities - as a function of net agricultural output and procurement prices of agricultural products:

$$YRP = f(XR, PXRS), \tag{11}$$

- incomes in non-socialized sector (excluding agriculture):

$$YINP = f(YPRP), \tag{12}$$

- other incomes:

$$YPOP = f(YPRP), \tag{13}$$

- total incomes:

$$YP = YRP + YPRP + YINP + YPOP. \tag{14}$$

Wage costs and material input (including import prices) determine producers' prices, i.e. deflators of industrial production. These, in turn, determine retail prices and prices for investment goods. Thus, it is possible to express in current

prices almost all commodity flows in the production and distribution process. The inflationary feedback was not explicitly included in this version, as wages are exogenous.

Foreign trade equations have been constructed in a special way. They satisfy the assumption that exports are determined by domestic production capacities and stimulated by accumulated foreign debt. Exports, on the other hand, are the main determinant of total imports. Figure 3 presents a detailed scheme of foreign trade sector. This sector contains 6 stochastic equations explaining exports (at constant prices), namely:

- exports to non-socialist countries:

$$EN = f(X, SNEMP/ENP), \tag{15}$$

-exports of a given group of commodities:

$$E_k = f(X_1, PE_k, SNEMP), \tag{16}$$

where: k - symbol of a group of commodities: k = 1, 24, 3, 7, PO.

Exports at current prices are obtained, by multiplying exports volumes by predetermined export prices. Total exports at current prices (being the sum of exports to socialist and non-socialist countries) determine jointly with the assumed foreign trade balance - total value of imports:

$$E_kP = E_k * PE_k, \tag{17}$$

$$MP = EP - SEMP + SEMP_{-1}, \tag{18}$$

where: $EP = ESP + ENP$, $ENP = EN * PEN$, $ESP = ES * PES$, $ES = ED - EN$, $ED = E_1 + E24 + E3 + E7 + EPO$.

Import volumes, total and by groups of commodities, are determined from the identities:

$$MD = MP/PMD, \tag{19}$$

$$M_k = (M_k/MD) * MD. \tag{20}$$

Exogenous variables are export deflators (PE_k, PEN, PES) and import deflators (PMD), cumulated total foreign trade balance (SEMP) and trade balance with non-socialist countries (SNEMP) and import allocation coefficients (M_k/MD). Thus the policy instruments allow for both changes in total import (by means of changing foreign debt) and its composition.

The W3S79 model explains three categories of inventory stocks:

- foodstuff in socialized trade:

$$RZ = f(RZ_{-1}, CHZA), \tag{21}$$

- non-food inventories in socialized trade:

$$RNZ = f(XQL, RNZ_{-1}), \tag{22}$$

- inventory investment outside socialized trade:

$$DRNH = f(DQQ, DQR). \tag{23}$$

The national income distributed is obtained from the identity:

$$XG = X - SG, \tag{24}$$

where: $SG = f(ED - MD)$,
i.e. it depends on the foreign trade balance and terms of trade, while other consumption, i.e. government expenditures, is determined as a residual from the well-known identity national income accounts:

$$G = XG - CX - JNET - DR, \tag{25}$$

where net investment outlays depend on the previously determined supplies of investment goods:

$$JNET = f(J, JNXGP)$$

and

$$DR = DRZ + DRNZ + DRNH.$$

2. The Analysis of a Control Solution

The fact that every regression equation satisfies basic requirements such as a high level of goodness of fit, significance of structural parameter estimates and their correct economic interpretations in the case of an interdependent system, is not a sufficient evidence that a "good" model has been constructed. It is necessary to evaluate the whole system of equations using a simulation experiment, i.e. based on the analysis of a control solution of the system.

By the control solution of the model we mean the set of values of endogenous variables $\{\hat{y}_t^s\}$ determined as ex-post forecasts on the basis of the whole system of equations, namely

$$\hat{y}_t^s = f\left[\hat{y}_{t,\ldots,}^{(s-1)}\ \hat{y}_{t-\tau}^{(s-1)},\ x_t\right] \quad \text{for each period } t,$$

where: s - number of iteration, y - vector of endogenous variables, x - vector of exogenous variables, τ - lag indicator.

The control solution of the model can be obtained directly from its structural form (without deriving its final form) utilizing iterative procedures.This is especially important for nonlinear systems. These procedures assume multiple generation of values of left-hand-side variables through substituting the values obtained in the previous iteration to the right-hand-side endogenous variables and assuming the observed values of exogenous variables.

The values of other predetermined variables, i.e. endogenous lagged variables are either set equal to their observed values - static simulation or put equal to their values computed by the system for previous periods - dynamic simulation, which will be analysed below.

The calculations are continued till a subsequent solution does not differ from the previous one by less than a small constant.

It can be argued that the model reflects the real world phenomena the better, the more precisely the solution $\{\hat{y}_t^s\}$ corresponds to the observed values $\{y_t\}$.

The following statistics are commonly used forecasts of accuracy measures:

1) the mean error:

$$ME = \frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y}_t),$$

2) the average absolute error:

$$MAE = \frac{1}{N}\sum_{i=1}^{n}|y_i - \hat{y}_i|,$$

3) the mean percentage error:

$$MPE = \frac{1}{N} \sum_{i=1}^{N} \frac{(y_i - \hat{y}_i)}{y_i} * 100,$$

4) the mean absolute percentage error:

$$MAPE = \frac{1}{N} \sum_{i=1}^{N} \frac{|y_i - \hat{y}_i|}{y_i} * 100.$$

The control solution for the W3S79 model has been obtained using the iterative procedure based on Gauss-Seidel method, and computer programs AKMO and MIM4.

Since the statistics ME and MAE cannot be compared in the case of variables expressed in various units, attention was focussed on the analysis of relative measures MPE and MAPE. The results are summarized in Tab. 1.

T a b l e 1

Characteristics of the control solution

Statistics	Shares in % of variables for which the statistics MPE and MAPE assume the values				
	0-2	2-5	5-10	10-20	20 and more
MPE	84.0	10.9	2.4	0.6	2.1
MAPE	30.2	42.6	15.1	6.9	5.2

The above presented information testifies to a fairly high accuracy of ex-post forecasts generated from the control solution. For the majority (72.8%) of the analysed variables, the mean absolute percentage error MAPE was below 5% and for 17% of variables it was smaller than 1%. Low accuracy was obtained only in the case[6] of surplus of exports over imports (SG, SGP), inventory increase (DRZ, DRNZ, DRNH) and increment of personal savings (DOZL,

[6] Where the variables were defined either as "small" residuals or increments.

DOZLP, DOKL). Thus, it can be claimed that from the formal point of view the system of equations constituting the W3S79 model can be treated as satisfactory.

3. Multipliers Analysis

In order to investigate the dynamic properties of the model the multipliers - direct and indirect, were completed against exogenous variables and intercept terms in these regression equations in which the change of intercept could be interpreted as a direct effect of applying a given instrument of the economic policy (e.g. in the equations explaining working time as an effect of the social measure introducing additional free Saturdays).

In the paper we shall restrict our attention to the multipliers analysis showing the impact of those areas and policy measures which in our opinion play the most important role i.e. foreign trade, investment outlays, activities of particular industrial branches and agriculture. These are the sectors of the national economy which have a decisive influence on the general economic performance and determine the prospects for overcoming the present economic crisis.

3.1. Foreign trade and the national economy

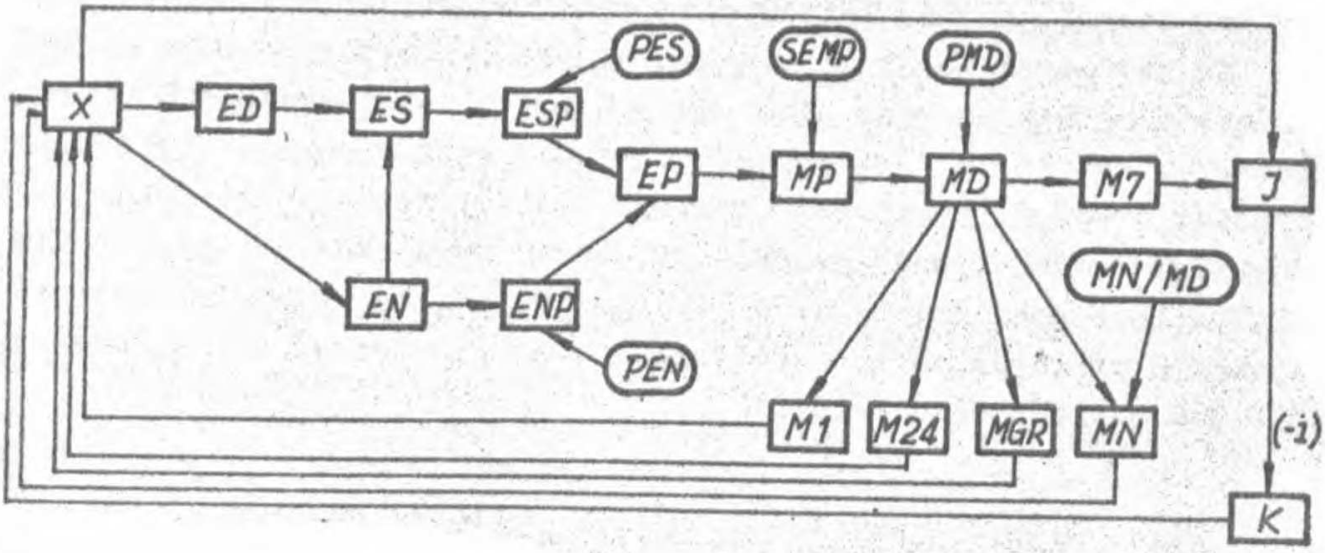
One of important sectors of the model is a submodel of imports and exports because of its interrelationships with other blocks (see Fig. 3).

The main exogenous variables in this block are export and import prices, cumulated foreign trade balance total and with the socialist countries (being a synonym for foreign debts) and coefficients of sectoral allocation of imports. Besides, it is desirable to analyse the changes in "propensities to export" and in directions of exports. We shall carry out this analysis applying the multipliers based on shocks induced by changes of intercept terms in particular export equations.

Dynamics of the W3S79 macromodel against the changes induced by foreign trade sector will be discussed using multipliers cal-

culated with respect to PEN, PMD, MN/MD, SEMP and intercept in equation EN[7]. They are presented in Tabs 2-7, respectively.

There are complex feedbacks between exports and imports and produced and distributed NMP, presented in graph 1. It has to be emphasized, however, that the model as it stands does not fully reflect the impact of import constraints, especially those concerning raw materials, semi-finished products and spare parts from non-socialist countries on the utilization of productive capacities, the spread of bottle-necks all over industry and decline in efficiency (due to forced substitution).The multiplier effect with regard to the crisis phenomena will thus be highly underestimated[8].



Graph 1

The increase of exports in particular commodity groups by 10% as well as an 10% increase of exports to non-socialist countries is equivalent to an excercise, where total export is increased by 10%, its composition by commodity groups and regions being unchanged. This increase is followed by an increase of imports (MD), which influences the productive activities. The increments of industrial net output (XQ) by 2.3% are a source of additional exports increase.Altogether exports (ED) grow by 11.3% (cf.Tab.2).

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[7] Cf. Figs 1-3.

[8] In model W-5 we tried explicitly to take into account the above effects.

Table 2

Multipliers of selected endogenous variables with respect to one period impulse increase by 10% (i.e. totally by 4.58) in the constant of equations explaining exports by commodity groups (E1, E24, E3, E7, EPO) and to nonsocialist countries (EN)

Variables	Units	Lags in year						
		0	1	2	3	4	5	10
X	bill.zł	25.398	29.742	6.840	6.950	7.699	8.607	14.717
	%	1.4126	1.5641	0.3365	0.3200	0.3923	0.3484	0.4186
XQ	bill.zł	21.9857	26.5924	9.3335	5.5950	5.1719	5.6590	9.1463
	%	2.3031	2.5657	0.8185	0.3369	0.3781	0.3804	0.1409
XG	bill.zł	24,1682	29,1592	6.7443	6.8449	7.6189	8.5238	14.5804
	%	1.3610	1.5523	0.3358	0.3190	0.3328	0.3492	0.4194
Y	bill.zł	8.2713	9.3555	7.0256	5.4712	4.4833	3.8534	3.2809
	%	0.6404	0.7044	0.5099	0.3813	0.2999	0.2476	0.1753
CX	bill.zł	25.2958	29.1416	10.3244	6.0235	5.3585	5.6352	8.6795
	%	2.3189	2.5322	0.8365	0.4541	0.3764	0.3695	0.4034
J	bill.zł	11.8841	15.4968	5.1797	2.9149	2.6398	2.8319	4.2712
	%	1.8792	2.3755	0.7551	0.4021	0.3441	0.3484	0.3858

Table 2 (contd.)

Variables	Units	Lags in year						
		0	1	2	3	4	5	10
JNET	bill.zł	6.4217	8.3718	2.7982	1.5747	1.4261	1.5299	2.3074
	%	1.5425	1.9605	0.6286	0.3378	0.2916	0.2978	0.3430
SG	bill.zł	1.229992	0.582207	0.096798	0.105805	0.080210	0.083792	0.136613
	%	5.5323	2.5246	0.3961	0.4078	0.2912	0.2867	0.3447
ED	bill.zł							
	exchange	5.2749	1.4813	0.5172	0.3047	0.2762	0.2974	0.4844
	%	11.3010	0.9526	0.9420	0.5069	0.5214	0.4175	0.4522
MD	bill.zł							
	exchange	5.175051	1.434014	0.509337	0.296112	0.269705	0.290581	0.473256
	%	11.3647	2.9289	0.9506	0.5047	0.4216	0.4181	0.4527

The increase of produced NMP by 1.4% as well as distributed NMP (XG)of 1.4% gives a rise in consumer goods supplies (CX) of 2.3% and in investment outlays total (J) of 1.9% and net (JNET) of 1.5%. Next year brings slightly higher rates of growth of NMP produced and distributed, supplies of consumer and investment goods (respectively by 1.5, 2.6, 2.5 and 2.4%). In the 3rd and 4th years the multipliers effects die, whereas in the following years due to the feedback linking investment and NMP their positive impact can be observed again.

Given the level of total exports (ED) unchanged the growth of exports to non-socialist countries (EN) will cause the equivalent decrease of exports to the socialist countries (ES). In order to analyse the results of the above likely change,which means partly restoring the previous foreign trade shares the multipliers were calculated in relation to the intercept in the stochastic equation explaining EN (cf. Tab. 3).

As a result of the assumed impulse, i.e. the growth of share of EN in ED by 10 points,due to differences between export prices to both groups of countries, there was an increase of total exports at current prices (EP), which in turn, caused an increase of imports at current prices (MP) and constant prices (MD) by 0.5%. As a consequence, a negative foreign trade balance at constant prices was obtained which gave a weak impulse towards production increase, and therefore a negligible increase of total exports at constant prices (by 0.06%). At the same time there was a small increase (by less than 0.1%) of personal consumption(CX), investment outlays (J and JNET) and social consumption (G). The short-term result proved to be an increase in stocks of inventories by 1.6%.In the next year, a slightly higher increase of NMP, consumption and investment outlays by 0.06, 0.10 and 0.10% respectively, was observed. An additional increase of exports (as a result of net production increase) induces a similar increase of imports, which in turn causes that the distributed NMP increases slower than the produced one. Since the personal consumption and investments increased, the stocks of inventories and social consumption decreased. After 3-4 years the multipliers effects expire, and then due to a feedback between produced NMP and investments, their slow increase is observed.

Table 3

Multipliers of selected endogenous variables with respect to one period impulse increase by 1.79 bill, of exchange złoty i.e. by 10% in the constant of equation explaining exports to nonsocialist countries (EN)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
EN	bill. zł exchange	2.1068	0.01744	0.01012	0.004114	0.004326	0.004756	0.007724
	%	11.9890	0.0914	0.0484	0.0179	0.0173	0.1750	0.0188
X	bill. zł	1.02732	1.2023	0.2768	0.2811	0.3116	0.3484	0.5959
	%	0.0571	0.0632	0.1360	0.0129	0.0134	0.0141	0.0169
XQ	bill. zł	0.8892	1.0754	0.3776	0.2263	0.2093	0.2291	0.3705
	%	0.0931	0.1037	0.0331	0.0181	0.0153	0.0154	0.0166
XG	bill. zł	3.2581	1.1793	0.2722	0.2772	0.3088	0.3455	0.5897
	%	0.1835	0.0628	0.0136	0.0129	0.0135	0.0142	0.0176
Y	bill. zł	0.3425	0.3908	0.2938	0.2275	0.1852	0.1581	0.1329
	%	0.0265	0.0294	0.0213	0.0159	0.0124	0.0102	0.0071
CX	bill. zł	1.0231	1.1806	0.3184	0.2439	0.2171	0.2284	0.3521
	%	0.0938	0.1026	0.0339	0.0184	0.0152	0.0150	0.0163
J	bill. zł	0.4808	0.6279	0.2099	0.1181	0.1069	0.1148	0.1739
	%	0.0760	0.0962	0.0306	0.0163	0.0139	0.0141	0.0156

JNET	bill. zł	0.2597	0.3392	0.1134	0.06379	0.05780	0.062000	0.09361
	%	0.0624	0.0794	0.0255	0.0137	0.0118	0.0121	0.0139
SG	bill. zł	-2.2317	0.02576	0.003750	0.004640	0.003579	0.003752	0.005393
	%	-10.0445	0.1030	0.0153	0.0179	0.0130	0.0128	0.0136
ED	bill. zł exchange	0.02810	0.05990	0.02092	0.01232	0.01178	0.01204	0.01962
	%	0.0602	0.1194	0.0381	0.0205	0.0171	0.0169	0.0183
MD	bill. zł exchange	0.2093	0.05800	0.02059	0.01198	0.01092	0.01177	0.01916
	%	0.4596	0.1185	0.0384	0.0204	0.0171	0.0169	0.0183
G	bill. zł	0.5812	-0.1879	0.5104	0.1419	0.05168	0.02791	0.09849
	%	0.3189	-0.1054	0.2822	0.0728	0.0242	0.0119	0.0242
DR	bill. zł	1.3941	-0.1527	-0.7699	-0.1725	-0.01782	0.02718	0.04555
	%	1.6155	-0.1250	-0.5206	-0.1096	-0.0110	0.0163	0.0187
ES	bill. zł exchange	-2.0787	0.0425	0.0108	0.0082	0.0069	0.0073	0.0119
	%	-7.1415	0.1366	0.0317	0.0221	0.00169	0.0165	0.0180

The above excercise did not yield satisfactory results,as the model does not link directly the increased receipts of hard currency with imports from the market economies, thus it does not allow to show the process of eliminating bottle-necks and inefficiency which might be a likely result of increase in imports from market economies. It is, however, possible to combine this analysis with an analysis of respective exogenous change in imports shares.

Another way of showing to what extent the W3S79 model reflects the dependence of the Polish economy on foreign trade with the market economies was to calculate the multipliers with respect to export prices to non-socialist countries (PEN). A decrease of export prices may serve as a proxy either for restricting practices directly forecasting a price decline or indirectly by means of increasing customs duties[9]. The calculated multipliers showing the result of 10% decrease in PEN[10] are presented in Tab. 4. Again,the results of this excercise are only jointly satisfactory. Through the decrease of exports to non-socialist countries in constant and current prices (EN and ENP by 2.8 and 12.5%, respectively) and thus through decrease of total exports(despite a slight increase of exports to socialist countries ES by 0.7%) the given impulse caused in the same time period a decrease of imports at constant prices (MD) by 4.5%. As a result the produced NMP (X) decreased by 0.6% and the distributed NMP(XG) decreased much more - by 1.8%.

This means a decrease of personal consumption (by 0.9%) and total investment (by 0.8%) and also of social consumption (by 3.2%) and stocks of inventories (by 15.9%). In the next year, as a result of import limitations we can observe a further decrease of produced NMP (by 0.6%), investments (by 1.0%), personal consumption (by 1.0%) and the volume of total exports (by 1.2%). The decrease of exports is so deep that it enforces export limitation to the socialist countries ES (by 1.4%).A slightly slower decrease is observed in distributed NMP which enables an increase of

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[9] This could be expected as a result of withdrawing the most-favoured-nation treatment by the USA.

[10] This means deterioration of the general coefficient of terms of trade.

Table 4

Multipliers of selected endogenous variables with respect to one period impulse decrease by 0.1 i.e. by 10% in the price index of exports to nonsocialist countries (PEN)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
X	bill. zł	-10.1229	-11.8494	-2.7248	-2.7726	-3.0730	-3.4362	-5.8713
	%	-0.5629	-0.6231	-0.1340	-0.1277	-0.1326	-0.1391	-0.1669
XQ	bill. zł	-8.7622	-10.5988	-3.7210	-2.2314	-2.0633	-2.2585	-3.6519
	%	-0.9178	-1.0225	-0.3263	-0.1782	-0,1508	-0.1518	-0.1640
XG	bill. zł	-32.1132	-11.6183	-2.6856	-2.7300	-3.0406	-3.4023	-5.8158
	%	- 1.8083	- 0.6185	-0.1337	-0.1272	-0.1328	-0.1394	-0.1672
Y	bill. zł	-3.4220	-3.9240	-2.9515	-2.2854	-1.8558	-1.5799	-1.3139
	%	-0.2649	-0.2954	-0.2142	-0.1593	-0.1241	-0.1015	-0.0702
CX	bill. zł	-10.0815	-11.6361	-4.1228	-2.4057	-2.1408	-2.2520	-3.4700
	%	-0.9241	-1.0109	-0.3339	-0.1813	-0.1503	-0.1476	-0.1611
J	bill. zł	-4.7376	-6.1887	-2.0688	-1.1645	-1.0549	-1.1319	-1.7080
	%	-0.7489	-0.9485	-0.3015	-0.1606	-0.1374	-0.1392	-0.1541
JNET	bill. zł	-2.5593	-3.3433	-1.1176	-0.6291	-0.5699	-0.6115	-0.9227
	%	-0.6147	-0.7828	-0.2510	-0.1349	-0.1165	-0.1190	-0.1370
SG	bill. zł	21.9906	-0.2312	-0.0380	-0.0419	-0.0317	-0.0332	-0.0543
	%	98.9775	-1.0027	-0.1554	-0.1616	-0.1152	-0.1134	-0.1370

Table 4 (contd)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
ED	bill. zł							
	exchnge	-0.2769	-0.5904	-0.2061	-0.1215	-0.1102	-0.1187	-0.1934
	%	-0.5933	-1.1767	-0.3754	-0.2021	-0.1681	-0.1666	-0.1805
MD	bill. zł							
	exchange	-2.0625	-0.5716	-0.2030	-0.1181	-0.1076	-0.1160	-0.1889
	%	-4.5291	-1.1674	-0.3789	-0.2012	-0.1682	-0.1668	-0.1806
EN	bill. zł							
	exchange	-0.4897	-0.1721	-0.0998	-0.0406	-0.0427	-0.0469	-0.0761
	%	-2.7871	-0.9020	-0.4776	-0.1769	-0.1706	-0.1727	-0.1855
ES	bill. zł							
	exchange	0.2128	-0.4183	-0.1063	-0.0809	-0.0675	-0.0718	-0.1172
	%	0.7311	-1.3452	-0.3126	-0.2176	-0.1665	-0.1629	-0.1774
G	bill. zł	-5.7343	1.8579	-5.0345	-1.3927	-0.5058	-0.2707	-0.9744
	%	-3.1463	1.0423	-2.7837	-0.7138	-0.2365	-0.1158	-0.2398
DR	bill. zł	-13.7380	1.5031	7.5893	1.6975	0.1758	-0.2682	-0.4487
	%	-15.9195	1.2306	5.1314	1.0781	0.1085	-0.1603	-0.1839

social consumption G (by 1.0%) and stocks of inventories (by 1.2%). After some inhibition of the decreasing tendency in the second period we can observe deepening of negative effects of decrease in the efficiency of exports to non-socialist countries.

The multipliers calculated in relation to import prices (PMD) allow us to analyse the direct influence of deterioration of general terms of trade on the economic situation of the country. According to the expectations an increase of PMD by 0.10 points (the export prices kept constant, no additional sources of financing imports available) caused similar, as for as the direction is concerned, but much stronger reactions than the previously analysed decrease of PEN (cf. Tab. 5). This can be explained by the fact that an increase of import prices caused an immediate decrease of imports in constant prices (MD) by 9.3% which induced a decrease of net industrial output (XQ) by 1.9% and investments (J) by 1.5% (mainly due to the decrease of import of machinery and equipment).

Because of many restrictions imposed by imports on the capacity utilization it seems most interesting to analyse their impact (having in mind the uncertainty of the analysis) taking into account the main sources of financing imports - exports and net-financing on credit terms (and/or other sources).

In the W3S79 model imports in current prices (MP) are determined from the identity of the form:

$$MP = EP - (SEMP - SEMP_{-1}),$$

where: SEMP - cumulated foreign trade balance.

Hence it is interesting to analyse the multipliers in relation either to exports EP, which we will postpone, or to SEMP, i.e. to the assumed change in the current commodity trade balance.

A change of SEMP can be analysed under various assumptions with regard to the assumed balance of trade with different country groups:

a) symmetric change for socialist and non-socialist countries,

b) total increase of new financing possibilities coming from hard currency areas (SEMP = SNEMP, where SNEMP - foreign trade balance with non-socialist countries),

Table 5

Multipliers of selected endogenous variables with respect to one period impulse increase by 0.1 points i.e. 10% in the price index of imports from nonsocialist countries (PMD)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
X	bill.zł	-20.794	-24.339	-5.591	-5.690	-6.305	-7.050	-12.028
	%	-1.1565	-1.2800	-0.2750	-0.2620	-0.2722	-0.2854	-0.3421
XQ	bill.zł	-18.001	-21.773	-7.642	-4.581	-4.234	-4.634	-7.488
	%	-1.8856	-2.1007	-0.6702	-0.3659	-0.3096	-0.3114	-0.3364
XG	bill.zł	-65.972	-23.864	-5.513	-5.602	-6.239	-6.980	-11.917
	%	-3.7150	-1.2704	-0.2745	-0.2611	-0.2725	-0.2860	-0.3428
Y	bill.zł	-7.1112	-8.1897	-6.1605	-4.7612	-3.8548	-3.2715	-2.6983
	%	-0.5506	-0.6166	-0.4471	-0.3318	-0.2578	-0.2102	-0.1442
CX	bill.zł	-20.710	-23.860	-8.459	-4.931	-4.387	-4.614	-7.106
	%	-1.8986	-2.0733	-0.6849	-0.3718	-0.3082	-0.3025	-0.3303
J	bill.zł	-9.7324	-12.6684	-4.2411	-2.3864	-2.1612	-2.3187	-3.4967
	%	-1.5386	-1.9450	-0.6183	-0.3292	-0.2817	-0.2853	-0.3158
JNET	bill.zł	-5.2577	-6.8546	-2.2911	-1.2892	-1.1676	-1.2526	-1.8890
	%	-1.2629	-1.6052	-0.5147	-0.2765	-0.2387	-0.2438	-0.2808

SG	bill.zł	-45.1764	-0.4740	-0.0787	-0.0861	-0.0651	-0.0680	-0.1123
	%	-203.3435	-2.0556	-0.3221	-0.3317	-0.2364	-0.2327	-0.2834
ED	bill.zł							
	exchange	-0.5689	-1.2128	-0.4233	-0.2494	-0.2261	-0.2435	-0.3964
	%	-1.2189	-2.4174	-0.7711	-0.4149	-0.3450	-0.3419	-0.3701
MD	bill.zł							
	exchange	-4.2371	-1.1742	-0.4170	-0.2424	-0.2208	-0.2379	-0.3874
	%	-9.3048	-2.3984	-0.7782	-0.4131	-0.3451	-0.3423	-0.3705
EN	bill.zł							
	exchange	-0.190041	-0.354076	-0.205147	-0.083242	-0.087559	-0.096249	-0.156010
	%	-1.0816	-1.8559	-0.9815	-0.3632	-0.3503	-0.3545	-0.3803
ES	bill.zł							
	exchange	-0.378878	-0.8586	-0.218185	-0.166137	-0.138508	-0.147245	-0.240426
	%	-1.3017	-2.7619	-0.6417	-0.4467	-0.3417	-0.3342	-0.3639

Table 6

Multipliers of selected endogenous variables with respect to one period impulse increase by 5.71 bill of exchange złoty i.e. by 10% in the SEMP

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
X	bill. zł	29.0621	4.9768	-26.3022	0.0358	0.8248	1.0302	1.0578
	%	1.6163	0.2617	-1.2937	0.0016	0.0356	0.0417	0.0301
XQ	bill. zł	25.1568	5.2753	-19.7394	-4.2746	-0.4878	0.5561	0.7239
	%	2.6351	0.5089	-1.7310	-0.3414	-0.0357	0.0374	0.0325
XG	bill. zł	92.1934	-58.8169	-25.7352	0.0316	-0.8568	1.0270	1.0448
	%	5.1915	-3.1311	-1.2812	0.0015	0.0374	0.0421	0.0300
Y	bill. zł	9.4276	0.8311	-1.9088	-1.0893	-0.5450	-0.2256	0.2051
	%	0.7299	0.0626	-0.1385	-0.0759	-0.0365	-0.0145	0.0110
CX	bill. zł	28.9446	4.4661	-21.5633	-4.9277	-0.7662	0.3143	0.6915
	%	2.6531	0.3880	-1.7466	-0.3714	-0.0538	0.0206	0.0321
J	bill. zł	13.6018	4.1675	-11.8244	-2.5951	-0.3175	0.2186	0.3221
	%	2.1501	0.6387	-1.7233	-0.3579	-0.0414	0.0269	0.0291
JNET	bill. zł	7.3480	2.2514	-6.3878	-1.4019	-0.1715	0.1181	0.1740
	%	1.7649	0.5272	-1.4346	-0.3006	-0.0351	0.0230	0.0258

SG	bill. zł	-63.1371	63.7931	-0.5674	0.0056	-0.0309	0.0022	0.0115
	%	-284.1739	276.6080	-2.3215	0.0215	-0.1120	0.0075	0.0290
ED	bill. zł exchange	-0.7951	0.9000	-1.1032	-0.2440	-0.0334	0.0239	0.0382
	%	1.7033	1.7938	-2.0094	-0.4059	-0.0510	0.0335	0.0356
MD	bill. zł exchange	5.9214	-4.2797	-1.0572	-0.2444	-0.0309	0.0237	0.0372
	%	13.0029	-8.7406	-1.9729	-0.4165	-0.0483	0.0341	0.0356
EN	bill. zł exchange	0.2643	0.2357	-0.1950	-0.1655	0.0071	0.0135	0.0141
	%	1.5039	1.2355	-0.9329	-0.7219	0.0283	0.0496	0.0344
ES	bill. zł exchange	0.5308	0.6643	-0.9082	-0.0785	-0.0405	0.0104	0.0241
	%	1.8238	2.1364	-2.6712	-0.2111	-0.0998	0.0236	0.0364
G	bill. zł	16.4581	-21.7835	-19.7108	-10.5482	-2.5809	-0.6868	0.1440
	%	9.0301	-12.2210	-10.8988	-5.4062	-1.2068	-0.2937	0.0354
DR	bill. zł	39.4426	-43.7508	-17.4948	16.9095	4.3753	1.2814	0.0353
	%	45.7059	-35.8187	-11.8289	10.7393	2.7007	0.7661	0.0145

c) total increase coming from socialist trading partners (SNEMP constant).

This last case can be explained by the fact that additional short-term credits from socialist countries are obtained (to be paid back in one year period). The results of this simulation are presented in Tab. 6.

The increase of SEMP by 10% caused an immediate increase of imports in constant prices by 13.0%. This enabled an increase of the net industrial output by 2.6%. Total investment outlays increased by 2.2% and net outlays by 1.8% - as a result of increase in imports of machinery and equipment and of electro-engineering industry output.The obtained increase in NMP (by 1.6%) enabled an increase of supplies of consumer goods (by 2.7%), and of total exports by 1.7% (EN by 1.5% and ES by 1.8%). The NMP distributed increased in the first year by 5.2% much higher than the NMP produced. It means that additional imports were not totally absorbed in production process and increased stocks of inventories by 45% and of social consumption (G). The increase by 9.3% of the last category is clearly overestimated (G is determined as residual)[11].

The repayment of foreign credits in the next year causes a decrease of imports (MD) by 8.7% despite an increase of exports by 1.8%. A positive foreign trade balance, with a slight increase of the produced NMP, causes a decrease of the distributed NMP by 3.1% which is followed by a decrease of inventory stocks (DR) by 35.8% and a decrease (overestimated again) of social consumption (G) by 12.2%.

The decrease of raw material imports (M24) by 8.7%, affecting with one-year lag the output of electro-engineering industry in the second period caused a decrease of industrial output by 1.7% and of the produced and distributed NMP by 1.3%. Consequently there was decrease of personal consumption by 1.7%, total investments by 1.7%, exports by 2.0%, and imports by 2.0%.

Since the beginning of the third year, the multipliers in relation to SEMP are close to zero. On the whole, there is a cumulative positive impact of the short-term credit on the economic activity. A sustained impact should bring, of course, higher stabilized activity levels.

[11] This remark has a more general meaning, indicating a deficiency in the model structure.

Table 7

Multipliers of selected endogenous variables with respect to one period impulse increase by 0.045 i.e. by 10% of the ratio of imports to nonsocialist countries (MN/MD)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
X	bill. zł	17.2644	-1.5921	0.8419	0.8058	0.8528	0.9542	1.6282
	%	0.9602	-0.0837	0.0414	0.0371	0.0368	0.0386	0.0463
XQ	bill. zł	22.1278	2.9613	0.7774	0.5752	0.5767	0.6307	1.0126
	%	0.3178	0.2857	0.0682	0.0459	0.0422	0.0424	0.0450
XG	bill. zł	16.9670	-1.5565	0.8049	0.7941	0.8431	0.9439	1.6135
	%	0.9564	0.0829	0.0401	0.0370	0.0368	0.0387	0.0464
Y	bill. zł	7.3329	4.1548	2.9750	1.9772	1.2492	0.8420	0.3831
	%	0.5832	0.3128	0.2169	0.9318	0.0833	0.0541	0.0208
CX	bill. zł	23.0586	3.9094	1.1530	0.7399	0.6487	0.6489	0.9625
	%	2.1136	0.3396	0.0934	0.0558	0.0455	0.0425	0.0447
J	bill. zł	1.4619	1.6425	0.4217	0.2962	0.2953	0.3157	0.4734
	%	0.2311	0.2671	0.0616	0.0408	0.0385	0.0388	0.0427

Table 7 (contd.)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
JNET	bill.zł	0.7898	0.9413	0.2278	0.1599	0.1595	0.1706	0.2558
	%	0.1897	0.2204	0.0512	0.0343	0.0326	0.0332	0.0380
SG	bill.zł	0.2961	-0.0861	0.0353	0.0105	0.0086	0.0090	0.0154
	%	1.3320	-0.1567	0.1445	0.0404	0.0311	0.0309	0.0389
ED	bill.zł exchange	0.6605	0.1007	0.0461	0.0337	0.0308	0.0330	0.0536
	%	1.4150	0.2006	0.0840	0.0560	0.0470	0.0463	0.0500
MD	bill.zł exchange	0,6364	0.1036	0.0432	0.0828	0.0801	0.0822	0.0623
	%	1.3976	0.2116	0.0807	0.0559	0.0471	0.0468	0.0501
G	bill.zł	-39.9649	22.9526	2.5949	0.4558	0.1166	0.0709	0.2711
	%	-21.9277	12.3720	1.4348	0.2336	0.0545	0.0303	0.0667
DR	bill.zł	33.0836	-28.4599	-3.1708	-0.5618	-0.0817	0.0536	0.1241
	%	33.3370	-23.3001	-2.1439	-0.3568	-0.0504	0.0320	0.0509

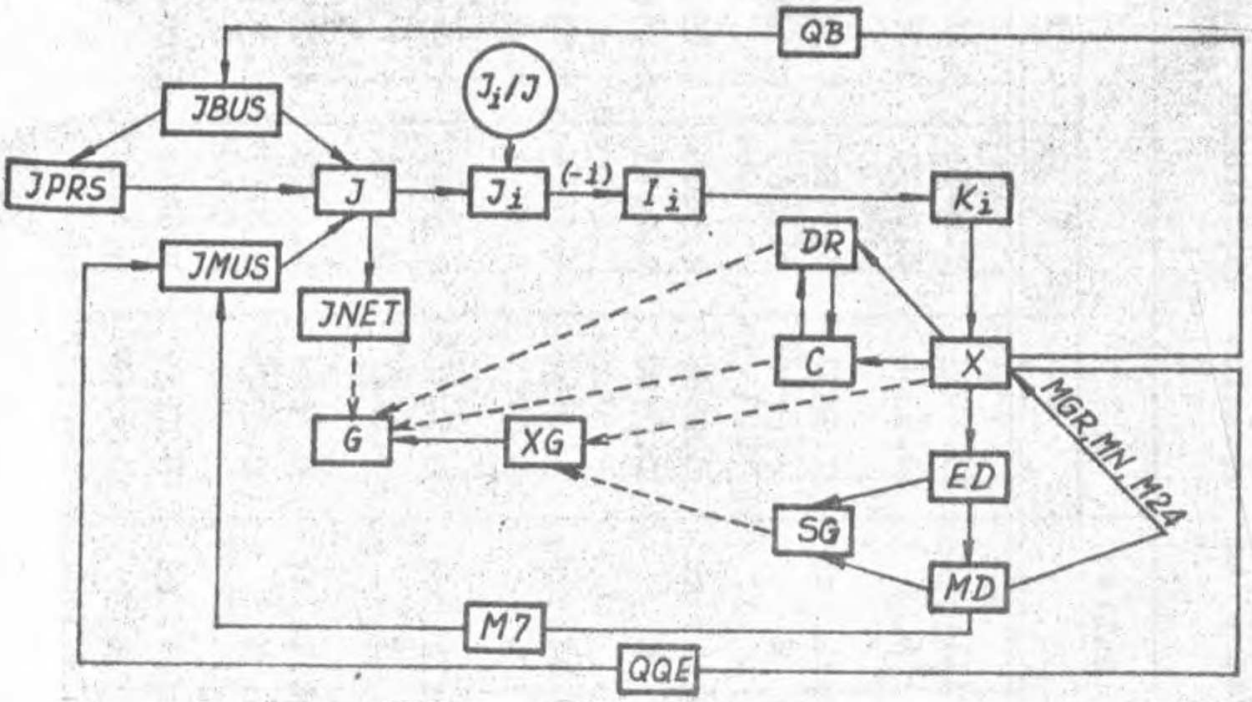
Total imports in constant prices (MD) are distributed among particular categories of goods and payment areas on the basis of predetermined allocation coefficients[12].

An increase in the share of imports from the non-socialist countries (MN/MD) by 5 points yielded in the initial period and the next year an increase of net industrial output by 0.3%, whereas in the case of the produced and distributed NMP by 1.0% in the initial period only. This means an increase of personal consumption by 2.1%, total investments by 0.2%, exports by 1.4% and imports by 1.4%.

The multipliers effect of the impulse imposed on the variable MN/MD run off very quickly - since the second period they are close to zero (cf. Tab. 7).

3.2. Investment and Production

In the supply-oriented model the investment sector is one of the main blocks. The interrelationships between investments and main variables of the W3S79 model are given in graph 2[13].



Graph 2

[12] Cf. Fig. 3.

[13] Cf. Fig. 2.

Table 8

Multipliers of selected variables with respect to one period impulse increase by 33.1 bill.zł in the constant of equation explaining investment outlays for buildings and construction (JBUS)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
JBUS	bill. zł	33.1093	0.0754	0.2052	0.3477	0.4693	0.5498	0.6698
	%	10.3360	0.0238	0.0653	0.1114	0.1509	0.1770	0.2068
X	bill. zł	1.3837	4.3458	6.9433	8.5031	9.4528	10.6331	17.5083
	%	0.0770	0.2285	0.3415	0.3915	0.4080	0.4304	0.4978
XQ	bill. zł	0.8588	2.5688	4.0824	5.1999	6.0410	7.0832	10.9173
	%	0.0900	0.2478	0.3580	0.4153	0.4416	0.4760	0.4903
XG	bill. zł	1.3687	4.3064	6.8857	8.4319	9.3696	10.5298	17.3439
	%	0.0771	0.2292	0.3428	0.3929	0.4093	0.4314	0.4988
Y	bill. zł	0.2850	1.0165	1.8530	2.4720	2.8402	3.1546	3.8131
	%	0.0221	0.0765	0.1345	0.1723	0.1900	0.2009	0.2037
CX	bill. zł	0.7884	2.4938	4.0906	5.2586	6.0310	6.8012	10.3755
	%	0.0723	0.2167	0.3313	0.3963	0.4235	0.4457	0.4817
JNET	bill. zł	19.8240	0.6164	1.0541	1.4122	1.6646	1.8649	2.7505
	%	4.7615	0.1443	0.2367	0.3028	0.3402	0.3629	0.4085

J	bill. zł	36.6959	1.1411	1.9512	2.6141	3.0814	3.4521	5.0913
	%	5.8007	0.1749	0.2844	0.3605	0.4014	0.4245	0.4593
SG	bill. zł	0.0147	0.0386	0.0563	0.0718	0.0839	0.1042	0.1637
	%	0.0663	0.1674	0.2304	0.2766	0.3046	0.3563	0.4130
ED	bill. zł exchange	0.0402	0.1275	0.2139	0.2772	0.3181	0.3677	0.5779
	%	0.0861	0.2542	0.3896	0.4611	0.4853	0.5163	0.5394
MD	bill. zł	0.0390	0.1244	0.2093	0.2714	0.3113	0.3593	0.5646
	%	0.0857	0.2540	0.3906	0.4625	0.4866	0.5169	0.5399
G	bill. zł	-20.3198	-1.0861	-1.3833	0.2522	0.5790	0.4139	2.8890
	%	-11.1489	-0.6093	-1.0219	0.1293	0.2707	0.1770	0.7111
DR	bill. zł	1.0759	2.2823	2.1244	1.5089	1.0949	1.4497	1.3290
	%	1.2468	1.8685	1.4364	0.9583	0.6758	0.8667	0.5446

Table 9

Multipliers of selected variables with respect to one period impulse increase by 24.930 bill. zł in the constant of equation explaining investment outlays for machinery and equipment (JMUS)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
JMUS	bill. zł	25.1674	0.7260	1.1841	1.5315	1.7605	1.9541	2.9882
	%	8.8888	0.2366	0.3446	0.3981	0.4109	0.4119	0.3058
X	bill. zł	0.9491	2.9814	4.7633	5.8338	6.4854	7.2948	12.0068
	%	0.0528	0.1568	0.2343	0.2686	0.2799	0.2953	0.3414
XQ	bill. zł	0.5891	1.7623	2.8007	3.5674	4.1444	4.8592	7.4894
	%	0.0617	0.1700	0.2456	0.2849	0.3030	0.3266	0.3364
XG	bill. zł	0.9317	2.9544	4.7238	5.7838	6.4270	7.2239	11.8950
	%	0.0529	0.1573	0.2352	0.2695	0.2807	0.2959	0.3421
Y	bill. zł	0.1954	0.6976	1.2719	1.6969	1.9499	2.1659	2.6163
	%	0.0151	0.0525	0.0923	0.1183	0.1304	0.1392	0.1398
CX	bill. zł	0.5408	1.7108	2.8062	3.6077	4.1375	4.6658	7.1176
	%	0.0496	0.1486	0.2273	0.2719	0.2905	0.3057	0.3305

J	bill. zł	25.1744	0.7828	1.3386	1.7934	2.1139	2.3682	3.4927
	%	3.9795	0.1200	0.1951	0.2473	0.2754	0.2912	0.3151
JNET	bill. zł	13.5998	0.4229	0.7231	0.9688	1.1420	1.2794	1.8868
	%	3.2665	0.0990	0.1624	0.2078	0.2334	0.2489	0.2802
SG	bill. zł	0.01028	0.02649	0.03862	0.04882	0.05708	0.07145	0.11276
	%	0.0463	0.1149	0.1580	0.1882	0.2072	0.2444	0.2844
ED	bill. zł exchange	0.02759	0.08749	0.14676	0.19015	0.21824	0.25228	0.39645
	%	0.0591	0.1744	0.2673	0.3163	0.3329	0.3542	0.3700
MD	bill. zł exchange	0.02676	0.08532	0.14360	0.18615	0.21356	0.23650	0.38733
	%	0.0588	0.1743	0.2680	0.3173	0.3338	0.3546	0.3703
G	bill. zł	-13.9396	-0.7452	-0.2629	0.1720	0.3963	0.2843	1.9796
	%	-7.6483	-0.4181	-0.1454	0.0882	0.1853	0.1216	0.4873
DR	bill. zł	0.7381	1.5658	1.4574	1.0353	0.7512	0.9944	0.9109
	%	0.8552	1.2819	0.9854	0.6575	0.4637	0.5945	0.3733

Table 10

Multipliers of selected endogenous variables with respect to one period impulse increase by 0.06969 i.e. by 10% of the ratio of investment outlays MP sector (JM/J)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
X	bill. zł	2.4106	7.5721	12.0971	14.8152	16.4694	18.5254	30.5320
	%	0.1341	0.3982	0.5950	0.6822	0.7108	0.7499	0.8681
XQ	bill. zł	1.4962	4.4759	7.1129	9.0602	10.5257	12.3415	19.0228
	%	0.1567	0.4318	0.6238	0.7236	0.7695	10.8294	0.8544
XG	bill. zł	2.3853	7.5035	11.9989	14.6910	16.3230	18.3433	30.2457
	%	0.1343	0.3906	0.5914	0.6846	0.7160	0.7516	0.8698
Y	bill. zł	0.4955	1.7688	3.2241	4.3002	4.9404	5.4855	6.6364
	%	0.0386	0.1332	0.2340	0.2907	0.3304	0.3525	0.3545
CX	bill. zł	1.3736	4.1200	6.8211	8.3355	10.1709	11.4989	17.7412
	%	0.1259	0.3579	0.5525	0.6658	0.7141	0.7535	0.8237
J	bill. zł	1.6207	1.9882	3.3996	4.5647	5.3689	6.0148	8.8715
	%	0.0981	0.3047	0.4955	0.6581	0.6994	0.7396	0.8004

JNET	bill. zł	0.3353	1.0741	1.8366	2.4606	2.9004	3.2494	4.7926
	%	0.0805	0.2515	0.4125	0.5276	0.5928	0.6322	0.7117
SG	bill. zł	0.0261	0.0673	0.0989	0.1251	0.1457	0.1809	0.2853
	%	0.1176	0.2918	0.4048	0.4826	0.5290	0.6190	0.7194
G	bill. zł	-1.1982	-1.6675	-0.3599	0.7657	1.3441	1.0698	5.5910
	%	-0.6574	-0.9355	-0.1990	0.3924	0.6285	0.4575	1.3270
DR	bill. zł	1.8745	3.9768	3.7011	2.6292	1.9026	2.5258	2.3209
	%	2.1722	3.2568	2.5026	1.6609	1.1776	1.5101	0.9510
ED	bill. zł exchange	0.0701	0.2222	0.3727	0.4829	0.5543	0.6407	1.0072
	%	0.1501	0.4429	0.6789	0.8034	0.8455	0.8995	0.9400
MD	bill. zł exchange	0.0679	0.2167	0.3647	0.4728	0.6424	0.6259	0.9339
	%	0.1493	0.4426	0.6807	0.8059	0.3478	0.9006	0.9408

This graph illustrates the crucial long-term feed-back characteristic for the supply-oriented model, "inverse" to the investment output feed-back

$$J \rightarrow K \rightarrow X \rightarrow J.$$

In the next Tabs 8-10 we present multipliers showing the impact of changes in intercepts of stochastic equations explaining the investment outlays for machinery and equipment (JMUS) and for building and construction (JBUS), and of changes in allocation of investments between the material and non-material production sectors (JM/J and JN/J).

The assumed increase of investment outlays by 10% of the 1979 level (JBUS by 33.1 and JMUS by 24.9 bill.zł) causes an immediate increase of the produced NMP (by 0.08 and 0.05%, respectively) and due to lag distribution in investments put into operation - also in the next years. This allows to increase the exports and imports (by 0.09% and 0.06%), personal consumption (by 0.07% and 0.05%) and inventories (by 1.25 and 0.9%) in the initial period. Both in the case of JBUS and JMUS this denotes a necessity to decrease government expenditure (G). A slight increase is observed only in the third period.

The growth of NMP makes possible the increase of investment outlays in the next year, strengthening in this way the reaction to the initial impulse. Hence, the multipliers do not expire but on the contrary, they reveal a clear-cut increasing tendency, which is confirmed by the investment output feed-back.

The variable JM/J is an instrument of economic policy determining the total investment allocation. An increase in the share of investment outlays for the material sector by 7 points (equivalent to the respective decrease of investments in non-material sector) causes a net production increase in all industrial branches which results in increase of the produced and distributed NMP by 0.1% in the initial period. In subsequent years these increments are higher and after 10 years they constitute 0.9%. Similar tendencies have been observed in the formation of personal and government consumption expenditure, exports, imports, and inventories.

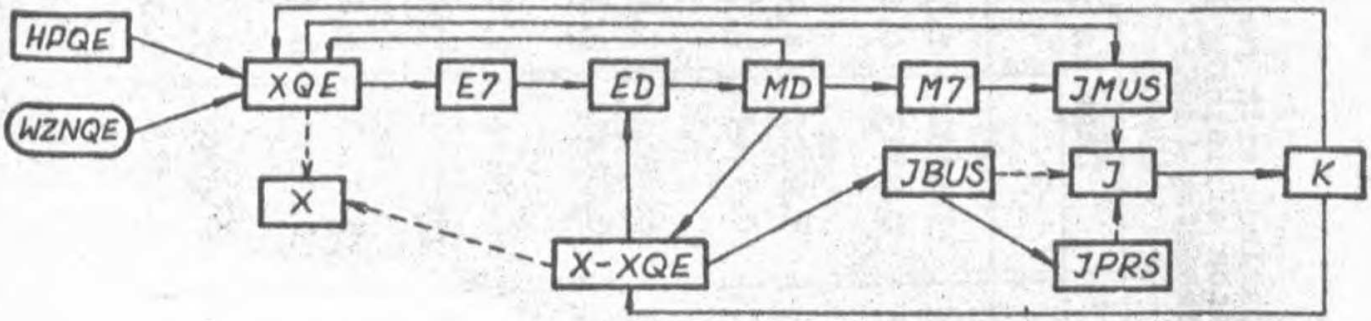
Intermediate multipliers are growing from one period to another as a result of the investment output feed-back.

3.3. Bottle-necks in Industrial Capacities

Lower utilization of production capacities observed in recent years is mainly due to energy limitations, shortage of raw materials (including those imported) and shortening of the working week. Solving these problems would contribute, to a big extent, to improvement of the economic situation in the country.

Multipliers calculated with respect to intercepts of production functions in particular industrial branches (cf. Tabs 11-15) illustrate the effects which could be expected as a result of overcoming the existing limitations.

We shall analyse them on the example of the electro-engineering industry. Its position in the W3S79 model is illustrated in graph 3[14].



Graph 3

Higher production capacity utilization in the electroengineering industry (the intercept in XQE equation grew by 28.81 bill.zł i.e. by 10% of net output of this industry in 1979) caused an immediate increase (through bigger exports of machinery and equipment) of exports (by 4.8%) and, therefore of imports too (by 4.7%). This enabled to overcome imports limitations and increase of net production also in other industrial branches and in agriculture, which in turn, brought an increase of NMP by 2.9% (distributed NMP by 2.8%).

The growth of imports of machinery and equipment (M7) and the increase of domestic production of investment goods (XQE) allowed

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[14] The scheme of the whole production sector is presented in Fig. 1. Cf. also Fig. 3.

Table 11

Multipliers of selected endogenous variables with respect to one period impulse increase by 28.81 bill. zł in the constant of equation explaining NMP originating in elektro-engineering industry (XQE)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
XQE	bill. zł	29.0680	8.5783	3.6131	2.5968	2.5699	2.7339	4.1183
	%	9.5119	2.5934	0.9713	0.6203	0.5485	0.5247	0.4917
XQ	bill. zł	39.6919	12.3521	5.9797	4.9307	5.1842	5.9131	9.2944
	%	4.1576	1.1917	0.5244	0.3938	0.3790	0.3974	0.4174
X	bill. zł	50.7452	6.5497	6.3861	7.1388	7.9523	8.9303	14.9304
	%	2.9222	0.3444	0.3141	0.3287	0.3434	0.3615	0.4245
XG	bill. zł	49.6595	6.4915	6.2616	7.0598	7.8803	8.8438	14.7908
	%	2.7968	0.3456	0.3117	0.3290	0.3442	0.3623	0.4253
Y	bill. zł	7.1689	6.4035	5.3323	4.6377	4.0349	3.6547	3.3118
	%	0.5550	0.4821	0.3870	0.3232	0.2699	0.2349	0.1769
CX	bill. zł	42.5746	13.4011	6.4059	5.1416	5.2599	5.7649	8.8327
	%	3.9024	1.1643	0.5189	0.3875	0.3693	0.3778	0.4101

J	bill. zł	23.3532	7.0287	3.1675	2.5225	2.6467	2.9144	4.3398
	%	3.6916	1.0772	0.4616	0.3479	0.3448	0.3584	0.3915
JNET	bill. zł	12.6159	3.7971	1.7112	1.3627	1.4298	1.5745	2.3444
	%	3.0302	0.8891	0.3843	0.2922	0.2922	0.3063	0.3482
SG	bill. zł	1.0865	0.0575	0.1252	0.0795	0.0750	0.0871	0.1391
	%	4.8902	0.2495	0.5121	0.3065	0.2743	0.2981	0.3509
ED	bill. zł exchange	2.2448	0.6781	0.3254	0.2654	0.2746	0.3085	0.4921
	%	4.8090	1.3515	0.5926	0.4415	0.4189	0.4331	0.4593
MD	bill. zł exchange	2.1566	0.6734	0.3152	0.2589	0.2685	0.3015	0.4808
	%	4.7357	1.3753	0.5883	0.4414	0.4196	0.4336	0.4597
DR	bill. zł	47.0781	-28.5984	-6.8381	-1.0639	0.3738	1.0105	1.1369
	%	49.9186	-23.4134	-4.6235	-0.6757	0.2307	0.6041	0.4659
G	bill. zł	-48.6091	17.8917	4.9827	1.6193	0.8167	0.4940	2.4767
	%	-26.6705	10.0376	2.7551	0.8299	0.3819	0.2113	0.6096

Table 12

Multipliers of selected endogenous variables with respect to one period impulse increase by 19.11 bill. zł in the constant of equation explaining NMP originating in light, wood and paper industry (XQL)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
XQL	bill. zł	21.0741	0.5897	0.2693	0.2326	0.2515	0.3025	0.2706
	%	10.7990	0.2869	0.1241	0.1016	0.1048	0.1206	0.1719
XQ	bill. zł	26.4439	7.8238	2.7778	1.6411	1.5204	1.6647	2.6929
	%	2.7699	0.5448	0.2436	0.1311	0.1112	0.1119	0.1209
X	bill. zł	33.6632	3.4592	2.0591	2.0314	2.2648	2.5325	4.3324
	%	1.8722	0.1819	0.1013	0.0930	0.0977	0.1025	0.1232
XG	bill. zł	37.8828	3.4243	1.9927	2.0003	2.2408	2.5076	4.2915
	%	1.8516	0.1823	0.0992	0.0932	0.0979	0.1027	0.1234
Y	bill. zł	8.0411	3.3691	1.8788	1.4981	1.2471	1.0929	0.9646
	%	0.6225	0.2536	0.1363	0.1044	0.0834	0.0702	0.0515
CX	bill. zł	15.5001	8.5923	3.0764	1.7695	1.5773	1.6601	2.5588
	%	1.4208	0.7465	0.2492	0.1334	0.1108	0.1088	0.1188

J	bill. zł	3.4755	4.5661	1.5464	0.8561	0.7772	0.8544	1.2595
	%	0.5491	0.6998	0.2254	0.1181	0.1012	0.1026	0.1136
JNET	bill. zł	1.8764	2.4667	0.8354	0.4625	0.4199	0.4508	0.6804
	%	0.4507	0.5776	0.1876	0.0992	0.0858	0.0877	0.1010
SG	bill. zł	0.7809	0.0358	0.0647	0.0306	0.0235	0.0244	0.0401
	%	3.5151	3.1553	0.2679	0.1178	0.0852	0.0852	0.1010
ED	bill. zł exchange	1.5756	0.4345	0.1542	0.0894	0.0812	0.0875	0.1426
	%	3.3753	0.8659	0.2809	0.1487	0.1239	0.1229	0.1331
MD	bill. zł exchange	1.5122	0.4316	0.1489	0.0869	0.0793	0.0855	0.1593
	%	3.3206	0.8814	0.2778	0.1481	0.1239	0.1230	0.1332
DR	bill. zł	41.8767	-29.9954	-7.8155	-1.7656	-0.2294	0.1761	0.3314
	%	43.5265	-24.5572	-5.2845	-1.1214	-0.1416	0.1055	0.1358
G	bill. zł	-26.3705	22.3606	5.8963	1.5339	0.4727	0.2205	0.7208
	%	-14.4688	12.5448	3.3603	0.7861	0.2210	0.0943	0.1774

Table 13

Multipliers of selected endogenous variables with respect to one period impulse increase by 9.24 bill.zł in the constant of equation explaining NMP originating in food industry (XQR)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
XQR	bill. zł	9.3458	0.0356	0.0124	0.0092	0.0095	0.0104	0.0162
	%	9.7105	0.0350	0.0115	0.0080	0.0077	0.0079	0.0090
XQ	bill. zł	10.1847	0.6364	0.2383	0.1310	0.1225	0.1343	0.2177
	%	1.0668	0.0614	0.0209	0.0105	0.0090	0.0090	0.0098
X	bill. zł	13.2717	-1.8459	0.1858	0.1593	0.1830	0.2047	0.3502
	%	0.7381	-0.0971	0.0091	0.0073	0.0079	0.0083	0.0100
XG	bill. zł	13.3195	-1.7953	0.1658	0.1555	0.1797	0.2012	0.3473
	%	0.7500	-0.0956	0.0083	0.0072	0.0078	0.0082	0.0100
Y	bill. zł	2.6936	0.5464	0.2625	0.1821	0.1301	0.1028	0.0781
	%	0.2085	0.0411	0.0190	0.0127	0.0087	0.0066	0.0042
CX	bill. zł	39.7653	2.2184	0.9111	0.4177	0.2450	0.1843	0.2075
	%	3.6449	0.1927	0.0738	0.0315	0.0172	0.0121	0.0096

J	bill. zł	0.2729	0.3705	0.1335	0.0682	0.0626	0.0673	0.1018
	%	0.0431	0.0568	0.0194	0.0094	0.0081	0.0083	0.0092
JNET	bill. zł	0.1474	0.2001	0.0721	0.0368	0.0338	0.0364	0.0550
	%	0.0354	0.0469	0.0162	0.0079	0.0069	0.0071	0.0082
SG	bill. zł	-0.0485	-0.0520	0.0207	0.0021	0.0017	0.0170	0.0036
	%	-0.2184	-0.2255	0.0849	0.0081	0.0062	0.0059	0.0091
ED	bill. zł exchange	0.1149	0.0348	0.0134	0.0071	0.0065	0.0071	0.0115
	%	0.2461	0.0694	0.0243	0.0119	0.0100	0.0099	0.0108
MD	bill. zł exchange	0.1188	0.0689	0.0117	0.0069	0.0064	0.0069	0.0113
	%	0.2609	0.0296	0.0218	0.0118	0.0100	0.0099	0.0108
DR	bill. zł	20.9853	-19.3417	-0.9671	-0.3389	-0.1031	-0.0238	0.0262
	%	24.3177	-15.8350	-0.6539	-0.2153	-0.0636	-0.0143	0.0107
G	bill. zł	-47.5785	15.1279	0.1498	0.0399	0.0040	0.0044	0.0586
	%	-26.1051	8.4871	0.0828	0.0204	0.0019	0.0019	0.0144

Table 14

Multipliers of selected endogenous variables with respect to one period impulse increase by 17.12 bill. zł in the constant of equation explaining NMP originating in metallurgie, chemical and mineral industry (XQM)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
XQM	bill. zł	17.5309	-0.1743	-0.0233	0.0174	0.0192	0.0222	0.0323
	%	9.6782	-0.0860	-0.0103	0.0070	0.0070	0.0075	0.0072
XQ	bill. zł	18.8836	0.4644	-0.4002	0.0079	0.0944	0.1013	0.1479
	%	1.9780	0.0448	-0.0351	0.0006	0.0069	0.0068	0.0066
X	bill. zł	1.6784	-3.7379	0.2421	0.2027	0.1269	0.1429	0.2361
	%	0.0933	-0.1966	0.0119	0.0093	0.0055	0.0058	0.0067
XG	bill. zł	1.5288	-3.6887	0.2305	0.2014	0.1247	0.1405	0.2322
	%	0.0861	-0.1964	0.0115	0.0094	0.0054	0.0058	0.0067
Y	bill. zł	7.3186	5.5282	4.4628	2.8059	1.5721	0.8914	0.8927
	%	0.5666	0.4162	0.3239	0.1956	0.1051	0.0573	0.0049
CX	bill. zł	1.0914	0.4738	-0.4341	0.0025	0.0938	0.0962	0.1406
	%	0.1000	0.0412	-0.0352	0.0002	0.0066	0.0063	0.0065

J	bill. zł	0.5129	0.3007	-0.2459	-0.0035	0.0494	0.0049	0.0688
	%	0.0811	0.0461	-0.0358	-0.0005	0.0064	0.0061	0.0062
JNET	bill. zł	0.2771	0.1624	-0.1328	-0.0019	0.0267	0.0269	0.0372
	%	0.0665	0.0380	-0.0298	-0.0004	0.0055	0.0052	0.0055
SG	bill. zł	0.1489	-0.0486	-0.0122	-0.0000	0.0009	0.0013	0.0019
	%	0.6705	-0.2109	0.0500	-0.0000	0.0034	0.0043	0.0049
ED	bill. zł exchange	0.2354	-0.1028	-0.0162	0.0052	0.0051	0.0050	0.0078
	%	0.5042	-0.2050	-0.0294	0.0086	0.0086	0.0078	0.0073
MD	bill. zł exchange	0.2233	-0.0989	-0.0171	0.0052	0.0050	0.0049	0.0076
	%	0.4903	-0.2019	-0.0320	0.0088	0.0078	0.0070	0.0073
DR	bill. zł	21.5684	-21.2125	-0.5969	0.2853	0.0717	0.0178	0.0176
	%	24.9933	-17.3667	-0.4036	0.1812	0.0442	0.0107	0.0072
G	bill. zł	-21.4079	16.8876	1.3943	-0.0846	-0.0674	-0.0005	0.0369
	%	-11.7460	9.4743	0.7710	-0.0433	-0.0315	-0.0002	0.0091

Table 15

Multipliers of selected endogenous variables with respect to one period impulse increase by 12.010 bill. zł in the constant of equation explaining NMP originating in fuel and power industry (XQF)

Variables	Units	Lags in years						
		0	1	2	3	4	5	10
X	bill.zł	7.5787	-0.7146	0.6102	0.5897	0.6092	0.6818	1.1616
	%	0.4215	-0.0376	0.0300	0.0272	0.0263	0.0276	0.0330
XQF	bill.zł	12.0100	0.000154	0.000669	0.001516	0.002438	0.003149	0.004692
	%	8.6077	0.0001	0.0004	0.0008	0.0012	0.0014	0.0014
XQ	bill.zł	14.5999	2.1162	0.4729	0.4004	0.4133	0.4516	0.7227
	%	1.5293	0.2042	0.0415	0.0320	0.0302	0.0303	0.0325
XG	bill.zł	7.3023	-0.7058	0.5895	0.5816	0.6022	0.6744	1.1496
	%	0.4112	-0.0376	0.0293	0.0271	0.0263	0.0276	0.0331
Y	bill.zł	3.6512	2.9894	2.5119	1.6556	1.0307	0.6796	0.2774
	%	0.2827	0.2251	0.1823	0.1154	0.0689	0.0437	0.0148
CX	bill.zł	2.3219	2.3062	0.5283	0.4288	0.4268	0.4479	0.6868
	%	0.2128	0.2004	0.0428	0.0323	0.0300	0.0294	0.0319

JNET	bill.zł	0.5895	0.6751	0.1361	0.1108	0.1144	0.1221	0.1825
	%	0.1416	0.1581	0.0306	0.0238	0.0234	0.0237	0.0271
J	bill.zł	1.0911	1.2497	0.2519	0.2052	0.2118	0.2259	0.3378
	%	0.1225	0.1915	0.0367	0.0283	0.0276	0.0278	0.0305
SG	bill.zł	0.2758	-0.008173	0.01965	0.007359	0.006081	0.006459	0.01053
	%	1.2411	-0.0354	0.0804	0.0284	0.0221	0.0221	0.0265
ED	bill.zł exchange	0.4974	0.05453	0.02923	0.02411	0.02211	0.02357	0.03827
	%	1.0656	0.1087	0.0532	0.0401	0.0337	0.0331	0.0357
MD	bill.zł exchange	0.4750	0.05522	0.02761	0.02349	0.02159	0.02303	0.03737
	%	1.0431	0.1128	0.0515	0.0400	0.01338	0.0331	0.0357
G	bill.zł	-9.8604	8.2044	1.5701	0.2111	0.05657	0.04774	0.1917
	%	-5.4101	4.6028	0.8681	0.1082	0.0265	0.0204	0.0472
DR	bill.zł	14.2513	-11.8916	-1.6450	-0.1691	0.004396	0.05664	0.08859
	%	16.5144	-9.7356	-1.1122	-0.1074	0.0027	0.0339	0.0363

to raise the total investment outlays (J) by 3.7% due to higher outlays for machinery and equipment (JMUS).

As a result of output growth (and market supplies growth) the supply of consumer goods went up by 3.9%. As the inventories were up by 49.9%, a decrease of government consumption expenditure by 26.7% followed.

The growth of imports from non-socialist countries effected in the initial year, enabled a further increase of XQE in the next years. That effect was additionally supported by increase of industrial capacities (KQE) caused by the increment of investment outlays (JQE) in the year 0. As a result of the above feed-backs XQE increased by 2.6%. The effect of this increase XQE on other variables was strengthened by the increase of production capacities obtained due to the increase J in the first year.

As a result of the quasi acceleration principle, the multipliers do not expire but, beginning from the third period, reveal an upward trend.

Similar simulation experiments were carried out in relation to the remaining industrial branches.

The assumed increase of intercepts in equations XQL, XQR, XQF and XQM (corresponding to the net output growth in each industrial branch of 10% in comparison with its 1979 level) caused an increase of the produced NMP by 1.87, 0.73, 0.42 and 0.09% respectively, supplies of consumer goods by 1.42, 3.64, 0.21 and 0.1%, and total investment outlays by 0.55, 0.04, 0.12, 0.08% respectively.

The multipliers in the next years are similar to those of the previously analysed electro-engineering industry but they are much smaller. This is due to the fact that the net output of these industries does not influence directly the level of investment outlays but only through exports and imports. Hence the effects of the "acceleration" principle are much lower.

On the basis of the presented model several simulation and forecasting experiments were carried out. They are presented in a separate paper.

Appendix 1

List of Variables

For the designation the following conventions are used:

i - added at the end of the symbol indicates the sector (industry, branch)
i = M, N, R, L, Q (QF, QE, QM, QR, QL, QI), B, H, T
where:
M - MP sector (material product sector)
N - non-material services sector
R - agriculture, L - forestry, Q - manufacture and mining
QF - fuel and power industry
QE - electro-engineering industry
QM - metallurgic, chemical and mineral industry
QR - food industry
QL - light, wood and paper industry
QI - other industries
B - building industry
H - trade
T - transportation

k - added at the end of the symbol denotes a particular category of goods in foreign trade
k = N, S, 1, 24, 3, 7, PO
N - other non-socialist countries
S - socialist countries
1 - foodstuffs, beverages, tobacco
24 - raw materials (excluding food)
3 - fuel
7 - machinery and equipment
PO - other industrial
FD - foodstuffs, beverages, tobacco (excluding corn)
GR - corn

D - before the symbol stands for the first difference operation

P - at the end of the symbol denotes a category in current prices

AX_i - financial accumulation in the i-th industry (sector)

C - personal consumption expenditure on material goods (except depreciation of residential structures)

CHZA - sales in socialized retail and catering trade, foodstuffs
CX - personal consumption, total
ED - exports total (constant price)
E_k - exports of the k-th category of goods
PUS_iP - wage bill in the i-th industry (sector)
G - other consumption, i.e. government expenditure on material goods consumed in non-material services sector
HPQ_i - man-hours worked by industrial workers in the i-th branch of manufacturing and mining
IK_i - investments, gross, estimated in the i-th branch (sector)
IOWA - index IOWA
J - investment outlays, total
J_i - investment outlays in the i-th branch (sector)
J_i/J - ratio of investment allocations to the i-th branch (sector)
JBUS - investment outlays, buildings and construction
JMUS - investment outlays, machinery and equipment
JNXGP - share of net investments in the distributed NMP
JPRS - investment outlays, other investment goods
JNET - investment outlays, net
KD_i - depreciation of gross fixed assets in the i-th branch (sector)
K_i - fixed assets (average stock) in the i-th branch (sector)
K_iK - fixed assets (stock year end) in the i-th branch (sector)
L - population, total
LM - population, urban, share
LW - population productive age: women 18-59, men 18-64 years of age
MD - imports, total
M_k - imports of the k-th category of goods
M_k/MD - share of imports of the k-th category in total imports
NA - employment total (active population)
NA_i - employment total (active population) in the i-th branch (sector)
NANSR - employment total except private farmers and employed in private farms
NNSR - employment, private farmers and employed in private farms

$NUSA_i$ - employment in the i-th branch, socialized sector
NNS_i - employment in the i-th branch, private sector
PC - personal consumption expenditure on material goods, price deflator
PED - exports, price deflator
PE_k - exports of the k-th category of goods, price deflator
PMD - imports, price deflator
PM_k - imports of the k-th category of goods, price deflator
PQ_i - deflators of gross production in the i-th branch
PX_i - NMP originating in the i-th branch, price deflator
PY - personal income, price deflator
Q_i - gross production in the i-th branch
R - inventories, total stock
RNH - inventories, stock of raw materials, materials, fuel, semi-finished products
RNZ - inventories, stocks of non-food commodities in socialized retail, wholesale trade
RZ - inventories, stock of foodstuffs in socialized retail, wholesale trade
SEMP - cumulated foreign trade balance
SG - excess of exports over imports
SN - chemical fertilizers - utilized land area ratio
SNEMP - cumulated foreign trade balance with non-socialist countries
SR - market supplies, total
SR_i - market supplies of goods produced in the i-th branch
$WZNQ_i$ - shift coefficient in the i-th branch
X - net material product (NMP)
X_i - NMP originating in the i-th branch (industry)
XG - national income, distributed
YP - personal income, total
YINP - personal income, private sector, except agriculture
YPOP - other personal income
YPRP - personal income, wages, salaries, transfers received by employees in socialized sector
YRP - personal income, private farmers' income from agriculture
ZUS_iP - wage rate, annual average in the i-th branch

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ANALIZA MNOŻNIKOWA NA PODSTAWIE MODELU W3S79

W artykule zaprezentowano średniookresowy model funkcjonowania gospodarki Polski W3S79, zbudowany w Instytucie Ekonometrii i Statystyki UŁ, a ściślej biorąc jego ostatnią podażową wersję.

Model W3S79 liczy 353 równania, z czego 153 stochastyczne. Wyróżnia się w nim m. in. następujące bloki równań: inwestycje i majątek trwały (nakłady, inwestycje oddane do użytku, likwidacje, majątek trwały), zatrudnienie (podaż siły roboczej, czas pracy w przemyśle), produkcja (czysta i globalna), dochody ludności, dostawy na zaopatrzenie rynku, konsumpcja, eksport, import oraz ceny.

Najważniejszymi zmiennymi egzogenicznymi wykorzystywanymi w modelu są: deflatory cen importu i eksportu, podaż siły roboczej poza indywidualnym rolnictwem, indeks pogody IOWA oraz współczynniki: struktury importu, działowej alokacji inwestycji i zmianowości w przemyśle.

Autorzy zaprezentowali charakterystykę statycznych i dynamicznych własności modelu przeprowadzoną w oparciu o analizę rozwiązania kontrolnego otrzymanego dla ekranu próby, tj. lat 1961-1979, oraz analizę mnożników policzonych względem wybranych zmiennych egzogenicznych i względem wyrazów wolnych w ważniejszych równaniach stochastycznych.