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THE MOSES MANUAL

Part 2

THE INITIALIZATION PROCESS

by

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CONTENTS Page

NOTE: * The Micro Data Base and the Micro initialization are also described in much detail in Albrecht-Lindberg (1982).

Preface

MOSES is short for "**Mo**del for **S**imulating the **E**conomy of **S**weden". Different versions of the model have been used within the institute for about five years by now. A number of simulation experiments have been performed. The whole model is written in the programming language APL. The present version of the model is installed on a computer in Bergen, Norway. This has come about through cooperation with the industrial institute for economic research, IØI, in Bergen.

For some time there has been a demand for a full documentation of the current version of the model.[1] "The MOSES Manual" fulfils one part of this request. Anyone interested in a large-scale simulation model of this kind needs to get acquainted with the techniques involved in starting up (initializing) and running the model. Experiments have shown that the initialization procedure, which constructs an initial state of the model economy, is crucial indeed, for the behaviour of the model. This paper is devoted to describing the initialization process.[2] One can divide the **initialization process** into three stages: **data base work**, the **initialization procedure** and **consistency controls**.

Quite a tremendous amount of information is needed to start up the model. The main reason for this is the fact that the model simulates the behaviour of the economy mainly by summing up the dynamic performance of individual firms (micro simulation). Each firm is described by about 100 variables. About 150 firms participate (in the present version of the model). There are also a large number of variables needed to describe the "macro-sectors" in the model, e.g. the household sector, the Government sector, non-industrial sectors etc. The collection of **micro data** and **macro data** needed for the initialization has been a drawn out research project at IUI, where a number of people have been involved.[3] The **data base work** is documented by the Sections 3, 5 and Appendices B and E.

Micro and macro data have to be transformed in several ways before they finally can be fed into the model. The **initialization procedure** is the name of this transformation process. In this procedure we also include the task of giving values to **parameters** affecting the behaviour of households and firms. The initialization procedure is documented by Sections 1, 2, 4 plus Appendices A, C and D. This has also been a lengthy research project at IUI with several people involved.[3]

Finally one has to check that all variables in the model (for the initial year) are consistent and that micro in all senses add up to the macro totals. This **consistency checking** has been done by the author of this paper, and is described in the Sections 3.2 and 6.

Part 1 of this manual describes how to run the model, in a technical sense. To be able to make experiments with the model one has to know the initialization procedure in some detail. Thus the user of the model must be well acquainted with both Part 1 and Part 2 of the manual. Section 7 of this paper is a bridge between Part 1 and Part 2 where some examples of simulation techniques are presented.

In conclusion, it should be pointed out that this paper has a twofold purpose. It is a documentation of the initialization process and an aid for the future users of the model.

Section 1 Introduction

The "micro-to-macro model" MOSES simulates the economy quarter by quarter from a given starting year. Before one can start a simulation of the Swedish economy with the model one has to **initialize** a vast number of variables. The starting year is, for the time being, 1976.[4] The reason for this is that 1976 is the earliest year for which a complete micro and macro data base exists.

"Initialization" means, mainly, that three kinds of variables are given values.

(1) Variables for 1976 needed to start up the model.
(2) Variables needed to determine the future of certain variables which get their values irrespective of what happens during the simulation.
(3) Certain constants. Some of these are parameters affecting the behaviour of firms, households and market mechanisms.

In what follows, the first kind of variables will be referred to as "**start-up variables**", the second will be referred to as "**exogenous time-series**" and the third will simply be called "**constants**". A constant which affects the behaviour of firms or households is called a **parameter**.

An example of a "start-up variable" is RU, the rate of unemployment 1976. An example of an "exogenous time-series" is the growth of the government employment in the model. There is a variable[5] called EXO∆REALCHLG, which is a vector (over time) containing the number of people to be added to the government-sector each quarter. An example of a "constant" is SMT which is a factor determining to what extent profit targets are updated with recent development during the simulation. More precisely:[6]

Targ(n+1) gets the value Targ(n) • SMT + M(n) • (1-SMT)

where

Targ(n+1) = profit target, quarter n+1
Targ(n) = profit target, quarter n
M(n) = actual profit, quarter n

The three mentioned kinds of variables can be **micro variables** or **macro variables**.

A "**micro variable**" is a variable which is connected with firms. Such variables are often vectors. A micro variable can be some characteristic of the firms (for example the value added share), a behaviour parameter (for example SMT above) or a variable which the firm can influence (for example L below).

Example:
L is the labour force (number of people) in each firm.
L(n) is the labour force in firm n.
n = 1,2,3,...,147 for the present.

The length of the vector is equal to the number of firms participating in the simulation. A micro variable can also be a constant, equal for all firms (a scalar). The constant SMT, mentioned above, determines the way profit target changes in each firm between any two quarters, and is an example of such a micro variable.

Typical macro variables are (for example) the rate of unemployment, the growth of the government-sector and tax-rates.

Certain macro variables apply to macro-entities but are **used** as micro variables as well. Such variables obviously lie somewhere between the two categories micro and macro.

An example of this is the variable IO, the input-output matrix.

IO(i,j) tells how much of production in sector j comes from input from sector i, and is a number between 0 and 1.

During the initialization IO gets the true values from real data for the economy for 1976. Throughout the whole simulation these shares are used (cf. Section 3) to determine **each firm's** demand from other sectors.

An alphabetical list of all variables (about 200) coming out from the initialization can be found in appendix A. An alphabetical list of all variables (about 400) in the model itself can be found in Eliasson-Heiman-Olavi (1978).

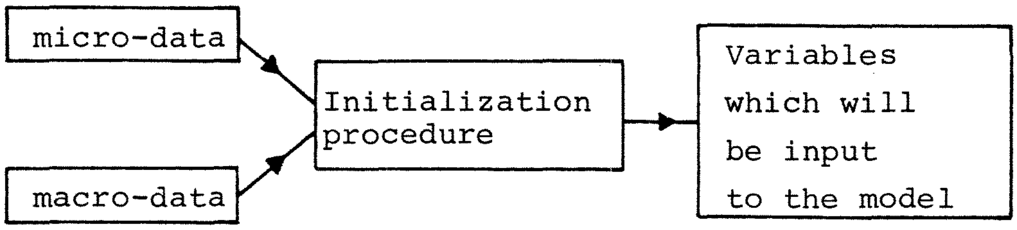
The main features of the initialization procedure are described in the next section. In Section 3 the input-output system is described, since it is an essential part of the initialization procedure and the data base work. The input-output system is described in rather much detail. The techniques involved are of general interest for builders of large scale simulation models of this kind. Section 4 presents the initialization procedure in more detail. Sections 5 and 6 are devoted to a documentation of the data bases and the consistency control system. Section 7 is of interest for users of the model.

Section 2 The Initialization, Main Features

The "initialization procedure" is a matter of converting raw-data (micro and macro data) to the variables mentioned in the previous section, needed for the model-simulation.

<u>Schematically:</u>

Figure 1



Input to initialization

Output from initialization

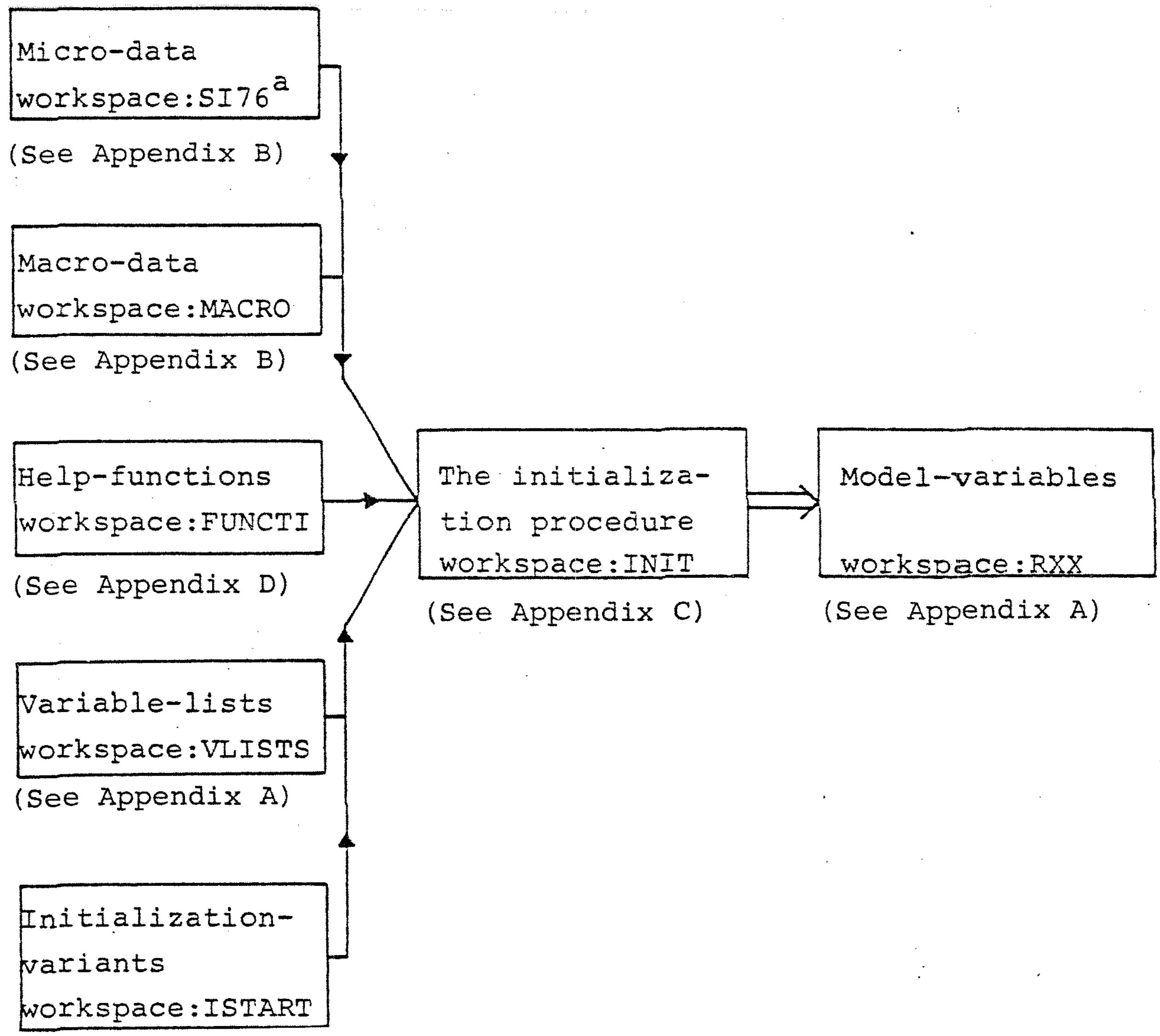
We will refer to "variables which will be input to the model" as "**model variables**", in what follows.

Micro data, which is data for real firms in the model, are stored in one work-space and macro data in another. Micro variables and macro variables are formed from micro data and macro data.

A more detailed schematic overview of the initialization procedure is shown in Figures 2 and 3. The whole initialization program was rewritten between 1980 and 1981 by the author of this paper. The logical structure of the initialization and the consistency checking were done during this period. An important addition was a part of the program called **OUTPUTΔOPERATIONS**, where the **model vari-**

ables were sifted from other data. Previously everything - raw data, intermediate variables and model variables - came out together after initialization. This meant that output from the initialization was "hidden" among a lot of redundant data. The new initialization procedure has notably facilitated practical work with the model.

Figure 2 The initialization procedure, input and output



[a] SI stands for the "Federation of Swedish Industries", which collected the micro data, through the so called Planning Survey. Reference persons: Ola Virin, Kerstin Wallmark.

The contents of each workspace in Figure 2 will be described below. The initialization procedure is written in the programming language APL. In APL both variables and functions are stored in so called workspaces which can be immediately transferred to computer-memory, by aid of certain system commands (cf. Part 1 of this manual). **We write APL-functions in boldface letters** in what follows, but not workspace names.

The program for the initialization procedure lies in a workspace called INIT. This program consists of a main-function **START** and a number of parts, so called sub-functions. Figure 3 shows the structure of the initialization program, in workspace INIT.

Figure 3 The initialization program

Main program	Sub-functions, level 1[a]	Sub-functions, level 2[a]
START	**ISTARTXX**[b]	**TAXΔPARAMETERS**
	SIΔINIT	**PUBLICΔSECTOR**
		MONETARY
		MARKETS
		HOUSEHOLDS
		ESTABLISHMENTS
		DISPOSEΔVARAΔINPUT
		MARKETSΔDATA
		SECONDARYΔDATA
		PUBLICΔDATA
		MONETARYΔDATA
		HOUSEHOLDSΔDATA
		OUTPUTΔOPERATIONS

[a] The greek letter "delta", Δ, is used in function-names in the APL-code instead of blanks, if the function-name consists of several words. Thus **PUBLICΔSECTOR** should be read "public sector" etc.

[b] XX in **ISTARTXX** stands for a number indicating different initialization variants.

The initialization is, as seen from Figure 3, divided into parts (sub-functions, level 2) according to the type of the variable.

Variables connected with taxes are set in **TAXΔPARAMETERS**. Variables connected with the government sector are set in **PUBLICΔSECTOR**. Variables connected with individual firms (micro variables) are given values in the function **ESTABLISHMENTS**, etc.

SIΔINIT (sub-function, level 1) calls all the sub-functions at level 2, and does some administration.[7]

Let us now turn to Figure 2 again.

Macro data are fetched from workspace MACRO in the beginning of **SIΔINIT** and **micro data** are fetched from workspace SI76 in the beginning of the sub-function **ESTABLISHMENTS**.

Help-functions for different applications are fetched from workspace FUNCTI.

To know the names of the model-variables **variable lists** are fetched from workspace VLISTS. In the sub-function **OUTPUTΔOPERATIONS** the variables mentioned in these variable lists are saved in a workspace RXX and the rest are **deleted**. XX stands for a number given by the user, which refers to the number of the initialization variant. The user gives this number when starting the initialization, by the call[8] **START** XX.

If one wishes to make an **initialization variant**, one makes a function **ISTARTXX** and stores this function in the workspace ISTART. The main-function **START** calls **ISTARTXX** before calling **SIΔINIT**. (See sub-functions, level 1 in Figure 3.) How to make **ISTARTXX**-functions and initialization variants is described in Part 1 of this manual.

2.1 Summary

What the user particularly should bear in mind is: **New macro data** should be added to workspace MACRO. **New micro data** should be added to workspace SI76. Micro data are mainly used in the part of the initialization program called **ESTABLISHMENTS**.

To make **initialization variants**, use workspace ISTART and check the instructions in Part 1 of the manual. As soon as **new model variables** are used, add the names of these in the variable lists in workspace VLISTS according to the instructions in Part 1. (If you forget this, the new variables will be **deleted**!)

The result from the initialization (= the model variables) winds up in a workspace RXX, where XX is the number used in the call "**START** XX", which starts the initialization.

A more detailed description of the initialization program will be presented in Section 4.

Section 3 The Input-Output System

It is worthwhile knowing more about the input-output system in the initialization and in the model for three reasons:

a) Among macro data (input to initialization, work-space MACRO) there is an input-output matrix for the Swedish economy for 1976, called IO76. This matrix is used to give many of the model variables (output from initialization) their values. We describe this in Section 3.1.

b) To check up the consistency of the whole initialization the input-output system is used. We describe this in Section 3.2.

c) To be able to understand how the input-output system is used in the model, one has to know more about the model-variable IO, which is a matrix of input-output coefficients constructed from IO76. We describe this in Section 3.3.

The input-output system can be described as a matrix with 14 rows and 21 columns. This matrix, IO76, stored in workspace MACRO, has the structure shown in Table 1. The economy is divided into 10 sectors of production (=the first 10 rows and columns) and a number of final demand categories (columns 11, 12...). The first 4 sectors are inhabited by individual firms after the initialization.

Let us first turn our attention to the first 10 columns. This part of the matrix shows the product-flows between the 10 sectors and the value added in each sector. For example:

Table 1 Input-output matrix (IO76) for the Swedish economy 1976
(Unit: Million of SEK in 1975 year's prices)
Explanations for column- and row-numbers, see next page

PRODUCTION MATRIX
Row 1,2,.....14 Column 1,2.....10

	1	2	3	4	5	6	7	8	9	10
1	5272	2890	5869	1321	245	94	0	4192	942	1943
2	2029	5195	4805	4465	908	117	0	3498	170	2035
3	954	2354	12296	915	503	213	0	6294	171	3079
4	803	2428	2041	14872	2078	87	0	2648	102	6484
5	2400	1964	341	10768	383	1	0	1689	0	312
6	2951	210	79	63	26	140	0	418	5	0
7	4136	600	151	261	130	213	0	1009	488	842
8	1235	1198	2838	961	1383	162	0	10928	708	9874
9	904	941	475	485	238	171	0	1118	328	1010
10	3293	3338	5919	4402	1792	640	0	9143	426	25656
11	63	71	142	-2377	163	10	0	350	5	2261
12	8736	14351	27422	19551	11452	2529	0	50892	6395	64383
13	154	-119	178	51	41	35	0	238	0	1
14	32933	35423	62558	55738	19341	4413	0	92417	9738	117881

FINAL DEMAND MATRIX
Row 1,2.....14 Column 11,12.....21

	11	12	13	14	15	16	17	18	19	20	21
1	758	5399	0	0	0	380	2754	12137	-11478	214	32933
2	1953	9075	558	0	869	2170	1135	14735	-12965	-5329	35423
3	3522	14903	3110	0	4836	10231	1687	29947	-24563	-7896	62558
4	5102	55944	112	0	175	132	752	7450	-15980	-29493	55738
5	243	6807	0	0	128	408	-95	1351	-3597	-3763	19341
6	81	24	0	0	0	0	67	1134	-3015	2230	4413
7	374	2346	0	0	0	0	188	1778	-6491	-6025	0
8	2929	26970	17893	12436	4682	765	1067	7062	-4453	-6221	92417
9	973	3580	0	0	0	0	-76	319	-306	-421	9738
10	8849	30617	379	0	591	0	-316	10370	-16362	29496	117881
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	24785	155664	22052	12436	11281	14085	7163	86284	-99209	-27209	430440

Source: Louise Ahlström, SAF. See also Appendix E.

Table 1 (cont)

Row 1:	Raw material sector
Row 2:	Intermediate goods
Row 3:	Investment goods and consumer durable goods
Row 4:	Consumption goods (excl. consumer durable goods)
Row 5:	Agriculture, forestry, fishing
Row 6:	Mining and quarrying
Row 7:	Oil
Row 8:	Construction
Row 9:	Electricity
Row 10:	Other services
Row 11:	Commodity based indirect taxes (Not value added tax (moms))
Row 12:	Value added in producer's prices
Row 13:	Corrections
Row 14	Vertical sum = production (producer's prices)
Column1,2 through 10	Corresponding rows
Column 11:	Government's consumption
Column 12:	Household's consumption
Column 13:	Government's investments
Column 14:	Investments, buildings
Column 15:	Investments in sector 5.....10
Column 16:	Other investments (= Investments made by firms)
Column 17:	Change in stock (inventories)
Column 18:	Exports
Column 19:	Imports
Column 20:	Moms etc. (Indirect taxes) are deducted
Column 21:	Horizontal sum = production (producer's prices)

Column 1: I076(m,1), m=1,2,...,10, shows how much sector 1 is buying from the other 10 sectors.

NOTE: Imports are included.

Rows 11 and 13 consist of rather small values and are described further in Appendix E. Row 12 is the value added in each production sector.

Value added (row 12) + Inputs (rows 1,2...10) equals total production in each sector (row 14).

Columns 11, 12 and onwards show the final demand-side in the economy.

NOTE: Imports are included.

The division into demand categories follows the usual pattern from national accounting where gross national product is described as C+I+G+X-M+ΔL. (C=household's consumption, G=government spending, I=investments, X=exports, M=imports and ΔL=change in stock.) Investments have been divided somewhat more, though.

The vertical sum of production (row 14, column 1,2...10) shall by definition be the same as the horizontal sum (rows 1,2...10; column 21). Column 20 has to be present to make this work. Columns 11,12... are defined in final prices including indirect taxes, value added taxes (VAT), whereas production in columns 1,2...10 are defined without these taxes. Thus, these taxes (VAT)* are subtracted in column 20 to make "vertical sum of production" match "horizontal sum of production". Some

* In Swedish called MOMS.

other adjustments of a technical nature are also made in column 20. For a more detailed description, see Appendix E, in this manual.

3.1 How the Input-Output Matrix IO76 is Used in the Initialization

IO76 is a matrix with flows in SEK (Swedish crowns) These flows are, in general, not used directly to give values to model variables during the initialization procedure. In 95 % of all cases shares, fractions, based on IO76, are used for this purpose. These shares are called IOCOEFF76 and are defined as:

$$\frac{IO76(i,j)}{IO76(14,j)} = IOCOEFF76(i,j)$$

$i=1,2,3,\ldots,13 \quad j=1,2,\ldots,19.$

The coefficient matrix IOCOEFF76 can be found in Appendix B.

The following **model-variables**, shown in Figure 4, (cf. Appendix A) get their values from the "input-output coefficient matrix" IOCOEFF76.

The first six model variables, in Figure 4, are constants throughout the simulation. The input-output matrix IO will be described more thoroughly below, in Section 3.3. QINVG, QINVBLD and QINVIN are start-up variables for the corresponding[9] exogenous time series, concerning non-industrial investments.

Export and import shares XIN and IMP are estimated from IO76.

Figure 4 Model variables created from IO76

Model variable	Coming from:	
OMEGA	Column 16	IOCOEFF76
OMEGAIN	Column 15	IOCOEFF76
OMEGABLD	Column 14	IOCOEFF76
OMEGAG	Column 13	IOCOEFF76
GKOFF	Column 11	IOCOEFF76
HH76 (household coefficients)	Column 12	IOCOEFF76
IO (input-output matrix)	Columns 1,2,...,10, rows 1,2,...,10	IOCOEFF76
IO2 (submatrix of IO)		IOCOEFF76
IO3 (submatrix of IO)		IOCOEFF76
QINVG		IO76(14,13)
QINVBLD		IO76(14,14)
QINVIN		IO76(14,15)
IMP (import shares)	Estimated from	IO76
XIN (export shares)	Estimated from	IO76

XIN is the export share of production in non-industrial sectors 5,6,7,...,10 and is estimated as: IO76(5,18)/IO76(14,5) etc. This is export shares for sectors which are modelled as **macro** units. Export shares, called X, for individual firms in the model come from **micro** data.
IMP is the import share of Swedish demand and is estimated as:

$$\frac{IO76(i,19)}{IO76(i,21)-IO76(i,20)-IO76(i,19)-IO76(i,18)}$$

where i=1,2,...,10, and column 19 consists of negative numbers (cf. Table 1).

The same import shares apply to both comsumers and firms. We lack information about individual firms' import shares. Hence import shares IMP refer to markets, in contrast to export shares X which refer to individual firms. Thus the **macro** shares are used for the individual firms in the import block of the model. In Appendix A one can see that IMP is classified as a micro variable for sectors 1, 2, 3, 4 and as a macro variable for the remaining sectors.

3.2 Consistency checking

For the purpose of checking the consistency of the initialization one would expect that IO76 should be used. This is, however, only the case to some extent. In principle IO76 can not be used since it is expressed in 1975 year's prices instead of 1976 year's prices. All model-variables coming out from the initialization should be in current prices, i.e. 1976 year's prices. This makes a direct comparison between IO76 and the input-output matrix coming out from the initialization a bit difficult.

Even if one managed to express IO76 in 1976 year's prices it would, all the same, be almost practically impossible to check the consistency of the initialization just by direct comparison with IO76. The explanation is as follows:

After the initialization the four industrial sectors (columns 1,2,3,4 in IO76) are inhabited with firms. S and Q are important firm-variables. S is individual firm sales and Q is individual firm production.

To determine the sum of S in each of the four sectors one must use SCB's national accounting statistics. Q is by definition equal to S minus changes in finished good's inventories. This also determines the sum of Q in each of the four sectors (approximately) and these figures of the production (in sectors 1,2,3,4) may differ substantially from figures from IO76 (row 14 IO76, reestimated in 1976 year's prices) due to **errors**[10] of different kinds.

The consistency of the initialization is instead tested as follows:

a) Form a matrix $IO76_{II}$ from the initialization by using the sum of micro-variables (for example Q above) when this is possible, and fill in with values from IO76 when this is not possible.

b) $IO76_{II}$ is considered consistent if (1) the values in $IO76_{II}$ don't differ "unreasonably much" from IO76 and (2) horizontal sum of production ≈ vertical sum of production in $IO76_{II}$.

For more details about the consistency check, see Section 6.

3.3 How the Model-Variable IO is Used

We now give a short description of how the model-variable IO, which is a 10x10 sub-matrix of IOCOEFF76 (the input-output coefficients), is used in the model.

The variable IO, with some exceptions[11], is **not** used for the purpose of determining macro variables during the simulation.

IO(i,j) tells how much of production in sector j comes from input from sector i, and is a number between 0 and 1, and i=1,2,...,10. Thus IO(1,j), IO(2,j), IO(3,j),...,IO(10,j) are the input-**shares** for each product (input from sectors 1,2,...,10) in sector j. The firms belong to sector 1, 2, 3 or 4.

The main use of the input-output matrix during the simulation is to determine **each firm's** demand for goods from other sectors. Thus, a firm in sector j producing q SEK (Swedish crowns) a certain quarter demands IO(1,j) • q • c SEK production from sector 1 and IO(2,j) • q • c SEK production from sector 2, etc.

$$c = \frac{\text{the individual firm's input-share}}{\text{average input-share in the sector}}$$

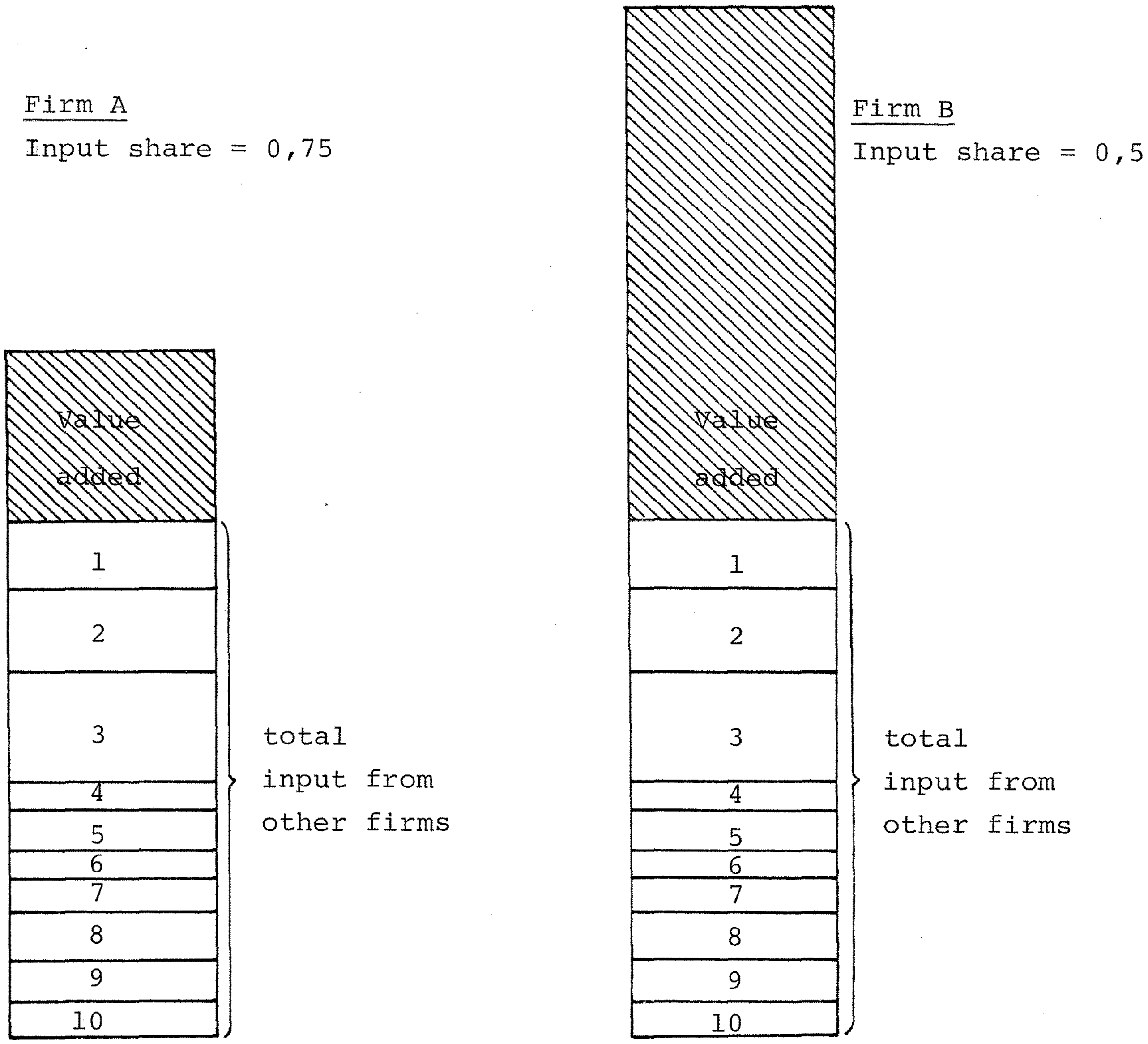
$$\text{The average input-share} = \sum_{i=1}^{10} IO(i,j)$$

The fractions c are only estimated for 1976 and are called SHARE in the initialization procedure.

Note that this specification means that the **macro** input-output coefficients are **variable** over time during a simulation. Since firms have **individual** input-shares (see c above) and firms grow at different rates, the macro input-output coefficients **vary endogenously** although the coefficients IO are **constant** over time and **exogenous**.

This can be clarified by Figure 5.

Figure 5 The production in individual firms



1 = input from sector 1
2 = input from sector 2
3 = input from sector 3
4 = input from sector 4
5 = input from sector 5
6 = input from sector 6
7 = input from sector 7
8 = input from sector 8
9 = input from sector 9
10 = input from sector 10

Production = Total input+value added

Firms A and B have different **individual input shares.** The individual input share is equal to 0.75 for firm A, whereas it is 0.5 for firm B. Information about such shares come from micro data. Thus the value added share is 0.25 and 0.5 respectively. How the inputs are divided onto the 10 sectors is determined from the input output matrix (the variable IO). These proportions are the same for all firms, which means that the quotient **(input from sector j)/(total input)** is the same, but not the quotient **(input from sector j)/(production).**

The **macro input shares**[12] will in general change if the relative size of the firms changes from one year to another during the simulation.

Let us give a concrete example of this. From a simulation performed in 1983[13] the following macro input shares were obtained:

Table 2 Simulation results

Year:	Macro input share (=total input/total production)			
	Sector 1	Sector 2	Sector 3	Sector 4
1976 (real values)	0.73	0.60	0.56	0.69
1977 (simulated values)	0.72	0.62	0.55	0.69
1978 (simulated values)	0.73	0.61	0.52	0.67
1979 (simulated values)	0.73	0.56	0.49	0.66
1980 (simulated values)	0.70	0.52	0.48	0.65

This illustrates some kind of structural change in the four industrial sectors in the simulated economy. In principle one could describe this structural change by investigating the chains of causes at the macro - and the micro - level during the simulation.

Section 4 The Initialization, Overview

This section will give a more detailed description of the initialization program. Those who wish a complete description of the program may turn to the programming code itself in Appendix C and use this section as a guide. The techniques involved are of general interest for someone wishing to construct a micro-to-macro simulation model.

As was shown in section 2, Figure 3, the initialization essentially consists of 13 parts (subfunctions, level 2 in Figure 3). 11 of these parts are dealing with giving values to model-variables, namely: **TAXΔPARAMETERS**, **PUBLICΔSECTOR**, **MONETARY**, **MARKETS**, **HOUSEHOLDS**, **ESTABLISHMENTS**, **MARKETSΔDATA**, **SECONDARYΔDATA**, **HOUSEHOLDSΔDATA**, **MONETARYΔDATA** and **PUBLICΔDATA**.

In the programming code, Appendix C, comment lines start with* the symbol **A**. Such comment lines are there just to make the program easier to understand. In the beginning of each sub-function there is a comment line beginning with "output from initialization". Thereafter follows a list of the names of those model-variables which have been given values in that particular subfunction. This is an important guide to the reader of the program, because he then knows what's to be considered as output from the sub-function. Other variable in the sub-function are either local variables (help-variables used to form the model-variables) or indata from the macro-data workspace or the micro-data workspace. The macro-data workspace and

* This symbol looks like an A, which is smoother than an ordinary A. For typographical reasons we write this as a boldface A, in this text.

the (non-confidential part of the) micro-data workspace are listed in Appendix B.

An alphabetical list of all model-variables can be found in Appendix A. Each of the 11 parts of the initialization program will now be commented.

o **TAXΔPARAMETERS**

"Start-up tax variables" (=tax last quarter 1976) are transferred directly from workspace MACRO. These variables are TXVA1,TXVA2.

The rest of the tax-variables in this part of the program are "exogenous time-series" which are formed by extending time-series for the period 1976 and onwards from workspace MACRO.

o **PUBLICΔSECTOR**

Some model-variables (OMEGAG, QINVG, GKOFF), mentioned in Section 3, get their values from the input-output system.

The number of people to be added to the government-sector (EXOΔREALCHLG) each quarter during the simulation is an exogenous time-series, and is determined as follows:

a) Quarterly labour force in the government sector is estimated from time-series data (1976-), TIMΔOFF, from workspace MACRO. For the present this determines EXOΔREALCHLG for the first 4 quarters of the model simulation.

b) A trend change of the government sector growth, estimated from historical time-series during the

1970s, (from workspace MACRO comes the trend change LGTRENDCH), is used for the remaining quarters in the EXO∆REALCHLG vector.

Wages in the government sector, the model variables QWG and WG, are determined from wage data in workspace MACRO for 1976-77 (LON∆OFF).

o **MARKETS**

Most of the model variables mentioned in Section 3.1 get their values in this part of the initialization program. It is variables connected with the input-output system, for example input-output coefficients of various kinds (="constants"), investments in different sectors (="start-up variables"), import shares of Swedish demand (=IMP ="start up variable") and export shares of production in certain sectors (=XIN="constant").

Model variables starting with "EXO" are "exogenous time-series".

The important model variable EXO∆QDPFOR (=changes in foreign price index) is set using historical price-behaviour (extrapolation). EXO∆QDPFOR is a matrix with the format "4 x number of quarters in the simulation" because it yields foreign price changes in each of the 4 industrial sectors.

All price-indices are equal to **100** for the base year (1976).

o **HOUSEHOLDS** and **MONETARY**

Household coefficients HH76, i.e. how the consumers distribute their purchases on products from the 10 sectors in 1976, are set. These coefficients are used later on in the initialization procedure (cf. **HOUSEHOLDSΔDATA** below). Some exogenous time-series in connection with the rate of interest (EXOΔRI and others) in the bank-system are set.

o **ESTABLISHMENTS**

This is the first time micro variables are given values. Real firms are given their values, and the residuals of each variable are splitted up on synthetic firms. By residuals we mean deviations from the national accounting level, 1976. For the present, 1983, we have 97 real firms and 50 synthetic firms. The synthetic firms have been created to be able to model the **whole** industrial sector by a **micro** simulation process in MOSES.

Only the 4 industrial sectors consist of micro-units, i.e. firms in the model. Micro-data are fetched from workspace SI76 (the first line in this sub-function).

Firm-data from this workspace are mainly stored in two variables: X and FΔDATA. X is a matrix where the first index is the firm index and the second is the number of the variable. For example: X(17;7) is export sales (question number 7 in the questionnaire) for the 17th firm.

The function establishments is rather complicated and only the main features will be described here.

Let us look at the variable sales, to get a picture of how the initialization of this variable is performed. A similar pattern can be found for many other micro variables.

(STEP 1) RealΔsales (=help variable) is a vector with R components, where R=number of real firms. RealΔsales(i) gets the value:

$$[\underline{X}(i,7) + \underline{X}(i,12)] \cdot 10^6.$$

export- sales, domestic sales

i = firm-index = 1,2,3...R

The rest of the sales value in each of the 4 industrial sectors is splitted up on the synthetic firms.

(STEP 2) ResΔsales (=help variable) is a vector of length 4 and is the rest of the sales value in the 4 sectors. RESΔsales(j) gets the value:

$$SALES76(j) - \sum_{i=1}^{R} (Real\Delta sales(i))$$
and i belongs to j

j=1,2,3,4=sector-index

SALES76(j) is sales for 1976 in each of the 4 sectors, fetched from SCB national accounting statistics. "i belongs to j" means summation of those real firms (i=1,2,...,R) which belong to sector j.

(STEP 3) SynthΔsales(i) gets the value Scale(i) $\cdot$ resΔsales(M(i)).

M(i) is the sector to which firm 'i' belongs. i=1,2,3,...,Q Q=number of synthetic firms, M(i)=1 or 2 or 3 or 4, R=number of real firms.

$$\sum_{i=1}^{Q} Scale(i) = 1$$

and i belongs to j

Scale is a vector with sizes (fractions), within a sector.

(STEP 4) The model-variable S (= individual firm sales) gets the values: S(i) = RealΔsales(i) for i=1,2,...,R and S(i) = SynthΔsales(i) for i=R+1,R+2,...,R+Q.

Thus:

STEP 1: RealΔsales(=sales for real firms) is set.

STEP 2: ResΔsales(=residuals between macro and sum of real firms) are set.

STEP 3: ResΔsales is distributed onto synthetic firms. SynthΔsales(=sales for synthetic firms) is set.

STEP 4: S(=sales=model variable) is the combination of RealΔsales and SynthΔsales.

This 4-step procedure is repeated for many other micro variables. Thus, W(wage-level in firms), L(labour-force in firms), X(export shares in firms) etc are set in much the same fashion.

In connection with "synthetic firm initialization" there are two other important technical points. Namely:

- (a) As soon as ratios appear, there is an inbuilt check that the Synthetic firms get the same mean and dispersion (standard deviation) as the real firms.
- (b) Certain variables ought to co-vary with other variables in the synthetic firms, and this is also taken into account.

Example:

L(i)=labor in each firm R=number of real firms
S(i)=sales in each firm Q=number of synthetic firms
i=1,2,...,R+Q.
ratio=L(i)/S(i)

This ratio is randomized for the synthetic firms in such a fashion that the mean and dispersion for the synthetic firms (i=R+1,R+2,...,R+Q) are the same, as that of the real firms. (Actually, it is a bit more complicated than this, since each sector (1,2,3,4) is treated independently.)

The export share for each firm (an important model-variable), X, is set in a similar manner.

Jim Albrecht, Columbia University, has made these randomization procedures in **ESTABLISHMENTS.**[14]

Production for each firm Q(i) is estimated as

$$Q(i) = \left(S(i)+\Delta K3\Delta FINISH(i)\right)/100$$

where ΔK3ΔFINISH is the change in the finished goods stock (a help variable) and 100=price index (the index equals 100 by definition 1976). Thus production in both synthetic and real firms is set indirectly, that is, by aid of sales figures and changes in finished goods stocks.

Each firm in the model has an individual input share (input/production), which is estimated from micro-data. Thus the model variable Share(i) is created:

$$\frac{\text{the individual firm's input share}}{\text{average input share in the sector}}.$$

Section 3.3 describes how this share is used, during the simulation.

o **MARKETSΔDATA**

Most of the constants, mainly **parameters**, in the model are set in this part of the initialization program. Constants connected with the bank system and the household sector are not here, though. These constants (parameters) are instead created in **HOUSEHOLDSΔDATA** and **MONETARYΔDATA.** Inventory-constants for firms (maximum-, minimum-inventory levels) are set in **ESTABLISHMENTS**.

o **MONETARYΔDATA**

Constants connected with the bank system are set. If RIΔISΔEXOGENOUS=1[15] then the bank system is partly set out of function, since the rate of interest in the economy is set exogenously in this case. In that case most of the other constants in this part become redundant. This is the case for the present (1983), since the bank system is not quite ready yet. Even when this module is ready it is of interest to be able to, for analytical simplicity, perform simulations with an exogenous rate of interest.

o **SECONDARYΔDATA** and **PUBLICΔDATA**

Certain labour market variables are given values, for example LU, the number of unemployed during the last quarter 1976. MTEC, a constant describing "the production function" for firms in each market, is set.

o **HOUSEHOLDSΔDATA**

Constants connected with the household part of the model are set here. For example; the coefficient-vectors BETA1, BETA2 (cf. Appendix A) are given values. BETA1 tells how much consumers tend to stick to historical consumption levels during the simulation and BETA2 are marginal propensities to consume when disposable income varies. Consumption levels last quarter 1976 are set.

$QC(j) = HH76(j) \cdot QDI$

$j=1,2,...,10$=sector index.

QC=consumption, QDI=disposable income, HH76=input-output shares (see Section 3).

QDI is estimated in a certain function which takes into account the whole tax system, wage system etc. This is done in the function **QDIΔINIT**.

Section 5 The Data Base

The macro data for the initialization come from workspace MACRO and the micro data from workspace SI76, see Appendix B.

Below, there is a brief documentation of the variables appearing in these two workspaces.

5.1 Workspace MACRO

In general, most of the variables refer to 1976 or 1976 and a couple of years ahead (to form exogenous time series). The only exceptions are:

	Period
TL∆EXP (export price indices)	1970-80
IMPL∆PRIS, IMPL∆PRIS∆IN (domestic price-indices)	1974-77
HIST∆TXVA2("moms")	1974-77

TL∆EXP is a long time series which is used to extrapolate a future time series starting 1977, i.e. the variable EXO∆QDPFOR mentioned previously. IMPL∆PRIS etc are a bit longer to be able to quarterlize data for 1976, 1977. The values for 1974 are redundant, though.

Sources:
Reference person for all variables except SALES76, TL∆EXP, LON and TIM: Louise Åhlström (previously IUI).

The national accounting statistics from SCB has been used. Reference persons for SALES76, TL∆EXP. LON, TIM: Thomas Lindberg, Fredrik Bergholm, IUI.

5.1.1 The Problem of Distributing Macro Data

There is a general problem of a practical nature in connection with the three variables LON(=total wage sum in sector 1,2,3,4), TIM(=total number of working hours in sector 1,2,3,4) and SALES76(=total sales in sector 1,2,3,4). LON, TIM and SALES76 are used for micro initialization, as was mentioned in Section 4. They are the macro totals for model variables like labour L and sales S.

The problem is that from SCB-figures we have
a) total wage sum in the industry
b) total number of working hours in the industry
c) total sales in the industry.

When a), b) and c) are distributed onto the 4 sectors (1-4 in the input-output system) we get the variables LON, TIM and SALES76. There is a so called "weighting matrix" which has been constructed to do this job. However, the result seems to be a bit unsatisfactory. In the consistency check (Section 6) we find residuals indicating that sector 1 is too small and sector 3 and (or) 4 are too large. A consequence of this is that synthetic firms in sector 1 get input shares (F∆INKOP=the quotient input/production, see Appendix A) larger than 1. The behaviour of these companies disturb the simulation during the first three-four years in quite a conspicuous manner.

Apparently this problem is a crucial one in order to obtain a proper initialization. In 1983 some measures were taken to improve matters. Of course there can be many reasons for the inconsistencies. However, the distribution process clearly yields different results compared with the figures in the input-output system IO76 in Section 3. This can be seen as follows:

Total sales in the 4 (industrial) sectors 1976 is 207 150 million Swedish crowns. SALES76 is a vector with four components where this amount has been distributed onto the 4 sectors by aid of the weighting matrix mentioned above. The following result is then obtained:

SALES76 = (0.14, 0.18, 0.34, 0.34) • 207 150

On the other hand, if one distributes total sales according to the proportions for gross production (assuming that sales ≈ production and thus neglecting changes in finished goods inventories) in the input-output system IO76 (cf. Table 1, row 14, columns 1 through 4) the following result is obtained:

NYSALES76 = (0.18, 0.19, 0.33, 0.30) • 207 150

In 1983 we started using NYSALES76 instead of SALES76 in the initialization procedure (initialization variant **ISTART10**). This reduced the inconsistencies in the initialization (cf. Section 6).

Future work in connection with the variables LON, TIM and SALES76 should be directed towards obtaining more precise distribution procedures, which **at the same time** are reasonably consistent with the input-output system.

5.1.2 Changes in the Input-Output Matrix

If the input-output matrix IO76 is changed (corrected) the function **COEFFΔIO** has to be executed to get new input-output coefficients IOCOEFF76.

5.2 Workspace SI76

A good description of this workspace can be found in Albrecht-Lindberg (1982). Sources: Reference persons: Thomas Lindberg, IUI, Jim Albrecht, Columbia University, New York. The Planning Survey ("Planenkäten"), collected by the Federation of Swedish Industries, has been used (Ola Virin, Kerstin Wallmark).

Section 6 The Consistency Control System

Many micro and macro variables are set during the initialization procedure.

One important question is: Are the variables consistent on the macro level?

To check this one has to sum the micro variables up to country total or sector total (4 industrial sectors) and check whether macro variables obtained in this way "fit the 1976 input-output system". This has already, briefly, been discussed in Section 3.2. The "input-output consistency check" of the initialization is done as follows:

a) Form a matrix $IO76_{II}$, having the same form as the input-output matrix IO76 (see Section 3), from the initialization by using the sum of micro variables when this is possible, and fill in with macro values from IO76 when this is not possible. We will call the input-output matrix $IO76_{II}$, the "control matrix" in this section.

b) $IO76_{II}$ is considered to be consistent if (1) the values in $IO76_{II}$ do not differ "unreasonably much"[16] from IO76 and (2) horizontal sum of production ≈ vertical sum of production in IO76.

A print-out of the control matrix $IO76_{II}$ is done during the initialization in the sub function **IOAMATRIX**, see Appendix C. On the following pages an example from 1982 of such a print-out is presented. It is from the present initialization version (that is, the one which can be found in Appendices C and D).

By definition, the horizontal sum (col 1,2 through 20 in row 1,2,...10) should be equal to the vertical sum in col 1,2...10. The residual between the horizontal and the vertical sum is printed out under the headline "residual". The first number is the residual in sector 1, the second in sector 2, etc. The residuals in this case indicate that there is too little production in sector 1 and too much in sectors 3 and 4. (sector 1: -1820, sector 3: 2573, sector 4: 7611).

This problem has already been discussed in Section 5 and is probably due to a bad distribution of production and sales between the 4 industrial sectors. The values in the "control-matrix" do not, in general, seem to differ unreasonably much from those of IO76. But the values in column 1 (sector 1) are apparently too small and the values in column 17 (yearly inventory changes) seem to be somewhat large in comparison with IO76.

The negative residual values in rows 5,6,...,10, are due to that values in columns 5,6,...,10 are expressed in 1975 year's prices. This error need not affect the simulation much, though, since production in sectors 5,6,...,10 in the simulation is determined by inverting the input-output coefficient matrix IO.

Some other consistency controls are made in the subfunction **CONTROLS**, see Appendix C. For example:

a) wages (average wage times number of employees) in firm i + profits[17] in firm i = value added in firm i. (i=firm index).

Table 3 The control matrix

INPUT-OUTPUT MATRIX FROM INITIALIZATION:

unit=10^6 SEK

1	2	3	4	5	6	7	8	9	10
5195	3291	6881	1713	245	94	0	4192	942	1943
1999	5916	5633	5790	908	117	0	3498	170	2035
940	2681	14416	1187	503	213	0	6294	171	3079
791	2765	2393	19287	2078	87	0	2648	102	6484
2365	2237	400	13965	383	1	0	1689	0	312
2908	239	93	82	26	140	0	418	5	0
4076	683	177	338	130	213	0	1009	488	842
1217	1364	3327	1246	1383	162	0	10928	708	9874
891	1072	557	629	238	171	0	1118	328	1010
3245	3802	6939	5709	1792	640	0	9143	426	25656
62	81	166	¯3083	163	10	0	350	5	2261
8608	16344	32150	25355	11452	2529	0	50892	6395	64383
152	¯136	209	66	41	35	0	238	0	1
32449	40339	73341	72285	19341	4413	0	92417	9738	117881

11	12	13	14	15	16	17	18	19	20	21
758	5666	0	0	0	464	4938	10737	¯13004	214	32449
1953	9524	576	0	894	2652	2035	15759	¯14535	¯5329	40339
3522	15640	3209	0	4979	12500	3025	33620	¯27314	¯7896	73341
5102	58711	116	0	180	161	1348	9340	¯17427	¯29493	72285
243	7144	0	0	132	498	¯170	1351	¯4143	¯3763	19341
81	25	0	0	0	0	120	1134	¯3069	2230	4413
374	2462	0	0	0	0	337	1778	¯6728	¯6025	0
2929	28304	18464	12630	4820	935	1913	7062	¯4647	¯6221	92417
973	3757	0	0	0	0	¯136	319	¯320	¯421	9738
8849	32131	391	0	609	0	¯567	10370	¯17123	29496	117881
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
24784	163363	22755	12630	11614	17210	12843	91470	¯108309	¯27209	462204

Table 3 (cont)

Rows and columns in the control matrix:

Row 1:	Raw material sector
Row 2:	Intermediate goods
Row 3:	Investment goods and consumer durable goods
Row 4:	Consumption goods
Row 5:	Agriculture, forestry, fishing
Row 6:	Mining and quarrying
Row 7:	Oil
Row 8:	Construction
Row 9:	Electricity
Row 10:	Other services
Row 11:	Commodity based indirect taxes
Row 12:	Value added in producer's prices
Row 13:	Correction
Row 14:	Sum = production
Column 1, 2 through 10:	Corresponding rows
Column 11:	Government's consumption
Column 12:	Household's consumption
Column 13:	Government's investments
Column 14:	Investments, buildings
Column 15:	Investments in sector 6..10
Column 16:	Other investments
Column 17:	Change in stock
Column 18:	Exports
Column 19:	Imports
Column 20:	Moms etc.
Column 21:	Horizontal sum = production

Residuals R(i): (million Swedish crowns)

Definition: $R(i) = A(i,21) - \sum_{j=1}^{20} A(i,j)$

where A is the control matrix in Table 3.

R(1) = -1 820	R(6) = -18
R(2) = 742	R(7) = -154
R(3) = 2 573	R(8) = -3 981
R(4) = 7 611	R(9) = -447
R(5) = -3 302	R(10) = -3 627

b) the input share (compare the variables FΔINKOP and BRINKOP in Appendix A) in sectors 1,2,3,4 obtained by summing the micro-units (Σpurchases/ Σproduction) should be equal to the input share from the input-output matrix IO76.

The printout of the consistency control matrix $IO76_{II}$ can be made (option) during any initialization, and the user can thus check whether the residuals can be considered to be small enough for performing the simulation experiment afterwards.

Section 7 On Simulation Techniques

This section is a bridge between Part 1 and Part 2 of the MOSES-manual. We give some examples of how this manual could be used in connection with simulation experiments. This section presupposes knowledge of the three first chapters in Part 1.

Let us assume, for example, that we wish to extend the micro data base with more real firms and that we want to make experiments varying the foreign export price index and the growth of the government sector. How do we go about to accomplish this?

To begin with the micro data base must be updated. This means that the 5 variables in the workspace SI76, see Appendix B, must be updated. This can be done according to instructions in Albrecht, Lindberg (1982). There is one problem, though. We **cannot repeat old experiments** if we simply update SI76 without taking extra measures. Therefore we must look at the function **ESTABLISHMENTS** where micro data are processed (cf. Section 4). We read the beginning of the function in Appendix C.

There is a line in the beginning where there is a test for whether a firm belongs to the list of firms chosen to be included in the experiment. This is line [31] in Appendix C, function **ESTABLISHMENTS**. Apparently this means that if we extend all other micro data base variables (i.e. X̲, F∆DATA, FIRMID, R∆MARKET) new firms won't enter the simulation unless LIST is updated as well. If we update LIST **during the initialization procedure** new firms enter the simulation as an **initialization variant**, which in turn means that old experiments can be repeated. Therefore we use the **ISTARTXX**-function (cf. Section 2) to extend LIST. The techniques involved can be found in part 1. The new line needed to update LIST will be (for example)

LIST ← LIST, 4.95 4.96.

The numbers 4.95 and 4.96 are code-numbers for new firms. We call the initialization version 11, i.e. we use **ISTART11**. **ISTART11** is shown in Figure 6.

Let us now change the export price index. From Section 4 we know that it is an exogenous time series called EXOΔQDPFOR. We find EXOΔQDPFOR in Appendix C in the subfunction **MARKETS** on line [56]. In **ISTART11** we should swap that line for a new one. The matrix EXOΔQDPFOR is (as we see in Appendix A) the **change** in the export price index each quarter during the simulation, for each of the 4 industrial sectors. If we, for example, wish to make an experiment with a 2 percent change every quarter for all firms, each component of EXOΔQDPFOR should be given the value 0.02. The size of EXOΔQDPFOR is not quite obvious. How many quarters ought one to use in the matrix? The maximum number of years to simulate[18] in the standard initialization is 30 years. Therefore it might be appropriate to use 120 quarters. The export price index must have a start value too. Close inspection of the subfunction **MARKETS** reveals that the model variables QPFOR and QDPFOR should be given new values too. If we don't care much about the first simulated quarter one could, however, skip this and let QPFOR and QDPFOR keep their values form the standard initialization version.

Let us finally change the government sector employment growth, which also is an exogenous time series (cf. Appendix A), called EXO∆REALCHLG. From Section 4 we know that one line in the subfunction **PUBLIC∆SECTOR** should be changed. We do this in **ISTART11**. If we let each component of the vector EXO∆REALCHLG take the value 2,500, this means that 2,500 people will be taken from "the pool of unemployment" each quarter during the simulation (unless the pool is empty). The government sector has priority, i.e. firms take people from the "pool of unemployment" after the government sector has satisfied its demand for people.[19]

ISTART11 is shown on the next page, together with another example, **ISTART12**.

Let us go on by describing another experiment, corresponding to **ISTART12**.

In this experiment we wish to change the behaviour of firms in connection with profit targets. We also want to make changes in the production function of individual firms. From Section 4 we know that most **parameters** (definition in Section 1) can be given values in the function **MARKETS∆DATA**. After having checked the parameters in this function with the description in Appendix A we find that SMT is a parameter affecting the profit target behaviour. SMT is not a vector,[20] so we can not change the behaviour of an individual firm, only all the firms at the same time. SMT could be given any value between 0 and 1. The construction of SMT is described in section 1, but in general one has to consult the MOSES code, i.e. the simulation program itself, to check the construction of the parameter. The MOSES code is not included in this paper, but is available at IUI. It will be included in another part of the documen-

Figure 6 Initialization variants and experiment variants, examples

```
      ∇ISTART11[⎕]∇
    ∇ ISTART11
[1]   SYNTH∆FIRMS← 8 16 18 8
[2]   'ESTABLISHMENTS' MODADD  ')COωLIST←LIST,  4.95 4.96  '
[3]  ⍝THIS MEANS THAT THE LINE
[4]  ⍝    LIST←LIST, 4.95 4.96
[5]  ⍝ IS INSERTED AS A NEW LINE AFTER THE LINE
[6]  ⍝    ∊')COPY SI76..   '
[7]   'MARKETS' MODSUBST 'EXO∆QDPFOR←ωEXO∆QDPFOR←(4 120)⍴0.02'
[8]   'MARKETS' MODSUBST 'QPFOR← 1ωQPFOR←4⍴100+(3÷8)×2×4'
[9]   'MARKETS' MODSUBST 'QDPFOR←(TωQDPFOR←4⍴0.02'
[10]  'PUBLIC∆SECTOR' MODDEL 'EXO∆REALCHLG←'
[11]  'PUBLIC∆SECTOR' MODADD 'LG←QLG[4]ωEXO∆REALCHLG←120⍴2500'
    ∇
```

```
      ∇ISTART12[⎕]∇
    ∇ ISTART12
[1]   SYNTH∆FIRMS← 8 16 18 8
[2]   'MARKETS∆DATA' MODSUBST 'SMT←ωSMT←1'
[3]   'MARKETS∆DATA' MODADD 'GAMMA←ωINVEFF←147⍴0.5'
    ∇
```

```
      ∇MSTART13[⎕]∇
    ∇ MSTART13
[1]  ⍝EXAMPLE
[2]   'NULLIFY' MODADDLAST ' SHRINK ''QF'' '
[3]  ⍝ MODADDLAST MEANS THAT THE LINE IS ADDED AS THE LAST LINE
    ∇
```

Note: These functions are examples which no longer are stored in ISTART- and MSTART-workspaces.

tation. We set SMT equal to 1 which means that we don't update profit targets over time. Similarly, we find a parameter INVEFF affecting the production function. The parameter INVEFF yields ΔQTOP/INV where QTOP is maximum production capacity and INV is investments in machinery and buildings. Apparently INVEFF describes the marginal efficiency of new equipment, i.e. how much the production frontier is pushed upwards due to investments. Since INVEFF is a vector (length = number of firms) we could change this parameter for individual firms. SMT and INVEFF are changed in **ISTART12**, in Figure 6.

7.1 New variables **(IMPORTANT)**

If new variables are added to the model two extra measures have to be taken. Firstly, add the name of the variable to a variable list in workspace VLISTS (cf. Part 1). All model variables coming out from initialization should be registered[21] there. Secondly, add a line in the MOSES-model in a subfunction called **NULLIFY**. Say that the new variable is called QF. Then the line:

SHRINK 'QF'

should be added in the function **NULLIFY**.

The reason for this procedure is that some firms go bankrupt during the simulation and then all micro variables which are **vectors** become shrunk (one firm is deleted from the vector). Micro variables which are vectors[22] must be part of this "shrinking system" and that's why the line above must be added. One should extend **NULLIFY by using** the function **MODADD** in a **MSTARTXX**-function (cf. Part 1). This is done in **MSTART13** in Figure 6.

7.2 Experiment variants, exogenous exports

One common experiment variant is to make some endogenous variable in the simulation exogenous instead. One can, for example, make exports exogenous. This was done in connection with experiments concerning multiplier effects on the Swedish economy described in Bergholm (1984).

The necessary changes can be made in a **MSTART**-function. In Figure 7 below some[23] lines from experiment version 10, **MSTART10**, are shown (cf. Part 1 of the manual):

Figure 7

```
     ∇  MSTART10
[10]    EXOΔEXPORT←X×QS÷QP
[12]    TID←1
[14]    RATE←(⍴Q)⍴1,05*(1÷4)
[18]    'EXPORTΔMARKETS' MODADD 'QSUFOR←ωQSUFOR←EXOΔEXPORT×RATE*TID
[19]    'EXPORTΔMARKETS' MODADDLAST 'X←QSUFOR÷QOPTSU'
[20]    'EXPORTΔMARKETS' MODADDLAST 'TID←TID+1'
[21]    'NULLIFY' MODADDLAST ' SHRINK ''RATE'' '
[22]    'NULLIFY' MODADDLAST ' SHRINK ''EXOΔEXPORT'' '
     ∇
```

Line [18] in **MSTART10** makes exports QSUFOR exogenous.

$$QSUFOR = EXO\Delta EXPORT \cdot (RATE)^{TID},$$

where EXOΔEXPORT is the export volume for TID = 0, TID is the time variable (measured in simulated quarters) and RATE is the growth rate. The function **MODADDLAST** adds the line at the end of the function specified as left hand argument. Note the necessary additions to the subfunction NULLIFY (cf. Section 7.1). To be able to construct and fully understand MSTART-functions like MSTART10 one has to consult the MOSES code, cf. Eliasson-Heiman-Olavi (1978).

7.3 Change of Starting Year of Simulation

To be able to start the simulation in some other year than 1976, requires the creation of a new data base for that year.

This manual provides the user with essential information for that task. The whole macro data base is described in Appendix B. This should be updated to the year in question. Price indices come (in general) from SCB data and taxes, sales etc. from national accounting statistics. The cumbersome task is, above all, the input-output system. To update this to, for example, 1982 would probably mean months of work. There is, however, a **short cut** method of updating the input-output matrix (coefficients).

One could simply run the model for five years and let the simulated coefficients be an approximation of the real coefficients. Consistency problems will probably appear, though (cf. Sections 5 and 6).

Micro data can rather easily be fetched from the Planning Survey, since it is collected yearly since 1975 with small changes in the format of the questionnaire.

The initialization procedure (Appendix C) applies, for the time being, only to the starting year 1976. However, one need not change it much to be able to use it in connection with another starting year. Some obvious changes are: New workspaces for macro and micro data should be input to the initialization program. One should not change the names of the variables (for example I076 etc.)

although that would be natural, or, alternatively, rename them (for example I082 ← I076) in the beginning of the initialization.

7.4 Simulation extension, the ENTRY block

In the MOSES code* there is a function making the entry of firms possible. It is called **ADDFIRM** and is documented in Appendix D.

The idea behind this facility was to remedy the asymmetry connected with the exit-mechanism in the standard version of the model. Firms (cf. Section 7.1) go bankrupt (exit) during the simulation but no inflow of new firms takes place. The ENTRY module is still rather primitive and improvements are to be made. **ADDFIRM** should be used in MSTART-functions.

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* Not documented in this manual. See Eliasson-Heiman-Olavi (1978). A full documentation will appear (not published yet).

APPENDIX A VARIABLES COMING OUT FROM INITIALIZATION, AN ALPHABETICAL LIST

The concepts "start-up variable", "exogenous time series, "constants", "parameters" and "micro variables" from Section 1 are used to describe type of variable.

This variable list is of utmost importance in connection with simulation experiments. To be able to set parameter values, change exogenous time series or start-up variables, this list must be consulted.

This list also specifies the result of the initialization. To be able to check this result Appendix A is a guide which considerably facilitates work with the model. Previously a lot of "time consuming detective work" was needed for almost any little change in the initialization procedure or the simulation. Knowledge about the meaning of the model variables below was, in the lack of written documentation, based on experience and scattered notes.

Appendix A is also needed if one wants to extend the model. In such a situation one must do a lot of checking up on the input to the model, i.e. the variables below.

Note that Appendix A yields a specification of input needed to start the model any year, not necessarily the present starting year 1976. Thus, this appendix is a piece of information needed when constructing another starting year for the simulation.

All the variables below (with exception for FΔINKOP och BRINKOP), are inputs to the model. Start-up variables usually refer to the last quarter 1976 since the model is running by quarters. Some variables also refer to the whole year 1976, though. In the "code-column" we write vectors and matrices with indexes, i.e., we write v(i) instead of v, if v is a vector. In the "type-column" we tell the range of the index i.

MODEL VARIABLES

– An Alphabetical List

Code	Type	Used in (purpose)
ALFABW	Constant, micro variable, parameter	INVFIN to determine firms' desired change in borrowing. INVFIN = investment part of model
ALFA3 ALFA4	Constants, parameters	The household sector part of the model
AMAN(i,j)	Start-up variable i=1,2,3... number of firms j=1,2,3 micro variable	For each firm, a three component vector accomodating the two-quarter lag of layoffs
AMANΔyear	Technical variable, needed for simulation	
BAD(i)	Start-up variable, micro variable. i=1,2...number of firms	Investment financing part of the model. Counts number of quarters a firm has negative net worth. If BAD > 6 then it is nullified in the model
BETA	Constant, micro variable parameter	Constant used to compute optimum finished-goods inventory level

Code	Type	Used in (purpose)
BETA1(j)	Constant. Vector of length 12 j=1,2,...12	COMPUTE EXPENDITURES to adjust household expenditures in different categories to the income constraint
BETA2(j)	Constant, j=1,2,...12	COMPUTE EXPENDITURES to adjust household expenditures in different categories to the income constraint SUM(BETA2) = 1
BETA3(j)	Constant, j=1,2,...12	COMPUTE EXPENDITURES to adjust household expenditures in different categories to the income constraint. All BETA3(j) = 0 for the present
BETABW	Constant, micro variable, parameter	INVFIN to determine firms' desired change in borrowing. INVFIN = investment financing part of the model.
BIG(i)	Constant, micro variable i=1,2,3... number of firms	Maximum inventory level (fraction of sales). Finished goods.
BRINKOP(j)	Information variable j=1,2,3,4	Average input share in each industrial sector. For the definition of input share, see Section 3.3 in this manual. BRINKOP=input/production
BW(i)	Start-up variable, micro variable i=1,2,..., number of firms	A firm's total borrowing Last quarter 1976.
CHM(i)	Start-up variable, micro variable i=1,2,3..., number of firms	Yearly change in M (profit margin). Change 1975-76.
CVA(j)	Start-up variable j=1,2,...11	CVA = QC but in fixed prices

Code	Type	Used in (purpose)
DELAY∆INV(i,j)	Start-up variable micro variable i=1,2,..., number of firms j=1,2,3	Investments between plan and fulfilment. Three stages.
DP(i) DW(i) DS(i) DQ(i)	Start-up variables, micro variables i=1,2,..., number of firms	Yearly change (a fraction) of P, W, S and Q respectively
DVA(i)	Start-up variable, micro variable i=1,2,..., number of firms	Change in VA (a fraction)
DUR	Index	DUR = 3
E1 E2	Constant, micro variable, parameter	Used in YEARLY EXPECTATIONS in the model. E2=0 at present (Jan. 1982)
ELINV	Constant, micro variable, parameter	An elasticity, reducing firms' desired new borrowing (and hence investments) whenever capacity utilization is low. Used in INVFIN.
ENTRY	Constant, parameter	A parameter regulating the inflow of new persons to the labour market (quarterly fraction of the total labour force).
EPS	Constant, micro variable, parameter	EPS = 0 and thus redundant at present (Jan. 1982).
EXO∆QCHTXVA1(j) EXO∆QCHTXVA2(j)	Exogenous time-series j=1,2,...NQR, NQR = number of quarters in the simulation.	TAXVA2 = value added tax rate = "MOMS"EXO∆QCHTXVA2 is change in the "MOMS-rate". TXVA1 refers to investment goods. EXO∆QCHTXVA1 is the change in that tax rate.

Code	Type	Used in (purpose)
EXO△QDINVBLD(j)	Exogenous time-series j=1,2..NQR NQR = number of quarters in the simulation	Quarterly change (a fraction) of QINVBLD = investments in residential construction
EXO△QDINVG(j)	Exogenous time-series j=1,2,..NQR NQR = number of quarters in the simulation	Quarterly change (a fraction) of QINVG = investments in the government sector
EXO△DINVIN(j)	Exogenous time-series j=1,2,..NQR NQR = number of quarters in the simulation	Quarterly change (a fraction) of QINVIN = investments in sectors 5,6,...10.
EXO△QDPFOR(i,j)	Exogenous time-series (a matrix) i=1,2,3,4 j=1,2,3..NQR. NQR = number of quarters in the simulation. micro variable	The change (a fraction) in foreign price index, for each of the 4 industrial sectors
EXO△QDPIN(i,j)	Exogenous time-series i=5,6,7,8,9,10 j=1,2,...NQR NQR = number of quarters in the simulation	Quarterly change in domestic price index in sectors 5,6,7,8,9,10.
EXO△REALCHLG(j)	Exogenous time-series j=1,2,..NQR NQR = number of quarters in the simulation	A variable (vector) telling the number of people to be added to the government sector each quarter. (Government demand)
EXO△RI(j)	Exogenous time-series NQR = number of j=1,2...NQR quarters in the simulation	The rate of interest.

Code	Type	Used in (purpose)
EXO∆RIBWFOR(j)	Exogenous time-series j=1,2...NQR NQR = number of quarters in the simulation	The foreign lending rate of interest
EXO∆RIDEPFOR(j)	Exogenous time-series j=1,2...NQR NQR = number of quarters in the simulation	The foreign deposit rate of interest
EXO∆RSUBS(i,j)	Exogenous time-series, micro variable i=1,2,3,4 j=1,2,...NQR NQR = number of quarters in the simulation. i = sector index	Subventions to the individual firm, expressed as a fraction of sales. Equal for all firms in a sector.
EXO∆TXC(j)	Exogenous time-series j=1,2...NYR NYR=number of years in the simulation	Corporate tax-rate. (Tax on firms)
EXO∆TXI1(j)	Exogenous time-series j=1,2,..NYR NYR=number of yearsin the simulation	Income-tax rate (for households)
EXO∆TXI2(j)	Exogenous time-series	Some kind of income tax rate used in another version of the MOSES-model than the present (Jan. 1982). Can't be omitted for technical reasons but redundant
EXO∆TXW(j)	Exogenous time-series j=1,2...NYR NYR=number of years in the simulation	Payroll-tax rate for the non-government sectors.

Code	Type	Used in (purpose)
EXO∆TXWG(j)	Exogenous time-series j=1,2...NYR NYR=number of years in the simulation	Payroll-tax rate for the government sector.
EXPDW(i) EXPDS(i) EXPDP(i)	Start-up variables, micro variables i=1,2... number of firms etc.	Expected change (a fraction) in P, W and S.
EXPXDP	Constants, micro variables	Expected rate of price-change
EXPXDW	parameters	Expected rate of wage-change
EXPXDS		Expected rate of sales-change These are the constant components of expectations, entered exogenously
FASS	Constant	Bank-parameter
FD	Constant	Bank-parameter
FIP FIW FIS	Constants, micro variables parameters	Used in "Quarterly-Expectations" in the model
First∆sim∆year	Technical variable, needed for simulation	
Funds∆are∆ enough	Constant	Bankparameter
F∆INKOP(i)	Information variable i=1,2,... number of firms	F∆INKOP is not used in the model. Each firms's input share (fraction of production) of input goods, 1976. See Section 3.3, Part 2.
GAMMA	Constant, micro variable, parameter	A constant telling how big a wage increase is needed, for making a person leave his job for another job. GAMMA = 0.1 at present

Code	Type	Used in (purpose)
GKOFF(j)	Constant j=1,2,...10	Government purchasing (less investments) in each sector, as a fraction of Government wage sum. GKOFF is a vector.
HISTDP(i) HISTDW(i) HISTDS(i)	Constants, micro variables i=1,2,... number of firms	For each firm a time-smoothed average of its experienced (historical) price changes (HISTDP), wage changes (HISTDW) and sales changes (HISTDS)
HISTDPDEV(i) HISTDSDEV(i) HISTDPDEV(i)	Start-up variables, micro variables i=1,2,... number of firms	For each firm a time-smoothed average of the difference between actual and expected increase in price level, wage level and sales
HISTDPDEV2(i) HISTDSDEV2(i) HISTDWDEV2(i)	Constants, micro variables i=1,2,... number of firms	Redundant at present because E2 = 0
IMBETA	Constant, micro variable, parameter	Constant used to compute optimum input-goods inventory level = 0.5
IMBIG(i)	Constant, micro variable i=1,2,... number of firms	Maximum inventory level (fraction of sales). Input goods.
IMP(i)	i=1,2,3,4 Start-up variable micro variable	Import share in sectors 1,2,3,4 (the industrial sectors). Start-up value
IMP(j)	j=5,6,...10 Constant, **macro** variable	Import share in external sectors 5,...10. Constant. NOTE: IMP is a start-up variable and a constant at the same time!
IMPLPΔREF	Technical variable needed for simulation	

Code	Type	Used in (purpose)
IMSMALL(i)	Constant, micro variable i=1,2,... number of firms	Minimum inventory level (fraction of sales). Input goods.
IMSTO(i,j)	Start-up variable (matrix), micro variable i=1,2,3.. number of firms j=1,2,3,...10	Inventory level of input goods for each type of product (10 sectors). Fixed (1976 year's) prices
IN	Vector-index	Index for external sectors IN = 5,6,7,8,9,10
INVEFF(i)	Start-up variable micro variable i=1,2,3... number of firms	The quotient $\frac{\text{change in QTOP}}{\text{investment}}$ QTOP = potential maximum production level. Production function parameter
IO(i,j)	Constant, micro variable i=1...10 j=1...10	Input-output coefficients, 10x10 matrix. Tells the share of production in sector j coming from sector i $\sum_{i=1}^{10} IO(i,j)$ + value added share = 1
IO2 (i,j)	Constant, i=1,2,3,4 j=5,6,...10	Input-output coefficient Submatrix of IO(i,j)
IO3 (i,j)	Constant, i=5,6..10 j=5,6,...10	Input-output coefficients. Submatrix of IO(i,j), which is inverted during simulation
IOTA	Constant, micro variable, parameter	A constant used by firms to form their initial wage offer in LABOUR SEARCH. IOTA=0.5 at present
K1(i)	Micro variable start-up variable i=1,2... number of firms	For each firm, the replacement value of its production equipment

Code	Type	Used in (purpose)
K2(i)	Micro variable start-up variable i=1,2,... number of firms	For each firm, its current assets last quarter 1976
Kappa1 Kappa2	Constants	Bankparameters
K1BOOK(i)	Start-up variable micro variable	For each firm, the book value (1976) (for taxation purposes) of its production equipment
KSI	Constant, micro variable, parameter	A constant, used in LABOUR SEARCH which tells by how much a firm raises its own wage level after it has performed an unsuccessful attack KSI = 0.25 at present
L(i)	Start-up variable i=1,2... number of firms micro variable	Number of people in each firm. Last quarter 1976
Lamda1 Lamda2	Constants	Bank-parameters
Last∆TXI2∆year	Technical variable needed for simulation	
Last∆year	Technical variable needed for simulation	Last∆year = 1976.
LEFT(i)	Logical vector (start-up variable) i=1,2... number of firms	Logical vector indicating whether a firm is out of business or not. During simulation LEFT(i) takes the value zero if firm i is nullified (deleted)
LG	Start-up variable	Number of people employed in the government sector last quarter 1976

Code	Type	Used in (purpose)
LIQB	Start-up variable	The bank's holdings of "liquidity" of an unspecified nature. Updated in BANK UPDATE
LIQBFOR	Start-up variable	The bank's current holdings of foreign "liquidity" of an unspecified nature. Updated in BANK TRANSACTIONS
LOSS	Constant, micro variable, parameter	Used in connection with production function
LU	Start-up variable	Number of people unemployed last quarter 1976
M(i)	Start-up variable micro variable i=1,2... number of firms	Profit margin (profit/value added) for each firm the whole 1976
MARKET(i)	Start-up variable micro variable i=1,2,3... number of firms	MARKET(i)=1 or 2 or 3 or 4. This variable tells to which sector a certain firm belongs
MARKET∆ITER	Parameter	Telling the number of iterations in the product market process in the model
MAXDP	Constant, micro variable, parameter	ADJUST-PRICES in the model
Maxqchri	Constant	Bank-parameter. Maximum change in rate of interest
Maxri	Constant	Bank-parameter
Maxridiff	Constant	Bank-parameter
MB	Constant	Bank-parameter
Minri	Constant	Bank-parameter

Code	Type	Used in (purpose)
MHIST(i)	Start-up variable micro variable i=1,2,3... number of firms	For each firm, an average of past profit margins (a fraction)
MKT	"Vector index" MKT=1,2,3,4	Index for industrial sectors=1,2,3,4. In the APL-language "vector indices" are allowed.
MTEC(j)	Start-up variable micro variable j=1,2,3,4	On each market, sector 1,2,3,4, a technology factor of modern equipment (potentially produced units per person and quarter). Last quarter 1976. Production function parameter
NDUR	"Vector-index" =1,2,4,5...11	
NDURΔDUR	"Vector-index" =1,2,3,4...11	
NITER	Parameter	Telling the number of labour-market iterations in the labour market process in the model
NH	Constant	The number of households in the model
NMARKETS	Index	The number of industrial sectors in the model=4
NWB	Start-up variable	The net value of the bank. Residual between assets and liabilities
OMEGA(j)	Constant, micro-variable j=1,2,...10	A distribution vector indicating how firms' outlays for investments are allocated on purchases from different model sectors. Assumed to be equal for all firms

Code	Type	Used in (purpose)
OMEGABLD(j)	Constant j=1,2,...10	A distribution vector indicating how investments in residential construction result in purchases different model sectors
OMEGAG(j)	Constant j=1,2...10	A distribution vector indicating how government investments result in purchasing from different model sectors
OMEGAIN(j)	Constant j=1,2,...10	A distribution vector indicating how investments from external sectors (5,6,7...10) (less residential construction) result in purchases from different model sectors
ORIGMARKET(i)	Vector i=1,2... number of firms	Copy of the vector MARKET. Needed because MARKET will be changed during simulation
P(i)	Start up variable i=1,2,3... micro variable	Yearly price index 1976 =100 for all i (IMPORTANT)
POSG	Start up variable	The government's net position in the bank
POSGFOR	Start up variable	The government's net foreign deposit/borrowing position 1976
P△REF(j)	Constant j=1,2...10	Reference-price level. QPDOM+"value added tax" (=MOMS) value
Q(i)	Start up variable micro variable i=1,2,3... number of firms	Yearly production in each firm 1976, in fixed (1976) prices

Code	Type	Used in (purpose)
QC(j)	Start up variable j=1,2...11	Each household's consumption of products from the 10 sectors. QC•(number of households) yields aggregate consumption. The 11th component is redundant. Last quarter 1976. Current prices
QCHRI	Start up variable	Change in RI (rate of interest)
QCPI	Start up variable	Quarterly consumer price index. Last quarter 1976
QDCPI	Start up variable	Quarterly change (a fraction) of quarterly price index QCPI. Last quarter 1976
QDI	Start up variable	Disposable income per household. QDI•(number of households)=aggregate disposable income. Last quarter 1976
QDMTEC(j)	Constant micro variable j=1,2,3,4 parameter	On each market, the rate of technology upgrade for production equipment (a fraction on quarterly basis). Entered exogenously
QDPDOM(i)	Start up variable micro variable i=1,2...10	Change in QPDOM. A fraction. Last quarter 1976. 10 sectors
QDWIND	Start-up variable	Average wage increase in the industry (sector 1+2+3+4) during one quarter (a fraction)
QIMQ(i,j)	Start-up variable micro variable i=1,2,3..., number of firms j=1,2...10	Each firm's quarterly purchases of each kind of product (10 sectors). Fixed (1976) prices. Last quarter 1976

Code	Type	Used in (purpose)
QINPAY	Start-up variable	Households' aggregate wage and capital income from the external sectors (sectors 5,6...10) during one quarter. Computed in EXTERNAL SECTORS. Last quarter 1976
QINV(i)	Start-up variable micro variable i=1,2,3... number of firms	Each firm's investments during a quarter. Will enter the bookkeeping next quarter (last quarter 1976). NOTE: QINV is in current prices.
QINVBLD	Start-up variable	Investments in the construction sector last quarter 1976
QINVG	Start-up variable	Government investments last quarter 1976
QINVLAG(i)	Start-up variable micro variable i=1,2,3... number of firms	Each firm's investment plans during a quarter. (There is a couple of quarter's delay between plan and fulfilment of investment.) Last quarter 1976
QINVIN	Start-up variable	Investments in sectors 5,6...10. Last quarter 1976
QP(i)	Start-up variable i=1,2... number of firms micro variable	Quarterly price-index for each firm. Last quarter 1976
QPDOM(j)	Start-up variable (micro-variable to some extent) j=1,2,3,4...11	Domestic quarterly price index in the four industrial sectors last quarter 1976. Each firm has the same domestic price in a sector
QPFOR(j)	Start-up variable j=1,2,...4 micro variable	The foreign price index last quarter 1976. 4 sectors. Each firm has the same foreign price in a sector

Code	Type	Used in (purpose)
QPH(j)	Start-up variable j=1,2...11	Domestic prices for households for 10 sectors. The 11:th component is redundant, but must be there for technical reasons
QQ(i)	Start-up variable micro variable	Same as Q, but applies to quarter instead of year. Last quarter 1976
QS(i)	Start-up variable micro variable	Same as S, but quarterly variable. Last quarter 1976
QSAVHREQ	Start-up variable	One quarter's reduction in aggregate household borrowing
QTOP(i)	Start-up variable micro variable i=1,2,3... number of firms	Potential maximum production in each firm's production function Last quarter 1976
QTDIV	Start-up variable	One quarter's aggregate payments of dividends from firms to households Last quarter 1976
QTTAX	Start-up variable	Total tax receipts by the government during one quarter. Updated in GOVERNMENT ACCOUNTING. Last quarter 1976
QVA(i)	Start-up variable micro variable	Same as VA, but last quarter 1976 instead of the whole year
QW(i)	Start-up variable micro variable	Same as W, but refers to quarter instead. (Wage is expressed as the yearly wage-sum though)
QWG(i)	Start-up variable micro variable i=1,2... number of firms	Same as WG, but refers to last quarter 1976. (Still expressed as early wage-level)

Code	Type	Used in (purpose)
R	Constant, micro variable parameter	Used in YEARLY-EXPECTATIONS in the model
REDCHBW	Constant, micro variable parameter	Maximum allowed change in borrowing (fraction of borrowing)
RES(i)	Start-up variable micro variable i=1,2... number of firms	Parameter connected with the production function
RESDOWN	Constant, micro variable parameter	Used in connection with production function
RESMAX	Constant micro variable, parameter	A constant telling maximum slack any firm can possibly have RESMAX = 0.2 (Jan. 1982)
RET	Constant, parameter	Retirement rate on the labour market (a fraction on quarterly basis)
RHO	Constant micro variable parameter	Physical depreciation rate of production equipment (a fraction on quarterly basis)
RHOBOOK	Constant micro-variable, parameter	Maximum allowed depreciation rate of production equipment, for taxation purposes. A fraction quarterly basis
RHODUR	Constant, parameter	Depreciation rate of consumer durable goods (a fraction on quarterly basis)
Rfund1 Rfund2	Constant	Bank parameters
RI	Start-up variable	Rate of interest (a fraction). Last quarter 1976

Code	Type	Used in (purpose)
R1△1S△EXOGENOUS R1△1S△EXOGENOUS	Logical variable = 1	Means that EXO△RI will be used, i.e rate of interest will be exogenous
RLU	Constant, parameter	Fraction used in HOUSEHOLD INIT to compute unemployment compensation in proportion to average wage level in the industry. RLU=0.6 (Dec.1982)
RSUBS△CASH(i)	Constant micro-variable i=1,2,3... number of firms parameter	Government subventions to individual firms. Temporary subvention. The amount is expressed as a fraction of sales
RSUBS△EXTRA(i)	Constant micro variable i=1,2... number of firms parameter	Government subventions to individual firms expressed as a fraction of sales in the firm. Non-temporary subvention
RTD	Constant micro variable parameter	Ratio between firms' dividend payments and corporate taxes
RTRANS	Constant, parameter	Ratio between total transfer payments to households (less unemployment compensation) and total taxes. Used in HOUSEHOLD INIT; assumed constant
RU	Start-up variable	Rate of unemployment (fraction of total labour-force) last quarter 1976
RW(i)	Constant, micro variable i=1,2... number of firms parameter	A constant giving firms' desired amount of work ing capital (K2) as a fraction of current yearly sales
S(i)	Start-up variable micro variable i=1,2,3... number of firms	Yearly sales in each firm (current prices) 1976

Code	Type	Used in (purpose)
SAV	Index. SAV=12	
SHARE(i)	Constant, micro variable i=1,2... number of firms	SHARE(i) = individual firm's input share / average inputshare in sector See Section 3.3
SKREPA	Constant, parameter	A constant factor by which the probability for the pool of unemployed to be selected at a labour market attack is upgraded, as compared with the probability for any firm to be selectd. Used in CONFRONT
SMALL(i)	Constant, micro variable i=1,2,3... number of firms	Minimum inventory level (fraction of sales) Finished goods
SMOOTH(j)	Constant j=1,2...12	Used in the household part of the model
SMP	Constant, micro variable, parameter	This variable is used by firms to (each year) time-smooth their price-experiences. Equal for all firms
SMS	Constant micro-variable parameter	This variable is used by firms to (each year) time-smooth their sales experiences
SMT	Constant micro variable value jan-82: 0.5 parameter	This variable controls how quickly the profit-target is changed between two quarters. Equal for all firms
SMW	Constant, micro variable, parameter	Used by firms to (each year) time-smooth their wage experiences
STO(i)	Start-up variable micro variable i=1,2,3... number of firms	Inventory level of finished goods. Fixed (1976 year's) prices. Last quarter 1976

Code	Type	Used in (purpose)
STODUR	Start-up variable	Each household's stock of durable goods, current prices, last quarter1976
TEC(i)	Start-up variable i=1,2... number of firms	Parameter connected with the production function of the individual firm
THETA	Constant micro-variable parameter	Parameter used in the labour market-process in the model
ThisΔyear	Technical variable needed for simulation	= 1976
TMFASS	Constant	Bank-parameter
TMFD	Constant	Bank-parameter
TMIMP(j)	Constant j=1,2,3,4 micro variable parameter	Time constant for Swedish consumers to adjust import share (of demand) in each of the 4 industrial sectors
TMIMSTO	Constant micro variable parameter	Constant used for inventories. See the PLANQREVISE-part of the model. Has to do with adjustment-speed to optimum inventory level
TMINV(j)	Constant micro variable j=1,2,3,4 parameter	Average delay time to install investments in new production equipment Used in INVFIN; assumed to be equal for all firms in a sector. Sectors 1,2,3,4
THMSTO	Constant micro variable parameter	Constant used for inventories. See the PLANQREVISE-part of the model. Has to do with adjustment-speed to achieve optimum inventory level
TMX(j)	Constant micro-variable j=1,2,3,4 parameter	Time constant for firms when they adjust export share. Common to all firms in a sector

Code	Type	Used in (purpose)
TSTOCURF(j)	Start-up variable j=1,2,3,4	For each industrial sector (1..4) the aggregate finished goods inventories at current factor prices
TSTOCURM(j)	Start-up variable =1,2,3,4	For each industrial sector, the aggregate finished goods inventories at current market prices
TXI3	Technical variable needed for simulation	
TXVA1	Start-up variable	Value added tax, last quarter 1976. Compare with EXOΔQCHTXVA1
TXVA2	Start-up variable	Value added tax rate = "Moms". Last quarter 1976
VA(i)	Start-up variable micro-variable i=1,2,3... number of firms	Valued added for each firm 1976. Current prices in the model
UTREF	Constant micro-variable	A "reference" level of capacity utilization. Used in INVFIN when firms form their desired new borrowing and correct it for their current degree of utilization. Assumed equal for all firms
W(i)	Start-up variable micro-variable i=1,2,3... number of firms	Wage-sum per employee (expressed as wage sum per year) the whole 1976
WG	Start-up variable	Wage level in government sector 1976. Expressed as: yearly wages/number of people

Code	Type	Used in (purpose)
WGΔREF	Copy of WG for technical reasons	
WH	Start-up variable	Each household's wealth last quarter 1976 (current value of its bank deposits)
WHRA	Start-up variable	Each household's so called wealth ratio (quotient between bank deposits and quarterly disposable income)
WSG	Start-up variable	Total government wage sum last quarter 1976. Expressed as yearly wage sum
WTIX	Constant WTIX=1	Probably redundant, at present
X(i)	Start-up variable micro-variable i=1,2,3,4,... number of firms	Export share (exports/production) for each firm in the 4 industrial sectors. Last quarter 1976
XIN(j)	Constant j=5,6,...10	Export share (exports/production) in external sectors (5,6...10).
Z	Index Z=11	

The names of all the model-variables are stored in a workspace VLISTS.

The contents of this workspace is listed below. The names are stored in the text-variables: VARIABELGRUPP1,...VARIABELGRUPP5, GRUPP1.

Two functions **COPYSAVE** and **KILL** are also stored in this workspace (documented in Appendix C).

APPENDIX A: WORKSPACE VLISTS

```
     DOKUMENTATION
DOKUMENTATION
A DOCUMENTATION:
A
A COMPLETE LISTS OF OUTPUT-VARIABLES FROM INITIALIZATION
A
A VARIABELLISTA1= EXOGENOUS VARIABLES
A VARIABELLISTA2= ENDOGENOUS VARIABLES
A VARIABELLISTA3= CONSTANTS
A VARIABLELISTA4,VARIABELLISTA5= OTHER VARIABLES (TECHNICAL)
A GRUPP1 = VARIABLES WHICH ARE TAKEN DIRECTLY FROM INPUT-
A WORKSPACE MACRO.
A
A
A IF NEW VARIABLES ARE ADDED TO THE INITIALIZATION,THE
A VARIABLELISTS ABOVE HAVE TO BE UPDATED WITH THE NEW
A VARIABLES,OTHERWISE THE VARIABLES WILL BE DELETED
A IN THE FUNCTION OUTPUTΔOPERATIONS.
A
A FREDRIK BERGHOLM ,DEC 1981
A=========================================
```

APPENDIX A: WORKSPACE VLISTS

VARIABELGRUPP1

```
EXO∆RSUBS QINVG EXO∆REALCHLG EXO∆QDINVG GKOFF OMEGAG XIN IMP IO IO2 IO3
 OMEGA OMEGABLD QINVBLD QINVIN EXO∆QDINVIN EXO∆QDINVBLD QPFOR EXO∆
QDPFOR EXO∆QDPIN   SHARE QDMTEC EXPXDP EXPXDW EXPXDS RET ENTRY EXO
∆QCHTXVA1 EXO∆QCHTXVA2 MTEC WSG RSUBS∆EXTRA RSUBS∆CASH NH  OMEGAIN
 EXO∆TXC EXO∆TXI1 EXO∆TXW EXO∆TXWG EXO∆RI EXO∆RIBWFOR EXO∆RIDEPFOR
 RET ENTRY EXO∆QDINVBLD
```

VARIABELGRUPP2

```
LG QWG WG LU IMP QPDOM X HISTDP HISTDW HISTDS HISTDPDEV2 HISTDWDEV2 HI
STDSDEV2 MHIST QIMQ L EXPDP EXPDW  EXPDS DP DW DS DQ QP QW QS QQ Q
VA Q P S W VA M DVA AMAN IMSTO STO QTOP TEC RES K1 K2    BW INVEFF
 QINV QINVLAG DELAY∆INV QTDIV K1BOOK QDWIND            TSTOCURF
TSTOCURM QPH WH WHRA QC CVA QDCPI STODUR QSAVHREQ QCPI  K1BOOK QDP
DOM HISTDPDEV HISTDWDEV HISTDSDEV  CHM QDI
```

APPENDIX A: WORKSPACE VLISTS

```
      VARIABELGRUPP3
BETA TMSTO IMBIG IMSMALL TMIMSTO IMBETA RHO RHOBOOK RESMAX LOSS RESDOWN
      WTIX RW ALFABW BETABW ELINV RTD TMINV EPS TMX TMIMP RLU MAXDP UTRE
      F_R E1 E2 SMP SMW SMS FIP FIW FIS GAMMA THETA KSI SKREPA IOTA SMAL
    - L BIG RTRANS POSGFOR TMFASS TMFD FD FASS  KAPPA1 KAPPA2 RFUND1 RFU
      ND2 LAMDA1 LAMDA2 MAXQCHRI MB MAXRIDIFF MINRI MAXRI FUNDSΔAREΔENOU
      GH RHODUR ALFA3 ALFA4 BETA1 BETA2 BETA3 SMOOTH  SMT BAD REDCHBW


      VARIABELGRUPP4
RIΔISΔEXOGENOUS MARKET MKT IN NDURΔDUR DUR NITER MARKETΔITER SAV Z NDUR
       LEFT              FΔINKOP BRINKOP


      VARIABELGRUPP5
WGΔREF PAREF ORIGMARKET


      GRUPP1
TXVA1 TXVA2 RI NWB LIQB  POSG LIQBFOR RU QCHRI  QTTAX QINPAY LASTΔYEAR T
      HISΔYEAR FIRSTΔSIMΔYEAR AMANΔYEAR LASTΔTXI2ΔYEAR NMARKETS EXOΔTXI2
        IMPLPAREF  TxI3
```

APPENDIX B **MACRO- AND MICRO-DATA**
DOCUMENTATION DEC. 1983
WORKSPACE **MACRO** AND **SI76**

All variables (dec 83) in workspace MACRO are listed in this appendix.This is a complete documentation of the macro data base. The micro data base is also complete, although firm variables are not printed since they are confidential. This appendix is needed, as a pattern, if one wants to initialize the micro-to-macro model for another starting year.

There are also 3 functions in workspace MACRO. They are used to form certain variables during the initialization procedure (**AGGRITAX** and **TLΔEXPΔPRISΔ76**) or before the initialization (**COEFFΔIO**).

The variables are:

AMANΔYEAR	BLDΔRATE1	BLDΔRATE2	EXOΔQTXVA1
EXOΔQTXVA2	EXOΔRI	EXOΔRIBWFOR	EXOΔRIDEPFOR
EXOΔTXC	EXOΔTXI1	EXOΔTXI2	EXOΔTXW
EXOΔTXWG	FIRSTΔSIMΔYEAR	GΔRATE1	GΔRATE2
HISTΔTXVA2	HOURSΔPERΔYEAR	HUSHALLSDEP	IMPLΔPRIS
IMPLΔPRISΔIN	IMPLPΔREF	INΔRATE1	INΔRATE2
INITΔGROWTH	IO76	IOCOEFF76	LASTΔTXI2ΔYEAR
LASTΔYEAR	LGTRENDCH	LIQB	LIQBFOR
LON	LONΔOFF	MACROLIST	NMARKETS
NWB	POSQ	QCHRI	QINPAY
QTTAX	RI	RU	SALES76
THISΔYEAR	TIM	TIMΔOFF	TLΔEXP
TRENDM	TXC	TXI1	TXVA1
TXVA2	TXVAZ	TXW	RSUBS

APPENDIX B   WORKSPACE MACRO

```
        AMANΔYEAR             Probably redundant (jan 1982) ,but needed for technical reasons.
75
        BLDΔRATE1
1.04215                      Growth-rate of investments in residential housing,1976.
        BLDΔRATE2
1.00275                      Long term growth rate,investments in residential housing.(yearly change)
        EXOΔQTXVA1
0 0 0 0 0                    Value added tax on investments goods.Quarterly series starting with
        EXOΔQTXVA2           first quarter 1977.
0.15 0.15 0.15 0.171 0.171   Value added tax       .Quarterly series starting with first quarter 1977.
        EXOΔRI               Rate of interest,quarterly series starting with first quarter 1977.
0.0981 0.0986 0.0979 0.098 0.0987 0.1011 0.0998 0.0999 0.0983 0.0954 0.0947 0.0992 0.1069
        EXOΔRIBWFOR          See appendix A.Quaterly series starting with first quarter 1977.
0.0614 0.0714 0.0746 0.0768 0.0847 0.0931 0.1191 0.1081 0.1093 0.1243 0.1508 0.1737
        EXOΔRIDEPFOR         See appendix A.Quarterly  series starting with first quarter 1977.
0.0519 0.0569 0.0677 0.0709 0.0731 0.081 0.0894 0.1154 0.1044 0.1056 0.1206 0.1471 0.17
        EXOΔTXC
0.564 0.58 0.575 0.575       Tax-rate,firms.Yearly series starting with 1977.
        EXOΔTXI1
0.392 0.395                  Income-tax rate ,households.Yearly series starting with 1977.
        EXOΔTXI2             Probably redundant,but needed for technical reasons.
0.00055124 0.0005466
        EXOΔTXW
0.280 0.289 0.288 0.294      Wage-tax rate.Yearly series starting with 1977.
        EXOΔTXWG
0.307 0.309 0.309 0.312      Wage-tax rate,goverment sector.Yearly series starting with 1977.
```

APPENDIX B WORKSPACE MACRO

```
      FIRSTΔSIMΔYEAR
77
```

First year of simulation.77 stands for 1977.

```
      GΔRATE1
1.08732
```

Growth-rate of investments in the Goverment-sector,1976.

```
      GΔRATE2
1.03269
```

Long term growth-rate,investments in the government-sector, yearly change.

```
      HISTΔTXVA2
  0.15          0.12          0.12          0.15
  0.15          0.15          0.15          0.15
  0.15          0.15          0.15          0.15
  0.15          0.15          0.171         0.171
```

VALUE-ADDED TAX,"moms".

Rows: Years ,starting with 1974.
Columns: Quarters .

```
      HOURSΔPERΔYEAR
1600
```

Average number of working hours per year,1976.Roughly.

```
      HUSHALSDEP
1.133900000E11
```

Household´s bank deposits 1976.

```
      IMPLΔPRIS
   88.27192527   94.18785677  100    107.3170732
   84.99043977   96.36711281  100    103.5372849
   80.23072889   89.77451494  100    106.6072365
   82.23609535   89.78433598  100    111.8047673
```

YEARLY PRICE-INDEX SERIES,domestic prices.

Rows: Sector 1,2,3,4 (Industrial sectors)

Columns: Years;1974,1975,1976,1977

```
      IMPLΔPRISΔIN
   74.98647333   90.96869026  100    111.1604083
   74.10440123   96.87819857  100     94.06345957
   83.47457627   85.2672751   100    108.8657106
   75.1002004    87.6252505   100    105.511022
   83.97033657   89.50370793  100    111.8653736
   81.640625     89.67633929  100    111.1049107
```

YEARLY PRICE-INDEX SERIES,domestic prices.

Rows: Sector 5,6,7,8,9,10

Columns: Years;1974,1975,1976,1977

APPENDIX B WORKSPACE MACRO

IMPLPAREF
27.18 40.38 44.34 30.91 60.26 58.35 100 55.71 65.7 56.54

Value added shares, from input-output matrix 1976.
Value added share=1-inputshare. 10 sectors. (percentage-figures).
This variable is used in some print-out functions in the MOSES-workspace.

INΔRATE1
1.08065

Growth rate of investments in non-industrial sectors (sector 5,6..10), 1976.

INΔRATE2
1.02519

Long term growth rate of investments in non-industrial sectors, (yearly change).

INITΔGROWTH
0.064 0.056 0.06 0.023

Growth rate, labour productivity in the 4 industrial sectors (sector 1,2,3,4). Used in function secondaryΔdata in the initialization procedure.

APPENDIX B WORKSPACE MACRO

INPUT-OUTPUT matrix ,1976,in kr,expressed in 1975 year´s prices.

14 rows and 21 columns.

Documentation ,see section 3.

The first 10 columns.

I076

5272	2890	5869	1321	245	94	0	4192	942	1943
2029	5195	4805	4465	908	117	0	3498	170	2035
954	2354	12296	915	503	213	0	6294	171	3079
803	2428	2041	14872	2078	87	0	2648	102	6484
2400	1964	341	10768	383	1	0	1689	0	312
2951	210	79	63	26	140	0	418	5	0
4136	600	151	261	130	213	0	1009	488	842
1235	1198	2838	961	1383	162	0	10928	708	9874
904	941	475	485	238	171	0	1118	328	1010
3293	3338	5919	4402	1792	640	0	9143	426	25656
63	71	142	¯2377	163	10	0	350	5	2261
8736	14351	27422	19551	11452	2529	0	50892	6395	64383
154	¯119	178	51	41	35	0	238	0	1
32933	35423	62558	55738	19341	4413	0	92417	9738	117881

The 11 remaining columns.Final Demand side of the matrix.

I076

758	5399	0	0	0	380	2754	12137	¯11478	214	32933
1953	9075	558	0	869	2170	1135	14735	¯12965	¯5329	35423
3522	14903	3110	0	4836	10231	1687	29947	¯24563	¯7896	62558
5102	55944	112	0	175	132	752	7450	¯15980	¯29493	55738
243	6807	0	0	128	408	¯95	1351	¯3597	¯3763	19341
81	24	0	0	0	0	67	1134	¯3015	2230	4413
374	2346	0	0	0	0	188	1778	¯6491	¯6025	0
2929	26970	17893	12436	4682	765	1067	7062	¯4453	¯6221	92417
973	3580	0	0	0	0	¯76	319	¯306	¯421	9738
8849	30617	379	0	591	0	¯316	10370	¯16362	29496	117881
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
24785	155664	22052	12436	11281	14085	7163	86284	¯99209	¯27209	430440

APPENDIX B WORKSPACE MACRO

INPUT-OUTPUT coefficients estimated from IO76.Vertical sum=1.13 rows,19 columns.

See function COEFF∆IO on p.12 in this appendix.See also section 3.

IOCOEFF76 The first 10 columns

0.16	0.08	0.09	0.02	0.01	0.02	0.00	0.05	0.10	0.02
0.06	0.15	0.08	0.08	0.05	0.03	0.00	0.04	0.02	0.02
0.03	0.07	0.20	0.02	0.03	0.05	0.00	0.07	0.02	0.03
0.02	0.07	0.03	0.27	0.11	0.02	0.00	0.03	0.01	0.06
0.07	0.06	0.01	0.19	0.02	0.00	0.00	0.02	0.00	0.00
0.09	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
0.13	0.02	0.00	0.00	0.01	0.05	0.00	0.01	0.05	0.01
0.04	0.03	0.05	0.02	0.07	0.04	0.00	0.12	0.07	0.08
0.03	0.03	0.01	0.01	0.01	0.04	0.00	0.01	0.03	0.01
0.10	0.09	0.09	0.08	0.09	0.15	0.00	0.10	0.04	0.22
0.00	0.00	0.00	¯0.04	0.01	0.00	0.00	0.00	0.00	0.02
0.27	0.41	0.44	0.35	0.59	0.57	0.00	0.55	0.66	0.55
0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00

INPUT-OUTPUT coefficients,continued.

IOCOEFF76 Column 11,12..19 .Final Demand coefficients.

0.03	0.03	0.00	0.00	0.00	0.03	0.38	0.14	0.12
0.08	0.06	0.03	0.00	0.08	0.15	0.16	0.17	0.13
0.14	0.10	0.14	0.00	0.43	0.73	0.24	0.35	0.25
0.21	0.36	0.01	0.00	0.02	0.01	0.10	0.09	0.16
0.01	0.04	0.00	0.00	0.01	0.03	¯0.01	0.02	0.04
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03
0.02	0.02	0.00	0.00	0.00	0.00	0.03	0.02	0.07
0.12	0.17	0.81	1.00	0.42	0.05	0.15	0.08	0.04
0.04	0.02	0.00	0.00	0.00	0.00	¯0.01	0.00	0.00
0.36	0.20	0.02	0.00	0.05	0.00	¯0.04	0.12	0.16
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

LASTΔTXI2ΔYEAR Probably redundant at present (jan 1982).
78

LASTΔYEAR "Year-counter" in the model.Start-value=76 (stands for 1976).
76

LGTRENDCH Trend growth in the goverment sector.Number of people added (net) each quarter.
7875

LIQB See appendix A. 1976.
4.630900000E10

LIQBFOR See appendix A. 1976.
10924000000

LON Total wage-sum in the 4 industrial sectors, 1,2,3,4 . 1976.
8376281000 1.065502900E10 2.400718000E10 1.450339000E10

APPENDIX B WORKSPACE MACRO

LONΔOFF 5.807200000E10 6.994700000E10	Total wage-sum in the goverment-sector.1976 and 1977.
NMARKETS 4	Number of industrial sectors in the model.(=4)
NWB 7.779457670E10	See appendix A.1976.
POSG ¯7.396300000E10	See appendix A.1976.
QCHRI 0.0002	Change in rate of interest,last quarter 1976.
QINPAY 3.240000000E10	See appendix A.Last quarter 1976.
QTTAX 3.780000000E10	Total tax receipts by the government,last quarter 1976.
RI 0.0979	Rate of interest,last quarter 1976.
RU 0.016	Rate of unemployment,1976.
SALES76 *) 2.913290600E10 3.788546400E10 7.025235800E10 6.988083000E10	Total sales in the 4 industrial sectors, (sector 1,2,3,4) in producer's prices,1976.
THISΔYEAR 76	"Year counter"in the model.
TIM 204338800 264942430 606865110 398119570	Total number of working-hours during a a year in the 4 industrial sectors,1976.
TIMΔOFF 1465950000 1498760000	Total number of working-hours during a year,in the government-sector.1976 and 1977 .

---

*) Since 1983 the following variable is,usually,used instead of SALES76:

NYSALES76
3.660000000E10 3.930000000E10 6.950000000E10 6.180000000E10

APPENDIX B WORKSPACE MACRO

Export price index,the four industrial sectors.(sector 1,2,3,4)
Price-series, 38 quarters. 1971:1 ..1980:2

These series are used to form future price-series.See function TL∆EXP∆PRIS∆76 on p.12 in this appendix.

TL∆EXP

101.4	101	98.6	96.5	95.2	95.2	96.6	
99.7	108.3	120.5	132.3	143.9	168.7	177	SECTOR 1
183.1	190.4	184.4	177.1	172.6	173.9	177.3	
182.9	185.1	181.7	183	182.6	186.7	180.4	
175.7	178.1	185.7	193	203.9	210.2	223.3	
233.5	252	255.6					
99.4	100	100.2	101.8	103.5	105.7	105.3	
105.4	109.2	113.4	118.2	123.2	149.4	163.5	
180.5	188	194.4	190.6	187.2	184.9	182.4	
183.9	184.8	182.4	184.2	187.5	195.9	199	SECTOR 2
203	201.1	204.6	207	216.8	228.8	235.8	
244.5	258.6	266.5					
99.9	99.6	100	101.5	103.2	104.8	108.1	
108.5	110.3	111.8	115.9	120.9	127.9	131.2	
137	141	144.9	150	154.3	157	165.2	SECTOR 3
168.3	173.2	174.2	179.9	183	188.9	190.5	
200.3	202.8	207.4	209.9	213.2	220.1	224.3	
225.7	235.1	242.7					
99	100.5	100.4	101.5	104.2	103.2	106.3	
106.5	112.3	115.8	118.7	122.9	133.2	139.5	
142.7	145.5	148.2	150.3	152.6	155.2	162	SECTOR 4
164.8	167.8	170.5	178.2	183.5	185.7	191.7	
200.8	203.3	204.1	208.3	219.8	221.9	226.8	
230.2	240.6	239.4					

APPENDIX B WORKSPACE MACRO

TRENDM 0.0133237 0.00840916 0.01729822 0.0124923 0.00989622 0.0141188	Trend change (quarterly change) in domestic price index for sector 5,6..10 .
TXC 0.561	Corporate tax-rate. 1976.
TXI1 0.354	Income tax-rate (households).1976.
TXVA1 0	Value added tax,investment goods.Last quarter 1976.
TXVA2 0.15	Value added tax-rate,"moms". Last quarter 1976.
TXW 0.267	Wage-tax rate . 1976.
TXWG 0.277	Wage-tax (government-sector) rate.1976.
RSUBS 0 0 0 0.035	Subventions to the 4 industrial sectors,(sector 1,2,3,4). 1976-."Food subventions " to sector 4. Subventions are expressed as fractions of sales in each sector.

APPENDIX B WORKSPACE MACRO

```
     ∇AGGRITAX[⎕]∇
   ∇ R←AGGRITAX Y
[1]  R←TXI1×Y
   ∇
```

This function estimates income-tax ,in kr.

Usage: See function QDI_INIT,subfunction in appendix C.

```
     ∇COEFF∆IO[⎕]∇
   ∇ COEFF∆IO;S;SUMMA;SUMMAMAT
[1]  S←(13 19)↑IO76
[2]  SUMMA←+/[1]S
[3]  SUMMAMAT←(13 19)⍴SUMMA
[4]  IOCOEFF76←S÷SUMMAMAT
[5] ⍝ 0÷0 GER 1,MASTE KORRIGERAS
[6]  IOCOEFF76[;7]←0
   ∇
```

This function estimates input-output coefficients from the input-output matrix IO76.

```
     ∇TL∆EXP∆PRIS∆76[⎕]∇
   ∇ R←TL∆EXP∆PRIS∆76 N;AR;CYCL;DU;DUM;DUMMY;FUT
[1] ⍝ EXPORT-PRICE CHANGES WITH NEW DATA, COVERING PERIOD
[2] ⍝ 1971:1 THROUGH 1980:2
[3] ⍝ OUTPUT IS QUARTERLY CHANGES FROM 1Q-76 UP TO END OF
[4] ⍝ SIMULATION = ARG. N. DUR AND NDUR ON THE AVER-
[5] ⍝ AGE TREND 1971-76. RAW AND IMED WITH A CYCLE FROM
[6] ⍝ 1980:3 AS THE ONE FROM 1975:1
[7]  AR←(1↓⍴TL∆EXP)
[8]  FUT←(1+4×N)-(¯1+AR-22)
[9]  CYCL←(¯16+1↓⍴TL∆EXP)
[10]  DUMMY←(¯1+(TL∆EXP[;1+⍳AR-1]÷TL∆EXP[;⍳AR-1]))
[11]  DUM← 0 22 ↓DUMMY
[12]  DU←(4,FUT)⍴((1,FUT)⍴(DUMMY[1;15+⍳CYCL])),[1]((1,FUT)⍴(DUMMY[2;15+⍳CYCL])),[1](⍉(FUT,2)⍴(+/DUMMY[3 4 ;])
     ÷(AR-1))
[13]  DU[;⍳FUT]←DU[;⍳FUT]×2÷3
[14] ⍝TEMPORARY CHANGE 4/12 1980,TO LOWER FOREIGN INFLATION RATE
[15]  R←DUM,DU
   ∇
```

This function estimates future export price-changes.

APPENDIX B   WORKSPACE SI76 - MICRO DATA

A vector telling what firm-group a certain firm belongs to.

```
  FIRMID
16 16 18 0 25 25 14 27 24 16 8 0 0 18 32 21 0 18 32 21 0 19 19 1 8 8 0 7 19 0 16 0 22 7 14 3 9 9 9 9 22 16 18 25 28
 28 17 0 0 27 32 0 30 0 18 6 24 1 2 2 2 15 5 5 0 3 23 23 28 11 11 26 7 11 31 3 23 23 23 28 28 7 20 20 20 23 12 3
 23 1 1 11 30 31 29 0 4 11 0 23 28 30 30 26 26 26 0 16 15 13 13 13 13 13 33 34 35 36 37 38 39 40
```

Firm-code.

```
  LIST
1,01 1.02 1.03 1.07 1.08 1.09 1.12 1.13 1.17 1.18 1.26 1.29 1.41 1.44 2.01 2.02 2.03 2.06 2.07 2.12 2.13 2.19 2.21
 2.26 2.27 2.28 2.3 2.31 2.32 2.33 2.35 2.4 2.42 2.44 2.46 2.47 2.51 2.61 2.72 3.01 3.05 3.06 3.07 3.08 3.09 3.1
 3.12 3.13 3.16 3.18 3.19 3.2 3.22 3.23 3.25 3.29 3.32 3.34 3.36 3.37 3.38 3.39 3.4 3.41 3.43 3.44 3.47 3.48 3.54
 3.55 3.56 3.57 3.58 3.61 3.68 4.06 4.22 4.3 4.32 4.33 4.38 4.39 4.44 5.01 5.03 5.09 5.11 5.14 5.18 5.19 5.24 5.25
 1.91 1.92 1.93 3.91 4.91 4.92 4.93 4.94
```

A vector telling what sector (1,2,3 or 4) a certain firm belongs to.

```
  RΔMARKET
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3
 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 4 4 4 3 3 3 3 4 4 4 2 2 2 2 3 2 2 2 2 2 1
 1 1 3 4 4 4 4
```

```
      ρX
122 50
      ρFΔDATA
40 26
```

All firm-data lie in an enormous matrix with 122 rows and 50 columns.

All firm-group data lie in an enormous matrix with 40 rows and 26 columns.

X and FΔDATA are not listed in this documentation,because the figures are given by the firms provided that the figures aren´t published.

APPENDIX C THE INITIALIZATION CODE, MAIN CODE

The functions listed below are the functions stored (jan 82) in workspace INIT. They are described in Sections 2 and 4, in Part 2.

The functions have line-numbers leftmost. A function stands between the symbols ∇ (upside-down delta).

Local variables in each function can be found on line zero after the semicolon (;). After the function-name a parameter to the function may appear. For example: **START** N. N is a parameter (an integer) to the function **START**.

APPENDIX C FUNCTION START

```
     ∇  START N
[1]     ⍎')MAXCORE 160 '
[2]    ⍝ NEEDED SPACE IN COMPUTER...
[3]     WORKSPACENAME←'R',⍕N
[4]    ⍝THE RESULT FROM THE INITIALIZATION WILL BE STORED IN A WORKSPACE
[5]    ⍝CALLED RXX,WHERE XX IS THE NUMBER N GIVEN IN THE CALL START N
[6]     ' RESULT FROM INITIALIZATION IS STORED IN WORKSPACE ',⍕WORKSPACENAME
[7]    ⍝
[8]    ⍝WORKSPACENAME IS USED IN FUNCTION OUTPUTΔOPERATIONS...
[9]    ⍝
[10]    NYR←30
[11]   ⍝NUMBER OF YEARS TO INITIALIZE VARIABLES.
[12]   ⍝CAN BE CHANGED IN FUNCTION ISTARTXX.
[13]   ⍝
[14]    ⍎')COPY FUNCTI MODADD MODDEL MODSUBST SCANMAT PACK ENS EQUALS ABOVE'
[15]    NAME←'ISTART',⍕N
[16]    ⍎')COPY ISTART'
[17]   ⍝START-FUNCTIONS SHOULD LIE IN WORKSPACE ISTART
[18]    ⍎NAME
[19]   ⍝THE LINE ABOVE MEANS THAT THE FUNCTION ISTARTXX WILL BE EXECUTED.
[20]   ⍝XX IS THE NUMBER OF THE INITIALIZATION.(XX=N)
[21]   ⍝ISTARTXX IS SPECIFIC FOR A CERTAIN EXPERIMENT.
[22]   ⍝IN ISTARTXX ONE CAN CHANGE LINES BELOW WITH 3 SPECIAL
[23]   ⍝FUNCTIONS MODADD,MODSUBST,MODDEL.
[24]   ⍝THUS ISTARTXX CAN CHANGE THE PROGRAM BELOW DURING EXECUTION.
[25]   ⍝
[26]   ⍝
[27]    SIΔINIT NYR
[28]    'INITIALIZATION COMPLETED'
[29]    ⍎')CLEAR'
[30]    ⍎')WS CLEAR'
     ∇
```

APPENDIX C FUNCTION SI∆INIT

```
    ∇  SI∆INIT NYR;DUMMY
[1]    ⍝ DUMMY←⍎')COPY SI76 FA∆DATA X FIRMID'
[2]    ⍝LINE ABOVE EXECUTED IN FUNCTION ESTABLISHMENTS
[3]     DUMMY←⍎')COPY MACRO'
[4]     DUMMY←⍎')COPY FUNCTIONS'
[5]    ⍝
[6]    ⍝FIRMDATA FROM WORKSPACE SI76
[7]    ⍝MACRODATA FROM WORKSPACE MACRO
[8]    ⍝HELPFUNCTIONS FROM WORKSPACE FUNCTIONS
[9]    ⍝
[10]   ⍝
[11]    TESTUTSKRIFT←0
[12]   ⍝NYR=NUMBER OF YEARS TO RUN THE SIMULATION.
[13]   ⍝
[14]   ⍝
[15]    NQR←4×NYR
[16]   ⍝NQR=NUMBER OF QUARTERS
[17]    NMARKETS←4
[18]   ⍝
[19]   ⍝
[20]    TAX∆PARAMETERS
[21]    PUBLIC∆SECTOR
[22]    MONETARY
[23]    MARKETS
[24]    HOUSEHOLDS
[25]    ESTABLISHMENTS
[26]   ⍝FUNCTION DISPOSE∆VAR∆INPUT DELETES VARIABLES FROM WORKSPACE MACRO...
[27]   ⍝XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
[28]   ⍝  SECOND PART OF INITIALIZATION
[29]   ⍝XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
[30]   ⍝THE FOLLOWING VARIABLES ARE NEEDED IN THE SECOND PART
[31]   ⍝OF THE INITIALIZATION.COPIES ARE TAKEN BECAUSE IT SEEMS LOGICAL
[32]   ⍝TO FORBID READING FROM INPUTFILES IN SECOND PART OF
[33]   ⍝INITIALIZATION...
[34]    GROWTH←INIT∆GROWTH
[35]    TXVA2COPY←TXVA2
[36]    RU∆COPY←RU
[37]    TXWCOPY←TXW
```

APPENDIX C FUNCTION SI∆INIT (cont.)

```
[38]   TXWGCOPY←TXWG
[39]   QINPAYCOPY←QINPAY
[40]   RI∆COPY←RI
[41]   TXI1COPY←TXI1
[42]  ⍝FROM NOW ON NO MORE READING FROM INPUT-WORKSPACES
[43]  ⍝(MACRO AND SI76).THERE WILL BE,ONLY,FURTHER WORK WITH
[44]  ⍝VARIABLES AND PARAMETER-SETTING.
[45]   DISPOSE∆VAR∆INPUT
[46]   MARKETS∆DATA
[47]   SECONDARY∆DATA
[48]   PUBLIC∆DATA
[49]   MONETARY∆DATA
[50]   HOUSEHOLDS∆DATA
[51]  ⍝
[52]  ⍝
[53]   OUTPUT∆OPERATIONS
[54]  ⍝THIS FUNCTION HANDLES OUTPUT.(UNNECESSARY VARIABLES ARE DELETED).
[55]   'TESTUTSKRIFT2'
     ∇
```

APPENDIX C FUNCTION TAX∆PARAMETERS

```
     ∇  TAX∆PARAMETERS
[1]    ⍝VARIABLES IN WORKSPACE MACRO WHICH IS FINAL OUTPUT FROM INITIALIZATION:
[2]    ⍝ TXVA1,TXVA2
[3]    ⍝
[4]    ⍝ OTHER VARIABLES IN TAX∆PARAMETERS WHICH WILL BE FINAL
[5]    ⍝ OUTPUT FROM INITIALIZATION:
[6]    ⍝ ALL EXO-VARIABLES TO THE LEFT OF '←' BELOW AND TXI3
[7]    ⍝
[8]     EXO∆QCHTXVA1←NQR↑DIFF EXO∆QTXVA1
[9]     EXO∆QCHTXVA2←NQR↑DIFF EXO∆QTXVA2
[10]    EXO∆TXC←NYR CONTINUE1 EXO∆TXC
[11]    EXO∆TXI1←NYR CONTINUE1 EXO∆TXI1
[12]    EXO∆TXW←NYR CONTINUE1 EXO∆TXW
[13]    EXO∆TXWG←NYR CONTINUE1 EXO∆TXWG
[14]    TXI3←1.6
     ∇
```

APPENDIX C   FUNCTION PUBLICΔSECTOR

```
    ∇  PUBLICΔSECTOR;ALG;QLG;WAGES;RATE1;RATE2;QCHLG
[1]    ⍝
[2]    ⍝  VARIABLES IN PUBLICΔSECTOR WHICH WILL BECOME
[3]    ⍝ FINAL OUTPUT FROM ININTIALIZATION:
[4]    ⍝ OMEGAG,QINVG,EXOΔQDINVG,EXOΔRSUBS,QWG,WG,LG,WGΔREF
[5]    ⍝GKOFF,EXOΔREALCHLG
[6]    ⍝
[7]    ⍝
[8]     OMEGAG←10↑IOCOEFF76[;13]
[9]     INVG←IO76[14;13]
[10]    RATE1←GΔRATE1
[11]    RATE2←GΔRATE2
[12]   ⍝ RATE1=YEARLY PERCENTAGE CHANGE IN INVG,RATE2=TREND CHANGE
[13]    ALG←TIMΔOFF÷HOURSΔPERΔYEAR
[14]   ⍝
[15]    WAGES←2⍴0
[16]    WAGES[1]←LONΔOFF[1]÷ALG[1]
[17]    WAGES[2]←LONΔOFF[2]÷ALG[2]
[18]   ⍝
[19]    QLG←(4×(⍴ALG))⍴0
[20]    QLG←MAKEQUARTERS ALG
[21]   ⍝RESULT FROM MAKEQUARTERS:QLG=
[22]   ⍝AVERAGE LABOUR FORCE IN EACH QUARTER.QLG(1)=
[23]   ⍝QUARTER 1 BASE YEAR AND SO ON...
[24]    QCHLG←DIFF QLG
[25]    LG←QLG[4]
[26]    EXOΔREALCHLG←NQR CONTINUE1(3↓QCHLG),LGTRENDCH
[27]    EXOΔREALCHLG←EXOΔREALCHLG×0.4
[28]   ⍝ATTEMPT TO MODIFY GOVERNMENT DEMAND FOR LABOUR DUE TO
[29]   ⍝FICTIOUS LABOUR-FORCE IN THE MODEL...
[30]   ⍝(GOVERNMENT LABOUR+INDUSTRY LABOUR)÷(TOTAL LABOUR FORCE)=1.7÷4.1 MILLION PEOPLE
[31]   ⍝THAT IS: FICTIOUS LABOURFORCE=1.7 MILL. PEOPLE IS
[32]   ⍝APPROXIMATELY 0.4×TOTAL LABOUR FORCE.
[33]   ⍝THAT'S WHY DEMAND IS MULTIPLIED WITH 0.4...
[34]   ⍝FREDRIK B
[35]   ⍝
[36]    QWG←WAGES[1]+0.375×(WAGES[2]-WAGES[1])
[37]    WG←WAGES[1]
```

APPENDIX C FUNCTION PUBLIC∆SECTOR (cont.)

```
[38]  ⍝
[39]   QINVG←(0.25×INVG×1000000)×RATE1*(1.5÷4)
[40]  ⍝QUARTER1: RATE1*(-2.5÷4)
[41]  ⍝QUARTER2: RATE1*(-1.5÷4)
[42]  ⍝QUARTER3: RATE1*(0.5÷4)
[43]  ⍝QUARTER4: RATE1* 1.5÷4)
[44]  ⍝SUM = (APPROX.) 4   ,WHICH MEANS THAT SUM(QINVG)=INVG
[45]   EXO∆QDINVG←(NQRρ(RATE2*(1÷4)))-1
[46]   EXO∆RSUBS←NYR CONTINUE2 RSUBS
[47]   GKOFF←(10*6)×(10↑IO76[;1])÷(WG×LG)
[48]  ⍝
[49]   WG∆REF←WG
     ∇
```

APPENDIX C FUNCTION MARKETS

```
    ∇  MARKETS;PDOM;MΔPRICE
   ⍝FINAL OUTPUT FROM THIS FUNCTION:
   ⍝XIN,IO,IO2,IO3,OMEGA,OMEGABLD,OMEGAIN,IMP,
   ⍝QINVBLD,QINVIN,EXOΔQDINVIN,EXOΔQDINVBLD,
   ⍝QPDOM,QDPDOM,EXOΔQDPIN,PΔREF,QPFOR,EXOΔQDPFOR
   ⍝
   ⍝OUTPUT TO FUNCTION HOUSEHOLDSΔDATA:
   ⍝QDPIN,QDPFOR
   ⍝
   ⍝
   ⍝
   ⍝
   ⍝
    IMP←10⍴0
    XIN←6⍴0
    XIN[3]←0
    XIN[1,2,4,5,6]←IO76[5,6,8,9,10;18]÷IO76[14;5,6,8,9,10]
   ⍝XIN=EXPORT SHARES IN SECTORS OUTSIDE OUR 4 MARKETS
    SWEDISHΔDEMAND←IO76[⍳10;21]-(IO76[⍳10;20]+IO76[⍳10;19]+IO76[⍳10;18])
   ⍝SWEDISHΔDEMAND←PRODUCTION(INCL. IMPORTS)-(DIFF+IMPORTS+EXPORTS).
   ⍝NOTE THAT IMPORTS IS STORED WITH NEGATIVE SIGN IN IO76...
   ⍝
    IMP←(|IO76[⍳10;19])÷SWEDISHΔDEMAND
   ⍝IMP= IMPORT-SHARE OF_SWEDISH_CONSUMER'S DEMAND ...
   ⍝ IMP=IMPORTS VECTOR FOR MARKETS 1,2..10
   ⍝
   ⍝
   ⍝
    IO←IOCOEFF76[⍳10;⍳10]
    IO2←IOCOEFF76[⍳4;4+⍳6]
    IO3←IOCOEFF76[4+⍳6;4+⍳6]
    OMEGA←10↑IOCOEFF76[;16]
    OMEGABLD←10↑IOCOEFF76[;14]
    OMEGAIN←10↑IOCOEFF76[;15]
   ⍝
   ⍝
   ⍝
   ⍝
```

APPENDIX C **FUNCTION MARKETS** (cont.)

```
 INVBLD←I076[14;14]
 INVIN←I076[14;15]
 QINVBLD←(0.25×INVBLD×1000000)×BLDΔRATE1*(1.5÷4)
 QINVIN←(0.25×INVIN×1000000)×INΔRATE1*(1.5÷4)
 EXOΔQDINVIN←¯1+(NQRρ(INΔRATE2*(1÷4)))
 EXOΔQDINVBLD←¯1+(NQRρ(BLDΔRATE2*(1÷4)))
⍝
⍝
⍝
⍝ HISTΔTXVA2[YEARS;QUARTERS] YEAR=1,2,3,4   YEAR 1=1974
⍝ P[MARKETS;YEARS]YEAR=1,2,3,4
 P←IMPLΔPRIS,[1]IMPLΔPRISΔIN
 PDOM←P DIV8 1-0.25×+/HISTΔTXVA2[⍳4;]
 ENS P[;3]=100
⍝QPFOR ESTIMATED FROM VARIABLE EXPORTΔPRIS IN
⍝OLD INITIALIZATION (BEFORE JULY 1980)...
 QPFOR← 101.4 100.8 102.1 101
 QDPFOR←(TLΔEXPΔPRISΔ76 NYR)[;1]
 EXOΔQDPFOR← 0 1 ↓TLΔEXPΔPRISΔ76 NYR
⍝
⍝THOMAS LINDBERG  HAS MADE THE FUNCTION TLΔEXPΔPRISΔ76
⍝WHICH YIELDS QUARTERLY EXPORTPRICE-CHANGES...
⍝
⍝
 QPDOM←PDOM[;3,4]+.× 0.625 0.375
 QDPDOM←¯1+(PDOM[;4]÷PDOM[;3])*(1÷4)
 QDPIN←¯1+((IMPLΔPRISΔIN[;4]÷IMPLΔPRISΔIN[;3])*(1÷4))+(HISTΔTXVA2[3;4]-HISTΔTXVA2[3;3])
 MΔPRICE←(6,4×(ρIMPLΔPRISΔIN)[2])ρ0
 J←1
ST:→(J=7)/SL
 MΔPRICE[J;]←MAKEQUARTERS IMPLΔPRISΔIN[J;]
 J←J+1
 →ST
SL:
 MΔPRICE←(0,11)↓MΔPRICE
 EXOΔQDPIN←NQR CONTINUE2((RELDIFF MΔPRICE),TRENDM)
 PΔREF←PDOM[;3]
∇
```

APPENDIX C SUBFUNCTION MONETARY AND HOUSEHOLDS

```
      ∇MONETARY[⎕]∇
    ∇  MONETARY
[1]    ⍝ VARIABLES FROM WORKSPACE MACRO   WHICH WILL REMAIN
[2]    ⍝ UNCHANGED  AND WHICH WILL BECOME FINAL OUTPUT FROM
[3]    ⍝INITIALIZATION: RI,LIQB,POSG,LIQBFOR
[4]    ⍝ OTHER VARIABLES WHICH WILL
[5]    ⍝ BECOME FINAL OUTPUT FROM INITIALIZATION: ALL EXO-VARIABLES HERE
[6]    ⍝
[7]     EXOΔRI←NQR CONTINUE1 EXOΔRI
[8]     EXOΔRIBWFOR←NQR CONTINUE1 EXOΔRIBWFOR
[9]     EXOΔRIDEPFOR←NQR CONTINUE1 EXOΔRIDEPFOR
    ∇
```

```
    ∇  HOUSEHOLDS
[1]    ⍝OUTPUT FROM INITIALIZATION: SEE HOUSEHOLDSΔDATA INSTEAD
[2]    ⍝WHSUM AND HH76 WILL  BE USED IN HOUSEHOLDSΔDATA IN
[3]    ⍝THE SECOND PART OF INITIALIZATION...
[4]     HH76←IOCOEFF76[⍳10;12]
[5]     WHSUM←HUSHALLSDEP
    ∇
```

APPENDIX C FUNCTION ESTABLISHMENTS

```
    ∇ ESTABLISHMENTS;R;F;ALPHA;SCALE;RATIO;RATIO1;RATIO2;HELP;FLAG;DUMMY
[1]    ⍎')COPY SI76 X FΔDATA FIRMID   LIST RΔMARKET'
[2]   ⍝FIRM-VARIABLES FROM WORKSPACE SI76.
[3]   ⍝
[4]   ⍝
[5]   ⍝INPUT FROM FUNCTION MARKETS:IO (INPUT-OUTPUT-MATRIX)
[6]   ⍝INPUT FROM ISTARTXX-FUNCTION: SYNTHΔFIRMS
[7]   ⍝
[8]   ⍝
[9]   ⍝OUTPUT FROM THIS FUNCTION:
[10]  ⍝MARKET,P,QP,DP,W,QW,DW,S,QS,DS,Q,QQ,DQ,
[11]  ⍝L,EXPDP,EXPDS,EXPDW,HISTDP,HISTDS,HISTDW,
[12]  ⍝HISTDPDEV2,HISTDWDEV2,HISTDSDEV2,MHIST,CHM
[13]  ⍝VA,QIMQ,QVA,DVA,M,AMAN,STO,IMSTO,
[14]  ⍝QTOP,TEC,QINV,QINVLAG,DELAYΔINV,K1,K1BOOK,K2,BW,
[15]  ⍝QTDIV,RSUBSΔCASH,RSUBSΔEXTRA,RES,INVEFF,RESMAX,BETA,
[16]  ⍝IMBETA,TMINV,BIG,SMALL,IMBIG,IMSMALL,FΔINKOP,BRINKOP,
[17]  ⍝SHARE,X,ORIGMARKET,LEFT
[18]  ⍝
[19]  ⍝
[20]  ⍝
[21]  ⍝INFORMATION ABOUT INDATA:
[22]  ⍝X IS FIRM-DATA.
[23]  ⍝FΔDATA IS INDATA ABOUT FIRM-GROUPS.
[24]  ⍝X IS A MATRIX WITH FIRST COMPONENT= FIRM
[25]  ⍝AND SECOND COMPONENT= VARIABLE (SALES,LABOUR,ETC..).
[26]  ⍝X CONSISTS MAINLY OF DATA FOR THE YEAR 1976.
[27]  ⍝
[28]  ⍝
[29]  ⍝ REDUCTION ON LIST
[30]  ⍝FIRMS WITH INCONSISTENT VARIABLES ARE OMITTED .
[31]  L0:F←FIRMID[(X[;1]∊LIST)/⍳ρX[;1]]
[32]   NAMNΔMARKET←RΔMARKET[(X[;1]∊LIST)/⍳ρX[;1]]
[33]   ALPHA←(+/X[(X[;1]∊LIST)/⍳ρX[;1]; 7 12])÷FΔDATA[F;15]
[34]  ⍝ CHECK ON ALPHA
[35]   →(0=ρFLAG←(1<ALPHA+.×F∘.=⍳⌈/F)/⍳⌈/F)/L2
[36]   HELP←⍳0
[37]  ⍝ OLD: L1:HELP←HELP,F⍳1↑FLAG
```

APPENDIX C **FUNCTION ESTABLISHMENTS** (cont.)

```
[38]  L1:HELP←HELP,ALPHA⍳L/ALPHA[((1↑FLAG)=F)/⍳ρF]
[39]   →(0<ρFLAG←1↓FLAG)/L1
[40]   'DROPPING ',(5 2 ⍕LIST[HELP]),' FROM LIST.'
[41]   LIST←(~(⍳ρLIST)∊HELP)/LIST
[42]   →L0
[43]  L2:X←X[(X[;1]∊LIST)/⍳ρX[;1];]
[44]  ⍝
[45]  ⍝
[46]  ⍝
[47]  ⍝ R=NUMBER OF REAL FIRMS.
[48]  ⍝MARKET=VECTOR WITH MARKET NUMBERS FOR EACH FIRM,
[49]  ⍝FOR EXAMPLE:  1 1 1 2 1 3 1 4 1 4 ...,ETC.
[50]  ⍝SΔMARKET=VECTOR WITH MARKET-NUMBERS FOR SYNTHETIC FIRMS.
[51]  ⍝
[52]   SΔMARKET←SYNTHΔFIRMS DUP⍳4
[53]   MARKET←NAMNΔMARKET,SΔMARKET
[54]   R←1↑ρX
[55]  ⍝
[56]   'SIZE-UTSKRIFT 2'
[57]   ⍎')SIZE'
[58]  ⍝
[59]  ⍝
[60]  ⍝
[61]  ⍝ SETTING SCALE FOR SYNTHETIC FIRMS:
[62]   SCALE←⍳0
[63]   SCALE←SCALE,SYNTHΔFIRMS[1]SCALE 0.02
[64]   SCALE←SCALE,SYNTHΔFIRMS[2]SCALE 0.001
[65]   SCALE←SCALE,SYNTHΔFIRMS[3]SCALE 0.02
[66]   SCALE←SCALE,SYNTHΔFIRMS[4]SCALE 0.0001
[67]   ENS 1=SYNTHΔSUM1 SCALE
[68]  ⍝
[69]   ⎕RL←123476
[70]  ⍝⎕RL YIELDS START-VALUE FOR PSEUDO-RANDOM-NUMBERS:
[71]  ⍝THIS MEANS THAT THE SAME 'RANDOM-NUMBERS' WILL BE
[72]  ⍝GENERATED IN DIFFERENT EXECUTIONS ,AS LONG AS ONE
[73]  ⍝DOESN'T CHANGE ⎕RL.
[74]  ⍝RANDOMNUMBERS OCCUR IN THE FUNCTIONS 'USING' AND 'RANDOMIZE'.
[75]  ⍝
[76]  ⍝
[77]  ⍝
```

APPENDIX C **FUNCTION ESTABLISHMENTS** (cont.)

```
⍝
⍝
⍝SALES:
⍝SUM1,REALΔSUM1,SYNTHΔSUM1 ETC. SUM FIRMVARIABLES TO
⍝MARKET-VARIABLES.A FIRM-VECTOR IS SUMMED UP TO A
⍝MARKET-VECTOR OF LENGTH 4.
 REALΔSALES←(+/X̲[; 7 12]×1000000)
 RESΔSALES←SALES̈76-REALΔSUM1(REALΔSALES)
 SYNTHΔSALES←SCALE×RESΔSALES[S̲ΔMARKET]
 S←REALΔSALES,SYNTHΔSALES
⍝
⍝
⍝
⍝LABOUR:
 REALΔLABOUR←X̲[;3]
 RESΔLABOUR←(T̄IM÷HOURSΔPERΔYEAR)-REALΔSUM1(REALΔLABOUR)
 SYNTHΔLABOUR←R↓S×RATIO←(REALΔLABOUR÷REALΔSALES)USING S
⍝
⍝FUNCTION 'USING' HAS THE FORM 'A USING B'
⍝FUNCTION 'USING' DOES:
⍝(1) EXTENDS VARIABLE A WITH RANDOMIZED VALUES FOR
⍝     SYNTHETIC FIRMS.
⍝ (2)THE RANDOMIZED VALUES OF A COVARIES WITH B.
⍝     THE VARIABLES A AND B ARE FIRM-VECTORS...
⍝
 SYNTHΔLABOUR←SYNTHΔLABOUR×(RESΔLABOUR÷(SYNTHΔSUM1 SYNTHΔLABOUR))[S̲ΔMARKET]
 L←REALΔLABOUR,SYNTHΔLABOUR
⍝
⍝
⍝
⍝EXPORT FRACTIONS   (EXPORTS÷SALES)   :
⍝XM=  EXPORT-SHARE (MARKET-AVERAGE). FROM
⍝IO-MATRIX. XM IS A VECTOR OF LENGTH=4 .
⍝SALES IS APPROXIMATED WITH PRODUCTION.
 XM←4⍴0
 XM←IO76[⍳4;18]÷IO76[14;⍳4]
⍝XM←EXPORTS (MARKETS 1,2,3,4) ÷ PRODUCTION (MARKETS 1,2,3,4)
 REALΔRATIO←(X̲[;7]÷(+/X̲[; 7 12]))
 SYNTHΔRATIO←R̄EALΔRATIŌ RANDOMIZE S
 RESΔEXPORT←(XM×(SUM1 S))-REALΔSUM1(REALΔRATIO×REALΔSALES)
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
[118]  SYNTHΔRATIO←SYNTHΔRATIO×(RESΔEXPORT÷(SYNTHΔSUM1(SYNTHΔRATIO×SYNTHΔSALES)))[S̲ΔMARKET]
[119]  X←REALΔRATIO,SYNTHΔRATIO
[120]  'TEST PA EXPORTANDEL:X>0.95  '
[121]  (X<0)∨(X>0.95)
[122]  X←0⌈0.95⌊X
[123] ⍝
[124] ⍝
[125] ⍝
[126] ⍝
[127] ⍝PRICES
[128]  P←(⍴MARKET)⍴100
[129] ⍝
[130] ⍝
[131] ⍝INVENTORIES
[132] ⍝RATIO=ACTUAL STOCK-RATIO=STOCK÷SALES
[133]  RATIO←(X[;48]÷100)USING S
[134]  STO←(S÷P̈)×RATIO
[135] ⍝RATIO1=NORMAL  LEVEL OF STOCK-RATIO
[136]  RATIO1←(X̲[;50]÷100)USING RATIO⌈0.01
[137] ⍝ NOTE WE¯ARE SETTING BIG, SMALL, ETC FOR EACH FIRM
[138]  BIG←RATIO⌈(1+Δ←0.5)×RATIO1
[139]  SMALL←RATIO⌊(1-Δ)×RATIO1
[140]  BIG[HELP/⍳⍴BIG]←(HELP←(RATIO<(1-Δ)×RATIO1))/(2×RATIO1)-RATIO
[141]  BIG←0⌈0.5⌊BIG
[142]  SMALL[HELP/⍳⍴BIG]←(HELP←(RATIO>(1+Δ)×RATIO1))/(2×RATIO1)-RATIO
[143]  SMALL←0⌈SMALL
[144]  ΔK3ΔFINISH←S×RATIO-RATIO1
[145] ⍝ THAT WAS PRODUCT INVENTORIES..NEXT IS INPUT GOODS INVENTORIES.
[146] ⍝
[147] ⍝INPUTRATIO=(PURCHASES OF RAW MATERIALS)÷SALES
[148]  INPUTRATIO←(X̲[;17]÷+/X̲[; 7 12])USING S
[149] ⍝
[150]  RATIO1←(X̲[;44]÷100)USING INPUTRATIO
[151] ⍝ RATIO1=ĀCTUAL STOCK-RATIO.
[152]  RATIO2←(X̲[;46]÷100)USING RATIO1⌈0.01
[153] ⍝RATIO2= N̈ORMAL STOCK LEVEL.
[154]  K3ΔIMED←S×INPUTRATIO×RATIO1
[155]  ĪMBIG←RATIO1⌈(1+Δ)×RATIO2
[156]  IMSMALL←RATIO1⌊(1-Δ)×RATIO2
[157]  IMBIG[HELP/⍳⍴IMBIG]←(HELP←(RATIO1<(1-Δ)×RATIO2))/(2×RATIO2)-RATIO1
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
[158]  IMBIG←0⌈0.5⌊IMBIG
[159]  IMSMALL[HELP/⍳⍴IMBIG]←(HELP←(RATIO1>(1+Δ)×RATIO2))/(2×RATIO2)-RATIO1
[160]  IMSMALL←0⌈IMSMALL
[161]  BETA←IMBETA←0.5
[162]  ΔK3ΔIMED←S×INPUTRATIO×RATIO1-RATIO2
[163] ⍝IMSTO  IS A FIRM×PRODUCT-MATRIX (=FIRM×10-MATRIX)
[164] ⍝MULT7 MULTIPLIES A MATRIX WITH A COLUMN-VECTOR.
[165] ⍝
[166] ⍝M  MULT7  V .M=MATRIX M(I,J)  V=VECTOR V(I)
[167] ⍝RESULT: A  MATRIX WITH ELEMENTS  M(I,J)×V(I)
[168] ⍝
[169] ⍝ NEXT: SPREAD K3ΔIMED ACROSS SECTORS USING IO-MATRIX
[170]  IMSTO←((((⍉IO)DIV7+/⍉IO)[MARKET;])MULT7 K3ΔIMED)÷100
[171] ⍝ NOTE: WE HAVE DIVIDED BY 100 ASSUMING BASE YEAR=START YEAR.
[172] ⍝IMSTO SHOULD BE IN FIXED PRICES,THUS DIVISION BY 100
[173] ⍝,WHICH IS THE PRICEINDEX FOR 1976
[174] ⍝ THE IDEA BEHIND THAT COMPUTATION WAS AS FOLLOWS:
[175] ⍝   (⍉IO)[1;] LOOKS LIKE A[1,1],......,A[1,10], WHERE
[176] ⍝   A[1,J]=FRACTION OF GROSS PRODUCTION IN SECTOR 1 ACCTD FOR BY
[177] ⍝      INPUTS FROM SECTOR J.
[178] ⍝   THEN A[1,J]÷SUM ON J OF A[1,J]  =  FRACTION OF INPUT GOODS
[179] ⍝      COMING FROM SECTOR J
[180] ⍝
[181] ⍝
[182] ⍝
[183] ⍝
[184] ⍝ COMPUTATION OF INPUT GOODS PURCHASES
[185]  REALΔINP←X[;17]×1000000
[186]  QCURR←S+ΔK3ΔFINISH
[187] ⍝
[188] ⍝QCURR=PRODUCTION IN CURRENT PRICES:SALES+CH. IN STOCK
[189] ⍝HELP (BELOW) IS TOTAL INPUT CONSUMPTION BY THE
[190] ⍝SYNTHETIC FIRM UNITS PER SECTOR (1,2,3,4).
[191] ⍝
[192]  HELP←(+/(⍉IO)[⍳4;]MULT7 SUM1 QCURR)-(REALΔSUM1(REALΔINP-R↑ΔK3ΔIMED))
[193]  HELP←HELP+SYNTHΔSUM1(R↓ΔK3ΔIMED)
[194] ⍝ HELP=TOTAL INPUT GOODS PURCHASES BY THE SYNTHETIC UNITS (⍴HELP=4)
[195] ⍝     IN EACH SECTOR
[196] ⍝ INP=INPUT GOOD PURCHASES FOR EACH PRODUCTION UNIT, SUMMED OVER SECTORS
[197] ⍝ ⍴INP = ⍴MARKETS
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
 INP←REALΔINP,(R↓S×INPUTRATIO)×(HELP÷(SYNTHΔSUM1 R↓S×INPUTRATIO))[SΔMARKET]
⍝
⍝ QIMQ=INP SPREAD ACROSS THE 10 SECTORS. JUST LIKE IMSTO ABOVE.
 QIMQ←((((⍉IO)DIV7+/⍉IO)[MARKET;])MULT7 INP)÷100
 QIMQ←QIMQ÷4
⍝ SAME COMMENT AS APPLIES TO THE DEFLATION OF IMSTO
⍝ VALUE ADDED
 VA←QCURR+ΔK3ΔIMED-INP
 DISPOSE1ΔFIRMS
⍝
⍝CONSUMPTION=INP-ΔK3ΔIMED=PURCHASES-CHANGE IN STOCK
⍝ VALUE ADDED=PRODUCTION-CONSUMPTION
⍝
 RESΔFORVF←SYNTHΔSUM1(R↓VA)
 FORVF←SUM1(VA)
 REALΔFORVF←R↑VA
 SYNTHΔFORVF←R↓VA
⍝FORVF,REALΔFORVF ETC. ARE USED  IN FUNCTION CONTROLS BELOW...
⍝
⍝
⍝
⍝
⍝
⍝ WAGES
 REALΔKRΔLON←X[;5]×1000000
 REALΔW←REALΔKRΔLON÷(R↑L)
 SYNTHΔW←R↓S×(RATIO←(REALΔKRΔLON÷REALΔSALES)USING L)÷L
 RESΔKRΔLON←LON-REALΔSUM1(REALΔW×(R↑L))
 SYNTHΔW←SYNTHΔW×(RESΔKRΔLON÷(SYNTHΔSUM1(R↓L)×SYNTHΔW))[SΔMARKET]
 W←REALΔW,SYNTHΔW
 SYNTHΔKRΔLON←SYNTHΔW×(R↓L)
 DW←(¯1+(×/X[; 2 5])÷×/X[; 3 4])USING W
 QDW←DW÷4
 QW←((⍉((2,(ρW))ρ(W,W+DW)))+.×(0.625,0.375))
 DVA←DS←(¯1+(+/X[; 7 12])÷+/X[; 6 11])USING DW
 QS←((⍉((2,(ρS))ρ(S,S+DS)))+.×(0.625,0.375))÷4
 QVA←VA×(1+DVA÷4)÷4
⍝
⍝
⍝
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
[238] ⍝
[239] ⍝ MARGINS
[240]  M←1-W×L÷VA
[241]  M75←1-(X[;4]÷+/X[; 6 11])×R↑S÷VA
[242] ⍝ M75=PRÖFIT MARĞIN 1975.
[243]  HELP←(R↑M)-M75
[244]  MHIST←0.5×(2×M)-CHM←HELP USING DS
[245] ⍝VARIABLES FOR FUNCTION CONTROL BELOW
[246] ⍝
[247]  OVERSKOTT←SUM1(M×VA)
[248]  SYNTH∆OVERSKOTT←R↓(M×VA)
[249]  REAL∆OVERSKOTT←R↑(M×VA)
[250]  DP←((R↑DS)-X[;26]÷100)USING DS
[251]  QP←((⍉((2,(¯ρP))ρ(P,P+DP)))+.×(0.625,0.375))
[252] ⍝ QUANTITIES
[253]  Q←(S+∆K3∆FINISH)÷P
[254]  QQ←(QS+∆K3∆FINISH÷4)÷QP
[255]  DQ←DS-DP
[256] ⍝ SOME VARIABLES ADDED 27 OCT 1980...
[257]  F∆INKOP←(INP-∆K3∆IMED)÷(100×Q)
[258] ⍝PURCHASING-SHARE PER FIRM =F∆INKOP
[259]  BRINKOP←4↑(+/[1]IO)
[260] ⍝PURCHASING SHARE PER MARKET =BRINKOP
[261]  SHARE←F∆INKOP÷BRINKOP[MARKET]
[262] ⍝SHARE IS USED IN THE MODEL IN THIS WAY:
[263] ⍝SHARE×(MARKET AVERAGE INPUT SHARE)=
[264] ⍝THE INDIVIDUAL INPUT SHARE FOR EACH FIRM.
[265] ⍝MARKET AVERAGE INPUT SHARE=BRINKOP[1]..BRINKOP[4]
[266] ⍝
[267] ⍝
[268] ⍝
[269] ⍝
[270] ⍝
[271] ⍝ A21 AND A22
[272]  A22←(-/X[; 30 32]÷100)USING A21←(-/X[; 32 26]÷100)USING M
[273]  A21←0⌈0.5⌊A21
[274]  A22←0.025⌈0.5⌊A22
[275] ⍝ MUST ENSURE A22>0 SO TEC CAN BE COMPUTED..
[276] ⍝ AMAN--BASED ON APPROXIMATION GIVEN IN INDUSTRIKONJUNKTUREN PAPER
[277]  AMAN←⍉(3,ρL)ρ(L×A21÷1+A21)÷3
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
[278] ⍝ EXPECTATIONS...NOTE THAT EXPDW SHOULD BE FIXED
[279]  HISTDS←EXPDS←(¯1+(+/X[; 8 13])÷+/X[; 7 12])USING DS
[280]  HISTDSDEV2←(HISTDSDEV←−0.02 BETWEEN(⍴HISTDS)⍴0.02)*2
[281]  HISTDP←EXPDP←((R↑EXPDS)−X[;28]÷100)USING EXPDS
[282]  HISTDPDEV2←(HISTDPDEV←−0.02 BETWEEN(⍴HISTDP)⍴0.02)*2
[283]  HISTDW←EXPDW←EXPDS−EXPDP
[284]  HISTDWDEV2←(HISTDWDEV←−0.02 BETWEEN(⍴HISTDW)⍴0.02)*2
[285] ⍝ PRODUCTION FUNCTION PARAMETERS.
[286]  QTOP←(QQ×1+A21+A22)÷1−RES←(⍴QQ)⍴0.5×RESMAX←0.2
[287]  TEC←¯1×(⍟A22÷1+A21+A22)×QTOP÷L
[288]  ENS(QQ−QFR1 L)<0.5
[289] ⍝ FINANCIAL VARIABLES
[290]  K1BOOK←S×((÷/FΔDATA[F; 5 15])USING S)
[291]  K1←S×((÷/FΔDATA[F; 26 15])USING K1BOOK)
[292]  K2←K1BOOK×(((+/FΔDATA[F; 1 2 4 6])÷FΔDATA[F;5])USING K1)
[293]  A←K1+K2+K1BOOK×((÷/FΔDATA[F; 3 5])USING S)
[294]  BW←K1BOOK×(((+/FΔDATA[F; 8 9 10])÷FΔDATA[F;5])USING K1)
[295]  BAD←(⍴BW)⍴0
[296]  QTDIV←SUM2 ¯0.25×K1BOOK×((÷/FΔDATA[F; 20 5])USING M)
[297]  INVEFF←QTOP×QP÷K1
[298]  QINV←S×(((+/X[; 21 24])÷+/X[; 7 12])USING S)÷4
[299]  QINVLAG←QINV×1+(VA AVG1 DP¯DDIV 4)[DUR←3]
[300]  TMINV← 2 1 1 0.5
[301]  DELAYΔINV←⍉(3,⍴QINV)⍴QINV MULT1(4×TMINV)÷3
[302]  RSUBSΔCASH←RSUBSΔEXTRA←L×0
[303] ⍝
[304] ⍝
[305]  CONTROLS
[306] ⍝
[307] ⍝
[308] ⍝ CONSISTENCY-CONTROLS ARE MADE IN FUNCTION CONTROLS
[309] ⍝
[310]  IOΔMATRIX
[311] ⍝IO-MATRIX IN FLOWS  IS WRITTEN OUT
[312] ⍝
[313]  DISPOSE2ΔFIRMS
[314] ⍝THIS FUNCTION DELETES VARIABLES OF NO FURTHER USE
[315] ⍝
[316] ⍝ SOME VARIABLES NEEDED FOR NULLIFY AND SHRINK
[317]  LEFT←MARKET=ORIGMARKET←MARKET
[318]  'SIZEUTSKRIFT 3'
[319]  ⍎')SIZE'
[320] ⍝
     ∇
```

Note: Line 290,..302 FINANCIAL variables.
Function CONTROLS is listed on the following page.
Function IO-MATRIX is listed on the following pages.

APPENDIX C SUBFUNCTION CONTROLS

(subfunction to ESTABLISHMENTS)

Consistency Control

```
    ∇ CONTROLS;DIFF
     ⍝
     ENS(LON+OVERSKOTT)=FORVF
     ENS LON=(REALΔSUM1 REALΔKRALON)+(SYNTHΔSUM1 SYNTHΔKRALON)
     ENS OVERSKOTT=(REALΔSUM1 REALΔOVERSKOTT)+(SYNTHΔSUM1
    SYNTHΔOVERSKOTT)
     ENS FORVF=(REALΔSUM1 REALΔFORVF)+(SYNTHΔSUM1 SYNTHΔFORVF)
     DIFF←SALES76-(SUM1 S)
     ENS DIFF<1.000000000E¯6 ×(SUM1 S)
     ENS(TIM÷HOURSΔPERΔYEAR)=(REALΔSUM1 REALΔLABOUR)+SYNTHΔSUM1
    SYNTHΔLABOUR
     ENS(REALΔFORVF-(REALΔKRALON+REALΔOVERSKOTT))<1.000000000E¯7
     ENS(SYNTHΔFORVF-(SYNTHΔKRALON+SYNTHΔOVERSKOTT))<1.000000000E¯7
     ENS(SYNTHΔSUM1(SYNTHΔW×SYNTHΔLABOUR))=SYNTHΔSUM1(SYNTHΔKRALON)
     ENS(REALΔSUM1(REALΔW×REALΔLABOUR))=REALΔSUM1(REALΔKRALON)
     ENS(SYNTHΔSUM1((R↓M)×SYNTHΔFORVF))=SYNTHΔSUM1(SYNTHΔOVERSKOTT)
     ENS(REALΔSUM1((R↑M)×REALΔFORVF))=REALΔSUM1(REALΔOVERSKOTT)
     ENS X≥0
     ENS X≤1
     ENS((SUM1 VA)÷(SUM1 QCURR))=(1-BRINKOP[⍳4])
     ENS((SUM1(INP-AK3ΔIMED))÷(SUM1 QCURR))=(BRINKOP[⍳4])
     DIFF←(XM×SUM1 S)-(SUM1 X×S)
     ENS DIFF<(0.01×SUM1 S)
    ∇
```

Note: The subfunction ENS is documented in Appendix D.

APPENDIX C SUBFUNCTION IO∆MATRIX

(subfunction to ESTABLISHMENTS)

(Consistency Control is performed)

```
    ∇  IO∆MATRIX;MA;PROD;CHAR;RESIDUAL;SWEDISH∆DEMAND
[1]    ⍝THIS FUNCTION DOES:
[2]    ⍝(1)    AN INPUT-OUTPUT MATRIX FOR THE SWEDISH
[3]    ⍝       ECONOMY IN FLOWS IS PRINTED OUT.
[4]    ⍝       THE INITIALIZED VARIABLES ARE USED.
[5]    ⍝(2)    VERTICAL SUM SHOULD BY DEFINITION BE
[6]    ⍝       EQUAL TO HORIZONTAL SUM.THE UNEXPLAINED
[7]    ⍝       RESIDUAL IS PRINTED OUT.
[8]    ⍝
[9]    ⍝
[10]   ⍝
[11]    'DO YOU WANT THE INPUT-OUTPUT-MATRIX PRINTED OUT?'
[12]    'YES OR NO :     '
[13]    CHAR←⍞
[14]    →(∧/(CHAR[1 2]='NO'))/0
[15]   ⍝
[16]    MA←IO76
[17]    PROD←SUM1(Q×100)
[18]    MA[;⍳4]←(IOCOEFF76[;⍳4],[1]1)MULT8(PROD÷10*6)
[19]   ⍝ THE FIRST 4 COLUMNS IN MA ARE REPLACED WITH FLOWS
[20]   ⍝ COMING FROM INITIALIZATION.
[21]   ⍝ COLUMN 5..10 UNCHANGED.
[22]    MA[⍳13;11]←(GKOFF×WG×LG÷10*6),(0,0,0)
[23]    MA[14;11]←+/[1]MA[⍳13;11]
[24]    MA[⍳13;12]←(HH76×4×QDI∆INIT2÷10*6),(0,0,0)
[25]   ⍝ QDI∆INIT2 YIELDS THE HOUSEHOLD'S DISPOSABLE INCOME
[26]    MA[14;12]←+/[1]MA[⍳13;12]
[27]    MA[;13]←(OMEGAG×QINVG×4÷10*6),(0,0,0,4×QINVG÷10*6)
[28]    MA[;14]←(OMEGABLD×QINVBLD×4÷10*6),(0,0,0,QINVBLD×4÷10*6)
[29]    MA[;15]←(OMEGAIN×QINVIN×4÷10*6),(0,0,0,4×QINVIN÷10*6)
[30]    MA[;16]←(OMEGA×(+/QINV)×4÷10*6),(0,0,0,4×(+/QINV)÷10*6)
[31]   ⍝
[32]    MA[⍳13;17]←(+/(∆K3∆IMED+∆K3∆FINISH)÷10*6)×IOCOEFF76[⍳13;17]
[33]    MA[14;17]←+/[1]MA[⍳13;17]
[34]   ⍝
[35]    MA[1 2 3 4 ;18]←(SUM1(X×S))÷10*6
[36]    MA[14;18]←+/[1]MA[⍳13;18]
[37]   ⍝
```

APPENDIX C SUBFUNCTION IO∆MATRIX (cont.)

```
SWEDISH∆DEMAND←+/MA[⍳10;⍳17]
MA[⍳13;19]←(IMP×SWEDISH∆DEMAND),(0,0,0)
MA[14;19]←+/[1]MA[⍳13;19]
MA[;19]←(¯1)×MA[;19]
⍝
MA[⍳13;21]←MA[14;⍳10],(0,0,0)
MA[14;21]←+/[1]MA[⍳13;21]
⍝
RESIDUAL←MA[;21]-((+/MA[⍳10;⍳20]),(0,0,0),(+/MA[14;⍳20]))
⍝
⍝***********O**************
⍝
⎕PW←110
⍝PAGE WIDTH
'INPUT-OUTPUT MATRIX FROM INITIALIZATION: '
80⍴' '
'       1         2          3         4          5          6         7        8         9          10'
80⍴' '
(8,0)⍕MA[;⍳10]
80⍴' '
'      11        12         13        14         15         16        17        18        19         20        21'
80⍴' '
(8,0)⍕MA[;10+⍳11]
'ROW 1: RAW MATERIAL SECTOR '
'ROW 2: INTERMEDIATE GOODS  '
'ROW 3: INVESTMENT GOODS AND CONSUMER DURABLE GOODS'
'ROW 4: CONSUMPTION GOODS '
'ROW 5: AGRICULTURE,FORESTRY,FISHING '
'ROW 6: MINING AND QUARRYING '
'ROW 7:   OIL  '
'ROW 8 : CONSTRUCTION  '
'ROW 9 : ELECTRICITY '
'ROW 10: OTHER SERVICIES '
'ROW 11: COMMODITY BASED INDIRECT TAXES '
'ROW 12: VALUE ADDED  IN PRODUCER''S PRICES '
'ROW 13: CORRECTIONS'
'ROW 14: SUM =PRODUCTION '
'COLUMN 1,2 THROUGH 10 = CORRESPONDING ROWS '
'COLUMN 11: GOVERNMENT''S CONSUMPTION '
'COLUMN 12: HOUSEHOLDS''S CONSUMPTION '
```

APPENDIX C SUBFUNCTION IO∆MATRIX (cont.)

```
[78]   'COLUMN 13: GOVERNMENT''S INVESTMENTS '
[79]   'COLUMN 14: INVESTMENTS,BUILDINGS '
[80]   'COLUMN 15: INVESTMENTS IN SECTOR 6..10 '
[81]   'COLUMN 16: OTHER INVESTMENTS '
[82]   'COLUMN 17: CHANGE IN STOCK '
[83]   'COLUMN 18: EXPORTS '
[84]   'COLUMN 19: IMPORTS '
[85]   'COLUMN 20: MOMS ETC. '
[86]   'COLUMN 21: HORIZONTAL SUM=PRODUCTION '
[87]   80ρ' '
[88]   'RESIDUAL '
[89]   RESIDUAL
[90]  ⍝
[91]  ⍝MADE BY FREDRIK BERGHOLM DEC 1981.....
    ∇
```

APPENDIX C SUBFUNCTION MARKETS-DATA

```
     ∇  MARKETSΔDATA;TMEXP;TMTARG
   ⍝
     output from initialization:All variables below except TMEXP,TMTARG,NPER
    NPER←4
    DUR←3
    MKT←⍳4
    IN←4+⍳6
   ⍝
    RET←¯1+1.035*(1÷4)
    ENTRY←RET+0.0068÷NPER
    EXPXDP←0.03
    EXPXDW←0.07
    EXPXDS←0.07
    R←0.5
    E1←0.1
    E2←0
    SMP←SMW←SMS←1-2÷1+TMEXP←3
    FIP←FIW←FIS←(1-R)×2÷1+NPER×TMEXP
    SMT←1-2÷1+TMTARG←3
   ⍝
    GAMMA←0.1
    THETA←0.01
    KSI←0.25
    SKREPA←50
    IOTA←0.5
    NITER←9
   ⍝
    TMSTO←1
   ⍝
    TMIMSTO←1
   ⍝
    RHO←¯1+(1+1÷35)*(1÷4)
    RHOBOOK←¯1+(1.15)*(1÷4)
    QDMTEC←¯1+(1.056 1.03 1.026 1.004)*(1÷4)
   ⍝ RESMAX←0.2 IS SET IN ESTABLISHMENTS...
    LOSS←0.1
    RESDOWN←0.9
    WTIX←1
   ⍝
```

APPENDIX C SUBFUNCTION MARKETS-DATA (cont.)

```
    RW←K2÷S
    ALFABW←0.075÷NPER
    BETABW←1
    UTREF←0.85
    ELINV←3
    RTD←1
   ⍝TMINV IS SET IN ESTABLISHMENTS
   ⍝

    EPS←0
    TMX← 3 3 3 3
    TMIMP← 3 3 3 3
   ⍝

    RLU←0.6
    MAXDP←0.06
  ∇
```

APPENDIX C SUBFUNCTIONS PUBLIC-DATA AND SECONDARY-DATA

```
    ∇  PUBLICΔDATA
[1]    ⍝ VARIABLES WHICH WILL BE OUTPUT FROM INITIALIZATION: WSG,RTRANS,T
       STOCURF,TSTOCURM
[2]     WSG←WG×LG
[3]     RTRANS←0.5
[4]    ⍝TSTOCURF IS A MARKET-VECTOR (4 MARKETS).FUNCTION SUM1 TRANSFORMS
       FIRMS-DATA TO MARKET-DATA...
[5]     TSTOCURF←SUM1(STO×QP)
[6]     TSTOCURM←QPDOM[⍳4]×(SUM1 STO)
    ∇
```

```
    ∇  SECONDARYΔDATA;MTECAPERAFIRM
[1]    ⍝VARIABLES WHICH WILL BE OUTPUT FROM INITIALIZATION:
[2]    ⍝MTEC,LU,QDWIND
[3]    ⍝RUΔCOPY IS A COPY OF RU WHICH COMES FROM INPUTFILE.
[4]    ⍝L,QW,QDW,QDMTEC,TEC COMES FROM ESTABLISHMENTS
[5]    ⍝GROWTH COMES FROM INPUTFILE (INITΔGROWTH=GROWTH)
[6]    ⍝LG COMES FROM FUNCTION PUBLICΔSECTOR
[7]     LU←(LG+SUM2(L))×RUΔCOPY÷(1-RUΔCOPY)
[8]    ⍝LG+SUM2 L=WORKING LABOUR FORCE=TOTAL LABOUR FORCE-UNEMPLOYED
[9]    ⍝UNEMPLOYED=R×'WORKING LABOUR FORCE'
[10]   ⍝WHERE R SHOULD BE UNEMPLOYED÷WORKING LABOUR FORCE
[11]   ⍝SINCE RU IS DEFINED AS UNEMPLOYED÷TOTAL LABOUR FORCE R=   RU÷(1-R
       U)...
[12]    QDWIND←¯1+(L AVG2 QW×(1+QDW))÷(L AVG2 QW)
[13]    MTECΔPERΔFIRM←TEC DIV1(1-QDMTEC÷((RHO+GROWTH)*(1÷4)))
[14]    MTEC←L AVG1 MTECΔPERΔFIRM
[15]   ⍝AVG1 YIELDS MARKET-AVERAGES FROM FIRMS-DATA (MTECΔPERΔFIRM) WEIGH
       TED BY LABOUR-SHARES (L÷SUM L)
[16]    ENS 0<MTEC
    ∇
```

APPENDIX C SUBFUNCTION MONETARY-DATA

```
∇ MONETARY∆DATA
  ⍝ALL VARIABLES BELOW WILL BE OUTPUT FROM INITIALIZATION
  POSGFOR←0
  TMFASS←3÷12
  TMFD←2÷12
  FD←FASS←(SUM2 X×S)×TMFASS
  KAPPA1←0.02
  KAPPA2←0.3
  RFUND1←0.5
  RFUND2←0.25
  LAMDA1←0.6
  LAMDA2←0.8
  MAXQCHRI←0.01
  MB←0.015
  MAXRIDIFF←0.05
  RI∆IS∆EXOGENOUS←1
  MINRI←MB
  MAXRI←0.25
  FUNDS∆ARE∆ENOUGH←0
  REDCHBW←0.15
∇
```

APPENDIX C SUBFUNCTION HOUSEHOLDS-DATA (cont.)

```
    ∇ HOUSEHOLDSΔDATA;PRICECHANGES;DUR
      ⍝INPUT TO THIS FUNCTION:
      ⍝GKOFF,LG,WG,L,QW,QTDIV,LU,QDWIND FROM FUNCTION PUBLICΔSECTOR,ESTA
      BLISHMENT,SECONDARYΔDATA
      ⍝QPDOM,QDPFOR,QDPIN FROM FUNCTION ESTABLISHMENTS
      ⍝RTRANS,RLU,RHO  FROM FUNCTION MARKETSΔDATA
      ⍝TXI1,TXW,TXWG,QINPAY,RI (INDIRECTLY) FROM WORKSPACE MACRO
      ⍝HH76,WHSUM  FROM HOUSEHOLDS...
      ⍝xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
      ⍝OUTPUT FROM THIS FUNCTION,WHICH WILL BE FINAL OUTPUT FROM INITIAL
      IZATION:
      ⍝Z,SAV,NDUR,NDURΔDUR,NH,WH,WHRA,QPH,QC,CVA,QDCPI,QCPI,QDI
      ⍝QSAVHREQ,RHODUR,STODUR,ALFA AND BETA-COEFFICIENTS,SMOOTH   ,MARKET
      ΔITER...
      ⍝
       DUR←3
       NDURΔDUR←⍳11
       Z←11
       SAV←12
       NDUR←(DUR≠⍳11)/⍳11
      ⍝NDUR,Z,SAV ARE INDEX-VARIABLES...
       NH←LG+(SUM2 L)+LU
       WH←WHSUM÷NH
       QDIΔINIT
      ⍝FUNCTION QDIΔINIT IS CALLED TO GIVE A VALUE TO QDI,AND THIS IS TH
      E ONLY PURPOSE OF THIS FUNCTION.QDI=DISPOSABLE INCOME
       WHRA←WH÷QDI
       QPH←QPDOM,0
      ⍝QPH USED TO BE A VECTOR OF LENGTH 11.QPH(11) WAS THE PRICE IN THE
       SERVICE SECTOR.THERE IS NO LONGER AN ELEVENTH SERVICE- SECTOR,SO
      QPH=QPDOM.FOR TECHNICAL REASONS WE SEE TO THAT QPH
      ⍝HAS THE LENGTH 11 DESPITE THIS,FOR THE TIME BEING,WHERE WE WILL H
      AVE A REDUNDANT 0 AT THE END...
       QC←(HH76×QDI),0
       QC←(1,⍴QC)⍴QC
       QC←⍉QC
      ⍝QC AND CVA MUST BE COLUMN-VECTORS FOR TECHNICAL REASONS...
      ⍝SEE MOSES-FUNCTION CPI1...
       CVA←QC DIV7 QPH
       QCPI←CPI1(QPH)
       PRICECHANGES←QDPFOR,QDPIN,0
       QDCPI←(PRICECHANGES+.×,QC)÷(+/,QC)
```

<u>Note</u>: QDI-INIT is a subfunction listed later on.

APPENDIX C SUBFUNCTION HOUSEHOLDS-DATA (cont.)

```
[36]  ⍝
[37]   RHODUR←RHO
[38]   STODUR←QPH[DUR]×CVA[DUR;1]÷RHODUR
[39]  ⍝
[40]   ALFA3←0.3
[41]   ALFA4←0.5
[42]   BETA1← 1 1 0.7 0.75 0.9 1 1 0.9 1 0.75 1 0.5
[43]   BETA2← 0 0.02 0.1 0.22 0.01 0 0 0.08 0 0.36 0 0.21
[44]   BETA3←0×BETA2
[45]   SMOOTH←(11ρ0.9),1
[46]  ⍝
[47]   MARKETΔITER←3
[48]  ⍝MARKETΔITER TELLS HOW MANY ITERATIONS WILL BE DONE IN THE  MARKET
       PROCESS DURING SIMULATION...
[49]   NH←1ρNH
    ∇
```

APPENDIX C **SUBFUNCTION DISPOSE1-FIRMS**

(deletes a number of variables)

This function is called in subfunction ESTABLISHMENTS.

```
     ∇DISPOSE1ΔFIRMS[⎕]∇
    ∇  DISPOSE1ΔFIRMS
[1]     →(TESTUTSKRIFT=0)/START
[2]     'REALΔRATIO'
[3]     REALΔRATIO
[4]     'SYNTHΔRATIO'
[5]     SYNTHΔRATIO
[6]     'INPUTRATIO'
[7]     INPUTRATIO
[8]     'REALΔSALES'
[9]     REALΔSALES
[10]    'SYNTHΔSALES'
[11]    SYNTHΔSALES
[12]    'SLUT PA TESTUTSKRIFT I DISPOSE1ΔFIRMS   '
[13]   START:
[14]   ⍝
[15]    KILL 'SCALE MAKEQUARTERS'
[16]    KILL 'RΔMARKET FIRMID RESΔLABOUR SYNTHΔSALES RESΔSALES RATIO1 RAT
       IO2 INPUTRATIO'
[17]    KILL 'REALΔRATIO SYNTHΔRATIO RESΔEXPORT REALΔINP LIST K3ΔIMED '
[18]   ⍝THIS FUNCTION DELETES VARIABLES AND FUNCTIONS OF NO FURTHER USE.
    ∇
```

APPENDIX C **SUBFUNCTION DISPOSE2-FIRMS**

(deletes a number of variables)

This function is called in subfunction ESTABLISHMENTS.

```
      ∇DISPOSE2ΔFIRMS[⎕]∇
    ∇  DISPOSE2ΔFIRMS
[1]    →(TESTUTSKRIFT=0)/START
[2]    'SΔMARKET'
[3]    SΔMARKET
[4]    'A21'
[5]    A21
[6]    'A22'
[7]    A22
[8]    'INP'
[9]    INP
[10]   'QCURR'
[11]   QCURR
[12]   'M75'
[13]   M75
[14]   'ΔK3ΔIMED'
[15]   ΔK3ΔIMED
[16]   'ΔK3ΔFINISH'
[17]   ΔK3ΔFINISH
[18]   'REALΔFORVF'
[19]   REALΔFORVF
[20]   'SYNTHΔFORVF'
[21]   SYNTHΔFORVF
[22]   'FORVF'
[23]   FORVF
[24]   'REALΔLABOUR'
[25]   REALΔLABOUR
[26]   'SYNTHΔLABOUR'
[27]   SYNTHΔLABOUR
[28]   'REALΔW'
[29]   REALΔW
[30]   'SYNTHΔW'
[31]   SYNTHΔW
[32]   'REALΔOVERSKOTT'
[33]   REALΔOVERSKOTT
[34]   'SYNTHΔOVERSKOTT'
[35]   SYNTHΔOVERSKOTT
[36]   'OVERSKOTT'
[37]   OVERSKOTT
[38]   'REALΔKRΔLON'
[39]   REALΔKRΔLON
[40]   'SYNTHΔKRΔLON'
[41]   SYNTHΔKRΔLON
[42]   'LON'
[43]   LON
```

APPENDIX C **SUBFUNCTION DISPOSE2-FIRMS** (cont.)

```
[45]  START:
[46]   KILL 'X̲ FΔDATA S̲ΔMARKET NAMNΔMARKET A21 A22 INP QCURR M75'
[47]   KILL 'Δ̄K3ΔIMED Δ̄K3ΔFINISH REALΔSALES REALΔFORVF SYNTHΔFORVF FORVF
       REALΔLABOUR SYNTHΔLABOUR '
[48]   KILL 'REALΔW SYNTHΔW REALΔOVERSKOTT SYNTHΔOVERSKOTT OVERSKOTT'
[49]   KILL 'REALΔKRΔLON SYNTHΔKRΔLON LON SCALE HELP'
[50]   KILL 'IOΔMATRIX CONTROLS REALΔSUM1 SYNTHΔSUM1 DISPOSE1ΔFIRMS RAND
      OMIZE USING QFR1 HISTORY BETWEEN'
[51]  ⍝
[52]  ⍝THIS FUNCTION DELETES FUNCTIONS AND VARIABLES OF NO FURTHER USE..
      .
    ∇
```

```
      ∇KILL[⎕]∇
    ∇ KILL NAMES;POS;DUMMY
[1]   L̲:→(0=⍴NAMES)/0
[2]    POS←NAMES⍳' '
[3]    DUMMY←⎕EX(POS-1)↑NAMES
[4]    NAMES←POS↓NAMES
[5]    →L̲
    ∇
```

This function is stored in workspace VLISTS.

APPENDIX C SUBFUNCTION DISPOSE-VAR-INPUT

```
      ∇DISPOSEΔVARΔINPUT[⎕]∇
    ∇ DISPOSEΔVARΔINPUT;COPΔRI;COPΔTXW;COPΔTXWG;COPΔRIDEPFOR;
      COPΔRIBWFOR;COPΔTXC;COPΔTXI1
[1]   ⍝THIS FUNCTION GETS RID OF INPUTVARIABLES FROM
[2]   ⍝FIRST PART OF INITIALIZATION
[3]   ⍝
[4]    COPΔRIDEPFOR←EXOΔRIDEPFOR
[5]    COPΔRIBWFOR←EXOΔRIBWFOR
[6]    COPΔRI←EXOΔRI
[7]    COPΔTXW←EXOΔTXW
[8]    COPΔTXWG←EXOΔTXWG
[9]    COPΔTXC←EXOΔTXC
[10]   COPΔTXI1←EXOΔTXI1
[11]  ⍝
[12]  ⍝MACROLIST CONTAINS VARIABLENAMES FOR INPUT-VARIABLES
[13]   KILL MACROLIST
[14]   EXOΔRIDEPFOR←COPΔRIDEPFOR
[15]   EXOΔRIBWFOR←COPΔRIBWFOR
[16]   EXOΔRI←COPΔRI
[17]   EXOΔTXW←COPΔTXW
[18]   EXOΔTXWG←COPΔTXWG
[19]   EXOΔTXC←COPΔTXC
[20]   EXOΔTXI1←COPΔTXI1
[21]  ⍝VARIABLES FROM WORKSPACE MACRO HAVE SOMETIMES THE SAME
[22]  ⍝ NAME AS AN OUTPUT-VARIABLE.SUCH VARIABLES MUST NOT
[23]  ⍝BE DELETED BY THE CALL ''KILL MACROLIST''  .
[24]  ⍝
    ∇
```

APPENDIX C SUBFUNCTION QDI-INIT

This function is called in subfunction HOUSEHOLDS DATA

```
      ∇QDIΔINIT[⎕]∇
    ∇  QDIΔINIT;QTWS;QTI;QWTAX;QINTH;QTRANS;QITAX;TXI1
[1]    ⍝INPUT TO THIS FUNCTION:
[2]    ⍝GKOFF,LG,WG,L,QTDIV,QW,LU FROM PUBLICΔSECTOR,ESTABLISHMENTS,SECON
       DARYΔDATA,.÷
[3]    ⍝RTRANS,RLU  FROM MARKETSΔDATA
[4]    ⍝TXI1,TXW,TXWG,QINPAY,RI COME (INDIRECTLY) FROM INPUTFILE  MACRO..
       .
[5]    ⍝LOCAL COPIES OF TXW,TXWG...ARE USED...
[6]    ⍝NH,WH  FROM HOUSEHOLDSΔDATA
[7]    ⍝
[8]     QTRANS←(RTRANS×(LG×QWG÷4)×1++/GKOFF)+RLU×0.25×LU×L AVG2 QW×1-
       TXWCOPY
[9]     QINTH←NH×(RIΔCOPY-MB)×WH÷4
[10]    QTWS←(LG×QWG÷4),SUM2 L×QW÷4
[11]    QTWS←QTWS+(0,QINPAYCOPY)
[12]    QWTAX←QTWS+.×(TXWGCOPY,TXWCOPY)÷1+(TXWGCOPY,TXWCOPY)
[13]    QTI←QTDIV+QINTH+QTRANS+((+/QTWS)-QWTAX)
[14]    TXI1←TXI1COPY
[15]    QITAX←0.25×AGGRITAX 4×QTI
[16]    QDI←(QTI-QITAX)÷NH
    ∇
```

APPENDIX C SUBFUNCTION QDI-INIT2

This function is called in subfunction IO-MATRIX.

```
      ∇QDI∆INIT2[⎕]∇
    ∇  ZZ←QDI∆INIT2;QTWS;QTI;QWTAX;QINTH;QTRANS;QITAX;LU;NH;MB;RTRANS;
      RLU
[1]   ⍝INPUT TO THIS FUNCTION:
[2]   ⍝GKOFF,LG,WG,L,QTDIV,QW,LU FROM PUBLIC∆SECTOR,ESTABLISHMENTS,SECON
      DARY∆DATA,.÷
[3]    RTRANS←0.5
[4]    RLU←0.6
[5]    MB←0.015
[6]   ⍝TXI1,TXW,TXWG,QINPAY,RI COME (INDIRECTLY) FROM INPUTFILE  MACRO..
      .
[7]    LU←(LG+SUM2(L))×RU÷(1-RU)
[8]    NH←LG+SUM2(L)+LU
[9]    WH←WHSUM÷NH
[10]  ⍝
[11]   QTRANS←(RTRANS×(LG×QWG÷4)×1++/GKOFF)+RLU×0.25×LU×L AVG2 QW×1-TXW
[12]   QINTH←NH×(RI-MB)×WH÷4
[13]   QTWS←(LG×QWG÷4),SUM2 L×QW÷4
[14]   QTWS←QTWS+(0,QINPAY)
[15]   QWTAX←QTWS+.×(TXWG,TXW)÷1+(TXWG,TXW)
[16]   QTI←QTDIV+QINTH+QTRANS+((+/QTWS)-QWTAX)
[17]   QITAX←0.25×AGGRITAX 4×QTI
[18]   ZZ←(QTI-QITAX)
    ∇
```

APPENDIX C SUBFUNCTION OUTPUT-OPERATIONS

```
      ∇OUTPUT∆OPERATIONS[⎕]∇
    ∇  OUTPUT∆OPERATIONS;LIST;TOTLIST
      ⍝OUTPUT FROM INITIALIZATION IS BEING GROUPED:
      ⍝VARIABELGRUPP1,VARIABELGRUPP2...COME FROM WORKSPACE VLISTS,
      ⍝AND ARE TEXT-VECTORS .THIS WORKSPACE ALSO CONTAINS SOME
      ⍝ EXTRA VARIABLES AND FUNCTIONS...
       ∊')WSID TEMPORARY'
       ∊')SAVE'
       LIST←⎕NL 2,3
       LIST←,LIST
       ∊')COPY VLISTS'
       MN←WORKSPACENAME
       KILL LIST
       ⎕RL←123467
       ⍎'∊'')COPY MACRO  ',GRUPP1,''''
       TOTLIST←VARIABELGRUPP1,' ',VARIABELGRUPP2,' ',VARIABELGRUPP3
       TOTLIST←TOTLIST,' ',VARIABELGRUPP4,' ',VARIABELGRUPP5
       ∊')ERASE VARIABELGRUPP1 VARIABELGRUPP2 VARIABELGRUPP3'
       ∊')ERASE VARIABELGRUPP4 VARIABELGRUPP5 GRUPP1 LIST'
       ∊')ERASE DOKUMENTATION   '
      ⍝
      ⍝
       MN COPYSAVE TOTLIST
      ⍝OUTPUT FROM INITIALIZATION,AND NOTHING ELSE,IS SAVED
      ⍝IN WORKSPACE(WHOSE NAME IS STORED IN WORKSPACENAME).
      ⍝
      ⍝
       ∊')DROP TEMPORARY'
    ∇
```

```
    ∇  Y COPYSAVE X
      ⍝THIS FUNCTION TAKES VARIABLES FROM WORKSPACE TEMPORARY
      ⍝,TAKING ONLY THOSE SPECIFIED IN LIST X.AND SAVES THEM IN A WORKSP
      ACE  WITH NAME Y...
       ⍎'∊'')COPY TEMPORARY ',X,''''
       ⍎'∊'')WSID ',Y,''''
       ∊')SAVE'
    ∇
```

This function is stored in workspace VLISTS.

APPENDIX D THE INITIALIZATION CODE, HELP-FUNCTIONS

The help-functions, in general, perform operations which occur many times during the initialization or which are so technical that they preferably should not be part of the main initialization code.

The help-functions are, in alphabetical order:

ABOVE, AVG1, AVG2, BETWEEN, CONTINUE1, CONTINUE2, CPI1, DDIV, DEV, DIFF, DIV1, DIV7, DIV8, DUP, ENS, EQUALS, HISTORY, MAKEQUARTERS, MODADD, MODDEL, MODSUBST, MULT1, MULT7, MULT8, PACK, QFR1, RANDOMIZE, REALΔSUM1, RELDIFF, SCANMAT, SUM1, SUM2, SYNTHΔSUM1, USING, SCALE

They are stored in workspace FUNCTI.

A short description of what some of the help-functions do:

AVG1:

Has 2 parameters W(=vector) and D(=vector).

Result: $\sum_{\mathbf{i\ in\ 1}} \left(\frac{W(i) \cdot D(i)}{\Sigma W(i)}\right), \sum_{\mathbf{i\ in\ 2}} \left(\frac{W(i) \cdot D(i)}{\Sigma W(i)}\right), \sum_{\mathbf{i\ in\ 3}} \left(\frac{W(i) \cdot D(i)}{\Sigma W(i)}\right), \sum_{\mathbf{i\ in\ 4}} \left(\frac{W(i) D(i)}{\Sigma W(i)}\right)$

i in 1 means: Summation over index **i** (usually number of firms) but only taking those **i** which belongs to sector 1, etc...

Thus we get a weighted average in each industrial sector (1,2,3,4) of a micro-variable. The result is a vector of length equal to 4.

SUM1:
Has 1 parameter V(=vector). (V=micro-variable).

Result: A vector of length=4 with the sum of V in one and each of the four industrial sectors. (compare with **AVG1** above).

MODADD, MODDEL, MODSUBST:
These functions can change lines in another function, i.e. the programming code itself.* They are described in Part 1, section 2.

MULT7:
Example:

$$M \textbf{ MULT7 } V = \begin{bmatrix} v_1 m_{11} & v_1 m_{12} \\ v_2 m_{21} & v_2 m_{22} \end{bmatrix}$$

$$\text{where } M = \begin{bmatrix} m_{11} m_{12} \\ m_{21} m_{22} \end{bmatrix} \text{ and } V = (v_1, v_2)$$

MULT7 is an operator which performs a kind of multiplication between a matrix and a vector.

* The possibility of changing lines in one program by aid of another program is a particular feature of the APL-language.

APPENDIX D

```
      ∇ABOVE[⎕]∇
    ∇  M←M1 ABOVE M2
[1]    ⍝ TO FORM A MATRIX WITH M1 ABOVE M2, PADDING WITH BLANKS OR ZEROES
        IF NEEDED.
[2]    ⍝ EACH OF M1 AND M2 IS MATRIX, VECTOR, OR SCALAR.
[3]     M←(((1↑⍴M1),1↓(⍴M1)⌈⍴M2)↑M1),[1]((1↑⍴M2),1↓(⍴M2)⌈⍴M1←(¯2↑ 1 1 ,⍴
       M1)⍴M1)↑M2←(¯2↑ 1 1 ,⍴M2)⍴M2
    ∇
```

```
      ∇AVG1[⎕]∇
    ∇  A←W AVG1 D
[1]    ⍝
[2]    ⍝ TO GET MARKET AVERAGES FROM FIRM DATA:
[3]    ⍝ 'D' IS THE FIRM (VECTOR) DATA TO BE AVERAGED.
[4]    ⍝ 'W' IS A WEIGHTING VECTOR.
[5]    ⍝ GLOBAL VECTOR 'MARKET' TELLS MARKET NUMBER OF EACH FIRM.
[6]    ⍝ GLOBAL 'NMARKETS' TELLS NUMBER OF MARKETS.
[7]    ⍝ 'A' IS THE (VECTOR) AVERAGE.
[8]    ⍝
[9]     A←((W×D)+.×MARKET∘.=⍳NMARKETS)÷(W+.×MARKET∘.=⍳NMARKETS)
    ∇
```

APPENDIX D

```
      ∇AVG2[⎕]∇
    ∇  A←W AVG2 D
[1]    ⍝
[2]    ⍝ TO GET A COUNTRY AVERAGE FROM FIRM DATA:
[3]    ⍝ 'D' IS THE FIRM (VECTOR) DATA TO BE AVERAGED.
[4]    ⍝ 'W' IS A WEIGHTING VECTOR.
[5]    ⍝ 'A' IS THE (SCALAR) AVERAGE.
[6]    ⍝
[7]     A←(+/W×D)÷(+/W)
    ∇
```

```
      ∇BETWEEN[⎕]∇
    ∇  R←A BETWEEN B
[1]     R←A+(B-A)×0.01×¯1+?101×B=B
    ∇
```

```
      ∇CONTINUE1[⎕]∇
    ∇  R←N CONTINUE1 V
[1]     R←N↑V,N⍴¯1↑V
    ∇
```

APPENDIX D

```
      ∇CONTINUE2[⎕]∇
    ∇  R←N CONTINUE2 M
[1]     R←((1↑⍴M),N)↑M,⍉(N,1↑⍴M)⍴M[;(⍴M)[2]]
    ∇
```

```
      ∇CPI1[⎕]∇
    ∇  Z←CPI1 PRICES
[1]    ⍝A÷B WHERE A=QC1×NH+QC2×NH... AND
[2]    ⍝B= QC1×NH÷P1 + QC2×NH÷P2 +...
[3]    ⍝
[4]     Z←(+/QC+.×NH)÷((QC+.×NH)+.÷PRICES)
    ∇
```

APPENDIX D

```
      ∇DDIV[⎕]∇
    ∇  Z←A DDIV B
[1]    ⍝
[2]    ⍝ TO 'DIVIDE' A TREND PERCENTAGE.
[3]    ⍝ 'Z' IS COMPUTED AS THE SOLUTION TO: (1+A)=(1+Z)*B
[4]    ⍝
[5]     Z←¯1+*(⍟1+A)÷B
    ∇
```

```
      ∇DEV[⎕]∇
    ∇  A←DEV X
[1]     A←X-+/X÷⍴X
    ∇
```

```
      ∇DIFF[⎕]∇
    ∇  R←DIFF F
[1]     R←((((¯1+⍴⍴F)⍴0),1)↓F)-((((¯1+⍴⍴F)⍴0),¯1)↓F)
    ∇
```

APPENDIX D

```
      ∇DIV1[⎕]∇
    ∇  Z←F DIV1 M
[1]    ⍝
[2]    ⍝ TO DIVIDE FIRMS' DATA WITH A MARKET VECTOR:
[3]    ⍝ 'F' IS THE FIRMS' DATA VECTOR.
[4]    ⍝ 'M' IS THE MARKET VECTOR.
[5]    ⍝ GLOBAL VECTOR 'MARKET' CONTAINS MARKET NUMBER OF EACH FIRM.
[6]    ⍝ 'Z' IS THE RESULTING (FIRM VECTOR) DATA.
[7]    ⍝
[8]     Z←F÷M[MARKET]
    ∇
```

```
      ∇DIV7[⎕]∇
    ∇  Z←M DIV7 V
[1]     ENS(⍴V)=(⍴M)[1]
[2]    ⍝
[3]    ⍝ TO DIVIDE A MATRIX WITH A VECTOR:
[4]    ⍝ EACH ELEMENT 'M[I;J]' IS DIVIDED BY 'V[I]'.
[5]    ⍝ THUS, 'M' MUST HAVE AS MANY ROWS AS 'V' HAS ELEMENTS.
[6]    ⍝
[7]     Z←M÷⍉(⌽⍴M)⍴V
    ∇
```

APPENDIX D

```
      ∇DIV8[⎕]∇
    ∇  Z←M DIV8 V
[1]     ENS(ρV)=(ρM)[2]
[2]    ⍝ TO DIVIDE A MATRIX WITH A VECTOR:
[3]    ⍝ EACH ELEMENT M[I;J] IS DIVIDED BY V[J].
[4]    ⍝ THUS, M MUST HAVE AS MANY COLUMNS AS V HAS ELEMENTS.
[5]     Z←M÷(ρM)ρV
    ∇
```

```
      ∇DUP[⎕]∇
    ∇  Z←NUM DUP EL
[1]    ⍝ Z←(NUM[1]ρEL[1]),(NUM[2]ρEL[2]), ... ,(NUM[N]ρEL[N])
[2]     ENS(1≥ρρNUM),(1≥ρρEL)
[3]     ENS(1≤ρ,NUM),(2≤ρ,EL)
[4]     ENS(1=ρ,NUM)∨((ρ,NUM)=(ρ,EL))
[5]     NUM←(ρEL)ρNUM
[6]     Z←EL[(0≠Z)/Z←,⍉(((⌈/NUM),ρNUM)ρ⍳ρNUM)×(⍳⌈/NUM)∘.≤NUM]
    ∇
```

APPENDIX D

```
      ∇ENS[⎕]∇
    ∇  ENS STRING
[1]     →(∧/STRING=1)/0
[2]     'ERROR DETECTED BY FUNCTION ENS'
[3]     1÷0
[4]     ⍝LINE ABOVE STOPS EXECUTION
    ∇
```

```
      ∇EQUALS[⎕]∇
    ∇  Z←A EQUALS B
[1]     →((⍴⍴A)≠⍴⍴B)/Z←0
[2]     →((,⍴A)∨.≠,⍴B)/0
[3]     Z←(,A)∧.=,B
    ∇
```

```
      ∇HISTORY[⎕]∇
    ∇  R←SM HISTORY DATA;W
[1]     R←DATA+.×W÷+/W←⌽×\(¯1↑⍴DATA)⍴SM
    ∇
```

APPENDIX D

```
      ∇MAKEQUARTERS[⎕]∇
    ∇  W←MAKEQUARTERS V;FUNKA;FUNKB;DELTA;DIFF;F0;F1;F2;NIVA0;NIVA1;R;I;
      J;K;M;N;LEVEL;EXPR1;EXPR2;FUNKX;FIKTIV1;FIKTIV2
      ⍝THIS FUNCTION DISTRIBUTES VARIABLES ON QUARTERS.FLOW-VARIABLES MU
      ST BE DIVIDED BY 4 AFTERWARDS...
      ⍝V=INPUT=YEARLY FIGURES   W=RESULT=QUARTERLY FIGURES
       W←(4×(⍴V))⍴0
       FUNKB←'DELTA×X*((DELTA-N)÷N)'
       FUNKA←'(((3×DELTA)-(6×N))×X*2)+((6×N)-(2×DELTA))×X'
      ⍝
       FIKTIV1←V[1]-(V[2]-V[1])
       FIKTIV2←V[⍴V]+(V[⍴V]-V[¯1+⍴V])
       V←FIKTIV1,V,FIKTIV2
       M←(⍴V)-1
       R←4⍴0
      ⍝
       I←1
      START:→(I=M)/SLUT
       F0←V[I]
       F1←V[I+1]
       F2←V[I+2]
       K←4×(I-1)
       NIVA0←F0+(F1-F0)÷2
       NIVA1←F1+(F2-F1)÷2
       DELTA←NIVA1-NIVA0
       N←(F1-F0)÷2
      ⍝
       FUNKX←FUNKB
       ⍎((×(F2-F1))≠×(F1-F0))/'FUNKX←FUNKA'
      ⍝
       J←1
      S:→(J=5)/L
       X←(J-1)÷4
       LEVEL←⍎'F0+N+',FUNKX
       EXPR1←⍎FUNKX
       X←J÷4
       EXPR2←⍎FUNKX
       R[J]←LEVEL+(EXPR2-EXPR1)÷2
       J←J+1
       →S
      L:
       DIFF←F1-(+/R)÷4
       →(TESTUTSKRIFT=0)/L3
       'TESTUTSKRIFT'
```

APPENDIX D

```
[41]    R[1],R[2],R[3],R[4]
[42]    ⎕ ←'DIFF'
[43]    DIFF
[44]   L3:
[45]    W[K+⍳4]←R+DIFF
[46]    I←I+1
[47]    →START
[48]   SLUT:
[49]    →(TESTUTSKRIFT=0)/EXIT
[50]    ⎕ ←'RESULTAT'
[51]    I←0
[52]   S2:→(I=(M-1))/L2
[53]    ⎕ ←V[I+1]
[54]    ⎕ ←W[(⍳4)+I×4]
[55]    I←I+1
[56]    →S2
[57]   L2:'OK'
[58]   EXIT:
     ∇
```

APPENDIX D

```
      ∇MODADD[⎕]∇
    ∇  NAME MODADD OLDNEW;BREAK;CR;ROWS
[1]     ENS 'MOD'∨.≠3↑NAME←,NAME
[2]     ENS 3=⎕NC NAME
[3]     ENS(BREAK>1),1=⍴BREAK←('ω'=OLDNEW)/⍳⍴OLDNEW
[4]     ENS 1=⍴ROWS←(CR←⎕CR NAME)SCANMAT(BREAK-1)↑OLDNEW
[5]     ENS ⎕EX NAME
[6]     ENS(PACK NAME)EQUALS ⎕FX CR[⍳ROWS;]ABOVE(BREAK↓OLDNEW)ABOVE(ROWS,
       0)↓CR
    ∇
```

```
      ∇MODDEL[⎕]∇
    ∇  N←NAME MODDEL STRING;CR;ROWS
[1]     ENS~'MOD'∧.=3↑NAME←,NAME
[2]     ENS 3=⎕NC NAME
[3]     N←''⍴⍴ROWS←(CR←⎕CR NAME)SCANMAT STRING
[4]     ENS~1∊ROWS
[5]     ENS ⎕EX NAME
[6]     ENS NAME EQUALS ⎕FX(∧⌿ROWS∘.≠⍳1↑⍴CR)/[1]CR
    ∇
```

APPENDIX D

```
      ∇MODSUBST[⎕]∇
    ∇  NAME MODSUBST OLDNEW;BREAK;CR;ROWS
[1]     ENS 'MOD'∨.≠3↑NAME←,NAME
[2]     ENS 3=⎕NC NAME
[3]     ENS(BREAK>1),1=⍴BREAK←('⍵'=OLDNEW)/⍳⍴OLDNEW
[4]     ENS 1=⍴ROWS←(CR←⎕CR NAME)SCANMAT(BREAK-1)↑OLDNEW
[5]     ENS ⎕EX NAME
[6]     ENS(PACK NAME)EQUALS ⎕FX CR[⍳ROWS-1;]ABOVE(BREAK↓OLDNEW)ABOVE(
      ROWS,0)↓CR
    ∇
```

```
      ∇SCANMAT[⎕]∇
    ∇  R←M SCANMAT S
[1]     R←(∨/∧⌿(⌽(⍴,S)≤⍳¯1↑⍴M)/(⍉((1↑⍴M),⍴,S)⍴¯1+⍳⍴,S)⌽(,S)∘.=M)/⍳1↑⍴M
    ∇
```

```
      ∇PACK[⎕]∇
    ∇  Z←PACK S
[1]     Z←1↓(Z∨1⌽Z←0,' '≠S)/' ',S
    ∇
```

APPENDIX D

```
      ∇MULT1[⎕]∇
    ∇ Z←F MULT1 M
[1]   ⍝
[2]   ⍝  TO MULTIPLY FIRMS' DATA WITH A MARKET VECTOR:
[3]   ⍝ 'F' IS THE FIRMS' DATA VECTOR.
[4]   ⍝ 'M' IS THE MARKET VECTOR.
[5]   ⍝ GLOBAL VECTOR 'MARKET' CONTAINS MARKET NUMBER OF EACH FIRM.
[6]   ⍝ 'Z' IS THE RESULTING (FIRM VECTOR) DATA.
[7]   ⍝
[8]    Z←F×M[MARKET]
    ∇

      ∇MULT7[⎕]∇
    ∇ Z←M MULT7 V
[1]    ENS((⍴V)=(⍴M)[1]),(2=⍴⍴M),(1=⍴⍴V)
[2]   ⍝
[3]   ⍝ TO MULTIPLY A MATRIX WITH A VECTOR:
[4]   ⍝ EACH ELEMENT 'M[I;J]' IS MULTIPLIED WITH 'V[I]'.
[5]   ⍝ THUS, 'M' MUST HAVE AS MANY ROWS AS 'V' HAS ELEMENTS.
[6]   ⍝
[7]    Z←M×⍉(⌽⍴M)⍴V
    ∇

      ∇MULT8[⎕]∇
    ∇ Z←M MULT8 V
[1]    ENS((⍴V)=(⍴M)[2]),(2=⍴⍴M),(1=⍴⍴V)
[2]   ⍝ TO MULTIPLY A MATRIX WITH A VECTOR:
[3]   ⍝ EACH ELEMENT 'M[I;J]' IS MULTIPLIED WITH 'V[J]'.
[4]   ⍝ THUS, 'M' MUST HAVE AS MANY COLUMNS AS 'V' HAS ELEMENTS.
[5]   ⍝
[6]    Z←M×(⍴M)⍴V
    ∇
```

APPENDIX D

```
      ∇QFR1[⎕]∇
    ∇  Q←QFR1 L
[1]     Q←(1-RES)×QTOP×1-*-L×TEC÷QTOP
    ∇


      ∇RANDOMIZE[⎕]∇
    ∇  C←A RANDOMIZE B;D;E;AID
[1]     C←((REALΔSUM1 A)÷+/NAMNΔMARKET∘.=⍳4)[SΔMARKET]
[2]    ⍝ EACH ELEMENT OF C EQUALS CORRESPONDING REAL MARKET  AVERAGE
[3]     →((0=B)∧1=⍴B)/END
[4]    ⍝ IF B=0, SKIP CORRELATION ASPECT
[5]     D←(⍴NAMNΔMARKET)↑B
[6]     E←(⍴D)↓B
[7]    ⍝ HELP VBLES: D=REAL PART OF B, E=SYNTHETIC PART OF B
[8]     AID←E-((E+.×SΔMARKET∘.=⍳4)÷+/SΔMARKET∘.=⍳4)[SΔMARKET]
[9]    ⍝ AID=DEVIATION OF ELEMENTS OF E FROM THEIR MKT AVERAGES
[10]    C←C+AID×((+/(DEV D)×DEV A)÷+/(DEV E)*2)×(⍴E)÷⍴D
[11]   ⍝ THAT USED THE APPROXIMATION COV(C,E)=COV(A,D)
[12]   END:AID←A-((A+.×NAMNΔMARKET∘.=⍳4)÷+/NAMNΔMARKET∘.=⍳4)[NAMNΔMARKET]
[13]   ⍝ AID=DEVIATION OF ELEMENTS OF A FROM THEIR MKT AVERAGES
[14]    C←C+((¯50+(⍴C)?100)÷50)×(((REALΔSUM1 AID*2)÷+/NAMNΔMARKET∘.=⍳4)*
       0.5)[SΔMARKET]
[15]   ⍝ C[I,J]=C[I]×(1+EPS[I,J])×SD(A[I])
[16]   ⍝ WHERE: C[I]=C FOR MARKET I AS COMPUTED ABOVE
[17]   ⍝        EPS[I,J] IS UNIFORM OVER [¯0.5, 0.5]
[18]   ⍝        SD(:)=STANDARD DEVIATION OF A ON THE ITH MARKET
    ∇
```

APPENDIX D

```
      ∇REALΔSUM1[⎕]∇
    ∇  A←REALΔSUM1 V
[1]    ⍝
[2]    ⍝ TO SUM FROM FIRMS TO MARKETS:
[3]    ⍝ 'V' IS THE FIRM DATA TO BE AGGREGATED, IF IT HAS MORE THAN
[4]    ⍝ ONE AXIS, FIRST DIMENSION MUST INDICATE FIRM NUMBER.
[5]    ⍝ GLOBAL VECTOR 'NAMNΔMARKET' TELLS MARKET NUMBER OF EACH FIRM.
[6]    ⍝ GLOBAL 'NMARKETS' TELLS NUMBER OF MARKETS.
[7]    ⍝ 'A' IS THE AGGREGATE.
[8]    ⍝
[9]     A←((⍳NMARKETS)∘.=NAMNΔMARKET)+.×V
    ∇
```

```
      ∇RELDIFF[⎕]∇
    ∇  R←RELDIFF F
[1]     R←(DIFF F)÷(((¯1+⍴⍴F)⍴0),¯1)↓F
    ∇
```

```
      ∇SUM1[⎕]∇
    ∇  A←SUM1 V
[1]    ⍝
[2]    ⍝ TO SUM FROM FIRMS TO MARKETS:
[3]    ⍝ 'V' IS THE FIRM DATA TO BE AGGREGATED. IF IT HAS MORE THAN
[4]    ⍝ ONE AXIS, FIRST DIMENSION MUST INDICATE FIRM NUMBER.
[5]    ⍝ GLOBAL VECTOR 'MARKET' TELLS MARKET NUMBER OF EACH FIRM.
[6]    ⍝ GLOBAL 'NMARKETS' TELLS NUMBER OF MARKETS.
[7]    ⍝ 'A' IS THE AGGREGATE.
[8]    ⍝
[9]     A←((⍳NMARKETS)∘.=MARKET)+.×V
    ∇
```

APPENDIX D

```
      ∇SUM2[⎕]∇
    ∇  A←SUM2 V
[1]    ⍝
[2]    ⍝ TO SUM FROM FIRMS TO A COUNTRY TOTAL:
[3]    ⍝ 'V' IS THE FIRM DATA TO BE AGGREGATED. IF IT HAS MORE THAN
[4]    ⍝ ONE AXIS, FIRST DIMENSION MUST INDICATE FIRM NUMBER.
[5]    ⍝ 'A' IS THE AGGREGATE.
[6]    ⍝
[7]     A←+⌿V
    ∇
```

```
      ∇SYNTHΔSUM1[⎕]∇
    ∇  R←SYNTHΔSUM1 V
[1]     R←((⍳NMARKETS)∘.=SΔMARKET)+.×V
    ∇
```

```
      ∇USING[⎕]∇
    ∇  OUT←REAL USING V
[1]     OUT←REAL,(REAL RANDOMIZE V)
    ∇
```

```
      ∇SCALE[⎕]∇
    ∇  S←N SCALE PAR
[1]     ENS(0<PAR),(1≤⍴PAR),(PAR≤S←1,¯1↓PAR)
[2]    ⍝ TO GET N SCALED NUMBERS IN DESCENDING ORDER.

[3]    ⍝ (¯1↓PAR) ARE SIZES OF NUMBERS 2,3,... RELATIVE TO FIRST NUMBER.

[4]    ⍝ AFTER THAT, MORE NUMBERS ARE GENERATED IN A LOGARITHMICALLY DECL
       INING FASHION DOWN TO (¯1↑PAR).
[5]    ⍝ NUMBERS ARE NORMALIZED TO HAVE SUM=1.

[6]     →(N=⍴S←(N⌊⍴S)↑S)/L
[7]     S←S,⌽(¯1↑PAR)×((÷/¯2↑1,PAR)*÷N-⍴S)*¯1+⍳N-⍴S
[8]    L:S←S÷+/S
```

APPENDIX D ENTRY VARIANT

```
MMM ADDFIRM PARMS;MM;NEWSYMBOL;Δ;RELSIZE;A22P;QP;DP;W;M;DVA;QVA;VA;Q;QQ;L;RES;QTOP
⍝ TO INSERT NEW FIRM(S) INTO ONE MARKET; TO BE USED AT A YEAR LIMIT ONLY.
ENS(0 1 ∨.=⍴⍴MMM),(1 2 ∨.=⍴,MMM),(1=⍴⍴PARMS),(2≤⍴PARMS)
NEWSYMBOL←(MMM←2⍴MMM)[2]
MM←MMM[1]
Δ←PARMS[1]
RELSIZE←1↓PARMS
⍝ MM IS MARKET NUMBER
⍝ NEWSYMBOL GIVES NUMERICAL CODE FOR PLOTTING
⍝ Δ IS PROFIT-MARGIN ADVANTAGE COMPARED TO THE AVERAGE FIRM
⍝ RELSIZE IS SIZE OF NEW FIRM(S) AS A FRACTION OF CURRENT MARKET AGGREGATE
ENS 0=⎕NC 'NRS'
⍝ THAT WAS TO ENSURE A YEAR LIMIT
⍝
RW←RW,(⍴RELSIZE)⍴S AVG5 RW
⍝
A21←VA AVG5 A21
A22←VA AVG5 A22
⍝
INVEFF←INVEFF,(⍴RELSIZE)⍴K1 AVG5 INVEFF
K1←K1,RELSIZE×SUM5 K1
K1BOOK←K1BOOK,RELSIZE×SUM5 K1BOOK
K2←K2,RELSIZE×SUM5 K2
BW←BW,RELSIZE×SUM5 BW
```

APPENDIX D ENTRY VARIANT (cont.)

```
QINV←QINV,RELSIZE×SUM5 QINV
QINVLAG←QINVLAG,RELSIZE×SUM5 QINVLAG
DELAYΔINV←DELAYΔINV,[1]RELSIZE∘.×SUM5 DELAYΔINV
⍝
X←X,(⍴RELSIZE)⍴S AVG5 X
⍝
P←P,P←(⍴RELSIZE)⍴S AVG5 P
QP←QP,QP←(⍴RELSIZE)⍴QS AVG5 QP
DP←DP,DP←(⍴RELSIZE)⍴S AVG5 DP
⍝
W←W,W←(⍴RELSIZE)⍴L AVG5 W
DW←DW,(⍴RELSIZE)⍴VA AVG5 DW
QDW←QDW,(⍴RELSIZE)⍴(L×QW)AVG5 QDW
QW←QW,(⍴RELSIZE)⍴L AVG5 QW
⍝
⍎(0≠⎕NC 'CHM')/'CHM←CHM,(⍴RELSIZE)⍴S AVG5 CHM'
M←M,M←(⍴RELSIZE)⍴Δ+S AVG5 M
⍝
DVA←DVA,DVA←(⍴RELSIZE)⍴VA AVG5 DVA
VA←VA,VA←RELSIZE×SUM5 VA
QVA←QVA,QVA←RELSIZE×SUM5 QVA
⍝
Q←Q,Q←VA÷P-((QPDOM×1-TXVA2)+.×IO)[MM]
QQ←QQ,QQ←QVA÷P-((QPDOM×1-TXVA2)+.×IO)[MM]
DQ←DQ,DVA-DP
⍝
DS←DS,(⍴RELSIZE)⍴S AVG5 DS
S←S,Q×P
QS←QS,QQ×QP
⍝
L←L,L←VA×(1-M)÷W
LU←LU-÷7,L
ENS LU≥0
AMAN←((⍴AMAN)+(⍴RELSIZE),0)↑AMAN
⍝
EXPDP←EXPDP,(⍴RELSIZE)⍴S AVG5 EXPDP
EXPDS←EXPDS,(⍴RELSIZE)⍴S AVG5 EXPDS
EXPDW←EXPDW,(⍴RELSIZE)⍴VA AVG5 EXPDW
HISTDP←HISTDP,(⍴RELSIZE)⍴S AVG5 HISTDP
HISTDPDEV←HISTDPDEV,(⍴RELSIZE)⍴S AVG5 HISTDPDEV
HISTDPDEV2←HISTDPDEV2, (⍴RELSIZE) ⍴S AVG5 HISTDPDEV2
HISTDS←HISTDS, (⍴PRELSIZE) ⍴S AVG5 HISTDS
```

APPENDIX E A MICRO-TO-MACRO DATA BASE. EXPERIENCES FROM THE CONSTRUCTION OF THE SWEDISH MICRO-TO-MACRO MODEL (MOSES)

by Louise Ahlström

Economists frequently have failed to explain economic developments in the seventies. Consequently a need has been felt for new and improved theory as well as statistical methods to come to grips with old problems. It has been suggested that if information regarding the individual decision makers and their role in the market process is taken into account while constructing a model of the economy as a whole, the information base for macro analysis can be improved. The results obtained in such a model could prove to be quite different from those brought forward by traditional theories and methodologies. Thus it might be possible to develop better guidelines for economic policies than those that have been used during the past decade. Above all it would be possible to treat the supply side and the structural adjustment process in a much more realistic fashion in a micro based macro model. The utilization of assumptions about the behavior of individual decision makers consequently would give the system dynamic features not provided by traditional simulation methods.

It is obvious that although it is easy to point to some advantages of micro simulation over traditional simulation methods, there are difficulties that have to be over-come before such a model project can be expected to bear fruit. One such major obstacle is the necessity to successfully handle the vast amount of data that this method calls for. The presence of advanced high-speed computers can be seen as a necessary but not sufficient condition for the development of micro simulation models. More importantly there is the obstacle of the need to develop a methodology for incorporating micro data into a macro model format. Anyone taking on the task of constructing a micro-based macro model will soon learn that the difficulties intrinsic to setting up an operable design for the micro and macro data bases, are quite substantial. Since one in order to fulfill the objective of developing the micro simulation model is forced to come up with a functioning scheme, it is necessary to make a series of decisions as to how to by-pass the problems. The process of making these decisions is a painful one, expecially since one does not know which problem will come next. Frequently, after having successfully dealt with one problem, it is necessary to rip it up since the solution of the problem that one stumbles on thereafter is not in line with the solution chosen for the first. The construction of a data base thus can be described as a tedious process of two steps forward and one step backward - sometimes one step forward and two steps backward. By necessity there will be many versions of the model and the corresponding data bases before the model project is terminated.

The structure we have finally chosen for the construction of the data bases must be seen as one way among a theoretically vast number of ways to deal with an operation analysis problem. We dare not claim that we have managed to find the best one. Our endevours ought to be judged only in the light of the objectives for our particular project. We will now point to some aspects of a general character.

The objectives for the construction of the Swedish micro-to-macro model were

1. to formulate a micro explanation for inflation and

2. to study the relationships between inflation, profits, investment and growth.

The chosen problems relate to typical dynamic processes and place heavy emphasis on the market process and its importance for price and income determination and growth at the macro level. For this reason an aggregation scheme that centers on markets and the <u>use</u> of industrial products rather than on the ordinary classification according to the production technique and raw material base is necessary. The aggregation scheeme includes four industrial production sectors:

Raw Material Processing Industries (RAW)
Intermediate Goods Industries (IMED)
Investment and Consumer Durable Goods Industries (DUR)
Non Durable Consumption Goods Industries (NDUR)

Each industrial sector holds a large number of individual firms which constitute the micro feature in MOSES. The market processes in the model operate both between and within the four sectors. The aggregation scheme has been designed on the same format as that of the Annual Planning Survey of the Federation of Swedish Industries. This means that the capacity utilization data of this survey can be directly incorporated into the micro data base. Regarding the macro data base we have had to develop a market oriented classification scheme of our own in order to adapt the national accounts macro statistics to our micro based sector classification. Lack of some firm data necessitates the use of industrial macro data as substitutes. The input-output matrix is one example where such simplifications have been necessary.[1]

In the early stages of constructing the model it was built around a 1968 base year macro data base. It was our ambition to be able to start the model in any year from 1950 and onwards. Thus a great deal of effort was put into collecting time series for macro variables. Due to lack of relevant data it was difficult to obtain time series that were consistent over time as well as with each other. The calibration of the model was done by starting simulations in 1968 and running them for a 10-year period. We compared the behavior of key macro variables in the model with reality, adjusted the parameters according to the results and started the process over again.

[1] For a description of how macro data are combined with real firm data see Eliasson, G, A Micro Simulation Model of a National Economy, Chapter 3 on estimation methods, in A Micro-to-Macro Model of the Swedish Economy, IUI Conference Reports 1978:1

We have had to put in substantial effort to overcome inconsistencies in the data base that have crept in not only because of our new aggregation type but also because of inconsistencies between the various parts of the national accounts statistics themselves. We have found by experience that a consistent data base for the first period of a simulation is imperative for a proper tracking by the model of historic macro test data. During the next stage of model life we wanted to update the data base in order to be able to start simulations in 1976 - we therefore decided to concentrate our efforts on obtaining a good base year. For this reason it was necessary to create an accounting system as a framework for the construction of the macro data base.

As the core around which we chose to build the accounting system (see Tables 1:1 through 1:3) we used the input-output system. The input-output coefficient matrix for 1976 used in the model is calculated from an input-output matrix expressed in producer´s prices. Since the final demand on the other hand is expressed in purchaser´s prices we have had to adjust the accounting system for the difference in price levels (DIF, Column 20). On the macro level the difference (DIF) is equal to the total of the commodity based indirect taxes on final demand. The production value in market prices is identical to the production value in purchaser´s prices on the macro level, since the transport and trade margins are included in the production value of the trade sector. For the individual sectors this is not true, which in turn depends on the existence of margins as well as on the mix-up of industrial sectors in the basic statistical material. The residual (RES, row 13) arises from differences in the gross production data if calculated from the demand side or from the production side. Since there is reason to believe that the data on the demand side have greater reliability we have chosen to treat the residual as a row vector.

Table 1:1

The Accounting System in MOSES

INPUTS into the production system	Raw Material Processing Industries	RAW
INPUTS into the production system	Intermediate Goods Industries	IMED
INPUTS into the production system	Investment and Consumer Durable Goods Industries	DUR
INPUTS into the production system	Non Durable Consumption Goods Industries	NDUR
INPUTS into the production system	Agriculture, Forestry and Fishing	A/F/F
INPUTS into the production system	Mining and Quarrying	ORE
INPUTS into the production system	Petroleum Products Imports	OIL
INPUTS into the production system	Construction	CONSTR
INPUTS into the production system	Electricity	EL
INPUTS into the production system	Other Services	SERVICE
FINAL DEMAND	Government consumption	GOVT
FINAL DEMAND	Private consumption	CONS
FINAL DEMAND	Investments	INV
FINAL DEMAND	Change in stocks	ΔSTO
FINAL DEMAND	Exports	EXP
FINAL DEMAND	Imports and duties	IMP

Columns alongside the production system rows: Gross production in producers' prices | Value added | Commodity based indirect taxes, net

Table 1:2

The Accounting System in MOSES

Vertically:	Row	
Inputs into sectors 1-10	1-10	
Total inputs		INPUTS
Commodity based indirect taxes, net	11	TAX
Value added in producers' prices	12	VA
Residual	13	RES
Gross production in producers' prices	14	TOTAL

Horizontally:	Column	
Input deliveries into sectors 1-10	1-10	
Total input deliveries		INPUTS
Government consumption	11	GOVT
Private consumption	12	CONS
Investments	13-16	INV
Change in stocks	17	ΔSTO
Exports	18	EXP
Total use		USE
Imports and duties	19	IMP
Gross production	(USE-IMP)	TOT
Difference	20	DIF
Gross production in producers' prices	21 (TOT-DIF)	TOTAL

Sectors 1-10: *		
Agriculture, Forestry and Fishing	1	A/F/F
Mining and Quarrying	2	ORE
Petroleum Products Imports	3	OIL
Raw Material Processing Industries	4	RAW
Intermediate Goods Industries	5	IMED
Investment and Consumer Durable Goods Industries	6	DUR
Construction	7	CONSTR
Non Durable Consumption Goods Industries	8	NDUR
Electricity	9	EL
Other Services	10	SERVICE

---

* The column and row numbers for sectors 1-10 have been altered in the present (March 1983) data base.

Table 1:3

The Accounting System in MOSES - A Schematic Description

FINAL DEMAND IN PURCHASER'S PRICES

GOVT + CONS + INV + ΔSTO + EXP - IMP

INPUTS	TAX	VA			DIF	MARG
in producers prices, incl. imports and duties	commodity based indirect taxes, net	wages	operating surplus incl. depreciation	non commodity taxes, net	commodity based indirect taxes on final demand, net	transport and trade margins

GROSS PRODUCTION IN PRODUCER'S PRICES

INPUTS in purchaser's prices | VALUE ADDED in producer's prices

GROSS PRODUCTION IN PURCHASER'S PRICES

Comment: On the macro level the production value in market prices is identical to the production value in purchaser's prices, since transport and trade margins are included in the production value of the trade sector (part of SERVICE).

The input-output system has been created through the aggregation of input-output matrices expressed in producer´s prices, provided by the Central Bureau of Statistics. Since data in producer´s prices were only available for 1975, we had to project the 1976 I/O matrix by assuming the same change between 1976 and 1975 in the coefficients expressed in producers prices as in those in purchaser´s prices. The input-output matrices shown in Section 3 of this manual were constructed in this way. The aggregation scheme consisting of a weighting matrix based on value added is documented in Table 2.

Technically speaking the input-output coefficients are kept constant over time in the model. The model is not solved by inverting the input-output matrix in the traditional way. For the four industrial production sectors the production volume is determined in the business system block while the corresponding input-output coefficients determine the amount of inputs needed to make this level of production possible. At both ends of these sectors, that is at both ends of each individual firm, there are buffer stocks to even out production flows. For the remaining six "external sectors" on the other hand the input-output matrix is operating as in a conventional macro input-output model complemented with a Keynesian demand system.Since individual firms within and between markets meet with success and failure differently they grow at very different rates. Consequently the macro input-output coefficients in the model vary endogenously over time.

Table 2 **The MOSES Aggregation Scheme According to the Standard for Swedish Classification of Economic Activities (SNI)** with Comparisons to the Industry Group in the Input-Output Statistics (I/0), the National Accounts Statistics (SNR) and the Classification Used in the IUI Long Term Survey (LB)

				1	2	3	4	5	6	7	8	9	10	
I/O	Sector	SNR	LB	A/F/F	ORE	OIL	RAW	IMED	DUR	CONSTR	NDUR	EL	SERVICE	SNI
1	Agriculture	1100	1	11										11
2	Forestry	1200	1	12										12
3	Fishing	1300	1	13										13
4	Mining and quarrying	2000	3		20 excl. (220)	(220)[a]								20
5	Sheltered food manufacturing	3111	4								3111/2 3116-8			3111/2 3116-8
6	Import - competing food manufacturing	3112	5								3113-5 3119-22			3113-5 3119-22
7	Beverage and tobacco manufacturing	3120	6								313/4			313/4
8	Textile and leather industries	3200	7				-	321·0.25	321·0.25	-	321·0.5 322-324			32
9	Manufacture of wood and wood products	3410	8				33111	3312/9	3320·0.4	33112/9	3320·0.6			33

Table 2 **The MOSES Aggregation Scheme According to the Standard for Swedish Classification of Economic Activities (SNI)** with Comparisons to the Industry Group in the Input-Output Statistics (I/O), the National Accounts Statistics (SNR) and the Classification Used in the IUI Long Term Survey (LB)

				1	2	3	4	5	6	7	8	9	10	
I/O	Sector	SNR	LB	A/F/F	ORE	OIL	RAW	IMED	DUR	CONSTR	NDUR	EL	SERVICE	SNI
10a	Manufacture of pulp	3420 part	8				34111	34112	-	34113	-			34111-3
10b	Manufacture of paper products	3420 part	8				-	3412	-	-	3419			3412/9
11	Printing and publishing	3430	9				-	-	-	-	3420			342
12	Manufacture of chemicals and chemical products	3520 part	11				-	351 3521/9	-	-	3522/3			351/2
13	Petroleum refineries, manufacture of products of petroleum and coal	3530	12			(353/4)[a]	353/4 excl. (353/4)	-	-	-	-			353/4
14	Manufacture of rubber products	3510	10				-	355·0.8	-	-	355·0.2			355
15	Manufacture of plastic-products	3520 part	11				-	35601	-	-	35609			356
12	Manufacture of non-metallic mineral products	3600	13				-	36202	-	36201/9 369	361 36203			36

Table 2 **The MOSES Aggregation Scheme According to the Standard for Swedish Classification of Economic Activities (SNI)** with Comparisons to the Industry Group in the Input-Output Statistics (I/0), the National Accounts Statistics (SNR) and the Classification Used in the IUI Long Term Survey (LB)

I/O	Sector	SNR	LB	1 A/F/F	2 ORE	3 OIL	4 RAW	5 IMED	6 DUR	7 CONSTR	8 NDUR	9 EL	10 SERVICE	SNI
17	Iron-, steel- and ferro-alloys industries	3700 part	14				37101/2	37103	-	-	-			371
18	Non-ferrous metal industries	3700 part	14				37201-3	37204	-	-	-			371
19	Manufacture of fabricated metal products, machinery and equipment	3810	15				-	3811 38199 38191/2	3812,382 3842-9 385	3813 38193/4	38195			381/2, 385 3842-9
20	Manufacture of electrical machinery, apparatus appliances and supplies	3830	15				-	3839	3831-3	-	-			383
								3521/9	-	-	3522/3	351/2		
21	Shipbuilding and repairing	3843	16						3841					3841
22	Manufacturing industries not elsewhere classified	3900	17								39			39
23	Repair of household applicances and motor vehicles etc.	3600 3842	13				36202		36201/9-		361			36
		9511/3	15										951	951

Table 2 **The MOSES Aggregation Scheme According to the Standard for Swedish Classification of Economic Activities (SNI)** with Comparisons to the Industry Group in the Input-Output Statistics (I/0), the National Accounts Statistics (SNR) and the Classification Used in the IUI Long Term Survey (LB)

				1	2	3	4	5	6	7	8	9	10	
I/O	Sector	SNR	LB	A/F/F	ORE	OIL	RAW	IMED	DUR	CONSTR	NDUR	EL	SERVICE	SNI
24	Electricity, gas and water	4000	18									40		40
25	Construction	5000	19							50				50
26	Wholesale and retail trade	6100	20										61/2	61/2
27	Restaurants and hotels	6300	23										63	63
28	Transport and storage	7100	21										71	71
29	Communication	7200	21										72	72
30	Financial institutions and insurance	8100	23										81/2	81/2
31	Letting of dwellings and use of owner-occupied dwellings	8300	22							83101/3				83101/3
32	Letting of other premises	8400	23							83102				83102
33	Business services	8500	23										832/3	832/3
34	Private services not elsewhere classified	9600 excl. 9511/3	23										92-4 952-9	92-4 952-9

[a] The SNI code within parentheses refers to imports.

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NOTES

[1] An earlier version of the model is described in full detail, in Eliasson (1978, abbreviated in (1981)). A new, updated presentation of the full model plus a complete bibliography will be presented in Eliasson (1984).

Documentation on the economic contents of MOSES is complete for an earlier version which is still quite accurate as far as the core micro-to-macro machinery is concerned. An important addition is the individual firm purchasing process, which is described in this manual. The need for a full, updated documentation, should, however, be remedied in a forthcoming research report, Eliasson (1984).

[2] A more detailed description of the micro (firm) database can be found in Albrecht-Lindberg (1982). In this working paper the micro initialization is also described.

[3] See Albrecht-Lindberg (1982), Ahlström (1978), Bergholm (1982), and Eliasson-Heiman-Olavi (1978).

[4] Comments about choosing another starting year are made in Section 7.

[5] For example:
EXOΔREALCHLG(1) = 3000 means that 3 000 persons will be added to the sector the first quarter 1977.

EXOΔREALCHLG(5) = 2500 means that 2 500 persons will be added to the fifth simulated quarter (=first quarter 1978)

EXOΔREALCHLG etc is a vector with a number of components = the number of quarters to be simulated ...

[6] For the present SMT = 1/2 so Targ(n+1) is an ordinary average of Targ(n) and M(n). Targ is specified for the individual firm.

[7] The only thing the function **SIΔINIT** does is to fetch data from workspace MACRO and FUNCTI and to call the sub-functions on level 2 in Figure 3.

[8] Formally XX is a parameter to the main-function **START**.

[9] The corresponding exogenous time-series are EXOΔQINVG, EXOΔQINVBLD etc.

[10] a) Statistical errors in SCB statistics.
b) IUI computation errors when distributing total industry sales on the 4 sectors in the model.

[11] In the sectors 5,6,...,10, where there are no firms in the model, IO is used to determine these sector's demand for products. This is done in a conventional input-output fashion by inverting a sub-matrix of IO.

[12] Both the share **(total input)/(total production)** and the share **(input from sector j)/(total production)** will change at the macro level.

[13] Initialization version 19 and experiment version 11 were used. The experiment is labelled S11V19 (cf. Part 1 of this manual).

[14] The sub-functions **RANDOMIZE** and **USING**. August 1980. See Appendix D. See also "The micro initialization of MOSES" by Albrecht-Lindberg (1982).

[15] The variable RIΔISΔEXOGEOUS is a logical variable being zero or one.

[16] Remember that IO76 is in 1975 year's prices (see Section 3) whereas $IO76_{II}$ should be in 1976 year's prices.

[17] Profits = gross operating surplus.

[18] To simulate more than 30 years one has to set the variable NYR equal to that number, in a ISTARTXX-function. For example NYR ← 50.

[19] This is behaviour of the government sector in the labour market in the present version of the model. One could think of other possibilities.

[20] If a parameter is a vector of length = the number of firms, one can change the behaviour of individual firms, otherwise it's much more tricky, i.e. one must make changes in the model to be able to do that.

[21] However, if one is sure that the new variable does not affect the initialization procedure and the consistency in any way, one can introduce the new variable directly in a MSTART-function.

[22] i.e. vectors of length = number of firms in the simulation.

[23] MSTART10 is a function stored (since 1983) in the MSTART-workspace.

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