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No. 118, 1983

THE MOSES MANUAL

Part 2

THE INITIALIZATION PROCESS

by

Fredrik Bergholm

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December, 1983

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NOTE: * The Micro Data Base and the Micro initiali-
zation are also described in much detail in Al-
brecht-Lindberg (1982).

Preface

MOSES is short for "**M**odel 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 variable⁵ called EXO Δ 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 $Targ(n) \cdot SMT + M(n) \cdot (1-SMT)$

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).

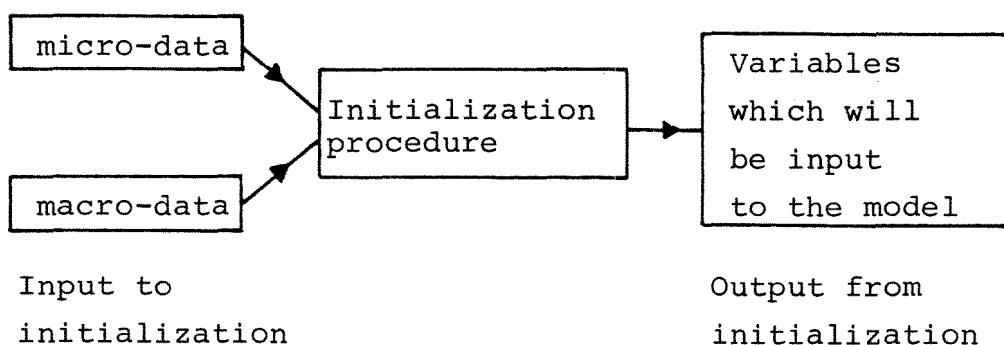
The main features of the initialization procedure are described in the next section. In Section 3 the input-output system is described, since it is an essential part of the initialization procedure and the data base work. The input-output system is described in rather much detail. The techniques involved 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.

Schematically:

Figure 1



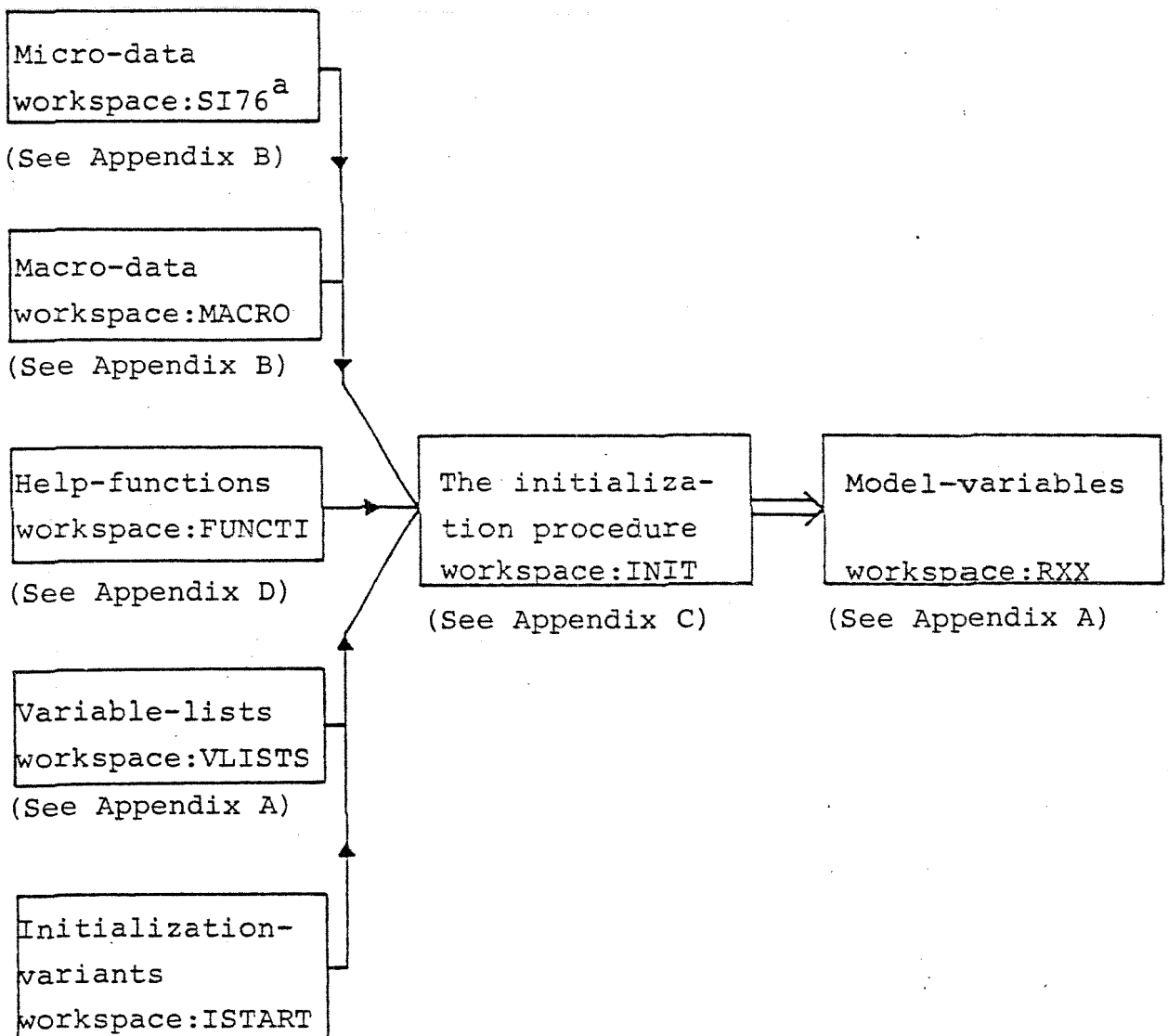
We will refer to "variables which will be input to the model" as "**model variables**", in what follows.

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 **OUTPUTAOPERATIONS**, 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 SIAINIT | TAXAPARAMETERS PUBLICASECTOR MONETARY MARKETS HOUSEHOLDS ESTABLISHMENTS DISPOSEAVARAINPUT MARKETSADATA SECONDARYADATA PUBLICADATA MONETARYADATA HOUSEHOLDSADATA OUTPUTOPERATIONS |

^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 **PUBLICASECTOR** 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 **TAXAPARAMETERS**. Variables connected with the government sector are set in **PUBLICASECTOR**. Variables connected with individual firms (micro variables) are given values in the function **ESTABLISHMENTS**, etc.

SIAINIT (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 **SIAINIT** 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 **OUTPUTAOPERATIONS** 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 call⁸ **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-func-

tion **START** calls **ISTARTXX** before calling **SIAINIT**. (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, workspace 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 (I076) 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 |

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) |
| 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 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: $I076(m,1)$, $m=1,2,\dots,10$, 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 $C+I+G+X-M+\Delta L$. (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:

$$\frac{IO76(i,j)}{IO76(14,j)} = IOCOEFF76(i,j)$$
$$i=1,2,3,\dots,13 \quad j=1,2,\dots,19.$$

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 corresponding⁹ 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

| <u>Model variable</u> | <u>Coming from:</u> | |
|-------------------------------|-------------------------------------|-------------|
| 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 $i=1,2,\dots,10$, and column 19 consists of negative numbers (cf. Table 1).

The same import shares apply to both consumers 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 \approx 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 exceptions¹¹, 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 $i=1,2,\dots,10$. Thus $IO(1,j)$, $IO(2,j)$, $IO(3,j),\dots,IO(10,j)$ are the **input-shares** for each product (input from sectors $1,2,\dots,10$) 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 $IO(1,j) \cdot q \cdot c$ SEK production from sector 1 and $IO(2,j) \cdot q \cdot c$ SEK production from sector 2, etc.

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

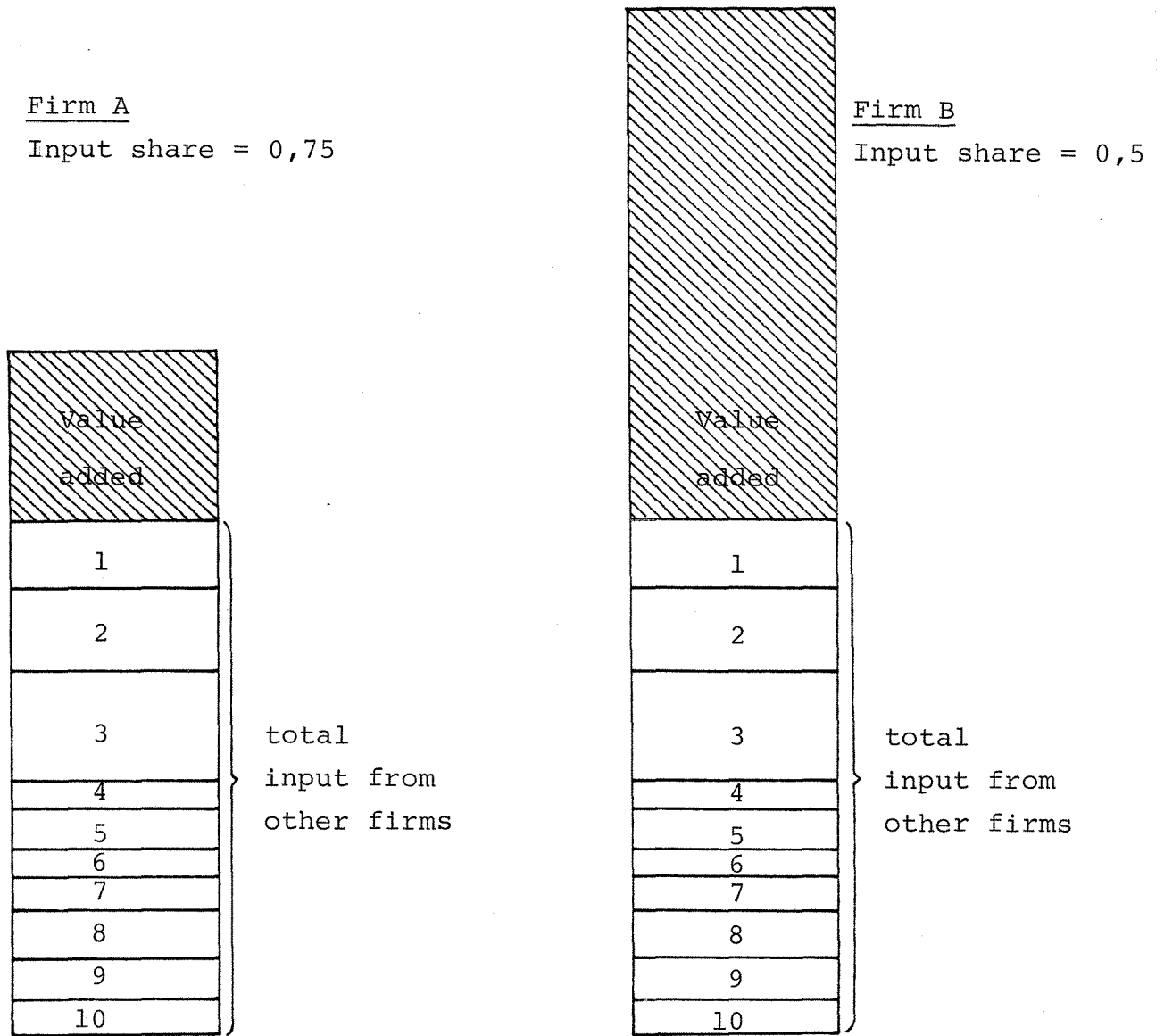
$$\text{The average input-share} = \sum_{i=1}^{10} IO(i,j)$$

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 1983¹³ the following macro input shares were obtained:

Table 2 Simulation results

| Year: | <u>Macro input share</u> | | | |
|-------------------------|---------------------------------|----------|----------|----------|
| | (=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: **TAXPARAMETERS, PUBLICASECTOR, MONETARY, MARKETS, HOUSEHOLDS, ESTABLISHMENTS, MARKETADATA, SECONDARYADATA, HOUSEHOLDSADATA, MONETARYADATA** and **PUBLICADATA**.

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 **TAXPARAMETERS**

"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 **PUBLICASECTOR**

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 (EXO Δ REALCHLG) 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-), TIM Δ OFF, from workspace MACRO. For the present this determines EXO Δ REALCHLG 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 Δ 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 Δ 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 Δ QDPFOR (=changes in foreign price index) is set using historical price-behaviour (extrapolation). EXO Δ 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. **HOUSEHOLDSADATA** below). Some exogenous time-series in connection with the rate of interest (EXOARI 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 FADATA. 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) Real Δ sales (=help variable) is a vector with R components, where R=number of real firms. Real Δ sales(i) gets the value:

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

export- domestic
sales 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) Res Δ sales (=help variable) is a vector of length 4 and is the rest of the sales value in the 4 sectors. RES Δ sales(j) gets the value:

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

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) Synth Δ sales(i) gets the value
Scale(i) \cdot res Δ sales(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.

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

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: $S(i) = \text{Real}\Delta\text{sales}(i)$ for $i=1,2,\dots,R$ and $S(i) = \text{Synth}\Delta\text{sales}(i)$ for $i=R+1,R+2,\dots,R+Q$.

Thus:

STEP 1: $\text{Real}\Delta\text{sales}$ (=sales for real firms) is set.

STEP 2: $\text{Res}\Delta\text{sales}$ (=residuals between macro and sum of real firms) are set.

STEP 3: $\text{Res}\Delta\text{sales}$ is distributed onto synthetic firms. $\text{Synth}\Delta\text{sales}$ (=sales for synthetic firms) is set.

STEP 4: S (=sales=model variable) is the combination of $\text{Real}\Delta\text{sales}$ and $\text{Synth}\Delta\text{sales}$.

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:

- o (a) As soon as ratios appear, there is an in-built check that the Synthetic firms get the same mean and dispersion (standard deviation) as the real firms.
- o (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
 $i=1,2,\dots,R+Q$.
 $\text{ratio}=L(i)/S(i)$

This ratio is randomized for the synthetic firms in such a fashion that the mean and dispersion for the synthetic firms ($i=R+1,R+2,\dots,R+Q$) 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

$$Q(i) = (S(i) + \Delta K3 \Delta \text{FINISH}(i)) / 100$$

where $\Delta K3 \Delta \text{FINISH}$ 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 $\text{Share}(i)$ is created:

the individual firm's input share
average input share in the sector

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

o **MARKETSADATA**

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 **HOUSEHOLDSADATA** and **MONETARYADATA**. Inventory-constants for firms (maximum-, minimum-inventory levels) are set in **ESTABLISHMENTS**.

o **MONETARYADATA**

Constants connected with the bank system are set. If $RI\Delta IS\Delta EXOGENOUS=1^{15}$ 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 **SECONDARYADATA** and **PUBLICADATA**

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 **HOUSEHOLDSADATA**

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.

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

$j=1,2,\dots,10$ =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 **QDIAINIT**.

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:

| | <u>Period</u> |
|--|---------------|
| TLΔEXP (export price indices) | 1970-80 |
| IMPLΔPRIS, IMPLΔPRISΔIN (domestic price-indices) | 1974-77 |
| HISTΔTXVA2("moms") | 1974-77 |

TLΔEXP is a long time series which is used to extrapolate a future time series starting 1977, i.e. the variable EXOΔQDPFOR mentioned previously. IMPLΔPRIS 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, TLΔEXP, LON and TIM: Louise Ahlström (previously IUI).

The national accounting statistics from SCB has been used. Reference persons for SALES76, TLΔEXP. 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 ($F\Delta\text{INKOP}$ =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:

$$\text{SALES76} = (0.14, 0.18, 0.34, 0.34) \cdot 207\ 150$$

On the other hand, if one distributes total sales according to the proportions for gross production (assuming that sales \approx 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:

$$\text{NYSALES76} = (0.18, 0.19, 0.33, 0.30) \cdot 207\ 150$$

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 **COEFFAIO** 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 $I076_{II}$, having the same form as the input-output matrix I076 (see Section 3), from the initialization by using the sum of micro variables when this is possible, and fill in with macro values from I076 when this is not possible. We will call the input-output matrix $I076_{II}$, the "control matrix" in this section.

b) $I076_{II}$ is considered to be consistent if (1) the values in $I076_{II}$ do not differ "unreasonably much"¹⁶ from I076 and (2) horizontal sum of production \approx vertical sum of production in I076.

A print-out of the control matrix $I076_{II}$ 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 + profits¹⁷ 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 | 4192 | 942 | 1943 | | |
| 1999 | 5916 | 5633 | 5790 | 908 | 117 | 3498 | 170 | 2035 | | |
| 940 | 2681 | 14416 | 1187 | 503 | 213 | 6294 | 171 | 3079 | | |
| 791 | 2765 | 2393 | 19287 | 2078 | 87 | 2648 | 102 | 6484 | | |
| 2365 | 2237 | 400 | 13965 | 383 | 1 | 1689 | 0 | 312 | | |
| 2908 | 239 | 93 | 82 | 26 | 140 | 418 | 5 | 0 | | |
| 4076 | 683 | 177 | 338 | 130 | 213 | 1009 | 488 | 842 | | |
| 1217 | 1364 | 3327 | 1246 | 1383 | 162 | 10928 | 708 | 9874 | | |
| 891 | 1072 | 557 | 629 | 238 | 171 | 1118 | 328 | 1010 | | |
| 3245 | 3802 | 6939 | 5709 | 1792 | 640 | 9143 | 426 | 25656 | | |
| 62 | 81 | 166 | 3083 | 163 | 10 | 350 | 5 | 2261 | | |
| 8608 | 16344 | 32150 | 25355 | 11452 | 2529 | 50892 | 6395 | 64383 | | |
| 152 | 136 | 209 | 66 | 41 | 35 | 238 | 0 | 1 | | |
| 32449 | 40339 | 73341 | 72285 | 19341 | 4413 | 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)

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

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 $F\Delta$ INKOP and BRINKOP in Appendix A) in sectors 1,2,3,4 obtained by summing the micro-units (Σ purchases/ Σ production) 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. X, FADATA, FIRMID, R_AMARKET) 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 experi-

ments 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 simulate¹⁸ 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 from 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 Δ REALCHLG. From Section 4 we know that one line in the subfunction **PUBLICASECTOR** should be changed. We do this in **ISTART11**. If we let each component of the vector EXO Δ 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 **MARKETSADATA**. 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

```
VISTART11[Q]V
V ISTART11
[1] SYNTHAFIRMS+ 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] # ε')COPY SI76., '
[7] 'MARKETS' MODSUBST 'EXOΔQDPFOR+ωEXOΔQDPFOR+(4 120)ρ0.02'
[8] 'MARKETS' MODSUBST 'QPFOR+ 1ωQPFOR+4ρ100+(3÷8)x2x4'
[9] 'MARKETS' MODSUBST 'QDPFOR+(TωQDPFOR+4ρ0.02'
[10] 'PUBLICASECTOR' MODDEL 'EXOΔREALCHLG+'
[11] 'PUBLICASECTOR' MODADD 'LG+QLGC4]ωEXOΔREALCHLG+120ρ2500'
V
```

```
VISTART12[Q]V
V ISTART12
[1] SYNTHAFIRMS+ 8 16 18 8
[2] 'MARKETSADATA' MODSUBST 'SMT+ωSMT+1'
[3] 'MARKETSADATA' MODADD 'GAMMA+ωINVEFF+147ρ0.5'
V
```

```
VMSTART13[Q]V
V MSTART13
[1] #EXAMPLE
[2] 'NULLIFY' MODADDLAST ' SHRINK ''QF'' '
[3] # MODADDLAST MEANS THAT THE LINE IS ADDED AS THE LAST LINE
V
```

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 $\Delta QTOP/INV$ 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 registered²¹ 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 vectors²² 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 some²³ 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←(ρQ)ρ1.05*(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 func-

tion **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 IO76 etc.)

although that would be natural, or, alternatively, rename them (for example IO82 ← IO76) 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.

* 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 F Δ INKOP 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 accompanying the two-quarter lag of layoffs |
| AMAN Δ year | 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 expen- ditures in different categories to the income constraint |
| BETA2(j) | Constant, j=1,2,...12 | COMPUTE EXPENDITURES to adjust household expen- ditures in different categories to the income constraint SUM(BETA2) = 1 |
| BETA3(j) | Constant, j=1,2,...12 | COMPUTE EXPENDITURES to adjust household expen- ditures 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 Δ 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 in vestments) 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 Δ QCHTXVA1(j) EXO Δ QCHTXVA2(j) | Exogenous time-series j=1,2,...NQR, NQR = number of quarters in the simulation. | TAXVA2 = value added tax rate = "MOMS"EXO Δ QCHTXVA2 is change in the "MOMS-rate". TXVA1 refers to investment goods. EXO Δ QCHTXVA1 is the change in that tax rate. |

| Code | Type | Used in (purpose) |
|------------------|---|--|
| EXOΔQDINVBLD(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 |
| EXOΔQDINVG(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 |
| EXOΔDINVIN(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. |
| EXOΔQDPFOR(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 |
| EXOΔQDPIN(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. |
| EXOΔREALCHLG(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) |
| EXOΔARI(j) | Exogenous time-series NQR = number of j=1,2...NQR quarters in the simulation | The rate of interest. |

| Code | Type | Used in (purpose) |
|------------------|---|---|
| EXOΔRIBWFOR(j) | Exogenous time-series j=1,2...NQR NQR = number of quarters in the simulation | The foreign lending rate of interest |
| EXOΔRIDEPPFOR(j) | Exogenous time-series j=1,2...NQR NQR = number of quarters in the simulation | The foreign deposit rate of interest |
| EXOΔRSUBS(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. |
| EXOΔTXC(j) | Exogenous time-series j=1,2...NYR NYR=number of years in the simulation | Corporate tax-rate. (Tax on firms) |
| EXOΔTXI1(j) | Exogenous time-series j=1,2,...NYR NYR=number of years in the simulation | Income-tax rate (for households) |
| EXOΔTXI2(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 |
| EXOΔTXW(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 Δ 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 EXPXDW EXPXDS | Constants, micro variables parameters | Expected rate of price-change Expected rate of wage-change 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 Δ sim Δ year | Technical variable, needed for simulation | |
| Funds Δ are Δ enough | Constant | Bankparameter |
| F Δ INKOP(i) | Information variable i=1,2,... number of firms | F Δ INKOP is not used in the model. Each firm'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! |
| IMPLP <u>Δ</u> REF | 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 vari- able (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 <u>change in QTOP</u> investment QTOP = potential maximum production level. Production function parameter |
| IO(i, j) | Constant, micro variable i=1...10 j=1...10 | Input-output coeffi- cients, 10x10 matrix. Tells the share of pro- duction in sector j coming from sector i $\sum_{i=1}^{10} IO(i, j) + \text{value}$ 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 coeffi- cients. Submatrix of IO(i, j), which is in- verted 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 vari- able 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 $i=1,2,\dots$ number of firms | For each firm, its current assets last quarter 1976 |
| Kapp1 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 $i=1,2,\dots$ number of firms micro variable | Number of people in each firm. Last quarter 1976 |
| Lamda1 Lamda2 | Constants | Bank-parameters |
| Last Δ TXI2 Δ year | Technical variable needed for simulation | |
| Last Δ year | Technical variable needed for simulation | Last Δ year = 1976. |
| LEFT(i) | Logical vector (start-up variable) $i=1,2,\dots$ 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 |
| MARKETΔITER | 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 equip- ment (potentially pro- duced 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 itera- tions in the labour mar- ket 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 pur- chases 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 <u>all i</u> (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 Δ 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, <u>in fixed (1976) prices</u> |

| 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 <u>current</u> 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 <u>same</u> 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 <u>early</u> 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 frac- tion 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 de- preciation rate of pro- duction 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) |
|--|--|--|
| R1Δ1SΔEXOGENOUS R1Δ1SΔEXOGENOUS = 1 | Logical variable | Means that EXOΔRI will be used, i.e rate of interest will be exogenous |
| RLU | Constant, parameter | Fraction used in HOUSEHOLD INIT to com- pute unemployment com- pensation in proportion to average wage level in the industry. RLU=0.6 (Dec.1982) |
| RSUBSΔCASH(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 |
| RSUBSΔEXTRA(i) | Constant micro variable i=1,2... number of firms parameter | Government subventions to individual firms ex- pressed 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 unem- ployment 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) = <u>individual firm's input share</u> <u>average inputshare in sector</u> See Section 3.3 |
| SKREPA | Constant, parameter | A constant factor by which the probability for the pool of unem- ployed to be selected at a labour market attack is upgraded, as com- pared with the probabil- ity 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 be- tween 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. <u>Fixed</u> (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 quarter 1976 |
| 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 PLANQRE-VISE-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 PLANQRE-VISE-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 VARIABELLISTA4,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 OUTPUT&OPERATIONS.
A
A FREDRIK BERGHOLM ,DEC 1981
A=====
```

APPENDIX A: WORKSPACE VLISTS

VARIABELGRUPP1
EXDARSUBS QINVG EXOAREALCHLG EXOQDINVG GKOFF OMEGAG XIN IMP IO IO2 IO3
OMEGA OMEGABLD QINVBLD QINVIN EXOQDINVIN EXOQDINVBLD QPFOR EXOQ
QDPFOR EXOQDPIN SHARE QDMTEC EXPXDP EXPXDW EXPXDS RET ENTRY EXO
QCHTXVA1 EXOQCHTXVA2 MTEC WSG RSUBSΔEXTRA RSUBSΔCASH NH OMEGAIN
EXOATXC EXOATXI1 EXOATXW EXOATXWG EXOARI EXOARIBWFOR EXOARIDEFFOR
RET ENTRY EXOQDINVBLD

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 QINVLG DELAYΔINV 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 RHOBOK 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 FUNDSAREΔENOU
GH RHODUR ALFA3 ALFA4 BETA1 BETA2 BETA3 SMOOTH SMT BAD REICHBW

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

VARIABELGRUPP5
WGAREF PAREF ORIGMARKET

GRUPP1
TXVA1 TXVA2 RI NWB LIQB POSG LIQBFOR RU QCHRI QTTAX QINPAY LASTΔYEAR T
HISAYEAR FIRSTΔSIMAYEAR 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 **TLAEXPAPRISA76**) or before the initialization (**COEFFAIO**).

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 | <u>RSUBS</u> |

APPENDIX B WORKSPACE MACRO

| | | |
|---|--------------|--|
| 75 | AMANYEAR | Probably redundant (jan 1982) ,but needed for technical reasons. |
| | BLDARATE1 | Growth-rate of investments in residential housing,1976. |
| 1.04215 | BLDARATE2 | Long term growth rate,investments in residential housing.(yearly change) |
| 1.00279 | EXOAGTXVA1 | Value added tax on investments goods.Quarterly series starting with |
| 0 0 0 0 0 | EXOAGTXVA2 | first quarter 1977. |
| 0.15 0.15 0.15 0.171 0.171 | EXOARI | Value added tax .Quarterly series starting with first quarter 1977. |
| 0.0981 0.0986 0.0979 0.098 | EXOARIBWFOR | Rate of interest,quarterly series starting with first quarter 1977. |
| | EXOARIDEPFOR | See appendix A.Quarterly 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 | EXOATXC | 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 | EXOATXI1 | Tax-rate,firms.Yearly series starting with 1977. |
| 0.564 0.58 0.575 0.575 | EXOATXI2 | Income-tax rate ,households.Yearly series starting with 1977. |
| 0.392 0.395 | EXOATXW | Probably redundant,but needed for technical reasons. |
| 0.00055124 0.0005466 | EXOATXWG | Wage-tax rate,Yearly series starting with 1977. |
| 0.288 0.289 0.288 0.294 | | Wage-tax rate,goverment sector.Yearly series starting with 1977. |
| 0.307 0.309 0.309 0.312 | | |

APPENDIX B WORKSPACE MACRO

| | | | | | |
|----------------|----------------|-------------|-------|-------------|---|
| 77 | FIRSTASIMAYEAR | | | | First year of simulation.77 stands for 1977. |
| | GARATE1 | | | | Growth-rate of investments in the Goverment-sector,1976. |
| 1.08732 | | | | | |
| | GARATE2 | | | | Long term growth-rate,investments in the government-sector, |
| 1.03269 | | | | | yearly change. |
| | HISTATXVA2 | | | | |
| | 0.15 | 0.12 | 0.12 | 0.15 | <u>VALUE-ADDED TAX,"moms".</u> |
| | 0.15 | 0.15 | 0.15 | 0.15 | |
| | 0.15 | 0.15 | 0.15 | 0.15 | Rows: Years ,starting with 1974. |
| | 0.15 | 0.15 | 0.171 | 0.171 | Columns: Quarters . |
| | HOURSAPERAYEAR | | | | |
| 1600 | | | | | Average number of working hours per year,1976.Roughly. |
| | HUSHALSDEP | | | | |
| 1.133900000E11 | | | | | Household's bank deposits 1976. |
| | IMPLAPRIS | | | | |
| | 88.27192527 | 94.18785677 | 100 | 107.3170732 | <u>YEARLY PRICE-INDEX SERIES,domestic prices.</u> |
| | 84.99043977 | 96.36711281 | 100 | 103.5372849 | |
| | 80.23072889 | 89.77451494 | 100 | 106.6072365 | Rows: Sector 1,2,3,4 (Industrial sectors) |
| | 82.23609535 | 89.78433598 | 100 | 111.8047673 | Columns: Years;1974,1975,1976,1977 |
| | IMPLAPRISAIN | | | | <u>YEARLY PRICE-INDEX SERIES,domestic prices.</u> |
| | 74.98647333 | 90.96869026 | 100 | 111.1604083 | Rows: Sector 5,6,7,8,9,10 |
| | 74.10440123 | 96.87819857 | 100 | 94.06345957 | |
| | 83.47457627 | 85.2672751 | 100 | 108.8657106 | Columns: Years;1974,1975,1976,1977 |
| | 75.1002004 | 87.6252505 | 100 | 105.511022 | |
| | 83.97033657 | 89.50370793 | 100 | 111.8653736 | |
| | 81.640625 | 89.67633929 | 100 | 111.1049107 | |

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08
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APPENDIX B WORKSPACE MACRO

Value added shares, from input-output matrix 1976.

| | | |
|--|--|---|
| IMPLPAREF | | Value added share = 1 - inputshare.10 sectors. (percentage-figures). |
| 27.18 40.38 44.34 30.91 60.26 58.35 100 55.71 65.7 56.54 | | This variable is used in some print-out functions in the MOSES-workspace. |

| | |
|------------------------|---|
| INARATE1 | Growth rate of investments in non-industrial sectors (sector 5,6..10), 1976. |
| 1.08065 | |
| INARATE2 | Long term growth rate of investments in non-industrial sectors, (yearly change). |
| 1.02519 | |
| INITAGROWTH | Growth rate, labour productivity in the 4 industrial sectors (sector 1,2,3,4). Used in function secondary data in the initialization procedure. |
| 0.064 0.056 0.06 0.023 | |

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: | 2890 | 5869 | 1321 | 245 | 94 | 0 | 4192 | 942 | 1943 |
|-------|-------|-------|-------|-------|------|---|-------|------|--------|
| 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 |

1
82
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The 11 remaining columns.Final Demand side of the matrix.

| I076: | 5399 | 0 | 0 | 0 | 380 | 2754 | 12137 | -11478 | 214 | 32933 |
|-------|--------|-------|-------|-------|-------|------|-------|--------|--------|--------|
| 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 Δ 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 |

APPENDIX B WORKSPACE MACRO

| INPUT-OUTPUT coefficients, continued. | | | | | Column 11,12..19 .Final Demand coefficients. | | | |
|---------------------------------------|-----------|------|------|------|--|-------|------|------|
| | IOCOEFF76 | | | | | | | |
| 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 |

78 LASTATX12AYEAR Probably redundant at present (jan 1982).

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

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

LIQB See appendix A. 1976.

4.630900000E10 LIQBFOR See appendix A. 1976.

10924000000 LDN 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 | | Total wage-sum in the goverment-sector.1976 and 1977. | | |
| 5.807200000E10 | 6.994700000E10 | | | |
| NMARKETS | | Number of industrial sectors in the model.(=4) | | |
| 4 | | | | |
| NWB | | See appendix A.1976. | | |
| 7.779457670E10 | | | | |
| POSG | | See appendix A.1976. | | |
| -7.396300000E10 | | | | |
| QCHRI | | Change in rate of interest,last quarter 1976. | | |
| 0.0002 | | | | |
| QINPAY | | See appendix A.Last quarter 1976. | | |
| 3.240000000E10 | | | | |
| QTTAX | | Total tax receipts by the government,last quarter 1976. | | |
| 3.780000000E10 | | | | |
| RI | | Rate of interest,last quarter 1976. | | |
| 0.0979 | | | | |
| RU | | Rate of unemployment,1976. | | |
| 0.016 | | | | |
| SALES76 *) | | | | |
| 2.913290600E10 | 3.788546400E10 | 7.025235800E10 | 6.988083000E10 | Total sales in the 4 industrial sectors, |
| THISΔYEAR | | | | (sector 1,2,3,4) in producer's prices,1976. |
| 76 | | "Year counter" in the model. | | |
| TIM | | | | Total number of working-hours during a |
| 204338800 | 264942430 | 606865110 | 398119570 | 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 . | | |

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85
1

*) 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 TLΔEXPΔPRISΔ76
 on p.12 in this appendix.

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

APPENDIX B WORKSPACE MACRO

```

VAGGRITAXI[[]]V
V R←AGGRITAX Y                    This function estimates income-tax ,in kr.
[1] R←TXI1×Y                      Usage: See function QDI_INIT,subfunction in appendix C.
V

VCOEFFΔIO[[]]V
V COEFFΔIO;S;SUMMA;SUMMAMAT      This function estimates input-output coefficients
[1] S←(13 19)↑I076              from the input-output matrix I076.
[2] SUMMA←+/[1]S
[3] SUMMAMAT←(13 19)ρSUMMA
[4] IOCOEFF76←S÷SUMMAMAT
[5] A 0÷0 GER 1,MASTE KORRIGERAS
[6] IOCOEFF76[;7]←0
V

VTLAEXPΔPRISA76[[]]V
V R←TLAEXPΔPRISA76 N;AR;CYCL;DU;DUM;DUMMY;FUT      This function estimates
[1] A EXPORT-PRICE CHANGES WITH NEW DATA, COVERING PERIOD      future export price-changes.
[2] A 1971:1 THROUGH 1980:2
[3] A OUTPUT IS QUARTERLY CHANGES FROM 1Q-76 UP TO END OF
[4] A SIMULATION = ARG. N. DUR AND NDUR ON THE AVER-
[5] A AGE TREND 1971-76. RAW AND IMED WITH A CYCLE FROM
[6] A 1980:3 AS THE ONE FROM 1975:1
[7] AR←(1↓ρTLAEXP)
[8] FUT←(1+4×N)-(1+AR-22)
[9] CYCL←(16+1↓ρTLAEXP)
[10] DUMMY←(1+(TLAEXPC;1+AR-1]÷TLAEXPC;AR-1))
[11] DUM← 0 22 ↓DUMMY
[12] DU←(4,FUT)ρ((1,FUT)ρ(DUMMY[1;15+CYCL])),[1]((1,FUT)ρ(DUMMY[2;15+CYCL])),[1]((FUT,2)ρ(+/DUMMY[3 4 ;])
÷(AR-1))
[13] DUC;FUT]←DUC;FUT]×2÷3
[14] ATEMPORARY CHANGE 4/12 1980,TO LOWER FOREIGN INFLATION RATE
[15] R←DUM,DU
V

```


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

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

V

APPENDIX C FUNCTION SIΔINIT

```
V  SIΔINIT NYR:DUMMY
[1]  A DUMMY←ε')COPY SI76 FADATA X FIRMID'
[2]  ALINE ABOVE EXECUTED IN FUNCTION ESTABLISHMENTS
[3]  IUMMY←ε')COPY MACRO'
[4]  DUMMY←ε')COPY FUNCTIONS'
[5]  A
[6]  AFIRMDATA FROM WORKSPACE SI76
[7]  AMACRODATA FROM WORKSPACE MACRO
[8]  AHELPPFUNCTIONS FROM WORKSPACE FUNCTIONS
[9]  A
[10] A
[11] TESTUTSKRIFT←0
[12] ANYR=NUMBER OF YEARS TO RUN THE SIMULATION.
[13] A
[14] A
[15] NQR←4xNYR
[16] ANQR=NUMBER OF QUARTERS
[17] NMARKETS←4
[18] A
[19] A
[20] TAXΔPARAMETERS
[21] PUBLICΔSECTOR
[22] MONETARY
[23] MARKETS
[24] HOUSEHOLDS
[25] ESTABLISHMENTS
[26] AFUNCTION DISPOSEΔVARΔINPUT DELETES VARIABLES FROM WORKSPACE MACRO...
[27] AXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
[28] A SECOND PART OF INITIALIZATION
[29] AXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
[30] ATHE FOLLOWING VARIABLES ARE NEEDED IN THE SECOND PART
[31] AOF THE INITIALIZATION.COPIES ARE TAKEN BECAUSE IT SEEMS LOGICAL
[32] ATO FORBID READING FROM INPUTFILES IN SECOND PART OF
[33] AINITIALIZATION...
[34] GROWTH←INITΔGROWTH
[35] TXVA2COPY←TXVA2
[36] RUACOPY←RU
[37] TXWCOPY←TXW
```

APPENDIX C FUNCTION SIΔINIT (cont.)

```
[38] TXWGCOPY←TXWG
[39] QINPAYCOPY←QINPAY
[40] RIACOPY←RI
[41] TXIICOPY←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] DISPOSEΔVARΔINPUT
[46] MARKETSΔDATA
[47] SECONDARYΔDATA
[48] PUBLICΔDATA
[49] MONETARYΔDATA
[50] HOUSEHOLDSΔDATA
[51] A
[52] A
[53] OUTPUTΔOPERATIONS
[54] THIS FUNCTION HANDLES OUTPUT. (UNNECESSARY VARIABLES ARE DELETED).
[55] 'TESTUTSKRIFT2'
```

v

APPENDIX C FUNCTION TAXΔPARAMETERS

```

      ▽ TAXΔPARAMETERS
[1]  ▽ VARIABLES IN WORKSPACE MACRO WHICH IS FINAL OUTPUT FROM INITIALIZATION:
[2]  ▽ TXVA1, TXVA2
[3]  ▽
[4]  ▽ OTHER VARIABLES IN TAXΔPARAMETERS WHICH WILL BE FINAL
[5]  ▽ OUTPUT FROM INITIALIZATION:
[6]  ▽ ALL EXO-VARIABLES TO THE LEFT OF '+' BELOW AND TXI3
[7]  ▽
[8]  EXOΔ@CHTXVA1+NQR↑DIFF EXOΔ@TXVA1
[9]  EXOΔ@CHTXVA2+NQR↑DIFF EXOΔ@TXVA2
[10] EXOΔTXC+NYR CONTINUE1 EXOΔTXC
[11] EXOΔTXI1+NYR CONTINUE1 EXOΔTXI1
[12] EXOΔTXW+NYR CONTINUE1 EXOΔTXW
[13] EXOΔTXWG+NYR CONTINUE1 EXOΔTXWG
[14] TXI3+1.6
      ▽
```

APPENDIX C FUNCTION PUBLICSECTOR

```
V PUBLICSECTOR:ALG;QLG;WAGES;RATE1;RATE2;QCHLG
[1]  A
[2]  A VARIABLES IN PUBLICSECTOR WHICH WILL BECOME
[3]  A FINAL OUTPUT FROM ININITIALIZATION:
[4]  A OMEGAG,@INVG,EXOΔQDINVG,EXOΔRSUBS,@WG,WG,LG,WGΔREF
[5]  A GKOFF,EXOΔREALCHLG
[6]  A
[7]  A
[8]  OMEGAG+10↑IOCOEFF76[;13]
[9]  INVG+IO76[14;13]
[10]  RATE1+GARATE1
[11]  RATE2+GARATE2
[12]  A RATE1=YEARLY PERCENTAGE CHANGE IN INVG,RATE2=TREND CHANGE
[13]  ALG+TIMΔOFF÷HOURSΔPERΔYEAR
[14]  A
[15]  WAGES+2ρ0
[16]  WAGES[1]+LONΔOFF[1]÷ALG[1]
[17]  WAGES[2]+LONΔOFF[2]÷ALG[2]
[18]  A
[19]  QLG+(4×(ρALG))ρ0
[20]  QLG+MAKEQUARTERS ALG
[21]  A RESULT FROM MAKEQUARTERS:QLG=
[22]  A AVERAGE LABOUR FORCE IN EACH QUARTER,QLG(1)=
[23]  A 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]  A ATTEMPT TO MODIFY GOVERNMENT DEMAND FOR LABOUR DUE TO
[29]  A FICTIOUS LABOUR-FORCE IN THE MODEL...
[30]  A (GOVERNMENT LABOUR+INDUSTRY LABOUR)÷(TOTAL LABOUR FORCE)=1.7÷4.1 MILLION PEOPLE
[31]  A THAT IS: FICTIOUS LABOURFORCE=1.7 MILL. PEOPLE IS
[32]  A APPROXIMATELY 0.4×TOTAL LABOUR FORCE.
[33]  A THAT'S WHY DEMAND IS MULTIPLIED WITH 0.4...
[34]  A FREDRIK B
[35]  A
[36]  @WG+WAGES[1]+0.375×(WAGES[2]-WAGES[1])
[37]  WG+WAGES[1]
```


APPENDIX C FUNCTION PUBLIC Δ SECTOR (cont.)

```
[38]    A
[39]    QINVG+(0.25*INVG*1000000)*RATE1*(1.5+4)
[40]    AQUARTER1: RATE1*(-2.5+4)
[41]    AQUARTER2: RATE1*(-1.5+4)
[42]    AQUARTER3: RATE1*(0.5+4)
[43]    AQUARTER4: RATE1* 1.5+4)
[44]    ASUM = (APPROX.) 4 ,WHICH MEANS THAT SUM(QINVG)=INVG
[45]    EXD $\Delta$ QDINVG+(NQR $\rho$ (RATE2*(1+4)))-1
[46]    EXD $\Delta$ RSUBS+NYR CONTINUE2 RSUBS
[47]    GKOFF+(10*6)*(10+1076[;11]) $\neq$ (WG*LG)
[48]    A
[49]    WG $\Delta$ REF+WG
      v
```

APPENDIX C FUNCTION MARKETS

```

▽  MARKETS; PDOM; MΔPRICE
[1]  AFINAL OUTPUT FROM THIS FUNCTION:
[2]  AXIN, IO, IO2, IO3, OMEGA, OMEGABLD, OMEGAIN, IMP,
[3]  AQINVBLD, QINVIN, EXOΔQDINVIN, EXOΔQDINVBLD,
[4]  AQPDOM, QDPDOM, EXOΔQDPIN, PΔREF, QPFOR, EXOΔQDPFOR
[5]  A
[6]  AOUTPUT TO FUNCTION HOUSEHOLDSΔDATA:
[7]  AQDPIN, QDPFOR
[8]  A
[9]  A
[10] A
[11] A
[12] A
[13]  IMP←10ρ0
[14]  XIN←6ρ0
[15]  XINC[3]←0
[16]  XINC[1,2,4,5,6]←I076[5,6,8,9,10;18]÷I076[14;5,6,8,9,10]
[17]  AXIN=EXPORT SHARES IN SECTORS OUTSIDE OUR 4 MARKETS
[18]  SWEDISHΔDEMAND←I076[10;21]-(I076[10;20]+I076[10;19]+I076[10;18])
[19]  ASWEDISHΔDEMAND+PRODUCTION(INCL. IMPORTS)-(DIFF+IMPORTS+EXPORTS).
[20]  ANOTE THAT IMPORTS IS STORED WITH NEGATIVE SIGN IN I076...
[21]  A
[22]  IMP←(I076[10;19])÷SWEDISHΔDEMAND
[23]  AIMP= IMPORT-SHARE OF SWEDISH CONSUMER'S DEMAND ...
[24]  AIMP=IMPORTS VECTOR FOR MARKETS 1,2,..10
[25]  A
[26]  A
[27]  A
[28]  IO←I0COEFF76[10;10]
[29]  IO2←I0COEFF76[4;4+16]
[30]  IO3←I0COEFF76[4+16;4+16]
[31]  OMEGA←10↑I0COEFF76[16]
[32]  OMEGABLD←10↑I0COEFF76[14]
[33]  OMEGAIN←10↑I0COEFF76[15]
[34]  A
[35]  A
[36]  A
[37]  A
```

APPENDIX C FUNCTION MARKETS (cont.)

```
[38] INVBLD←I076[C14;14]
[39] INVIN←I076[C14;15]
[40] QINVBLD←(0.25×INVBLD×1000000)×BLDARATE1*(1.5÷4)
[41] QINVIN←(0.25×INVIN×1000000)×INARATE1*(1.5÷4)
[42] EXOΔQDINVIN← $1+(NQR\rho(INARATE2*(1÷4)))$ 
[43] EXOΔQDINVBLD← $1+(NQR\rho(BLDARATE2*(1÷4)))$ 
[44] A
[45] A
[46] A
[47] A HISTATXVA2[YEARS;QUARTERS] YEAR=1,2,3,4 YEAR 1=1974
[48] A PCMARKETS;YEARS]YEAR=1,2,3,4
[49] P←IMPLAPRIS,[1]IMPLAPRISAIN
[50] PDOM←P DIV8 1-0.25×+/HISTATXVA2[C;4;]
[51] ENS PC;3]=100
[52] A QPFOR ESTIMATED FROM VARIABLE EXPORTAPRIS IN
[53] A OLD INITIALIZATION (BEFORE JULY 1980)...
[54] QPFOR← 101.4 100.8 102.1 101
[55] QDPFOR←(TLAEXPAPRISA76 NYR)[C;1]
[56] EXOΔQDPFOR← 0 1 ↓TLAEXPAPRISA76 NYR
[57] A
[58] A THOMAS LINDBERG HAS MADE THE FUNCTION TLAEXPAPRISA76
[59] A WHICH YIELDS QUARTERLY EXPORTPRICE-CHANGES...
[60] A
[61] A
[62] QPDOM←PDOM[C;3,4]+.x 0.625 0.375
[63] QDPDOM← $1+(PDOM[C;4]÷PDOM[C;3])*(1÷4)$ 
[64] QDPIN← $1+((IMPLAPRISAIN[C;4]÷IMPLAPRISAIN[C;3])*(1÷4))+ (HISTATXVA2[C;4]-HISTATXVA2[C;3])$ 
[65] MΔPRICE←(6.4×(ρIMPLAPRISAIN)[2])ρ0
[66] J←1
[67] ST:→(J=7)/SL
[68] MΔPRICE[J;J]←MAKEQUARTERS IMPLAPRISAIN[J;J]
[69] J←J+1
[70] →ST
[71] SL:
[72] MΔPRICE←(0,11)↓MΔPRICE
[73] EXOΔQDPIN←NQR CONTINUE2((RELDIFF MΔPRICE),TRENDM)
[74] PAREF←PDOM[C;3]
```

v

APPENDIX C SUBFUNCTION MONETARY AND HOUSEHOLDS

```
VMONETARY[[]]
▽ MONETARY
[1]  A VARIABLES FROM WORKSPACE MACRO WHICH WILL REMAIN
[2]  A UNCHANGED AND WHICH WILL BECOME FINAL OUTPUT FROM
[3]  A INITIALIZATION: RI,LIQB,POSG,LIQBFOR
[4]  A OTHER VARIABLES WHICH WILL
[5]  A BECOME FINAL OUTPUT FROM INITIALIZATION: ALL EXO-VARIABLES HERE
[6]  A
[7]  EXOARI←NQR CONTINUE1 EXOARI
[8]  EXOARIBWFOR←NQR CONTINUE1 EXOARIBWFOR
[9]  EXOARIDEPFOR←NQR CONTINUE1 EXOARIDEPFOR
```

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

APPENDIX C FUNCTION ESTABLISHMENTS

```
V ESTABLISHMENTS;R;F;ALPHA;SCALE;RATIO;RATIO1;RATIO2;HELP;FLAG;DUMMY
[1]  €')COPY SI76 X FADATA FIRMID LIST RMARKET'
[2]  AFIRM-VARIABLES FROM WORKSPACE SI76.
[3]  A
[4]  A
[5]  AINPUT FROM FUNCTION MARKETS:IO (INPUT-OUTPUT-MATRIX)
[6]  AINPUT FROM ISTARTXX-FUNCTION: SYNTHAFIRMS
[7]  A
[8]  A
[9]  AOUTPUT FROM THIS FUNCTION:
[10] AMARKET,P,QP,DP,W,QW,DW,S,QS,DS,Q,QQ,DQ,
[11] AL,EXPDP,EXPDS,EXPDW,HISTDP,HISTDS,HISTDW,
[12] AHISTDPDEV2,HISTDWDEV2,HISTDSDEV2,MHIST,CHM
[13] AVA,QIMQ,QVA,DVA,M,AMAN,STO,IMSTO,
[14] AQTOP,TEC,QINV,QINVLG,DELAYAINV,K1,K1BOOK,K2,BW,
[15] AQTDIV,RSUBSACASH,RSUBSAEXTRA,RES,INVEFF,RESMAX,BETA,
[16] AIMBETA,TMINV,BIG,SMALL,IMBIG,IMSMALL,FAINKOP,BRINKOP,
[17] ASHARE,X,ORIGMARKET,LEFT
[18] A
[19] A
[20] A
[21] AINFORMATION ABOUT INDATA:
[22] AX IS FIRM-DATA.
[23] AFADATA IS INDATA ABOUT FIRM-GROUPS.
[24] AX IS A MATRIX WITH FIRST COMPONENT= FIRM
[25] AND SECOND COMPONENT= VARIABLE (SALES,LABOUR,ETC...).
[26] AX CONSISTS MAINLY OF DATA FOR THE YEAR 1976.
[27] A
[28] A
[29] A REDUCTION ON LIST
[30] AFIRMS WITH INCONSISTENT VARIABLES ARE OMITTED .
[31] L0:F+FIRMIDC(XC;1]€LIST)/\pXC;1]]
[32] NAMNAMARKET+RMARKETC(XC;1]€LIST)/\pXC;1]]
[33] ALPHA+(+/XC(XC;1]€LIST)/\pXC;1]; 7 12]]+FADATACF;15]
[34] A CHECK ON ALPHA
[35] →(0=pFLAG+(1<ALPHA+.xF°.=(\Γ/F)/\Γ/F)/L2
[36] HELP←\0
[37] A OLD: L1:HELP←HELP,F\1↑FLAG
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
[38] L1:HELP←HELP,ALPHA\|/ALPHAC((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+XC(XC;1]←LIST)/\ρXC;1];]
[44] A
[45] A
[46] A
[47] A R=NUMBER OF REAL FIRMS.
[48] MARKET=VECTOR WITH MARKET NUMBERS FOR EACH FIRM,
[49] A FOR EXAMPLE: 1 1 1 2 1 3 1 4 1 4 ...ETC.
[50] A MARKET=VECTOR WITH MARKET-NUMBERS FOR SYNTHETIC FIRMS.
[51] A
[52] MARKET←SYNTHAFIRMS DUP\4
[53] MARKET←NAMNMARKET,MARKET
[54] R←1↑ρX
[55] A
[56] 'SIZE-UTSKRIFT 2'
[57] ←')SIZE'
[58] A
[59] A
[60] A
[61] A SETTING SCALE FOR SYNTHETIC FIRMS:
[62] SCALE←\0
[63] SCALE←SCALE,SYNTHAFIRMSC1]SCALE 0.02
[64] SCALE←SCALE,SYNTHAFIRMSC2]SCALE 0.001
[65] SCALE←SCALE,SYNTHAFIRMSC3]SCALE 0.02
[66] SCALE←SCALE,SYNTHAFIRMSC4]SCALE 0.0001
[67] ENS 1=SYNTHASUM1 SCALE
[68] A
[69] [RL←123476
[70] A[RL YIELDS START-VALUE FOR PSEUDO-RANDOM-NUMBERS:
[71] ATHIS MEANS THAT THE SAME 'RANDOM-NUMBERS' WILL BE
[72] AGENERATED IN DIFFERENT EXECUTIONS ,AS LONG AS ONE
[73] ADOESN'T CHANGE [RL.
[74] A RANDOMNUMBERS OCCUR IN THE FUNCTIONS 'USING' AND 'RANDOMIZE'.
[75] A
[76] A
[77] A
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

[78] A
[79] A
[80] A SALES:
[81] A SUM1, REALASUM1, SYNTHASUM1 ETC. SUM FIRM VARIABLES TO
[82] A MARKET-VARIABLES. A FIRM-VECTOR IS SUMMED UP TO A
[83] A MARKET-VECTOR OF LENGTH 4.
[84] REALASALES+(+/XC; 7 12]*1000000)
[85] RESASALES+SALES\$76-REALASUM1(REALASALES)
[86] SYNTHASALES+SCALE*RESASALES[SMARKET]
[87] S+REALASALES, SYNTHASALES
[88] A
[89] A
[90] A
[91] A LABOUR:
[92] REALALABOUR+XC; 3]
[93] RESALABOUR+(TIM+HOURSAPERAYEAR)-REALASUM1(REALALABOUR)
[94] SYNTHALABOUR+R+S*RATIO+(REALALABOUR+REALASALES)USING S
[95] A
[96] A FUNCTION 'USING' HAS THE FORM 'A USING B'
[97] A FUNCTION 'USING' DOES:
[98] A (1) EXTENDS VARIABLE A WITH RANDOMIZED VALUES FOR
[99] A SYNTHETIC FIRMS.
[100] A (2) THE RANDOMIZED VALUES OF A COVARIES WITH B.
[101] A THE VARIABLES A AND B ARE FIRM-VECTORS...
[102] A
[103] SYNTHALABOUR+SYNTHALABOUR*(RESALABOUR+(SYNTHASUM1 SYNTHALABOUR))[SMARKET]
[104] L+REALALABOUR, SYNTHALABOUR
[105] A
[106] A
[107] A
[108] A EXPORT FRACTIONS (EXPORTS+SALES) :
[109] A XM= EXPORT-SHARE (MARKET-AVERAGE). FROM
[110] A IO-MATRIX. XM IS A VECTOR OF LENGTH=4 .
[111] A SALES IS APPROXIMATED WITH PRODUCTION.
[112] XM+4*0
[113] XM+IO76[4; 18]*IO76[14; 4]
[114] A XM+EXPORTS (MARKETS 1,2,3,4) + PRODUCTION (MARKETS 1,2,3,4)
[115] REALRATIO+(XC; 7]*+/XC; 7 12])
[116] SYNTHARATIO+REALRATIO RANDOMIZE S
[117] RESAEXPORT+(XM*(SUM1 S))-REALASUM1(REALRATIO*REALASALES)

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

[118] SYNTHARATIO←SYNTHARATIO×(RESΔEXPORT÷(SYNTHASUM1(SYNTHARATIO×SYNTHASALES))) [SΔMARKET]
[119] X←REALΔRATIO, SYNTHARATIO
[120] 'TEST PA EXPORTANDEL: X>0.95
[121] (X<0)∨(X>0.95)
[122] X←0∩0.95∪X
[123] A
[124] A
[125] A
[126] A
[127] A PRICES
[128] P←(ρMARKET)ρ100
[129] A
[130] A
[131] A INVENTORIES
[132] A RATIO=ACTUAL STOCK-RATIO=STOCK÷SALES
[133] RATIO←(XC;48]÷100) USING S
[134] STO←(S÷P)×RATIO
[135] A RATIO1=NORMAL LEVEL OF STOCK-RATIO
[136] RATIO1←(XC;50]÷100) USING RATIO∩0.01
[137] A 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/∖ρBIG]←(HELP←(RATIO<(1-Δ)×RATIO1))/(2×RATIO1)-RATIO
[141] BIG←0∩0.5∪BIG
[142] SMALL←HELP/∖ρBIG]←(HELP←(RATIO>(1+Δ)×RATIO1))/(2×RATIO1)-RATIO
[143] SMALL←0∩SMALL
[144] AK3ΔFINISH←S×RATIO-RATIO1
[145] A THAT WAS PRODUCT INVENTORIES. NEXT IS INPUT GOODS INVENTORIES.
[146] A
[147] A INPUTRATIO=(PURCHASES OF RAW MATERIALS)÷SALES
[148] INPUTRATIO←(XC;17]÷+/XC; 7 12] USING S
[149] A
[150] RATIO1←(XC;44]÷100) USING INPUTRATIO
[151] A RATIO1=ACTUAL STOCK-RATIO.
[152] RATIO2←(XC;46]÷100) USING RATIO1∩0.01
[153] A RATIO2= NORMAL STOCK LEVEL.
[154] K3ΔIMEI←S×INPUTRATIO×RATIO1
[155] IMBIG←RATIO1∩(1+Δ)×RATIO2
[156] IMSMALL←RATIO1∪(1-Δ)×RATIO2
[157] IMBIG←HELP/∖ρIMBIG]←(HELP←(RATIO1<(1-Δ)×RATIO2))/(2×RATIO2)-RATIO1

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
[158] IMBIG←0|0.5|IMBIG
[159] IMSMALL←HELP/|ρ|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] ρIMSTO IS A FIRM×PRODUCT-MATRIX (=FIRM×10-MATRIX)
[164] ρMULT7 MULTIPLIES A MATRIX WITH A COLUMN-VECTOR.
[165] ρ
[166] ρM MULT7 V ρM=MATRIX M(I,J) V=VECTOR V(I)
[167] ρRESULT: A MATRIX WITH ELEMENTS M(I,J)×V(I)
[168] ρ
[169] ρ NEXT: SPREAD K3ΔIMED ACROSS SECTORS USING IO-MATRIX
[170] IMSTO←((((ρIO)DIV7+|ρIO|)CMARKET;J)MULT7 K3ΔIMED)÷100
[171] ρ NOTE: WE HAVE DIVIDED BY 100 ASSUMING BASE YEAR=START YEAR.
[172] ρIMSTO SHOULD BE IN FIXED PRICES, THUS DIVISION BY 100
[173] ρ, WHICH IS THE PRICEINDEX FOR 1976
[174] ρ THE IDEA BEHIND THAT COMPUTATION WAS AS FOLLOWS:
[175] ρ (ρIO)C1;J LOOKS LIKE AC1,1J, . . . . ., AC1,10J, WHERE
[176] ρ AC1,JJ=FRACTION OF GROSS PRODUCTION IN SECTOR 1 ACCTD FOR BY
[177] ρ INPUTS FROM SECTOR J.
[178] ρ THEN AC1,JJ÷SUM ON J OF AC1,JJ = FRACTION OF INPUT GOODS
[179] ρ COMING FROM SECTOR J
[180] ρ
[181] ρ
[182] ρ
[183] ρ
[184] ρ COMPUTATION OF INPUT GOODS PURCHASES
[185] REALΔINP←XC;17]×1000000
[186] ρCURR←S+ΔK3ΔFINISH
[187] ρ
[188] ρCURR=PRODUCTION IN CURRENT PRICES: SALES+CH. IN STOCK
[189] ρHELP (BELOW) IS TOTAL INPUT CONSUMPTION BY THE
[190] ρSYNTHETIC FIRM UNITS PER SECTOR (1,2,3,4).
[191] ρ
[192] ρHELP←(+/(ρIO)C\4;]MULT7 SUM1 ρCURR)-(REALASUM1(REALΔINP-R↑ΔK3ΔIMED))
[193] ρHELP←HELP+SYNTHASUM1(R↓ΔK3ΔIMED)
[194] ρ HELP=TOTAL INPUT GOODS PURCHASES BY THE SYNTHETIC UNITS (ρHELP=4)
[195] ρ IN EACH SECTOR
[196] ρ INP=INPUT GOOD PURCHASES FOR EACH PRODUCTION UNIT, SUMMED OVER SECTORS
[197] ρ ρINP = ρMARKETS
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

```
[198] INP+REALΔINP,(R+S×INPUTRATIO)×(HELP+(SYNTHASUM1 R+S×INPUTRATIO))[SAMARKET]
[199] A
[200] A QIMQ=INP SPREAD ACROSS THE 10 SECTORS, JUST LIKE IMSTO ABOVE.
[201] QIMQ+(((QIO)DIV7+/(QIO)[MARKET;])MULT7 INP)÷100
[202] QIMQ+QIMQ÷4
[203] A SAME COMMENT AS APPLIES TO THE DEFLATION OF IMSTO
[204] A VALUE ADDED
[205] VA+QCURR+ΔK3AIMED-INP
[206] DISPOSE1ΔFIRMS
[207] A
[208] A CONSUMPTION=INP-ΔK3AIMED=PURCHASES-CHANGE IN STOCK
[209] A VALUE ADDED=PRODUCTION-CONSUMPTION
[210] A
[211] RESΔFORVF+SYNTHASUM1(R+VA)
[212] FORVF+SUM1(VA)
[213] REALΔFORVF+R+VA
[214] SYNTHΔFORVF+R+VA
[215] A FORVF, REALΔFORVF ETC. ARE USED IN FUNCTION CONTROLS BELOW...
[216] A
[217] A
[218] A
[219] A
[220] A
[221] A WAGES
[222] REALΔKRΔLON+XC;5]×1000000
[223] REALΔW+REALΔKRΔLON÷(R+L)
[224] SYNTHΔW+R+S×(RATIO+(REALΔKRΔLON÷REALΔSALES)USING L)÷L
[225] RESΔKRΔLON+LON-REALΔSUM1(REALΔW×(R+L))
[226] SYNTHΔW+SYNTHΔW×(RESΔKRΔLON÷(SYNTHASUM1(R+L)×SYNTHΔW))[SAMARKET]
[227] W+REALΔW,SYNTHΔW
[228] SYNTHΔKRΔLON+SYNTHΔW×(R+L)
[229] DW+(1+(X/XC; 2 5])÷X/XC; 3 4])USING W
[230] QDW+DW÷4
[231] QW+((Q((2,(PW))ρ(W,W+DW)))+,X(0.625,0.375))
[232] DVA+DS+(1+(X/XC; 7 12])÷X/XC; 6 11])USING DW
[233] QS+((Q((2,(PS))ρ(S,S+DS)))+,X(0.625,0.375))÷4
[234] QVA+VA×(1+DVA÷4)÷4
[235] A
[236] A
[237] A
```

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

[238] a
[239] a MARGINS
[240] $M \leftarrow 1 - W \times L \div VA$
[241] $M75 \leftarrow 1 - (XC; 4] \div + / XC; 6 11]) \times R \uparrow S \div VA$
[242] a M75=PROFIT MARGIN 1975.
[243] $HELP \leftarrow (R \uparrow M) - M75$
[244] $MHIST \leftarrow 0.5 \times (2 \times M) - CHM \leftarrow HELP$ USING DS
[245] a VARIABLES FOR FUNCTION CONTROL BELOW
[246] a
[247] $OVERSKOTT \leftarrow SUM1(M \times VA)$
[248] $SYNTHAOVERSKOTT \leftarrow R \downarrow (M \times VA)$
[249] $REALAOVERSKOTT \leftarrow R \uparrow (M \times VA)$
[250] $DP \leftarrow ((R \uparrow DS) - XC; 26] \div 100)$ USING DS
[251] $QP \leftarrow ((\rho((2, (\rho P)) \rho(P, P + DP))) + .x(0.625, 0.375))$
[252] a QUANTITIES
[253] $Q \leftarrow (S + \Delta K3 \Delta FINISH) \div P$
[254] $QQ \leftarrow (QS + \Delta K3 \Delta FINISH \div 4) \div QP$
[255] $DQ \leftarrow DS - DP$
[256] a SOME VARIABLES ADDED 27 OCT 1980...
[257] $FAINKOP \leftarrow (INP - \Delta K3 \Delta IMED) \div (100 \times Q)$
[258] a PURCHASING-SHARE PER FIRM =FAINKOP
[259] $BRINKOP \leftarrow 4 \uparrow (+ / [1] IO)$
[260] a PURCHASING SHARE PER MARKET =BRINKOP
[261] $SHARE \leftarrow FAINKOP \div BRINKOP [MARKET]$
[262] a SHARE IS USED IN THE MODEL IN THIS WAY:
[263] a $SHARE \times (MARKET \text{ AVERAGE INPUT SHARE}) =$
[264] a THE INDIVIDUAL INPUT SHARE FOR EACH FIRM.
[265] a $MARKET \text{ AVERAGE INPUT SHARE} = BRINKOP [1], BRINKOP [4]$
[266] a
[267] a
[268] a
[269] a
[270] a
[271] a A21 AND A22
[272] $A22 \leftarrow (- / XC; 30 32] \div 100)$ USING A21 $\leftarrow (- / XC; 32 26] \div 100)$ USING M
[273] $A21 \leftarrow 0 \uparrow 0.5 [A21$
[274] $A22 \leftarrow 0.025 \uparrow 0.5 [A22$
[275] a MUST ENSURE A22 > 0 SO TEC CAN BE COMPUTED..
[276] a AMAN--BASED ON APPROXIMATION GIVEN IN INDUSTRIKONJUNKTUREN PAPER
[277] $AMAN \leftarrow \rho(3, \rho L) \rho(L \times A21 \div 1 + A21) \div 3$

APPENDIX C FUNCTION ESTABLISHMENTS (cont.)

[278] A EXPECTATIONS...NOTE THAT EXPDW SHOULD BE FIXED
[279] HISTDS+EXPDS+(1+(+/XC; 8 13))÷+/XC; 7 12)USING DS
[280] HISTDSDEV2+(HISTDSDEV-0.02 BETWEEN(ρHISTDS)ρ0.02)*2
[281] HISTDP+EXPDP+((R+EXPDS)-XC; 28)÷100)USING EXPDS
[282] HISTDPDEV2+(HISTDPDEV-0.02 BETWEEN(ρHISTDP)ρ0.02)*2
[283] HISTDW+EXPDW+EXPDS-EXPDP
[284] HISTDWDEV2+(HISTDWDEV-0.02 BETWEEN(ρHISTDW)ρ0.02)*2
[285] A PRODUCTION FUNCTION PARAMETERS.
[286] QTOP+(QQ×1+A21+A22)÷1-RES+(ρQQ)ρ0.5×RESMAX+0.2
[287] TEC+1×(A22÷1+A21+A22)×QTOP÷L
[288] ENS(QQ-QFR1 L)<0.5
[289] A FINANCIAL VARIABLES
[290] K1BOOK+S×((÷/FADATACF; 5 15))USING S)
[291] K1+S×((÷/FADATACF; 26 15))USING K1BOOK)
[292] K2+K1BOOK×(((÷/FADATACF; 1 2 4 6))÷FADATACF; 5))USING K1)
[293] A+K1+K2+K1BOOK×((÷/FADATACF; 3 5))USING S)
[294] BW+K1BOOK×(((÷/FADATACF; 8 9 10))÷FADATACF; 5))USING K1)
[295] BAD+(ρBW)ρ0
[296] QTDIV+SUM2 0.25×K1BOOK×((÷/FADATACF; 20 5))USING M)
[297] INVEFF+QTOP×QP÷K1
[298] QINV+S×(((+/XC; 21 24))÷+/XC; 7 12))USING S)÷4
[299] QINVLAG+QINV×1+(VA AVG1 IP DDIV 4)CDUR+3)
[300] TMINV+ 2 1 1 0.5
[301] DELAYΔINV+Q(3, ρQINV)ρQINV MULT1(4×TMINV)÷3
[302] RSUBSACASH+RSUBSAEXTRA+L×0
[303] A
[304] A
[305] CONTROLS
[306] A
[307] A
[308] A CONSISTENCY-CONTROLS ARE MADE IN FUNCTION CONTROLS
[309] A
[310] IOAMATRIX
[311] A IO-MATRIX IN FLows IS WRITTEN OUT
[312] A
[313] DISPOSE2ΔFIRMS
[314] A THIS FUNCTION DELETES VARIABLES OF NO FURTHER USE
[315] A
[316] A SOME VARIABLES NEEDED FOR NULLIFY AND SHRINK
[317] LEFT+MARKET=ORIGMARKET+MARKET
[318] 'SIZEUTSKRIFT 3'
[319] ←')SIZE'
[320] A
V

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

```

V  CONTROLS;DIFF
[1]  A
[2]  ENS(LON+OVERSKOTT)=FORVF
[3]  ENS LON=(REALASUM1 REALAKRALON)+(SYNTHASUM1 SYNTHAKRALON)
[4]  ENS OVERSKOTT=(REALASUM1 REALAOVERSKOTT)+(SYNTHASUM1
SYNTHAOVERSKOTT)
[5]  ENS FORVF=(REALASUM1 REALAFORVF)+(SYNTHASUM1 SYNTHAFORVF)
[6]  DIFF+SALES76-(SUM1 S)
[7]  ENS DIFF<1.000000000E-6 x(SUM1 S)
[8]  ENS(TIM+HOURSΔPERΔYEAR)=(REALASUM1 REALALABOUR)+SYNTHASUM1
SYNTHALABOUR
[9]  ENS(REALAFORVF-(REALAKRALON+REALAOVERSKOTT))<1.000000000E-7
[10] ENS(SYNTHAFORVF-(SYNTHAKRALON+SYNTHAOVERSKOTT))<1.000000000E-7
[11] ENS(SYNTHASUM1(SYNTHAW×SYNTHALABOUR))=SYNTHASUM1(SYNTHAKRALON)
[12] ENS(REALASUM1(REALAW×REALALABOUR))=REALASUM1(REALAKRALON)
[13] ENS(SYNTHASUM1((R↓M)×SYNTHAFORVF))=SYNTHASUM1(SYNTHAOVERSKOTT)
[14] ENS(REALASUM1((R↑M)×REALAFORVF))=REALASUM1(REALAOVERSKOTT)
[15] ENS X≥0
[16] ENS X≤1
[17] ENS((SUM1 VA)÷(SUM1 QCURR))=(1-BRINKOPE[4])
[18] ENS((SUM1(INP-ΔK3ΔIMED))÷(SUM1 QCURR))=(BRINKOPE[4])
[19] DIFF+(XM×SUM1 S)-(SUM1 X×S)
[20] ENS DIFF<(0.01×SUM1 S)
V
```

Note: The subfunction ENS is documented in Appendix D.

APPENDIX C SUBFUNCTION IOAMATRIX

(subfunction to ESTABLISHMENTS)

(Consistency Control is performed)

```

V IOAMATRIX;MA;PROD;CHAR;RESIDUAL;SWEDISHDEMAND
[1] A THIS FUNCTION DOES:
[2] A (1) AN INPUT-OUTPUT MATRIX FOR THE SWEDISH
[3] A ECONOMY IN FLOWS IS PRINTED OUT.
[4] A THE INITIALIZED VARIABLES ARE USED.
[5] A (2) VERTICAL SUM SHOULD BY DEFINITION BE
[6] A EQUAL TO HORIZONTAL SUM.THE UNEXPLAINED
[7] A RESIDUAL IS PRINTED OUT.
[8] A
[9] A
[10] A
[11] 'DO YOU WANT THE INPUT-OUTPUT-MATRIX PRINTED OUT?'
[12] 'YES OR NO : '
[13] CHAR=0
[14] ->(^(CHAR[1 2]='NO'))/0
[15] A
[16] MA←I076
[17] PROD←SUM1(Q×100)
[18] MAC;14]←(IOCOEFF76[;14],C111)MULT8(PROD÷10*6)
[19] A THE FIRST 4 COLUMNS IN MA ARE REPLACED WITH FLOWS
[20] A COMING FROM INITIALIZATION.
[21] A COLUMN 5..10 UNCHANGED.
[22] MAC\13;11]←(GKOFF×WG×LG÷10*6),(0,0,0)
[23] MAC14;11]←+/[1]MAC\13;11]
[24] MAC\13;12]←(HH76×4×QDIAINIT2÷10*6),(0,0,0)
[25] A QDIAINIT2 YIELDS THE HOUSEHOLD'S DISPOSABLE INCOME
[26] MAC14;12]←+/[1]MAC\13;12]
[27] MAC;13]←(OMEGAG×QINVG×4÷10*6),(0,0,0,4×QINVG÷10*6)
[28] MAC;14]←(OMEGABLD×QINVBLD×4÷10*6),(0,0,0,QINVBLD×4÷10*6)
[29] MAC;15]←(OMEGAIN×QINVIN×4÷10*6),(0,0,0,4×QINVIN÷10*6)
[30] MAC;16]←(OMEGAX×(+/QINV)×4÷10*6),(0,0,0,4×(+/QINV)÷10*6)
[31] A
[32] MAC\13;17]←(+/(AK3AIMED+AK3AFINISH)÷10*6)×IOCOEFF76[;13;17]
[33] MAC14;17]←+/[1]MAC\13;17]
[34] A
[35] MAC1 2 3 4 ;18]←(SUM1(X×S))÷10*6
[36] MAC14;18]←+/[1]MAC\13;18]
[37] A
```

APPENDIX C SUBFUNCTION IOAMATRIX (cont.)

```

[38] SWEDISHDEMAND+MAC\10;\17]
[39] MAC\13;19]+(IMP*SWEDISHDEMAND),(0,0,0)
[40] MAC14;19]+/[1]MAC\13;19]
[41] MAC;19]+(-1)*MAC;19]
[42] A
[43] MAC\13;21]+MAC14;\10],(0,0,0)
[44] MAC14;21]+/[1]MAC\13;21]
[45] A
[46] RESIDUAL+MAC;21]-((+/MAC\10;\20]),(0,0,0),(+/MAC14;\20]))
[47] A
[48] A*****O*****
[49] A
[50]   PW+110
[51] A PAGE WIDTH
[52] 'INPUT-OUTPUT MATRIX FROM INITIALIZATION: '
[53] 80ρ' '
[54] '           1           2           3           4           5           6           7           8           9           10'
[55] 80ρ' '
[56] (8,0)+MAC;\10]
[57] 80ρ' '
[58] '           11           12           13           14           15           16           17           18           19           20           21'
[59] 80ρ' '
[60] (8,0)+MAC;10+\11]
[61] 'ROW 1: RAW MATERIAL SECTOR '
[62] 'ROW 2: INTERMEDIATE GOODS '
[63] 'ROW 3: INVESTMENT GOODS AND CONSUMER DURABLE GOODS'
[64] 'ROW 4: CONSUMPTION GOODS '
[65] 'ROW 5: AGRICULTURE,FORESTRY,FISHING '
[66] 'ROW 6: MINING AND QUARRYING '
[67] 'ROW 7: OIL '
[68] 'ROW 8 : CONSTRUCTION '
[69] 'ROW 9 : ELECTRICITY '
[70] 'ROW 10: OTHER SERVICES '
[71] 'ROW 11: COMMODITY BASED INDIRECT TAXES '
[72] 'ROW 12: VALUE ADDED IN PRODUCER'S PRICES '
[73] 'ROW 13: CORRECTIONS'
[74] 'ROW 14: SUM =PRODUCTION '
[75] 'COLUMN 1,2 THROUGH 10 = CORRESPONDING ROWS '
[76] 'COLUMN 11: GOVERNMENT'S CONSUMPTION '
[77] '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] ^a
[91] ^aMADE BY FREDRIK BERGHOLM DEC 1981.....

∇

APPENDIX C SUBFUNCTION MARKETS-DATA

```
V  MARKETSADATA;TMEXP;TMTARG
[1]  A      output from initialization:All variables below except TMEXP,TMTARG,NPER
[2]  NPER←4
[3]  DUR←3
[4]  MKT←14
[5]  IN←4+16
[6]  A

[7]  RET←1+1.035*(1÷4)
[8]  ENTRY←RET+0.0068÷NPER
[9]  EXPXDP←0.03
[10] EXPXDW←0.07
[11] EXPXDS←0.07
[12] R←0.5
[13] E1←0.1
[14] E2←0
[15] SMP←SMW+SMS+1-2÷1+TMEXP+3
[16] FIP←FIW+FIS+(1-R)×2÷1+NPER×TMEXP
[17] SMT←1-2÷1+TMTARG+3
[18] A

[19] GAMMA←0.1
[20] THETA←0.01
[21] KSI←0.25
[22] SKREPA←50
[23] IOTA←0.5
[24] NITER←9
[25] A

[26] TMSTO←1
[27] A

[28] TMIMSTO←1
[29] A

[30] RHO←1+(1+1÷35)*(1÷4)
[31] RHOBOOK←1+(1.15)*(1÷4)
[32] QDMTEC←1+(1.056 1.03 1.026 1.004)*(1÷4)
[33] A RESMAX←0.2 IS SET IN ESTABLISHMENTS...
[34] LOSS←0.1
[35] RESIDOWN←0.9
[36] WTI←1
[37] A
```

APPENDIX C SUBFUNCTION MARKETS-DATA (cont.)

[38] RW+K2+S
[39] ALFABW+0.075+NPBR
[40] BETABW+1
[41] UTREF+0.85
[42] ELINV+3
[43] RTD+1
[44] A TMINV IS SET IN ESTABLISHMENTS
[45] A

[46] EPS+0
[47] TMX+ 3 3 3 3
[48] TMIMP+ 3 3 3 3
[49] A

[50] RLU+0.6
[51] MAXDP+0.06

v

**APPENDIX C SUBFUNCTIONS PUBLIC-DATA AND
SECONDARY-DATA**

▽ PUBLICADATA
[1] A VARIABLES WHICH WILL BE OUTPUT FROM INITIALIZATION: WSG,RTRANS,T
 STOCURF,TSTOCURM
[2] WSG+WG*LG
[3] RTRANS+0.5
[4] A TSTOCURF IS A MARKET-VECTOR (4 MARKETS). FUNCTION SUM1 TRANSFORMS
 FIRMS-DATA TO MARKET-DATA...
[5] TSTOCURF+SUM1(STO*QP)
[6] TSTOCURM+QP*DOMC(4)*X(SUM1 STO)
▽

▽ SECONDARYADATA;MTECAPERAFIRM
[1] A VARIABLES WHICH WILL BE OUTPUT FROM INITIALIZATION:
[2] A MTEC,LU,QDWIND
[3] A RUACOPY IS A COPY OF RU WHICH COMES FROM INPUTFILE.
[4] A L,QW,QDW,QDMTEC,TEC COMES FROM ESTABLISHMENTS
[5] A GROWTH COMES FROM INPUTFILE (INITAGROWTH=GROWTH)
[6] A LG COMES FROM FUNCTION PUBLICASECTOR
[7] $LU+(LG+SUM2(L))*RUACOPY/(1-RUACOPY)$
[8] $ALG+SUM2 L=WORKING LABOUR FORCE=TOTAL LABOUR FORCE-UNEMPLOYED$
[9] A UNEMPLOYED=R*WORKING LABOUR FORCE'
[10] A WHERE R SHOULD BE UNEMPLOYED÷WORKING LABOUR FORCE
[11] A 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] $MTECAPERAFIRM←TEC DIV1(1-QDMTEC÷((RHO+GROWTH)*(1+4)))$
[14] $MTEC←L AVG1 MTECAPERAFIRM$
[15] A AVG1 YIELDS MARKET-AVERAGES FROM FIRMS-DATA (MTECAPERAFIRM) WEIGH
 TED BY LABOUR-SHARES (L÷SUM L)
[16] ENS 0<MTEC
▽

APPENDIX C SUBFUNCTION MONETARY-DATA

▽ MONETARYADATA
[1] ALL VARIABLES BELOW WILL BE OUTPUT FROM INITIALIZATION
[2] POSGFOR+0
[3] TMFASS+3+12
[4] TMFD+2+12
[5] FI+FASS+(SUM2 X+S)XTMFASS
[6] KAPPA1+0.02
[7] KAPPA2+0.3
[8] RFUND1+0.5
[9] RFUND2+0.25
[10] LAMDA1+0.6
[11] LAMDA2+0.8
[12] MAXQCHRI+0.01
[13] MB+0.015
[14] MAXRIDIFF+0.05
[15] RIAISAEXOGENOUS+1
[16] MINRI+MB
[17] MAXRI+0.25
[18] FUNDSAAREAEENOUGH+0
[19] REDCHBW+0.15

▽

APPENDIX C SUBFUNCTION HOUSEHOLDS-DATA (cont.)

```

V HOUSEHOLDSADATA; PRICECHANGES; DUR
[1] INPUT TO THIS FUNCTION:
[2] AGKOFF, LG, WG, L, QW, QTDIV, LU, QDWIND FROM FUNCTION PUBLICASECTOR, ESTA
    BLISHMENT, SECONDARYADATA
[3] AQPDOM, QDPFOR, QDPIN FROM FUNCTION ESTABLISHMENTS
[4] ARTRANS, RLU, RHO FROM FUNCTION MARKETSADATA
[5] ATXI1, TXW, TXWG, QINPAY, RI (INDIRECTLY) FROM WORKSPACE MACRO
[6] AHH76, WHSUM FROM HOUSEHOLDS...
[7] AXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
[8] AOUTPUT FROM THIS FUNCTION, WHICH WILL BE FINAL OUTPUT FROM INITIAL
    IZATION:
[9] AZ, SAV, NDUR, NDURADUR, NH, WH, WHRA, QPH, QC, CVA, QDCPI, QCPI, QDI
[10] AQSAVHREQ, RHODUR, STODUR, ALFA AND BETA-COEFFICIENTS, SMOOTH , MARKET
    AITER...
[11] A
[12] DUR+3
[13] NDURADUR+11
[14] Z+11
[15] SAV+12
[16] NDUR+(DUR+11)/11
[17] ANDUR, Z, SAV ARE INDEX-VARIABLES...
[18] NH+LG+(SUM2 L)+LU
[19] WH+WHSUM+NH
[20] QDI=INIT
[21] AFUNCTION QDI=INIT IS CALLED TO GIVE A VALUE TO QDI, AND THIS IS TH
    E ONLY PURPOSE OF THIS FUNCTION. QDI=DISPOSABLE INCOME
[22] WHRA+WH+QDI
[23] QPH+QPDOM, 0
[24] AQPH 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
[25] AHAS THE LENGTH 11 DESPITE THIS, FOR THE TIME BEING, WHERE WE WILL H
    AVE A REDUNDANT 0 AT THE END...
[26] QC+(HH76*QDI), 0
[27] QC+(1, QC)QC
[28] QC+QC
[29] AQC AND CVA MUST BE COLUMN-VECTORS FOR TECHNICAL REASONS...
[30] ASEE MOSES-FUNCTION CPI1...
[31] CVA+QC DIV7 QPH
[32] QCPI+CPI1(QPH)
[33] PRICECHANGES+QDPFOR, QDPIN, 0
[34] QDCPI+(PRICECHANGES+.x, QC)/(+/, QC)

```

Note: QDI-INIT is a subfunction listed later on.

APPENDIX C SUBFUNCTION HOUSEHOLDS-DATA (cont.)

```
[36]  A
[37]  RHODUR←RHO
[38]  STODUR←(PHCDUR)×CVACDUR;1]+RHODUR
[39]  A
[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]  A
[47]  MARKETΔITER←3
[48]  AMARKETΔITER 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.

```

      VDISPOSE1AFIRMS[0]V
      V DISPOSE1AFIRMS
[1]  →(TESTUTSKRIFT=0)/START
[2]  'REALRATIO'
[3]  REALRATIO
[4]  'SYNTHARATIO'
[5]  SYNTHARATIO
[6]  'INPUTRATIO'
[7]  INPUTRATIO
[8]  'REALSALES'
[9]  REALSALES
[10] 'SYNTHASALES'
[11] SYNTHASALES
[12] 'SLUT PA TESTUTSKRIFT I DISPOSE1AFIRMS '
[13] START:
[14] A
[15] KILL 'SCALE MAKEQUARTERS'
[16] KILL 'RÅMARKET FIRMID RESALABOUR SYNTHASALES RESASALES RATIO1 RAT
      IO2 INPUTRATIO'
[17] KILL 'REALRATIO SYNTHARATIO RESAEXPORT REALAINP LIST K3AIMED '
[18] ATHIS FUNCTION DELETES VARIABLES AND FUNCTIONS OF NO FURTHER USE.
      V

```

APPENDIX C SUBFUNCTION DISPOSE2-FIRMS

(deletes a number of variables)

This function is called in subfunction ESTABLISHMENTS.

```

      VDISPOSE2AFIRMS[]V
V  DISPOSE2AFIRMS
[1]  +(TESTUTSKRIFT=0)/START
[2]  'SAMARKET'
[3]  SAMARKET
[4]  'A21'
[5]  A21
[6]  'A22'
[7]  A22
[8]  'INP'
[9]  INP
[10] 'QCURR'
[11] QCURR
[12] 'M75'
[13] M75
[14] 'AK3AIMED'
[15] AK3AIMED
[16] 'AK3AFINISH'
[17] AK3AFINISH
[18] 'REALAFORVF'
[19] REALAFORVF
[20] 'SYNTHAFORVF'
[21] SYNTHAFORVF
[22] 'FORVF'
[23] FORVF
[24] 'REALALABOUR'
[25] REALALABOUR
[26] 'SYNTHALABOUR'
[27] SYNTHALABOUR
[28] 'REALAW'
[29] REALAW
[30] 'SYNTHAW'
[31] SYNTHAW
[32] 'REALAOVERSKOTT'
[33] REALAOVERSKOTT
[34] 'SYNTHAOVERSKOTT'
[35] SYNTHAOVERSKOTT
[36] 'OVERSKOTT'
[37] OVERSKOTT
[38] 'REALAKRALON'
[39] REALAKRALON
[40] 'SYNTHAKRALON'
[41] SYNTHAKRALON
[42] 'LON'
[43] LON
```


APPENDIX C SUBFUNCTION DISPOSE2-FIRMS (cont.)

```
[45] START:
[46] KILL 'X FADATA SAMARKET NAMNAMARKET A21 A22 INP QCURR M75'
[47] KILL 'AK3AIMED AK3AFINISH REALASALES REALAFORVF SYNTHAFORVF FORVF
REALALABOUR SYNTHALABOUR'
[48] KILL 'REALAW SYNTHAW REALAOVERSKOTT SYNTHAOVERSKOTT OVERSKOTT'
[49] KILL 'REALAKRALON SYNTHAKRALON LON SCALE HELP'
[50] KILL 'IOAMATRIX CONTROLS REALASUM1 SYNTHASUM1 DISPOSE1AFIRMS RAND
OMIZE USING QFR1 HISTORY BETWEEN'
[51]   a
[52]   aTHIS FUNCTION DELETES FUNCTIONS AND VARIABLES OF NO FURTHER USE..
```

∇

```
      VKILLCQIV
∇ KILL NAMES; POS; DUMMY
[1] L: →(0=ρNAMES)/0
[2] POS+NAMES; ' '
[3] DUMMY+DEX(POS-1)↑NAMES
[4] NAMES+POS↑NAMES
[5] →L
```

∇

This function is stored in workspace VLISTS.

APPENDIX C SUBFUNCTION DISPOSE-VAR-INPUT

```

V DISPOSEAVARAINPUT[ ]V
  DISPOSEAVARAINPUT;COPARI;COPATXW;COPATXWG;COPARIDEPFOR;
  COPARIBWFOR;COPATXC;COPATXI1
[1]  ATHIS FUNCTION GETS RID OF INPUTVARIABLES FROM
[2]  AFIRST PART OF INITIALIZATION
[3]  A
[4]  COPARIDEPFOR+EXOARIDEPFOR
[5]  COPARIBWFOR+EXOARIBWFOR
[6]  COPARI+EXOARI
[7]  COPATXW+EXOATXW
[8]  COPATXWG+EXOATXWG
[9]  COPATXC+EXOATXC
[10] COPATXI1+EXOATXI1
[11] A
[12] AMACROLIST CONTAINS VARIABLENAMES FOR INPUT-VARIABLES
[13] KILL MACROLIST
[14] EXOARIDEPFOR+COPARIDEPFOR
[15] EXOARIBWFOR+COPARIBWFOR
[16] EXOARI+COPARI
[17] EXOATXW+COPATXW
[18] EXOATXWG+COPATXWG
[19] EXOATXC+COPATXC
[20] EXOATXI1+COPATXI1
[21] AVARIABLES FROM WORKSPACE MACRO HAVE SOMETIMES THE SAME
[22] A NAME AS AN OUTPUT-VARIABLE.SUCH VARIABLES MUST NOT
[23] ABE DELETED BY THE CALL 'KILL MACROLIST'
[24] A
V
```

APPENDIX C SUBFUNCTION QDI-INIT

This function is called in subfunction HOUSEHOLDS DATA

```
V@DIAINIT[[]V
V QDIAINIT;QTWS;QTI;QWTAX;QINTH;QTRANS;QITAX;TXI1
[1] #INPUT TO THIS FUNCTION:
[2] #GKOFF,LG,WG,L,QTDIV,QW,LU FROM PUBLICASECTOR,ESTABLISHMENTS,SECON
DARYADATA,.,#
[3] #RTRANS,RLU FROM MARKETSADATA
[4] #TXI1,TXW,TXWG,QINPAY,RI COME (INDIRECTLY) FROM INPUTFILE MACRO.,
.
[5] #LOCAL COPIES OF TXW,TXWG,...ARE USED...
[6] #NH,WH FROM HOUSEHOLDSADATA
[7] #
[8] QTRANS←(RTRANS×(LG×QWG÷4)×1++/GKOFF)+RLU×0.25×LU×L AVG2 QW×1-
TXWCOPY
[9] QINTH←NH×(RIACOPY-MB)×WH÷4
[10] QTWS←(LG×QWG÷4),SUM2 L×QW÷4
[11] QTWS←QTWS+(0,QINPAYCOPY)
[12] QWTAX←QTWS+.x(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
V
```

APPENDIX C SUBFUNCTION QDI-INIT2

This function is called in subfunction IO-MATRIX.

```

VQDIAINIT2[[]]V
  ZZ←QDIAINIT2;QTWS;QTI;QWTAX;QINTH;QTRANS;QITAX;LU;NH;MB;RTRANS;
  RLU
[1]  A INPUT TO THIS FUNCTION:
[2]  A GKOFF, LG, WG, L, QTDIV, QW, LU FROM PUBLICASECTOR, ESTABLISHMENTS, SECON
  DIARYADATA. . .
[3]  RTRANS←0.5
[4]  RLU←0.6
[5]  MB←0.015
[6]  A 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] A
[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)
V
```

APPENDIX C SUBFUNCTION OUTPUT-OPERATIONS

```

V OUTPUTAOPERATIONS[[]]V
  OUTPUTAOPERATIONS;LIST;TOTLIST
[1]  AOUTPUT FROM INITIALIZATION IS BEING GROUPED:
[2]  AVARIABLEGRUPP1,VARIABLEGRUPP2,,,COME FROM WORKSPACE VLISTS,
[3]  AAND ARE TEXT-VECTORS .THIS WORKSPACE ALSO CONTAINS SOME
[4]  A EXTRA VARIABLES AND FUNCTIONS,,,
[5]  ε')WSID TEMPORARY'
[6]  ε')SAVE'
[7]  LIST←[NL 2,3
[8]  LIST←,LIST
[9]  ε')COPY VLISTS'
[10] MN←WORKSPACENAME
[11] KILL LIST
[12] [RL←123467
[13] ε'ε')COPY MACRO ',GRUPP1, ''
[14] TOTLIST←VARIABLEGRUPP1,' ',VARIABLEGRUPP2,' ',VARIABLEGRUPP3
[15] TOTLIST←TOTLIST,' ',VARIABLEGRUPP4,' ',VARIABLEGRUPP5
[16] ε')ERASE VARIABLEGRUPP1 VARIABLEGRUPP2 VARIABLEGRUPP3'
[17] ε')ERASE VARIABLEGRUPP4 VARIABLEGRUPP5 GRUPP1 LIST'
[18] ε')ERASE DOKUMENTATION '
[19] A
[20] A
[21] MN COPYSAVE TOTLIST
[22] AOUTPUT FROM INITIALIZATION,AND NOTHING ELSE,IS SAVED
[23] AIN WORKSPACE(WHOSE NAME IS STORED IN WORKSPACENAME),
[24] A
[25] A
[26] ε')DROP TEMPORARY'
V
```

```

V Y COPYSAVE X
[1]  ATHIS FUNCTION TAKES VARIABLES FROM WORKSPACE TEMPORARY
[2]  A,TAKING ONLY THOSE SPECIFIED IN LIST X.AND SAVES THEM IN A WORKSP
    ACE WITH NAME Y...
[3]  ε'ε')COPY TEMPORARY ',X, ''
[4]  ε'ε')WSID ',Y, ''
[5]  ε')SAVE'
V
```

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, MODEL,
MODSUBST, MULT1, MULT7, MULT8, PACK, QFRI,
RANDOMIZE, REALASUM1, RELDIFF, SCANMAT, SUM1,
SUM2, SYNTHASUM1, 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: $\sum_{i \text{ in } 1} \left(\frac{W(i) \cdot D(i)}{\sum W(i)} \right), \sum_{i \text{ in } 2} \left(\frac{W(i) \cdot D(i)}{\sum W(i)} \right), \sum_{i \text{ in } 3} \left(\frac{W(i) \cdot D(i)}{\sum W(i)} \right), \sum_{i \text{ in } 4} \left(\frac{W(i) \cdot D(i)}{\sum W(i)} \right)$

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:

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

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

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

```
VABOVE[[]]V
V M←M1 ABOVE M2
[1]  A TO FORM A MATRIX WITH M1 ABOVE M2, PADDING WITH BLANKS OR ZEROES
      IF NEEDED.
[2]  A EACH OF M1 AND M2 IS MATRIX, VECTOR, OR SCALAR.
[3]  M←(((1↑ρM1),1↓(ρM1)ΓρM2)↑M1),[1]((1↑ρM2),1↓(ρM2)ΓρM1+(-2↑ 1 1 ,ρ
      M1)ρM1)↑M2+(-2↑ 1 1 ,ρM2)ρM2
V
```

```
VAVG1[[]]V
V A←W AVG1 D
[1]  A
[2]  A TO GET MARKET AVERAGES FROM FIRM DATA:
[3]  A 'D' IS THE FIRM (VECTOR) DATA TO BE AVERAGED.
[4]  A 'W' IS A WEIGHTING VECTOR.
[5]  A GLOBAL VECTOR 'MARKET' TELLS MARKET NUMBER OF EACH FIRM.
[6]  A GLOBAL 'NMARKETS' TELLS NUMBER OF MARKETS.
[7]  A 'A' IS THE (VECTOR) AVERAGE.
[8]  A
[9]  A←((W×D)+.xMARKET°. ,= \NMARKETS)÷(W+.xMARKET°. ,= \NMARKETS)
V
```


APPENDIX D

```
      VAVG2[[]]V
      V A+W AVG2 D
[1]  A
[2]  A TO GET A COUNTRY AVERAGE FROM FIRM DATA:
[3]  A 'D' IS THE FIRM (VECTOR) DATA TO BE AVERAGED.
[4]  A 'W' IS A WEIGHTING VECTOR.
[5]  A 'A' IS THE (SCALAR) AVERAGE.
[6]  A
[7]  A+(+WxD)/(+W)
      V
```

```
      VBETWEEN[[]]V
      V R+A BETWEEN B
[1]  R+A+(B-A)*0.01*x-1+?101*B=B
      V
```

```
      VCONTINUE1[[]]V
      V R+N CONTINUE1 V
[1]  R+N↑V.Ne-1↑V
      V
```

APPENDIX D

```
VCONTINUE2[[]]V
V R+N CONTINUE2 M
[1] R+((1+rM),N)↑M, Q(N,1+rM)ρME; (ρM)[2]
V
```

```
VCPI1[[]]V
V Z+CPI1 PRICES
[1] A÷B WHERE A=QC1×NH+QC2×NH... AND
[2] B= QC1×NH÷P1 + QC2×NH÷P2 +...
[3] A
[4] Z+(+/QC+,xNH)÷((QC+,xNH)+.+PRICES)
V
```

APPENDIX D

```

VDDIV[0]V
V Z+A DDIV B
[1] A
[2] A TO 'DIVIDE' A TREND PERCENTAGE.
[3] A 'Z' IS COMPUTED AS THE SOLUTION TO: (1+A)=(1+Z)*B
[4] A
[5] Z+1+*(1+A)÷B
V
```

```

VDEV[0]V
V A+DEV X
[1] A+X-+X÷eX
V
```

```

VDIFF[0]V
V R+DIFF F
[1] R+(((1+eF)e0),1)÷F)-(((1+eF)e0),1)÷F)
V
```

APPENDIX D

```
      VDIV1[[]]V
      V Z+F DIV1 M
[1]  A
[2]  A TO DIVIDE FIRMS' DATA WITH A MARKET VECTOR:
[3]  A 'F' IS THE FIRMS' DATA VECTOR.
[4]  A 'M' IS THE MARKET VECTOR.
[5]  A GLOBAL VECTOR 'MARKET' CONTAINS MARKET NUMBER OF EACH FIRM.
[6]  A 'Z' IS THE RESULTING (FIRM VECTOR) DATA.
[7]  A
[8]  Z+F÷M[MARKET]
      V
```

```
      VDIV7[[]]V
      V Z+M DIV7 V
[1]  ENS( $\rho V$ )=( $\rho M$ )[1]
[2]  A
[3]  A TO DIVIDE A MATRIX WITH A VECTOR:
[4]  A EACH ELEMENT 'M[I;J]' IS DIVIDED BY 'V[I]'.
[5]  A THUS, 'M' MUST HAVE AS MANY ROWS AS 'V' HAS ELEMENTS.
[6]  A
[7]  Z+M÷ $\Phi$ ( $\rho M$ ) $\rho V$ 
      V
```

APPENDIX D

```

      VDIV8[[]]V
    ▽ Z←M DIV8 V
[1]  ENS(ρV)=(ρM)[2]
[2]  A TO DIVIDE A MATRIX WITH A VECTOR:
[3]  A EACH ELEMENT MCI;J] IS DIVIDED BY VCJ].
[4]  A THUS, M MUST HAVE AS MANY COLUMNS AS V HAS ELEMENTS.
[5]  Z←M÷(ρM)ρV
    ▽
```

```

      VDUP[[]]V
    ▽ Z←NUM DUP EL
[1]  A 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←ELC(0≠Z)/Z+, ⅈ(((Γ/NUM), ρNUM)ρ\ρNUM)×(ιΓ/NUM)∘, ⅈNUM]
    ▽
```

APPENDIX D

```
      VENS[0]V
      V  ENS STRING
[1]   +(^/STRING=1)/0
[2]   'ERROR DETECTED BY FUNCTION ENS'
[3]   1=0
[4]   aLINE ABOVE STOPS EXECUTION
      V
```

```
      VEQUALS[0]V
      V  Z+A EQUALS B
[1]   +((pA)≠pB)/Z+0
[2]   +((,pA)∨,≠,pB)/0
[3]   Z+(,A)∧,=,B
      V
```

```
      VHISTORY[0]V
      V  R+SM HISTORY DATA;W
[1]   R+DATA+,xW++/W+0x\(-1↑pDATA)pSM
      V
```

APPENDIX D

```

VMMAKEQUARTERS[0]V
V W←MAKEQUARTERS V;FUNKA;FUNKB;DELTA;DIFF;F0;F1;F2;NIVA0;NIVA1;R;I;
J;K;M;N;LEVEL;EXPR1;EXPR2;FUNKX;FIKTIV1;FIKTIV2
[1] THIS FUNCTION DISTRIBUTES VARIABLES ON QUARTERS.FLOW-VARIABLES MU
ST BE DIVIDED BY 4 AFTERWARDS...
[2] AV=INPUT=YEARLY FIGURES W=RESULT=QUARTERLY FIGURES
[3] W←(4×(ρV))ρ0
[4] FUNKB←'DELTA×X×((DELTA-N)÷N)'
[5] FUNKA←'(((3×DELTA)-(6×N))×X×2)+((6×N)-(2×DELTA))×X'
[6] A
[7] FIKTIV1←VC[1]-(VC[2]-VC[1])
[8] FIKTIV2←VC[ρV]+(VC[ρV]-VC[1+ρV])
[9] V←FIKTIV1,V,FIKTIV2
[10] M←(ρV)-1
[11] R←4ρ0
[12] A
[13] I←1
[14] START:→(I=M)/SLUT
[15] F0←VC[I]
[16] F1←VC[I+1]
[17] F2←VC[I+2]
[18] K←4×(I-1)
[19] NIVA0←F0+(F1-F0)÷2
[20] NIVA1←F1+(F2-F1)÷2
[21] DELTA←NIVA1-NIVA0
[22] N←(F1-F0)÷2
[23] A
[24] FUNKX←FUNKB
[25] ±((X(F2-F1))≠X(F1-F0))/'FUNKX+FUNKA'
[26] A
[27] J←1
[28] S:→(J=5)/L
[29] X←(J-1)÷4
[30] LEVEL←±'F0+N+',FUNKX
[31] EXPR1←±FUNKX
[32] X←J÷4
[33] EXPR2←±FUNKX
[34] RC[J]←LEVEL+(EXPR2-EXPR1)÷2
[35] J←J+1
[36] →S
[37] L:
[38] DIFF←F1-(+/R)÷4
[39] →(TESTUTSKRIFT=0)/L3
[40] 'TESTUTSKRIFT'
```

APPENDIX D

```
[41] RE1],RE2],RE3],RE4]
[42] [] ←'DIFF'
[43] DIFF
[44] L3:
[45] WCK+(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] [] ←VCI+1]
[54] [] ←WC(4)+I×4]
[55] I←I+1
[56] →S2
[57] L2: 'OK'
[58] EXIT:
  v
```


APPENDIX D

```
▽MODADD[ ]▽  
  NAME MODADD OLDNEW; BREAK; CR; ROWS  
[1]  ENS 'MOD' v, #3↑NAME+, NAME  
[2]  ENS 3= [ ] NC NAME  
[3]  ENS (BREAK > 1), 1= ρBREAK+ ('ω'=OLDNEW) / 1 ρOLDNEW  
[4]  ENS 1= ρROWS+ (CR+ [ ] CR NAME) SCANMAT (BREAK-1) ↑OLDNEW  
[5]  ENS [ ] EX NAME  
[6]  ENS (PACK NAME) EQUALS [ ] FX CRC \ ROWS; ] ABOVE (BREAK ↓ OLDNEW) ABOVE (ROWS,  
  0) ↓ CR
```

```
▽MODEL[ ]▽  
  N←NAME MODEL STRING; CR; ROWS  
[1]  ENS ~'MOD'^, #3↑NAME+, NAME  
[2]  ENS 3= [ ] NC NAME  
[3]  N←' ' ρ ρROWS+ (CR+ [ ] CR NAME) SCANMAT STRING  
[4]  EHS+1εROWS  
[5]  ENS [ ] EX NAME  
[6]  ENS NAME EQUALS [ ] FX ( ^ / ROWS * , # 1 ↑ ρCR ) / [ ] CR
```

APPENDIX D

```

V MODSUBST [ ] V
V NAME MODSUBST OLDNEW; BREAK; CR; ROWS
[1] ENS 'MOD' V, #3↑NAME+, NAME
[2] ENS 3= [ ] NC NAME
[3] ENS (BREAK > 1), 1= ρ BREAK+ ('ω' = OLDNEW) / \ ρ OLDNEW
[4] ENS 1= ρ ROWS+ (CR+ [ ] CR NAME) SCANMAT (BREAK-1) ↑ OLDNEW
[5] ENS [ ] EX NAME
[6] ENS (PACK NAME) EQUALS [ ] FX CRC \ ROWS-1; J ABOVE (BREAK ↑ OLDNEW) ABOVE (
ROWS, 0) ↓ CR
V
```

```

V SCANMAT [ ] V
V R+M SCANMAT S
[1] R+ (√/Λ / (Φ(ρ, S) ≤ \ ~ 1 ↑ ρ M) / (Q((1 ↑ ρ M), ρ, S) ρ ~ 1+ \ ρ, S) Φ(, S) °, =M) / \ 1 ↑ ρ M
V
```

```

V PACK [ ] V
V Z+PACK S
[1] Z+1↑ (Z v 1 0 Z+0, ' ' ≠ S) / ' ', S
V
```

APPENDIX D

```

      VMULT1[[]]V
      V Z+F MULT1 M
[1]  A
[2]  A TO MULTIPLY FIRMS' DATA WITH A MARKET VECTOR:
[3]  A 'F' IS THE FIRMS' DATA VECTOR,
[4]  A 'M' IS THE MARKET VECTOR,
[5]  A GLOBAL VECTOR 'MARKET' CONTAINS MARKET NUMBER OF EACH FIRM,
[6]  A 'Z' IS THE RESULTING (FIRM VECTOR) DATA,
[7]  A
[8]  Z+F*M[MARKET]
      V
```

```

      VMULT7[[]]V
      V Z+M MULT7 V
[1]  ENS((pV)=(pM)[1]), (2=pM), (1=pV)
[2]  A
[3]  A TO MULTIPLY A MATRIX WITH A VECTOR:
[4]  A EACH ELEMENT 'MCI;JJ' IS MULTIPLIED WITH 'VCIJ',
[5]  A THUS, 'M' MUST HAVE AS MANY ROWS AS 'V' HAS ELEMENTS,
[6]  A
[7]  Z+M*(pM)pV
      V
```

```

      VMULT8[[]]V
      V Z+M MULT8 V
[1]  ENS((pV)=(pM)[2]), (2=pM), (1=pV)
[2]  A TO MULTIPLY A MATRIX WITH A VECTOR:
[3]  A EACH ELEMENT 'MCI;JJ' IS MULTIPLIED WITH 'VCJJ',
[4]  A THUS, 'M' MUST HAVE AS MANY COLUMNS AS 'V' HAS ELEMENTS,
[5]  A
[6]  Z+M*(pM)pV
      V
```

APPENDIX D

```

      V QFR1[0]V
      Q+QFR1 L
[11] Q+(1-RES)*QTOP*1--L*TEC+QTOP
      V

      VRANDOMIZE[0]V
      V C+A RANDOMIZE B;D;E;AID
[11] C+((REALASUM1 A)÷÷/NAMNAMMARKET*.=(4)[SAMARKET]
[12] A EACH ELEMENT OF C EQUALS CORRESPONDING REAL MARKET AVERAGE
[13] →((0=B)^1=ρB)/END
[14] A IF B=0, SKIP CORRELATION ASPECT
[15] D+(ρNAMNAMMARKET)↑B
[16] E+(ρD)↓B
[17] A HELP VBLES: D=REAL PART OF B, E=SYNTHETIC PART OF B
[18] AID+E-((E+.xSAMARKET*.=(4)÷÷/SAMARKET*.=(4)[SAMARKET]
[19] A AID=DEVIATION OF ELEMENTS OF E FROM THEIR MKT AVERAGES
[20] C+C+AID×((+/(DEV D)×DEV A)÷÷/(DEV E)*2)×(ρE)÷ρD
[21] A THAT USED THE APPROXIMATION COV(C,E)=COV(A,D)
[22] END:AID+A-((A+.xNAMNAMMARKET*.=(4)÷÷/NAMNAMMARKET*.=(4)[NAMNAMMARKET]
[23] A AID=DEVIATION OF ELEMENTS OF A FROM THEIR MKT AVERAGES
[24] C+C+((50+(ρC)?100)÷50)×(((REALASUM1 AID*2)÷÷/NAMNAMMARKET*.=(4)*
      0.5)[SAMARKET]
[25] A C[I,J]=C[I]×(1+EPSCI,J)×SD(A[I])
[26] A WHERE: C[I]=C FOR MARKET I AS COMPUTED ABOVE
[27] A EPSCI,J IS UNIFORM OVER [-0.5, 0.5]
[28] A SD(:)=STANDARD DEVIATION OF A ON THE ITH MARKET
      V
```

APPENDIX D

```
      VREALASUM1[]V
      V A+REALASUM1 V
[1]  A
[2]  A TO SUM FROM FIRMS TO MARKETS:
[3]  A 'V' IS THE FIRM DATA TO BE AGGREGATED, IF IT HAS MORE THAN
[4]  A ONE AXIS, FIRST DIMENSION MUST INDICATE FIRM NUMBER.
[5]  A GLOBAL VECTOR 'NAMNΔMARKET' TELLS MARKET NUMBER OF EACH FIRM.
[6]  A GLOBAL 'NMARKETS' TELLS NUMBER OF MARKETS.
[7]  A 'A' IS THE AGGREGATE.
[8]  A
[9]  A+((\NMARKETS)*.=NAMNΔMARKET)+.xV
      V
```

```
      VRELDIFF[]V
      V R+RELDIFF F
[1]  R+(DIFF F)÷(((~1+ρρF)ρ0),~1)+F
      V
```

```
      VSUM1[]V
      V A+SUM1 V
[1]  A
[2]  A TO SUM FROM FIRMS TO MARKETS:
[3]  A 'V' IS THE FIRM DATA TO BE AGGREGATED, IF IT HAS MORE THAN
[4]  A ONE AXIS, FIRST DIMENSION MUST INDICATE FIRM NUMBER.
[5]  A GLOBAL VECTOR 'MARKET' TELLS MARKET NUMBER OF EACH FIRM.
[6]  A GLOBAL 'NMARKETS' TELLS NUMBER OF MARKETS.
[7]  A 'A' IS THE AGGREGATE.
[8]  A
[9]  A+((\NMARKETS)*.=MARKET)+.xV
      V
```

APPENDIX D

```
VSUM2[[]]V
V A+SUM2 V
[1] A
[2] A TO SUM FROM FIRMS TO A COUNTRY TOTAL:
[3] A 'V' IS THE FIRM DATA TO BE AGGREGATED. IF IT HAS MORE THAN
[4] A ONE AXIS, FIRST DIMENSION MUST INDICATE FIRM NUMBER.
[5] A 'A' IS THE AGGREGATE.
[6] A
[7] A++/V
V
```

```
VSYNTHASUM1[[]]V
V R+SYNTHASUM1 V
[1] R+((\NMARKETS)*. =SΔMARKET)+.xV
V
```

```
VUSING[[]]V
V OUT+REAL USING V
[1] OUT+REAL,(REAL RANDOMIZE V)
V
```

```
VSCALE[[]]V
V S=N SCALE PAR
[1] ENS(0<PAR),(1<PAR),(PAR<S+1,~1<PAR)
[2] A TO GET N SCALED NUMBERS IN DESCENDING ORDER.
[3] A (~1<PAR) ARE SIZES OF NUMBERS 2,3,... RELATIVE TO FIRST NUMBER.
[4] A AFTER THAT, MORE NUMBERS ARE GENERATED IN A LOGARITHMICALLY DECL
    INING FASHION DOWN TO (~1<PAR).
[5] A NUMBERS ARE NORMALIZED TO HAVE SUM=1.
[6] + (N=ρS+(N[ρS]†S)/L
[7] S+S.φ(~1<PAR)×((÷7~2†1,PAR)*÷N-ρS)*~1+~N-ρS
[8] L:S+S÷+/S
```

APPENDIX D ENTRY VARIANT

```
MMM ADDFIRM PARMS;MM;NEWSYMBOL;Δ;RELSIZE;A22P;Q̄P;DP;W;M;DVA;Q̄VA;VA;Q;Q̄Q;L;RES;Q̄TOP
a TO INSERT NEW FIRM(S) INTO ONE MARKET; TO BE USED AT A YEAR LIMIT ONLY.
ENS(0 1 √. =ρMMM),(1 2 √. =ρ,MMM),(1=ρPARMS),(2≤ρPARMS)
NEWSYMBOL+(MMM+2ρMMM)C2]
MM+MMMC1]
Δ+PARMSC1]
RELSIZE+1↓PARMS
a MM IS MARKET NUMBER
a NEWSYMBOL GIVES NUMERICAL CODE FOR PLOTTING
a Δ IS PROFIT-MARGIN ADVANTAGE COMPARED TO THE AVERAGE FIRM
a RELSIZE IS SIZE OF NEW FIRM(S) AS A FRACTION OF CURRENT MARKET AGGREGATE
ENS 0=Q̄NC 'NRS'
a THAT WAS TO ENSURE A YEAR LIMIT
a
RW+RW,(ρRELSIZE)ρS AVG5 RW
a
A21+VA AVG5 A21
A22+VA AVG5 A22
a
INVEFF+INVEFF,(ρRELSIZE)ρK1 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
DELAYAINV←DELAYAINV,(1)RELSIZE×SUM5 DELAYAINV
#
X←X,(ρRELSIZE)ρS AVG5 X
#
P←P,P←(ρRELSIZE)ρS AVG5 P
QP←QP,QP←(ρRELSIZE)ρQS AVG5 QP
DP←DP,DP←(ρRELSIZE)ρS AVG5 DP
#
W←W,W←(ρRELSIZE)ρL AVG5 W
DW←DW,(ρRELSIZE)ρVA AVG5 DW
QDW←QDW,(ρRELSIZE)ρ(L×QW)AVG5 QDW
QW←QW,(ρRELSIZE)ρL AVG5 QW
#
I(0≠[INC 'CHM'])/'CHM←CHM,(ρRELSIZE)ρS AVG5 CHM'
M←M,M←(ρRELSIZE)ρΔ+S AVG5 M
#
DVA←DVA,DVA←(ρRELSIZE)ρVA 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-DF
#
DS←DS,(ρRELSIZE)ρS 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←((ρAMAN)+(ρRELSIZE),0)↑AMAN
#
EXPDP←EXPDP,(ρRELSIZE)ρS AVG5 EXPDP
EXPDS←EXPDS,(ρRELSIZE)ρS AVG5 EXPDS
EXPDW←EXPDW,(ρRELSIZE)ρVA AVG5 EXPDW
HISTDP←HISTDP,(ρRELSIZE)ρS AVG5 HISTDP
HISTDPDEV←HISTDPDEV,(ρRELSIZE)ρS AVG5 HISTDPDEV
HISTDPDEV2←HISTDPDEV2,(ρRELSIZE)ρS AVG5 HISTDPDEV2
HISTDS←HISTDS,(ρRELSIZE)ρS 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, especially 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 endeavours 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 use of industrial products rather than on the

ordinary classification according to the production technique and raw material base is necessary. The aggregation scheme 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

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

Table 1:2

The Accounting System in MOSES

| <u>Vertically:</u> | <u>Row</u> | |
|--|---------------|---------|
| 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 |
| | | |
| <u>Horizontally:</u> | <u>Column</u> | |
| 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 | TOTAL |
| | (TOT-DIF) | |
| | | |
| <u>Sectors 1-10: *</u> | | |
| 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 producer's 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/O), 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 |
|-----|---------------------------------------|------|----|------------|-------------------|--------------------|----------|-----------|----------|-------------|--------------------|---------|---------------|-------------------|
| 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 |

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| 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 |
|-----|---|-----------|----|------------|----------|----------------------|------------------------|---------------|----------|----------------|--------------|---------|---------------|---------|
| 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 | | | | - | 3550.8 | - | - | 3550.2 | | | 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/O), 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 3521/9 | 3831-3 | - | - | 3522/3 | 351/2 | 383 |
| 21 Shipbuilding and repairing | 3843 | 16 | | | | | | 3841 | | | | | 3841 |
| 22 Manufacturing industries not elsewhere classified | 3900 | 17 | | | | | | | | 39 | | | 39 |
| 23 Repair of household appliances and motor vehicles etc. | 3600 3842 9511/3 | 13 15 | | | | 36202 | | 36201/9- | | 361 | | | 36 951 951 |

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/O), 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 |
|-----|---|----------------------|----|------------|----------|----------|----------|-----------|----------|-------------|-----------|---------|---------------|---------------|
| 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 ser- vices not elsewhere classified | 9600 excl. 9911/3 | 23 | | | | | | | | | | 92-4 992-9 | 92-4 992-9 |

^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 **SIAINIT** 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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