THE MARKET ORIENTED INTER-INDUSTRY STOCK AND FLOW DATA AGGREGATION SCHEME USED IN THE SWEDISH MODEL

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The objectives of the Swedish Micro-to-Macro Model have been stated as

1. to formulate a micro explanation for inflation and

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

The model thus places heavy emphasis on the market process and its importance for price and income determination and growth at the macro level. The chosen problems, however, also relate to typical dynamic processes and hence require that the time dimension and the cyclical features of simulations are quite well controlled empirically. 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 has been necessary. We have chosen an aggregation level with 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)

The reason for choosing such a small number of sectors is not only to keep the statistical work input within limits and to avoid getting bogged down in unnecessary detail. It can be shown that this particular aggregation principle emphasizes the variations in activity over the

cycle as well as between industry sectors.[1] It can also be claimed that this aggregation has certain advantages over alternative ones, since the input-output matrix obtains an easily understood structure that has a tendency towards a one-way delivery pattern. This in turn facilitates a consistent projection of changes in the input-output coefficients.

Four industrial production sectors is a small number compared to what is normal in contemporary input-output models. However, in strong contrast to other model work - even of the microsimulation kind - each sector (market) in MOSES holds a large number of individual firms. The market processes in the model operate both between and within the above four sectors. The basic micro feature in MOSES in fact lies in the large number of firms within each sector and the aggregation scheme has been designed accordingly. This also means that the capacity utilization data from the Annual Planning Survey of the Federation of Swedish Industries can be used directly in the model.[2] On the other hand we run into difficulties when dealing with macro data. 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. Also lack of some firm data makes it necessary to use industrial macro data as substitutes.[3] The input-output matrix is one example where such simplifications have been necessary. Finally 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.

1) See Virin, O, "Industrins Utveckling 1974-76, enligt Industriförbundets planenkät 1975/76", Industrikonjunkturen, Våren 1976, Special Study D.

2) This planning survey covering all Swedish firms with more than 200 employees has in fact been designed on the format of MOSES.

3) 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 this conference report.

In our efforts to obtain consistency in the data base it has been natural to use the input-output matrix as the reference base towards which adjustments are made. The input-output matrix for the total production system in MOSES consists of ten sectors:

1. Agriculture, Forestry and Fishing (A/F/F: 1.10 + 4.10)
2. Mining and Quarrying (ORE: 1.20 + 4.20)
3. Petroleum Products Imports (OIL: 5.11)
4. Raw Material Processing Industries (RAW: 2.10 + 5.10 excl 5.11)
5. Intermediate Goods Industries (IMED: 2.20 + 5.20)
6. Investment and Consumer Durable Goods Industries (DUR: 2.30 + 5.30, 2.51 + 5.51)
7. Construction (CONSTR: 2.40 + 5.40)
8. Non Durable Consumption Goods Industries (NDUR: 2.52 + 5.52, 2.53 + 5.53)
9. Electricity (EL: 3.10 + 6.10)
10. Other Services: (SERVICE: 3.20 + 6.20).

This aggregation corresponds to the general structure related to the input-output statistics (I/O) published by the Central Bureau of Statistics, that is described in Table 1. Of the four industrial production sectors that hold individual firms DUR and NDUR have a product content that differs somewhat from what is conventional as to the treatment of Capital Goods (2.51 + 5.51). In the input-output matrix we have included Consumer Capital Goods with Investment Goods, thus referring to this group as DURables and calling the remainder of Consumption Goods NonDURables. The six non-industry sectors (A/F/F, ORE, OIL, CONSTR, EL and SERVICE) are "external sectors" to the model appearing only as suppliers of certain goods in the conventional input-output fashion. Note here that the I-O sectors "Construction of Buildings" and "Letting of Dwellings and Use of Owner-Occupied Dwellings" - rents - both go into the CONSTRuction sector.

In order to obtain the general classification described in Table 1, we have constructed a weighting matrix, based on value added, by which the allocation is made. Since this allocation is based on macro data there is not necessarily a one-to-one correspondence between these data (allocated according to the market defined classification) and data based on industrial activities (SNI). Statistically the demand and output classification hence will be approximate when translated either way. When total value added for each market defined sector was compared to total value added, obtained by assigning specific companies to the market defined sectors, the correspondence was very good, however.

Table 1.1 Input

		ROW	I/O
I.	Produced Commodities	1-11	1-34
	1.00 Primary Production	1-2	1-4
	1.10 Agriculture, Forestry and Fishing	1.	1-3
	1.20 Mining and Quarrying	2.	4
	2.00 Industrial Production	3-9	5-22[a)]
	2.10 Raw Material Processing	3.	
	2.20 Intermediate Goods	4.	
	2.30 Investment Goods	5.	
	2.40 Construction incl Rents	6.	
	2.50 Consumption Goods	7-9	
	2.51 Capital Goods	7.	
	2.52 Food and Beverage	8.	
	2.53 Other Consumer Goods	9.	
	3.00 Services	10-11	23-34[a)]
	3.10 Electricity	10.	24
	3.20 Other Services excl Rents	11.	23-34 excl 24[a)]

a) The sectors 25, 31 and 32 are included in Industrial Production and excluded from Services.

II.	Primary Commodities	12-30 excl 13, 16-18	36-42 45-48 [b]
4.00	Primary Production Imports	12+14	(1-4) [b]
4.10	Agricultural, Forestry and Fish Products	12	(1-3)
4.11	Agricultural Products	13	(1)
4.20	Mineral Products excl Crude Oil	14 (excl Crude Oil)	(4)
5.00	Industrial Production Imports	15+(19-24)	(5-22)
5.10	Raw Material Processing Imports	15	
5.11	Petroleum Products Imports incl Crude Oil	16 (incl Crude Oil)	
5.12	Ferrous Metal Imports	17	
5.13	Non Ferrous Metal Imports	18	
5.20	Intermediate Goods Imports	19	
5.30	Investment Goods Imports	20	
5.40	Construction Material Imports	21	
5.50	Consumption Goods Imports	22-24	
5.51	Capital Goods Imports	22	
5.52	Food and Beverage Imports	23	
5.53	Other Consumer Goods Imports	24	
6.00	Imports of Services	25-26	(23-34) [a]
6.10	Electricity Imports	25	(24)
6.20	Other Imports of Services	26	(23-34 excl 24) [a]
7.00	Duties, Taxes, Subsidies etc	27-28	37-42, 45-47
7.10	Commodity Taxes and Subsidies, Duties etc	27	37-42
7.20	Non Commodity Indirect Taxes and Subsidies	28	45-47
8.00	Value Added (SNR)	29-30	48
8.10	Wages	29	49
8.20	Profits and Depreciation	30	50
9.00	Total Input	1-30 excl 13, 16-18	51

a) The sectors 25, 31 and 32 are included in Industrial Production and excluded from Services.

b) Numbers within parenthesis refer to imports (table 5b in SCB Statistical Reports 1972:44).

Table 1.2 Output

		Column	I/O
I.	Use Within Prod. System	1-11	1-34
	1.00 Primary Production	1-2	1-4
	1.10 Agriculture, Forestry and Fishing	1.	1-3
	1.20 Mining and Quarrying	2.	4
	2.00 Industrial Production	3-9	5-22[a]
	2.10 Raw Material Processing	3.	
	2.20 Intermediate Goods	4.	
	2.30 Investment Goods	5.	
	2.40 Construction Material	6.	
	2.50 Consumption Goods	7-9	
	2.51 Capital Goods	7.	
	2.52 Food and Beverage	8.	
	2.53 Other Consumer Goods	9.	
	3.00 Services	10-11	23-34[a]
	3.10 Electricity	10.	24
	3.20 Other Services	11.	23-34 excl 24[a]
II.	Final Consumption	12-16	37-41
	4.00 Public Consumption	12	37
	5.00 Private Consumption	13	38
	6.00 Gross Investments	14	39
	7.00 Change in Stocks	15	40
	8.00 Exports	16	41
	9.00 Total Output	1-16	43

a) The sectors 25, 31 and 32 are included in Industrial Production and excluded from Services.

Since the MOSES aggregation scheme centers on markets and the use of industrial products the input-output structure does not differentiate between imports and produced commodities. Instead import shares obtained from macro National Accounts time series data are varied over time for the four industrial production sectors. The same proportion of imports regardless of sector origin is assumed. The input-output structure is specified in basic values ("ungefärlig produktionskostnad") and thus makes use of available information on trade margins. Since our input-output matrix is specified in basic values it has been necessary to adjust all macro time series brought into the data base to this value level in order to

obtain consistency in the "initialization" - the start-up of a simulation. A not insignificant amount of data are compiled from industrial statistics or other macro statistics which are not readily obtainable in basic values. This has created problems which have forced us to make a number of simplifying assumptions. On a number of occasions we have for instance assumed the same growth pattern for our variables specified in basic values as for time series valued at purchaser's prices. This implies that trade margins and commodity indirect taxes are growing proportionately. It is likewise assumed that margins and indirect taxes are identical for all inputs into each production system sector or final demand category regardless of sector origin. On the other hand we have managed to avoid problems with secondary production by using a commodity by commodity specification.[1)]

The input-output coefficients of one cell in the input-output matrix are allocated to each firm in that particular market. The coefficients of each firm are kept constant over time in the model (for the time being we use 1968 figures - see Table 2.1). Since individual firms within and between markets meet with success and failure very differently in the model they also grow at very different rates. Thus the macro input-output coefficients vary endogenously over time. Here we have had to assume, however, that price increases are the same for products from the four industrial production sectors regardless of which sector they are sold to as inputs or as final demand. The average spending shares for the five final demand categories - GOVernmenT, Household CONSumption, INVestments, Change in Stocks (ΔSTO) and EXports - are shown in Table 2.2.

The use of 1968 I/O coefficients each year clearly means introducing an inconsistency in the macro data basic system even though the macro coefficients will vary because of the way they are used in individual firms. This assumption will have to be relaxed in the future. Until we have got the necessary statistical information to allow time dependent I/O coefficients, however, we will have to be satisfied with the fixed coefficient assumption.

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1) For a detailed discussion of alternative methods in input-output analysis, see Höglund, B and Werin, L, The Production System of the Swedish Economy, An Input-Output Study, IUI, 1964.

Finally, it should be pointed out how the input-output structure is used in MOSES. 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.

TABLE 2.1
INPUT OUTPUT COEFFICIENT MATRIX, 1968

	A/F/F	ORE	OIL	RAW	IMED	DUR	CONSTR	NDUR	EL	SERVICE	TOTAL
A/F/F	.02	.00	.00	.07	.06	.01	.01	.22	.00	.00	.04
ORE	.00	.07	.00	.06	.01	.00	.01	.00	.00	.00	.01
OIL	.01	.01	.00	.07	.01	.00	.00	.00	.03	.01	.01
RAW	.01	.02	.00	.18	.07	.10	.05	.02	.01	.01	.05
IMED	.03	.02	.00	.07	.14	.08	.03	.06	.00	.02	.05
DUR	.02	.04	.00	.04	.07	.18	.06	.02	.00	.02	.05
CONSTR	.07	.02	.00	.03	.03	.04	.11	.02	.09	.07	.06
NDUR	.09	.01	.00	.03	.08	.03	.02	.22	.01	.05	.07
EL	.01	.03	.00	.02	.02	.01	.01	.01	.03	.01	.01
SERVICE	.08	.05	.00	.09	.06	.06	.09	.06	.03	.16	.10
TAXES	.06	.09	.00	.03	.02	.03	.04	.00	.03	.01	.02
VA	.60	.64	.00	.32	.42	.46	.56	.37	.82	.66	.53
TOTAL	1.00	1.00	.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

TABLE 2.2
AVERAGE SPENDING SHARES, 1968

	GOVT	CONS	INV	STO	EXP	TOTAL
A/F/F	.01	.03	.00	.19	.03	.06
ORE	.00	.00	.00	.01	.03	.01
OIL	.02	.01	.00	.00	.01	.01
RAW	.01	.01	.00	.21	.15	.07
IMED	.11	.03	.04	.03	.18	.09
DUR	.23	.04	.20	.24	.28	.14
CONSTR	.21	.19	.69	.08	.07	.25
NDUR	.17	.20	.01	.29	.09	.15
EL	.03	.01	.00	.00	.00	.02
SERVICE	.29	.33	.02	.02	.16	.25
TAXES	.08	.15	.03	.04	.01	.08
TOTAL	1.00	1.00	1.00	1.00	1.00	1.00

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