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THE USE OF A NORDIC INFORUM SYSTEM OF INPUT-OUTPUT MODELS IN NORWEGIAN ECONOMIC PLANNING[1)]

By

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1. Introduction

There is a long tradition in use of input-output models for economic planning in Norway. Input-output models play a central role in short-to medium term economic planning and policy-making as well as in long-run projections.

The Norwegian tradition in economic planning going back to the immediate postwar period have distinctive features. The philosophy and practice of economic planning in Norway has developed in response to the national political and economic background but to a considerable extent it is also due to the pervasive influence of the late professor Ragnar Frisch over several vintages of Norwegian economists. The model tools for short-term analysis, in particular the MODIS model to be described below, are thus rather different from short-term models developed and used in other countries.

Since the 1960s the exports and imports figures of the Norwegian economy have been steadily above forty per cent of GDP. The foreign trade thus is of central importance for the national economic development. The economic models in use have until recently dealt with foreign trade in a detailed but simple way relying more on expert assessment than econometric estimates. In the 1960s and the early 1970s the development of Norway's foreign trade caused little ground for concern. Although rapid changes

in industrial structure took place as a consequence of the lowering of trade barriers in a period of high and sustained economic growth the Norwegian economy seemed to adapt very well to changing trade patterns. International booms and recessions in this period caused only small cyclical effects in the Norwegian economy. The expert assessments used in the economic planning were quite reliable with a marked tendency to underestimate the fast growth in exports. The urgency of improved model tools for foreign trade was thus not very strongly felt.

In the 1970s, however, the expert assessments turned out to be gravely overoptimistic, even in the short run. In retrospect the explanation is partly a neglect of domestic production costs as a factor in export performance and partly incorrect assumptions about the development in major trading countries.

The four Nordic countries Denmark, Finland, Norway and Sweden constitute a group of small open economies with a considerable amount of intragroup trade. (The smallest Nordic country, Iceland, with about one per cent of the total Nordic population is for practical reasons left completely out of consideration in the following). In spite of the fact that one country (Denmark) is a member of the EEC, two countries (Denmark and Norway) belong to NATO, there are strong political and popular affiliations between the countries. The establishment of a Nordic INFORUM system of input-output models is very much in line with ideas expressed in many quarters of the need and desirability of increased Nordic economic cooperation. There exists no major study of structural dependencies of the Nordic economies. The idea of an international INFORUM system of input-output models seems to fit very well into the Nordic context.

2. The model system in use in Norwegian economic planning

The MODIS model is the main tool for macroeconomic planning in Norway. The model is used in short and medium term analysis and forecasting. The model originated around 1960 but has undergone successive reconstructions and extensions. The present version, MODIS IV, has been in operation since 1973.

The reliance on the MODIS model marks Norway out as having a different approach to the use of models in economic planning than many other

countries. The MODIS model can be characterized, in general terms, as a very disaggregated and detailed macroeconomic model with an elaborated input-output structure, but with less economic behaviour embodied in the formal relations of the model than is common in macroeconomic short-term models.

The core of the model is an input-output framework comprising about 200 commodities and 150 industries. Final demand is specified as several hundred separate items including about 50 items of private consumption demand. The specifications of the model are closely related to the Norwegian national accounts. The results of the model include complete accounts consistent with the definitions of the national account. The model has 2 000 - 2 500 exogenous variables and about 5 000 endogenous variables. Because of the accounting aspect of the model the stated number of endogenous variables may give an exaggerated indication of the size of the model.

The model is subdivided in two main parts, the quantity part and the price part. A somewhat simplified description of the working of the model runs as follows. In the quantity part all final demand except private consumption is exogenous. Exports by commodity (about 100) are thus wholly exogenous. Imports are determined endogenously by a matrix of import shares, by imported commodity and by industry or final demand category. The use of a matrix of import shares thus gives a differential treatment not only of each imported commodity (more than 100) but also between the import requirements of different receivers within the economy. It has been found empirically that the import shares for a great number of commodities vary considerably between receivers. The model is thus well equipped to take care of import changes due to changes in the composition of production and final demand. The import shares are constant coefficients which can be adjusted exogenously by across-the-board changes for each commodity. The input of labour in industries is determined by labour requirement functions basically consisting of an estimated labour coefficient and exogenously given productivity growth.

The price part incorporates the hypothesis of a dichotomy between exposed and sheltered industries. Prices of exposed commodities as well as export and import prices are exogenous. The prices of sheltered commodities are determined by adding up intermediate and primary costs in a simultaneous equation system. Wage rates and indirect tax and subsidy

rates are exogenous. Gross profits (operating surplus plus depreciation) in sheltered industries vary proportionally with wage costs with proportionality coefficients subject to exogenous adjustment. The price part includes the same detailed representation of the market shares of imported commodities as described above.

The model has a very detailed representation of fiscal items, i.e. direct and indirect tax rates, government expenditures etc., of less interest in the present context.

The model may be assessed on the basis of this somewhat superficial description. For a proper assessment of the benefits of its use it is necessary to take into account how the model is used within its administrative environment. The openness of the model and the requirements for its use in terms of exogenous data, are in the fact effective barriers which prevent widespread use of the model for full-scale forecasting. The model has been designed and constructed by the Central Bureau of Statistics to be used by the Ministry of Finance for planning and policy-making and only someone with the staff resources and expert knowledge similar to those of the Minstry will be able to use the model to full advantage. The model is generally available for any interested user but is seldom used for forecasting without explicit or tacit support by the Ministry.

The philosophy underlying the use of the model by the Ministry of Finance is that the disadvantages of working with an incomplete, open-ended model are outweighted by the advantages of being able to draw upon expert knowledge and only partly formalized models from various sources within the government administration. The model is used as an integrating tool which provides overall consistency in definitions and balance equations as well as taking well care of some central behavioural relationships of the economy. To serve in this role the iterative use of the model is crucial. The model is used in sequential runs where each computes a main alternative as well as side alternatives expressing partial deviations from the main alternative. The side alternatives may express alternative uses of policy instruments or alternative assumptions of exogenous variables, for instance for exports. Thus, through sequential runs one aims at recovering the loss in simultaneity that follows from using an incomplete model.

For the foreign trade sector, in particular, the model forecasts gain from being based on detailed assessments of import prices, export prices and export volumes. On the other hand there are no built-in mechanisms which lead from changes in import prices to changes in import shares of

intermediate inputs in production. Likewise, the export volumes are not derived within the context of a complete behavioural description of the firms constituting an industrial sector. The exogenous foreign trade variables are, of course, neither deduced from an international model giving a consistent picture of the development of Norway as well as her main trading partners.

The MODIS model has a number of support models connected with it. Some support models are used to prepare exogenous input, others to derive results in more detail or to check and corroborate the overall macroeconomic consistency of the results. The support models cover i.a. financial flows, tax incidence and tax revenues, social security system, energy flows, external competitiveness and export shares. The support model developed to check the external competitiveness, called KONK, has an input-output structure consisting of only four aggregate industries, three exposed industry groups and one industry aggregate for all sheltered industries. In the model the changes in the price indices of exposed industries, i.e. the export prices as well as the domestic import-competing industries, are determined as weighted averages of a unit costs and a representative world market price index. The cost structure of the industries are connected through the input-output structure of intermediate goods. Changes in wage levels and productivities are exogenous as in MODIS. On the basis of the price forecasts the changes in market shares both for exports and imports are derived straightforwardly as the product of estimated or assumed elasticities and time-weighted differences between Norwegian and world market prices.

The development of this support model of MODIS should perhaps not be considered as more than a way of systematizing the preparation of exogenous estimates for MODIS and also as a means of exploring consequences of changes in competitiveness from a MODIS reference path. No real effort has been put into the estimation of the coefficients of the model and preliminary tests of some crucial parts of the model have not been too promising. The model has been found useful within the Ministry of Finance, however, as a way of structuring the problem of forecasting the foreign trade development. The model has an extension (GLOBKONK) that forecasts the world market prices by means of a model simulating the cost structure of the same industries in Norway's trading partners. In the international extension of KONK unit labour costs are transformed to commodity prices and the results from the combined models can be considered as a transformation into commodity prices of a relative unit labour cost comparison. This extension is logically

interesting but has so far neither been corroborated empirically nor tested in practice.

While the KONK model originated in the user environment of MODIS and MSG another model project of more econometric content, called MODEX, has been developed by the Central Bureau of Statistics. The MODEX model aims at explaining Norwegian exports. In the model the volume and price of Norwegian exports are determined from variables representing costs (unit labour costs) and production level (GDP) of 14 other OECD countries. The model has been estimated only for one commodity aggregate, namely manufacuring goods (SITC 5-9, excl. 68 and 735).

In the MODEX model there is a simultaneous system of price equations in which each country's export price is determined as a function of an index of production costs and a competitive price which is a doubly weighted sum of all export prices. In the reduced form of this system each of the export prices is a function of all cost indices. In another set of equations of the model the volume of imports of each country is determined as a function of the GDP and the ratio of the domestic price level to an import price index defined as a weighted sum of export prices (adjusted for the difference between fob and cif prices and customs duties). The import volumes are again weighted and summed to the Norwegian export market which together with the ratio of the Norwegian export price index and the competitive price for Norwegian exports determine the volume of Norwegian exports.

The MODIS model is too large to be included in an international system of models even if full simultaneity is not attempted. The model is too cumbersome and costly to solve to be part of an iterative solution of a system of models. There exists, however, a recently developed aggregate version of the MODIS model called MODAG.

The MODAG model has about 30 industries. The current version is quite similar to MODIS. Further development is going on to make the model less open and with more behavioural relations and short-run dynamics than in the MODIS model. The development work comprises factor demand, credit flows, foreign trade, and price and income determination.

For long-run projections the model in use is the MSG model which in its current version (MSG-4) uses the same input-output table as the MODAG model. The MSG model originated in a study by professor Leif Johansen, published in 1959. Since 1973 the model has been developed further in successive versions by the Central Bureau of Statistics. The MSG model is a general equilibrium model built around an input-output framework. Each

industry has a neoclassical production function in labour, capital, energy, and materials. The demand for labour and capital services by the industries is derived assuming full mobility of productive resources. The available resources are thus always fully utilized in the model. The total productive capacity is exogenously given as growth in total labour force, growth in total capital stock and coefficients of neutral technical change. The nominal price level is determined by exogenous wage rates. The relative prices of commodities and the returns on capital are determined within the model as equilibrium prices of the respective markets. The volume of imports is determined endogenously via a matrix of import shares as described above for MODIS IV. The volume of exports is exogenously determined. The import prices are exogenously given and have to be independently forecasted while the implicit assumption about export prices is that they are the same as the domestic prices. The MSG model is used within a similar administrative framework as the MODIS model.

3. The need for improved forecasts of foreign trade

The Norwegian economy with export and import figures steadily above forty per cent of GDP, obviously qualify as small, open economy. The total value of exports in 1981 was 157 billion kroner corresponding to 48 percent of GDP. Of the total value of exports 68 percent consisted of goods, of which 45 percent came from crude oil and natural gas. The export basket of goods has traditionally been based on certain industries comprising fish prosessing, pulp and paper, basic chemicals, and primary metals with increased diversification over time. From a modest beginning in 1971, the crude oil and natural gas export have grown rapidly and are today almost as important as the export of all other goods. Shipping is still an important part of Norwegian exports and counted for 63 percent of the export of services in 1981.

Norwegian imports amounted to 131 billion kroner in 1981 i.e. 40 percent of GDP. Both traditional imports and import intensive investments in the oil sector increased rapidly in the middle 1970s, and total imports peaked in 1976 with 51 percent of GDP. Import of goods amounted to 69 percent of the total value of imports.

Due to the rapid growth in the Norwegian production of crude oil and natural gas and the rising oil prices, the balance of payments has had a positive surplus on current account since 1980 after years with

heavy deficits. The surplus amounted to almost 14 billion kroner in 1981. High expected export of oil and gas in the future will allow a considerable import surplus in other commodities in years to come.

The foreign trade pattern between Norway and other countries have been relatively stable in spite of instability of world commodity markets and increased uncertainty in the international economic development in general during the last decade. The foreign trade statistics of Norway specify trade by exporting or importing country in the SITC commodity classification. Tables 1 and 2 show the exports and imports in 1980 by country (group of countries) in the commodity classification of the MODAG model. About 90 percent of the trade took place with OECD-countries. The main trade partners beside the Nordic countries were the United Kingdom and West Germany.

Although the foreign trade sector plays an important role in the Norwegian economy, little emphasis has been placed - as explained above - on export and import relations in the macroeconomic models in current use for economic planning and policy-making in Norway. The main models in use are the MODIS model for short and medium term planning and the MSG model for long term projections. Especially in the MODIS model the treatment of the foreign trade sector is very detailed and explicitly made so in an attempt to benefit from expert assesment of world market development. Imports are determined endogenously by a matrix of import shares, while exports are wholly exogenous.

In an attempt to evaluate the model in use, the forecasts from the "national budgets" , the annual economic plans, were combined with the observed values for the foreign trade in the 1970s. Table 3 shows the forecasts and observed percentage changes in columnes of exports and imports by type of goods and services. The same figures are shown also for another important demand component, namely private consumption and for gross domestic product. By comparing forecasts and observed values one may see to what extent the economic developments occuring in the period were expected by policy makers or foreseen by experts. The forecasts shown in table 3 have been made midyear in preparing the national budget for the coming year, while the observed values are taken from the national accounts.

The main impression from the table is that there have been very great discrepancies between forecasts and observed values both for imports and exports. The average absolute deviation between forecasts and observed

Table 1. Norwegian commodity imports in 1980 by MODAG-classification and exporting country (group of countries). Mill.kr.

		Den-mark	Fin-land	Sweden	United King-dom	West Germany	Other OECD	Develop. count-ries	Total[1)]
11	Agricultural products	114	11	120	28	40	931	145	1 396
12	Forestry products	10	5	208	2	5	12	25	287
13	Fishery products	6	1	4	4	1	31	9	56
32	Coal	0	0	0	39	19	188	3	321
33	Other ores and minerals	4	1	144	80	35	141	36	452
16	Food products	424	31	335	174	190	963	234	2 397
17	Beverages and tobacco	22	58	9	72	17	229	10	425
18	Textiles and wearing apparel	939	796	799	1 016	663	2 144	742	7 267
26	Wood and wood products	322	198	1 291	30	88	170	149	2 310
34	Paper and paper products	73	454	943	57	119	219	179	2 046
37	Industrial chemicals	67	49	386	410	715	1 518	1 087	4 337
41	Petrol	0	0	282	131	220	648	76	1 392
42	Fuel oils etc.	167	0	566	266	215	1 196	343	2 960
27	Non industrial chemicals etc.	960	244	1 808	1 968	1 961	4 128	334	11 568
43	Metals	251	305	1 451	867	1 391	2 992	92	7 517
45	Metal products, machinery and equipment	1 234	736	4 540	2 022	4 723	7 000	185	20 569
50	Ships and oil platforms	117	77	423	189	298	938	275	2 691
28	Printing and publishing	96	86	231	76	87	130	4	715
71	Electric power	82	0	150	0	0	0	0	241
66	Crude oil and natural gas	0	0	0	4 501	0	0	3 101	7 725
	Non-Competitive imports								
00	Food and agricultural products	220	59	16	103	36	800	1 295	2 543
01	Raw materials	30	0	25	6	8	152	319	576
02	Industrial products	14	13	261	214	763	2 435	4	3 772
	T o t a l	5 152	3 124	13 992	12 255	11 594	26 965	8 657	83 563

1) COMECON is included in the total.

Table 2. Norwegian commodity exports in 1980 by MODAG-classification and importing country (group of countries). Mill.kr.

		Den-mark	Fin-land	Sweden	United King-dom	West Germany	Other OECD	Develop. count-ries	Total [1]
11	Agricultural products	13	13	13	41	96	180	10	368
12	Forestry products	6	0	155	2	6	1	1	171
13	Fishery products	71	3	44	37	72	119	4	351
32	Coal	1	0	1	0	19	0	1	22
33	Other ores and minerals	9	37	55	64	508	260	6	1 035
16	Food products	220	312	943	781	261	1 932	1 207	5 793
17	Beverages and tobacco	3	12	32	1	7	19	2	76
18	Textiles and wearing apparel	168	101	414	104	119	231	25	1 204
26	Wood and wood products	121	6	212	142	164	293	42	983
34	Paper and paper products	245	12	161	949	742	1 216	696	4 389
37	Industrial chemicals	751	145	873	526	312	685	778	4 127
41	Petrol	138	0	129	270	35	256	1	829
42	Fuel oils etc.	411	37	430	214	154	504	40	1 790
27	Non industrial chemicals etc.	298	133	962	349	347	1 150	387	3 732
43	Metals	587	234	1 276	2 003	3 065	4 195	944	12 620
45	Metal products, machinery and equipment	577	392	1 979	527	616	2 084	944	7 285
50	Ships and oil platforms	66	21	277	249	67	309	1 404	2 405
28	Printing and publishing	16	7	38	2	4	9	2	78
71	Electric power	87	0	175	0	0	0	0	262
66	Crude oil and natural gas	0	0	297	31 556	8 870	676	0	41 399
	Non-Competitive imports								
00	Food and agricultural products	2	0	10	0	1	0	0	13
01	Raw materials	1	0	1	1	1	0	1	5
02	Industrial products	6	13	10	15	4	212	3	268
T o t a l		3 797	1 478	8 487	37 833	15 470	14 331	6 498	89 205

1) COMECON is included in the total.

annual percentage changes in the period 1972-81 is calculated to 6.6 percent for commodity exports and 4.4 for commodity imports. Even in these figures there is a certain amount of uncertainty left out because oil and gas, ships and equipment for oil production are excluded. The forecasts for services are even more imprecise. A closer examination of the table reveals an extremely bad forecast for the imports of commodities in 1978. Imports went down with almost 10 percent this year while the predicted value was a growth of nearly 4 percent. A great deal of the discrepancies between observed values and forecasts are due to contractive policy measures introduced during the year in 1978. This change in policy led to a drop in private consumption and also to a lower growth rate in GDP than predicted. If this year is left out, the average absolute error for imports of commodities is reduced to 3.3 percent. This is yet more reliable than the export forecasts, but more than twice as high as the error for private consumption and GDP.

The export forecasts were overoptimistic in the 1970s until 1978 when the predictions turned out to be more reliable. In retrospect one may say that the expert assessments failed partly in the assumption about the development abroad and partly in misjudging the domestic production costs as a factor behind export performance. The optimistic export forecasts also led to overestimation of the growth rate of GDP.

From examination of table 3 it is rather obvious that the imprecise forecasts of foreign trade have caused considerable uncertainty in the short term outlook of the economy. Efforts in improving the analytical tools are therefore highly welcomed by the planning authorities.

4. Outline of a Nordic INFORUM system of models

The basic ideas behind the INFORUM-IIASA international system of input-output models were stated by its founder professor Clopper Almon in a paper for the Seventh International Conference on Input-Output Techniques in 1979 in three main points:

- connection through international trade
- similarity in input and output conventions
- freedom for diversity in internal structure.

As a result of this initiative today about 20 institutions from different countries participate in the model system. The final goal of linking models contributed by national partners still lies ahead, but will hopefully be achived in the near future.

Table 3. Export and import of commodities and services, private consumption, and gross domestic product. Annual percentage changes in volume (forecasts and observed values), and current values for 1981

	Bill.kr 1981	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	e
Export of commodities[1] ...	53.9										
Forecasts		11.8	6.1	5.2	16.6	12.0	3.0	5.0	4.0	0.1	6.6
Observed		10.3	-1.0	-12.5	11.0	-2.7	4.3	9.2	-0.5	3.0	
Export of services[2]	9.3										
Forecasts		10.1	28.1	23.9	9.9	10.3	6.4	4.7	4.4	7.9	7.9
Observed		13.0	20.9	14.3	10.7	-5.4	-6.9	17.7	0.3	3.3	
Import of commodities[3] ...	84.9										
Forecasts		10.0	9.5	7.5	7.9	10.2	3.9	6.0	3.7	0.4	4.4
Observed		14.5	10.5	1.1	10.0	7.5	-9.8	4.7	9.0	-2.5	
Import of services[4]	9.3										
Forecasts		11.6	5.1	5.9	5.8	7.5	6.1	5.0	2.5	1.8	6.3
Observed		9.1	10.0	17.7	10.3	6.5	14.3	-10.4	-0.8	-3.5	
Private Consumption	155.5										
Forecasts		4.3	4.0	5.7	4.3	4.4	3.2	0.0	2.1	2.0	1.7
Observed		2.9	3.9	5.1	6.1	6.9	-1.6	3.2	2.2	1.5	
Gross Domestic Product	328.0										
Forecasts		4.6	5.4	6.2	7.0	8.0	6.8	1.8	4.2	1.0	1.5
Observed		4.1	5.2	4.2	6.8	3.6	4.5	5.1	3.9	0.8	

1) Excl. oil and gas, ships, and equipment for oil production.
2) Excl. tourism, gross receipts from shipping, and oil drilling and pipeline services.
3) Excl. ships and equipment for oil production.
4) Excl. tourism and gross expenditure for shipping and oil drilling.

e = Average absolute error between forecasted and observed annual percentage changes in the period 1972-81.

The international INFORUM system of models fits very well into the Norwegian framework of planning models, and there is a growing interest and concern for modeling the foreign trade sector of the models in use. Such a system can improve assessments of foreign trade if the forecasts of the national models in the system are reliable and the linking mechanism represents foreign trade relations in a satisfactory way.

As part of this more comprehensive international project, government and research institutions in the Nordic countries (Denmark, Finland, Norway and Sweden) decided at a meeting in February 1982 to try to establish a Nordic INFORUM system of models or a submodel to the INFORUM system, called NORDHAND. The four Nordic countries constitute a group of small open economies with a considerable amount of mutual trade. The model system in preparation is also planned to include foreign trade with other countries. The data base will comprise 12 countries or groups of countries. In addition to the four Nordic countries, these are the United Kingdom, West Germany, Other EEC countries, the United States + Canada + Japan, other OECD-members, Centrally planned economies in Europe, OPEC countries, Other countries.

The Nordic system of models will be based on a grouping of commodities that comprise 36 groups. These groups are defined so as to be aggregates of the 119 SITC-commodities in the INFORUM-system. (See the Danish paper for details.) National input-output models for the respective countries will be joined in the model system. The use and further development of the national models will be left to the participating institutions. The model system will include a trade model, and the first approach to this will be quite simple.

With differing commodity specifications in the national models, transformation matrices for converting exports and imports to the common grouping of commodities must be established. The transformation matrices must also take into account the necessity of transforming the national trade figures to a common currency. The data work in the first phase of this project will be to establish time series for market share matrices for exports and imports by commodity and countries. The model system will also include export relations for exports to some countries outside the Nordic area.

The national model for Norway will be the model MODAG in current use in the Central Bureau of Statistics. The model is described earlier

in this paper, and the current version is quite similar to MODIS. The Swedish model, named ISMOD, comprises 28 industries with a detailed representation of different technologies in the manufacturing sector. The national model for Finland, named FMS, also comprises about 30 industries. The model system consists of various submodels with the input-output production-consumption model and the price model as the main parts. The Danish model is the most disaggregated one with 117 industries. The model is at present simple with regard to economic content, but development is going on to make the model less open and with more behavioural relations.

The outline of a trade model presented below is meant as a first step in creating a more comprehensive trade model. The model presented is a simple market share model. The national models are represented here only through a vector of activity levels, comprising production as well as final demand, and a vector of commodity exports.

Imports of each commodity represented in the national model is estimated from an import share matrix.

(1) $B^k = T_B^k \cdot m_k \cdot A^k$ Vector of imports by commodity in country k

where A^k = activity levels of country k,

m_k = import share matrix for country k, and

T_B^k = transformation matrix for imports in country number k, i.e. for transforming national commodity classification to the common Nordic list of commodities.

The inter-Nordic trade structure is described by a matrix M, each element of which is a vector:

M_{kl} = market shares by commodity of country k in the imports of country l.

The exports of country k can now be determined from other countries' imports as

(2) $X^k = \sum_{l \neq k} M_{kl} \circ B^l$

By means of a transformation matrix T_x^k, X^k can be transformed to the commodity classification of the national model.

The trade matrix M, which really is threedimensional, can be constructed from foreign trade statistics, such as given for Norway in tables 1 and 2 above. Implicit in the above reasoning is that for a given year import of a given commodity by country i from country j is equal to the export of the same commodity from country j to country i. This is not necessarily the case in the foreign trade statistics. There are several reasons why deviations from this may occur. The statistical data will have to be reconciled to fulfil this condition. There is now work going on to compile time series for the elements in M.

The model (2) will be applied to inter-Nordic trade. Exports to countries outside the Nordic countries will be estimated from export relations very much like the short-cut link in the INFORUM system of models described in the Status Report, December 1980.

$$(3) \quad X_L^k = (\alpha + \beta \sum_j M_{kj} \cdot D_j) \left(\frac{P_k}{P_L}\right)^{\gamma}$$

where X_L^k = exports from country k to the rest of the world,

D_j = domestic demand in country j,

p_k = export price for country k,

p_L = weighted average of exportprices for export-competing countries, and

γ = price elasticity

In the ongoing work with the Nordic INFORUM project the export relations (3) will be estimated for four aggregate commodity groups, food, raw materials, energy and manufactures. This strong aggregation is mainly due to data problems, but also because of the difficulty of achiving reliable estimates to be used in the model forecasts.

The Nordic INFORUM system of models as outlined above, will be operating in the following way:

Each Nordic country carries out model calculations of the national I-O model based on estimation of exports to the world outside the Nordic

countries and preliminary guesses of the Nordic trade. From the preliminary estimation of imports in the national models, the inter Nordic exports can be determined. Differences between the "guesstimates" and the model calculated exports, requires another round of national I-O model calculations - and so on until the discrepancies are acceptable. The evaluation of the overall model results may of course lead to further model calculations based on revised market shares, changes in other exogeneous variables or policy instruments. The iteration procedure presupposes that each participant in the project easily can run the national model, and that the model results quickly can be distributed to the others. No steps have been taken so far to make the national models run on the same computer or be programmed in a common language. In connection with further development of the model system, and specially in the case of linking the Nordic system to the international INFORUM system of models, these problems will have to be resolved and SLIMFORP might then be the nearest alternative.[1)]

The use of the national models in the model system are an important feature of the project. And the success of the project is highly dependent on them. Specially in the use and analysis of the model results it is necessary that the national models are built upon a common framework and that the economic behaviour in the formal relations are of approximately the same type covering equal parts of the economy.

The model system will benefit from operational I-O models in use in the Nordic countries. The system will secure consistent trade between them, and the feed-back effects will be fully taken care of. The detailed specification of exports and imports and the integration into the input-output structure of production and demand, make the model system very well suited in analyzing structural changes and the development of trade.

The model system are, of course, very simple in economic content, and should be further developed, first of all by introducing prices or cost indices to endogenize the inter-Nordic market shares. At present the shares are treated exogenously given, and changes have to come from trends in time series, or intuitive assessments of the impact of the use of policy instruments or other factors.

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1) The SLIMFORP program is converted to a NORD 10 computer in the Central Bureau of Statistics, and a slim version of MODAG is implemented.