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MACROECONOMIC MODELS FOR MEDIUM AND LONG-TERM PLANNING

By

Knut Eggum Johansen and Henning Strand

MAKROØKONOMISKE MODELLER FOR PLANLEGGING PÅ MELLOMLANG OG LANG SIKT

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PREFACE

An important feature of the Norwegian model building effort has been the close co-operation between model builders, planners, data suppliers, and the main academic institutions for economic research. The Central Bureau of Statistics has had a double role in this co-operation, being the main model building agency as well as the data supplier.

This report on macroeconomic models in use in economic planning and policy making in Norway was prepared for the "Seminar on Recent Innovations in Economic Models including Methods for Planning Complex (large-scale) Development Projects", arranged by United Nations Economic Commission for Europe, Senior Economic Advisers to ECE Governments. The seminar took place in Geneva, Switzerland, 27 April - 1 May, 1981.

The report has been prepared in the Government Secretariat for Long Term Planning and Coordination by Mr. Knut Eggum Johansen in co-operation with Mr. Henning Strand. The report is to a considerable extent based on model documentation available in the Central Bureau of Statistics. The report gives a comprehensive survey of macroeconomic modeling within the government administration that may have interest for a wider public.

Central Bureau of Statistics, Oslo, 4 September 1981

Odd Aukrust

FORORD

Et viktig trekk i arbeidet med økonomiske modeller i Norge er det nære samarbeidet mellom modellbyggere, modellbrukere, dataleverandører og de akademiske forskningsinstitusjonene. Statistisk Sentralbyrå har en dobbeltrolle i dette samarbeidet idet Byrået, ved siden av å levere data, er den sentrale institusjon i modellutviklingsarbeidet.

Denne rapporten om makroøkonomiske modeller i bruk i økonomisk planlegging og politikkutforming i Norge er utarbeidd for presentasjon på "Seminar on Recent Innovations in Economic Models including Methods for Planning Complex (large-scale) Development Projects", arrangert av United Nations Economic Commission for Europe, Senior Economic Advisers to ECE Governments. Seminaret foregikk i Geneve 27. april til 1. mai 1981.

Rapporten er skrevet i Planleggingssekretariatet av underdirektør Knut Eggum Johansen i samarbeid med førstekonsulent Henning Strand. Rapporten bygger i utstrakt grad på modelldokumentasjon utarbeidd i Byrået. Byrået har ønsket å publisere rapporten fordi den gir en samlet oversikt over modellverktøy som kan ha interesse for en videre krets.

Statistisk Sentralbyrå, Oslo, 4. september 1981

Odd Aukrust

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1. SUMMARY

Economic and social planning has been an integral part of Norway's institutional structure and government policy since the end of World War II. It has enjoyed broad political support.

It is significant that the planning function has been built into government administration, instead of being left to agencies outside the government. This reduces the risks for duplication, rivalry and blurred lines of responsibility, while at the same time enabling government bodies to act more effectively, concentrating their attention on major policy matters.

Use of quantified economic models as analytical tools in the planning and policy-making process, has a long tradition in Norwegian macroeconomic planning. The first version of MODIS (an input-output model for short- and medium-term analyses) was used in the elaboration of the National Budget for 1961. An important basis for the model development was the administrative routines that were already established for the elaboration of the National Budgets.

The importance of the quantified models has grown, also for long-term analyses. During the 1970's, a model system for long-term analysis has been established with the socalled MSG-model as a core.

An important feature of the Norwegian model building effort has been the close co-operation between model builders, planners, data suppliers, and the main academic institutions for economic research. The Central Bureau of Statistics has had a double role in this co-operation, being the main model building agency as well as the data supplier. The Ministry of Finance and now also the Government Secretariat for Long Term Planning and Coordination, which have the main responsibility for macro-economic analyses, has to a large extent adapted their planning routines according to the requirements of the model. The administration has, however, also had ample opportunity to influence the model development, and the successive model versions have been more and more adapted to the policymaking framework.

This note gives a brief review of the two model systems which are currently in use for medium- and long-term policy analyses. The purpose is not to give technical documentation, but rather to review the various models which now are included in the two model systems. Furthermore, the note describes the main assumptions that the various models are based on and the administrative setting within which they are used.

2. INTRODUCTION

Economic and social planning has been an integral part of Norway's institutional structure and government policy for the last 35 years (cfr. i.a. Bjerve (1976)). It has enjoyed broad political support. While there are differences among the policital parties about the use and tuning of the instruments of economic and other policies, whichever party is in power makes full use of the planning machinery.

Five main characteristics are often referred to in descriptions of economic and social planning in Norway:

- Planning is the responsibility of the constitutional authorities.
- The planning units are an integral part of the government administration, not separate organizations.
- The plans are not mere forecasts but, to a large extent, actual programmes of the Government.
- The economic part of the plans is prepared within the framework of national accounts with the aid of disaggregated economic models.
- Main instruments of planning are fiscal and monetary policies, and in some areas, regulatory laws or agencies.

It is significant that the planning function has been built into government administration, instead of being left to agencies outside government. This reduces the risks of duplication, rivalry and blurred lines of responsibility, while at the same time enabling government bodies to act more effectively, concentrating their attention on major policy matters.

There are three main policy documents with a national coverage:

- Annual fiscal budgets for the Central government and for the Social Security System. This document contains also four-year fiscal budgets for the Central government and the Social Security System. These are revolved each year, but are more aggregated in their presentation than the annual budgets.
- Annual plans, covering the entire economy called "National Budgets". The first National Budget was worked out for the year 1947.
- Long-term programmes, presented with full coverage every four years. These programmes also contain perspectives beyond the four-year period. The first Long-Term Programme covered the period 1949 - 1952.

The National Budget and Fiscal Budget both cover the calendar year. They are presented at the same time and are based on co-ordinated general economic assumptions and policies. The Long-Term Programme is presented every fourth year and is closely co-ordinated with the elaboration of the four-year fiscal budget.

In addition to these documents, long-term planning documents covering subjects of specific importance, such as the Norwegian petroleum industry or natural resources and economic development, are presented as the occasion demands. All these documents are submitted by the Government to the Storting, (the Parliament) and thus form a basis for major policy decisions. All Ministries are involved in preparing these documents.

Use of quantified economic models as analytical tools in the planning and policy-making process, has a long tradition in Norwegian macroeconomic planning. The first version of MODIS, which is a model for short- and medium-term analyses, was used in the elaboration of the National Budget 1961. Work with quantified models had then been going on since the first few years after the Second World War, particularly at the Institute of Economics at the University of Oslo, and in the Central Bureau of Statistics. An important basis for the model development was the administrative routines which were established for the elaboration of the National Budgets. The common conceptual basis was the national accounts.

When the first models were taken into active use, extensive administrative routines were already established to which the model had to be adapted. The various sector ministries continued to be important sources for assumptions and target formulations, which the model calculations were based on. In this way the use of models became an integrated part of the already existing administrative routines in the planning and policy-making processes.

During the 1970's, a model system for long-term analyses was established with the socalled MSG-model as a core. The importance of these analyses has grown, i.a. as background for long-term sectoral plans.

The planning machinery has been considerably extended during the 1970's. Most ministries now have their own planning departments. Parallel to this development the analytical methods have also been improved. In addition to improvements of the two "core-models", MODIS and MSG, an extensive system of smaller models have been developed around these models. These models are used to generate assumptions to the models (pre-models) and to analyse the results of these models (post-models).

An important feature of the Norwegian model building effort has been the close co-operation between model builders, planners, data suppliers and the main academic institution for economic research.

The Central Bureau of Statistics has served in a double role within this co-operation, as the main model building agency as well as the data supplier. The Ministry of Finance and now also the Government Secretariate for Long Term Planning and Coordination, which carries the main responsibility for macroeconomic planning, has to a very large extent adapted administrative routines according to the requirements of the models. But there has been a two-way channel of adaption. The administration has had ample opportunity to influence the model development, and the successive model versions have been more and more dedicated to the policy-making framework.

This note gives a brief review of the model systems which are currently in use for medium- and long-term policy analyses. The purpose is not to give technical documentation, but rather to review the many models which now enter the model systems and to describe the main assumptions on which the various models are based.

3. MODELS FOR MEDIUM-TERM ECONOMIC ANALYSIS

3.1. MODIS IV

MODIS IV is the core of a group of models which is utilized for analysis both for short- (one year) and medium-term (four years) (cfr. Bjerkholt and Longva (1980) and Aukrust (1979)). The construction and use of the MODIS models have been an ongoing project for nearly twenty years. For a long time before the first MODIS model was constructed in 1960, stretching all the way back to the period immediately after the Second World War, a comprehensive model for national economic planning was envisaged as a future development, and the foundations for such a model were laid.

Over the years since 1960 the successive versions of MODIS have become useful tools for the management of the Norwegian economy. The use of the model has been integrated in the day-to-day tasks of the administration. Changes in the model structure have induced altered routines in the preparation of economic policies and, reversely, changes in user needs have thoroughly influenced the development of the model. Other models have been developed and put in regular use in the wake of MODIS.

The first MODIS model, MODIS I was a simple Leontief model with an aggregate consumption function. The number of industries was about 125. The model had variables in constant prices only and no price

relations. The theory underlying the use of the model was that of Keynesian demand management.

The next version, MODIS II, which arrived in 1965, had much more ambitious aims. This version included a complete set of input-output relations in prices as well as quantity relations. The number of production sectors was increased to about 140 and final demand and other variables were dealt with in a considerably more detailed way. The price model was based on the subdivision of the industries in sheltered vs. exposed industries, sometimes referred to as the Norwegian model of inflation.

MODIS II had, however, its weaknesses both with regard to content and in terms of operationality and reliability. The model has therefore been improved in various ways.

The present version of the MODIS model, - MODIS IV - specifies about 200 commodity categories and 250 production activities, including government activities.

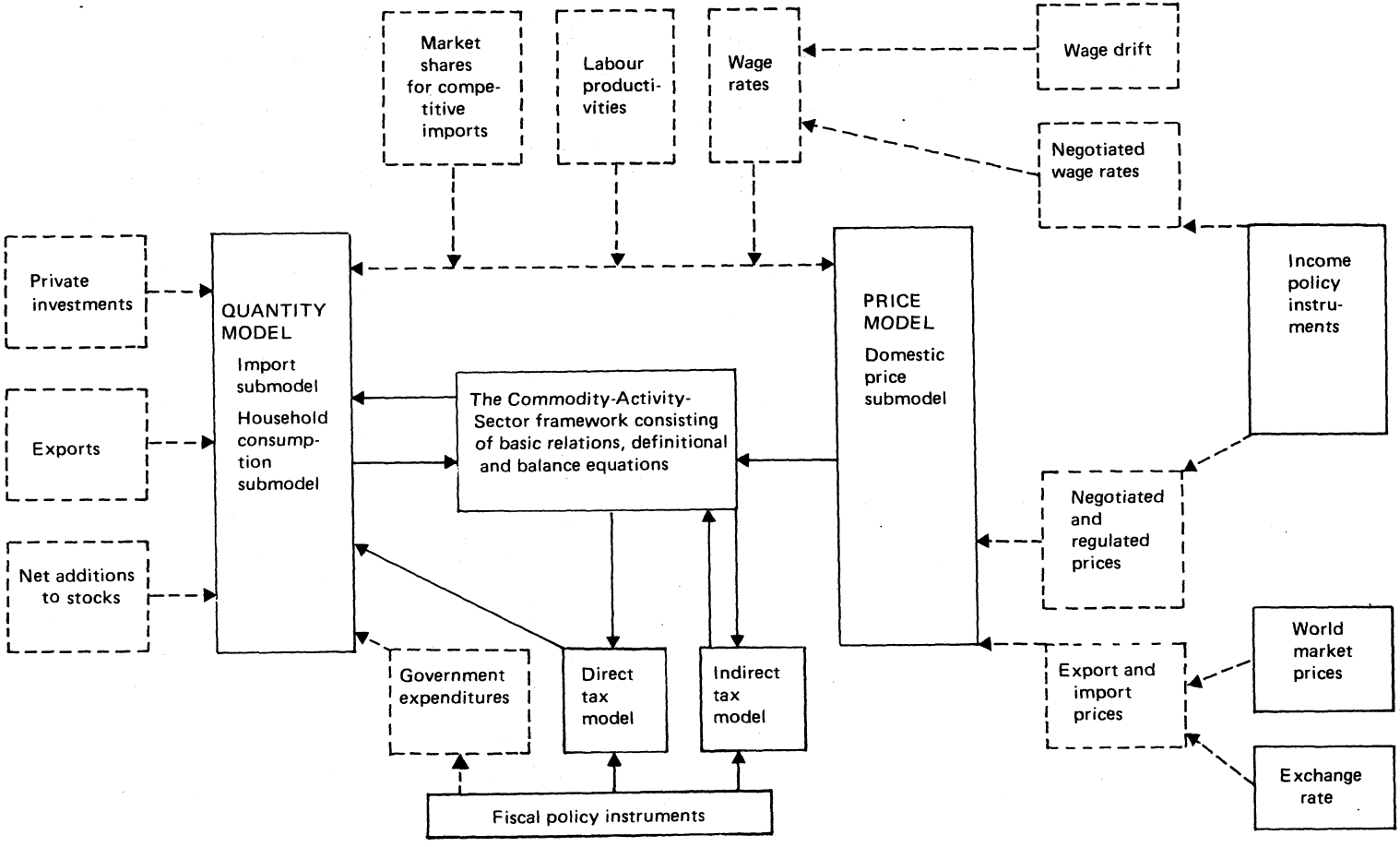
The structure of the model may be outlined as in diagram 3.1. Full-drawn boxes indicate formalized parts of MODIS IV. Dotted boxes indicate still unformalized parts. Other informal models, e.g. sector models, might be added to the diagram. The connection between informal models and MODIS IV is mediated through exogenous variables and parameter changes. The model is thus, at the present stage, "closed" at various points by exogenous assumption instead of appropriate additional models.

The central part of the model is the conceptual and accounting definitions and the basic relations representing the technoligical structure and the cost structure of the economy. The technological and cost structures are modelled by using a modified form of the input-output formulation of Leontief.

Apart from the accounting definitions and the basic structural relations the model consists of a number of parts, or submodels, the main ones being those belonging to the quantity model and the price model. At present there are in addition two submodels for direct and indirect taxes, respectively.

Indicated in diagram 3.1 are also additional submodels which at the present time are not formalized within the MODIS IV-framework, but which reside in the administrative environment. In the further development it is an aim to include in the formal framework all interrelations between the variables of the model. It is almost inevitable, however, that the full model of the functioning of the economy as seen by the user is for some parts too complex or too vague to be included in the computational set-up.

Diagram 3.1. STRUCTURE OF MODIS IV



The MODIS model is very open in the sense that it contains very few assumptions about economic behaviour. The development for a vast number of key variables has to be set exogenously by the model user. Many of the variables which are exogenous in the model are clearly endogenous in the economy. This means that their values should be consistent with each other and with the values that are endogenous in MODIS. One therefore often has to go through a number of solutions of the model in order to attain a consistent picture of the economic development. An example is the investment estimates in various sectors. Investment assumptions must therefore be related to the model-generated estimates of corporate profits.

On the output side the output from the model consists of values of about 5 000 variables for each year of each time path. The number of individual values may thus easily come in the range of hundreds of thousands.

To ease the use of the model there are developed socalled impact tables which indicate the result on endogenous variables by a specified change in one exogenous variable (cfr. Cappelen, Holm and Sand (1980)). The impact tables contain the partial derivatives, numerically calculated, of the reduced form of the model. The tables are constructed by solving the model for a large number of alternatives, in each alternative a different group of exogenous variables is changed slightly to produce the impact on main categories of endogenous variables. The impact coefficients (the partial derivatives) are recalculated each time the model is updated, i.e. once a year, and normally the impact of separate changes in 100-150 groups of exogenous variables are computed. The impact tables are used in the preparation of input for sequences of model runs and also for ad hoc analysis. The use of such impact tables may reduce the number of computations necessary to reach a certain result with the model. The impact tables may also be used to develop alternatives in relation to an established reference path as long as the dveiation is not too large, and the number of exogenous variables that are changed is not too extensive. The tables are freely available and are used for widely varying purposes when a full model run is not needed.

The model has about 2 000 exogenous variables. For a time path of six years there will be about 12 000 input assumptions to make. With alternative time paths and sequential runs the number of input assumptions in one single application of the model will reach quite unmanageable heights. In actual fact the number is not quite that overwhelming.

The alternative time paths and the sequential runs will usually differ only slightly or to a limited extent from the "main alternative" in the first run of the model in terms of the number of exogenous variables that differ. To simplify the use of the model the set of input variables can be aggregated in alternative aggregations. The whole set of input variables is divided up into subsets by type of input assumptions. For each subset several levels of aggregation can be defined in advance. To give a total set of input assumptions one may choose an appropriate level of aggregation for each subset. On the output side the whole set of values for output variables is passed on to a program package for tabulating national account data. The output variables from the model are given identification codes which correspond closely to those used within the national accounting system with identical codes when variable definitions coincide. The tabulating system includes a library with a wide range of edited tables. The user may choose tables from the library to fit the problems under consideration or even have special tables made. The produced tables may also include historical values from the national accounts for the preceding years according to the user's wish.

The approach for medium-term analysis has to a large degree been based on an instrument/target type of analysis. The possible set of various economic policies in the short run is relatively limited. Instruments are often tied to decisions already made.

For medium-term planning it is often of more interest to sketch out the various possibilities for reaching certain specific targets for the economic development. The use of the model for target/instrument analysis may, however, take considerable time and thereby be comparatively costly.

As mentioned above, a central part of the MODIS IV models in the input-output table (the "commodity-activity-sector" framework in diagram 3.1), representing the technoligical structure and cost structure of the economy.

This table is in Norway an integral part of the national accounts and is therefore re-estimated yearly as new national accounts figures are calculated. This particular trait of the Norwegian national accounting system secures that an updated picture of the input-output structure always is available. This is of importance in connection with short-term planning. The short-term planning is in most countries to a large degree based on the development in cyclical indicators. These

indicators, relating both to exogenous and endogenous variables in the MODIS IV system in the Norwegian case, will contain random disturbances which even the most refined statistical methods will be unable to eliminate. Such disturbances may then lead to misinterpretations of the economic development.

Having an updated input-output table picturing the structure of the economy, gives the opportunity of reconciling the development in different cyclical indicators. This will obviously be a convinient way to evaluate the development in cyclical indicators relating to endogenous variables in the model. In cases where one deems these cyclical indicators to be more accurate than the indicators relating to exogenous variables, the model might also preferably be used to evaluate these indicators. For instance, indicators of production in manufacturing industries may in several countries be more reliable than indicators for final demand components.

Furthermore, the use of this part of the model in conjunction with a cyclical indicator system may give some information about the development in variables for which there exist no current indicators. This may e.g. be done for the development in market shares for imports which is exogenous in MODIS IV, cfr. diagram 3.2a. This variable is crucial both to the development in production in manufacturing industries and to total imports of goods, both are variables for which reliable current indicators exist.

The recognized incomplete character of the model naturally raises the question of extending the model to become a more self-contained representation of the economy. One main obstacle in pursuing this idea, is the sheer size of the model. An extension of the model with new relations will easily make the model unmanageable from an operational point of view without drastically reducing the dimensions of the model or reprogramming from scratch.

Another consideration preventing the extension of the model to include more behavioural relationships is the fact that model is deeply embedded in the administrative planning routines. If this is to continue the detailed links to the fiscal budget must be further developed. In addition, the model should not be developed to become a "black box" for the model users by introducing more or less well-founded and maybe not generally accepted relationships into the model, however promising such experiments may seem from a purely exploratory point of view. All

experiences with the MODIS model up to now have shown that if the model is to be used for useful purposes in the national budgeting and planning process it must be possible to have a full understanding of the logic of the model and to be able to "control" the running of it in such a way that the results can be accepted by the model users as a reasonable picture of the economy.

In extending the MODIS system the strategy chosen is to leave the formal model as it is with only modest improvements in basic structure and improve the use and usefulness of the model through conjunction in use with other models. These models are of two kinds:

- General models considerably more aggregated than MODIS IV but covering the whole economy

  and

- special support models to improve deficient or simply non-existent parts of MODIS IV.

A typical use of a support model is thus to provide exogenous estimates for MODIS IV. The purpose of the general models is to provide better and more manageable tools for analysing important economic issues so that the results can be "translated" into MODIS specifications for fully detailed breakdown using the latter model.

Under construction at present is a comprehensive system of general models to surround MODIS IV rather than replace it. The central elements of this system will be three macroeconomic models of different time horizon. One of these is a medium-term annual model with about 30 industries, the others are a quarterly short-term model with about 12 industries and a long-term model with about 30 industries.

The medium-term model will have strong similarities with MODIS IV and may be considered at the outset as a more aggregate version of MODIS. Plans for further development of this model, which has been baptized MODAG, will turn it into a more complete model of the economy (cfr. Bjerkholt and Longva (1980)). Results from exercises with the more aggregate model can be spread out in full MODIS IV detail by appropriate translation of assumptions and results into exogenous variables and parameters of MODIS IV. This will allow the development of more complete models while still retaining the links with the details of MODIS IV. Several of the support models designed to provide exogenous estimates ("pre-models" in the current jargon) are discussed in chapter 3.2.

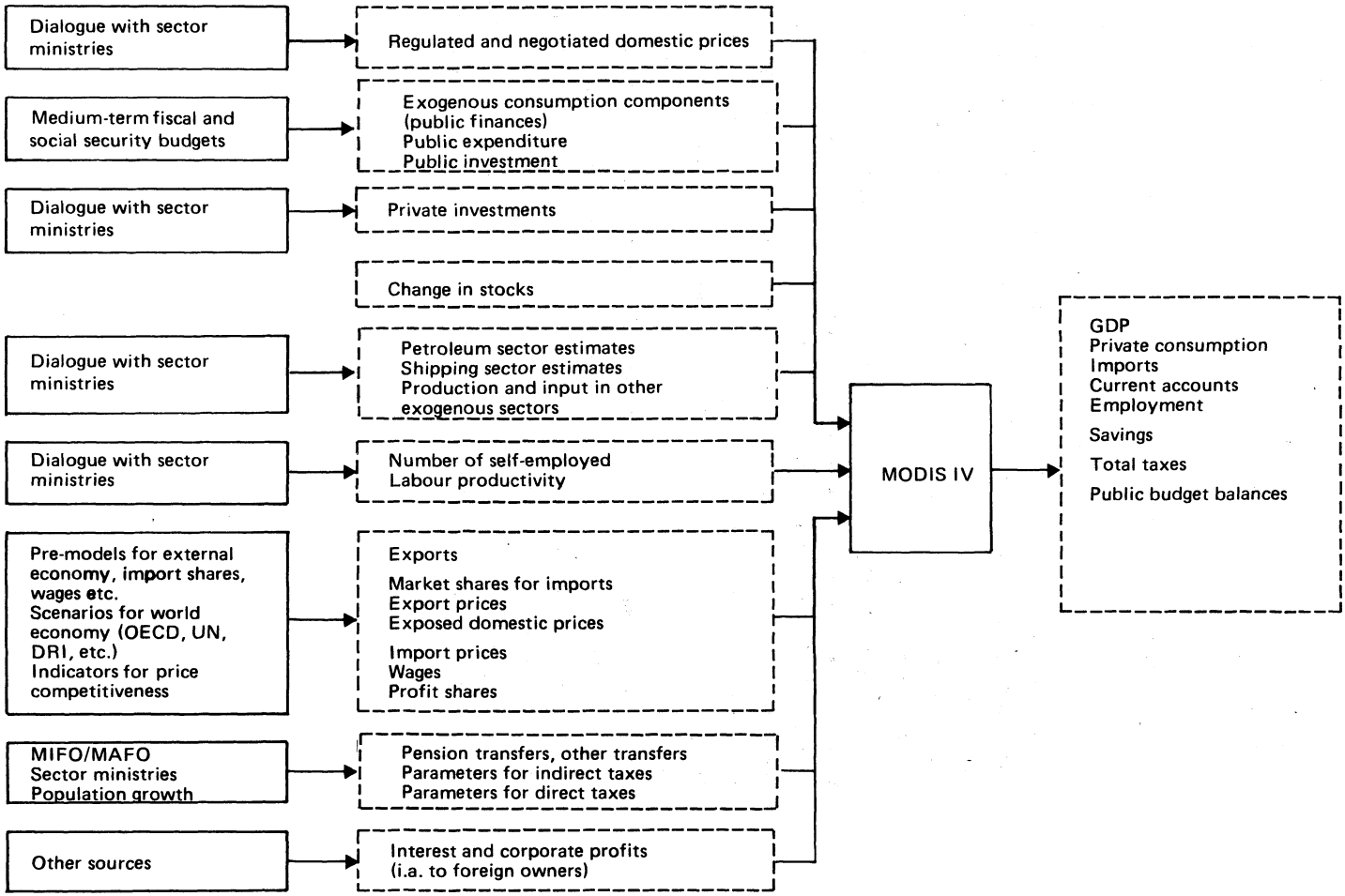
Most of these pre-models include variables which are endogenous in the main model. This means that an iterative use of the system is necessary to achieve fully consistent solutions. With the more or less continuous use of the MODIS model satisfactory degrees of consistency are usually well within reach.

3.2. Support models and other sources of information

Diagram 3.2a gives a schematic presentation of the model system and the various sources of information which is currently used in connection with MODIS IV. The various blocks of exogenous variables are indicated by boxes with dotted lines. Sources of information are indicated in boxes with complete lines. Some of these sources of information will be commented upon before the formalized models which enter the system are presented.

A medium term fiscal and social security budget is revised yearly. These budgets have a four-year perspective. They shall as far as possible indicate expenditure estimates which follow from the current decisions and new programmes that are planned for the period. For the medium-term macroeconomic planning the estimates of the public demand for goods and services are essential. The transfer estimates are to a large degree reassessed according to their impact on private consumption, investment and saving. In this regard policy goals will be linked to the development of real disposable income for various social groups and not to the size of the transfers as such. In the macroeconomic computations the assumptions about various income components, wage income corporate profit etc. will be balanced in order to attain an acceptable development of other variables like employment, production, consumptions, current account balance, etc.

Diagram 3.2 a. MODEL SYSTEM AND SOURCES OF INFORMATION IN MEDIUM-TERM ANALYSIS



Government's purchase of goods and services will to a larger degree than for the transfers be related to specific policy goals. In this context the impact on employment, public budget balances, relationship between public and private sectors etc. will be of greater importance. The macroeconomic analysis is therefore an important background when the public budgets are worked out.

In the municipalities, medium-term budgeting is still in an early introductory state. Only a few municipalities have medium-term budgets, and these budgets are not easily comparable. The different assumptions these budgets are based on will probably also differ quite substantially between the different municipalities. An aggregation of such budgets will easily show for instance that increase in employment and tax revenue will far over-rate the employment and tax figures assessed by the central authorities.

The assessment of the municipalities' purchase of goods and services is therefore problematic in the short-term planning. Another factor is that the accounting system is very slow-working. It takes more than one year before the first comprehensive accounts are presented. The result is that the estimates for municipal expenditure have to be very tentative.

As it occurs in diagram 3.2a assessment of oil exploration, oil drilling and shipping are all exogenous in the model. The estimates fed into the model are elaborated in close co-operation with the Ministry of Petroleum and Energy and the Ministry of Foreign Trade and Shipping.

Other sectors are treated exogenous as well, especially sectors where access to natural resources is determining the production. Examples of such sectors are farming, forestry, fishing and the production of hydro-electricity. Assumptions about these sectors are therefore based on information from the ministries responsible for these sectors. The production from all other sectors is in MODIS determined from the demand side. The production estimates have, however, to be checked against assumptions about the capacity in the various production sectors. Such assumptions will then be related to the anticipated investments.

Private investments are to a large extent based on assumptions from the various ministries. In recent years when the investment demand to some degree has decreased and the interest rate has been raised, the availability of credit will no longer limit the investment level. A satisfactory theory for determining investment demand is lacking. The investment estimates are therefore clearly uncertain.

It should, however, be noted that the greater part of gross investments in Norway is either under direct or indirect control by the government, such as gross investments in general government, in oil activities and in dwellings and transportation, or determined mainly by external developments like gross investments in shipping. Gross investments in manufacturing industries, which also include government-owned enterprises, constitute only a small fraction of total gross investments. For the one year projections estimates for investments in manufacturing industries are to some extent based upon anticipation data, collected by the Central Bureau of Statistics on a quarterly basis.

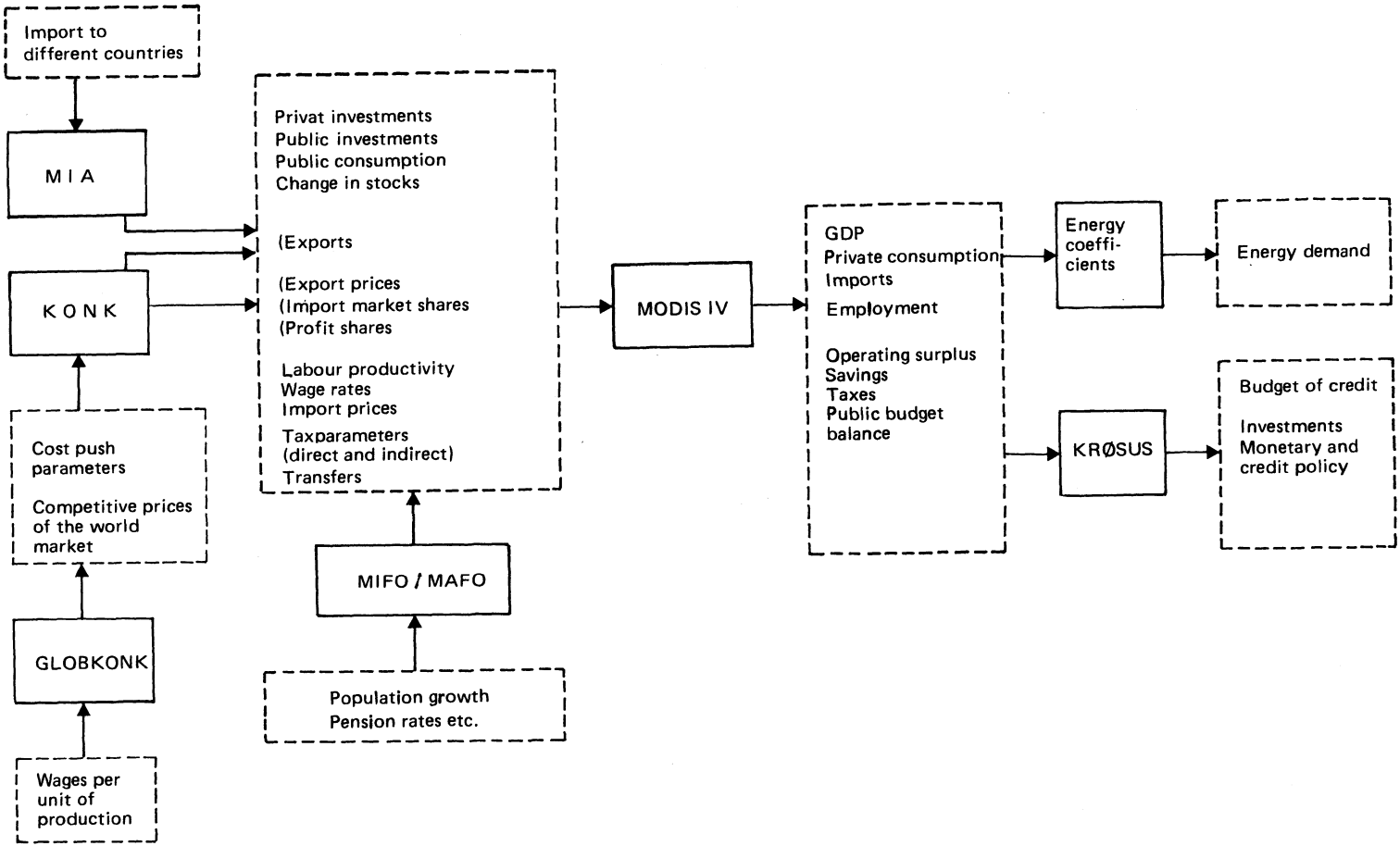
Various credit market regulations form a group of very important policy instruments in Norway. These instruments are not explicitly included in MODIS IV but are underlying the exogenous estimates. A model developed by the Bank of Norway, called KRØSUS, is used to study the impact of these credit policy instruments (cfr. Ross (1978)).

Assumptions of labour productivity are crucial for the employment estimates which the model produces. In the current situation such estimates are highly uncertain. For the last couple of years it has been extremely difficult to attain reliable forecasts of the productivity performance even in the very short run. The estimates are to a large degree elaborated in collaboration with the ministries, first and foremost the Ministry of Manufacturing Industries. Methods to improve these estimates are currently being developed.

In connection with MODIS IV a system of smaller models has been developed. In the "pre-models", routines are systematized to establish the exogenous assumptions which enter MODIS. In the "post-models", routines are established to analyze further the model results. Diagram 3.2b shows the link between variables in MODIS and the pre- and post-models. Results from one computation are used to imporove the estimates for the next computation.

Gross taxes and tax rates are determined according to goals for private consumption and the financial situation of the public sector. It is possible to attain a certain development in the gross consumption estimates by using an unspecified tax figure in addition to the tax rate in the base year. The model results are then analyzed further in the tax model connected to MODIS.

Diagram 3.2 b. MODELS FOR INPUT TO AND OUTPUT FROM MODIS IV To be used in planning for a period of 1-2 years.



These analyses are carried out by the Central Bureau of Statistics. As a result one will attain estimates for tax rates etc. which correspond with the consumption development and income development before taxes. In the short-term analysis the tax model is generally used as a pre-model to clarify the macro tax rates which enter MODIS IV.

The KONK-model (model for analyzing price-competitiveness) consists of a price block and a quantity block (cfr. Ponte Ferreira (1979)). The price part is mainly a construction of cost-input-output matrixes, and a set of relations representing the product price for Norwegian commodities determined by costs and competing world market prices. The quantity model determines changes in market shares for Norwegian exports and imports as a function of differentials in Norwegian domestic prices and world market prices.

The KONK-model has built in felxibility as to the choice of exogenous and endogenous variables. Diagram 3.2c illustrates how the model can be used. For an assumed development in wage rates, productivity, import prices and competing prices for Norwegian goods at the world market, the model computes estimates for i.a. export prices and market shares of Norwegian export and import to Norway. The changes in the market shares are result only from changes in price competitiveness. Other factors as i.a. changes in the international division of labour, quality etc. are not built into the model. The KONK-model produces first and foremost export price estimates, which enter MODIS IV. Furthermore the market shares of import and export can be determined when factors other than price competitiveness are taken into account.

The KONK-model may be used for target/instrument analyses. One can start out with certain goals for the market shares of export and then determine the consistent development of wage rates per produced unit on the basis of the model assumptions.

The experiences after about one year's utilization of KONK are that the model is particularly useful for partial analysis in relation to an established reference path. To establish reasonable estimates for the parameters in KONK has proved to be difficult.

Estimates of market shares in export markets have i.a. to be supplied with assumptions about the growth in the various export markets before it is possible to establish the exogenous export volumes to be put into MODIS. Such estimates may be given on a "free-basis". By the use of the MIA-model (Model for International Activity Level) it is, however, possible to attain a certain consistency check. MIA is a very

simple model. Demand in the various countries is determined from assumptions about the level of activity in the various countries. The total import demand is distributed according to countries through a trade matrix. The experiences in utilization of MIA are, however, so far very limited.

More simple methods are, however, often used to make estimates of the growth in Norwegian export markets. In the short-term planning one often relies directly on the estimates elaborated by the OECD and other sources.

In the model system which is described above many factors that are exogenous in MODIS are made endogenous with the aid of the model system. To utilize KONK, however, it is necessary to establish specific assumptions about price sensitivity in the various sectors. Assumptions about world market prices can be checked through GLOB-KONK (Global Model for Price Competitiveness). This model produces competing prices for Norwegian products on the basis of assumptions of production structure and wage development abroad. As a simplification, the model assumes the same cost structure abroad and domestically for these products. The model is to a larger extent than the other models intended as a pure supplement to other sources of information.

The model MODEX is presently being developed by Central Bureau of Statistics (cfr. Frenger, P., Jansen, E.S., Reymert, M. (1979)). This model will be a supplement to KONK/GLOB-KONK and MIA. The MODEX-model consists of three parts. One block for prices, one block for import volumes and one block for Norwegian export. The theoretical basis for this model is a general equilibrium model with supply and demand relations for export goods. These relations distribute the demand according to countries.

Diagram 3.2 c.

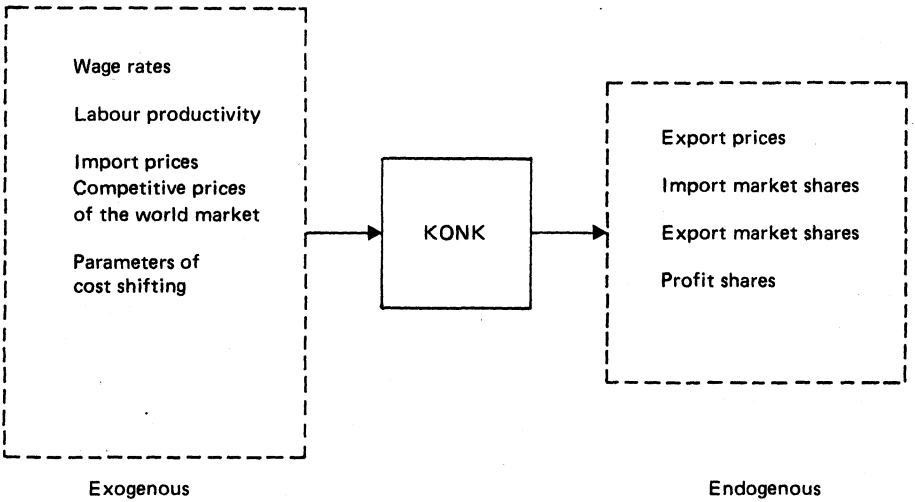
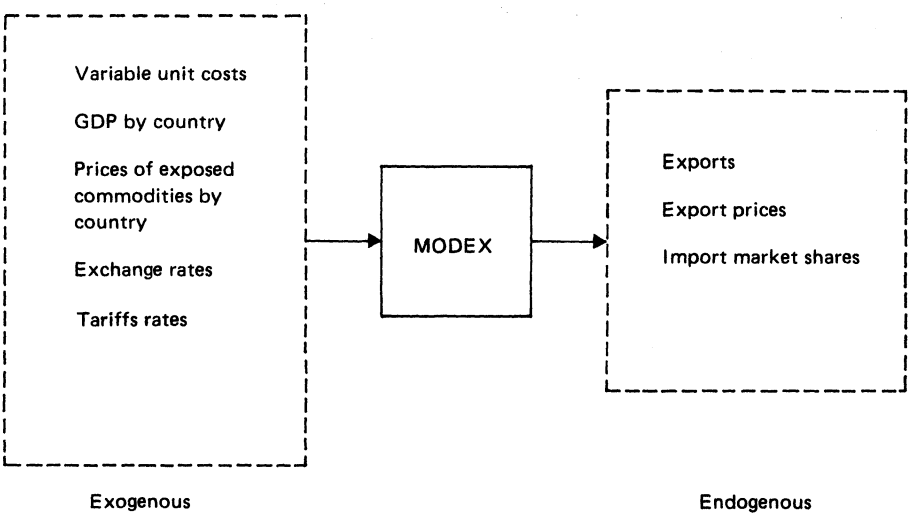


Diagram 3.2 d.



In its present version the model gives estimates for exports of traditional commodities on a very aggregated level. The model will, however, be extended to a more disaggregated treatment of the various commodity groups. Diagram 3.2d shows the main elements in the model.

KONK is based on assumptions about the domestic production structure and the inter-relationship between the sectors. In addition the relations between variable unit costs and prices for imported goods are taken into account. MODEX gives a simultaneous representation of the countries which are specified in the model, but does not contain relations between export prices and variable unit costs and prices of imported goods.

MIFO (Micro Model for Pension Transfers) is a model developed for analyses of the pension transfer sector (cfr. Koren, C. (1981)). The model can be used for a closer analysis of the distribution effects between groups of old age pensioners according to certain assumptions about the pension rates etc.

MAFO (Macro Model for the Pension System) is under development (cfr. Koren, C. (1979)). This model will produce estimates for the total of transfers based on assumptions of demographic development, pension rates etc.

MIFO and MAFO will enter the system as pre-models to MODIS.

MODIS IV produces estimates for saving according to sector. Together with the investment assumptions made, this forms a basis for assessing to what degree the various sectors have to finance their investments through additional credits. This credit demand has to be distributed through the various credit institutions. For short-term planning purposes the Bank of Norway has developed a model, KRØSUS, (cfr. Ross, K. (1978)), where endogenous variables from MODIS enter. This model describes the finance flow in the economy. It also contains variables representing monetary and credit instruments.

The relation between the real and financial flows in the economy has not, to a large extent, been taken into account in the medium-term analysis. However there is reason to believe that these problems will be more emphasized in years to come, particularly because of the huge oil revenues in the Norwegian economy.

For analyses of short- and medium-term energy demand a separate post-model to MODIS has been developed. The results from MODIS IV are used to produce estimates on future energy demand from the various production sectors and from the private households. The model assumes fixed energy coefficient in the various production sectors. It is, however, possible to change these coefficients according to available information. The energy demand estimates are analyzed in relation to assumptions made in MODIS i.a. for the investments in the hydro-electric power sector.

The assumption of fixed energy coefficients may seem unrealistic. MODIS IV is, however, very disaggregated. This means that the effects which in a more aggregated model occur as a result of substitution in one sector, in MODIS may occur as a result of changes in the proportions between the more numerous sectors.

One of the main advantages of the system of models outlined in the preceding paragraphs, are the possibility to have a full understanding of the logic of the system. The price one has to pay for this, is the frequent reruns that will have to be made to make a consistent picture of the economic development. In a more simultaneous comprehensive model this may to some degree be avoided. For this purpose the Economic Policy Department in the Ministry of Finance has developed a model FINMOD which contains many aspects of the greater MODIS IV system as depicted in diagram 3.2b. The main elements in the model are the relationship between export and import shares and the competitive position of the Norwegian economy as described in KONK, a Phillips-curve relationship between prices, wages and labour market pressure, and the relationship between final demand components and production and employment as described by the impact coefficients of MODIS IV.

Many important economic relationships are, however, yet not integrated into FINMOD, and the use of the model is still in a tentative and exploratory stage. For instance are most of the parameter values based on a priori assumptions and are not the result of estimations on historical data. Up to now, the main use had been to examine alternative paths to the one described by MODIS IV, especially paths generated by assigning different values to fiscal policy instruments.

4. MODELS FOR LONG-TERM ANALYSIS

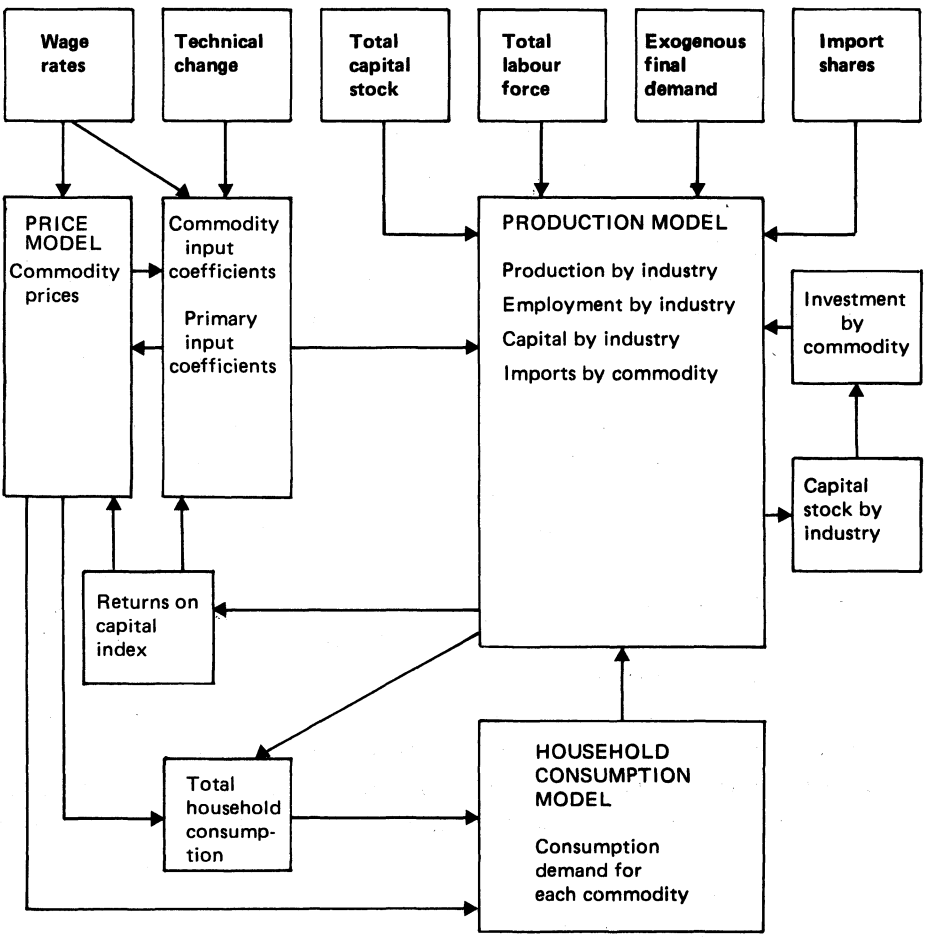
Long-term macroeconomic analysis (20-25 years) is an integrated part of the planning activities in the central administration. Such long-term perspectives have been presented since 1969 in connection with the Long-term programmes.

The Long-Term Programme 1970-73 contained a separate perspective analysis up to the year 1990 as a supplement. In the long-term programmes 1974-77, 1978-81 and in the Report to the Storting No. 50 for 1974-75 on Natural Resources and Economic Development, long-term perspectives up to year 2000 were presented in the programme documents themselves. The elaboration and discussion on these perspectives were an integrated part of the administrative and political process which was the basis of these documents. The models and the methodologies in these analysis have been considerably improved during the 1970's and are now an important basis for long-term energy planning.

The long-term perspectives are based on computations with the MSG-model (Multi-Sector Growth). A new version of the model, MSG-4 model (cfr. Longva, S., Lorentsen L. & Olsen, Ø. (1980)), has been used for elaborating the long-term analyses (up to year 2000) which are presented in the Long-Term Programme 1982-1985. The tests made so far are successful, and the new version which also contains integrated treatment of energy flows will replace the older version. Diagram 4a shows the structure of the MSG-4.

Compared with the present version of the MSG model (MSG-3) several parts have been modified or added in MSG-4. The model has a revised industry classification to include new elements in the modeling of energy flows and the generation and absorption of energy. The input-output part, based on national accounts, traces flows of energy and non-energy commodities measured in constant prices as inputs to industries and final demand. To identify the flows of energy in physical terms, differentiated distribution costs and the occurence of price discrimination have to be accounted for.

Diagram 4 a. STRUCTURE OF MSG—4



The production side of the model has been developed to allow for price dependent substitution between various energy inputs and between energy and other inputs. For most industries the specification of the production structure is at present based on neoclassical theory of production (Generalized Leontief production function). In the description of the supply of hydro electric power, the project benefits from calculations carried out by the Norwegian Water and Electricity Board (NWEB). The results are used to estimate a cost function for the electricity producing sector. In addition the model includes information of resource use in the transportation or distribution of electricity from the power stations to the various user sectors.

The consumption side of the model includes effects on energy demand due to changes in stocks of consumer durables.

As for MODIS the national accounting system forms the conceptual framework of the MSG-4 model. The model includes balance equations and definitional relations, which to a great extent are identical with the real flows of the national accounts. The financial flows are at present not included. A major part of the statistical data required for estimation, including base year values, are supplied by the national accounts.

The production sectors in MSG-4 are aggregates of the production sectors in MODIS. This principle is also used for the sectors representing the final deliveries and the commodities. This implies that the post-models to MSG-4 also can be used with a basis in MODIS results if they are aggregated to the MSG-level. If diagram 3.2a and diagram 4b are compared it happens that MSG-4 and MODIS IV to a large extent have the same exogenous variables. The sources of information for assessing these variables are to a large degree the same for the long-term and the medium-term analysis.

The system of models around MSG-4 the current version of MSG, is presented in diagram 4b. The principal considerations concerning the use of MODIS are certainly relevant also in this context. The assumptions about total employment and total capital formation are crucial in MSG. From assumptions about the capital formation yearly investment development is deduced. In contradiction to MODIS, however, the capital stock in MSG is distributed according to sector on the basis of behavioural assumptions and production functions for the different sectors.

The total employment development will be determined on the basis of analysis of the supply of labour. The Central Bureau of Statistics has developed a model to estimate the supply of labour and this model

is used as a pre-model to MSG. The assumptions about employment development which are fed into MSG have, however, to be evaluated in light of the results concerning labour productivity.

Assumptions about technical change (the trend factor in the production-function) are crucial for the development of the labour productivity. The rates of the technical change according to production sectors are exogenous in the model. These estimates are first and foremost based on the experiences from previous periods.

The MSG model may be regared as a general equilibrium model which describes how the resources, labour, capital and energy are distributed between sectors along a general equilibrium path where all resources are fully employed. When using the model it has to be taken into account that the model describes a movement towards a general equilibrium. The base year may have elements of underutilization of available resources, but this capacity utilization increases over time. Such effects may be simulated by altering the parameters.

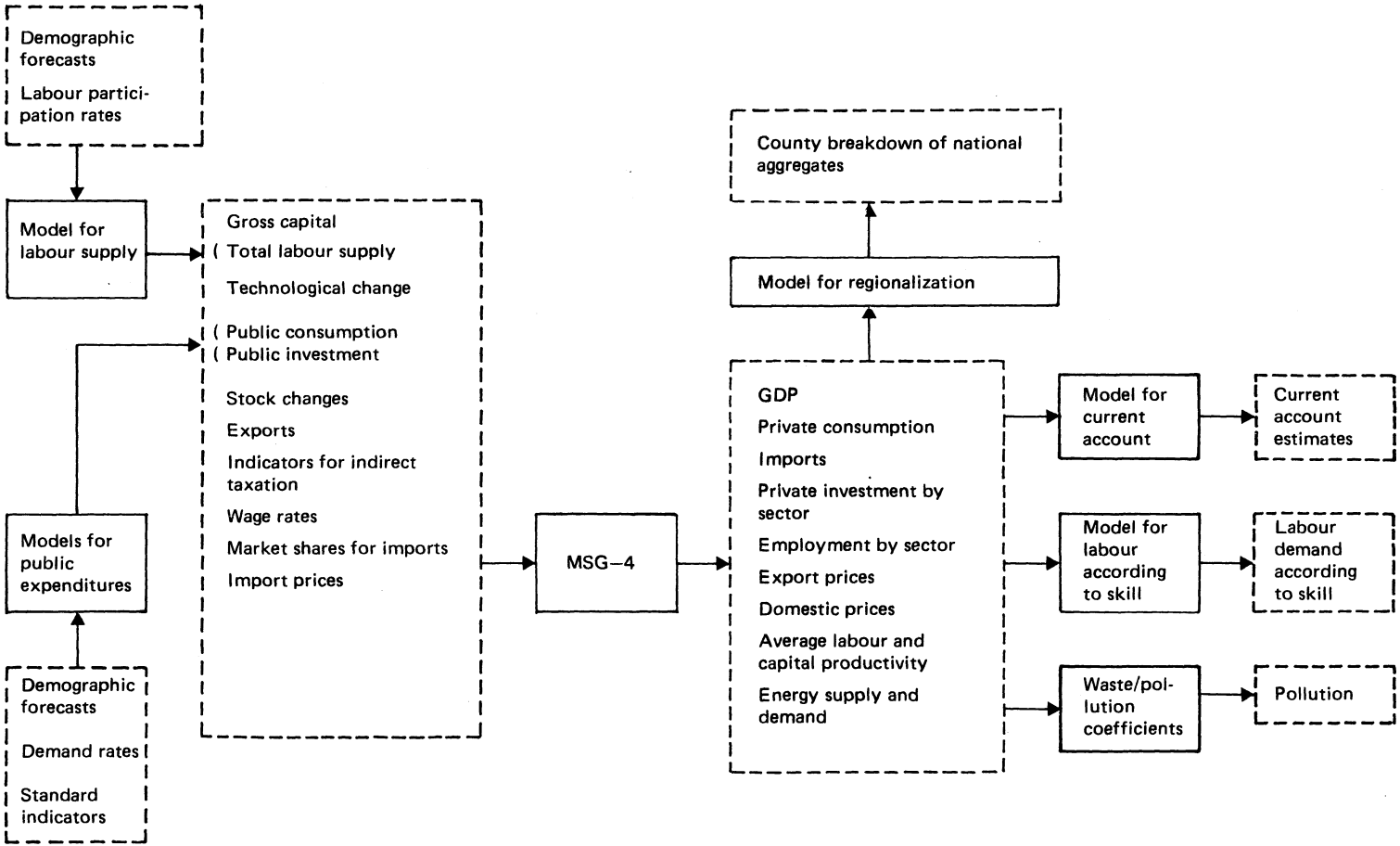
The MSG model determines the balance on the trade account but not the current account. For this purpose a separate post-model for interest transfers is developed. This model produces estimates for the current account on the basis of results from MSG-4 and assumptions about the development of interest rates, claims and debts and transfers to and from Norway.

In connection with MSG computation some calculations of labour demand according to industry and educational skills have been carried out. An independent research institute is currently working out demand projections and comparing these projections with supply estimates.

Results from MSG have also been used to analyse the pollution problems. In both these cases very simple assumptions about proportionality are used to generate the model results.

The Central Bureau of Statistics has also developed an input-output model for regionalization (REGION) (cfr. Skoglund (1980)). This model is also meant to supplement the existing model system. In this model the results from the model representing the national level will be broken down to county level. The model is now in operation and is currently being tested by the Ministry of Environment which is responsible for the co-ordination of the county planning. The purpose of such a model is to aid in the administrative routines of linking the central planning closer to the regional planning and vice versa. In its present form the model does not, however, contain the instruments in regional policy.

Diagram 4 b. THE MODEL SYSTEM FOR LONG-TERM ANALYSIS.



5. THE INTER-LINK BETWEEN THE MODEL SYSTEMS FOR LONG- AND MEDIUM-TERM PLANNING

The MODIS model has been at great help in improving the co-ordination between the short-term and the medium-term plan. Common but often difficult practical problems arise when the original assumptions of the medium-term plan are revised during the plan period on the basis of more recent data, assessments and policy decisions. When revisions are comprehensive a proper updating of the plan may be cumbersome to undertake and the result may be that the medium-term plan fades into the background and only the short-term plan is used in the policy-making. A macroeconomic model geared to deal with this problem may be a necessary requirement for achieving an appropriate co-ordination for short-term and medium-term planning. The MODIS model and especially MODIS IV has been designed to tackle this problem and make possible a recurrent updating of medium-term projections.

The National budgeting (1 year planning) was the task the model originally was designed to tackle. The extension to cover also medium-term projections has been a natural development. In later years the model has been used also on many other occasions than in the explicit plan preparation process. The model has been brought in on numerous occasions of ad hoc policy analyses, often of a very aggregate character relative to the specifications of the model. The advantage of the model in such situations is that the particular policy issues are analyzed within the framework of the current national budget or four-year plan. The disadvantages are basically that the model may have little to offer pertaining directly to the problem under consideration and it may seem a big apparatus to put into motion for a problem formulated in very aggregate terms.

Even if MODIS and MSG in the present versions are basically different in many respects, they also have some common features. This applies both to the variables that are specified exogenous and to the input-output core of the two models. MSG sectors and MSG commodities are aggregates of MODIS sectors and MODIS commodities. The greatest differences between the two models are that investments in MODIS do not have an effect on the capacity, only a demand effect. The prices in MODIS are determined independent of the various quantities. Whereas MSG has a simultaneous determination of prices and quantities in such a way that supply and demand are balanced in all markets.

In order to achive a proper coordination between long- and medium-term planning the ideal procedure would be that MSG elaborated the long term development path. Then MODIS could be used to assess the various instruments necessary in the medium-term to attain this long-term development. As pointed out previously the model assumptions are different. The two models are designed to analyse different questions and this makes it rather difficult to attain full integration in the use of the two models.

It has proved to be technically difficult to have the models simulating the same development for the medium-term even for the aggregates. This certainly complicates integrated use of the two models.

In relation to the current design of MODIS IV, the MSG-4 contains more assumptions about economic behaviour. If one believes that the equilibrium mechanisms which enter MSG-4 are a fair representation of the functioning of the economy, it should be possible to utilize the model results to assess the parameters in MODIS. First and foremost the MSG estimates of the productivity according to sector and the distribution of investments should to some degree be utilized in MODIS even if in the medium term there are fewer possibilities of substitution than represented in MSG. If the available information for the shorter run indicates an entirely different development than MSG generates, this is a reason for looking further into the question. One could then try to assess in what sectors it is realistic to assume pricetaking behaviour and where it is realistic to assume other types of behaviour. Likewise it should be possible to evaluate the MODIS results which are dominated from the demand side, with regard to the more realistic representation of the supply side in MSG.

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