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THE INTEGRATION OF FISCAL BUDGETING AND INCOME POLICY IN MODIS IV

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CONTENTS

1. INTRODUCTION*

1.1 The concept of a system of models for economic planning

The concept of a system of models for economic planning has come into current use as a pragmatic concept in countries well experienced in use of models for economic planning. It replaces earlier notions of the universal all-embracing model from which the optimal economic plan can be deduced on the basis of given preferences and initial conditions. The concept of a system of models has several dimensions. The models of the system may cover separate parts of the economy with only partly overlaping sets of variables, e.g. sector models. This may be called the horizontal dimension of the system. The horizontal dimension may be structured with a central model connecting and integrating the various submodels.

The system may include models for different levels of analysis and planning. High-level models, e.g. aggregate growth models, may be used to provide key indices for intermediate and lower level models. This aspect may be called the vertical dimension.

A third dimension is the organisational aspect. Different models may reside with different agencies. The communication between the agencies taking part in the plan preparation can be organised as an interchange of information between models. The organizational aspect of a system of models may put into focus the efficiency of interdepartmental communication and the type of model the different agencies ought to possess from the point of view of the overall coordination.

Several other aspects might be mentioned as distinguishing the system of models approach from the universal model approach as a way of formalising the overall planning effort. In general, the system of model approach allows a more pragmatic and pluralistic combination of existing knowledge and models - formal as well as informal or heuristic - within the existing planning hierarchy. Models based on slightly - or even widely - different assumptions may be brought into correspondence within the system of models. The intervention of planners to interpret and modify the model results and, in general, control the flow of information between models has to be accepted as a rule rather than as an exception. The working of the whole system may be interpreted as an iterative process towards

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a consistent plan or, alternatively, as some kind of simulation of economic phenomena, or as a power game between a number of interested parties, or as a mixture of these or something completely different.

This rather loose description of a system of models may resemble to some extent the way planning work actually takes place in widely different environments. The usefulness of a system of models approach is the focusing on the functional roles of the parts of the system. Such analysis may lead to more systematic model building efforts to bridge gaps or strengthen weak points in the overall system as well as to improvements in the organisational set-up.

1.2 The concept of an integrative framework for economic planning

MODIS IV may be considered both as a system of closely integrated models and as a part of a wider system of models. Within the entire area of general, short-to-medium term economic planning MODIS covers only part of the field. Outside the range of MODIS are the determinants of private investments and the important aspects of technical change, just to mention a couple of examples. What MODIS IV does include, however, is more than just a small set of models to serve within a complete system. The backbone of MODIS IV is its close connection with the national accounts. The detailed picture of the manifold economic transactions given by the national accounting system is carried over into the model. Together with the open linear structure this makes the model an integrative framework useful for uniting submodels and various assumptions into an overall consistent scheme.

The model has been constructed and the implementation system designed with due regard for the need to graft submodels onto MODIS or accomodate auxiliary assumptions derived from the problem under consideration. The development of the possibilities for building a formal system of models around MODIS IV has not progressed beyond what is reported below. Further development has yet to be decided and has to be weighed against further development of the integrative framework itself, for instance towards optimization or other improvements as a tool for policy decisions. Up to now, as will be pointed out later much effort has been put into fitting the model into the administrative system of policy-making with due attention to the demands for operationality and data management. Decisions as to extending the formal system of models through new models to replace informal models and heuristic reasoning ought to be derived from

an evaluation of the administrative system as a whole.

The advantages of the integrative framework approach is the unity it supplies to the analysis of quite separate problems. As in the case of the Norwegian revaluation in November 1973, see section 4.2, the relation between the key variables could have been analysed adequately in a desk-top model and was probably thoroughly analysed in an informal way prior to the use of MODIS. The function of the model was to confirm the basic macro-economic effects of revaluation from the informal considerations and thereby corroborate the reliability of the computed detailed effects throughout the economy.

The disadvantages of the reliance on a model of MODIS type for almost any kind of macro-economic problems is, for one thing, its demands on the user. The model is in practice almost impossible to use for anyone else than its main user, the Ministry of Finance, unless given assistance by the Ministry. Second, the model's onesidedness with regard to explanatory power leaves some important problems outside the model. The model's openness obviously reduces its explanatory power. In any case, it may be a matter for discussion what is the best choice of "unexplained" variables. The heavy reliance on MODIS IV in the macro-economic policy making in Norway may be described as putting all eggs in one basket. The risk is not that the basket might break, but that other means of carrying eggs may be overlooked or remain undeveloped.

1.3 Outline of MODIS IV

MODIS IV is the fourth generation in a series of macro-economic models constructed by the Central Bureau of Statistics of Norway. Like its predecessors[1] MODIS IV will combine a disaggregated input-output framework with a number of additional relations and auxiliary assumptions. The model variables include the items in a detailed system of accounts in real and financial flows for a great number of economic units. While the model is rather poor in the behavioural content of relation much emphasis has been put on inter-sectorial and intra-sectorial accounting consistency as well as on a detailed representation of institutional structures like tax systems.

The model, like its predecessors, has been built mainly for use by the Ministry of Finance in the preparation of one-year plans ("National Budgets"), four-year plans, and other purposes. The needs of the main user

1) See [4], [5], and [11]. For a survey of methods of planning in Norway before 1965, see [17].

have strongly influenced the detailed specifications of the model. The main benefits of the model is threefold: (i) to organize a great amount of detailed information into a consistent and comprehensive accounting system from which it can be retrieved in an easily interpretable and analytically useful form, (ii) to assess the combined effect of a great number of detailed assumptions about the functioning of the economy, and (iii) to evaluate the impact on the working of the economy of outside influences and of the use of steering instruments. The model itself contains no mechanisms for the selection of an optimal economic policy but serves to make possible a rational choice between alternatives in economic decision-making.

The model is closely related to the national accounting system in current use in Norway. Even in this respect it is like its predecessors but while these were related to an accounting system based on inter-sectorial transactions the present system is an adaptation of the revised System of National Accounts (SNA) of the United Nations [1]. The new system puts more emphasis on commodity flows rather than inter-sector transactions. The new system also includes an integration of real and financial flows. The linkage between the model and the accounting system is provided, first, by the reliance of the model on the national accounts as the basic data source and, second, by the model's use of price and quantity variables as defined within the national accounting system. Therefore any user who is well acquainted with the accounting system is spared the trouble to learn a new set of "model definitions" in order to use the model and to interpret model results.

The model consists of a number of parts, or submodels. The structure of the model can be outlined as in diagram 1. Full-drawn lines indicate interrelations between formalized parts of MODIS IV. Dotted lines indicate still unformalized parts of the total model structure. 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 central part is the formal framework containing the conceptual and accounting definitions and the basic relations. The main parts are the quantity submodel and the price submodel. At present there are in addition two submodels for direct and indirect taxes respectively. This is the formal or "computerized" structure of the model. Indicated in the diagram are additional submodels which are not formal models but reside in the administrative environment. The interplay between the formal model

and the administrative environment is a matter of great importance for model design if the model is to be used as an integrated part of administrative procedures and decision-making.

MODIS IV is a tool for practical use rather than an exercise in model building. Much emphasis has been put on user-oriented design and operational efficiency. The user-oriented design shows up in the interface between the model and the user and in the attempt of programming the model so as to allow recurrent changes of specifications and modification of relations according to user needs.

The model has been in operation since the summer of 1973. A number of model computations have been run since then and contributed to an evaluation of the utility of the model. A full assessment of the performance of the model and its various parts based on historical data is under way but still not completed.

2. MAIN FEATURES OF MODIS IV

2.1 The commodity-acitivty-sector framework

The three most central concepts of the model framework are commodity, sector and activity. By "commodity" is meant a grouping of goods and services. The commodities of the model are aggregates of the commodities of the national accounts and include all commodities of the Bruxelles nomenclature and in addition groupings of services (and some artificial commodities for accounting purposes). The number of commodities is about 200. Of these about 100 are commodities from manufacturing.

By "sector" is generally meant a functional unit of the economy which takes part in the commodity circulation. The commodity flows are flows of commodities between sectors. A sector may generate commodities or absorb commodities, or both. The most important group of sectors are the production sectors. The production sectors transform input flows of commodities into output flows of commodities and thereby absorb some commodities while generating others. The other main sectors and sector groups are the import sector, the export sector, the private consumption sector, government consumption sectors, and investment sectors.

By "activity" is meant a subdivision of sectors according to characteristic properties of the type of commodity generation, absorption or transformation which are taking place. The subdivision of sectors into activities carries a different meaning for each type of sector. The basic

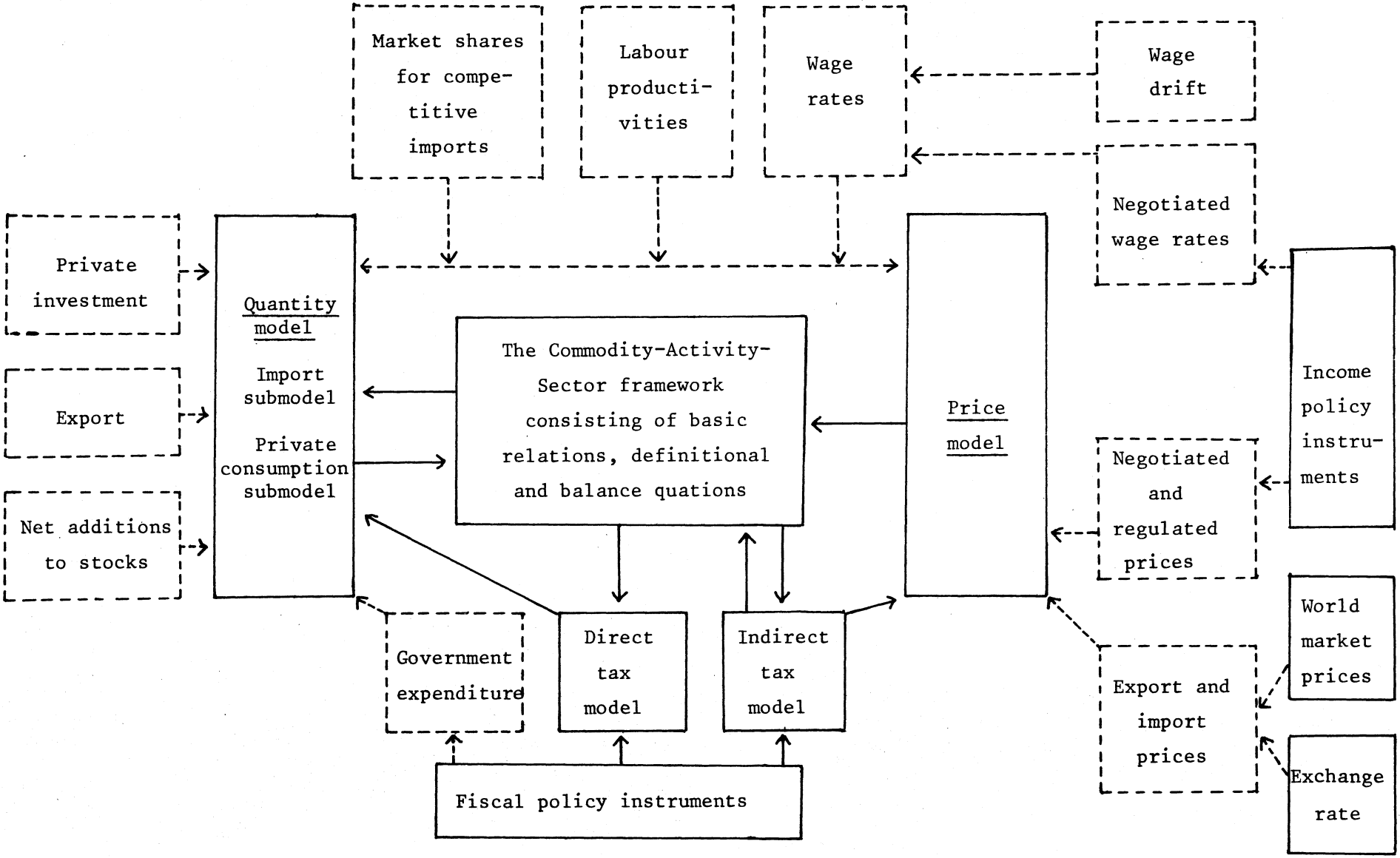

Diagram 1. Structural map of MODIS IV

assumption of the quantity submodel of MODIS IV is that the quantities of commodity inputs to and outputs from an activity are related in a linear way. The system of commodity flows is closed with regard to all generation and absorption of commodities except changes in stocks. The excess of commodities generated over commodities absorbed is thus defined as net addition to stocks.

The production sectors are aggregates of establishments and similar production units defined in accordance with the principles of the International Standard Industrial Classification.[2] The production sectors include production of government services. The number of production sectors is about 170. About 110 of the production sectors encompass only one production activity each while the rest have more than one production activity. The production activities can be interpreted as macro processes aggregated across establishments within the same production sector. Altogether there are about 250 production activities. The main principle of subdividing a production sector is to let each important output commodity of the sector be produced in a separate activity. The activity with the biggest share of total output of the sector is called the main activity of the sector. Minor output commodities, if any, are lumped together and included as joint products in the main activity. The subdivision does imply a problem of estimation from observable data as inputs to production activities are not directly observable when there are more than one activity in the sector.

The problem of distributing inputs of a production sector among its activities is at present solved in a simple way by classifying each of the production activities as having either a commodity technology, or a sector technology.

An activity with a commodity technology is assumed to have the same commodity input structure as other commodity technology activities with the same output commodity.

An activity with a sector technology is assumed to have the same input structure as other sector technology activities which belong to the same sector. If all activities within a sector are classified as having a sector technology they will all have the same input structure and equal to the input structure of the sector itself.

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2) See [9] and [10].

The import sector has separate activities for all imported commodities. (Import activities might conceivably be used to distinguish between imports of identical commodities from different foreign markets.)

Likewise, the export sector has separate activities for all exported commodities. There are about 120 import activities and 110 export activities in the model.

The export activities absorb commodities, i.e. withdraw commodities from the flow circulation without producing new commodities. The same is true for the other final demand activities to be dealt with below. Import activities, on the other hand, generate commodities, i.e. add to the flow circulation.

The private consumption sector consists of activities representing a conventional breakdown of total private consumption into categories of consumption goods. There are about 50 private consumption activities in the model.

Government consumption sectors constitute a conventional breakdown of total government consumption into a number of government purposes. The activities of the government consumption sectors (purposes) represent different types of government services.

The investment sectors are defined in the same manner as the production sectors but are considerably more aggregated. The investment activities represent investment in different types of capital goods within each investment sector. There are about 40 investment sectors and about 110 investment activities.

For convenience and accounting purposes there are a number of transformation activities where, by assumption, the value of commodity output equals the value of commodity input.

The commodity-activity-sector framework is a mapping of the commodity flows of the economy. The link between the sectors and economic entities outside the commodity sphere is provided by primary inputs and final outputs of the sectors. By definition, each sector shall be balanced in the sense that the value of primary input plus commodity input equals the value of final output plus commodity output.

A production sector has a primary input of labour, capital, entrepreneurial services, and indirect taxes making up the difference between the value of commodity output and commodity input. The import sector has a primary input from foreign account equal to the value of commodity output. The export sector has a final output to foreign account equal to the

value of commodity input. A government consumption sector has a final output equal to the value of government consumption for the given purpose. The private consumption sector has a final output equal to the value of private consumption. An investment sector has a final output equal to the value of investment in the sector.

For completeness and accounting consistency it may be advantageous to introduce activities with no commodity transactions. Such activities are called dummy activities. An example is transfer of used fixed capital between investment sectors. There are a few dummy activities included in the model.

The principal concept for evaluating commodity flows is basic values.[3)]

All model computations start from a given base year, usually the year prior to the current year. Quantities of commodity flows are measured in the basic values of the base year. Prices of commodity flows are indices of basic values relative to the base year.

By activity level is meant a measure of the commodity generation, absorption or transformation taking place in an activity. The activity level is defined, in general, as the net output of commodities evaluated in market values of the base year.[4)] (For transformation activities the

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3) In terms of the more commonly used concepts of producers' value and purchasers value the basic value of a commodity flow is defined as the producers value less commodity taxes, net, in respect of production; or the purchasers value less trade margins and commodity taxes, net, in respect of production and trade. This definition of basic value corresponds to that of approximate basic value of [1].

The basic value concept is preferred to producers' value or purchasers' value because the trade margins (which include transport charges) and commodity tax rates may vary between recipients or buyers for some commodities. (This will be the case even with a more disaggregated commodity classification than that of MODIS IV.) If the relative shares of buyers of such a commodity deviate from the base year distribution this will in itself appear as a change in demand of the commodity as measured in producers' or purchasers' values. In input-output models it therefore seems advantageous to use the basic value concept for measurement of commodity flows. See furthermore [1], p. 40 and pp. 53-56.

4) The use of market values in the definitions of activity levels gives the valuation scheme of the model framework a hybrid form combining commodity flows in basic values with activity levels in market values. The rationale for evaluating commodity flows in basic values is given in footnote 3) above. On the other hand, activity levels measured in basic values is a concept which can hardly be said to exist outside the model. It seems desirable to remain with the accounting framwwork of the environment at the expense of some awkwardness in the price relations. See equation (2) at the end of section 2.2. The market value of activity levels is computed as producers' value of commodity output less purchasers' value of commodity input.

activity level is defined as the total value sum of either commodity input or commodity output.) Note that by this definition the activity level of a final demand activity is negative. Sector levels are defined by adding up activities.

2.2 Basic relations

The basic equation of MODIS IV will replace the Leontief equation of the former MODIS versions and is

$$(1) \qquad \Lambda A = X$$

where A is a vector of activity levels,

X is a vector of addition to stocks (by commodity),

Λ is a matrix in which the typical element λ_{ij} (positive or negative) gives net output of commodity i per unit of activity level j.

The units of activity level as defined above implies that the sum total of addition to stocks equals the sum total of activity levels (with transformation activities excluded).

The activity matrix Λ and the vector of activity levels A may be partitioned by type of activity and the equation (1) can be rewritten as

$$(1') \qquad \Lambda_B A_B + \Lambda_P A_P + \Lambda_C A_C + \Lambda_C A_G + \Lambda_I A_I + \Lambda_E A_E = X$$

The import activity matrix Λ_B and the export activity matrix Λ_E have typically columns with only one non-zero element each. To each imported and exported commodity there corresponds at least one activity with a unit element on the row of the commodity in question.

The columns of the production activity matrix Λ_P are related to the columns of the traditional input-output matrix. The fixed ratios between input commodities are maintained. The production activity matrix differ, however, from the columns of the traditional input-output matrix in four respects. First, inputs and outputs are defined by a classification of commodities, not by a classification of sectors of origin. Second, output of more than one commodity from a single activity are allowed. Third, the same commodity may be produced in different activities and fourth, the activity coefficients are normalized by value added (gross product), not gross production.

The private consumption activities are typically activities with only a small number of input commodities, input from trade (trade margins) frequently among them. The columns of the private consumption activity matrix Λ_C will consequently have only a few non-zero elements each. The same is true for the government consumption activity matrix Λ_G and the investment activity matrix Λ_I.

Heuristically, equation (1) can be interpreted as the technological possibilities of the economy. For exogenously given additions to stocks there are still a number of degrees of freedom equal to the excess of the number of activities over the number of commodities. In the complete model some of the degrees of freedom are eliminated through exogenous determination of the levels of some of the final demand activities and through determination of some activity levels by income relationships. The remaining degrees of freedom correspond to the alternatives with regard to sources of supply for the various commodities. Commodities may be brought into circulation either by imports or by production in one of the activities which has the commodity in question as one of its outputs. In this respect the basic equation of the model has more degrees of freedom than the corresponding equation in the traditional Leontief model where a given input in most formulations can be supplied from one source only. The structure is more similar to the general activity analysis allocation model. A straightforward computation of an optimal choice of non-zero activity levels is, however, only possible if a preference function can be defined, and even in that case the "either-or answers" of linear programming may not carry much meaning except as a hypothetical reference point. At least for the time being, other ways of closing the model in regard to the sources of supply are therefore preferred. In determining the sources of supply it must be considered that the aggregation of the set of all goods and services in the economy into a number of about 200 commodities means that many of these commodities are inhomogeneous. Use of the same label for corresponding groups of imported and domestically produced goods may obscure the fact that these commodities may not be fully substitutable, that they may be different with regard to technology or taste possessed by prospective buyers and that, accordingly, they may be marketed at different prices.

At the present stage the model is "closed" on various points by assuming exogenous data rather than including an appropriate submodel or additional relations. The point of view adopted is that the full model of

the functioning of the economy envisaged by the user may not be fully formalized, too complex or too vague to be included in the computational set-up. The envisaged full model we shall refer to as the "outer model". The basic equation together with the "projection", so to say, of the outer model onto the basic equation will be referred to as the "inner model".

The inner model has a clearcut formal structure given by a set of endogenous variables, a set of exogenous variables, a set of relations equal in number to the number of endogenous variables, and a set of coefficients and parameters entering into the relations. The outer model includes the inner model as an embedded part. Exogenous variables of the inner model may be either exogenous in the outer model or determined by relations assumed to exist in the outer model but not represented in the inner model. Even coefficients and parameters of the inner model may be considered as determined in the context of the outer model. From this follows that the outer model provides much of the interpretation and operational meaning of the inner model.

The inner model includes price relations as a dual counterpart to (1). The basic price equation is

$$(2) \qquad b_X \Lambda + t = p_A$$

where b_X is a row vector of commodity prices in basic values,
p_A is a row vector of prices of activity levels in market values.

The row vector t is the net value of commodity taxes per unit of activity level. The occurrence of the vector t in (2) is a consequence of evaluating commodity flows in basic values and activity levels in market values (see footnote 4)).

2.3 The quantity model

The formal structure of the quantity model is as follows. The degrees of freedom of (1) have to be eliminated by introducing additional relations between activity levels, or by singling out a sufficient number of exogenous activity levels. The solution vector is denoted Z.

$$(3) \qquad A = \Pi_A Z + A^*$$

$$(4) \qquad X = \Pi_X Z + X^*$$

In (3) - (4) each of the vectors A and X are the sum of an endogenous and an exogenous (indicated by asterix) part. Π_A and Π_X are coefficient matrices of appropriate dimensions and Z is an auxiliary vector of additional endogenous variables. For the system (1), (3) and (4) to be uniquely determined it is required that Z is of dimension equal to the number of commodities and that $(\Lambda\Pi_A - \Pi_X)$ is non-singular. The precise content and interpretation of Z depends upon the outer model. The coefficient matrices Π_A and Π_X are imposed on the inner model by the outer model as a general reduced form expression. Heuristically, Z may be interpreted as total demand by commodity. In (3) and (4) total demand is divided up among sources of supply, production activities, import activities, and stocks. In this interpretation (3) and (4) can be said to represent the market structure while (1) can be said (se section 2.2) to represent the technological structure.

The matrices Π_A and Π_X may be interpreted to include linear specifications of different types of relations. The most usual extensions to the traditional input-output model may be incorporated within this scheme. The explicit solution of A in terms of X^* and A^* (eliminating Z) is

$$(5) \qquad A = \Pi_A(\Lambda\Pi_A - \Pi_X)^{-1}X^* + (I - \Pi_A(\Lambda\Pi_A - \Pi_X)^{-1}\Lambda)A^*$$

In the present version of MODIS IV stocks, denoted by the elements of X, and the activity levels for private investments, government expenditure and exports, denoted by the elements of A_I, A_G and A_E respectively, are exogenously given. The production, private consumption and import activity levels are, on the other hand, with a few exceptions, endogenous.

The production activity part of the coefficient matrix Π_A is used to determine the relative market shares of production activities with identical output commodities. These market shares are estimated from the base year of the model and are assumed to remain unchanged.

A few production activity levels are assumed to be exogenously given. These activities are mostly located in agricultural and raw material production sectors.

The private consumption and import activity parts of the coefficient matrix Π_A are used to tie the private consumption activity levels, A_C, and the import activity levels, A_B, to the production activity levels, A_P. This is done in the submodels for private consumption and import.

2.3.1 The private consumption submodel

The main elements of the submodel for private consumption are (i) a macro consumption function, and (ii) a set of distribution relations (see [8] for a detailed description). What follows is a quite summary description.

The macro consumption function determines the total demand for private consumption as a function of real disposable income for (i) wage and salary earners (wages and salaries) (ii) independents (mainly incomes from unincorporated enterprises etc., including agriculture), and (iii) pensioners (pensions)[5].

The set of distribution relations distribute the total demand for private consumption among the private consumption activities by means of income (Engel) and price (Cournot) derivatives[6].

The main groups of input variables in the submodel are: (i) exogenously given wage rates and labour productivities, (ii) private consumption activity prices (consumer good prices), including the consumer price index, from the price model and (iii) the parameters of the macro tax functions from the direct tax model.

The wage rate and labour productivity estimates tie the private consumption sub-model to the activity levels of the production activities. By solving for the private consumption activity levels the submodel is reduced to linear constraints on the inner model (1). These constraints are linear equations between the levels of production activities. The coefficients of these equations are composites which depend on a number of variables like wage rates, labour productivities, private consumption activity prices, tax rates, the coefficients of the macro consumption function and Engel and Cournot derivatives.

2.3.2 The import submodel

Imported commodities are divided more or less conventionally in competitive and non-competitive commodities.

The import relations for competitive commodities is built around a matrix of relative import shares for each commodity in each receiving

5) The coefficients of the macro consumption function are determined from time series regression on national accounts data (see [8] for further details).

6) The Engel and Cournot derivatives are determined from regression on cross section consumer survey data and time series national accounts applying the Frisch method of independent utilities (see [8] for further details).

activity. The data source for this matrix is the last available final national accounts updated to the base year of the model. However, it is possible to change these relative import shares exogenously.

The matrix of import shares (specified by commodity and receiving activity) reflects the fact that the import content of a given commodity will differ between receiving activities, especially between export and domestic demand.

The import share matrix ties the competitive import activity levels to the production and final demand activity levels. By solving for the competitive import activity levels the import submodel is reduced to linear constraints on the inner model. The constraints are linear functions of the production activity levels. The coefficients of these function are composites of variables like relative import shares and activity coefficients, exogenous final demand estimates, and coefficients from the private consumption linear constraints on the inner model.

The non-competitive import activity levels are directly determined by demand. The same is the case for competitive import activities for which domestic production of the output commodity is determined by exogenous stipulation of the production activity level.

2.4 The price model

The main ideas of the price model of MODIS IV are the same as those of MODIS III[7] and PRIM[8]. The changes are mostly a consequence of the new commodity-activity-sector approach, but also some new elements are included.

The commodity prices in basic values are the most important variables determined in the price model. The price of a given commodity flow is assumed to differ depending on whether it is imported or domestically produced and on whether it is exported or delivered to the domestic market. Each commodity may, accordingly, have an import price, an export price, and a domestic price.

The import and export prices are exogenously given through forecasts for the world market prices and of the exchange rate.

Reflecting the openness of the Norwegian economy an important feature of the price model is the distinction between the exposed and the sheltered domestic prices. The exposed domestic prices are prices of

7) See [11], ch. 4.

8) See [12], [13].

commodities sold under strong foreign competition in domestic markets. In the model it is assumed that the exposed domestic prices normally are adjusted to the corresponding import prices (prices of similar imported commodities).

The sheltered domestic prices on the other hand are prices of commodities sold in domestic markets sheltered - to greater or lesser extent - from foreign competition. For such commodities the model assumes two different kinds of price formation, namely regulated and negotiated prices and cost determined prices.

The regulated and negotiated prices are prices which are either fixed or regulated more or less completely by public bodies or determined through negotiations between the Government and producer organisations (agricultural prices).

The cost determined prices are assumed to be adjusted to changes in the costs of producing the commodities. Wagecosts per unit of production are given by exogenous estimates for labour productivities and wage rates. The model assumes further that the cost determined prices are adjusted so that the ratio of profits to wages in the production of the commodities is left unaffected by changes in costs.[9] The necessary parameters for the computation of the net indirect tax costs are determined in the indirect tax model. The price propagation process which follows from the fact that higher output prices of commodities from one production sector means higher input prices, i.e. higher cost, in others, is taken care of in MODIS IV through an input-output technique.

The description just given of the determination of the commodity prices in the price model shows that the prices are either exogenously given or explained entirely in terms of costs with no reference to demand.

After the determination of commodity prices, vector b_X, the prices of the activity levels, vector p_A, are computed from equation (2) above.

3. TAXES, TRANSFERS AND FISCAL BUDGETING IN MODIS IV

The treatment of fiscal items in MODIS IV is intended to serve a threefold purpose. First, while remaining within the macro-economic framework of the model, the specification of exogenous variables relative to fiscal budgets are made to correspond closely with fiscal instruments

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9) For further details about this assumption, see [12] pp. 25-26.

as determined by law or regulations. This means for instance for indirect taxes that the various tax rates are specified in the model in sufficient detail - to allow a direct translation from government decisions on changes in tax rates to the corresponding input to the model. An additional burden of computational work and data handling is the price of this convenience. MODIS IV goes far in this direction partly as a result of experiences gained by the use of earlier MODIS versions.

Second, for the purpose of fiscal budgeting it has been seen to that each fiscal item in the model belong to one and only one of the General government accounts. The model distinguishes between five General government accounts or sectors, namely, Central government accounts, Other central government accounts, Social security funds, Local government, and Tax collectors.

Third, arrangements have been made to allow a thorough treatment of the interrelations between the various fiscal items and the general framework of commodity flows. The maze of intricate tax rules for instance can, of course, not be represented in an adequate way in a macro-economic context. Priority has been given to the more important items in terms of revenue collected. The treatment of personal direct taxes is based on a submodel in which individual tax schedules at micro level are transformed into macro tax rates. Indirect tax revenue is calculated in the minutest detail allowed by the specification of commodity flows.

3.1 Direct taxes

The submodel for direct taxes existed as an independent model prior to MODIS IV. At the time the direct tax sub-model and MODIS III gave to some extent competing forecasts of tax revenues. The two models had quite complementary advantages. The direct tax model combined a detailed representation of the institutional tax structure with exogenous assumptions about growth of income in socio-economic groups. MODIS III on the other hand determined growth and distribution of income within a general, disaggregated framework with the tax structure represented in a much more crude way. Inconsistencies between the results of the two models led to numerous sessions of clarification and discussion as to which model was most reliable. This situation led typically to a separation of the general economic policy analysis which was based on MODIS and the fiscal budgeting based on the direct tax model. Hence the effort to integrate the direct tax model into the MODIS IV structure.

The direct tax model distinguishes between three socio-economic groups of households[10]. The grouping is based on the definitions of the Norwegian tax statistics. The groups are: (i) wage and salary earners, i.e. households whose earned income comes mainly from wages or salaries, (ii) independents, i.e. households whose earned income comes mainly from unincorporated enterprise etc. including agriculture, and (iii) pensioners, i.e. all other households[11].

The income distribution by income intervals within groups is represented in the model. The data source is the last available tax return statistics covering all households updated to the base year of the model.

The model specifies about 30 different types of direct taxes. The proceeds of some of these are wholly exogenous. For the others the tax assessment rules are represented in a very detailed way in the micro part of the model. The micro part can be run as a separate model which requires input of forecasted growth of income, employment, number of pensioners etc. As a part of MODIS IV the micro part is used to estimate parameters of macro tax functions which enter into the private consumption sub-model and therefor into the simultaneous solution of the quantity part of MODIS IV (see [2] for a detailed description).

The model is in accordance with the principles adopted for the national accounts according to which taxes are recorded on an accrued basis. This implies that taxes are computed for the same period as the income on which the taxes are levied was earned (see also [1], p. 128). This is the concept used in the calculation of income disposable for consumption in the private consumption sub-model. It differs from a concept based on date of payment which is the principle (see [3]) used for registration in government accounts in Norway. A special sub-model of the direct tax model makes the transformation from "taxes accrued" to taxes paid" in the government accounts. The functionally defined government account called Tax collectors holds the margins or differences between taxes accrued and taxes paid.

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10) The actual groups are groups of individuals with separate tax assessment rather than households.

11) The groups are in fact further subdivided according to whether the head of the household has dependents or not as different tax rules apply in the two cases.

3.2 Indirect taxes

The design of the model for indirect taxes (and subsidies) is strongly influenced by the general framework of MODIS IV. The disaggregated representation of the commodity flows opens up the possibility of establishing rather close connections between the indirect tax parameters of the model and the kind of information contained in tax rules.

Priority is also given to maintaining a possibility to introduce new indirect taxes in the model. Therefore, the indirect tax model is given a rather general form and is not merely designed for the indirect taxes that existed in the base year of the model. Each indirect tax (or subsidy) is classified as either a commodity tax or an industry tax. There are about 40 commodity taxes and about 30 industry taxes. The proceeds from industry taxes are exogenous. The proceeds from commodity taxes are endogenous in the model.

Each commodity tax (or subsidy) is further classified according to the tax base and the tax payer. The tax base of a commodity tax is either the volume of commodity flows, volume commodity tax, or the value of commodity flows, value commodity tax.

The tax payer of a commodity tax is either the importing and producing sectors of the commodities on which the tax is levied, producer commodity tax[12)], or the trade sector, trade commodity tax.

The tax rate for each commodity tax is given by a vector. The vector gives the tax rate on commodity flows to each activity. In this way the model reflects the fact that the tax rate of a commodity tax may differ between the receivers of the commodities on which the tax is levied. Typically, the tax rate will be zero on deliveries to export, but the tax rate may be differenciated on deliveries to other receivers as well.

The indirect tax model computes the revenue of each commodity tax. In accordance with the national accounts, and quite parallel to the treatment of direct taxes, the indirect taxes and subsidies are computed as taxes accrued rather than as taxes paid. As in the direct tax model a special sub-model of the indirect tax model transforms the taxes accrued to taxes paid as registered in the government accounts.

In addition to the revenue computations the flows of commodity taxes to and from each activity are estimated. This makes it possible to

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12) Commodity taxes on imports are, following the conventions of the national accounts, assumed to be payed by a subsector of the trade sector in the model.

determine the "net output" of commodity taxes pr. unit of activity level which is necessary for the estimation of activity and sector levels in market values[13]. Breakdowns of indirect taxes and subsidies as part of gross product of production sectors (production sector levels) at market prices are also computed.

3.3 Fiscal budgeting

For use in fiscal budgeting the revenue models for direct and indirect taxes play a central role. There is no corresponding model covering the fiscal expenditures (apart from subsidies included in the indirect tax model). As a preliminary for such a model efforts have been made for a specification of fiscal expenditure items in the model to link the national accounts data to the fiscal budget. Expenditure for goods and services is specified in a four-way classification: (i) by government purposes, such as Health, Education, Defence etc., (ii) by government production sectors that is classification by production sector such as Government administration sector, Health sector, Education sector etc., (iii) by government account such as Central government, Local government etc., and (iv) by type, that is whether the expenditure is for labour power or for commodities bought in the market. Transfer expenditures are similarly classified by government purposes, by type of government and by socio-economic groups. Sale of government services to the public is also specified to fit into this classification.

Some preliminary work has been done on a model of fiscal expenditure. Such a model may be envisaged as using socio-demographic variables to determine important expenditure items and to take care of all the interrelations between various fiscal expenditure items, like for instance expenditure sharing between central and local government, which makes the government expenditure much less exogenous than is usually assumed in most models.

4. IMPLEMENTATION AND USE OF MODIS IV

MODIS IV was completed as an operational model in its current version by August 1973. Minor changes in details of specification and efficiency have been implemented later on. By the "operational model" is

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13) See footnote 4) and equation (2) above.

here ment not only the programmed solution of a system of equations. The term includes also the data processing required for a complete updating of the model and for efficient handling of input to the model as well as the organization and systematic presentation of results from model computations.

4.1 Implementation of the model

The decision to implement a new generation of the MODIS models after MODIS III was based on two sets of considerations. First, the introduction of the new SNA in the national accounting of Norway would make the MODIS III outdated. Second, a need was felt to put into operational use the accumulated experience from the use of MODIS III. There were weaknesses related to a lack of integration with coexisting models and to certain inflexibilities and difficulties of a technical nature in the further development of that model.

The transition to the new SNA in the national accounts of Norway was put into effect by the National Accounts Division of the Bureau working on the same floor as the model building group. As the transition took place jointly with the construction of the model great advantage was derived from very frequent consultations between the two working parties about the specifications and accounting details of the national accounts as well as the model.

The implementation of the model on the computer was given due consideration at a very early stage. The system used for MODIS III was based on simple building blocks of Fortran subroutines for a UNIVAC 1108 computer. The inherent weaknesses of that system were foremost that it required too much effort to modify the relations of the model and it was virtually impossible to change specifications like for instance the number of sectors without a thorough revision of the whole program. However, its operational efficiency in computing model solutions was quite up to the standard required (see [5]). In demand for MODIS IV was a system for implementation which would make the way short from the equations and specifications of the model to the program on the computer. This implementation should not only be done once and for all but should function as a system for frequent modification and adaptation of the model, without reducing operational efficiency. A general implementation system, named DATSY, was developed by the Norwegian Computing Center on a contractual basis. The DATSY system has been used for MODIS IV and also applied for other projects. A description of the properties of DATSY is a topic for

a paper in itself.[14] Let it here only be said that the idea behind DATSY was to develop a tool which would allow the model builder to do the programming in a reasonably efficient way as he goes along working out the model with almost no presumptions as to his programming capabilities. Not unexpectedly, the initial intentions were not quite fulfilled but sufficiently so to put the computer aspects of the MODIS models on a completely new footing.

Model solutions may be computed simultaneously for a number of years and for several alternatives within each year. The exact capacity of the computer program is not known but it is safe to assume that at least fifty year-by-alternatives may be computed simultaneously.

The operational efficiency of the programmed model is at present considered to be fairly good but improvements are expected as experience is gained.

4.2 Administrative environment and use of MODIS IV

The administrative environment of MODIS IV is about the same as for the earlier MODIS models (see [4], p. 13-17). The model building work with regard to MODIS has been a major task of the Research Department of the Central Bureau of Statistics. The Research Department is also responsible for the national accounts of Norway.

Central economic planning in Norway is part of the responsibility of ordinary government agencies. Ministries, directorates, and other administrative institutions take part in the planning process. The Ministry of Finance coordinates the plan preparations and mediates between the political decision-making and the agencies taking part in the planning process. The Ministry of Finance is thus the main user of the model.

The use of the model by the Ministry of Finance is related to a small number of different tasks. Outside this use the model may be called into operation by the Ministry or other agencies on a more ad hoc basis. The main task for the use of the model is the preparation of the annual "national budget". The national budget is a government document containing a declaration of the policy which the government intends to pursue in the coming calendar year as well as a comprehensive description of the development in the economy which is expected to follow if the

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14) The system is described in a number of reports from the Norwegian Computing Center not yet available in English, see [14], [15], and [16].

proposed policy is put into effect. The national budget is prepared during summer and presented to and thoroughly discussed by the Parliament in the autumn of the year prior to the budget year but it is not formally acted upon by the Parliament. Instead, the policy recommendations implied in the national budget document are formally put before the Parliament for approval in separate documents at a later date. In the first half of the year the government will prepare and present to the parliament a revised national budget for the current year.

The model plays a central role in the preparation of the national budgets. The flow of information in the planning process starts with the Ministry of Finance laying down general conditions for the plan in a circular to all agencies taking part in the planning preparations. The agencies (ministries and government directorates) return to the Ministry their proposals and estimates of plan figures based on their own assessment, taking into regard the directives of the circular. The Ministry is now ready to fill in the forms for exogenous variables of the model for the first round of model computations. In some cases the forms are filled in by the relevant agency, although for most of the input to the model the final judgement rests with the Ministry of Finance.

After the first round of computations the results are analysed and proposals and estimates are revised by the Ministry or the relevant agency. The time schedule allows 2-4 rounds of model computations during the preparation of the national budget. Each round may include a number of alternatives. A similar process takes place in the winter as preparation of the revised national budget.

The four-year plans used in Norway are similar to the national budgets in scope and outline but they are less specific with regard to policy proposals. The model is used in the preparation of these plans in a quite similar way to that used for the national budgets. The four-year plan is presented to the Parliament every fourth year, and not as a rolling plan. The Ministry of Finance, however, for its own use and as a background for the national budgets, usually prepares five-year projections more than once a year by means of the model.

A special Reporting Committee on Income Settlements, "Beregningsutvalget",[15] uses the model in close collaboration with the Ministry of

15) This committee, known unformally as "the Aukrust committee", is chaired by the research director of the Bureau, Mr. Odd Aukrust. The committee is the successor of an earlier committee which originated the PRIM model, see [12], p. 7.

Finance in the analysis of price and income effects of wage and income settlements. Computations are performed - prior to income settlements - in order to estimate the effect of alternative proposals and after settlements in order to assess the effects of the agreements.

Prior to MODIS IV the price-income model PRIM was used for this purpose[16]. As mentioned in section 2.4 the main ideas of PRIM are built into the price sub-model of MODIS IV.

The Reporting Committee on Income Settlements is a committee with representatives from labour unions, the farmers' and the employers' organizations and from the Government, together with non-partisan experts. The income settlements in Norway are usually strongly centralized and coordinated. Typically,bi-annual negotiations on wage rates between the organizations of the employers and the employees take place simultaneously with the negotiations between the Government and the farmers' organization on agricultural prices.

The Reporting Committee uses the model by taking the fiscal policy more or less for granted. Assumptions with regard to world market prices, productivity rates and other variables are evaluated in collaboration with the Ministry of Finance. The results are presented as a set of forecasts, each set relating to one particular combination of changes in the negotiated wage rates and the agricultural prices. These alternative forecasts are intended to bring the negotiating parties in a better position to anticipate the short-run implications for prices and income distribution of the possible outcomes of their negotiations. The model forecasts for prices and income distribution are heavily dependent not only of the outcome of the negotiations but also of the assessment of the general economic situation. If the forecasts are to be accepted by the negotiating parties as reasonably good estimates of the short-term consequences for prices and income distribution of alternative outcome of the income settlements, under the assemption of no changes in the fiscal policy, it is necessary that the parties agree about the main assumptions on which the forecasts are based. To achieve such an agreement is perhaps the main purpose of the Reporting Committee.

Ad hoc computations are made from time to time. The type of problem studied in such computations may be exemplified by recent examples. In November 1973 the model was used prior to the Norwegian revaluations as

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16) About PRIM, see [12], [13].

a basis for the decision to be taken. In December 1973 computations were performed to analyse the impact on the Norwegian economy in the nearest years of all activity emanating from the discovery of crude oil in the North Sea.

Altogether the Ministry of Finance is going to use the model at least on a monthly basis. Together with the Bureau's own use, and possibly that of others, the model is going to be run on a more or less continuous schedule. This implies high demands on the operationality and efficiency of the model and surrounding parts. The delivery schedule is at present 48 hours from input forms to edited tables.

In most kinds of computations the possibility of running parallel alternatives will be utilized. In most cases the alternatives are used to estimate the effect of marginal changes compared to a basic or central alternative rather than as independent alternatives. The model is supplied with special input processing to simplify the filling in of exogenous estimates. The model has around 2 500 exogenous variables altogether. It is, however, possible to use the model with much more aggregated sets of input variables. At present there exist two alternative aggregations both amounting only to about 250 input variables. The model itself is not aggregated, but it can thus be used as if it were and thereby reduce the demands on the user.

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