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ECONOMETRIC METHODS IN SHORT-TERM PLANNING:

THE NORWEGIAN LESSON

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ECONOMETRIC METHODS IN SHORT-TERM PLANNING: THE NORWEGIAN LESSON¹⁾

1. Introduction

Ragnar Frisch, the spiritual father of the generation of Norwegian economists to which I belong, had a favourite idea which he returned to often in the early postwar years. As he saw it, scientifically based economic planning in Norway - and Frisch was very much for scientific planning - would have to develop as the result of joint efforts by three centres: University economists would provide the theoretical tools. Economists at the Central Bureau of Statistics would organize data to fit the theory and turn the theoretical tools into workable models. Finally, the group of economists within the Ministry of Finance responsible for planning would put the models to practical use. As we shall see, this vision by Frisch proved to be a fairly accurate anticipation of what was later actually to happen. Even today, macro-economic planning in Norway is organized pretty much according to the pattern he foresaw.

Over the years, several types of econometric models have been developed in Norway, each with its particular field of applications. Four of them, in particular, have been used as tools for macro-economic planning, viz. (i) models in the MODIS-series (MODIS = Model of DISaggregated type) which have been used for short-time and medium-term economic planning, (ii) the MSG model (MSG = Multi-Sectoral Growth), which in different editions has been used for long-term projections, (iii) the PRIM model (PRIM = PRice and Income Model), developed for use in incomes policy, and (iv) a number of "taxation models", designed as instruments for studying how changes in direct and indirect taxation affect public receipts from taxation, personal income distribution, etc. All these models were built by the Central Bureau of Statistics except the MSG model. The MSG model was designed originally by professor Leif Johansen at the University of Oslo as an academic piece of research and later implemented for practical use (as MSG-2F) at the initiative of the Ministry of Finance; it exists today (as MSG 3) in a modified version prepared by the Central Bureau of Statistics. The most prominent user of all models has been the Ministry of Finance, while the Central Bureau of Statistics has been technically responsible for operating and updating them and keeping them in good working order. Co-operation is insured through the advisory work of a "model committee" with representatives of the University, the Ministry of Finance, the Central Bureau of Statistics and the Bank of Norway²⁾.

It is the aim of this paper to review, for the benefit of other countries, some of the lessons to be learned from Norway's experience with the use of mathematical models in the administrative planning process. However, keeping in line with the general plan of the conference, we shall narrow our subject to a discussion of models applied in demand management policy in the short run. Consequently, we shall focus on the successive models in the MODIS series. We shall try to indicate how they have been used, areas in which they have been particularly successful, problems which have come to light in applying them, how these problems have been gradually overcome, and the directions in which further improvements may be sought.

MODIS as it exists today has developed gradually over a large number of years. It was first introduced in 1960. Since then, four different versions have been in use, each new version representing in some way an improvement on earlier versions and drawing always on experiences earned in the past. It is possible, therefore, to give an account of "the Norwegian lesson" simply by describing, chronologically and in some detail, how the various versions of the MODIS model were successively improved, and by showing how the improvements were related to its practical use. This is the approach

1) This paper is intended as a survey paper. No attempt at originality has been made although the author naturally accepts responsibility for all value statements made. The author has borrowed freely from presentations of the MODIS model written earlier by others; in particular he has leaned heavily on a recent paper, available in Norwegian only, by Olav Bjerkholt: MODIS som et verktøy i makroøkonomisk planlegging ("MODIS as a Tool in Macro-economic Planning") in Statistisk Sentralbyrå: Samfunnsøkonomiske Studier No. 26, Oslo 1975, and also on the two papers in English by Petter Jakob Bjerne, listed in the annexed bibliography. 2) The Bank of Norway is engaged in a research project aiming at constructing a model ("KRØSUS") of the Norwegian Credit Market and the influence of credit variables on other parts of the economy. A first version of the model has recently been put to experimental uses. It is hoped that the KRØSUS model, if successful, may eventually be merged with the MODIS model.

which will be adopted in what follows. In so doing, developments will be traced along four different lines: The structure, or economic content, of the model; its data base; its user characteristics; and its integration into the planning process.

It is convenient, before we proceed, to point out a few characteristics of MODIS which distinguishes this model from some models in use in other countries and which the reader may want to note from the outset:

- (i) The model has been developed as an instrument to be used in the planning process, not as an academic exercise; hence - especially in later versions - much effort has gone into making the model "user-friendly".
- (ii) Historically, work on the MODIS model grew naturally out of national accounting work. As a result of this, the relationships of the model correspond closely to the accounting structure of the national accounts, and concepts and classifications in the two systems are largely identical.
- (iii) The model may be described as a static, disaggregated, Keynes-inspired model built around an input-output core. Its economic content is not very sophisticated: In its latest version the model includes behaviouristic relationships describing consumers' demand, taxation, and the formation of prices and incomes, while exports and investments are taken to be exogenous variables and money and credit market variables are neglected altogether.
- (iv) The model is intended for simulation studies rather than for unconditioned forecasting.
- (v) While meager in economic content the model is at the same time strongly disaggregated. For instance, in its latest version it has about 140 production sectors. Hence, when measured by the number of variables and equations the model is by no means small.

As a further background, a brief sketch must be given of the planning procedure in Norway as it developed during the pre-MODIS period.

2. Economic Planning in the Pre-Model Period (1946-1960)

Norway got her first annual economic plan in 1946. Since then, similar plans, called national budgets, have been published every year.

Up to about 1960 the national budgets were worked out through a decentralized, administrative procedure. Ultimate responsibility for the national budget document rested, at the civil servant level, with a group of planners within the Ministry of Finance. However, it was left to the various ministries to work out plan proposals for all sectors of the economy under their management (e.g. the Ministry of Agriculture would suggest a plan, or prognosis, for agriculture) and to submit these to the Ministry of Finance. Here, the proposed sector plans were combined into a tentative master plan and subjected to a critical examination with respect to internal consistency, economic realism, and political content. Quite often the sector plans were returned to the ministries responsible for them, with requests for revisions. Sometimes this had to be done in more than one round so that the national budget, when it finally emerged, was the outcome of a lengthy administrative process of successive approximation.

This "administrative method" (as it has been called) of preparing the annual economic plan had certain obvious advantages: It ensured maximal use to be made in the planning process of the expert knowledge available anywhere within the civil service; it occasioned the various administrative agencies to co-ordinate their plans and programmes; and it fostered a widespread sense of loyalty towards the plan since all ministries tended to consider the plan in part a result of their own contribution. Equally obvious, the administrative method had its shortcomings: Most important, it could not guarantee the internal consistency and economic realism of the final plan. Without a formal economic model at their disposal the planners at the Ministry of Finance could do little more in this respect than check that all important definitional equations had been respected, that obvious constraints known to exist in the economy had not been violated, and that the plan figures looked "plausible" - meaning by this that they did not conflict in any obvious way with structural relationships believed to exist. However, without a reliable set of national account figures not much was known about these relationships.

The possibility for the planners to exercise plausibility control was greatly increased in 1952 when the Central Bureau of Statistics completed a 6 years job and published revised and detailed national accounts series back to 1930. The new estimates were prepared by the commodity flow approach and the system included a set of input-output accounts. With the new series available it became possible for the planners of the Ministry of Finance to control, among other things, that consumption quotas, import quotas and similar proportions as projected in the national budget looked reasonable in the light of corresponding, historical numbers recorded in the national accounts.

Furthermore, the new national accounts data soon became the basis of econometric research useful to the planners, such as studies of consumers' behaviour. One particularly important line of development was started in the early 1950's when the Central Bureau of Statistics and the University Institute of Economics used the input-output tables of the national accounts for 1948 and 1950 as a data basis for constructing and starting experiments with a 30-sector Leontief-model. From the middle of the 1950's results derived by this model were used by planners at the Ministry of Finance to check that national budget figures were consistent with what was known about the production relationships existing in the economy. In particular, the planners learned to rely heavily on results from the input-output model, rather than on subjective judgement, in ensuring that projections for imports were compatible with anticipated consumption, investments, and exports. However, throughout all of the 1950's the "administrative method" remained the main tool for setting up the national budget. This started gradually to change in 1960 when MODIS I became available, the first model explicitly designed for planning needs.

3. The Early "Quantity" Model: MODIS I (1960-1965)

MODIS I might be described briefly as a "production-consumption model": It combined information about consumers' behaviour derived from demand analysis with a revised input-output model completed by the Central Bureau of Statistics in 1959. The new input-output structure had a greatly improved data basis, in 1954 prices, compared with earlier input-output models.

MODIS I was, in some respects, rather detailed. It distinguished some 130 industries, about half of which (e.g. agriculture, fisheries, housing), were assumed to have exogenously determined production levels. However, the economic content of the model (determined by the structural equations recognized) was meager: Apart from definitional equations, the model included one set of equations describing the input-output structure of the economy, including the import structure; one set of equations describing how private consumption, by items and in total, depended on aftertax wages and profits; one set of equations describing how wages and profits together with accrued indirect taxes and subsidies were related to production, and little else. Thus, investments, exports, government expenditures and government receipts from (net) direct taxation were all considered exogenous variables. The model was a pure "quantity" model, meaning that it had no variables relating to prices.

MODIS I, like all its successors, relied on the national accounts as a data basis and accepted the definitions and classifications used in the national accounting system. The model worked in 1954 prices. This meant that, whenever the model was to be used, current price figures had to be translated back and forth to the price system of the model by means of an extensive set of price indices. When used in national budgeting work the model could produce estimates for two successive years, usually the current year (the year when the planning took place) and the following, or "plan", year. Only one policy alternative could be studied during one run of the model.

The model was programmed for solution by a first generation electronic computer (English Electric's DEUCE). The computer had properties which placed restrictions on the size of the model as well as on its design. Thus the capacity of the computer for handling data was no bigger than that of a modern mini-computer. The computer had no printing facilities, all output was in the shape of punch-cards. In order to get output tables the punch-cards had to be further processed by other machines using additional routines.

MODIS I was used in the preparation of five national budgets during the years 1960-1965 and also in the preparation of the Government long-term programme for the period 1962-1965. On a few occasions the model was used also for academic research, mainly to demonstrate its analytical applicability. To begin with, before the planners through experience had learned to trust the model, it was used in national budgeting work mainly to provide a check on estimates derived, as in the 1950's, by means of the administrative planning method. Later, as faith in the model increased, the model more and more became the main instrument relied upon in forecasting the real flows of the economy. In particular, it was soon found that the model was far superior to administrative methods in projecting private consumption and imports.

Yet, as a planning model, MODIS I had obvious short-comings. For one thing, its economic content was limited, which meant that there were wide ranges of important problems for which the model had no answer: Since it was a pure quantity model it could not very well be used, for instance, in the analysis of incomes and prices. Nor could it help in judging the effects to be expected on the economy of changes in wage rates, or in instrument variables such as tax rates and subsidy rates. The fact that the model contained no credit variable meant that the effects of credit policy on investments, and through investments on the rest of the economy, had to be analyzed outside the model, more or less intuitively, as before.

In addition to its economic short-comings MODIS I had operating properties which hampered its practical use. To mention a few: The model required exogenous variables to be specified in great detail, very often in greater detail than they were easily available within the administration. Translation of input and output data back and forth between current prices and 1954-prices was cumbersome. The computer programme was such as to make each run of the model time-consuming and rather expensive. For these and other reasons MODIS I tended to be used only once or at most twice in connection with the preparation of each ("original" or "revised") national budget.

Yet, with all its short-comings MODIS I undoubtedly worked; and the planners soon came to consider it with respect. Compared to the situation before 1960, therefore, the model represented a great step forward which foreshadowed a complete breakthrough for econometric methods in Norwegian planning.

4. Extensions with Price and Income Variables: MODIS II (1965-1967)

The next version of the model, MODIS II, was ready for use in 1965. It represented a considerable improvement on MODIS I in that a price model was added to the volume model. The price model was built around the input-output core of the existing quantity model by classifying industries as either "sheltered" or "exposed" and by making assumptions about the "price behaviour" of these two industry groups: For the sheltered industries the model assumed cost-plus pricing, i.e. the model took output prices to be functions of costs and exogenously given rates of profit per unit of production. For the exposed industries the model assumed output prices to be determined by the world market and thus to be exogenously given; for these industries the model provided estimates of profits as functions of costs and of given output prices. A third category of industries were industries which had their output prices fixed by government decree; these industries were treated formally like exposed industries.

With the above extensions a number of new variables were introduced into the model, notably output prices, wage rates, rates of indirect taxes and subsidies, and other price variables. Furthermore, by combining price and quantity variables, variables such as various types of income flows, tax amounts, transfer payments, etc. could also be defined. A number of new relationships could be added. One group of relationships represented the price behaviour of industries, as indicated above. Another group of relationships defined values as products of prices and quantities. A third group of relationships linked various categories of government receipts and expenditures to tax rates, prices, and quantities. Commodity prices were added as explanatory variables in the relationships describing consumers' behaviour.

MODIS II represented a great improvement on MODIS I also from a technical point of view in that it was implemented on a much bigger computer (UNIVAC 1107). The improved computer facilities made it possible to write a programme which allowed the model to be solved for ten different policy

alternatives simultaneously, each alternative covering two consecutive planning periods (years). Hence the planners were given an option to study simultaneously, with moderate extra costs in terms of computer time, one master policy alternative and as many as nine partial deviations from the master plan. Furthermore, the output of the model could be presented to the planners in a more convenient way than had been possible with MODIS I. Output was now made available in the shape of tables which were edited so as to correspond closely to the tables of the national accounts, with figures showing rates of change etc. added as required.

The fact that MODIS II covered more aspects of the economy than MODIS I had done meant that it had a wider field of potential application. Particularly important was the fact that the model could be used to study income flows and thus allowed estimates to be made of changes in incomes likely to follow from different policy alternatives. This made MODIS II a potentially useful instrument for an incomes policy. From an incomes policy point of view it was also important that the model, having price variables, could provide estimates of year-to-year changes in the overall price level. In a wholly different field the model could be used to provide estimates of many entries in the state fiscal budget, notably estimates of tax receipts, which were consistent with assumptions made about economic trends in general.

In practice, MODIS II turned out to be used less frequently than had been hoped for by its constructors. True, like MODIS I, it continued to be considered an indispensable tool in preparing the ordinary and revised national budget and it was routinely run for these purposes about three times each year. It was also used in preparing the 1966-1969 4-year plan and to some extent in the annual preparations of the state fiscal budgets. However, for other purposes it was hardly used at all. In particular it lost out to the much smaller model PRIM, which was constructed at the same time, as a key analytical instrument in incomes policy.¹⁾

There were a number of reasons why MODIS II was not used more extensively. First, in spite of the bigger computer and improved machine programmes available it still took considerable time and resources to operate the model. In particular, it was a lengthy process to prepare the input needed for each run. Second, the model lacked flexibility: Once programmed, it was very difficult to change the model structure, or even to modify individual relationships, for instance to shift an industry from the "sheltered" to the "exposed" category. Third, and most importantly, it was an exacting task to prepare, in advance of each run, forecasts for each one of the 650 exogenous variables of the model. Many of these variables were "model-exogenous" but "economy-endogenous" (as it has been called) in that they could not be considered exogenous in any economic sense; they were tied to other variables by relationships which probably existed in the real world but which were neglected by the model. To ensure consistency under such circumstances in the choice of values for the exogenous variables called for careful work and a high level of competence amongst the users of the model.

5. Improved Computer and Programming Technology: MODIS III (1967-1973)

The next version of the model, MODIS III, from 1967, was essentially a reprogrammed and more "user-friendly" version of MODIS II. It aimed at remedying some of the technical weaknesses of the latter while making no attempt to improve its economic content.

First, and most important, the system for handling exogenous input was greatly simplified. The new system represented a saving in manual work especially when many policy alternatives were to be studied simultaneously, thus weakening one of the chief obstacles to an extensive use of the model.

1) PRIM, in comparison with MODIS II, had one big advantage: It was so simple that its logic and mode of operation could be understood even by non-economists, and representatives of the trade unions, the employers' associations etc. quickly developed considerable respect for the ability of PRIM to provide forecasts of incomes and prices. This probably delayed the use of MODIS II for the same purpose. On the other hand PRIM contributed much to create in general a favourable attitude towards econometric models, including MODIS, amongst many influential groups.

Second, more efficient machine programmes reduced to moderate quantities the costs, in machine time and money, of solving the model. Third, the use of parallel solutions was made more flexible so as to allow computations for any number of years, within an overall limit of years by alternatives less than or equal to twenty. This feature led the way towards an integration between the annual national budgets and the 4-year plans. Fourth, some of the key classifications of the model were made to depend on parameters the value of which could be chosen by the model user; in this way, the planners were given some opportunity to influence the structure of the model: They could control, for instance, the exact classification of industries into the two groups "sheltered" and "exposed". In an attempt to provide planners and analysts with a tool for working out quick answers to economic problems MODIS III (like MODIS II before it) was used as a basis for computing a set of so-called "tables of effects". These tables showed, in a systematic way, the effects to be expected on endogenous variables of given changes in individual exogenous variables or groups of variables.¹⁾ The tables of effects were found by the planners to be a helpful accessory to the model itself.

With these improvements successfully incorporated, the MODIS model became an instrument which planners in the Ministry of Finance found it comparatively easy to use. More extensive use of the model, in turn, added to their experience and stimulated a re-organization of the work within the Ministry of Finance to make it ever more model-oriented. Thus a cumulative process was started which (as will be described in the next session) led ultimately to the use of MODIS becoming a part of the regular routines of the Ministry of Finance e.g. for keeping the national budget forecasts up to date.

In addition to its place in the national budgeting process MODIS III was used on some occasions for the analysis of ad hoc policy problems. Thus, in 1969, extensive calculations were made by means of the model to predict the effects of the comprehensive tax reform planned for 1970; this analysis was widely publicized and demonstrated clearly the value of having a model which allowed incomes, prices, and outputs to be studied simultaneously. In 1971 MODIS III was used in an attempt to forecast the effects on prices and incomes in Norway to be expected from the devaluation of the US dollar, under alternative assumptions as to which other currencies might follow the dollar.

6. Revised Data Basis and More Flexibility: MODIS IV (1973-)

Towards the end of the 1960's it was decided to bring the Norwegian national accounts into correspondance with the revised System of National Accounts of the United Nations ("SNA revised"). For this purpose a large number of changes were made in the accounting frame-work, in the definition of variables, and in the detailed specification and classification of variables. It was clear that similar changes would have to be made in the definition and classification of variables of MODIS if the all-important correspondance between the structure of the model and the structure of the data base was to be maintained. Accordingly, work on a new version of MODIS (MODIS IV), adapting the model to its new data base, started in 1969 and was completed in 1973. The opportunity was taken to incorporate into the model certain new features which, it was hoped, would remove some of the weaknesses known from experience to hamper the use of the model as a planning instrument.

Important changes were made in the model structure: First, the new data basis allowed the input-output core of the model to be changed from a sector-sector structure to a commodity-activity-sector-structure, thereby introducing commodities as a separate category of variables distinct from inter-industry flows. This made the description of the economy more realistic and had definite analytical advantages; in particular, it made MODIS a better instrument for analyzing problems of indirect taxation and subsidies. Second, the new input-output structure required consequential changes

1) For instance, the table of effects would show the effects to be expected on the consumer price index of a partial change of one per cent in the wage level, or of a partial change by one percentage point of the rate of the general purchase tax, or of a proportionate increase by one per cent in all import prices. However, in order to interpret correctly the figures in the tables the user had to have an intimate knowledge of the structure of MODIS III; in particular he had to remember which economic relationships were taken account of in the model and which were not.

to be introduced in a number of other relationships. Third, other changes, mostly minor, were needed to adapt the model to the definitions and classifications chosen for the revised national accounts. Fourth, a certain amount of flexibility was infused into the model by arranging for ad hoc changes to be possible, without great difficulties, in certain key variables. Finally, steps were taken to integrate fully into MODIS IV certain routines which in relation to MODIS III had been treated as sub-models; this applied to sub-models for the calculation of depreciation and imports, and to sub-models which linked macro-economic variables to the detailed rules of the taxation system.

None of these changes extended the economic content of the model much. MODIS IV, like its predecessors, remained a comparatively "open" model. They did, however, have the effect of adding considerably to the number of variables of the model. In its latest version MODIS IV has approximately 2 000 exogenous variables. It is capable of handling simultaneously, if required, between 400 and 500 policy alternatives. It has become a formidable task, therefore, to prepare the input needed for even one run of the model, i.e. to choose values for each one of the exogenous variables, perhaps in many alternatives, to ensure their consistency and to feed them - physically - into the model. In fact, the difficulty of handling inputs constituted a serious threat to the practical usefulness of the model and simplifications obviously had to be sought.

The solution to this problem was found in the shape of an auxiliary programme which allowed the model user, if he so preferred, to present his input in aggregated form. (This option had been available already for MODIS III but was further developed for MODIS IV). The programme accepts forecasts for the 2 000 exogenous variables at any level of aggregation. It then transforms them, in accordance with instructions received, into the disaggregated format required by the main model. The practical consequence is that the model user is given freedom to operate with a level of aggregation of his input which he may choose according to the needs of the problem on which he happens to be working. For instance, he may want to specify some categories of exogenous variables in great detail while at the same time others, of less importance to his problem, are given in aggregated form.

A similar flexibility is provided for in the presentation of the output of the model. The number of endogenous (output) variables of MODIS IV is of the order of magnitude of some 5 000 and can be made available to the model user in the form of edited tables. The system allows the model user to select from a large number of possible tables exactly those which he wants to have, with a specification of detail which he himself is free to choose. Since the model variables are defined in conformity with the variables of the national accounts it is possible to have the tables set out so as to show model results (forecasts) together with corresponding historical figures. This facilitates the interpretation of the model results and has proved a great convenience.

The fact that the user of MODIS IV has a choice amongst different levels of aggregation of inputs and outputs means, in effect, that he has access to a number of "variants" of the model. These variants are identical in model structure, but differ in input requirements and in output specification. From the point of view of the model builder this is essentially equivalent to having at his disposal a number of different models, one big and strongly disaggregated for general use (the basic MODIS IV), and others, at various levels of aggregation, being easier to operate and adapted to specific analytical needs.¹⁾

For a model to become an effective instrument in the planning process it is not enough that the model is available; it is equally necessary that planners are inclined to use it. Ideally, one would like to see the use of the models integrated into the administrative planning process on a routine basis. This requires a level of competence and determination on the side of the planners which can only be built up gradually. The Ministry of Finance has made determined efforts in recent years to increase its ability to exploit fully the model tools available. Training courses in the operation of MODIS have been arranged for all staff members, and for officers of other ministries who are involved in the planning process. Within the department responsible for short-term planning, who's present

1) One of the variants in use has been deliberately specified so as to compare closely to PRIM in the amount of detail shown. This particular variant of MODIS has replaced PRIM in recent years as the key analytical instrument for use in incomes policy.

head is a former member of the model building group of the Central Bureau of Statistics, work routines have been reorganized with a view to putting the unit in a position to use MODIS more efficiently: Administrative changes ensures a division of work such that there are specialists charged with the responsibility of providing, when required, up-to-date estimates of various categories of exogenous input to the model. Other staff members are trained in the operations needed to prepare the input data for the computer, or in editing the output data for use in the administrative process. This means that at any time a high degree of readiness for running the model is permanently maintained.

With the flexibility of MODIS IV and the present ability of the administrative system to avail itself of the model the days are now passed when MODIS was run only a few times each year, e.g. whenever a national budget or a 4-year plan had to be worked out or revised. The present routine is that, for use within the administration if not necessarily for publication, the national budget is being kept permanently up-dated by means of regular runs of the MODIS model, the planners at each run basing their assumptions on the latest economic information available to them. During 1975, when economic trends were particularly difficult to predict, MODIS IV was run upwards to 20 times for the purpose of short-term economic policy. During 1976 no less than some 35 runs of the model were undertaken, some of which were aimed at the analysis of specific problems on an ad hoc basis. For instance, in connection with a complex set of income negotiations which took place during the spring between representatives of the government, the trade unions, the employers' association and the farmers' associations, MODIS IV was used extensively to provide the negotiating parties with background material - notably estimates of the effects to be expected on prices and various kinds of incomes, before and after taxes, of alternative "package deals" considered by the negotiating parties and involving simultaneous changes in wage rates, agricultural prices, tax rates, and subsidy rates. It has been stated publicly by the Minister of Finance that the existence of MODIS IV, and the fact that the negotiators accepted estimates prepared by the model as dependable, were instrumental in making it possible to reach an agreement. This tells much about the standing of MODIS in the eyes of the Norwegian public.

7. Summary: The Lessons to Be Learned

Before trying to sum up the lessons to be learned it must be stressed once more that the Norwegian experiences with use of models in short-term planning are won exclusively with a static, Keynes-oriented input-output type model, working with annual data. The model is strongly disaggregated and comparatively big if measured in numbers of variables and equations. Yet it is meager in economic content in the sense that it has few behaviouristic equations. The model, therefore, is extremely "open"; in its latest version it has about 2 000 degrees of freedom and the same number of exogenous variables.

One lesson to be learned is that the location of the model building work within the national statistical agency has much to recommend it. The important point is that this allows model construction work to be intimately connected with national accounting work. Indeed, in Norway, the national accounting unit and the model construction unit are parts of the same Research Department and are located literally on the same floor. Obviously, this favours the establishment of close links, conceptually and otherwise, between the planning model and its data base, with beneficial effects to all parties concerned: To the model builder it means that the data problems connected with model construction are immensely simplified, and that the annual updating of the model can be made a simple routine job. To the national accountant it means feed-back effects, helping him to choose his definitions and classifications in such a way as to make the national accounts data maximally useful for analytical purposes. To the planner or model user, finally, it means that model results can be brought easily together with historical series and studied against the background of data for the past.

The fact that the planning model is extremely disaggregated has proved to imply disadvantages as well as advantages. Clearly, a big model is more costly both to establish, to up-date and to keep in good working order than a small one, and although MODIS is technically not too difficult to operate, its sheer size undoubtedly has made it a somewhat cumbersome instrument for planners to use. In particular, the need to prepare advance estimates for a long list of exogenous variables for each run of the model has proved in practice to discourage frequent use of it. Yet the tendency has clearly

gone in the direction of making the model ever bigger and more detailed by adding new specifications of variables, rather than the opposite. The extensions have been added in most cases at the request of the users of the model who have wanted the model to be detailed enough to specify as separate instrument variables the many individual tax rates, subsidy rates, and other policy instrument with which they are concerned. They have asked, furthermore, since the model is to be used as a means in preparing the fiscal budget, that individual budget entries, e.g. the revenues to be expected from individual taxation schemes, should be detailed as far as possible. Apparently, the needs of the planners is for a model with considerable detail in order that it may be of maximum use in the daily routine.

Rather than incorporating into the model behaviouristic relationships of doubtful validity Norwegian model constructors have preferred to treat as formally exogenous many variables which are "model-exogenous" but "economy-endogenous" (i.e. dependent on other variables in the real world), well knowing that the number of exogenous variables is thereby greatly increased. In defence of this policy it has been argued that it frees the model user from having to accept doubtful hypothesis about the working of the economy which the model constructor has built into the model once and for all. On the other hand, it does require a high level of economic competence and considerable efforts from the model users who will have to apply their own judgement to make sure that a set of values of exogenous variables, apriori chosen for a run of the model, are internally consistent and plausible. It appears that users of the model within the Ministry of Finance are happy with this division of responsibility. For example, they undoubtedly feel that, with present knowledge, future investments can be predicted better by "reasoning outside the model" with the help of statistics on investment plans than would be possible by means of a model which attempted to treat investments as endogenous variables.

The practical operation of a model as big as MODIS is no simple task. Norwegian experiences show that determined efforts are needed, by the model user as well as by the model constructor, if the use of the model is to become part of the daily routine of economic policy formulation. Within the agencies responsible for economic planning a systematic education of staff and a rearrangement of working routines may be essential. The model constructors should strive to make their models "user-friendly". There are a number of ways in which this may be achieved: (i) The model can be programmed so as to allow a large number of policy alternatives to be studied simultaneously, that is, in one run of the model. (ii) The model can be programmed so as to accept inputs (i.e. estimates of exogenous variables), and deliver output, at alternative levels of aggregation. (iii) The model can be used as a basis for producing "tables of effects" which in many cases may serve as a substitute for the model itself in providing quick answers to simple problems. (iv) The variables of the model can be chosen so as to reflect concepts and classifications already known to the planners from the national accounts. (v) Since planners tend to think in terms of changes from the present, the model should be continuously up-dated so that model results will appear as changes from a recent base year.

In spite of what has been achieved so far with the use of econometric models in Norwegian planning much remains to be done. The Ministry of Finance has recently announced that it wants the work on model building to be considerably strengthened. During the 1960's the total academic staff at the Central Bureau of Statistics engaged in constructing, maintaining and using economic models of all kinds (including taxation models) rarely exceeded 2-4 persons. This number has been increased in the last few years to 8 or 9 persons, partly as a result of the Bureau having accepted responsibility for the MSG model. The academic staff has the backing of (at present) some 4-6 non-academic staff for programming and data handling tasks. As a result of the initiative of the Ministry of Finance the model building group of the Bureau may be expanded by some 10 additional personnel in the course of the next few years. There are many directions in which research efforts could go: (i) There is a large scope for improving the economic-theoretical content of the models, e.g. for adding new, behaviouristic relationships in order to reduce the number of exogenous variables. (ii) Administrative routines for preparing input to and handling output from the models can be further mechanized. (iii) Existing models may be adopted to serve as tools for a wide range of analytical needs, e.g. sector studies, energy studies, foreign trade problems, price propagation problems, indirect taxation etc. (iv) There is strong demand for models to be used in some new fields of public policy, notably in the planning of regional policy and anti-pollution policy. (v) Norway might become a member of the project LINK. (vi) It would be desirable to start experimental work with dynamic models.

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