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The use of macroeconomic models in economic policy making: the Norwegian experience

by

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The use of macroeconomic models in economic policy making

The Norwegian experience

Tore Eriksen and Jan Fredrik Qvigstad

Planning in Norway has a long tradition. The use of models is an integral part of short- and medium-term economic policy administration. A large-scale input–output model, MODIS IV, is used as the short- and medium-term forecasting and planning model. The use of the model secures consistency when analysing the economy. The model is very open in the sense that important interrelations in the economy are left out. The model contains only 'good' relations in the Leif Johansen sense of the word. Smaller aggregate and more closed versions of the model are used for analysing policy alternatives. These models contain both 'good' and 'bad' relations. The use of macroeconomic models is an important aid for proposals regarding economic policy in the Ministry of Finance. Because the whole ministry (with expert help from other ministries) takes an active part in the model work, MODIS IV serves as the centralizing mechanism. It helps to make economists from many ministries go around the same centre, speak the same 'language' and organize all relevant information and judgements in a consistent way. Experience shows that 'numbers discipline' and force the different arguments on to a higher level of precision.

Keywords: Macroeconomic models; Planning; Norway

This paper describes the models used as an analytical aid in short- and medium-term economic policy making in Norway. The emphasis is on how models are used inside the administration rather than on the models themselves. This paper is written by 'insiders'. A sympathetic 'outsider's' view of the Norwegian planning system can be found in Barker [1].

The Norwegian national budget is the official plan for the forthcoming year, not only for the public sector, but also for the economy as a whole.[1] The budget sets out a comprehensive plan for fiscal, monetary, income, industrial and labour market policies. Targets for economic policy are presented, together with assumptions about factors that are outside government control.

This has been the practice for many years. In 1945 the Labour Party gained a majority in Parliament for the first time and wanted to put into effect its ideas for a planned economy. The immediate post-war period had a mood of optimism, reconstruction and national unity and this helped to pave the way for new ideas. The first national budget was presented by the government to Parliament in 1947 and was later supplemented by a four year plan called the long-term programme. Important pre-conditions for the national budgets and long-term programmes were

(i) the construction of a system of national accounts;
(ii) the new economic theory of Keynes, and Frisch's ideas about planning;

[1]The fiscal budget is presented to Parliament at the same time as the national budget.

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This paper is an extended and revised version of Qvigstad [8]. Views expressed here are those of the authors and should not necessarily be interpreted as representing official views in the Ministry of Finance. We would like to thank John Llewellyn, OECD, for many useful comments.

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(iii) the prevailing political situation.

The national accounts were geared quite early on towards a system for economic planning under the direction of Aukrust, who also was influenced by Frisch, Leontief and Stone. Input–output tables were included in the national accounts from 1949. By the middle of the 1950s operational routines for the construction of annual national accounts were well established, and by the end of the 1950s the first electronic computer was installed. In 1960 the first input–output model, called 'Model of Disaggregated Type' (MODIS I), was worked out. This model has an aggregation level very close to that of the national accounts.

Keynes' contribution to economic theory and the implications for economic policy are well known. Keynes (both personally and his theories) played a particularly important role in Norway, probably due to Frisch and his position in Norwegian society. Letters from Keynes to Frisch were even referred to in the Norwegian Parliament in 1934.

Frisch talks about the different stages in economic forecasting[2]. The first stage is the 'on-looker approach', where the observer tries to guess what will happen without analysing what ought to be done to influence the course of affairs. A more advanced stage is the 'feasible instrument approach', where the analysis takes place within a complete model in which the degrees of freedom correspond to the instrument variables and the pure exogenous variables. With such a model an attempt is made to pick out the feasible alternatives and to help the authorities find out which is the most desirable from their point of view. The last stage is the 'optimalization approach', which includes a preference function and techniques for locating the most preferred solution among the feasible policy alternatives. Planning in Norway has never reached the final stage, a stage which perhaps is unrealistic in real-world policy making.

In the early post-war period, the Norwegian economy was governed by a much more widespread system of rationing and direct controls. The intention of the national budget was that it should be an overall plan for the whole economy. This was reflected in the administrative set-up for the budgetary process. The various ministries should make plans for their respective spheres which the Ministry of Finance should then coordinate. The national budget was thus heavily based on contributions from the other ministries. Today most of the direct controls, eg for imports and the system of rationing, have been abolished. There is more of a market economy, the private sector being governed by a system of taxes and general indirect measures. The government sector, however, has increased, a sector which traditionally 'belongs' to the Ministry of Finance. These institutional changes are reflected in the national budget. The Ministry of Finance is now the main author, although inputs and contributions from other ministries are still an important part of the process.

The notion of planning the economy met fierce opposition in the first years from the Conservative Party. However, a consensus has been reached on the need for a national budget. National budgets have been presented and the model apparatus has been used by all governments since the war, both Labour and non-Labour. The capabilities and loyalties of the civil servants are also recognized. One must bear in mind that Norwegian society is rather homogeneous.

Successive versions of MODIS have been designed to make it operational as a tool for the Ministry of Finance. There has been a two-way channel of adaptation, the Central Bureau of Statistics being the data supplier and model builder and the Ministry of Finance being the main user. Today, MODIS IV is an integrated part of the day-to-day routine of the economists in the Ministry. This administrative set-up has its pros and cons.

(i) The producers of the statistics and the model builders are close, giving positive feedbacks to national accounting as well as to model building.
(ii) The models are to some extent built aloof from the political climate. The models represent a stable element, and are in practice accepted by all major political groupings.
(iii) One disadvantage is that the model builders are not directly confronted with the concrete policy questions that need to be answered.

A brief description of MODIS IV

MODIS IV is the central model in the national budgetary process. It is well documented in several articles and books, the most complete description being in Bjerkholt and Longva [2]. Only its key characteristics are summarized here.

MODIS IV may be described as a demand-oriented model with a detailed input–output core. The input–output part of the model describes the technological and cost structures of the economy. The input–output matrices, as well as the rest of the model, are updated every year.

[2]See Frisch [5].

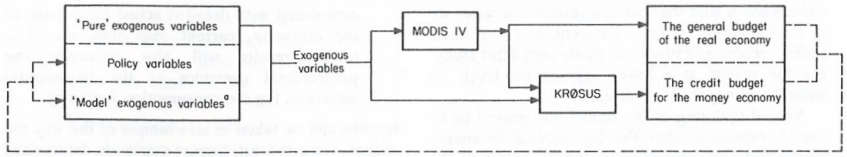

Figure 1. The national budget process.

[a]Variables exogenous in the model but not in the economy.

In the quantity part of the model there is a consumption block and an import block. Changes in import shares, however, are determined exogenously. Private investments, exports, and government expenditure are also all given exogenously. In the price part of the model, prices are either exogenously determined or determined by costs and mark-up rates. There are separate direct and indirect tax models. The input of the tax models is almost as detailed as the actual tax rules.

A few figures indicate the size of the model. It contains 122 industrial production sectors and 182 industrial commodities. There are 17 general government production sectors and 10 marketed government services. Altogether, the model has about 2000 exogenous variables. The output from the model consists of values of about 5000 variables.[3] The set of output variables can be aggregated in alternative aggregations. The whole set of input variables is divided into subsets. For each subset alternative levels of aggregation can be defined in advance. In normal use of the model, it is necessary to supply values for only 400–500 exogenous variables.

The preliminary version of the annual national accounts (with input–output tables) for year $t-1$, published in March of year t, serves as the database for the model. The updating of the model is done by the Central Bureau of Statistics and is usually finished by the beginning of July. The model is then ready for the final work of the national budget for year $t+1$. This work takes place in July–September of year t, although planning economic policy starts late in year $t-1$.

The administrative process

The central document describing the government's economic policy for the forthcoming year is, as described above, the national budget, presented to Parliament each October. It is revised in May the following year in the light of the major wage settlements (which usually take place at that time) and other relevant new information, with MODIS IV playing a central role. The credit market is partly regulated through credit rationing and a system of state banks. The plan for money and credit policy is given in the so called 'credit budget', which is an important part of the national budget. In making the credit budget use is made of the KRØSUS model.[4] The input to this model comes partly from MODIS IV and partly from policy decisions. Figure 1 describes the national budget process.

The Economic Policy Department of the Ministry of Finance is responsible for the national budget. Filling out the forms for exogenous variables is done by economists in this department. Responsibility is divided according to the behavioural relations in any standard macroeconomic model. One person is responsible for private consumption, another for investment, and so on. Most of the analysis is thus demand-oriented. There is also, however, direct information from the production side. Sector and supply side analyses are also carried out.

Considerable work has been invested in making the model input fit the actual 'language' of the administration. In certain areas where detailed information is not available, it is necessary to operate at a rather aggregative level (eg changes in import shares) whereas in other areas input is more detailed (eg tax input). The input is adjusted to the level and form of the actual information.

Some of the current information is in the form of quarterly data. Other information is obtainable only in annual form. A logical extension of the disaggregative philosophy of MODIS IV would be to have MODIS as basically a quarterly model with the option of time aggregation according to the actual form of the information. However, at present this has to be done outside the model.

Usually the model output is analysed at a level of aggregation of about 20 industrial sectors. However,

[3]Even so, requests for yet further disaggregation are not infrequently expressed by the other ministries, and by the political leadership in the Ministry of Finance!

[4]For a description of this model, see Bank of Norway [3].

experience is that the cost and production structure of the industries are quite different, and sometimes policy recommendations are made only after studying the results at a lower aggregation level; on occasion disaggregation matters.

Annual updating of the model has proved to be useful, especially after the big increase in energy prices and the emergence of the oil sector in the Norwegian economy. However, on occasion the base year may be 'atypical' for certain industries,[5] so that it would have been better in that case to estimate the parameters in the input–output structure with a two- or three-year moving average. On the other hand, that would introduce practical problems, because simulation of the model would not reproduce the base year automatically.

In certain areas of the economy it is natural to think in nominal terms (the credit budget), whereas elsewhere real terms are more appropriate (production). Furthermore, it is sometimes appropriate to think in terms of levels (balance of payments) while at other times growth terms are more relevant (production impulses). The economists in the department can choose whichever combination of nominal/real terms and level/growth terms is practical. This point may seem trivial from a theoretical point of view, but is nevertheless important when a model is used in the daily routine of an administration.

As an aid in the final production of the national budget, three or four simulations of the model are usually required. The reasons for this are as follows:

(i) Although policy analysis always starts with the general guidelines of the government's economic targets, it is almost invariably the case that the policy variables need to be analysed further.

(ii) There is a continual flow of new information about the exogenous variables, particularly the 'pure' exogenous variables that are independent of the Norwegian economy (eg international economic developments) (see Figure 1).

(iii) Analysis of the model results will influence the judgement of these model exogenous variables. The successive simulations may be looked upon as an 'iteration' process to help to close the possible range of the model exogenous variables (and the policy variables). The iteration process is shown by the dotted line in Figure 1. Because of the disaggregated level of the model output, the model output can be confronted with detailed actual knowledge of the economy, current indicators, etc. The model results will also influence the judgemental overrides to the behavioural equations (eg the consumption function).

Imports can be taken as an example of the way the analysis is carried out. Import shares are determined in two ways. From the demand side it is assumed that relative import prices are the main determinants. They are, however, also determined from the production side, and the ministry analysts will have views on production levels based on current indicators, supply-side analysis and on direct information from the Ministry of Industry. MODIS IV helps to reveal any overdetermination, and thereby forces consistency on the system.

Because the whole department (with expert help from other ministries) takes an active part in the model work (filling out the forms of exogenous variables, etc), MODIS IV serves as the central point of the department in the same way as INTERLINK does in the production of international forecasts by the Economics and Statistics Department of the OECD.[6] It helps to make the economists of a large ministry go around the same centre, to speak the same 'language' and to organize all relevant information and judgements in a consistent way. Experience shows that 'numbers discipline', forcing the different arguments on to a higher level of precision.

Thus the economic content of MODIS IV is relatively simple, and judgement is put into the few behavioural relations there are. In use, MODIS IV is primarily an advanced accounting system, but as such it is very useful. It may be better to describe MODIS IV as a national budget routine, which ensures that the identities are fulfilled, rather than a national budget model

The use of support models

The model can be described as open because there are so many model exogenous variables.[7] A number of support models have been developed during recent years. One use of these models is to determine variables which are model exogenous in MODIS IV. MODIS IV and the support models make up together what can be termed a model system. MODIS IV is closed through the iteration process, including a sequence of simulations on the

[5]For example, sectors producing big units like oil production platforms.

[6]See Llewellyn and Samuelson [7].

[7]Even an 'open' model is of course well defined as a system of equations.

model system. The support models may for illustrative purposes be divided into pre-models and post-models. Pre-models are small models that are used to determine the value of the model exogenous variables before a MODIS IV simulation is carried out. They are not formally connected to MODIS IV, and are used only as one of many tools in the determination of the exogenous variables. KRØSUS can be taken as an example of a post-model (see Figure 1). However, because of the iteration process, the distinction between pre-models and post-models may not be very clear. For instance, KRØSUS may assist post-model analysis of the effects from the goods market to the financial markets. As a pre-model it may be used to analyse the effects from the financial markets to the goods market.

The translation from one set of definitions to another, however, has proved to be time-consuming both in actual use and in the maintenance of the models. In general, definitions and solutions are not consistent between MODIS IV and the support models.

Within the administration, as in any organization, it is difficult to discuss everything at the same time. It is necessary to structure the analysis. In the Ministry this is done by separate discussions on the different exogenous variables as the first stage, and a consistency check with the help of MODIS IV as the second stage. The third stage is a more detailed study of the results. The support models are heavily used at all stages, together with more or less formalized methods. This analysis requires so much work that there is seldom time to work out detailed alternatives to the main reference path. Underlying this reference path are the guidelines for policy, which of course may imply a change in present policy.

Policy alternatives

Although the bulk of the work is directed towards establishing the reference path, there is a continuing search for policy alternatives, that can on occasion represent significant departures from the reference path. The need for analysing changes in policy may emerge suddenly, for example because of a change in government, unexpected developments concerning wage settlements or an oil price rise. For minor changes, it is possible to use ready reckoners or impact tables. These tables, produced annually, give detailed results for the endogenous variables of changes in specific exogenous variables. They can save a lot of time. In the case of, for example, a devaluation, complete analysis with the help of MODIS IV and KRØSUS would take too long; especially because of the openness of the models, several model simulations would be required. On the other hand, on occasion the use of impact tables will often be too rough.

The purpose of such policy analysis should be to elaborate, though not necessarily in full detail, an alternative to a well established reference path. When choosing between the reference and alternative paths, the politicians usually ask for some key variables such as employment, inflation, balance of payments, real incomes, etc. This is less detailed information than is required in the national budget, but more advanced information than what can be obtained by impact tables. Some of the support models to MODIS IV are designed for this type of analysis. FINMOD is taken here as an example. The model is designed especially to analyse on an aggregate level changes in fiscal policy, and changes in the exchange rate.

FINMOD includes an aggregate version of MODIS. It has only four production sectors, and is a much more closed model than MODIS IV. Some of the standard chains of reasoning that are normally used between the model simulations of MODIS IV have been used to 'close' the model. Thus much more behaviour is modelled in FINMOD than in MODIS IV.

To illustrate the use of FINMOD, a brief description is presented. Export and import market shares in FINMOD are determined as functions of relative differences between Norwegian and world market prices. Wages are determined in an extended Phillips curve equation, including also tax parameters, consumer price expectations and external competitiveness of the Norwegian economy. Productivity and labour supply are also endogenous. FINMOD is a demand-oriented model, almost as much as MODIS IV. It can be regarded as an aggregate version of the MODIS IV iteration process.

Even if FINMOD is a closed model compared with MODIS IV, it is still a partial model in so far as the supply side and the money and credit markets are not modelled.[8] Repercussions from the financial markets and supply side analysis must be taken care of outside the model. However, if the purpose is to construct a new reference path, the money and credit market implications eventually will be thoroughly analysed by the KRØSUS model in the MODIS IV process.

[8]Neither is the detailed checking of the model results *v* the current indicators, nor the economists' 'Fingerspitz Gefühl' for actual numbers modelled. These elements are very important in the MODIS IV process.

As far as possible, estimated parameters are used in FINMOD. However, for key parameters in FINMOD, well established econometric work either does not exist, or it is not possible to determine the parameters with significant confidence. For instance, in the import share functions, relative prices and import shares have moved more or less in the same direction over the last 20 years. It is, accordingly, difficult to distinguish between trend and price elasticity effects. In the wage equation it is difficult to establish the values of the parameters which give the effect of changes in indirect and direct taxes. Therefore, when modelling some of the behavioural equations, it is necessary to go beyond the econometrics. Some important parameters are determined by judgement, not by estimation. The economic policy makers have to make decisions. The use of models is one way of making the assumptions explicit. 'Formalizing judgement' is not ideal but it does have advantages:

(i) It increases the need for being explicit in the analysis.
(ii) It is one way of accumulating knowledge. It is not necessary to start from scratch each time a specific problem arises, and it serves to document the standard reasoning and to give continuity to the knowledge. This is important since labour is a mobile factor, even in the government sector.
(iii) The need for econometric work is made explicit. The model can be regarded as a 'shopping list' for research projects from the Ministry.
(iv) Consistency of the parameters is ensured across the different problems that are raised. The elasticity of the labour supply, for example, cannot easily be varied to give pleasant answers to specific problems!

There is, however, a danger of the results being given too much weight because they are generated by a 'model'. Usually, analysts in the Ministry try to avoid this problem by always giving the results specified as intervals, depending on one or two of the central judgemental parameters.

When using FINMOD, the first step is to generate a reference path which is identical to the MODIS IV reference path. However, even if the same exogenous values are used, FINMOD and MODIS IV will in general not generate the same reference paths, because:

(i) FINMOD is a much more aggregative model (ie aggregation matters).
(ii) The behavioural equations that are explicitly modelled in FINMOD may differ from the implicit equations (through the iteration process) in MODIS IV.

Even though, in principle, these (implicit and explicit) relations should be identical, the MODIS IV process does, to a greater extent, make use of actual detailed knowledge. In FINMOD, therefore, *add-factors* are determined so that FINMOD reproduces exactly the MODIS IV reference path. The add-factors can be thought of as stochastic variables with expected values that equal zero. After coordinating the FINMOD and MODIS IV models, they may have values that differ from zero. A disaggregated model such as MODIS IV incorporates information which, in an aggregative model, is put into the add-factors.[9]

Another aggregate version of MODIS IV, called MODAG, has recently been built. This model has approximately 30 production sectors aggregated from MODIS IV by the principle of strict hierarchy. Because of its smaller size, it was possible to program the model in the interactive data system TROLL. Routines have been developed that automatically transform MODIS IV output to MODAG input. Routines have also been developed so that updating MODIS IV and MODAG is almost the same job. The MODAG model has also been extended – more closed, experimental versions of the model have been built. There is now a MODAG system which includes many of the 'old' support models.

Accordingly, the options now are MODIS IV as the dissaggregated open budget model, and MODAG as the more aggregated model system with flexibility in the degree of openness, suitable for analysis of the policy alternatives. The FINMOD model is incorporated as the most closed MODAG variant. MODIS IV, however, will probably survive. MODAG is at present thought of as too aggregated to be used as the main tool in the budgeting routine.

Some general problems in model building and use of models

A general problem in model building is what variable to treat as exogenous, and what to try to explain endogenously. The answer depends much upon the use of the model and the viewpoint of the model user. From what may in Ragnar Frisch's scheme be termed as an on-looker approach, it may seem natural to explain as much as possible within the model. For models designed for policy making, which clearly is the case for the Norwegian national budget model MODIS IV, the case may be somewhat different.

Advances in economic theory and in computing methods have made it possible to extend the sets of endogenous variables in planning models, and clearly this has been the trend. According to Professor Leif Johansen, tendencies in the economic environment may be somewhat contradictory to this (Johansen [6]):

(i) the growth of the public sector;
(ii) the increasing role of organizations and large corporations;
(iii) the increasing influence of international conditions (applying to national models and in particular to small countries).

Johansen also expresses a more general view on how to design model systems: equations explaining economic behaviour should be ranked according to their 'goodness'. Models and procedures of using models should be carefully arranged so as to discriminate between good and bad relations, as the weaknesses of the latter will affect the outcome of the whole application of the model, which might be a non-efficient use of information and model systems.

This is reflected in some sense in the Norwegian model system. The core of the system, MODIS IV, contains a detailed national accounting framework with few and mainly non-controversial behavioural and technological relationships. The less reliable and more experimental equations are organized in the system of support models. Which support models should be used, and which versions, may vary according to the purpose of the simulations; ie short-term *v* medium-term analysis, pure forecasting *v* policy analysis, and so on.

Concluding remarks

If the Norwegian system of models is regarded as one big model, then this model is in principle not very different from other large macro models. They are all large, closed and disaggregated input–output models. The uniqueness of the Norwegian system perhaps lies in:

(i) The way the models are *integrated in the administration*. The models are not on the sideline operated by a group of technicians; they are considered useful in the daily routines of the whole Ministry. This special feature can perhaps explain the strong position the national budget and economic planning enjoys in the Norwegian society.
(ii) *The very disaggregated approach*, with annual updating of the model base including the input–output matrices. The reason for this is probably the close link between the model builders and the national accounts statisticians. Perhaps the inheritance of Ragnar Frisch is another reason; he never did anything on a small scale!

The strong side of 'the big Norwegian model' is its usefulness when working out what, in this paper, has been called the reference path. The weak side has so far been the analysis of policy alternatives. Such analyses have often been done *ad hoc*. The development of support models has improved this branch of the work.

Some of the basic questions in macroeconomic modelling are not easy to answer, including:

(i) the optimal level of aggregation;
(ii) how open/closed the model should be, ie how much should be left to add-factors and exogenous variables endogenized through an iteration process;
(iii) how to treat 'judgement' when using the model.

This paper has tried to give some of the Norwegian experiences concerning these questions. The present system operates at fairly low cost. Nevertheless, if we were to start the whole model-building process afresh, perhaps we would choose less disaggregation.[10] The investment has been substantial. It would also have been easier to implement MODIS IV in one of the interactive program packages already on the market.[11] In deciding how to close the model, it seems appropriate to take a very pragmatic view. Much depends on the administrative set-up. But no matter how closed and disaggregated the model, there will always be a need for judgement either in the form of add-factors, by manipulating parameters, or by varying the exogenous variables in different simulations. It is essential to make explicit what is 'judgement' and what is 'the model'.

When deciding upon the type of model that should be developed, there is always the choice between economic complexity and administrative simplicity.

[9]A description of FINMOD is given in Qvigstad [9] and The Royal Norwegian Ministry of Finance [10]. A more detailed description is given (in Norwegian) in Eriksen, Qvigstad and Rødseth [4].

[10]The MODIS system has been exported to Portugal and Jamaica. These models are much more aggregative than the Norwegian MODIS IV. This is partly due to the less developed national accounts in these countries.

[11]MODIS IV is programmed in DATSY, a data language especially designed for this purpose.

We have argued that from an administrative point of view, it is often preferable to have a simple model as the national budget routine for short-term planning, a model

(i) which can be partitioned into separate blocks and where simultaneity is kept to a minimum;
(ii) where the relations contain a minimum of lags.

This is because it is often necessary for a group to 'think aloud'. Our experience is that the bigger the group, the simpler is the model that is appropriate. It should also be possible to explain the results to non-economists without too big a pedagogical effort. Of course, these criteria cannot be adopted without sacrifices. For example, when having to choose between two alternative formulations of the consumption function, one with and the other without a lag, the one with lag was marginally better according to the econometric criteria. But after a couple of months the lagged relationship was dropped, because the marginal gain in the precision of forecasting was more than offset by the increase in administrative costs. In addition, all the policy recommendations were to all intents and purposes invariant to the choice between the two functions. It must never be forgotten that in an administration the constant rivals to the complex macro model are calculations (and theories)[12] on the back of an envelope. The complex model will lose out the very first time its results cannot be explained; the administration seldom gets as much time for explanations as the university lecturer has when he is giving classes. Because, at least in the Ministry of Finance, models are aids for decisions on economic policy, they are useful only if they contribute to better decisions.

[12]Eg the Laffer curve.

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