ARTIKLER 141

EXPERIENCES IN USING INPUT-OUTPUT TECHNIQUES FOR PRICE CALCULATIONS

By
OLAV BJERKHOLT

BRUK AV KRYSSLØPSMODELLER FOR PRISBEREGNINGER

STATISTISK SENTRALBYRA

CENTRAL BUREAU OF STATISTICS OF NORWAY

ARTIKLER FRA STATISTISK SENTRALBYRÅ NR. 141
REPRINT FROM STÄGLIN, R. (ED.): INTERNATIONAL USE OF INPUT–OUTPUT ANALYSIS

EXPERIENCES IN USING INPUT-OUTPUT TECHNIQUES FOR PRICE CALCULATIONS

By
OLAV BJERKHOLT

BRUK AV KRYSSLØPSMODELLER FOR PRISBEREGNINGER

STATISTISK SENTRALBYRÅ
OSLO–KONGSVINGER 1983

ISBN 82-537-1926-4
ISSN 0085-431x

EMNEGRUPPE

Økonomisk og statistisk
teori og analyse

STIKKORD

Kryssløpsmodeller
Prisanalyser

PREFACE

The use of input-output models for economic policy purposes is a long tradition in Norway. In the 1970s price calculations by means of input-output models have been of great importance.

The present article was presented at an international conference on input-output analysis organized by the German Statistical Association in Dortmund, May 1982. It deals briefly with the development of input-output models in Norwegian planning and discusses the current use of price calculations.

The Central Bureau of Statistics gratefully acknowledges the permission of Vandenhoeck & Ruprecht in Göttingen to reprint the article.

Central Bureau of Statistics, Oslo, 1 December 1983

Arne Øien

FORORD

Bruk av krysløpsmodeller for økonomiske planleggingsformål er en lang tradisjon i Norge. I de seinere år har prisberegninger ved hjelp av krysløpsmodeller fått stadig større betydning.

Denne artikkelen var opprinnelig et innlegg i en internasjonal konferanse om krysløpsanalyse arrangert av den tyske statistikkforening i Dortmund i mai 1982. Den beskriver kort utviklingen av krysløps-modeller i Norge og drøfter bruken av prisberegninger for ulike formål.

Statistisk Sentralbyrå vil takke Vandenhoeck & Ruprecht i Göttingen for samtykke til opptrykk av artikkelen.

Statistisk Sentralbyrå, Oslo, 1. desember 1983

Arne Øien

Experiences in Using Input-Output Techniques for Price Calculations

By OLAV BJERKHOLT, Oslo

The use of macroeconomic models in Norway has some distinctive features. One is the use of a detailed input-output model, called MODIS, for short-term macroeconomic analysis. In other countries input-output models are typically used for structural and long run studies while the short-term is covered by aggregate econometric models. Another feature is the role played by the model within the institutional environment. Economic policy is formulated, analyzed and implemented within the framework of the model. The model has itself become part of the institutional environment and serves as a system for gathering, evaluating, and presenting information as well as a representation of the functioning of the economic system. In the following I shall speak first about the origin and background of input-output models in Norwegian planning, then outline the development of Norwegian input-output models and give some details of the input-output model in current use, in particular the price part of it, and finally discuss the more important uses of price calculations.

I. The background of input-output models in Norwegian planning

The use of input-output models for economic policy purposes is a long tradition in Norway. The first use of input-output calculations were made in the 1950s. The first input-output model explicitly designed for planning needs became available in 1960. Input-output tables have been compiled as an integrated part of the national accounts for every year since 1949.

Macroeconomic planning started in Norway in 1946 with annual economic plans called national budgets. The national budget is a budget in national accounting terms for the total economy, not only for the government sector, and thus implied an extension of the political responsibility for the economic development compared to the prewar period. The pressing economic problems of this time were those of reconstruction: scarcity of materials, import constraints, rationing of consumer goods etc. As the economy recovered from the abnormal postwar situation and the external environment changed, the set of policy instruments changed with less direct controls

and rationing and more emphasis on indirect policy measures for managing the economy. The overall framework of the national budget as the annual economic plan has been maintained, however, for every year since 1946.

Until around 1960 the national budgets were worked out through a decentralized, administrative procedure. The various ministries worked out plan proposal for their respective sectors of the economy and submitted these to the Ministry of Finance which combined the sector plans into an overall national budget. The Ministry of Finance did more than just add the plans together , of course. The national budget had to be checked for internal consistency and economic realism and it was a political document that should represent the governments targets with regard to economic development.

As already indicated the national budgeting in the early postwar period was a very detailed process because of the many constraints in the economy at this time. The task of checking internal consistency in such a plan is a problem which begs for an input-output model. As this was not available the consistency checking was limited to looking after definitional equations and subjective plausibility considerations. When input-output tables became available a lot more could be done to corroborate the national budgets by comparison with historical observations of various relationships. From the middle of the 1950s experimental input-output calculations were performed on a 30-sector Leontief model in a cooperation between the Institute of Economics at the University of Oslo and the Central Bureau of Statistics. From these calculations were derived inverse input-output coefficients that were of great value in estimating the direct and indirect import content of various demand components.

In 1960 the first MODIS model, MODIS I, was completed and as it was designed specifically for national budgeting it could be put to work immediately, within the administrative environment. It took, of course, several years before the national budgeting process was completely reorganized with the model at the very center. For some years one may talk of a coexistence of the old administrative method of preparing the national budget and the new model based way. But soon the model became an irreplacable tool for the national budgeting and even more so when the further development of computer techniques increased the utilization of the model within the administrative environment.

II. The development of Norwegian input-output models

The first MODIS model, MODIS I, was completed in 1959 and used from 1960 to 1965. It was a simple Leontief model with an aggregate consumption function. It had three sets of equations: input-output equations for 125 industries and imports, income equations determining wages, profits and indirect taxes from production, and consumption equations determining the size and composition of household consumption from after-tax wages and profits. The MODIS I model had its limitations with regard to problems that could be dealt with by means of the model, above all that it did not include price relations and only very limited income relations. The model also had operational limitations, it was programmed for a first-generation computer and was cumbersome and time-consuming in use. Nevertheless, the model served an important purpose in proving the superiority of input-output techniques over administrative methods, gaining trust within the planning administration as a reliable tool in forecasting the real flows of the economy, and thus preparing the ground for more ambitious models.

The next version, MODIS II, which arrived in 1965, included a complete set of input-output relations in prices as well as quantity relations. The number of industries was increased to about 140 and final demand and other variables were dealt with in a considerably more detailed way.

By combining prices and quantities the results from MODIS II also displayed incomes. Furthermore, the model included relations for direct taxes and for indirect taxes and subsidies. The final results included a set of hierarchic accounts of disposable income. Disposable income for Norway was subdivided in government and private disposable income. The latter was subdivided further in disposable income for enterprises and disposable income for households which again was subdivided in disposable income for wage and salary earners and disposable income for selfemployed.

The effort behind MODIS II was very ambitious with regard to completeness, in trying to build a model framework to cover the main areas of economic policy. Up to that time the whole national budget exercise was conducted in constant prices only. Prices were dealt with as a separate area of economic policy. The inclusion of price relations in MODIS II paved the way for securing the consistency of the national budget in a general equilibrium sense just as MODIS I had been a tool to secure the consistency between final demand and the composition of production.

MODIS II had, however, weaknesses both with regard to content and in terms of operationality and reliability. The model was improved and rebuilt as MODIS III in 1967. Throughout the period of MODIS III from 1967 until 1973 the use of the model by the Ministry of Finance increased tremendously. The model acquired in this period its central place in the national budgeting process and was also used for other purposes such as medium term planning, calculation of impact coefficients, and for ad hoc analysis of macroeconomic problems such as tax reform, consequences of the devaluation of the dollar etc. The model was updated from new input-output tables every year. A valuable feature of the model was also its ability to calculate up to twenty solutions simultaneously.

MODIS IV was completed in 1973 and is the current version of the MODIS model. The basic input-output structure of the model differs from that of its predecessors by being based on commodity by industry tables rather than industry by industry tables. This made the description of the economy more realistic and had definite analytical advantages, in particular for price calculations. The experience from the use of MODIS III played a major role designing the user properties of the new model such as the system of communications between the model and its user.

Some numbers may indicate the amount of details in these models. The number of commodities in MODIS IV is about 200, the number of industries is about 125 with an additional 17 government production sectors. Household consumption is subdivided in 48 categories and government consumption in 65 categories. Another characteristic feature of these models is the amount of institutional details that have been embedded in them. MODIS IV distinguishes for instance between 28 direct taxes, 85 indirect taxes and subsidies, and 21 government income transfers.

One could get the impression from these numbers that the Norwegian economy is one of extensive government control executed through an all-inclusive model. That would be a misleading impression. The model has limited explanatory power. It is a very open model in the sense that much is left unexplained and represented in the model through exogenous variables. This is the case for instance for private investment, exports, wage rates, and productivity growth. The model serves mainly as a tool to secure consistency in the

policy-making process. An important part of the consistency checking is provided by the input-output relations. The main behavioural element of the model is the consumption relations determining the amount as well as the composition of consumption from disposable incomes and prices.

Much emphasis has been put on the detailed representation of government instruments like taxes. The idea is that the tax rules should be represented as exact as possible within the model. This requires that the overall amount of detail in the model is sufficient to represent for instance indirect taxes in an adequate way.

An overall account shows that MODIS IV has about 2000 exogenous variables and the number of output variables is about 5000. The model is capable of handling several hundred policy alternatives simultaneously. From these numbers it is easy to see that the data handling properties of the model is quite important for its use as an efficient tool. One important property of the model is that the user may communicate with the model at different levels of aggregation. The model itself is not aggregated, only the input and output data. A user may choose aggregation levels to fit the needs of his problem by combining a high level of aggregation for some variables with a more disaggregate treatment of variables of particular interest. In this way one has tried to overcome the disadvantages of always having to deal with a very detailed model. For the presentation of model results there are similar flexibilites in giving the user a choice of edited tables at various levels of aggregation.

III. The price model of MODIS IV: an embodiment of the Scandinavian model of inflation

So far little has been said about the theoretical content of the MODIS model apart from it being an input-output model. As we are here mainly concerned with applications of the price part of the model I shall leave the rest of the model with what I have already said about but go somewhat deeper into the price relations.

The price model of MODIS IV is the combination of two strands of thought: the input-output price model of Leontief determining supply prices by adding up cost components within a simultaneous system of equations and, on the other hand, the Scandinavian model of inflation formulated in the 1960s, although it had its forerunners, and normally

presented within a twosector representation of the economy.

The basic assumption of the input-output model is often rendered as an assumption of constant input-output coefficients. But this is the assumption relevant for the quantity model, not for the price model. Constant input-output coefficients implies that quantity components in the same column of the input-output table change proportionately. The corresponding dual assumption for the price model is that the price components along a row of the input-output table changes proportionately. This assumption is far from trivially fulfilled. It depends on the choice of price concept in the accounting and on the specification of the rows of the input-output table. In MODIS IV much emphasis has been placed on the requirements for the validity of this basic assumption of the price model.

The input-output table underlying the MODIS IV model is a commodity by industry table with about 200 commodities and 140 industries (incl. government productions sectors). It has been found quite crucial for the price model that the rows represent commodities and not industry outputs. Of the 200 commodities more than half are tradables, i.e. they are exported or imported and often both. The price model distinguishes for each tradable commodity between import price, domestic price and export price. This has been found necessary to account adequately for short term price changes. The price concept itself is that of basic price, which is defined as producers' price less-indirect taxes. The reason for this choice is that indirect taxes on a commodity are often - at least in Norway - dependent upon its destination. Typically commodities destined for exports are exempt for taxation. Some commodities may be taxed differently when used for consumption than when used for investment or intermediate input.

All these details of the specifications of the price relations have been found important enough for the validity of the results to be included in the price model of MODIS IV although they complicate the solution of the price model considerably compared to the original Leontief version. The distinction between domestic price and export price also implies that prices cannot be solved independently from the solution of quantities.

The Scandinavian model of inflation is a model of the interrelation of prices and incomes in small, open economies. A fundamental distinction is drawn in this model between sheltered and exposed industries. The latter group consists of industries which are exposed to strong competition from abroad, either because they export most of their products or because they sell their products on the domestic market under strong foreign competition while shel-

tered industries, on the other hand, are those whose products are marketed at home under conditions that leave them relatively free of foreign competition.

There is a long-run version of the Scandinavian model of inflation that aims at explaining the long-term movement of wages and prices in an economy where, because of foreign trade, national wage and price trends are subject to strong price impulses from abroad. Only the short-term implications of the model are included in MODIS IV. Among these are that import and export prices are exogenous. Domestic prices of commodities with competition from imports are also exogenous; in the underlying theory they are assumed to follow the prices of similar imported goods, but this is not formally built into the model. Industries which produce commodities with exogenously determined prices have residually determined profits. In sheltered industries, on the other hand, prices are determined by cost-plus pricing in such a way that the profit share (profits as a share of factor income) will assume a predetermined value. For a number of commodities in the sheltered category the government influence over prices is so strong, in particular in the short run, that the prices in the model are set exogenously. These regulated and negotiated prices comprise for instance agricultural prices stipulated through income settlements and prices of commodities from government owned or dominated sectors such as electricity, transport , post and telecommunications.

Another important feature of the price model of MODIS IV, in particular from a policy point of view, is the detailed treatment of indirect taxes and subsidies. Altogether there are 85 indirect taxes and subsidies specified within the model, and they fall into different categories with regard to how they are treated in the model. Some are taxes on values, others on quantities. One is a general value added tax, others may be taxes or subsidies on one particular use of a commodity.

The price model of MODIS IV is a fully integrated part of the complete model. It can logically be considered as a separate part of the model, but it is normally not used independent from the rest of the model. In the following we shall look at some uses of the model when the price part is of particular interest.

IV. The need for price calculations

What is the need for price calculations for instance for a central government and what kind of price calculations are needed? Most governments would appreciate to have price forecasts from a reliable source. A number of research institutes in the major industrialized countries provide such forecasts. But how can the government use price forecasts when the price development depends upon the decisions of the government yet to be taken. Obviously, the forecasters have made, at least implicitly, some assumptions about what the government's decisions will be. This is a puzzle which was posed and answered by the late professor Ragnar Frisch. He said in an article many years ago and wellknown to Norwegian economists:

"How can it be possible to make a projection without knowing the decisions that will basically influence the course of affairs? It is as if the policy maker would say to the economic expert: "Now you expert try to guess what I am going to do, and make your estimate accordingly. On the basis of the factual information thus received I will then decide what to do". The shift from the on-looker view-pont to the decision view-point must be founded on a much more coherent form of logic. It must be based on a decision model, i.e. a model where the possible decisions are built in explicitly as essential variables".

Frisch here rejects the idea that a government in the use of models should adopt what he calls an on-looker point of view. It should instead adopt a decision point of view, i.e. use models which can analyze the effects of government decisions. Frisch has been influential in almost every aspect of model building in Norway. No wonder then that Norwegian models adhere to his views, as they do, in particular in this case.

What motivated Frisch here is the possibilites he saw for using economic theory and mathematical techniques as scientific tools for analyzing the interelationships between targets and instruments. He also had strong convictions on the obligation of a government to apply scientifically based economic planning to promote the welfare of the society.

The MODIS model is thus a decision model in the sense of Frisch, an instrument to be used in and analyzing economic policy, a purpose which is completely different from that of providing the best possible price forecasts for the general public. The experiences of using price calculations in Norway are therefore mainly related to the use of formulating and deciding an economic policy from an evaluation of the effects.

Since price calculations by means of input-output techniques were incorporated in the MODIS model from 1965 they have become of ever increasing importance. There are several reasons for this.

The Norwegian economy has gradually become more open with exports and imports amounting to 40-50 percent of gross domestic product. This makes the economy more exposed to inflationary impulses from abroad. The ability to assess in a fairly detailed way the impact of increasing import prices has been of particular importance in the 1970s. The breakdown of the system of fixed exchange rates in the OECD area caused a similar need to assess the impact of fluctuating exchange rates on domestic prices as well as on trade volumes, incomes etc. Revaluation as well as devaluation has been used as a policy instrument by the Norwegian government in the 1970s.

Increasing government expenditure and changes in the tax system including the introduction of a value added tax put more emphasis on indirect taxes and subsidies and thus implied a greater impact on domestic prices, in particular food prices, from fiscal policy. Increased concern with relative incomes between and within socioeconomic groups has increased the inflationary pressure and focused attention on incomes policy. Government participation in income settlements may take different forms, but almost any kind of active government incomes policy requires a good basis of information on the price consequences of wage and salary increases.

In the 1970s the international trade within the OECD area has grown much slower than in the preceding decade. This has led to sharper competition between exporting countries and more concern with competitiveness. In Norway the cost level in manufacturing increased considerably above that of the competitors in the mid 1970s and the government was faced with the task of recovering competitiveness while maintaining a lower level of unemployment than most competitors. Price controls were among the instruments considered and used to achieve this aim. Naturally, price calculations on the effect, at least the temporary effect, of such strong measures were a necessity.

V. The use of price calculations by means of impact tables

One way of presenting the content of an economic model is by means of impact tables. An impact table shows the impact on one or more of the endogenous variables of the model of changes in selected exogenous variables. An example of an impact table is given in table 1 below. The table shows the effect on the price indices of private consumption, government consumption, gross investment, and gross domestic product of changes in import prices, wage rates and selected indirect taxes and subsidies. The table is calculated by means of MODIS IV for 1980.

Table 1. Some impact coefficients for MODIS IV. 1980

10 percent change in	Percentage change in the price index of Private consumption	Government consumption	Gross investment	Consumer price index
Import prices	2.85	1.19	3.83	2.91
Wage rates	2.22	7.88	3.22	2.23
Productivity rates	-2.05	-1.10	-2.93	-2.03
Value added tax	1.19	0.42	0.67	1.29
Gasoline tax	0.14	0.05	0.02	0.17
Tax on liquour, wine etc. .	0.17	0.00	0.00	0.09
Subsidies on milk and milk-products	-0.12	-0.01	0.00	-0.07

From the table one can see for instance that a ten percent increase in import prices will increase the price index of private consumption with 2.85 percent while the price index of government consumption increases with less than half, only 1.19 percent. This reflects, of course, the difference in import content between private consumption and government consumption. The increase in the price index of gross investment on the other hand is 3.83 percent revealing the much higher import content of investment goods.

The other rows of the table show in a similar way the differential impact on the same price indices of ten percent increases in wage rates, productivity rates, three indirect taxes, and milk subsidies. A fourth column shows the impact on the official consumer price index, a Laspeyres index with weights based on a 1973 consumer survey. The impact on this index is quite similar to but not identical with the price index of private consumption. Quite notable is the impact of the tax on liquour, wine etc.which affects the price index of private consumption almost twice as much as the consumer price index. This reflects the wellknown tendency to underestimate expenditures on liquour, wine etc. in consumer surveys.

The results presented in impact tables are calculated by full simulation runs on the model. In practice it is both more convenient and efficient to calculate the impact coefficients by simulation than by analytic derivations from the equation system. Impact tables can be useful as an introduction to a model. They offer a shortcut to the reduced form of the equation system with numerical results that can be interpreted and applied. It should be stressed, however, that proper use of impact tables requires a deeper understanding of the theoretical content of the model. To understand fully the meaning of the impact of a specific exogenous variable on a given endogenous variable, it is necessary to have an overall knowledge of the theoretical

content of the model and, in particular, which variables are exogenous and which are endogenous.

Impact tables cannot give the full content of a large-scale model. In MODIS IV there are about 2000 exogenous variables and about 5000 endogenous variables. The impact tables can be constructed at different levels of aggregation. For some purposes more aggregate tables are convenient while for others more detailed tables are needed. In Norway impact tables for MODIS IV have been found very useful. They are published for every year in a publication of 250 pages.

The impact tables are used first of all by the Ministry of Finance before and between model runs to calibrate the use of policy instruments, to assess margins of uncertainty in external influences etc. The impact tables can also be used by political parties to assess the effect of policy proposals. Requests from companies, research institutes and others to the Central Bureau of Statistics for use of the MODIS model to analyze a variety of problems are often dealt with by means of impact tables which in most cases can give a fully adequate answer and thus saving the user the trouble and expence of a full use of the model.

VI. The use of price calculations in income settlement

Input-output price calculations have played an important role in income settlements in Norway since 1965. This is no doubt the most important use of price calculations. Such calculations have been used at two stages in the income settlement process: first at a preparatory stage prior to negotiations and later when the government has intervened in the final stage of the negotiations.

Income settlements in Norway comprise settlements between trade unions and employers' organizations - normally every second year - and settlements between the government and agricultural organizations. About two thirds of all wage and salary earners belong to a union.

The preparatory use of price calculations originated in 1965 when the government appointed a small expert committee to prepare background material for the upcoming income settlements. The expert committee constructed a small input-output called PRIM, which could be characterized as a pedagogical simplification of the price part of the MODIS model. Calculations by means of this model illustrated the consequences

of alternative income settlements with regard to prices and real incomes. The experts made assessments of all relevant background variables such as world market prices and productivity changes and then represented the outcome of the income settlements by two key parameters: the average wage and salary increase and the increase in agricultural prices. The response to the report of the expert committee from the organizations taking part in income settlements was quite favorable.

The expert committee continued its work also for the next round of income settlements. The reports of the committee did not include any recommendations, at least not explicitly, but presented the background material in a way which allowed the participants in the ensuing income negotiations to use other assessments of background variables than those adopted by the committee. This was done by means of impact tables presenting the effect of background variables as well as the key parameteres on prices and real incomes.

The importance which the PRIM model acquired as a medium for discussing alternative income settlements was due in great extent to its formal simplicity. The model was transparent enough to be understood and used by the parties of the income settlements. On the other hand the model was too aggregate and simplified to represent the consequences of income settlements in more detail.

The expert committee was later replaced by a committee with representatives from the tradeunions, employers' organizations, agricultural organizations, and the government. The committee has no mandate to negotiate or reach agreements on behalf of their organizations. The use of the PRIM model was later replaced by the full MOLIS model. In recent years the committee has put much less emphasis on alternative outcomes of the income settlements and concentrated more on the general outlook and assessment of important background variables. The use of input-output price calculations is still, however, the central analytic framework of the committee. The use of this framework has doubtlessly done much to provide a common ground in understanding the basic interrelationships of prices and incomes.

The Norwegian system of determining wage and salary increases is based on freenegotiations between tradeunions and employers' organizations. Agreements are normally made for one or two years. When agreement cannot be reached by negotiations the government can by Parliamentary decision in each individual case have the agreement settled by a national arbitration committee.

The normal outcome of wage negotiations is then agreement by negotiation. The agreements are, of course, of great importance for the government's short-term economic policy, with considerable effects on price and cost development as well as on income distribution. It is of considerable concern to the government that the negotiating parties reach an agreement that the government find consistent with the situation of the economy. The government will normally not intervene in the negotiations, but, of course, present relevant background information etc. The establishment of the abovementioned committee for preparing material and calculations for the income settlements has been of particular importance.

In the 1970s the central government has intervened on a number of occasions to influence the outcome of wage negotiations. The interventions have resulted in agreements that have been called "combined income settlements" or "package deals". The interventions have taken different forms from time to time, but basically they have been of two different forms. One is that the government has presented just prior to negotiations a package of policy measures that implied increased real incomes to wage earners through tax reductions, increases in food subsidies or childrens allowances etc. In return the government has wanted lower nominal wage increases. The other way is by entering the negotiations as a third party committing itself to a similar package in return for an agreed wage settlement. In 1973 and 1974 the first way was chosen, in 1975, 1976 and 1977 the second was used.

A considerable part of the wage increases are the result of wage drift not accounted for in the negotiated agreements. This creates problems for the government whose concern is with the overall wage increase rather than the negotiated part of it. The agreements have normally index clauses that provide automatic compensation for price increases. This is also a worry for the government in its effort to keep nominal increases within bounds. For some years the government stated as part of combined income settlements an intention with regard to the increase in average real disposable wage incomes, e.g. 3.5 percent from 1975 to 1976 and 2.5 percent from 1976 to 1977. This amounted to a virtual guarantee of the stated development in real incomes through tax and price policies.

The government participation in income settlements as described very briefly above would have been impossible without model tools for price and income

calculations as detailed and comprehensive as the MODIS IV. Throughout the income settlements in the middle of the 1970s price and incomes calculations were used intensively for preparing and putting into effect the policies that the government had committed itself to.

VII. The use of price calculations in maintaining an full employment economy

After the oil price shock in 1973-74 most industrialized countries have experienced an economic development that has differed in many ways from the stability and steady growth of the preceding period. Unemployment has in many industrialized countries risen to levels comparable to the depression period of the 1930s, while at the same time inflation rates have been high and a number of countries have run into severe balance of payments difficulties.

The Norwegian government has in this period pursued a policy different from that of most other OECD countries. Employment has been maintained at a high level by counteracting slow growth in foreign demand by boosting domestic demand for private and government consumption. The choice of policy reflects a higher priority given to the target of full employment, while other countries have stressed control over the inflation as the prime target in economic policy. Both economic policy and economic development in Norway in the 1970s has been influenced very much by the discovery of vast oil and gas reserves in the Norwegian sector of the North Sea. The oil and gas riches eased the balance of payments constraint. The prospekts of future export earnings from oil and gas allowed a policy that incurred balance of payments deficit in the middle 1970s. On the other hand the booming sector of oil related activities caused imbalances in the economy and difficulties in economic policy management.

To cope with these problems the government applied a number of selective measures and run into wellknown problems of accurately calibrating and timing the policy measures. Domestic demand tended to increase more than expected causing problems of overfull employment, severe inflationary pressure, and loss of competitiveness. The use of price calculations played a great role in policy considerations in this period.

The government has as a rule not published price forecasts except for one or two years. In the National Budget publication there are since 1975 published figures, however, of gross national product and its main components in constant and current prices. With a pocket calculator the im-

plicit price assumptions could easily be calculated. For private consumption the implicit forecasts - usually circumscribed as assumptions used in calculations - are as follows:

Table 2. Private consumption price index. Current growth rate

Year	National budget (previous autumn)	National accounts
1975	11.6	11.7
1976	8.7	8.6
1977	8.3	8.6
1978	9.0	8.3
1979	4.4	5.2
1980	6.1	9.8
1981	10.8	13.6

As can be seen from the table there is a remarkable record of correct price assumptions in the middle 1970s. These are the year of the incomes policy described earlier. The results are to a large extent due to policy measures to fullfill the governments commitment as part of the incomes policy rather than good forecasting. From 1978 strict price and incomes control were introduced for a period of 16 months in an effort to get control over inflation once and for all as it was expressed. As the table indicates the underlying inflationary pressure was stronger then expected and not only did the rate of inflation increase but also the difference between the actual rate and the assumption in the national budget. The inflation rate in 1981 was not only higher than in the preceding years, it was the highest since 1951. The government fulfilled its aim of full or nearly full employment, however, and could hardly have done so without the use of a policy oriented model as detailed as MODIS IV. When price controls have been used, as they have in some form or other for a considerable part of the period since 1974, a detailed model for price calculations is particularly useful.

A model like the price model of MODIS IV gives a good overview of the situation but it has its limitations. The most important is undoubtedly that the dynamics of the inflation process is not represented within the model.

VIII. Some final comments

The input-output price model has been applied in Norway and elsewhere for analyzing a variety of problems. The Norwegian experience is an example of intensive use of the input-output price model in short-term economic policy making, a use which is not very common in other countries. It may be true that the input-output price model has got much less attention than its quantity counterpart. The input-output relationships in prices and quantities describe dual aspects of the structure and functioning of modern economies. It is hardly meaningful to ask which aspect is more important. The main reason why the input-output price relationships are used less has got to do, I believe, with the data requirements. The price data in input-output tables are often of poor quality, in particular for non-manufacturing sectors.

There is a lot to say about weaknesses and insufficiencies of price data in the Norwegian input-output tables too. There are two advantages worth mentioning for input-output modeling in Norway which have done a lot to overcome data deficiences and to a large extent are prerequisites for the current use of input-output models.

The first advantage is the updatedness of the input-output tables. The first preliminary and somewhat incomplete input-output table appears already in January after the completion of the year. A second preliminary - and usually more reliable - table appears in April, the third preliminary table in November and then the final table about 18 months after the completion of the year. In some countries the most recent input-output table is several years old. In particular for economic policy use of price calculations this is a disadvantage.

The other advantage in Norway is the close cooperation between those working with national accounts, input-output tables, model building and model use. Input-output tables are constructed as an integrated part of the national accounts and the national accounting work takes place literally on the same floor as the modelbuilding work of the Central Bureau of Statistics. This has meant that the compilation of input-output tables has been influenced to a considerable degree by model needs. Again, this has been of particular importance for the price calculations which are quite dependent upon the value concepts used in the input-output tables, the treatment of indirect taxes, the commodity specification etc.

In the preceding I have only dealt with the use of input-output price calculations in a short-term perspective. I would just like to mention at the very end that I think there may be an important future use of input-output price calculations to provide information on relative prices in a long term perspective. Such information on future prices may be valuable for households, firms and local government as well as for the central government for decisions taken today.

References

General

Aukrust, Odd: Econometric Methods in Short-Term Planning. In Richard Stone and William Peterson (eds.): Econometric Contributions to Public Policy, Macmillan Press Ltd. London, 1978, pp.64-83.

Bjerve, Petter Jakob: Trends in Norwegian Planning 1945-1975. Artikler No.84, Central Bureau of Statistics, Oslo, 1976.

Frisch, Ragnar: A Survey of Types of Economic Forecasting and Programming and a Brief Description of the Oslo Channel Model. Memorandum from the Institute of Economics, May 13, 1961.

PRIM

Aukrust, Odd: PRIM - A Model of the Price and Income Distribution Mechanism of an Open Economy. Review of Income and Wealth, Series 16, 1970, pp. 51-78.

Aukrust, Odd: Inflation in the Open Economy. In Lawrence B. Krause and Walter S. Sâlant (eds.): Worldwide Inflation: Theory and Recent Experience, Brookings, Washington D.C., 1977, pp. 109-166.

MODIS

Sevaldson, Per: An Interindustry Model of Production and Consumption in Norway. Income and Wealth, Series X, London, 1964, pp. 23-50.

Sevaldson, Per: MODIS II: A Macro-Economic Model for Short-Term Analysis and Planning. In Macro-Economic Models for Planning and Policy-Making, United Nations, Geneva, 1968, pp. 161-171.

Bjerkholt, Olav: A Precise Description of the System of Equations of the Economic Model MODIS III, Economics of Planning, Vol. 8, No. 1-2, Oslo, 1968, pp. 26-56.

Bjerkholt, Olav and Svein Longva: MODIS IV - A Model for Economic Analysis and National Planning. Central Bureau of Statistics, Oslo, 1980.

Utkommet i serien Artikler fra Statistisk Sentralbyrå (ART)

Issued in the series Articles from the Central Bureau of Statistics (ART)

Nr. 132 An-Magritt Jensen: Barnetall og yrkesaktivitet Number of Children and Female Employment 1981 52 s. kr 15,00 ISBN 82-537-1643-5 ISSN 0085-431X

" 133 Olav Bjerkholt, Lorents Lorentsen and Steinar Strøm: Using the Oil and Gas Revenues: The Norwegian Case Virkninger av bruk av olje- og gassinntekter i Norge 1982 19 s. kr 10,00 ISBN 82-537-1652-4 ISSN 0085-431X

" 134 Lars Østby: Norwegian Fertility Survey 1977 A Summary of Findings Fruktbarhetsundersøkelsen 1977 Et sammendrag av resultatene 1982 22 s. kr 10,00 ISBN 82-537-1710-5 ISSN 0085-431X

" 135 Bjørg Moen og Per Sevaldson: Fødselstallene i Norge 1950 - 1975 Endringsfaktorer Births in Norway 1950 - 1975 Components of Change 1982 81 s. kr 15,00 ISBN 82-537-1716-4 ISSN 0085-431X

" 136 Petter Frenger, Eilev S. Jansen og Morten Reymert: MODEX - En modell for verdenshandelen og norsk eksport av bearbeidde industrivarer A Model of World Trade and the Norwegian Export of Manufactured Goods 1982 35 s. kr 10,00 ISBN 82-537-1717-2 ISSN 0085-431X

" 137 Petter Jakob Bjerve: Three Decades of the Conference of European Statisticians: Past Achievements and Perspectives for the Future Den europeiske sjefsstatistikarkonferansen gjennom tre ti-år: Mål som vart nådd og perspektiv for framtida 1982 22 s. kr 10,00 ISBN 82-537-0000-0 ISSN 0085-431X

" 138 Arne Rideng: Befolkningsutviklingen i Norge fram til år 2025 The Changes of Population in Norway to 2025 1982 83 s. kr 15,00 ISBN 82-537-1852-7 ISSN 0085-431X

" 139 Nils Terje Furunes and Svein Lasse Røgeberg: Compilation of Input-Output Tables in Norway Beregning og sammenstilling av krysløpstabeller i Norge 1983 37 s. kr 12,00 ISBN 82-537-1885-3 ISSN 0085-431X

" 140 Turid Noack og Lars Østby: Barnløshet - savn eller ønske? Om ufrivillig og frivillig barnløshet Childless or Childfree? About Infecundity and Intentional Childlessness 1983 50 s. kr 12,00 ISBN 82-537-1894-2 ISSN 0085-431X

" 141 Olav Bjerkholt: Experiences in Using Input-Output Techniques for Price Calculations Bruk av krysløpsmodeller for prisberegninger 1983 22 s. kr 12,00 ISBN 82-537-1926-4 ISSN 0085-431X

Fullstendig oversikt over tidligere nummer av serien Artikler finnes i nr. 130.

Publikasjonen utgis i kommisjon hos
H. Aschehoug & Co. og Universitetsforlaget, Oslo,
og er til salgs hos alle bokhandlere
Pris kr 12,00

Omslag trykt hos Grøndahl & Søn Trykkeri, Oslo

ISBN 82-537-1926-4
ISSN 0085-431x