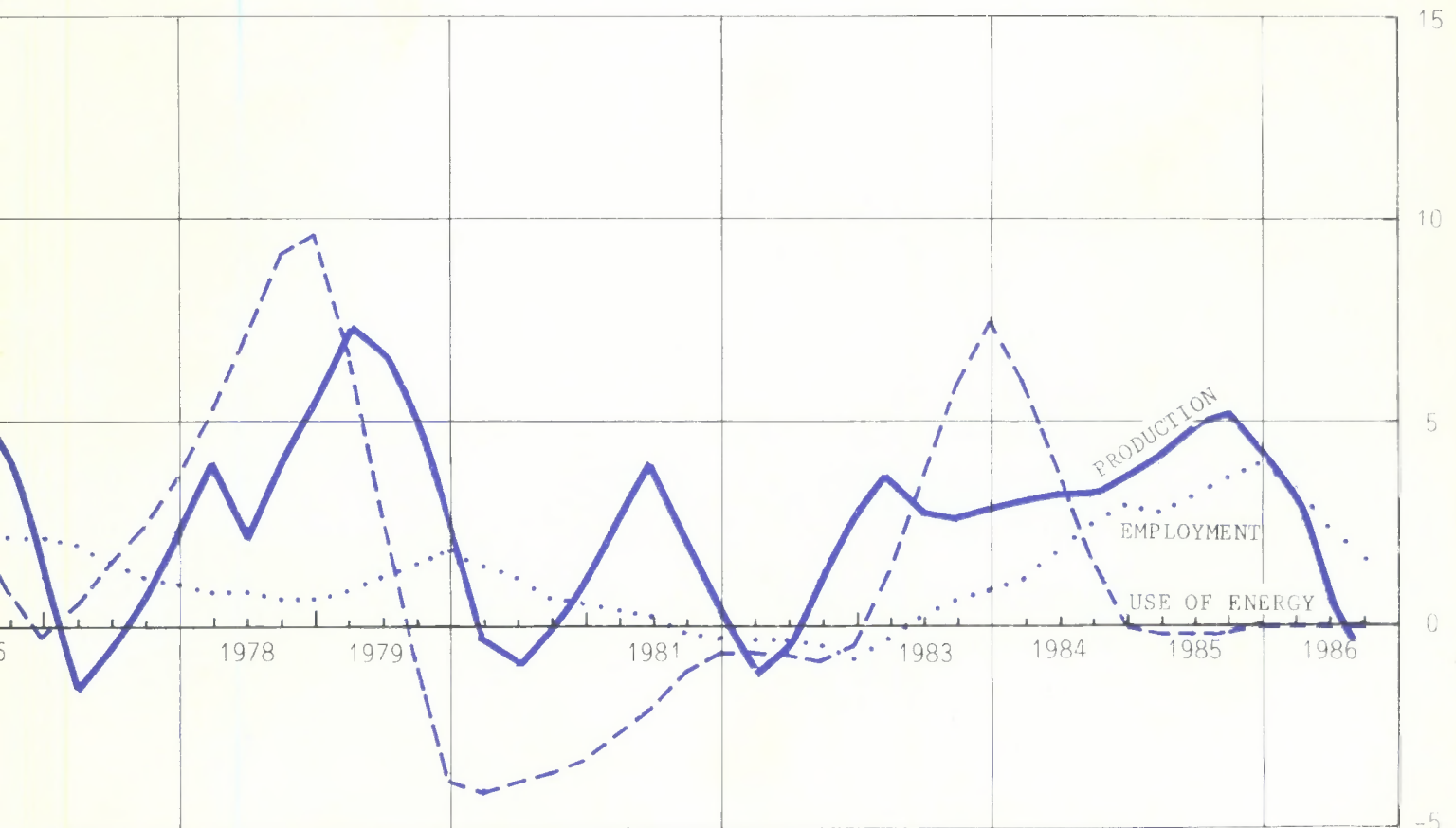# SSB

RESEARCH DEPARTMENT
THE CENTRAL BUREAU OF STATISTICS, NORWAY

ANNUAL REPORT
1986

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C O N T E N T S

"FUTURE CHALLENGES MORE IMPORTANT THAN PAST RESULTS"

If the daily life of the central government of Norway were to be presented as a movie picture, the Research Department of the Central Bureau of Statistics of Norway, CBS, might be credited with providing various elements of infrastructure. The major results of the Department's work over more than thirty years have, in fact, accumulated as model tools of various kinds and analytic data services, such as national accounts, demographic projections and tax calculations, necessary for the conduct of business in Ministry departments and other institutions alike. The inventory of models now includes more than 20 specimens that are kept regularly updated and ready for use. The Grand Old Man (or woman?) among these is the MODIS model, which has been in regular and frequent use – in successive versions – since 1960, most likely one of the most longlasting macroeconomic models in the world. Some of the model names such as MSG, MODAG, KFS, LOTTE, MATAUK and others have become household words in various user environments outside the CBS.

Most of the model tools and data services have required cumulative efforts over several years. When they finally reach the stage of becoming part of government infrastructure and generally known in user environments, they may already be marked as in need of major revision or reevaluation! Issues brought forth by social and economic development are often of a kind that cannot be satisfactorily illuminated and analyzed by existing model tools. Better data and both theoretical and empirical studies may be required to analyze the future impact of observed trends or tendencies. On the other hand, existing models are often underutilized, even when their weaknesses and inherent limitations are accounted for. This may be a result of distrust and in some cases ignorance, but more often the model in question has not been made sufficiently accessible to those in need of its services, or there is a lack of skills required to operate the model.

Observations of long-term government projections over the last 15 years give an impression of the impelling strength of the method of trend extrapolation, often in the form of the tangential take-off from the current situation. This serves to remind us that for long-term projections – a re-current task for governments – improvements are urgently needed in our model tools to come to grips with e.g. intertemporal relations, uncertainty, and perhaps also the modelling of financial markets and other parts of the substructure which traditionally have not been well represented in the models developed in the CBS.

To some extent caught up by the need to maintain, update and promote earlier achievements, the Research Department nevertheless pursues a policy in which a considerable amount of resources are allocated towards methodological problems and "new" issues, that are not necessarily new, but not well covered by existing model tools. Current efforts are presented elsewhere in this report. In general terms the main directions of the research frontier are the following:

- The continuing need to improve the availability and quality of data for econometric analysis. The national accounts are in a process of extension, improvement and revision with a view towards the coming revision of the SNA and of extending the national accounts with "satellites" for special purposes.

- Improved methodology in the use of econometric analysis of microeconomic information and further use of micro data in macroeconomic modelling and analysis. This implies an increased interest in the design of surveys and other data collections. The analytic use of individual observations favours panel data, coordination between various surveys, coherence in definitions and classifications.

- The volatility of economic indicators in recent years emphasises the need for an appropriate time phasing and dynamic relations of the macro-economic models. Hopefully, the higher volatility of economic time series in recent years will provide a better means of estimating dynamic relations.

- In important areas the government is faced with the task of making far-reaching decisions in the face of uncertainty in many factors. The current CBS models offer limited support for analyzing the future impact of such decisions. Especially for government decisions in areas where there is considerable – and sometimes undiversifiable – risk as certain oil and gas decisions, there is a definite need for better tools in the form of a decision-oriented stochastic analytic framework.

THE RESEARCH DEPART-MENT IN THE CENTRAL BUREAU OF STATISTICS

The CBS enjoys a long tradition as a research institution, although the Research Department (as a separate part of the organization) has only existed for one-third of the 110 years that the Bureau has existed. Proximity to primary data sources is of undisputed benefit for a research institution within a statistical bureau. The autonomy traditionally maintained by statistical bureaus and the central position they hold in the production and distribution of information in our societies is also invaluable in research work. The Research Department of the CBS has enjoyed these advantages since its inception.

FROM THE BEGINNING ...

From an early stage there has been a research tradition within the CBS. From the beginning, statistical information was used to enlighten the general public about social conditions. Anders Nicolai Kiær, the Director General for the first 37 years of the Bureau's history, ensured that this became a tradition.

The Research Department was not established, however, until 1953. It was formed as a result of the main research effort in the first postwar years, namely the establishment of the national accounts. It was firmly believed, even in that precomputer age, that national accounts data would provide the basis for macroeconomic modelling and analyses of national economic development. The early activities of the Research Department comprised national accounting, input- output analysis, consumer demand analysis, tax research and economic surveys. The first large-scale model (MODIS) was developed in 1960.

The postwar austerity of the 1940s and early 1950s brought economic issues to the forefront of politics. Input-output analysis based on the new national accounts came to be adopted as a multi-task tool for policy analysis and has been a cornerstone in the Department's work since then. In the 1960s the population wave created by the baby boom of the 1940s swelled the inflow to the labour market. As a result there was an increasing interest in population issues, changes in the labour market, and migration, which led to the establishment of a demographic research unit within the CBS to cover these fields. From the early 1970s a growing interest in environment and natural resource issues emerged, which in 1978 led to the establishment of another research unit in the CBS. The latter two units were not formally incorporated into the Research Department until 1983.

During the last 10 to 15 years there has been a great expansion of the Department's activities. The issues of thirty years ago are no less important today. The concepts of the national accounts – at that time known and understood only by a small community of postwar economists – are now a general frame of reference in public debate, taught in school at the intermediary level etc. The development of macroeconomic models and other model tools in this period has been prolific. The challenging task of managing a modern economy has not, however, become any easier. We have to recognize that even the best models we are able to build at present fall far short of ideal requirements.

The tax research activity, which also started in the 1950s, has provided both government and political opposition parties with confidential analyses of the effect of changes in tax rules for more than thirty years. The volume of this service increased immensely after computer-based tax models were developed in the late 1960s.

The 1980s up to now have provided more volatility in economic development than any other part of the postwar period. This has accentuated the need to better understand the international environment and the changes that take place in our own society. There is less unanimity about the future, and perhaps also less belief in traditional forecasting. The practice of extending observed trends without asking what supports such trends, and to take a narrow view with regard to the set of interdependent factors, is still widespread. Furthermore, there is an overwhelming tendency to underestimate the uncertainty of projections.

Norwegian society in the 1990s, the 2000s and the 2010s is being formed by decisions made today. The major challenge for the Research Department is to contribute information to this process and to provide the requisite expertise for providing the best tools and analyses for such decisions in the future.

MAIN ACTIVITIES

The activities of the Research Department comprise:

- National accounts, input- output data, balance of payments

- Economic analysis, macroeconomic models, economic surveys, tax research, input-output analysis, econometric studies

- Population models, family and fertility studies, labour market analysis

- Natural resource analysis, energy analysis, land use accounts, environmental studies

- Petroleum economics

- Regional demographic and geographical analysis

The scope of research activity is not matched by many other research institutions in Norway. One important dimension in this range of activities is the emphasis on the use of detailed information to create a picture of the aggregate development in various areas. A second dimension is the emphasis on providing tools and analyses that can be used in general social planning. Models are made available for ministries and others, and forecasts and analyses, e.g. economic growth, population development and indicators of environmental standards are made regularly or on request. A third dimension is the emphasis on academic standards, contact with international research activities etc. to support and complement the applied orientation.

Most of the Research Department's activities are funded via the regular annual budget of CBS, but an increasing share have in recent years come from Norwegian Research Councils and research contracts. The research contracts are mostly with ministries and other central government institutions.

The general orientation of the Department's work makes Norwegian Ministries a particularly important user group. Of particular importance are the ties with the Ministry of Finance and the Ministry of Environment. Also in close contact with the Research Department are the Ministry of Oil and Energy, the Ministry of Family and Consumer Affairs and the Ministry of Labour and Municipalities. With 5–6 other Ministries the contacts are more sporadic. It is of importance for these links that the Research Department is – as part of the CBS – embodied in the central government administration.

Research results are reported and published in the following series from the CBS:

NOS Norwegian Official Statistics

SØS Social and Economic Studies

RAPP Reports

DP Discussion Papers (in English)

RS Reprint Series

IN Internal documentation

In addition, the Research Department publishes the "Økonomiske analyser" ("Economic Survey") with 10 volumes a year. The first volume of each year presents an economic review of the past year and is also made available in English. Other issues contain economic surveys both of the Norwegian and the international economic development, quarterly and annual Norwegian national accounts figures with comments and short articles presenting results from ongoing research projects.

ORGANIZATION

The Head of the Research Department is also Assistant Director General of the CBS. The Research Department is divided into 4 Divisions:

- Division of National Accounts

- Economic Analysis Division

- Socio-Demographic Division

- Division of Natural Resource and Environment Analysis

The divisions are subdivided into smaller units working with one or several related projects within defined research programmes. Separate units working with regional analysis and petroleum economics have been organized across divisions. There is also a separate unit for administration.

MANAGEMENT AND PERSONNEL

The Research Department employs over 100 persons, of which 70–75 have an academic background. Most of the academic staff of the Division of National Accounts and the Economic Analysis Division are economists.

Altogether there are about 50 economists in the Department. Other academic staff represent many disciplines. An incomplete list includes sociology, geography, statistics, computer science, agricultural science, physics, biology and engineering. Most of the non- academic staff are highly trained specialists.

Figure 1. ORGANIZATION AND MANAGEMENT OF THE RESEARCH DEPARTMENT, 1. JANUARY 1987
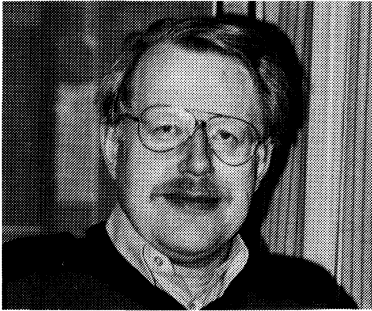
ASSISTANT DIRECTOR GENERAL
Olav Bjerkholt

— CENTRAL UNIT OF ADMINISTRATION:
 Tiril Vogt

DIVISION OF
NATIONAL ACCOUNTS
Erling J. Fløttum

— Annual accounts: Randi Hallén
— Income and capital accounts: Rolv Lea
— Foreign accounts: Kari Fossum
— Employment accounts: Anders Harildstad
— Annual county accounts: Per Schanche
— Quarterly accounts: Tore Halvorsen

ECONOMIC ANALYSIS
DIVISION
Svein Longva

— Tax research: Inger Gabrielsen
— Structural analysis and input-output models: Paal Sand
— Economic surveys and analysis: Per Richard Johansen
— Macroeconomic models and analysis: Ådne Cappelen
— Econometric methods and microeconomic analysis: Petter Frenger
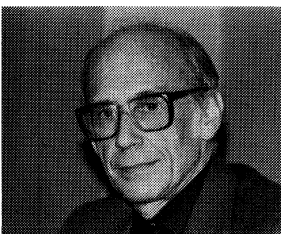
SOCIO—DEMOGRAPHIC
DIVISION
Per Sevaldson

— Labour supply and education: Olav Ljones
— Demographic analysis: Turid Noack

— UNIT OF REGIONAL ANALYSIS:
 Tor Skoglund
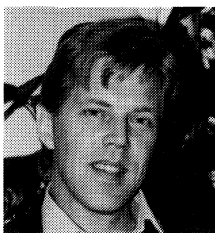
DIVISION OF
NATURAL RESOURCE AND
ENVIRONMENT ANALYSIS
Lorents Lorentsen

— Energy analysis: Torstein Bye
— Land use: Øystein Engebretsen
— Environmental economics: Knut H. Alfsen
— Environment and health: Tiril Vogt
— Environmental statistics: Torbjørn Østdahl

— UNIT OF PETROLEUM ECONOMICS:
 Øystein Olsen

NATIONAL ACCOUNTS

MAIN ACTIVITIES

The national accounts are a comprehensive and balanced system of accounts for the Norwegian economy based on the principles of double book-keeping. The accounts give both a systematic statistical description of the economy as a whole and a quite detailed map of the transactions between the various parts of the economy and between Norway and other countries. This mapping makes use of concepts and classifications that are stipulated according to adopted rules and conventions, often as a result of international collaboration. In all essential aspects the system of accounts follows recommendations given by the United Nations.

A main characteristic of Norwegian national accounts is the complete integration of annual input-output tables including close to 200 production sectors and approximately 2000 commodities. This implies a strong emphasis on commodity flows and commodity balances, as well as on production, consumption expenditure and capital formation accounts rathei than income and outlay and capital finance accounts. Thus, the "production approach" has been the main approach used for computing gross domestic product. In recent years, higher priority has been given to completing work on the construction of income and outlay and capital finance accounts. This effort has so far resulted in income and outlay accounts figures being

presented on a current basis.

The national accounts figures are of major importance to the develop- ment and co-ordination of Norwegian economic statistics and contributing as the main data source for macroeconomic analysis in the CBS.

The annual national accounts are being presented in two preliminary versions until the final figures are constructed. All versions are published (annually) in Norwegian Official Statistics (NOS) of National Accounts. Additionally, quarterly national accounts are published annually in the NOS. Balance of payments data are produced monthly, and income and outlay accounts by institutional sectors and employment data by industry are produced with regular intervals. National accounts by county are being published every 3-4 years.

ACTIVITIES IN 1986 AND PLANS 1987

During 1986 efforts have been made towards further development and improvement of the quality of the Norwegian national accounts, – such as improvement of methods applied in the accounting system and the use of technical means or routines of production.

Work accomplished in 1986 will result in finalizing some large projects during 1987, such as to publish figures on employment accounts for the period 1962–1985, as well as introducing figures on hours of work in the employment tables in the national accounts on a regular basis. Furthermore, the plan is to publish reconciled figures of the income and outlay and capital finance accounts for the period 1975–1985. This will imply a further extension of the annual accounts subsequent to the integration of the income and outlay accounts with the regular publishing of the national accounts some years ago.

The major part of the calculation work on county-specified figures on national accounts for 1983 has been accomplished in 1986 and will be published in the NOS in 1987. Furthermore, the Division plans to publish input-output figures for single years in 1987.

However, the most extensive project during 1987 will be to alter the national accounts system itself. Improved quarterly accounts will provide a more simplified version to the preliminary annual accounts and an adjustment to a simplified basis model for the work on the national budget. In addition, a limited main revision of the annual national accounts will provide revised series of figures in 1988, and at the same time indicating an increased effort – towards a revision of the national accounts in itself in the early 1990s.

Quarterly national accounts

From the beginning of the 1950s, the Central Bureau of Statistics has been compiling annual national accounts for the Norwegian economy. The accounts give information on the annual development of the economy; for instance growth in gross domestic product, inflation, change in the external trade etc.

A year is too long a period to analyse the short-term movements of the economy. Until 1970, the CBS currently compiled quarterly national accounts. This compilation ceased due to lack of resources, i.e. one had to rely on the short-term economic statistics in analysing the cyclical movements.

In analyses of cyclical movements, analysts are often forced to pay attention to some aggregated economic variables, such as total production and private consumption. Accordingly, it is difficult to utilize all the available short-term statistics without producing accounts. In the latter case, all available statistics could be utilized far better, as a large number of statistical sources are used for the compilation of aggregated accounts estimates. Furthermore, it will be possible to estimate the value of variables that are not directly observable from the short-term statistics through the use of definitional relationships in the national accounts.

The CBS has prepared quarterly accounts for the years 1978–1986 based on a new system of compilation. The main results of the compilation for the years 1980–1985 are presented in NOS Quarterly National Accounts 1980–1985. Figures for 3 quarters in 1986 have thus been published in Economic Survey no. 1A–1987. The publication also presents preliminary figures for the year 1986 based on available data and forecasts for the fourth quarter of 1986.

The accounting system of quarterly accounts

In principle, the accounting system of the quarterly accounts is similar to the annual accounts. The quarterly accounts, however, do not include:

- capital finance accounts for institutional sectors,

- opening balance sheets accounts,

- revaluations accounts,

- closing balance sheets accounts.

Except for interest, dividends etc. to and from abroad, financial flows are not included.

The specifications employed in the quarterly accounts are derived by aggregations of similar items of the annual accounts. The quarterly accounts thus consist of:

- 53 commodity accounts

- 57 production accounts (of which 13 for government services)

- 22 accounts for private final consumption expenditure

- 2 accounts for government final consumption expenditure

- 32 accounts for fixed capital formation by industries

- 10 accounts for fixed capital formation by producers of central government services and 4 for producers of local government services

- 3 accounts for changes in stocks

- 1 account for exports

- 1 account for imports

Sources and methods of estimation

Compilation of the quarterly national accounts implies the use of comprehensive data sets – of in fact more than 850 series. The compilation is mainly based on the short-term statistics from the CBS, such as price indices, the index of industrial production, the foreign trade statistics and so forth. In addition some information from other sources is being used. The data are arranged in a way that corresponds with the classification of commodities, industries and types in the quarterly accounts. Based on the development of these short-term indicators the figures of the quarterly national accounts are finally computed.

However, for some variables information on short-term development is lacking. Figures for these variables are computed through breakdown of annual figures into quarters. The main item following this approach is government expenditure on goods and services. The data situation will, however, improve for the government data from 1987.

The new approach to compile the quarterly national accounts is highly "automized". This concerns the updating of variables of the national accounts based on short-term statistics as well as the balancing of commodities, the computation of indirect taxes and factor incomes and the overall balancing of GDP

and main aggregates. Apart from the data situation, this is maybe the main difference from the annual accounts. It is not possible to include selective judgement and ad hoc changes to a great extent – as in the annual accounts – in the compilation of the quarterly accounts.

Harmonization with the annual accounts

Whenever possible, the same methods in the compilation of the quarterly accounts have been applied as those used in the first version of the annual accounts. Apart from the deviations mentioned above, differences between the one-year accumulated quarterly accounts and the annual accounts will mainly occur due to different levels of aggregation. Although compilation of the quarterly accounts is carried out at a more detailed level than is being published, the annual accounts are even more detailed.

Due to these differences between the annual and quarterly accounts the accumulated first version of the quarterly accounts most often will differ from the first released version of the annual accounts. Most of the series in the quarterly accounts will be recalculated by distributing the annual figures on the quarters by using the original quarterly figures as keys. The recalculated quarterly accounts will then add up to the annual accounts at constant and current prices.

The annual accounts are compiled in three subsequent versions as more and more information is available. The quarterly accounts will be harmonized whenever a new version of the annual accounts is released.

When the accounts of the first quarter are to be compiled, the accounts of the last year are harmonized with the annual accounts. In order to obtain coherent series, the quarterly accounts will be compiled in such a way that changes from the corresponding quarter of the previous year are the same as changes in the unharmonized accounts.

Some weaknesses of the compilation

In using the quarterly accounts figures some weaknesses must be noted. Firstly, the data sources are poor within some fields, and particularly data on service industries, construction and wholesale and retail trade are inaccurate.

The harmonization of the quarterly figures with the annual accounts leads to a change of the seasonal pattern of the series. This change may be different from one year to another depending on the magnitude of the errors. The development according to the harmonized series may be somewhat different from the originally computed series. An apparent change in the series may in fact be caused by technical factors referring to the computations.

By chaining the accounts of the current year with that of the last year, the growth from the corresponding quarter of the previous years is retained, although not necessarily the growth from one quarter to the next.

Despite the above-mentioned weaknesses, the accounts contain many series that are considered to be of good quality. Manufacturing industries, foreign trade and a number of other items are well covered through the use of short-term indicators.

ECONOMIC ANALYSIS

MAIN ACTIVITIES

The major economic research activities aim at analysing the structure and functioning of the Norwegian economy and constructing empirically based analytical tools to be employed in economic analysis and macroeconomic planning. The development of macroeconomic and general equilibrium models, all firmly rooted in the national accounts, forms the core of the economic research activity.

Economic surveys of recent Norwegian and international development are being published quarterly in "Economic Survey". The surveys have a strong basis in the annual and quarterly national accounts. An annual review of the Norwegian economy is presented in Economic Survey at the turn of the year.

The tax research is concentrated on analyses of the effects on income distribution and government revenues from changes in the tax or the allowance system. Several micro and macro based models have been developed to serve as tools in this work. Reviews of the Norwegian tax system are published annually.

The development of econometric methodology and econometric analyses of both micro- and macroeconomic data are important fields of research in the CBS. It is also a condition for advances to take place in the other areas of economic research. Hence it is important to maintain a relatively high level of activity and competence within this field.

The macroeconomic models of the CBS are all designed with basis in the account-system of the national accounts. The core of the models are input-output relations of supply and use of specified goods

and services and furthermore being connected to behavioural relations etc. for the different sectors of the economy. It is the extent and type of these relations and the level of disaggregation that vary between the models. The models are updated on an annual basis and hence being used and maintained regularly.

ACTIVITIES IN 1986 AND PLANS 1987

TAX RESEARCH

For 1987 a new "gross-tax" element has been introduced in the personal tax system, and accordingly, analysis of the effects of the proposed changes were given priority. The annual publications of tax figures and taxes and transfers to private consumers were updated in 1986. In 1987 increased attention will be given to work on distribution analyses both by the further development of the microsimulation model LOTTE and other household based models.

STRUCTURAL ANALYSIS AND INPUT-OUTPUT MODELS

The macroeconomic model MODIS IV was updated in 1986 and a new set of impact tables were produced. In co- operation with The Ministry of Finance the development of a new and rather more aggregated MODIS-version (MODIS V) will be started in 1987, in order to replace the existing MODIS IV. Production of input-output tables will continue and new tables will be published in 1987, co-ordinated with the national accounts.

The economic model MAKKO (a model for the municipal sector and transfers from central government) was updated and sub-models for health services and primary education were incorporated.

MACROECONOMIC ANALYSIS

The MODAG-model will be central in macroeconomic analyses and further model development in the years to come. Work in 1986 has concentrated on modelling the labour market. The development in 1987 will comprise financial relations, modelling of the labour market and wage formation, and producer behaviour. As in 1986, MODAG will be used for various medium-term economic analysis in 1987, – studying the effects on the domestic economy of i.e. the international economic development, oil prices and oil investment changes, and economic policy.

Figure 2 a. THE MAIN MACROECONOMIC MODELS

The macroeconomic models of the CBS are all both conceptually and empirically based on the national accounts. The core of the models are input-output relations of demand and use of goods and services supplemented by behavioural relations etc. for the sectors of the economy. The extent and type of these relations and the level of disaggregation vary between the models. The models are updated on an annual basis.

MODIS: The most detailed of the models and was originally developed in the early 1960's. Today's version — MODIS IV — has an input-output core comprising 210 goods and 150 sectors of production, covering both quantities and prices. The model offers a detailed and thorough representation of public income and expenses, especially taxes and subsidies. The model is mainly used by The Minstry of Finance in annual economic planning and budgetary work.

MODAG: Less detailed and much more behaviourally based than MODIS. The input-output core specifies 41 goods and 33 sectors of production and is specifically intended for analysis on a medium-term basis. The behavioural relations cover production, consumption, investment, imports-exports, prices, and wages and the labour market. The model is in the Klein-Tinbergen-tradition also including elements from the Scandinavian model of inflation. The model is used by The Research Department and The Ministry of Finance for impact and economic policy analyses.

KVARTS: A quarterly model with mainly the same behavioural content as MODAG. Somewhat more aggregated than MODAG, KVARTS has an input-output core specifying 25 goods and 16 sectors of production. The model emphasizes dynamical short-term relations implying that the development during past quarters are decisive for the present course. The model is mainly used in the CBS's work on economic surveys, but is also part of the international LINK—project.

MSG: An applied general equilibrium model that presupposes full utilization of labour and capital. The model is especially suited for studying the shifts in the structure of trade and industry along a growth path for the economy. The present version — the MSG 4 — is mainly used for long-term calculations in connection with The Government's long-term programme and in structural and growth analysis of the economy.

Figure 2 b. TAX AND ALLOWANCE MODELS

KFS: A model calculating income taxes and disposable income for different types of private households by alternative sets of tax rules.

SKATT: A model for forecasting income and tax revenues based on different tax rates and net income and wealth distribution.

LOTTE: Estimates the distribution effects of changes in taxable income, the basis of the model being data from a sample of individual income and outlay reports to the tax authorities.

INSIDENS: Estimates the distributive effects of changing excise taxes and subsidies on consumer goods.

MIFO: Analyses the consequenses on disposable pensions from changes in pension and tax rules.

MAFO: A budget model for the public pension system.

The development of several aggregate equilibrium models, using MSG-4 as a point of departure, will continue in 1987. The work will concentrate on modelling the labour and capital markets and the foreign sector. This will improve the possibility for studying i.e. resource allocation effects of changes in the tax system, and the relationship between relative factor prices, industry structure and the external balance.

ECONOMIC SURVEYS

Norwegian and foreign business cycle analysis is published in the journal "Economic Survey" on a regular basis. The quarterly model KVARTS is now used in the analyses to a larger extent than before. In 1986 the development of the KVARTS-model has mainly been directed at studies of wage formation and use of the model for forecasting purposes. The use of the model in 1987 will to a large extent, however, still be adressed to studies of past economic history and events that will increase the understanding of the short-run dynamics of the Norwegian economy.

ECONOMETRIC METHODS AND MICRO-ECONOMIC ANALYSIS

The main activities in 1986 have been concentrated on the measurement of real capital, analysis of time series, description of dynamic producer behaviour in the medium-term and studies of consumer behaviour. This work will continue in 1987, while increased emphasis will be given to studies of consumer behaviour. Additionally, work on the production structure and dynamics in equilibrium models, and selected problems within econometric methodology will continue in 1987.

Macroeconomic impacts of lower oil prices on the Norwegian economy analyzed with the MODAG model

Based on an analysis of the crude oil market, the oil price is assumed not to remain at a low level ($ 15 per barrel in real terms) throughout this century. The positive impact on the international economy subsequent to a temporary low crude oil price will thus most probably represent an incidental event. Accordingly, if we will experience high oil prices in the 1990s, the world income will once more be distributed in favour of oil producing countries. In the case of Norway this implies that the deficits that are likely to

occur on the current account and the governmental financial account may turn to a surplus in the 1990s.

However, the possibility of the oil price to remain at a relatively low level (e.g. $ 15 per barrel) for some years to come – perhaps for a decade or so – cannot be ignored. This possibility should to a reasonable extent be taken into account when determining future economic policy, and consequently, a certain moderation in domestic absorption might follow - particularly for consumption purposes.

Following the present decline in oil prices, oil investments are assumed to decrease, and hence the extent to which the government should counteract such a development will depend on the assumptions of the probability of considerable oil price increases in the 1990s. Bearing in mind that government receipts are already highly dependant on oil taxes, any further involvement in the oil sector will not necessarily be the most rational policy to pursue. The choice, however, will influence the future oil production capacity in Norway significantly. Consequently, it is assumed in the low price scenario in table 1 that oil production will decline after 1991 because of low investments and thereby reduced capacity. Additionally, if the analysis was prolonged for another ten years the effects on future production from low investment in the years to come would be more obvious.

The effect on the Norwegian economy from lower oil prices is mainly a deterioration in the terms of trade. Even in the high price scenario real disposable income in Norway will be lower in 1989 as compared to 1985, following the loss in terms of trade. In the low price scenario ($ 15 per barrel until 1989) this difference represents 10 per cent. Alternatively, by assuming constant terms of trade from 1985 to 1989, the low price scenario (without a policy restraint) might imply a loss corresponding to 7 years of normal economic growth (3 per cent a year).

Table 1 summarises major impacts of lower oil prices on the Norwegian economy – with and without changes in fiscal policy. The shift in terms of trade will lead to deficits on the foreign account and an almost similar loss in net government receipts. Thus the crucial question is to what extent this loss in income ought to be met by reduced consumption or reduced investments. In the low price scenario with a fiscal restraint the decline in saving almost equals the loss in income. Furthermore, private and government consumption in 1989 correspond to the high price scenario and thus the deficit on the current account increases pari passu with the loss in income.

The MODAG simulations show that a more restrictive fiscal policy will increase unemployment and cause less wage growth and thus an improved rela-

TABLE 1	IMPACT ON THE NORWEGIAN ECONOMY FROM LOWER OIL PRICES. Average deviations from the levels in the high price scenario			
	Without a policy change		Fiscal policy restraint	
	1986-89	1990-93	1986-89	1990-93
Per cent				
Real disposable income........	-6.5	-6.0	-6.8	-9.3
GDP.............	-0.3	-1.4	-1.6	-4.0
GDP mainland....	-0.4	-0.3	-1.9	-3.7
Unemployment....	0.2	0.1	1.0	2.0
Real wages......	0.6	-0.6	0.1	-3.2
Billion Norwegian kroner				
Current account..	-15	-27	-13	-17
Surplus on government fiscal account..	-15	-25	-12	-16

tive cost situation in the manufacturing sector. Together with less capacity utilization resulting from the fiscal restraints, this also improves relative prices compared to the trading partners, and accordingly, import shares are being reduced and exports being increased. The increased profitability in competing sectors as well leads to increased production capacity and thereby potential production growth. The effects on the current account, on economic growth and on employment are thus more favourable than what will result directly from the cut in public and private consumption.

The supply-side mechanisms that have been outlined are represented in the model that has been used. However, they may indeed be underestimated. The redistribution of resources from private and public consumption to import and export- competing industries which is a main objective of the fiscal restraint alternative, may thus be underestimated in the computations presented. Accordingly, the size of the reallocation problems that are expected to arise – based on the assumptions being used – is probably somewhat exaggregated in this analysis.

The model simulations have been based on the assumption of a close (negative) relation between nominal wage growth and unemployment, thus originating from empirical studies. If this connection was being cut off and lower wage growth accordingly being achieved without relying on unemployment, it would to some extent be possible to avoid huge deficits on

the current account. However, the question of whether a change in the relationship between nominal income growth and unemployment can be achieved through income policies or by other means, still remains unanswered.

The analysis was carried out before the Norwegian krone was devaluated in May 1986. The devaluation was undertaken partly to counteract some of the possible events that have been discussed – and in particular the huge deficits likely to occur on the current account for the rest of this decade if the oil price will remain at a low level. However, the devaluation is assumed to have only a moderate impact on the Norwegian economy and thus ought not reduce the significance of this analysis.

Effects of the devaluation in 1986

The composition of total demand for the Norwegian economy changed radically through 1985. While traditional merchandise exports showed signs of stagnation, a high level of domestic demand resulted in a vigorous growth in imports, amplified by the fact that the growth particularly related to demand components with a high import share.

The prospects for the balance of payments were weakened further by the plunge in oil prices in the first half of last year. All in all, the wage settlement led to an estimated growth in wages for 1986 which was noticeably higher than the level many enterprises exposed to competition can sustain without registering a deterioration in their competitive position in the longer run.

Against this background, a number of economic measures were adopted in the second quarter of 1986 which will influence economic developments in both the short and medium term. Among other things, the Norwegian krone was officially devalued by 12 per cent. In August the same year the Research Department of the CBS presented an analysis of the effects of the devaluation based on the use of the quarterly model KVARTS.

The effect on prices and wages

The immediate effect of the devaluation was that the exchange rate for the Norwegian krone fell by about 8 per cent, as it stabilized in the "strong" section of the swing margin for the krone. Because the analysis shows that the balance of payments during the next

few years will continue to be weak – in spite of the devaluation and austerity measures – it was assumed that the exchange rate would gradually be further weakened, so that all total the devaluation would be about 10 per cent at the beginning of 1987. This entails that the krone stabilizes around the middle of its new index band. The actual exchange rate performance has shown a slightly weaker krone, and the magnitude of the devaluation has thus been slightly underestimated in the analysis. The development in the exchange rate which has been used as a basis for the calculations is shown in figure 3.

For many import goods a devaluation will be immediately reflected in correspondingly higher import prices, while other import prices will increase less than the devaluation, at least in the short term. In the calculations, it has been assumed that the devaluation will have a full impact on total import prices, but not until almost two years have elapsed. This is based in part on calculations for similar developments in connection with earlier devaluations.

For exports, the extent to which the devaluation is passed on to prices will also vary between commodity groups. For some export goods and services and for which prices are clearly determined by the world market, an immediate and full upward adjustment in prices measured in Norwegian kroner was assumed. The export prices for other goods are largely determined by relationships in the model. The effects on domestic prices and wages are also primarily determined by relationships in the model.

In combination with the model's calculations of the price effects, we adjusted the nominal developments in other variables, such as nominal interest rates, credit variables and transfers to households, to take account of behaviour which is not included in the model. The estimated effects on some prices and wage rates are shown in table 2.

As the table indicates (cf. also figure 3 and 4), the model under these assumptions shows that the devaluation will have a close to full impact on all the prices and wage rates shown by the end of 1990. The effects appear most quickly in import prices and thereafter in export prices, a development which contributes to worsening the terms of trade for traditional goods through 1986 followed by an improvement through 1987 and 1988. The impact on consumer prices and wages takes slightly longer. In relative terms, the effects on wages are particularly weak the first two years, thereby resulting in a decline of 1 – 1 1/2 per cent in real wages during this period.

The effect on production and demand

The development in price effects entails that companies operating in markets with competition from foreign producers will gain acceptance for their product prices more quickly than wage-earners and companies that are sheltered from foreign competition. The result will be an improvement in costs for activities exposed to competition relative to foreign companies. The strengthening of the exposed sector has a counterpart in the less than full compensation for other Norwegian income earners.

For manufacturing industry, the improved competitiveness results in higher market shares on export and domestic markets, and thus in increased production, employment and investment, as shown in figure 5. As will be seen, the impact on output and employment will be greatest as early as 1987, i.e. at a time when the labour market will still be tight. The effect on investment, on the other hand, will particularly be evident in 1988 and 1989, i.e. in a period when – as estimated at this time – a weaker cyclical situation must probably be expected.

The decline in real income for the household sector as a result of the under-compensation for price increases entails that consumer and investment demand is adjusted downwards – with a slight lag in relation to the fall-off in income. The effects on domestic demand will be stronger after 1 1/2 years, as will be seen from figure 6. The total result will be that a short-term strengthening of production for mainland Norway in 1986 and 1987 is reversed to a modest deterioration the following two years.

As the household sector gradually receives compensation through 1989 and 1990, domestic demand will pick up again. The positive effect on production will nonetheless be modest because the compensation for these income earners entails a rise in costs for the exposed sector which thereby looses the improved competitiveness the devaluation initially pro-

TABLE 2	ESTIMATED EFFECTS OF THE DEVALUATION ON PRICES. Average annual deviation in per cent of the price level in the reference path				
	1986	1987	1988	1989	1990
Exchange rate...	5.4	10.1	10.1	10.1	10.1
Trad. imports...	4.4	9.1	10.0	10.1	10.1
Trad. exports...	1.7	6.1	8.9	9.8	9.9
Private consumption....	1.6	4.8	6.9	8.5	9.3
Manufacturing wages.........	0.5	3.7	6.6	8.6	9.6
Total wages.....	0.4	3.1	6.0	8.2	9.4

ESTIMATED EFFECTS FROM DEVALUATION
(Cumulated)

FIGURE 3. EXCHANGE RATE, EXPORT AND IMPORT
PRICES

Pct.

- Exchange rate
- Import prices 1)
- Export prices 1)

1980   1987   1988   1989   1990
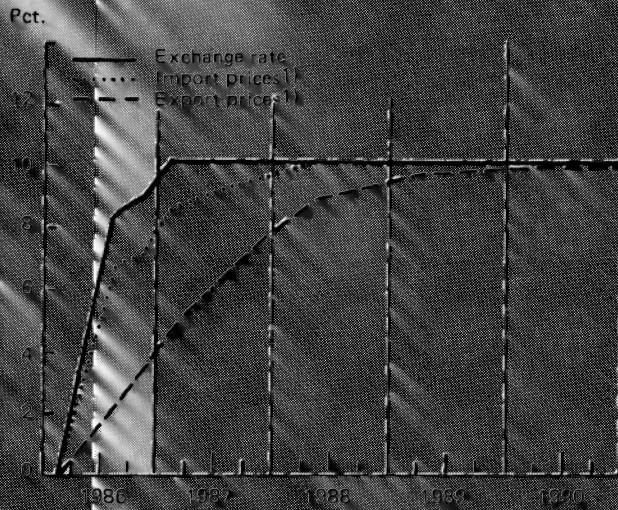
FIGURE 4. WAGE RATES AND CONSUMER PRICES

- Consumer prices
- Wage rate, manufacturing
- Wage rate, all industries

1986   1987   1988   1989   1990
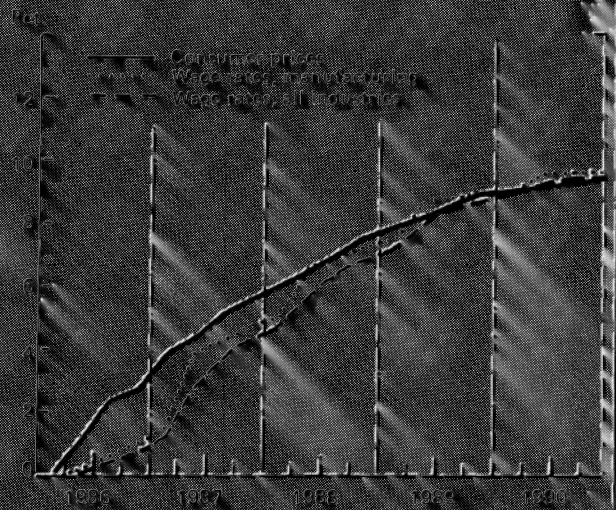
FIGURE 5. MANUFACTURING PRODUCTION

- Production
- Gross fixed capital formation
- Employment

1.0
0.6
0.2

1986   1987   1988   1989   1990
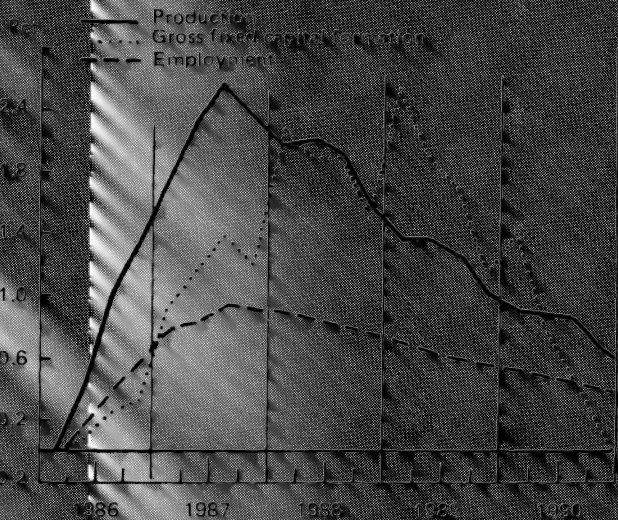
FIGURE 6. PRODUCTION AND DOMESTIC DEMAND

- GDP excl. oil and shipping
- Gross fixed capital formation
- Private consumption

1986   1987   1988   1989   1990
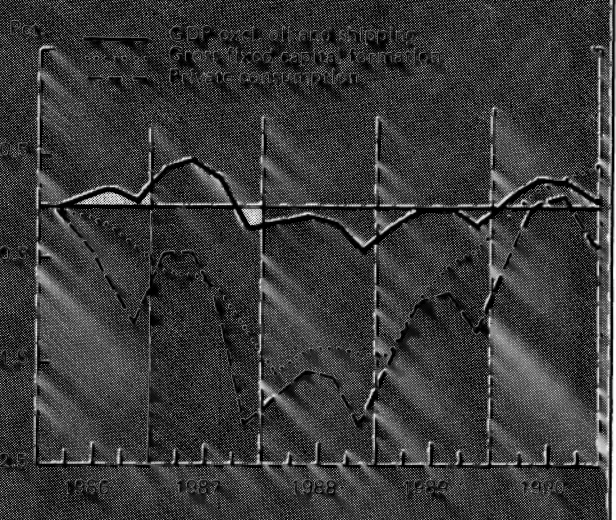
FIGURE 7. VOLUME OF EXPORTS AND IMPORTS

Pct.

- Exports 1)
- Imports 1)

1986   1987   1988   1989   1990

FIGURE 8. CURRENT EXTERNAL ACCOUNT

Millions of kr.

- Current account
- Export surplus

1986   1987   1988   1989   1990

1) On goods excl. crude oil, natural gas, ships and oil platforms.

vided. The result will be that exports revert to their reference path level, as shown in figure 7. The same applies to imports, helped along by the upward adjustment in domestic demand. All the estimated effects of the devaluation on volume must be characterized as very modest in terms of magnitude. This applies not only to the total output effects, but to the effects on the various components as well. The effects on employment will be extremely modest, as shown by table 3 which summarizes the effects on production and demand in relation to the level in the reference path.

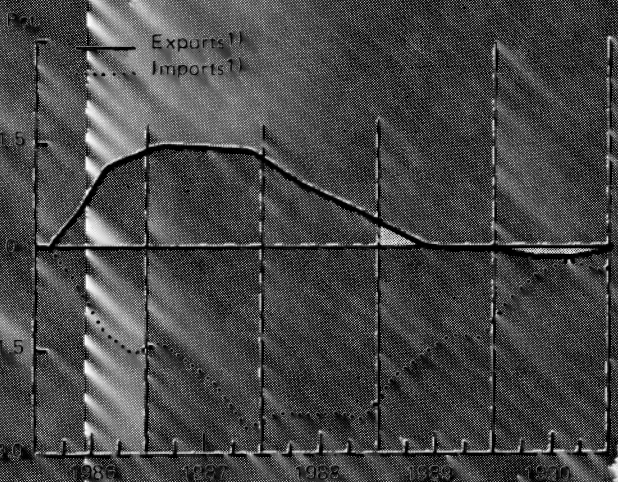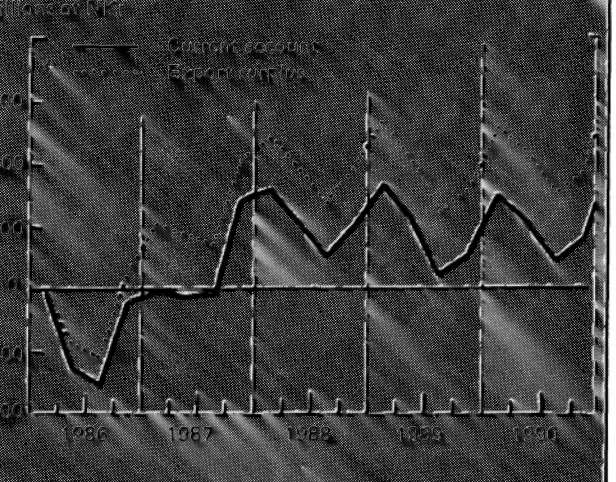| TABLE 3	ESTIMATED EFFECTS OF THE DEVALUATION ON VOLUME. Average annual deviation in per cent of the level at constant prices in the reference path				
	1986	1987	1988	1989	1990
Private consumption......	-0.5	-1.0	-1.8	-1.1	-0.2
Gross cap. formation	-0.2	-0.8	-1.4	-0.8	0.2
- manufacturing..	0.2	1.2	1.8	1.7	0.6
- dwellings......	-1.0	-3.0	-1.7	0.0	1.3
Trad. merch. exports..........	0.7	1.5	0.8	0.1	-0.1
Trad. merch. imports..........	-0.8	-1.9	-2.4	-1.5	-0.4
GDP excl. oil and shipping......	0.1	0.2	-0.2	-0.1	0.2
- manufacturing...	0.6	1.8	1.6	1.0	0.7
Total man-hours.....	0.1	0.4	0.2	0.1	0.1
- manufacturing...	0.3	0.9	0.8	0.6	0.5
Total employment....	0.1	0.3	0.1	0.1	0.1

The effects on the balance of payments

The magnitude of the devaluation in May 1986 was probably determined by expectations of a sizeable deficit on the current account of the balance of payments in the years ahead. Even if we assume that oil prices within one year will rise to a real price of about $ 20 a barrel (see separate article on the effects of the fall in oil prices), calculations indicate that the balance of payments will be in equilibrium in 1990 at the earliest, i.e. at the end of the period of analysis. With this starting point, we shall examine how the devaluation affects the development in the balance of

payments in this period.

As figure 8 shows, the immediate effect of the devaluation is a deterioration in the trade balance (higher deficit) through mid-1986, thereafter followed by an improvement as from 1987. This sequence – which describes a curve formed as a J and is therefore often referred to as the "J- curve effect" – can be ascribed to the fact that the immediate effect of the devaluation on export and import prices is a deterioration in the terms of trade, at the same time that the positive effects on volume are small in the beginning. It will be seen from the figure that the improvement as from 1988 and through the period stabilizes at a level of about Nkr 3 billion a year.

The positive effect of the devaluation on the trade balance is appreciably offset by a negative effect on the balance of interest and transfers, for which the deficit measured in Norwegian kroner will rise as a result of the devaluation. This effect appears in spite of the fact that the improvement in the trade balance in isolation helps to reduce the foreign debt and thereby net interest expenses. The reason is that the net debt at the time of the devaluation increases measured in Norwegian kroner, and as a result net interest expenses also rise in the underlying reference path. Because the net debt continues to rise in spite of the devaluation, the importance of the effect of measuring net interest in devalued Norwegian kroner will increase over time.

Does KVARTS underestimate the real economic effects of the devaluation?

A devaluation of 10 per cent is so considerable that it cannot be precluded that the model overestimates the effects on prices and wages and correspondingly underestimates the effects of the devaluation on volume. Not only the magnitude of the devaluation, but also the balance of payments problems underlying this, may entail that wage-earners do not obtain full compensation so quickly. For example, experience from the Swedish devaluation in 1982 seems to indicate a lower degree of compensation than that shown by the KVARTS calculations. However, this is not necessarily at variance with our calculations: The devaluation in Sweden was greater than in Norway and took place at a time when there was considerable idle capacity in the economy. If the degree of compensation should be less than estimated, it will result in a more lasting improvement in competitiveness for manufacturing industry and a higher current account surplus. Viewed in this way, the calculations represent a possible upper limit for price effects and a lower limit for the effects on volume as a result of the devaluation.

Taking into account the size of the devaluation, it cannot be ruled out that the shift in relative prices, which initially follows from the devaluation, in the longer run provides a basis for an output growth which is stronger than that generated by the model's relationships. If this possibility is to have any significance at all, however, the shift in relative prices must be more or less permanent, i.e. that not all income earners obtain full compensation after just a few years. Again, the degree of compensation will thus be the decisive question for the analysis.

SOCIO-DEMOGRAPHIC ANALYSIS

MAIN ACTIVITIES

Socio-demographic research in the CBS is to a large extent focused on the development of projection models for the main dimensions of the population and the supply of labour. The research program entails development and operation of large scale numerical models, as well as the modelling and estimation of behavioural relationships which are essential for the performance of such models. The models are used to great advantage in Norwegian social and economic planning at the national and regional level.

Recent and ongoing changes in fertility and family formation patterns are made the subject of intensive studies, partly based on Norway's rich supply of data from population registers, partly based on survey data. A representative fertility survey was carried out in 1977, and a follow-up survey is planned.

The labour market is studied by simple trend analysis as well as through econometric studies at the micro level of the labour market behaviour of individuals and families.

The main models are kept continuously operational, and are regularly updated and successively modified, as new results become available.

ACTIVITIES IN 1986 AND PLANS 1987

EMPLOYMENT AND EDUCATION

In 1986 an updated and revised version of the model of educational development, MONS, was published, with updated projections up to the year 2000. A program analysing the patterns of choice of educational direction and transfer to the labour market for youths was started in 1986 and will continue in 1987.

A revised version of the model for projecting labour supply, MATAUK, including the new sub-model for hours of work has just been published. A further revision, incorporating i.a. econometric estimates of the supply functions for the various groups of persons will be completed in 1989 and new projections will be made.

Figure 9 a.   DEMOGRAPHIC MODELS FOR THE COUNTRY AS A WHOLE

BEFPROG: Component model for population projection by sex and age.

MAKE: Component model for population projections by sex, age and marital status.

MONS: Model for projections of the school population by sex, age and educational activity and of the non-school population by sex, age and educational status.

MATAUK: Model for projections of labour supply and hours of work offered, by sex, age and educational status.

Based on the micro-econometric studies of labour force participation and working hours offered, a static model was completed in 1986. Decisive for labour market participation in this model are i.a. tax structure, wage levels and income of spouses. A report on labour market behaviour of married women has been published. The model has also been used in analysing the effects of proposed changes in the normal hours of work - as for example the introduction of a 6-hour work-day in Norway.

In 1987 the model will be used for the study of income distribution and level of living, and it will be used in conjunction with the models MATAUK and MODAG in order to include behaviour relations of the labour market in macroeconomic analyses. A dynamic version of the micro-behaviour model is also under way.

Mobility in the labour market is being studied separately, and problems in estimating the duration of unemployment and the distribution by length of unemployed periods have been studied.

POPULATION MODELS AND DEMOGRAPHIC STRUCTURE

The model for projecting marital status, MAKE, was completed and a description was published in 1986 with alternative projections up to the year 2050.

Work on the development of a model for projecting births by parity, and the distribution of women by number of children has been initiated.

A new Fertility survey for Norway is planned for 1988 or early 1989 and will be a follow-up of the previous survey of 1977. The survey will be designed to provide the basis for life-cycle analysis in particular and the application of proportional hazard rates methods.

An analysis of changes in family formation patterns and the distribution of families by size and composition will be concluded in 1987. A study of the experiences of children in regard to changing family environments: Number of siblings, changes in grown-up reference persons etc., will then follow.

A study of the characteristics and marriage history of divorced persons is expected to be concluded in 1987.

REGIONAL ANALYSIS

The model for regional population projections, BE-FREG, has been transferred to a new computer and new program language (SAS).

In view of this, and as a result of recent, important changes in the pattern of internal migration, a new full scale projection is being considered in 1988. Work on the improvement of relations for fertility and migration in the model continues.

Improvement of the theoretical content of the model REGION is being planned as well as the studies of the dimensions and structure of regional labour markets.

Figure 9 b. REGIONAL MODELS

BEFREG: Component model for population projections by sex, age and region (down to municipalities).

DRØM: Model system consisting of interrelated models for analysis and prediction of labour market conditions in Norway's 19 counties and migration between these counties.

REGION: Model for breaking down to the county level national projections of production and labour demand by industry. A central component in DRØM.

Econometric analysis of labour supply and income distribution

In an effort to establish econometric models for the supply of labour, the behaviour of individuals in the labour market has been studied. The analysis requires the use of matched files of micro data and the development of new econometric methodology. The basic data are extracted from individual tax declaration formulas, interview data from the level of living survey, etc.

Distinguishing features of the approach is a relatively detailed representation of the existing taxation rules, and the focusing on joint supply decisions of married couples. The taxation rules imply a non-convex budget set, and hence traditional marginal calculus cannot be applied.

A latent (unobservable) choice variable which is interpreted as type of job and which is characterized by a number of attributes and requirements for a given job is specified. The individual is assumed to choose the job which maximizes utility.

The probability distribution for the household's labour supply is derived as a function of parameters related to preferences and to the distribution of available hours of work and wage rates. This distribution of hours and wage rates is related to the demand side and it explicitly introduces the notion of latent rationing into the model. More specifically, it allows the specification of restrictions on hours of work determined by the authorities or by the firm.

The derived distribution of the supply function relies on certain statistic properties of the utility function which follow from assumptions that are considered to be plausible. An identification problem, related to the influence of demand, has not yet found a satisfactory solution, but it is believed that it will not, fundamentally, influence the results so far produced.

The model has been estimated and is currently being used in a series of simulation experiments. Typical experiments are:

1. The effects on household consumption and joint labour supply from husband and wife of switching from joint taxation to separate taxation of husband and wife.

2. The effects on the income distribution from changing the tax schedule as in (1). Alternative measures of income are used together with a method for decomposing changes in income distribution.

3. The effects on consumption and labour supply from different types of changes in the tax sched-

ules subject to the restrictions that the total amount of taxes is kept constant.

4. The effects on the income distribution from the type of changes in (3).

Table 4 illustrates some preliminary simulation results concerning the effect of husband's income on the probability that the wife will work.

Table 4	THE AVERAGE PROBABILITY OF WORKING FOR MARRIED WOMEN BY HUSBAND'S INCOME	
Husband's income, Nkr.	Wife's marginal wage at first working hour	Average probability of working
0	29.8	0.83
20.000	24.5	0.77
50.000	20.0	0.70
100.000	15.5	0.60
150.000	11.7	0.48
200.000	8.4	0.34

Recent fertility trends in Norway

The first Norwegian fertility survey – conducted in november 1977 – provided fairly detailed information on the trends and determinants of fertility in Norway from the 1950s and up to 1977. A number of reports from the survey have documented in detail the extent to which fertility in Norway varied during that period, according to socioeconomic factors such as individual education, labour force participation, income, marriage or cohabitation status – to name just a few.

After 1977 a comparably detailed source of information is missing. However, official population statistics show that the total fertility rate has remained virtually constant for the last 10 years. To investigate more thoroughly the underlying factors of this apparent levelling off of fertility in Norway, a file based on data from the Central Population Register has recently been established, consisting of individual birth and marriage histories for all Norwegian women born between 1920 and 1971. The findings that follow are results from computations based on data drawn from that file.

Historical perspective

The average number of children ever born per woman decreased from approximately 4.5 children for women born before 1850 to less than 2.0 for those born in 1905. The figure then increased and reached 2.5 for the 1935 cohort, which is the highest average ever registered for a cohort of Norwegian women in this century. Less than 10 per cent of the 1935 women remained childless and almost 50 per cent had three children or more. For the subseqent cohorts there has been a declining fertility compared to the 1935 cohort.

Childlessness

The proportion of childlessness observed for the 1945 cohort was 10 per cent, and thus, the same as that of the 1935 cohort. In the 1954 cohort, which can be observed only up to the age of 30 in the data file, 21 per cent have not yet had a child, while there were 15 per cent childless at the same age in the 1945 cohort.

If the women in the 1954 cohort who were childless in 1984 (at the age of 30) have the same first birth probabilities at later ages as the older cohorts had in 1984, 12 per cent of the cohort will be permanently childless. The same reasoning can be applied to women aged 25: Among women born in 1959, 50 per cent were childless at the age of 25, as opposed to 33 per cent in the 1945 cohort. A simple projection by means of the 1984 probabilities predicts that 16 per cent of women born in 1959 will never have a child.

Age at first birth

The median age at first birth has increased by more than 2 years from the 1950 cohort to the 1959 cohort, for which it was 25 years. In the 1950 cohort as well as in the 1955 cohort 23 per cent had at least one child by the age of 20. Because teenage fertility reached a maximum level in 1972 and has decreased afterwards, the average number of children at the age of 20 has been reduced considerably for cohorts born after 1955. In the 1959 cohort – for instance – 17 per cent have had a child at that age, the corresponding proportion in the 1964 cohort was only 12 per cent.

Obviously, a considerable change in the timing of fertility is under way. After a long period of almost constant age at first birth, it has become more and more unusual to have a first child before the age of 25. This decline started in the beginning of the 1970s, and has occurred in spite of a gradually decreasing age at first intercourse. The rising age at first birth may be attributed partly to an increasing length of education and to the more widespread use of modern contraceptive methods.

Second birth

Most one child mothers have a second child. In fact, more than 85 per cent of the women who had their first child at the age of 18–25 in 1965, had another child within 10 years. In 1975 the corresponding proportion was slightly smaller. This might indicate a delay of second birth or that more women stop at one child. In the 1940 cohort 11 per cent of the 35 year old women have had one (and only one) child, as opposed to 15 per cent in the 1949 cohort.

Third and fourth birth

The results from the Fertility Survey 1977, as well as analysis based on the Central Population Register, show that the steep decline of the total period fertility rate from the mid-1960s (a reduction from 2.98 in 1964 to 1.75 in 1977 and to 1.66 in 1985) was due to a decreasing proportion of families with three or more children. In the 1945 cohort only 37 per cent have had a third child, whereas 49 per cent of the 1935 cohort had three or more children.

These results indicate that, since the mid-1960s, fewer women with two children tend to have another child. Similar patterns have been documented in most other industrialized countries. The Norwegian results show, however, that the age- specific third birth probabilities in Norway suddenly stabilized by the end of the 1970s.

Summary

- The proportion of childless women appears to have remained fairly stable at about 10 per cent, but recent data indicate a slightly rising tendency.

- The median age at first birth is increasing and by more than 2 years since 1950.

- The dominating cause of the decline in fertility is the declining proportion of women who have more than two children, whereas the proportion of one child mothers so far has remained stable.

NATURAL RESOURCE AND ENVIRONMENT ANALYSIS

MAIN ACTIVITIES

Research on natural resources and the environment in the CBS has the following aim:

- To compile resource accounts for important natural resources, including emissions of polluting residuals to the environment; and

- provide analyses to envisage possible future resource and environmental problems, identify inconsistencies and target conflicts in economic, energy and environmental planning, suggest measures that can moderate problems and calculate costs and benefits of such measures.

The natural resource accounts provide information on reserves, extraction, conversion and use of important natural resources like petroleum, minerals, hydro power, fish, forest and land use as well as information on emissions to air, generation of hazardous waste etc. The resource accounts serve as a coherent framework for organizing data needed for the management of natural resources. The accounts are kept in physical units, but are supplemented with information on prices, quality and availability measures of the various resources. The sector and commodity specifications are kept close to those of the UN System for National Accounts (SNA).

The analyses are concentrated on issues within the field of petroleum economics, energy and environmental economics and on land use and links between hu-

man health and the environment.

The research activities have been focused on the use of the macroeconomic models MODAG and MSG that are designed for integrated forecasts of energy development and economic growth. By modifications of the models or post calculations to model runs, it is possible to make forecasts of important future environmental stresses as emissions of pollutants and generation of hazardous wastes. In these forecasts consistency with official plans for economic growth is emphasized.

ACTIVITIES IN 1986 AND PLANS 1987

ENERGY

Energy accounts are updated and published annually.

Re-estimation of the models used for long- and medium-term energy forecasting has been given special priority in 1986. Studies of energy use in households will be carried out in 1987 with special emphasis on discrete- continuous choice models. Costs and benefits of alternative sources for electric power (e.g. natural gas), the effects of various pricing policies and the consequences of different types of uncertainties will be studied in 1987.

LAND USE AND FOREST

Because of a lack of currently updated primary statistics on land use, new technology (image processing) and new data sources (remote sensing data) were introduced in the land use accounting system in 1986. The classification of land use in 2–3 selected areas in Norway will be carried out in 1987 based on information from the SPOT satellite. The establishment of a geographical information system for Norway, and studies of land use development and its relation to social development are fields of priority in the years to come.

Work on the valuation of forest resources in Norway will continue in 1987 in addition to updating of the forest accounts.

ENVIRONMENTAL ECONOMICS

Work in 1986 was concentrated on studies of the interdependencies between economic activity and air pollution. National emission accounts for sulphur dioxide, nitrogen oxides, carbon monoxide and lead have been published and possible effects from the fall in oil prices on future emissions have been assessed. Additionally, the expected costs and benefits of some control policies have been studied. In 1987 an updating and extension of the forecasting model to a new

base-year (1985) is planned, as well as development of a short-term model for analysis of recent trends in emissions to air. A study of the macroeconomic (general equilibrium) costs of acid atmospheric induced corrosion in Norway will be initiated. Modelling the interaction of economic development in Europe, including international trade, energy production and use, emissions to air and transboundary transport of air pollution is included in future plans.

ENVIRONMENT AND HEALTH

Studies of relations between recreation and health, noise and psychical health and between health and water quality have so far been given priority. In 1986 a study of a possible relation between aluminium in drinking water and mortality from presenile and senile dementia was published. The activities on environment and health will be reduced in 1987.

PETROLEUM ECONOMICS

Work in this field aims at using existing macroeconomic models (MSG and MODAG) to analyse interactions between the petroleum sector and the overall Norwegian economic activity, developing support models for the energy market and providing planning authorities with data and analyses to facilitate an optimal management of Norwegian oil and gas resources. A central issue in 1986 has been the effects of the fall in crude oil prices on the Norwegian economy. To study this problem a simple model for the world oil market has been applied in combination with simulations on macroeconomic models for Norway (MODAG) and the world economy (LINK). Another project in 1986 was the analysis of the European natural gas markets. Efforts have been made to establish support models for the evaluation of the potential of future Norwegian gas sales.

In 1987 work will continue on constructing and developing operational models for the oil and gas markets. An evaluation of different investment profiles in the North Sea and studies of their impact on the Norwegian economy will be carried out as well.

MISCELLANEOUS

Resource accounts for fish, forest and minerals were published in 1986 and will be updated in 1987. Work on generation and collection of hazardous waste and investments in cleaning equipment and cleaner production technologies in Norwegian industry will be carried out in 1987.

The next Compendium of environmental statistics will be published in 1988.

Impacts of lower oil prices; domestic energy demand and air pollution

The dramatic fall in crude oil prices which was experienced through 1986, caused a considerable deterioration in terms of trade and a reduction in national disposable income. Some macroeconomic impacts on the Norwegian economy are described in the section on Economic analysis, page 13.

Due to the fall in oil prices it is at present cheaper to use fuel oil than electricity for heating purposes in most regions in Norway. For the first time in many years total annual consumption of electricity was reduced from 1985 to 1986.

Figure 10. ENERGY PRICES, 1973–1986. ALL TAXES INCLUDED
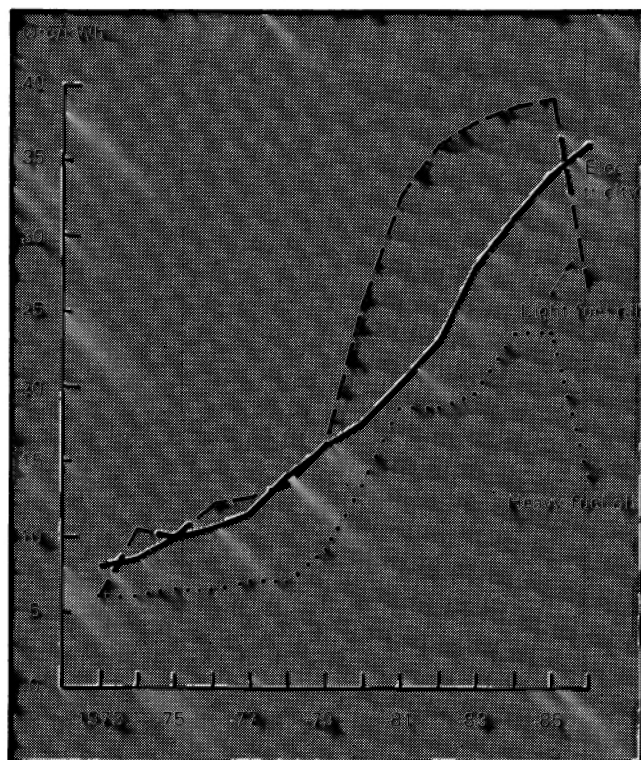
Studies of the expected responses of a fall in the price of oil relative to the price of electricity have shown that there are reasons to expect symmetry in the response to price adjustments. I.e. the response to a fall in the relative price is similar, but opposite, to the response to an increase of the price ratio. Observed "asymmetry" in the adjustments are probably

due to non-neutral technical change and increasing returns to scale with respect to the use of electricity.

Calculations on the macroeconomic model MSG indicate that a reduction in the crude oil price of 1 per cent corresponds to an overall reduction in the use of electricity equal to 0.02 per cent in the indus-

Figure 11. CONSUMPTION RATIO BETWEEN ELEC-
TRICITY AND OIL AND INVERSE PRICE
RATIO BETWEEN OIL AND ELECTRICITY.
PRIMARY MARKET. 1962–1984. 1980 = 1

try sectors and a reduction by 0.25 per cent in the household sector. If measures are taken to restore the balance of trade by belt-tightening and increase in traditional exports, calculations indicate a reduction in household consumption of electricity of 0.8 per cent and an increase in industrial use of electricity of 0.21 per cent for each percentage reduction in the price of crude oil.

The substitution to fuel oil from electricity substantially increases the emissions to air of pollutants like sulphur dioxide (SO_2), nitrogen oxides (NO_x) and carbon monoxide (CO). In addition, higher reliance on traditional export industries, also enhance the emissions of SO_2. On the other hand, the expected reduction in the growth of private consumption as a consequence of reduced national income, will tend to reduce emissions of consumption related pollutants like NO_x and CO. Based on oil price scenarios like those shown in figure 12, and estimates on necessary adjustments in the structure of the Norwegian economy, forecasts of future emissions of SO_2, NO_x and CO have been generated, see figure 12. The forecasts are post calculations to the macroeconomic model MSG-4E.

Based on the above results, rough estimates of emission elasticities with respect to the price of crude oil and the level of private consumption can be calculated. As a seemingly robust rule of thumb we find that a 1 per cent reduction in the price of crude oil is likely to increase domestic emissions of SO_2 by 0.15 per cent, NO_x by 0.3 per cent and CO by 0.35 per cent. Similarly, 1 per cent increase in total private consumption is estimated to increase the emission of SO_2 by 0.55 per cent, NO_x by 1.1 per cent and CO by approximately 1.35 per cent.
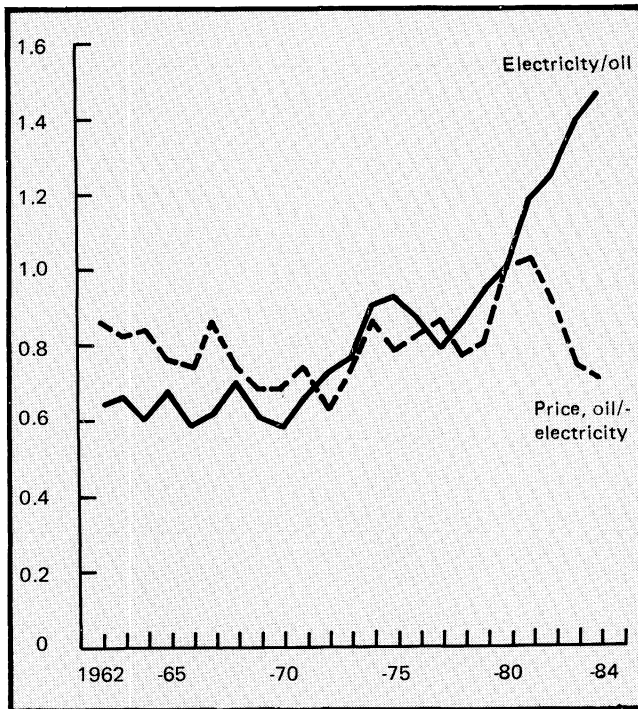
Figure 12. FORECASTS OF FUTURE EMISSIONS OF SO_2, NO_x AND CO. 1983—2000

PRICE INDICES FOR OIL. 1983—2000

Price indices (1983=1)

SULPHUR DIOXIDE (SO_2)

1000 tons

NITROGEN OXIDES (NO_x)

1000 tons

CARBON MONOXIDE (CO)

1000 tons
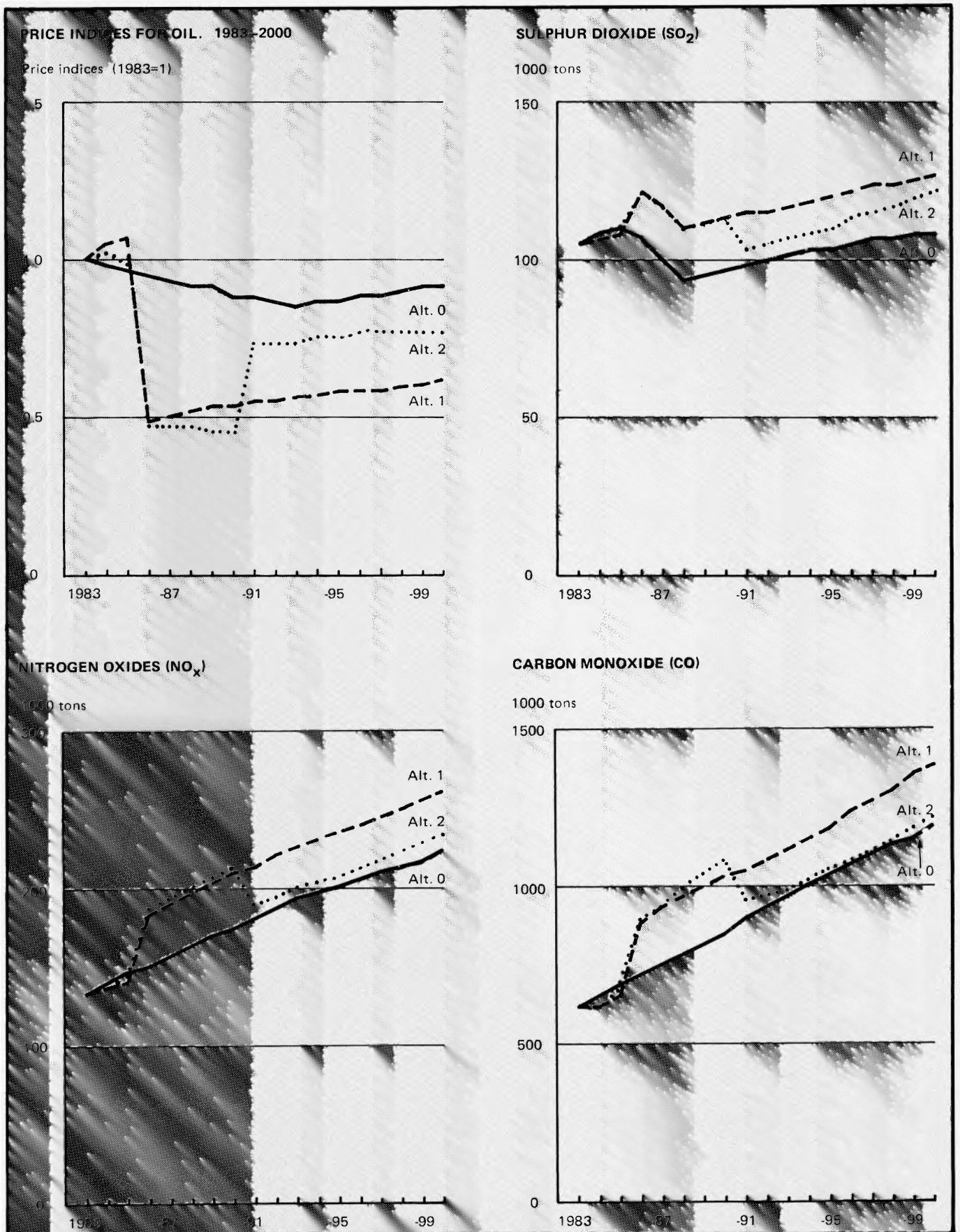
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