Economic Survey 3/92

Economic Trends in Norway

Article:

Growth and productivity in Norway 1970-1991

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Economic Survey

is published four times a year by the Research Department of the Central Bureau of Statistics of Norway. The issues contain comments and analysis of economic trends in Norway, based on the latest quarterly national accounts data.

Economic Survey no.1 presents the first set of preliminary national account figures for the previous year.

The publication also contain articles on other topics, selected from the outcome of various projects in the Research Department.

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The current issue of Economic Survey contains a review of current economic trends in Norway and an outlook for 1992 and 1993. The main source of information is the quarterly national account system. The quarterly calculations are carried out on a less detailed level than the annual national accounts. The cut-off date for information used in the publication was 2 September 1992.

Economic Trends has been prepared by the Research Department in the Central Bureau of Statistics. Please aknowledge the source if quoting from this publication. Inquiries should be directed to Knut Moum or Øystein Olsen.

In addition the present issue includes an overview of recent developments in stocks of fish spices important for Norwegian fisheries.

Economic Trends

SUMMARY

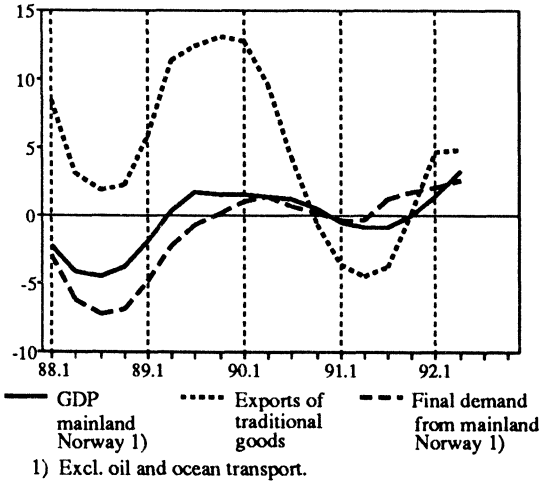
According to preliminary quarterly national accounts figures, mainland demand rose by 2 per cent (seasonally adjusted) in the second quarter of the current year, after a decline of almost 1 per cent in the first quarter. The upswing is largely ascribable to growth in private consumption. Investment in mainland Norway also picked up, however, but continued to show a seasonally-adjusted decline between the second half of last year and the first half of this year. Public sector demand (i.e. consumption and investment) continued to expand in the first two quarters of 1992.

The main impetus to growth in the Norwegian economy thus far in 1992 has come from the oil sector. Accrued oil investment costs, which measures current investment activity in the oil sector, is estimated to increase by more than 15 per cent in volume terms from 1991 to 1992. The rapidly increasing level of activity is providing substantial growth impacts to other Norwegian industries, and was an important factor behind the output growth in manufacturing and in parts of the service sector in the first half of 1992. Mainland GDP expanded by 2.2 per cent (seasonally adjusted) between the first and second quarter of the current year, having fallen slightly in the first quarter.

Traditional merchandise exports picked up markedly in the first quarter from a low level towards the end of 1991. The low export figures in the second half of last year are, however, due to maintenance work at the Mongstad refinery. When refined petroleum products and electricity are excluded, traditional merchandise exports have shown little change in the past year.

The labour market survey (AKU) for the first half-year suggests that the decline in man-hours worked and the number of people employed is continuing, but at a slower pace than up to the

CYCLICAL DEVELOPMENT
(Per cent growth from previous quarter.
Seasonally adjusted and smoothed. Annual rates.)



1) Excl. oil and ocean transport.

Source: CBS.

MACROECONOMIC INDICATORS
Growth from previous quarter, seasonally adjusted.
Per cent[1)]

	91.3	91.4	92.1	92.2
Demand and output volume indicators				
Final domestic use of goods and services	-1.6	3.8	-5.5	4.4
- Demand from mainland Norway	2.1	0.7	-0.9	2.0
- Private consumption	2.2	0.7	-0.6	2.0
- Government consumption	2.1	-1.7	3.9	-0.8
- Gross fixed capital formation, mainland Norway	1.5	4.7	-8.8	6.4
Exports	-1.9	1.6	6.5	1.1
- Traditional goods	-3.8	-1.0	6.4	-0.6
Imports	-4.7	9.1	-6.6	6.9
- Traditional goods	-3.8	5.0	-1.4	0.3
GDP	-0.6	0.9	0.6	1.8
- Mainland Norway	-0.6	0.3	-0.4	2.2
Labour market				
Man-hours worked	0.1	0.4	-0.5	-0.8
Employed persons	1.1	-0.3	-0.6	0.0
Unemployment rate[2)]	5.7	5.7	5.8	6.0
Prices				
Consumer Price Index[3)]	3.4	2.3	2.4	2.4
Income				
Current balance, NOK bn[4)]	12.3	2.4	5.5	2.0

1) See "Technical comment".
2) Seasonally adjusted levels in per cent.
3) Growth from same period previous year.
4) Unadjusted levels in NOK bn.

summer of 1991. Growth in the total labour force has also contributed to the unemployment rate of 6 per cent (seasonally adjusted) reached in the second quarter of 1992. The Directorate of Labour's figures on the number of registered unemployed persons and persons on labour market measures for the period up to and including July this year confirm the continuing rise in unemployment.

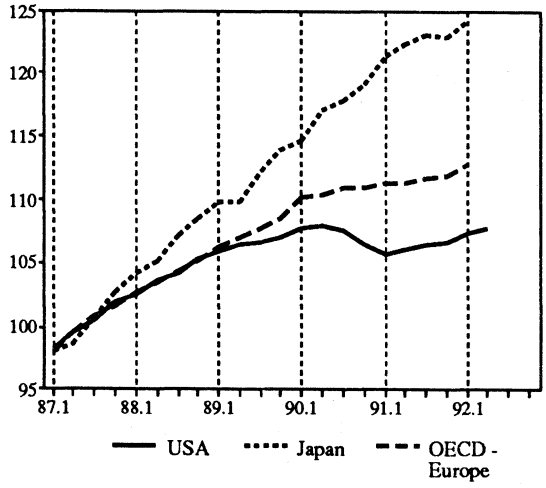
The inflation rate in Norway, measured by the twelve-month growth rate in the consumer price index, remained fairly stable at around 2.4 per cent through the first half of 1992, but increases in indirect taxes pushed the twelve-month rate up to 2.5 per cent in July. The average inflation rate among our trading partners is receding and in the first half-year was less than 1 percentage point above the Norwegian rate.

According to preliminary calculations the surplus on the current account of the balance of payments fell from almost NOK 18 billion in the first half of 1991 to about NOK 7.5 billion in the same period of this year. The main factors behind the reduction in the current account surplus are a substantial fall in the price of crude oil and of other Norwegian export products (in NOK), and large dividend payments from the oil sector to foreign shareholders.

International economy: A staggering upturn

According to seasonally-adjusted GNP/GDP figures, the cyclical downturn in the *USA* bottomed out in the first quarter of 1991. The ensuing upturn has been hesitant and weaker than expected. Judging from several discouraging economic indicators of recent months, it is now doubtful whether economic growth will gather momentum this year. Both consumer and investment demand have proved weaker than is usually the case at this stage of the business cycle. As in a number of other OECD countries, this is related to financial consolidation on the part of households and enterprises after periods of strong increase in indebtedness. The consolidation process has probably progressed further in the USA than in Europe. This, together with a low interest rate level, has contributed to an upswing in residential investment. Vigorous productivity growth and improved profitability in business and industry will probably also stimulate non-residential investment demand later in 1992 and in 1993.

GROSS DOMESTIC PRODUCT
1987=100. Seasonally adjusted



Source: OECD.

In *Japan* the rate of economic growth has fallen off substantially in the past year. GDP expansion is expected to slow down during the year from the relatively high level of 4.5 per cent in the first quarter, so that growth for 1992 as a whole could fall to a level approaching 2 per cent. The reduction in economic growth is caused by a downswing in domestic demand, whereas exports have continued to grow - partly as a result of increased sale to other Asian countries. Thus, Japan may experience a record surplus on the current account in 1992, and for this reason the authorities have been under pressure to stimulate the economy by means of fiscal policy measures. So far the government have sought to counteract the recession primarily by lowering interest rates. In late August this year, however, a package of fiscal policy measures worth NOK 85 billion was announced for the fiscal year 1992 (up to 31 March 1993). This amounts to 2.3 per cent of GDP and is expected to provide a substantial impetus to economic growth, particularly in 1993.

The economic picture in *Western Europe* is still characterized by weak growth, high and rising unemployment and a high interest rate level. Recent *German* interest rate changes should primarily be seen as a signal that the Bundesbank does *not* consider an easing of monetary policy; the first priority is to bring down the inflation rate and money supply growth in Germany. With free capital movements and the DM's traditional strong position within the ERM, German monetary policy largely determines the interest rate level in the other countries of western Europe. But in spite of the Maastricht agreement, not all EC members are ready to follow the German path. The approaching French referendum brought the tensions between the ERM parities and the underlying economic realities to the fore. However, the devaluation and later floating of the lira and the floating of the pound during the days before 20 September relieved much of the exchange rate pressure. The prospects for a significant interest rate decrease in Europe in the current year are still poor.

The persistent high interest rate level, financial consolidation by households and enterprises and

the delayed upturn in the US economy are important explanations for the downward adjustment of GDP growth forecasts for many European countries for 1992. In *Germany (west)* GDP is expected to expand by as little as 1 per cent between 1991 and 1992, compared with 3.2 per cent in the previous year. In addition to a significantly weaker trend in domestic demand, growth in exports will probably drop from a level in excess of 12 per cent in 1991 to about 3½ per cent in the current year.

In the *United Kingdom* the recession has in part levelled off, but GDP growth could prove negative for the second consecutive year. The demand picture is a familiar one in many countries: weak consumer demand and declining residential construction and investment in business. The unemployment rate has risen substantially in the past two years. In 1992 it could rise to a level close to 11 per cent - an increase of 2 percentage points from 1991.

Sweden is presently undergoing a deep recession. After a contraction of GDP in 1991, the most optimistic forecasts now point to zero growth in 1992 and only a weak improvement of GDP in 1993. The downturn occurred later in Sweden than in most other European countries, but in the past year the country has experienced declining output and a sharp increase in unemployment. Registered unemployment rose from 4.2 per cent in April of this year to 6.5 per cent in July, a dramatic rise even when adjusted for seasonal variations. The rise in unemployment has contributed to a marked deepening of the public sector budget deficits. The result has been upward pressure on Swedish money market rates and a substantial capital outflow, accelerating at the end of August and in the first weak of September. To counteract these tendencies and prevent further speculation against the krona, the Swedish central bank has raised the overnight lending an deposit rate in several steps. On the 16 of September, the central bank rate reached the extreme level of 500 per cent. If market confidence in the government's policy is restored, the central bank can be expected to lower its lending rate after a fairly short period.

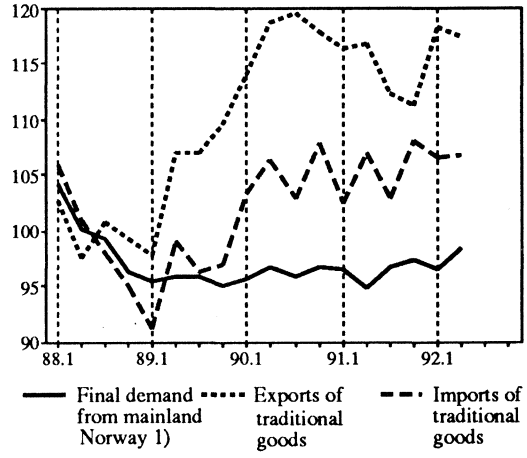
In *Denmark* the cyclical picture has shown little change in the past year: moderate growth in output and private consumption, and substantial export growth, while investment demand lags behind somewhat. The high unemployment, approximating 11 per cent of the total labour force, remains a main problem in the economy. It is expected to remain at a level in excess of 10 per cent in 1993. A sizeable public sector debt allows little freedom of movement in fiscal policy, which is fairly tight.

In recent months *oil prices* have hovered around USD 20, with a somewhat weaker tendency apparent in the second half of August. The forecasts for demand for crude oil point towards a slight increase. With moderate stock levels and a continued embargo on Iraqi oil exports, the stage looks set for a seasonal oil price rise later this autumn and winter. However, given the low dollar exchange rate during the summer months, it seems likely that oil prices in Norwegian kroner will fall substantially between 1991 and 1992. From last year's level of NOK 133 per barrel, prices may fall to a level below NOK 120 per barrel in 1992.

Norway: weak growth in traditional merchandise exports

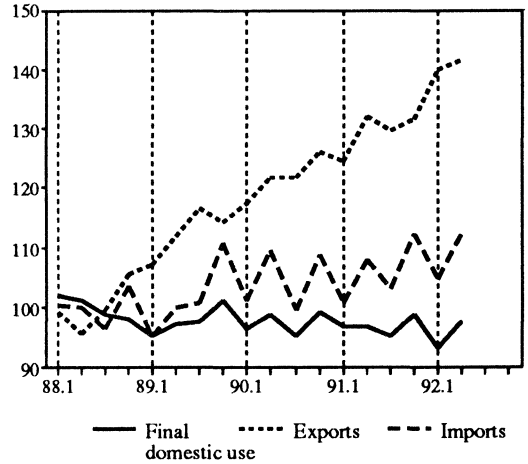
According to preliminary quarterly national accounts figures, total exports rose by 7.9 per cent (seasonally adjusted) between the second half of last year and the first half of 1992. This figure incorporates an upward adjustment of exports of

EXPORTS, IMPORTS AND FINAL DEMAND FROM MAINLAND NORWAY
1988 = 100. Seasonally adjusted



1) Excl. oil and ocean transport, and changes in stocks.
Source: CBS.

TOTAL EXPORTS, IMPORTS AND FINAL DOMESTIC USE
1988 = 100. Seasonally adjusted



Source: CBS.

services in the first quarter of this year, as a result of a switch to recording foreign exchange statistics for some services on a gross basis. The import figures have also been revised upwards.

Traditional merchandise exports increased by 5.5 per cent (seasonally adjusted) between the second half of last year and the first half of this year. The growth in the current year is essentially ascribable to increased exports of refined petroleum products in the first quarter, following the halt to maintenance work at the Mongstad refinery last autumn. When refined petroleum products and electricity are excluded, traditional merchandise exports have shown little change in the past two years, after an average growth of some 7 per cent in the period 1986 to 1990. Norway's export markets will hardly expand by more than 3 per cent this year. Concurrently, some Norwegian manufacturers are facing increased competition from earlier eastern bloc countries, so that the growth in traditional merchandise exports apart from energy-intensive goods is unlikely to exceed 2 per cent. Including energy-intensive goods, traditional merchandise exports may rise by slightly more than 3 per cent in 1992.

The volume of oil and gas exports rose by about 17 per cent last year after a moderate increase from 1989 to 1990. This growth rate continued in the current year. Based on current knowledge about the development on the continental shelf during the rest of the year, oil exports are set to increase by a good 10 per cent in volume between 1991 and 1992.

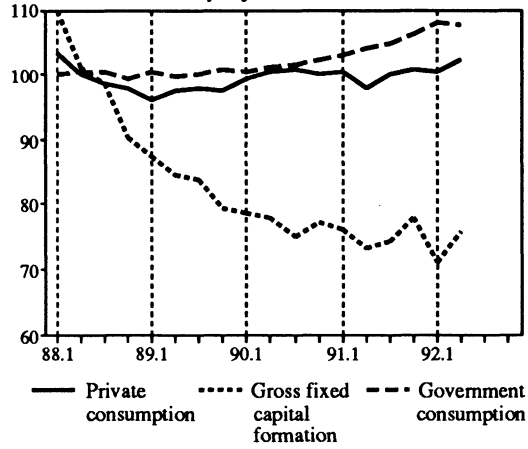
Moderate increase in mainland demand

Mainland demand, i.e. public and private consumption plus fixed capital formation in mainland industries, rose by almost half a per cent (seasonally adjusted) between the second half of last year and the first half of this year. The growth was entirely confined to the second quarter, after a decline between the fourth quarter of last year and the first quarter of 1992. Demand in the first half-year stood about 1.2 per cent above the average for last year. Accordingly, growth in domestic demand could be the largest since 1986 even in the absence of a further increase in the second half-year.

Private consumption, which accounts for almost 60 per cent of mainland demand, rose by 0.7 per cent (seasonally adjusted) in the first half of this year after a rise of 1.4 per cent between the first and second half of last year. Even so, consumption for 1991 as a whole fell by 0.3 per cent, despite a 2.4 per cent increase in household real disposable income. With an estimated growth in real disposable income of about 4 per cent this year, consumption may increase by 2 per cent, even if the savings ratio is expected to increase from a little over 3 per cent last year to about 4¾ per cent this year.

According to preliminary national accounts figures, public consumption was almost 4 per cent higher in the first half of this year than in the same period of last year. Gross public sector investment rose by 16.6 per cent in the same period. With no change in the seasonally adjusted level of total public sector demand between the first and the second half of this year, the annual growth will still be about 4 per cent.

CONSUMPTION AND FIXED CAPITAL FORMATION IN MAINLAND NORWAY 1)
1988 = 100. Seasonally adjusted



1) Excl. oil and ocean transport, and changes in stock.

Source: CBS.

After an appreciable rise through 1990, manufacturing investment fell in the second half of last year. The decline continued in the first half of 1992, despite a seasonally adjusted increase of 6 per cent in the second quarter. According to the Central Bureau of Statistics' investment survey from June this year, a volume fall of about 5 per cent in manufacturing investment is expected from 1991 to 1992. According to preliminary estimates, investment in other goods-producing sectors fell by 6.2 per cent in the first half-year (seasonally adjusted), after showing a rising trend in 1991.

Residential investment fell by about 25 per cent from 1990 to 1991, and the decline continued in the first half of this year to a level 18 per cent below the average for 1991. There are, however, signs that the fall in housing starts is levelling off. The decline in residential investment from 1991 to 1992 could thus be about 20 per cent. Investment in other private services fell by almost 3 per cent in the first half of this year, despite marked growth (seasonally adjusted) in the second quarter. Although the fall in investment in mainland Norway is expected to level off towards year-end, a reduction of 2 per cent on an annual basis is likely, i.e. about the same as in 1991.

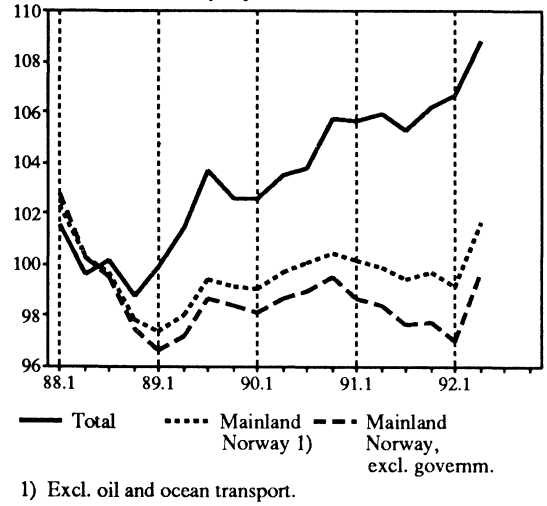
According to the Central Bureau of Statistics' investment survey for the second quarter of this year, accrued investment costs in oil and gas production (excluding pipeline transport) rose by more

than NOK 8 billion from 1990 to 1991. Preliminary estimates indicate a growth of the same order of magnitude this year, representing a real impetus to demand of the order of 1.5 per cent of GDP for mainland Norway. The estimate for 1993 indicates a further increase in accrued investment costs of more than NOK 1.5 billion, to NOK 48 billion.

Little change in traditional imports

Imports of traditional merchandise goods showed insignificant change between the first and the second quarter of this year (seasonally adjusted), and the level in the first half-year of 1992 as a whole was 1.2 per cent above the level of the second half of last year. Major acquisitions of aircraft and submarines have contributed to marked fluctuations in traditional merchandise imports in recent years. As a result of the weak trend in demand, the underlying growth in traditional imports has been moderate, but with signs of some increase in the last two quarters. Even with an unchanged (seasonally adjusted) level of demand in mainland Norway for the rest of the year, marked growth in accrued oil investments will contribute to a growth in traditional imports of about 1½ per cent on an annual basis for 1992.

GROSS DOMESTIC PRODUCT
1988 = 100. Seasonally adjusted



1) Excl. oil and ocean transport.

Source: CBS.

PRODUCTION AND EMPLOYMENT
1988=100. Seasonally adjusted volume indices

Source: CBS.

Output growth in the second quarter

According to preliminary estimates, GDP in mainland Norway rose by 2.2 per cent (seasonally adjusted) between the first and second quarter of this year, after showing little change in the preceding five quarters. The growth was strongest in the construction sector and in other private services. An increase in domestic demand through the year could result in a 2 per cent expansion of GDP in mainland Norway in 1992, whereas the increase in total GDP could be 1 percentage point higher as a result of the persistent growth in the production of oil and gas.

No signs of reduced unemployment

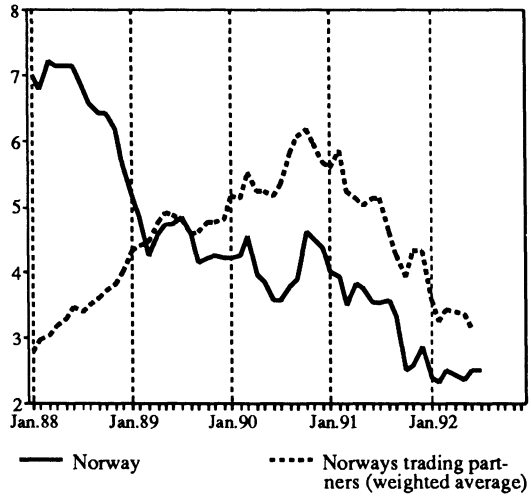
The Central Bureau of Statistics' labour market survey (AKU) indicates that the fall in man-hours worked is continuing, but at a slower pace. For 1992 as a whole, man-hours worked may remain at about the same level as last year, as increased activity in the public sector almost offsets the strong productivity growth and reduced employment in the private sector. According to the AKU survey, unemployment has continued to increase thus far in 1992. The tendency of rising unemployment is supported by the Directorate of Labour's figures for registered unemployed persons and persons on labour market schemes. Due primarily to growth in the total labour force, unemployment this year may rise to more than 6 per cent, i.e. an increase of more than half a percentage point compared to 1991. Even if employment were to pick up next year, an underlying demographic trend of increases in the total labour force may result in a high level of unemployment in the period ahead.

Slowdown in price and wage growth

After completion of this year's wage round, hourly wage growth in manufacturing is likely to come down to about 3 per cent in 1992. In the public sector, annual wage growth will probably end up a little above 3 per cent, and the average hourly wage growth in mainland Norway could fall to a level approaching 3.5 per cent this year, compared with 5.1 per cent on average in 1991.

The twelve-month rise in the consumer price index averaged 2.4 per cent in the first seven months of the year, despite the fact that increased

CONSUMER PRICES
Percentage change from same month previous year



Source: CBS.

indirect taxes pushed up the twelve-month rate to 2.5 per cent in July. Price competition in wholesale and retail trade and the continued slow rise in import prices indicate that consumer prices will rise by 2.5 per cent in the year as a whole, compared with 3.4 per cent in 1991. Price inflation among Norway's trading partners has also come down, so that the differential in the first half-year of 1992 was about 0.9 percentage point (twelve-month rates).

Increasing financial market unrest and upward pressure on interest rates

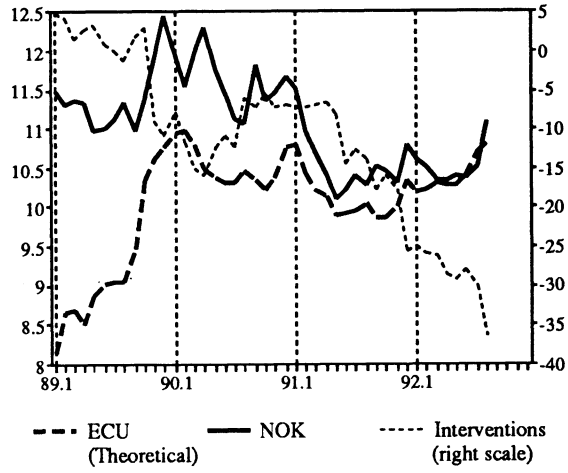
After fluctuating around 10.4 per cent in the period from February to July this year, the three-month krone interest rate followed the rising interest rate level in the ecu area in August, to an average level of 11 per cent for the month as a whole. In the second half of August the unrest in Nordic financial markets in general and in parts of the Norwegian market in particular, led to an increase in the Norwegian interest rate on three-month deposits to a level approaching 13 per cent at the beginning of September. Even prior to these events, the Bank of Norway had to sell foreign currency in support of the krone exchange rate.

Between April of last year and end-July, Bank of Norway sold foreign currency for a good NOK 23 billion, and up to 27 August it sold a further NOK 6 billion. Uncertainty concerning the prospects for European Monetary Union and the problems in the Norwegian certificate market may induce agents in the money market to demand a higher premium for short-term deposits in Norwegian kroner, despite low inflation, a surplus on the current account and signs of an upturn in the mainland economy. Accordingly, the interest rate level will probably remain at an appreciably higher level in the last four months of 1992 than in the first eight months of the year.

The relatively high interest rate level in the money market probably imply that financial institutions' lending rates will show only a small decline from 1991 to 1992. With a fall in the rate of inflation and with the new tax reform, household real after-tax interest rates now appear to rise by about 2 percentage points from 1991 to 1992. This suggests that the non-financial private sector will continue to consolidate its net asset position. The Bank of Norway indicators of the development in non-financial private sector debt and of the money supply in the first half of 1992 support this view.

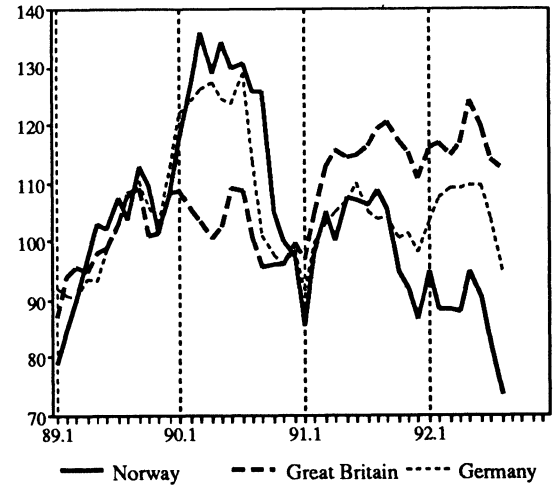
Partly as a result of the turbulence surrounding UNI-Storebrand, the Oslo Stock Exchange share-price index fell by almost 19 per cent between 3 August and 1 September, after a decline of 13 per cent between January and July. The fall in share

THREE MONTHS EURO INTEREST RATES AND THE CUMULATED SPOT FOREIGN EXCHANGE INTERVENTIONS BY BANK OF NORWAY



Source: Bank of Norway.

SHARE
1989=100. Indices



Source: Bank of Norway.

prices makes it more costly for Norwegian companies to bring in fresh capital through the share market. At the same time, the costs of short-term financing have increased, and lenders' assessments of creditworthiness may now be far more cautious than earlier. These factors indicate that many enterprises will show caution - or will have problems - in initiating new investment projects in the period ahead. At the same time, vulnerable enterprises may have difficulties in financing their day-to-day operation.

Reduced current account surplus in 1992

The surplus on the current account for 1991 is estimated at NOK 32.4 billion. Preliminary estimates for the first half of this year indicate a surplus of NOK 7.5 billion, which is a decline of a good NOK 10 billion compared to the first half of last year. However, due to the reorganisation of foreign exchange statistics, the preliminary figures for 1992 are subject to greater uncertainty than usual. The surplus on the goods and services balance was about NOK 6.5 billion lower in the first half of 1992 compared to the same period of 1991, mainly as a result of an increase in the value of imports. Strong growth in oil exports compensated for lower prices, leaving the value of oil and gas exports approximately unchanged. The deficit on the interest and transfers balance increased by almost NOK 4 billion, most of which can be ascribed to increased dividends paid to foreign shareholders from the oil companies. With low oil prices (reckoned in Norwegian kroner) in the second half-year, the surplus on the current account for 1992 could fall below NOK 15 billion.

DEVELOPMENT TRENDS IN SELECTED MACROECONOMIC VARIABLES

Percentage change in volume in 1990 prices [1)]

	NOK billion	Growth from same period previous year					Growth from previous quarter, seasonally adjusted			
	1991	1991	91.3	91.4	92.1	92.2	91.3	91.4	92.1	92.2
Private consumption	336.4	-0.3	-0.4	0.8	0.5	4.3	2.2	0.7	-0.6	2.0
Goods	208.1	-0.6	-0.4	0.2	0.3	4.2	2.5	-0.4	-0.1	1.9
Services	118.9	2.7	3.8	2.1	-0.1	2.3	1.4	0.2	-1.5	2.4
Norwegian consumption abroad	20.7	-8.6	-8.5	6.8	14.1	13.4	6.4	13.1	-6.0	0.4
- Non-residents' consumption	11.3	7.9	16.6	15.6	10.9	-2.9	6.3	-1.3	-10.1	2.4
Government consumption	142.4	2.3	4.7	-0.2	4.2	3.6	2.1	-1.7	3.9	-0.8
Central government	56.7	1.1	6.8	-5.5	2.9	4.1	4.1	-6.2	7.5	-1.3
Civilian	35.0	2.7	10.2	-5.5	7.0	9.5	5.7	-9.3	14.1	0.1
Military	21.7	-1.4	0.6	-5.5	-5.5	-4.9	1.5	-0.9	-2.6	-3.7
Local government	85.7	3.2	3.5	4.0	5.0	3.4	0.8	1.3	1.6	-0.5
Gross fixed capital formation	125.9	1.0	1.4	0.2	-17.6	47.2	-1.6	12.1	-11.2	36.6
Oil and shipping	31.9	11.4	9.6	-7.1	-58.4	145.9	-12.1	40.9	-18.1	134.1
Mainland Norway	94.0	-2.1	-0.7	2.7	-4.5	2.0	1.5	4.7	-8.8	6.4
Manufacturing and mining	15.6	6.0	10.1	-11.3	-15.3	-13.0	-8.4	-4.1	-6.1	6.0
Production of other goods	12.8	-3.5	-4.2	9.1	4.6	0.1	3.6	3.7	-11.5	8.2
Other services	65.6	-3.5	-2.3	5.0	-3.5	6.6	3.7	7.1	-8.8	6.1
Stocks (contribution to GDP growth)[4)]	5.0	(-1.0)	(-0.9)	(-0.5)	(-0.8)	(-9.1)	-1.6	-0.6	1.5	-5.5
Ships and oil platforms in progress (contribution to GDP growth)[4)]	11.1	(-0.7)	(-1.4)	(0.6)	(-0.3)	(-7.2)	-1.4	0.8	1.7	-3.8
Other stocks[3)] (contribution to GDP growth)[4)]	-6.0	(-0.3)	(0.5)	(-1.1)	(-0.5)	(-1.9)	-0.2	-1.4	-0.2	-1.7
Final domestic use of goods and services	609.7	-0.5	0.1	-0.1	-3.0	3.4	-1.6	3.8	-5.5	4.4
- gross capital formation in oil and shipping (incl. stocks)[2)]	43.0	-3.3	-18.5	2.9	-42.0	25.5	-24.0	80.0	-45.2	73.2
- demand from mainland Norway	572.8	0.1	0.8	0.9	0.7	3.8	2.1	0.7	-0.9	2.0
Exports	311.1	6.3	7.1	4.1	15.4	2.5	-1.9	1.6	6.5	1.1
Traditional goods	112.8	-3.0	-5.7	-5.7	4.6	-0.2	-3.8	-1.0	6.4	-0.6
Crude oil and natural gas	103.6	17.0	15.1	11.2	14.2	7.9	-5.5	8.6	5.4	-0.3
Ships and oil platforms	14.3	33.9	85.9	57.1	207.0	-30.3	13.8	-12.4	45.8	-52.0
Services	80.5	4.1	7.3	3.1	14.1	5.8	2.4	-0.4	0.8	20.1
Total use of goods and services	920.8	1.7	2.4	1.2	3.1	3.1	-1.7	3.0	-1.4	3.2
Imports	246.8	1.3	3.8	3.2	6.0	3.2	-4.7	9.1	-6.6	6.9
Traditional goods	151.0	-0.1	0.4	0.2	6.5	-0.9	-3.8	5.0	-1.4	0.3
Crude oil	1.7	2.5	-47.5	13.0	-39.6	-64.2	-74.9	120.7	-50.5	30.7
Ships and oil platforms	17.9	-5.9	13.7	-7.4	-64.6	-9.4	-33.1	72.4	-74.8	213.9
Services	76.3	6.0	9.4	13.5	23.4	17.9	3.8	5.2	3.2	4.7
Gross domestic product (GDP)	674.0	1.9	1.9	0.5	2.1	3.0	-0.6	0.9	0.6	1.8
- Mainland Norway	548.4	0.1	0.0	-0.7	0.3	2.0	-0.6	0.3	-0.4	2.2
Oil activities and shipping	125.5	10.5	12.0	5.9	9.8	7.4	-1.1	3.4	4.5	0.2
Mainland industry	507.4	-0.2	-0.4	-1.1	-0.0	1.4	-0.8	0.2	-0.4	2.2
Manufacturing and mining	91.5	-1.0	-2.7	-1.5	1.7	-1.9	-4.1	0.9	0.5	-0.5
Production of other goods	68.6	-5.1	-6.2	-5.7	-3.9	2.5	-2.4	0.5	0.5	2.7
Other services	347.3	1.1	1.6	0.0	0.3	2.1	0.5	-0.1	-0.8	2.9
Correction items[5)] (contribution to GDP growth)[4)]	41.0	(0.2)	(0.3)	(0.2)	(0.2)	(0.6)	1.4	0.1	0.3	0.4

[1)] Notes, see "Technical comment".

PRICE INDICES FOR SELECTED MACROECONOMIC VARIABLES

		Percentage change from the same period the year before				Growth from previous quarter, seasonally adjusted. Per cent			
	1991	91.3	91.4	92.1	92.2	91.3	91.4	92.1	92.2
Private consumption	3.7	3.6	2.8	2.5	2.6	0.7	0.7	0.4	0.7
Government consumption	3.4	3.1	2.3	3.0	3.7	1.0	0.9	1.3	0.6
Gross fixed captial formation	0.4	1.9	0.2	3.3	2.5	-0.7	-6.3	12.2	-1.4
- mainland Norway	-1.2	-1.3	-0.4	2.3	0.8	0.3	0.4	1.3	-1.1
Final domestic use of goods and services	2.9	3.1	1.8	3.1	2.7	0.5	-0.9	3.0	0.3
- demand from mainland Norway	2.8	2.7	2.1	2.6	2.6	0.7	0.7	0.9	0.4
Exports	-0.8	1.4	-12.1	-8.6	-8.1	-0.2	-2.3	-6.9	1.8
- traditional merchandise exports	-0.4	1.6	-6.7	-8.3	-7.0	-1.0	-2.8	-3.8	0.5
Total use of goods and services	1.6	2.5	-3.0	-1.3	-1.0	0.3	-1.3	-0.6	0.9
Imports	0.9	3.5	1.0	2.3	-1.5	1.8	-1.1	0.0	-2.2
- traditional merchandise imports	-0.3	1.1	0.5	3.6	-1.8	0.6	-0.6	0.8	-2.5
Gross domestic product (GDP)	1.9	2.1	-4.4	-2.5	-0.8	-0.3	-1.4	-0.8	2.0
- mainland Norway	3.1	2.8	1.6	0.6	1.9	0.3	0.2	0.6	0.8

TECHNICAL COMMENT ON THE QUARTERLY ACCOUNTS FIGURES

Footnotes: 2) Including ships, oil platforms and platform modules in progress. 3) Excluding ships, oil platforms and platform modules in progress. 4) Contributions to GDP growth are calculated as the difference between corresponding figures calculated as a percentage of GDP. 5) Corrected for free bank services and certain excises.

Quarterly calculations: The calculations are made on a less detailed level than the calculations for the annual national accounts, and are based on more simplified procedures. The quarterly national accounts figures for the years up to and including 1989 have been reconciled against the most recently published annual accounts figures.

Gross fixed capital formation: Total gross fixed capital formation is heavily influenced by significant fluctuations in investment in oil activities. These fluctuations are inter alia due to the fact that platforms that have been under construction for several years are counted as investment in the quarter and with the capital value they have at the time they are towed out to the field.

Seasonally-adjusted figures: The quarterly national accounts are not seasonally-adjusted, as these accounts are attempts to register the actual transactions that have taken place in each quarter. Many of the statistical series thus show clear seasonal variations. These are therefore seasonally adjusted on the detailed accounts level and then added together with the other statistical series to obtain the figures presented in the tables and charts of this volume. Seasonal adjustments for the public sector's purchase of goods and services are based on estimates, as there is not enough information available yet to map out the seasonal pattern.

Underlying trend: The Norwegian economy is so small that random or single important occurrences can give wide variations in the figures. The seasonally adjusted figures are therefore smoothed so that it is possible to find the underlying trend for each series. Smoothing is an attempt to distinguish between random and systematic variations in the series.

REVISIONS OF UNDERLYING TREND

Per cent growth from previous quarter. Seasonally adjusted and smoothed. Annual rates

Publ.	88.3	88.4	89.1	89.2	89.3	89.4	90.1	90.2	90.3	90.4	91.1	91.2	91.3	91.4	92.1	92.2
							GDP mainland Norway									
June -89	-3	-4	-3													
Sept.-89	-4	-4	-2	1												
Dec.- 89	-4	-4	-2	1	3											
Feb.- 90	-3	-3	-1	2	3	2										
June -90	-4	-3	-1	1	1	0	-2									
Sept.-90	-4	-3	-2	1	1	1	1	3								
Dec.- 90	-4	-3	-2	1	1	1	2	3	3							
Feb.- 91	-4	-3	-1	1	2	1	1	2	2	2						
June -91	-5	-5	-3	0	1	1	1	1	1	0	-1					
Sept.-91	-5	-5	-3	0	1	1	1	1	1	0	0	-1				
Dec.-91	-5	-5	-3	0	1	1	1	1	1	0	0	-1	-1			
Feb.-92	-5	-5	-3	0	1	1	1	1	1	0	0	0	0	1		
June-92	-5	-4	-2	0	2	2	2	2	1	1	0	-1	-1	0	1	
Sept.-92	-5	-4	-2	0	2	2	2	2	1	0	0	-1	-1	0	2	3
							Final demand from mainland Norway									
June -89	-5	-4	-3													
Sept.-89	-7	-6	-4	0												
Dec.- 89	-6	-6	-5	-2	0											
Feb.- 90	-6	-6	-4	-2	0	1										
June -90	-7	-7	-4	-2	-1	-1	-1									
Sept.-90	-7	-7	-5	-2	0	1	2	3								
Dec.- 90	-7	-7	-5	-2	-1	0	1	2	2							
Feb.- 91	-7	-7	-5	-2	0	1	1	2	2	2						
June -91	-8	-7	-5	-3	-1	0	1	1	0	0	-2					
Sept.-91	-8	-7	-5	-3	-1	0	1	1	0	-1	-2	-3				
Dec.-91	-8	-7	-5	-3	-1	0	1	1	0	-1	-2	-2	0			
Feb.-92	-8	-7	-5	-3	-1	0	1	1	0	-1	-1	0	3	4		
June-92	-7	-7	-5	-2	-1	0	1	1	1	0	0	0	2	2	2	
Sept.-92	-7	-7	-5	-2	-1	0	1	1	1	0	0	0	1	2	2	3

COMMENTS ON THE REVISIONS

Revisions can either be due to new/revised quarterly figures for the current year, new/revised annual national accounts figures for previous years, or a change to a new base year for prices. Because the growth rates following the change-over to an annual rate are rounded off to the nearest whole per cent, a 1 percentage point change in the growth rate can be due to different rounding.

Published:	Price basis:	New annual accounts:	Other comments:
June -89	1987	1986-87	
Sept.-89	"		Revised seasonal adjustment programme
Dec.-89	"		
Feb.-90	"		
June -90	1988	1987-88	
Sept.-90	"		
Dec.-90	"		
Feb.-91	"		
June -91	1989	1988-89	
Sept.-91	"		
Dec.-91	"		
Feb.-92	"		
June-92	1990	1989-90	
Sept.-92	"		

Outlook for 1992 and 1993

This section presents projections for macroeconomic developments in Norway for 1992 and 1993. The calculations have been made by running the Central Bureau of Statistics' macroeconomic quarterly model KVARTS. The main results from the calculations are presented in the table below, which also includes recent projections from other institutions.

In the calculations, mainland demand is estimated to expand by a good 1.5 per cent in 1992 and 2 per cent in 1993. The estimate for 1992 is the highest since 1986. Weak growth in Norway's export markets will result in an increase of slightly less than 2 per cent in traditional merchandise exports apart from energy-intensive goods in 1992. Growth is expected to pick up towards the end of next year, but the annual growth rate will only be moderately higher than in the current year.

Increased payments from the social security system and tax reliefs in 1992 will result in a rise in consumption of about 2 per cent both this year and next year. Gross fixed capital formation in mainland Norway is estimated to fall by about 2 per cent this year, about the same as in 1991. The decline will come to a halt in the first half of 1993, and for the year as a whole a moderate increase in investment is likely.

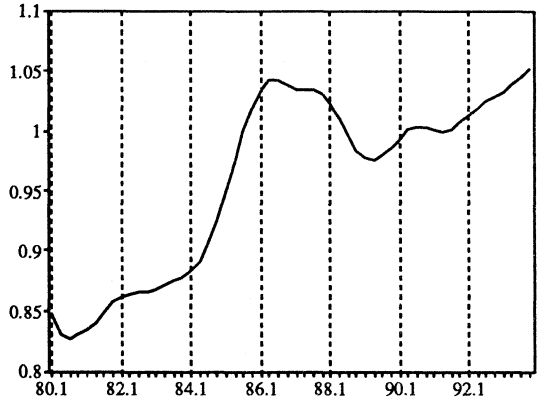
The calculations indicate that GDP in mainland Norway will expand by 1.8 per cent in 1992, which is 0.4 percentage point higher than the forecast from June this year. Next year, the GDP growth of mainland-Norway will increase further to 2.8 according to the forecast. As usual in a cyclical upturn, productivity will also pick up, and employment will therefore show only moderate growth next year after edging down in the current year. With a slight growth in the total labour force, unemployment is therefore estimated to increase to more than 6 per cent this year, and to remain at this high level in 1993.

The rise in unemployment this year and the weak trend in import prices will contribute to an average hourly wage growth slightly in excess of 3.5 per cent this year and about 3 per cent in 1993. Consumer prices are estimated to rise by 2.5 per cent in 1992 and 2.4 per cent next year. Partly as a result of relatively low oil prices in Norwegian kroner in the second half of this year, the current account surplus will fall to about NOK 13 billion for the year as a whole, increasing somewhat in 1993.

Increased growth in export markets

The calculations are based on a recovery of output and imports in Norway's trading countries by year-end, and a strengthening of this trend through 1993. It is now assumed that the recovery of the international economy will be weaker and that it will materialise later than previously envisaged. If we exclude energy-intensive goods, we now expect traditional merchandise exports to grow by a little less than 2 per cent in 1992 and by about 2.5 per cent in 1993. Export and import prices will pick up in the second half of 1993 as a result of the cyclical upswing.

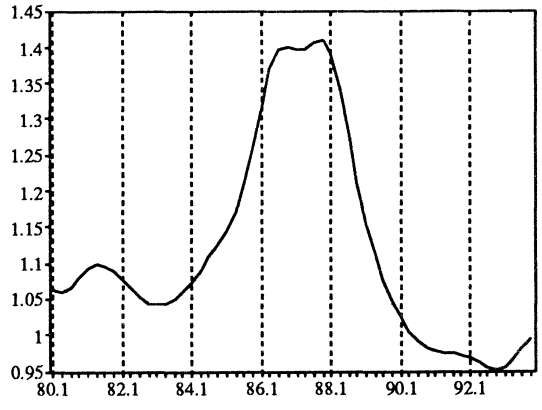
CONSUMPTION
1990 = 100. Seasonally adjusted



— Private consumption

Source: CBS.

INVESTMENT
1990 = 100. Seasonally adjusted



— Gross investment mainland Norway

Source: CBS.

Stronger growth in public consumption and investment

According to the projection, public consumption will increase by almost 3 per cent in 1992. Continued strong growth is also expected in public investment. The figures for public consumption in 1992 and 1993 are affected by the scaling-back of programmes for major military procurements. Hence military government consumption will be reduced in both years. We assume that the growth in central government civilian consumption will be somewhat smaller in 1993 than in 1992.

For the household sector the projection is based on a relief in direct taxes of about NOK 5 billion for 1992, as compared to an unchanged average tax from 1991. No further tax reliefs are assumed in 1993.

Low price and cost growth

With the central wage rounds almost completed, the yearly growth in wages and prices in 1992 should be appreciably lower than in 1991. According to the projection, consumer prices are expected to rise by 2.5 per cent in 1992, while average hourly earnings are estimated to increase by about 3½ per cent. For 1993 wage growth is estimated at 3 per cent. The effect on domestic prices of a slower rise in labour costs is offset by a slight increase in imported inflation towards year-end.

Turnaround in mainland investments during 1993

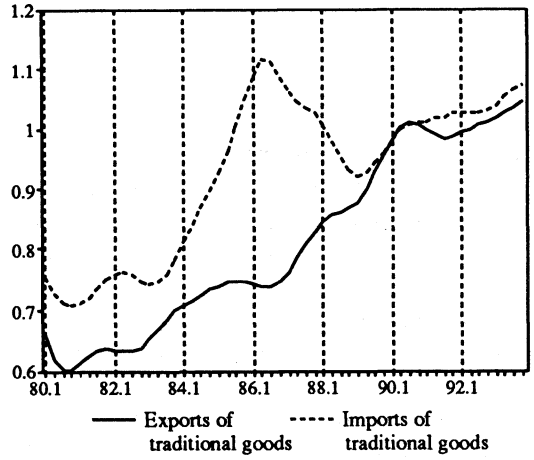
The decline in total fixed capital formation in the mainland economy has continued thus far in the current year. After a fall in manufacturing investment in the first half of 1992, we expect a weak upswing from the end of 1992 and into 1993. Of greater significance for domestic demand, however, is residential investment and investment in the private services sector, especially in commercial buildings. We still expect the decline in such investment to come to a halt in the first half of 1993 before recovering towards year-end as a result of higher output and improved profitability.

Oil investment (accrued) will provide a substantial impetus to growth in the mainland economy both in 1992 and 1993.

Household demand: both consumption and savings

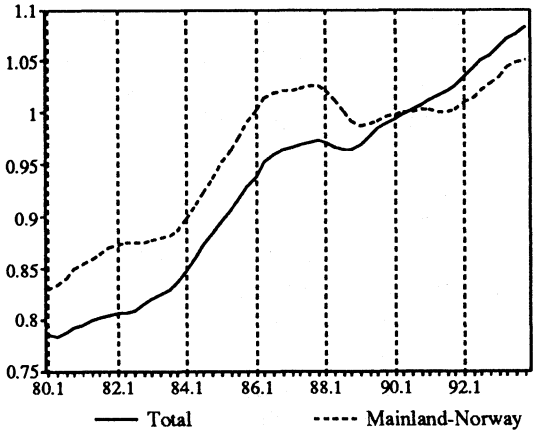
Private consumption edged down in 1991, but so far this development may seem to be replaced by an upturn in 1992. The estimates for growth in private consumption in the current year have accordingly been adjusted upwards, whereas the estimates for 1993 have been revised downwards, both

EXSPORTS AND IMPORTS OF TRADITIONAL MERCHANDISE. 1990 = 100. Seasonally adjusted



Source: CBS.

GROSS DOMESTIC PRODUCT
1990 = 100. Seasonally adjusted



Source: CBS.

compared with the projection from June this year. According to the calculations, growth of a little less than 4 per cent in real disposable income will result in an increase in private consumption slightly in excess of 2 per cent, and a rise to 4¾ per cent in the savings ratio. In 1993 weaker income growth will result in a somewhat slower increase in consumption than in the current year, but the savings ratio will continue to rise.

Higher output growth, but negligible impact on unemployment

Output growth will pick up in 1992 and 1993 as a result of accelerating demand growth both in export and domestic markets. However, the upswing in the mainland economy will be modest this year, resulting in no change in employment in terms of the number of persons employd and in man-hours. In both years the labour supply will increase by about

10,000 persons. Unemployment will thus be higher in 1992 than in 1991. The increase in output from the second half of 1992 will, however, be sufficiently strong to ensure that employment will increase at a somewhat faster rate than the supply of labour in 1993.

External economy

Oil production is expected to increase by about 11 per cent in volume terms from 1991 to 1992. We now forsee a further 2 per cent increase in oil production for 1993. The projection is based on an average crude oil price of NOK 118 p/b in 1992 and NOK 126 p/b in 1993, i.e. somewhat lower than previously assumed. The downward revisions of the 1992-estimates for the current account surplus, is to some extent explained by reduced incomes from oil and gas exports. The price figures for traditional merchandise exports in the forecasting period are also lower than previously assessed. Furthermore, the 1992-estimates for traditional imports are increased upwards. All considered, the trade surplus for traditional goods is expected to decline both in 1992 and 1993. The transition to recording exports and imports of some services in the foreign exchange statistics on a gross basis has the implication that the growth in total exports and imports will be higher than earlier estimates.

Share dividends from oil companies are assumed to be somewhat lower in 1993 than in 1992. Altogether the surplus on the current account in 1992 will be reduced to less than half the 1991 figure, but will pick up in 1993 according to these estimates.

MAIN ECONOMIC INDICATORS
Percentage change in volume from previous year unless otherwise noted[1)]

	1991	1992			1993	
	Accounts	CBS	MoF	NB	CBS	NB
Private consumption	-0.3	2.1	2.5	1 1/2	2.0	2 1/2
Public consumption	2.3	2.8	2.9	3	2.3	1
Gross fixed capital formation[2)]	1.0	8.6	-3.5	-1 1/2	14.7	5 1/2
- mainland Norway	-2.1	-2.3	-1.4	-3/4	1.8	1 1/2
Exports	6.3	6.5	2.5	2 3/4	1.5	1/2
-crude oil and natural gas	20.0	8.5	10.1	10	1.9	0
- traditional exports	-3.0	3.3	1.0	2 1/2	2.2	4
Imports	1.3	4.0	-1.0	0	3.0	3 1/4
- traditional imports	0.0	1.4	3.0	3	3.6	4 3/4
Gross Domestic Product (GDP)	1.9	2.9	2.9	2 1/4	2.6	1 1/2
- mainland Norway	0.1	1.8	1.4	1	2.8	2
Man-hours worked, employees	-1.1	0.1	-1/4	-1/2[3)]	0.3	1/2[3)]
Unemployment rate (level)	5.5	6.2	-	-	6.1	-
Rise in wages per man-hour	5.0	3.6	3.0	3 1/2	3.0	-
Consumer Price Index	3.4	2.5	2.5	2 1/4	2.4	2 1/4
Current account (level, bill.NOK)	32.4	13.0	25.8	24	18.6	18
Memorandum items						
Demand from mainland Norway[4)]	0.1	1.6	2.0	-	2.0	-
Real investment in the oil sector (accrual base)[5)]	26.6	16.3	-	7 1/2	11.1	12
Crude oil price, NOK (level)	133	118	120	121	126	124

1) CBS: Forecast according to Central Buerau of Statistics, Economic Survey no. 6/92.
MoF: Forecast according to Ministry of Finance, National Budget Proposal 1992.
NB: Forecast according to Bank of Norway, Economic Bulletin. 1992/2.
2) Includes oil platforms. In the National Account these are measured as additions to the capital stock at the time they are installed offshore. As a consequence, the growth rates may show significant flucations.
3) Mainland Norway.
4) Private consumption + Public consumption + Gross fixed capital formation in mainland Norway.
5) Gross fixed capital formation in the oil sector + changes in stock of oil platforms under construction.

Growth and productivity in Norway 1970 - 1991

by

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This article discusses how economic growth in Norway can be decomposed into contributions from growth in input factors and a residual called total factor productivity (TFP). We also apply this growth accounting approach on data from the Norwegian National Accounts (NA) and characterize the pattern of growth in the Norwegian economy during the last twenty years, both at the aggregate and at the industial level. We look for answers to the following three questions:

1) **Has TFP been an important contributor to economic growth in Norway ?**
2) **Has there been a slow-down in productivity growth in Norway during the last 20 years?**
3) **Has there been significant differences between the Norwegian industries w.r.t. the pattern of TFP growth?**

To summarize, we find that our results on the aggregate level are strongly influenced by the rapid productivity growth in the petroleum activities. Ignoring these activities together with ocean transport and producers of government services, the average annual TFP-growth rate for the remaining "Mainland industries" was 0,9 percent in the period 1970-1990. This implies that 37,5 percent of the growth in value added in these industries could be allocated to TFP growth. If gains from reallocations of labour between industries are added, the average annual TFP-growth rate increases to 1,2 percent. As to the second question, we find some evidence of slowdown in TFP growth. This aggregate picture mirrors the development in the sheltered manufacturing and service industries. These industries have also experienced the slowest average TFP growth over the last two decades, which could be a result of measurement errors. On the other hand, some export oriented industries, in addition to the petroleum activities, have experienced productivity growth significantly above the average of all industries.

1. Introduction

TFP is often used as an indicator of the rate of technical change. The method is attributed to Solow (1957), and his work initiated a vast literature on both theoretical and practical problems involved in productivity measurement. An essential feature of Solow's method is that it provides a simple formula for TFP-growth that requires observable market data only.

However, the standard productivity growth formula is true only if the technology in the production units exhibits constant returns to scale and if the firms operate in perfectly competitive markets. These assumptions may be a quite unrealistic description of most OECD economies in the last 15-20 years. Several authors have been concerned about how TFP can be identified and calculated under less restrictive assumption on the technology and the producer behaviour. For example, Hall (1990) and Klette (1989) take scale economies and imperfect competition into account in their work on TFP measurement. Unfortunately, their results show that TFP no longer can be identified unless unobservable parameters, like demand and scale elasticities, are known. If such knowledge does not exist, the "Solow residual" becomes a complex mixture of effects, often referred to as a "measure of ignorance". Consequently, one should be very cautious when interpreting changes in TFP calculated in the standard way, and another aim of this paper is to contribute to such an attitude to TFP-figures. We therefore briefly discuss how TFP-growth should be adjusted when the basic assumptions in the underlying theoretical model are relaxed. This is done in section 2 and 3. Here we draw

extensively on work by other authors. Our contribution is an attempt to add some intuition to the formulas.

TFP-figures are often calculated on data from the National Accounts. So are ours. Unfortunately, a closer study of these data reveals several weaknesses as to their suitability for productivity measurement. Our description and evaluation of NA data for productivity measurement is found in section 4. Empirical results are given in section 5.

2. The theoretical fundament for growth accounting and TFP-measurement

2.1 The basic model

The literature on growth accounting and TFP-measurement provides several explanations of how the basic growth accounting formula can be derived from neoclassical theory of producer behaviour, see e.g. Jorgenson (1987), Hall (1990), Klette (1989). Instead of repeating the technicalities involved in the derivations of the relevant formulas, our exposition will be rather brief and non-technical with focus on the intuition behind the central growth accounting formula.

The basic starting point is a description of the technology that transforms inputs like labour, capital, energy, raw materials and other material inputs into outputs. This description can be formalized by introducing a production function. In the simple case where only one commodity is produced, we write the production function:

$$(1) \quad Y = F(A_1X_1,...,A_nX_n)$$

where X_j is the input of production factor j, A_j is a corresponding productivity parameter and A_jX_j is the input of factor j measured in efficiency units. Y is the maximum output of the product for given amounts of inputs. For the function, F(.) to describe the production technology of a firm, it must obey some (weak regularity) conditions[1], but we will not go into details at this point. What is important, is that the inputs and outputs may be substituted for each other. This means that a fixed amount of output can be produced by several combinations of inputs.

In mainstream economic theory, the production function concept is not confined to the description of the technology of a single firm. The same qualitative assumptions are imposed on the technology for an industry as a whole. Hence, all results in the theory of producer behaviour can be applied independent of whether we study a single firm or a more aggregated industry. We follow this mainstream approach in the following.[2]

Eq. (1) says that growth in output has two main sources; growth in the volumes of inputs or growth in the efficiency parameters which we associate with productivity growth. The question is how data of outputs and inputs over a certain time period can help us to identify the separate contributions from these sources of growth when we know nothing about the parameters in the production function. By using standard neoclassical theory of producer behaviour it is quite easy to derive a theoretical formula for how output growth can be attributed to growth in the different inputs and productivity changes[3]. In order to simplify the exposition we make the following assumptions which we will discuss and relax below.

First, we assume that the technology exhibits constant returns to scale, which means that a proportional increase in all inputs yields the same proportional increase in output. The assumption of constant returns to scale is rather unrealistic in industries based on extraction of natural resources (Agriculture, Depletion of oil, gas, minerals etc., Forestry, Hydro power electricity production etc.). Here we would expect decreasing returns to scale, because rationality implies that the most profitable resources are depleted first. On the other hand we may have industries where "learning by doing" and synergy effects plays a significant role and give rise to increasing returns to scale.

Second, we assume that the decision maker behaves competitively, which means that he maximizes profits taking prices as given. Given these assumptions each input factor should be adjusted until its marginal contribution to income (i.e. the value of the marginal product) equals its price. Moreover, constant returns to scale implies that the income from sales is equal to total costs including a return to the capital owners that equals the return that can be obtained in alternative investment projects. It is then possible to write the growth accounting formula in the following simple way:

$$(2) \quad y(t) = \sum_{j=1}^{n} S_j(t)x_j(t) + \sum_{j=1}^{n} S_j(t)a_j(t)$$

1 F(.) is assumed to be concave and differentiable in all arguments.

2 This means that the reader has to consult other sources if he/she wants to learn about the (Cambridge) controversies related to the existence and properties of an aggregate production function with aggregated capital as one input factor.

3 This method is due to the famous article of Solow (1957) Aukrust and Bjerke (1958) performed a related macro analysis on Norwegian National accounting data. The latter work, however, imposed unnecessary restrictions on the production function (Cobb-Douglas).

where lower case letters denote relative changes during a "very" short time period at time t. Formally we have $y(t) \equiv \frac{dY(t)/dt}{Y(t)}$ etc.. S_j is the cost share of input factor j. When all factor inputs $(X_1(t),...,X_n(t))$ and factor prices $(W_1(t),...,W_n(t))$ can be observed it is trivial to calculate the costs shares as:

$$(3) \quad S_j(t) = \frac{W_j(t)\, X_j(t)}{\sum_{j=1}^{n} W_j(t)X_j(t)}$$

The last term in equation (2) is an average of the factor specific productivity growth rates. Like Klette (1991) we define this average as the TFP growth, a(t), at time t:

$$(4) \quad a(t) \equiv \sum_{j=1}^{n} S_j(t)a_j(t) = y(t) - \sum_{j=1}^{n} S_j(t)x_j(t)$$

Note that TFP is defined as a growth rate. The level of TFP can only be defined in relative terms, i.e. we can fix the initial level of the index at , say 100, and cumulate the changes over time.

That TFP is an index, is the result of a computation where growth in several kinds of heterogeneous input factors are subtracted from the growth in output. Therefore, the literature on TFP-measurement is closely related to the theory of index numbers, see e.g. Diewert (1976) and (1980) and Tiainen (1991) for examples of detailed treatment of the theory of economic index numbers relevant to productivity measurement. The indices involved in equation (2) are called Divisia indices in the index number literature. Divisia indices are characterized by weights (cost shares in equation (2)) that are continuously updated. Note that the use of the Divisia index in equation (2) is not introduced ad hoc; it is a logical consequence of our initial assumption about the technology and producer behaviour. Remember also that these assumptions, except for those related to economies of scale, did not impose any restrictions on the unknown parameters in the production function.

Behind the TFP-formula implied by eq. (2) is a rational adjustment of the input factors so that total costs are minimized. However, the technology may have very restricted possibilities for factor substitution. A limiting case, which may be quite realistic at the micro level, is a technology with fixed input coefficient (often called Leontief technology). In this case all inputs, measured in physical units, will grow at the same rate as the output as long as there is no technical change. Otherwise there will be waste of resources. In this case there is no difference between the growth in TFP and the growth in the (partial) productivity of one of the inputs, e.g. labour. Hence, the frequent use of labour productivity as a productivity measure, may be an acceptable approximation provided that the substitution possibilities are highly restricted. If this is not the case, the growth in the labour productivity may be misleading as a measurement of technical changes defined as shifts in the production function. This is easily seen if we rewrite eq. (2) to the following accounting formula for the growth in labour productivity:

$$(5) \quad y(t) - 1(t) = a(t) + \sum_{j=1}^{n} S_j(t)(x_j(t) - 1(t))$$

where 1(t) is the relative growth in labour input at time t. Hence, (5) attributes labour productivity growth to two main sources: 1) TFP-growth and 2) more capital, energy, raw-materials etc. behind each worker. The case of Leontief-technology is precisely the case where the second effect is zero for technological reasons. In the case with significant substitutability between, say labour and capital, the growth in labour productivity will overestimate the shift in the technology if there has been an increase in the capital/labour ratio.

At this stage of the exposition, the reader may have a somewhat uncomfortable suspicion that it is too good to be true that something as complex as technical change can be calculated by a formula as simple as eq. (2). One reason to suspect the TFP-growth defined above not to capture the true underlying technical changes, is that the calculated TFP-growth tends to follow the cycle. In years of expansion, TFP is unusually large; in years of recession, it is low or even negative, cf. Hall (1990). In the following we shall demonstrate that year-to-year changes in TFP indeed may have other sources than technical changes.

The next subsections shows how the TFP-measure should be corrected when we successively relax some of the theoretical assumptions made so far. First, we will consider the situations where the set of outputs is heterogeneous. Second, we will relax the assumptions of constant returns to scale. Third, we will see how the formulas must be modified when the firms realize that they have some degree of monopoly power in the markets for outputs. Fourth, we will relax the assumptions that all factors and factor prices are observable. Fifth, we show how one should treat factor income from other sources than production. As we proceed, it will gradually become clear why TFP-growth is often called the "unknown residual" rather than an index of technical change. The relevance of these problems are more clearly recognized when we are faced with an actual data set and are about to undertake the TFP computations. Therefore, it is

difficult to draw a clear distinction between these problems and those treated in section 3. The rough rationale for the present outline is that the issues in the remainder of this section is more related to the assumptions in our underlying theoretical model whereas those problems discussed in section 3 are more directly empirical.

2.2 Heterogeneous output

By heterogeneous output we mean that the production unit produces several commodities that are too different to be added together as if they constituted a homogeneous commodity. The more aggregated is the production sector we consider, the more heterogeneous will the output mix be, but even at the firm level multi-output rather than single-output production is the common situation. Formally, the production function is replaced by a so-called transformation function frontier written as:

$$(6) \quad T(A_1X_1,...,A_nX_n, Y_1,..., Y_m) = 0$$

if the production unit produces m distinct commodities. We will not go into details about the regularity condition that are usually imposed on the transformation function. The basic assumptions underlying it include the possibility that the output mix can be optimally adjusted dependent on prices and scale of operation. We do not exclude the possibility that changes in the composition of inputs may affect the optimal composition of outputs. This means that the optimal composition of inputs may not be a decision problem that is separable from the decision problem of finding the optimal output composition.

It turns out, see e.g. Klette (1989), that our theoretical model leads us to use a Divisia index, analogous to the one used to measure aggregate input growth, to measure correctly the growth in aggregate output:

$$(7) \quad y(t) = \sum_{i=1}^{m} V_i(t)y_i(t)$$

where y(t) is defined as the relative growth rate in output (considered as an aggregate) and Vi (t) is the value share of commodity i in the total output value of the industry:

$$(8) \quad V_i(t) = \frac{P_i(t)\, Y_i(t)}{\sum_{i=1}^{m} P_j(t)Y_j(t)}$$

where $P_i(t)$ is the price on commodity i at time t. We can then use the formula in eq. (2) provided that y(t) is calculated according to (7) and (8). This means that the growth accounting formula and the TFP-growth is easily defined in the case of several outputs.

2.3 Variable returns to scale and unobserved factors

So far we have assumed that there are constant returns to scale which implies that the (optimal) relative composition of inputs and outputs are independent of the production level. We now alter this assumption, and introduce a scale elasticity, η, which is larger, smaller or equal to unity corresponding to increasing, decreasing or constant returns to scale. It should be noted that the case of increasing returns to scale cannot be supported by competitive behaviour since remuneration according to marginal productivities implies that total unit costs exceeds the output price. Excluding the possibility of increasing returns to scale as long as we assume perfect competitive behaviour, it turns out that the cost shares used as weights in eq. (2) and (4) should be calculated in the following way (see Klette (1989) for details):

$$(9) \quad S'_j(t) = \eta\, S_j(t)$$

Hence, in the case of decreasing returns to scale all cost shares are reduced proportionally causing the Divisia index of aggregate input to grow more slowly than in the case of constant returns to scale. Therefore, we underestimate the TFP-growth by using the unadjusted cost shares from eq. (3) if the true technology is characterised by decreasing returns. The intuition is that output growth by itself brings about a reduction in the overall productivity of the input factors. This negative effect is included in our TFP-measure if we are not able to identify η and to separate it from shifts in the production function.

Although it is formally easy to adjust the TFP-measurement for scale economics, we have now introduced a parameter, η, that is unobservable. The scale elasticity does not belong to market data; it may be identified by econometric methods (see e.g. Klette (1991)). However, an alternative is to use the unadjusted version of eq. (2) but to reinterpret the TFP-growth to include the effects of variable returns to scale. This is in fact what we have done in our empirical calculations presented in section 5.

2.4 Imperfect competition

If the production unit has some degree of monopoly power, it recognizes that the demand curves (possibly more than one in the case of heterogeneous output) are downward sloping. This means that it is profitable for the producer to reduce outputs from

the level associated with the case of perfect competition because the positive effect on profits of higher prices dominates the negative effect of reduced output. The optimal behaviour is characterized by equality between marginal revenues and marginal costs. The output price will be equal to marginal costs times a mark-up factor which we denote μ. μ is greater than unity and is negatively related to the price sensitivity of demand[4].

It can be shown that the existence of imperfect competition does not involve any problems for TFP measurement as long as 1) all input factors can be adjusted optimally, 2) all input factors and factor prices can be observed, and 3) output consists of one commodity only. If these conditions are met, and there is constant returns to scale, TFP can be calculated by using the formulas in equation (3) and (4). It should be noted, however, that under imperfect competition it is imperative to divide the various factor outlays by total costs when calculating the cost shares. Under perfect competition and constant returns to scale one may alternatively divide the factor outlays by total income since total income in this case is equal to total costs.

When output is made up of more than one commodity, it turns out that the value shares defined in eq. (8) and used as the appropriate weights in the Divisia index of aggregate output growth in eq. (7), should be based on marginal revenues instead of prices. Formally we get the following formula:

$$(10)\quad V^*_i(t) = \frac{(1/\mu_i)P_i(t)\,Y_i(t)}{\sum_{i=1}^{m}(1/\mu_j)P_j(t)Y_j(t)}$$

We see that the value shares are only affected if the demand elasticities, determining the mark-up factors, differ among the outputs. However, the importance of knowing these elasticities increases when we have reasons to suspect that the value of the marginal product of some input factors can not be measured by the corresponding factorprices. This is the subject in the following section.

2.5 Fixed factors of production

Allthough growth accounting and TFP-growth is most relevant when describing and explaining long-run growth trends, one has to use data that may be strongly influenced by short-run rigities. A relevant example is the existence of input factors that are more or less fixed in the short run, so-called quasi-fixed factors of production. This means that the input volumes will only be adjusted rather slowly due to adjustment costs increasing very rapidly to prohibitively high levels if one tries to undertake large adjustments in given time period. Examples may be parts of the capital stock, like e.g. buildings and constructions which are especially designed to fit into the specialized kind of production process taking place in these firm. Although such factors were adjusted according to profit maximizing behaviour at the time of installation, conditions may change in an unexpected way so that the marginal revenue for such factors differs from the market price of the factor. The question is then how we can calculate the contribution to output growth from such input factors.

Klette (1989) shows how this problem can be solved if there is only one fixed factor in the short run, say capital. It then turns out that the relevant factor price (which is a shadow price in the sense that it is a measure of the value of the marginal productivity of capital) and cost share can be calculated residually. In the presence of non-constant returns to scale and imperfect competition, it can be shown that the cost shares required for an unbiased measure of TFP, should be calculated by the following formula:

$$(11)\quad S_j = \frac{W_jX_j}{\eta\sum_{i=1}^{m}\frac{P_iY_i}{\mu_i}}\qquad ,j=1,\ldots,n-1$$

$$(12)\quad S_n = 1 - \sum_{j=1}^{n-1} S_j$$

where we have defined capital as input no. n. All variables are dated at time t. Note that under constant returns to scale and perfect competition the denominator in eq. (11) is equal to the total output value which equals the total input value when all factors are payed according to their marginal productivities. This is fullfilled when capital costs are calculated residually implying that they are payed with the (variable) profit or the gross operating surplus.

Decreasing returns to scale and/or market power implies pure profits that is attributed to capital if the cost share of capital is calculated residually using unadjusted figures of gross operating surplus. Such a cost share of capital will be positively biased as a measure of the actual growth contribution from capital. If capital grows faster than the Divisia index of the other factors, the resulting TFP growth is overestimated. However, as long as the demand- and scale elasticities ar unknown, nothing general can be said about the direction and the significance

4 The mark-up factor can be written: $\mu = 1/(1+\sigma)$ where σ is the elasticity of the output price w.r.t. a change in output. $\sigma < -1$ by assumption.

of the bias of the TFP-measure calculated under the assumption of constant returns to scale and perfect competition.

If more than one input is not adjusted so that the value of the marginal productivity is reflected by the observable market factor price in every period, we have serious problems even in the case of perfect competition and constant returns to scale. We do not know how to distribute the variable profits among these factors. In our empirical TFP-calculations we treated capital as the only factor which cost share is calculated residually and labour and material inputs as two factors that can be optimally adjusted in each year. Especially with respect to labour, this is probably not completely satisfactory due to the many rigidities in the labour market, the presence of labour hoarding etc. Our "credo" is that we during a period of several years do not have a systematic bias in the evaluation of the marginal product of labour.

2.6 Factor income from other sources than production

In practice the firms pay indirect taxes and receive subsidies and transfers in addition to those levied on the commodities they sell and buy. Suppose that a firm is a net receiver of subsidies. It may be difficult to identify how these subsidies are distributed to the factors employed. In the model discussed above, where capital is the only fixed input factor, capital receives the operating surplus which now includes the value of the net subsidy. This means that the contribution from capital to output is overestimated and we get the same bias as in the case of positive pure profits caused by decreasing returns to scale and/or monopoly profits. The correct way to estimate the marginal productivity of capital is to divide gross operating surplus, net of subsidies, by the value of the capital stock. In the case of constant returns to scale and perfect competition the correct formal expression for the cost shares in eq. (11) should be:

$$(13)\quad S_j = \frac{W_j X_j}{\sum_{i=1}^{m} P_i Y_i - Z} \qquad , j = 1,\ldots, n-1$$

where Z is the value of the net subsidies included in the factor income.

2.7 Our choice of theoretical model

Our choice of the underlying theoretical model can be considered as a compromise between two concerns. At the one hand, we want to capture aspects of reality that may prove to be important for TFP-measurement. On the other hand we do not want to make our results dependent on econometric estimates or guesstimates. Among the alternatives given in sections 2.1 - 2.6 our "optimal" compromise is uniquely defined as the model where several outputs are specified and capital is treated as a quasi fixed factor of production. According to the conclusions drawn in section 2.6 the cost share of capital is calculated from the gross operating surplus net of net subsidies. Thus, our TFP growth rates possibly include much more than pure technical change. To summarize we have used the following formula as our theoretical reference point:

$$(14)\quad a(t) = \sum_{i=1}^{m} V_i(t) y_i(t) - \sum_{j=1}^{n} S_j(t) x_j(t)$$

where $V_i(t)$ is calculated by equation (8) and $S_j(t)$ is calculated according to eqs. (12) and (13).

3. From theory to empirical calculations

Faced with actual data, one easily recognizes that the formula in eq. (14) is not ready for numerical calculations. Our data base is the Norwegian National Accounts and the suitability of these data for productivity analyses will be further discussed in section 4. Here, it suffices to point out that the production units are far from individual firms. Instead, we operate with the concept production sectors or industries including firms with different technologies and different inputs and outputs. Furthermore, our theoretical formula is based on continuous time, but any actual time series consist of discrete periods. In the National Accounts the time period is one year. In this section we will confine the discussion to three problems. First, we will discuss what measure of output that should be used. This is not an obvious matter at the aggregate level where intermediate material inputs constitutes a substantial fraction of the production. Second, we will point out that TFP-growth may include gains from reallocation of inputs in an aggregate production sector. Third, we show how our theoretical formula in eq. (14) can be converted to a corresponding formula based on discrete time.

3.1 Choice of output concept

In productivity analysis our basic interest is to compare the flow of commodities coming out of the production process with the flow of inputs going into the process. We may have the case where parts of the production of a firm is used as inputs in the same firm. These commodity flows are not interesting at least with respect to productivity measure-

ment, and in principle they should be netted out both on the output and the input side of the production process. The remaining part of the output is often referred to as the net output. At the firm level the official statistics on gross production is likely to correspond quite closely to the net output concept and figures of intermediate inputs are net of internal deliveries.

However, the more aggregated an industry becomes, the larger becomes the fraction of the production used as inputs in the same industry. This means that the difference between gross production and net output increases. For the economy as a whole, the use of net output as output concept requires that all intermediate goods produced by the economy are netted out both on the output and the input side of the production process. In a closed economy where neither exports nor imports take place, net output would be equal to value added for the economy as a whole, and only primary input factors, like e.g. labour and capital should be included on the list of input factors. In an open economy like the Norwegian, the use of the net output concept would imply that imports of intermediate inputs were added to the list of input factors, and there is in general a difference between the net output concept and value added.

The problem with using the net output concept in a consistent way is that figures of net output and intermediate inputs net of internal deliveries are not readily avaliable. They have to be constructed from input-output tables. In Norway such tables exist on anual basis and the relevant figures could in principle be calculated. The figures of internal deliveries are, however, likely to be influenced by mergers and split-ups among the firms. Such institutional changes would affect the reported figures of outputs and inputs and induce changes in productivity that have nothing to do with changes in technology. Instead of undertaking the task of netting out internal deliveries from the figures of output and input of intermediate goods, we have taken the following approach: At our most detailed level of aggregation the Norwegian economy is classified into 43 production sectors. For these individual industries output is measured by gross production and intermediate goods are specified as an input factor along with labour and capital. For any production sector being an aggregate of more than one of these 43 sectors, we have used value added as the output concept and labour and capital are the only input factors. In spite of the shortcomings, the use of value added as the output concept, at least at aggregate levels of industry classification, is is the most common approach in the literature. Another reason to this is that value added is regarded as a more interesting output concept from a normative point of view.

3.2 Gains from reallocations

According to our theoretical framework input factors are payed according to the value of their marginal productivity. Suppose that, say labour, is a homogeneous input. This means that a man-hour represents the same amount of productive services in all firms even if some produce metal products and other produce tomatoes or transport services. If the workers are free to move where they want, it would be impossible to pay workers wages differing more than the costs involved in changing jobs. However, there may be rigidities and obstacles that prevent immediate elimination of wage differentials; the market forces work more slowly. This implies that moving labour from an industry, A, with low wages to an industry, B, with higher wages, increases the average marginal productivity of the labour. A similar argument holds for other inputs as well. We will call this effect "gains from reallocation". This effect may be important when we perform TFP-calculations on more and more aggregated levels of industry classification. But they are caused by factor price differentials, not the productivity parameters in the individual sectors. Therefore, it would be of interest to separate the gains from reallocations from shifts in the individual production technologies.

However, such identification is difficult in practice. Let us continue to use labour as an example. The service flow from labour, measured by e.g. man-hours, is in general not a homogenous factor. It may differ significantly between employees according to differences in skills and other relevant quality characteristics. Hence, the fundamental question is to what extent wage differentials between industries reflect qualitative heterogenity or imperfections/rigidities. If heterogenity is the dominating reason to such differentials, labour services should be aggregated by a Divisia index just like other heterogeneous goods. In this case "gains from reallocation" are ruled out by assumption. If imperfections dominate, man-hours should be added together and an average wage rate should be constructed by dividing the total wage costs by the total number of man-hours.

The same point can in principle be made for capital and intermediate goods too, but any evaluation of factor price differentials between industries would require prices per physical unit. This in turn, presupposes data for every single physical commodity which are not available. Therefore, we have treated all inputs except for labour as heterogeneous inputs. It turns out that it is possible (see Klette (1988) for a formal derivation) to separate the effect of reallocation (a^{RC}) of labour by using the following formula :

(15) $a^{C} = a^{DC} + a^{RC}$

where a^{DC} is a Divisia index of individual sectoral TFP-growth rates calculated by:

$$(16) \quad a^{DC}(t) = \sum_{j=1}^{k} S_j(t)a_j(t)$$

where the index j runs over the k industries included in the aggregate industry C. s_j is the share of total costs in industry j in total costs in the aggregate industry C. a^C is calculated for industry C according to formula (14) above, where labour in different subindustries is treated as homogeneous. a_j is calculated according to formula (14) for the individual industry j. Eqs. (15) and (16) follows from a decomposition of the output growth in the aggregate industry C. We present figures of TFP-growth both gross and net of gains from reallocations of labour, i.e. both a^{DC} and a^{RC}.

3.3 A TFP-formula with discrete time periods

The Divisia indices of growth rates presented in the formulas in section 2, are all defined as infinitesimally small changes since time is treated as a continuous variable. There is a large literature, see e.g. Diewert (1980), discussing how Divisia indices should be calculated on actual discrete time series like annual data. According to our experiences the differences between various methods are very small when the data are as frequent as annual. What is important is that the weights in the index formulas are frequently updated. Therefore we see no reason to complicate this exposition by technical index number theory. What we have done is to compute a discrete version of eq. (14) where the growth rates are defined by $x_t = (X_t - X_{t-1})/X_{t-1}$ a.s.o. The cost shares are calculated as the arithmetic mean of their values in two subsequent periods, i.e. $\bar{S}_t = (S_t + S_{t-1})/2$ and similarly for the value shares.

4. The data

4.1 The Norwegian National Accounts

We have based our calculations on data for the period 1970 to 1990 from the Norwegian National Accounts. The following discusses the suitability of the data for productivity studies.

An outstanding features of the Norwegian National Accounts is that it has integrated annually input-output matrixes or industry by commodity supply and use tables with about 170 industries and 1750 commodities at the most detailed level. According to UN recommendations and in line with the observations in the primary statistics the Norwegian National Accounting system treats the production sectors as producers of joint outputs. The industry classification are based on the international standard industrial classification (ISIC) which follows the main producer principle, i.e. the name of the industry matches the name of the commodity which mainly is produced in this industry. Thus we should in principle be able to keep a multi-output multi-input production structure in the empirical calculations. For practical reasons however, our calculations are based on time series of aggregated National Account figures from a database specifying 7 producers of local and central government services and 36 other industries. For each industry there are specified 3 input factors; Labour (L), Capital (K) and intermediate input (M). Up to this level of aggregation we are then stuck with the aggregating practise used in the National accounts.

In the Norwegian National Accounts there are, compared with most other countries, a long tradition for frequent changes of the base year. Before 1987 the general practice was to change base year every five year. In 1987 this was changed to annual changes of base year due to observed rapid changes in relative prices for commodities of significant importance for Norwegian economy. The constant price National Account figures for 1970 to 1975 are then calculated in 1970 prices, the figures for 1975-1980 in 1975 prices, the figures for 1980-1984 in 1984 prices, the figures for 1984-1986 in 1984 prices and the figures from 1987 in the last years prices (T-1). This practice implies that the corresponding volume and price indices are chained Laspeyres and chained Paasche indices respectively, with five year links for the period from 1970 to 1986 and annual links for the latest years. There are reason to believe that this yields an acceptable approximation to the true Divisia indices.

In the calculations are all variables evaluated from the point of view of the producer. This implies that gross output by industry is valuated in basic values while intermediate input is valuated at purchaser value. Basic value, which is defined as the purchaser value of the commodity minus trade margins and net commodity taxes, are equal to the producers sale revenue. Our figures for value added are however, according to the valuation in the National Accounts, measured in market prices, i.e. gross output in producers value (basic value pluss net commodity taxes levied on the producer) minus intermediate input in purchaser value. By definitions, the growth rates in basic and producer value are equal on the most detailed level. At more aggregated levels, however, the growth rates will in general be different, due to the effects of the net commodity taxes on the weights to be used.

4.2 The general methods of constant price estimations for gross output and intermediate input

The general method of volume or constant price estimation in the Norwegian National Accounts is to reevaluate all elements in the industry by commodity supply and use tables in the prices of the base year. The starting point is industry by commodity supply and use tables in current market prices. The supply table in producer prices (net of VAT) is then divided into different tables for the commodity flows in basic value and for net commodity taxes. The latter is based on detailed information on tax revenue by commodity. In the same way the use table in purchaser prices are split into different tables for the commodity flows in basic value, for net commodity taxes and for trade margins (based on information on trade margin rates).

Based on the supply and use table in basic value the following steps are undertaken:

- Each commodity produced for the domestic market in basic value is deflated by a price index for production for the domestic market. Most of these price indices are unpublished detailed price indices from the Producers' price indices.
- Each commodity produced for the export market in basic value is deflated by unit price indices from foreign trade statistics.
- Import by commodity in basic value is deflated by unit price indices from foreign trade statistics.
- All domestic use by commodity in basic value is deflated by a weighted average of the unit import price index and the price index for domestic production for the domestic market. The weights are the shares in total supply.

All price indices are adjusted for changes in net commodity tax rates thereby reflecting price changes in basic value only.

Constant price figures in purchaser prices for final and intermediate consumption by commodity are then constructed as the sum of figures in constant basic prices and constant price estimates for commodity taxes and trade margins. The latter is estimated by use of the base year rates on the relevant flows in constant prices.

Constant price figures in basic value for total domestic production by commodity are then calculated as the sum of the constant price figures for the domestic and the export market. This is equivalent with deflating total domestic production in basic value with a weighted average of the unit export price index and the price index for domestic production for the domestic market. The weights are the shares of total domestic production by commodity in the current year. Constant price figures for total domestic production by industry in basic value are then obtained as the sum of the constant price figures by commodity for each industry. In the same way total intermediate input in constant purchaser prices are the sum of the constant price figures by commodity for each industry. By this the resulting volume and price indices by industry (and aggregates of industries) are chained Laspeyres and chained Paasche indices respectively. Constant price figures for value added by industry are calculated as gross output in constant prices minus total intermediate input in constant prices. This method is known as the double deflating method.

4.3 Data quality and measurement errors for gross output and intermediate input

The method described above enables us to utilize all the available information in an efficient, systematic and consistent way. The quality of the Norwegian National Account figures in constant prices is generally good compared with most other countries (See Hill (1971) for an old international comparison of the different methods). Still, there are several important areas where the data quality makes growth accounting or total factor-productivity studies problematic or impossible. In Norway the most problematic industries is most of ISIC 4 Construction, 8 Financing, Insurance, real estate and business services and ISIC 9 Community, social and personal services. The reason to this will be discussed in the following subsections.

4.3.1 Lack of collected data in current prices

For large part of the service industries (specially ISIC 8 Financing, Insurance, real estate and business services and ISIC 9 Community, social and personal services) there are none or very limited information on even total gross output in current prices for most of the 1970s. The dominant method for measuring output in these industries was to construct value-indicators based on employment figures and wage rates to extrapolate the production levels established by the last main revision of the National Accounts around 1970. New primary statistics on this area have been established during the last 10 to 15 years which have revealed quite serious estimation errors for parts of these industries. These will be corrected during the on-going main revision of the Norwegian National Accounts.

For these industries there were no information either on the level and the compositions of intermediate input, which had to be estimated by using gross output in constant or current prices to extrapolate benchmark year figures (ie. constant input shares).

For most of the industries outside manufacturing industries and for government service productions there is very little direct information available on the commodity compositions of intermediate input. This make it difficult to estimate the volume of intermediate input in these industries in a precise way.

4.3.2 Problems with defining operational measures of output in current prices

For some industries it is difficult to define or measure output even in current prices. Certain fundamental difficulties arise in connection with the measurements of the banking sector. If only paid bank service charges should be taken as a measure of the current value of the bank's services, value added in the sector would be negative since administration expenses typically are substantially higher than actual commission income. The remaining income consists of net property income. In order to avoid underestimation of the value of services produced by the banking sector, an imputed bank service charge, equal to the the interest margin, is computed and included in the value of gross output.

The gross output of insurance institutions consists of the element of service charge in the premiums paid. This is difficult or almost impossible to measure. Thus conventionally, the service charge for casualty insurance is calculated as the differences between the premiums received and the claims paid. For life insurance the service charge is calculated as the difference between the premium received and the sum of claims paid and net additions to the actuarial reserves.

Producers of government services do not normally sell their output on the market. Thus there are no market prices which can be used to value these services. This is also the situation for other non-market services produced by other non-profit institutions such as different types of membership organisations, research institutes, health and welfare services and recreational and cultural services. According to the recommendations in United Nations a System of National Accounts (SNA) the value of their production is set equal to the total cost of production.

For the housing sector (dwellings) the value of gross output would in principle be expressed as the market value of the services of dwellings, i.e. the value that would have been obtained by adding up rents for all dwellings if the housing market had been a perfect rental market. However, only few dwellings are let out for rent at market value, while the remainder consists of owner-occupied dwellings, co-operatives, dwellings subject to rent control etc. For this part of the housing sector a gross rent is imputed.

It is important to emphasize that the problems discussed here do not imply that it is impossible or connected with any principal problems to identify and measure the quantity of each of these individual services. It is obvious that the physical units in which quantities of output of either goods or services are to be measured, and the possibility to define, observe and measure them, are quite independent of the prices at which they may be sold. The lack of market prices imply problems with establishing the weights to be used in aggregating inhomogeneous commodities. In practice, the problems related to defining and measuring gross output in current prices coincide with the problems of defining and measuring the quantity of output discussed in subsection 4.3.3 below. It is the latter that constitute the well known measurement problems for producers of government services.

4.3.3 Problems with defining and measuring the quantity of output

For many industries, the physical unit of output to which the prices refer are either obscure or continually changing. Thus there are great difficulties in defining and observing comprehensive standardized homogeneous units of productions that are unchanged for at least to periods. This is necessary if we in practice shall be able to separate changes in current prices in a price and quantity component.

This relates to the problem of treating quality differences and quality changes, new commodities, public services and complex and unique commodities. These are problems that apply particularly to many types of service industries such as health, education, finance, insurance and capital goods industries. In the case of services these problems are often exacerbated because the nature of the quantity unit may not be clear even at the level of the individual service. No matter how complex a material commodity may be, or how it may be subject to qualitative changes over time, there is no difficulty in pointing to the commodity in question and observing its physical characteristics at any single moment of time. On the other hand, the nature of many services tends to be obscure in the sense that it may not be immediately apparent exactly what is the service provided by a doctor, teacher or other service work. Services to individuals which are not physical in nature, and collectively services to the community as a whole is particularly difficult to quantify.

Thus, measurement in constant prices (volume measurement) often poses almost insuperable problems which in practice only can be resolved by arbitrary decisions on the part of the statisticians responsible. In practice most statistical offices are

forced to try to side-step the problems by using one of the following approximations:

- The current value of new goods, goods that undergo important quality changes, or other complex and heterogeneous goods that are often subject to rapid technological progress, are usually deflated by price indices constructed on the basis of commodity flows of related goods with readily identifiable physical units of output which remain fairly homogeneous over time.

  The normal case for many of these goods would be a quite rapid quality improvement combined with an increase in the price per unit well below the average (e.g. "infant industries"). Quality improvements should be treated as increases in the quantity of the commodity and not as a part of changes in the price. Thus, it is reasonable to believe that this procedure introduces a positive bias in the assessment of the price increase of these goods. This bias is likely to be correlated with the rate of technological progress and productivity growth.

- The current value of complex commodities such as construction work is quite usually deflated by factor cost indices. In many situations this is done in a quite simple way using indices for wage rates as a proxy for output prices. Another practice which are also in use is to take a weighted average of wage rates and prices for intermediate consumption or to construct total factor cost indices which include proxies for the user cost of capital.

There exist (definitional) relationships between the average output price index, the total factor cost price index and growth in total factor productivity. Thus when using price indices for total factor cost as a proxy for the real output price index we directly or indirectly are forced to an arbitrary a priori setting of the growth rate in total factor productivity. Normally ranking from 0 to 1,0 per cent per year.

Obviously it is not very enlightening to use such data for productivity measurement. A similar shortcoming relates to output figures constructed by extrapolating benchmark year figures with indicators based on employment statistics. This is quite common in many service industries. The employment statistics in use could be total man-hours worked, the number of employees or an index of labour input services. The latter can be constructed as changes in man-hours worked by grade (or "skill-category") weighted by that grade's share in compensation of employees in the base year. This class of methods implies quite restrictive a priori settings of the development of labour productivity.

The solutions described here are crude and results in data that should be used with care or not used at all (as far as productivity calculations are conserned). There are good reason to believe that the solutions chosen in practice tend to overestimate the price increase in average, and then to underestimate the growth in volume. It is also reasons to believe that the bias is correlated with the rate of technological progress and productivity growth.

As mentioned earlier, the most problematic industries in Norway are whole or large part of ISIC 4 Construction, 8 Financing, Insurance, real estate and business services and ISIC 9 Community, social and personal services. The National Account figures for these industries are not fit for use in analyses of the factors behind economic growth. Still the resulting figures are valuable as indicators of the growth in these problematic industries, and their contribution to the overall growth. They contain the only "information" we have.

During the last 20 years there has been made some promising progress in clarifying the concepts of quantity output in the problematic industries, especially some of the service industries (see UN (1979)). Still the overall situations is quite similar to that described in Hill (1971), and it is not realistic to expect any substantial progress in solving these problems in the near future. The methodical difficulties, data requirements and costs are too large.

4.4 Capital data

Figures for total capital stock by industry are also taken from the National Accounts. We interpret the sectoral constant-price time series as a proxy for the development of the services from the capital stock. The capital stock figures in the National Accounts are calculated from time series of gross investment in fixed capital by the perpetual inventory method, assuming depreciation to be linear. The time series of gross investment are cross classified by industry and kinds of capital goods. It can be questioned whether these capital figures are intended to measure the capital's capacity dimension, i.e. "gross capital" according to Biørn et. al. (1989) or the wealth dimension i.e. "net capital" in Biørns terminology. The relevant capital concept to be implemented in productions functions studies is the "gross capital" and we have accordingly treated the National Account figures as gross-capital"-figures, although we are aware of the lack of reasons to accept a linear survival profile of capital units as more realistic than other survival profiles. It is at present difficult to ascertain how the lifetime assumptions have effected the quality of the capital data. However the chosen lifetime assumptions for cars seems to be far to short (Magnussen (1990)).

Our capital stock figures include only produced fixed capital goods, i.e. they do not include inventory and land (except forest). Most of the discussions of data quality and constant price estimations for gross output and intermediate input in chapter 4.2 are relevant for the investment figures too.

There are none or very poor information about gross investment for large part of the service industries (especially business services (part of ISIC 8) and ISIC 9 Community, social and personal services), for most of the seventies. To a large extent the figures for this period are based on "guesstimates". The growth rates for the last 10 years are based on new primary statistics in this field indicating that the level of investment, and thereby the capital stock, in these industries are seriously underestimated.

Investment goods are in general more complex and heterogeneous than consumption goods. The problems of defining and measuring the physical unit of output which is necessary for separating changes in current prices into a price and quantity component are thus exacerbated in the case of investment goods. Based on the discussion in section 4.2 there are reason to believe that the chosen deflating procedures tend to underestimate the growth in investment volume in average.

4.5 The data on labour input

Our data on labour input consist of man-hours worked by kind of activity for employees and self-employed separately. We have no data on man-hours worked by grade (or "skill-category"). The man-hours are estimated as a part of the large wage and labour statistical accounting system related to the National Accounts. The accounting system, which was established during the mid part of the eighties, utilize the definitional relationship between the different wage and labour statistical concept to reconciliate the different primary statistical observations. Thus, they are general of good quality and consistent with the National Account figures. However, there are areas where we know that the data quality is poor. This is the case for some of the service industries and for agriculture. In the latter we know that the level of compensations to employees is probably too underestimated, yielding too low average wage rates, too low labour cost shares and too high capital cost shares. Due to the relative rapid growth in capital stocks in agriculture, this will lead to an underestimation of total factor productivity growth in this industry.

4.6 Capital- and labour shares

The general problem of distinguishing between wage income and property income for self-employed is well known. For this reason the national accounting concept gross operating surplus includes both self-employees wage income and the residual payment to capital. According to the theoretical foundation discussed in section 2, the cost share of labour defined in (3) should be related to total labour cost and not only to labour cost related to employees. Thus, it is necessary to impute a wage income for self-employed to adjust the cost shares. The simplest way to do this is to assume that self-employed are paid according to the average wage rates in the same industry. This is what we have done. It is reasonable to believe that we by this method have underestimated wage income to self-employed and then the labour cost shares.

Gross operating surplus can be defined as gross output in basic value (the producers sales income) minus intermediate input in purchaser value plus other net indirect taxes. The latter consist of different indirect taxes and subsidies that not are directly linked to specific commodities. This comprise subsidies aimed at stimulating certain types of investment and subsidies with the aim of improving profitability in certain industries. For parts of these there are reasons to believe that they do not affect the marginal adjustments of the individual firms. Thus they should not be included in the concept of gross operating surplus used in estimating the shadow price on capital. We have performed our calculations with both other net indirect taxes included and excluded from gross operating surplus. The results differed only to a negligible degree.

5. The results

We will use our results to try to shed some light to the questions put forward in the introduction of this paper.

5.1 The importance of TFP for macroeconomic growth

Table 1 and especially figure 1 provides a picture of macroeconomic growth in Norway the last two decades and how the growth can be attributed to contributions from labour, capital and TFP. TFP growth averaged 2,4 percent for the whole period which means that almost half of the output growth can be attributed to this source. Note that this figure does not include gains from reallocations of labour. It is a weighted average of the industrial TFP growth rates with the industrial shares of value added in current prices as weights. Reallocations of labour account on average for 0,3 percent per year of the growth in value added in the total economy net of producers government services. This means that there has been a net reallocation of labour into those industries with wages above the average le-

Table 1. GROWTH IN VALUE ADDED BY INDUSTRY AND ITS SOURCES, 1971-1990[1].
Average annual growth rates.

	Volume growth[2] in value added	Contributions from			
		Labour	Capital	Total Factor Productivity	Gains from reallocations of labour
Industries[3]					
1971-90	4.6	-0.1	2.3	2.4	0.3
1971-75	7.2	0.0	2.2	5.0	0.5
1976-80	5.4	0.0	2.4	3.1	0.2
1981-85	3.2	0.2	2.9	0.1	0.3
1986-90	2.7	-0.4	1.6	1.6	0.1
Agriculture, forestry, fishing					
1971-90	2.1	-0.9	1.1	2.0	0.0
1971-75	2.3	-2.0	0.9	3.4	-0.4
1976-80	1.7	0.1	1.6	0.0	0.5
1981-85	2.3	-0.8	0.5	2.7	0.0
1986-90	2.2	-0.9	1.4	1.7	-0.1
Oil activities, ocean transport					
1971-90	17.6	-0.2	5.9	11.8	0.4
1971-75	31.6	-1.2	3.3	29.5	0.4
1976-80	24.3	-0.1	10.5	13.8	0.8
1981-85	5.4	0.3	7.0	-1.9	0.4
1986-90	10.9	0.3	3.1	7.4	-0.1
Manufacturing, mining, quarrying					
1971-90	1.0	-1.3	1.5	0.9	0.2
1971-75	3.9	-0.1	3.3	0.7	0.2
1976-80	-0.5	-1.6	1.1	0.0	0.1
1981-85	1.2	-1.5	0.8	1.8	0.2
1986-90	-0.4	-2.0	0.7	0.9	0.1
Sheltered manufacturing					
1971-90	-0.2	-0.6	1.0	-0.5	0.0
1971-75	2.0	-0.9	0.9	1.9	0.1
1976-80	-0.1	-0.2	1.0	-0.9	0.0
1981-85	-1.0	-0.5	1.0	-1.5	0.1
1986-90	-1.4	-0.8	1.0	-1.6	0.1
Export-oriented manufacturing					
1971-90	3.1	-1.5	2.7	1.9	0.1
1971-75	3.2	-0.8	8.4	-4.4	0.2
1976-80	1.2	-1.8	1.3	1.7	0.1
1981-85	4.2	-2.2	0.7	5.7	0.1
1986-90	3.9	-1.2	0.6	4.5	0.2

Table 1. continued

	Volume growth[2] in value added	Contributions from			
		Labour	Capital	Total Factor Productivity	Gains from reallocations of labour
Import-competing manufacturing					
1971-90	0.6	-1.6	1.0	1.2	0.3
1971-75	4.8	0.4	1.6	2.7	0.3
1976-80	-1.2	-2.1	1.0	-0.2	0.2
1981-85	0.7	-1.6	0.8	1.6	0.4
1986-90	-1.7	-3.0	0.7	0.7	0.1
Electricity					
1971-90	4.2	0.3	2.4	1.5	
1971-75	6.2	0.3	2.2	3.7	
1976-80	2.2	0.5	3.3	-1.6	
1981-85	5.0	0.3	2.9	1.9	
1986-90	3.4	0.1	2.4	1.9	
Construction					
1971-90	2.0	-0.6	0.1	2.5	
1971-75	2.9	-0.6	0.6	2.0	
1976-80	3.5	0.3	0.0	3.3	
1981-85	2.0	-0.3	-0.1	2.4	
1986-90	-0.2	-1.6	0.1	1.5	
Other services					
1971-90	2.9	0.7	1.8	0.4	0.0
1971-75	4.0	0.8	1.8	1.4	0.1
1976-80	3.7	0.9	1.5	1.3	0.0
1981-85	2.6	1.1	2.3	-0.8	0.1
1986-90	1.4	0.1	1.7	-0.4	0.0
Memo:					
Mainland industries[3]					
1971-90	2.4	-0.1	1.6	0.9	0.3
1971-75	3.8	0.1	2.1	1.6	0.5
1976-80	2.3	0.0	1.3	1.0	0.2
1981-85	2.4	0.1	1.6	0.6	0.3
1986-90	1.0	-0.6	1.3	0.3	0.1
Export-oriented manufacturing excl. petroleum refining					
1971-90	2.8	-1.6	0.9	3.5	0.1
1971-75	3.4	-1.0	1.1	3.2	0.1
1976-80	1.5	-2.0	1.1	2.4	0.1
1981-85	4.0	-2.2	0.7	5.4	0.0
1986-90	2.2	-1.4	0.6	3.0	0.1

1) Inconsistencies in the tables are due to computerized rounding.

2) Due to differences in the weighting procedure will in general the growth rates differ from the official one in the National Accounts.

3) Excl. producers of government services

vel, but the importance of this kind of aggregate productivity growth is quite small compared to the average of the industrial TFP growth rates. Whether we include gains from reallocations of labour in our aggregate measure of TFP or not, our figures give Norway a quite good productivity record compared to other OECD countries, cf. Englander and Mittelstadt (1988). Capital turns out to be the second most important contributor to growth (2,3 percent) and accounts for a substantial part of the growth in labour productivity during the period.

The TFP-growth rate for all industries (except the producers of government services) is, however, strongly influenced by the performance of the industries constituting the petroleum activities. These industries were built up during the seventies and although large investments in oilplatforms, pipelines supply ships etc. has been necessary, the TFP-growth in these sectors was outstanding in the seventies. In fact TFP grew by almost 30 percent per year on average from 1971-75. However, as noted in section 2, it is naive to take the TFP growth in the petroleum industries as an indicator of technical progress. The crucial inputs are the unexploited reserves of oil and gas and these inputs are not accounted for. The input of crude oil and gas from the earth will grow by approximately the same rate as output. When capital grows more slowly than output, and receives all the resource rent, the actual aggregate input growth is underestimated. The technical change may have been modest, cf. the negative TFP-growth in the first part of the 1980s when the output growth were relatively small. Furthermore, growth patterns for short periods in these industries should be interpreted with great caution because each investment project is typically large compared to the total investments causing large fluctuations in the time series. It is also doubtfull whether the investment decissions in the petroleum industries are well described by the simple model underlying our TFP-growth formula.

Due to the special characteristics of the petroleum activities, it has become quite customary to exclude these activities together with ocean transport from the aggregative picture in analyses of the Norwegian economy. As explained above this is highly relevant when studying growth and productivity. The TFP-growth in all industries except oil activities, ocean transport and producers of government services is not very impressive. Net of gains from labour reallocation, the annual TFP-growth is 0,9 percent on average for the whole period. This means that TFP-growth accounts for 37,5 percent of the output growth for these industries. Adding gains from reallocation of labour increases the average anual productivity growth to 1,2 percent which accounts for 50 percent of the output growth. This means that the relative importance of reallocation effects becomes more significant when ocean transport and petroleum industries are excluded from the overall picture. Moreover, the figures indicate that productivity and capital turn out to be the most important contributors to the GDP-growth for this group of industries.

Statements about the relative importance of the different sources to output growth must, however, be interpreted cautiously. Ultimately we believe that capital formation is a result of investment decisions derived from expectations about profitability. Hence, increases in capital productivity, due to technical change or growth in the labour force, is likely to induce capital formation. Therefore, the effect of a given technical change upon growth is larger than the residual called TFP. On the other hand, modern theories of economic growth (see e.g. Helpman (1992) for a survey) is concerned with the opposite effect; technical change is a result of learning, experience, intentional R&D actvity. In effect, TFP growth depends on the input of labour and capital. The growth accounting presented in table 1 is consequently not to be interpreted as an impact table of various growth factors. It reflects a decomposition in order to identify the contributions from inputs and productivity, but not the overall impact of a hypothetical change in one or several of them. In order to evaluate the total growth effect of, say, TFP, a model of how the whole economy reacts to technical change is needed.

5.2 Has there been a productivity slow-down in Norway?

TFP-measurement using methods similar to the one underlying our results, has been undertaken in many countries. The figures of the OECD countries typically reveals that the productivity growth has slowed down during the last two decades. This process is usually estimated to have started in the years after OPEC 1. We did not have access to sufficiently long time series to check whether the productivity development in the last two decades are significantly different from the development in the 1950s and the 1960s. However, for the period after 1970 our results for the mainland industries net of producers of government services indeed show evidence of a slowdown in the TFP growth at the macro level. This can partly be explained by a reallocation of value added towards the service industries where the TFP-growth rate has been below the average growth rate. Moreover, much of the slow-down in output growth can be attributed to a decrease in the contribution from capital. In the last period, 1986-1990, the contribution from labour also declines from a level close to zero. These years were characterized by a recession in the Norwegian economy. The decrease in the contribution from

labour is a reflection of the decrease in employment. Any slack in the capacity utilization of the capital stock should in principle be accounted for by calculating the cost share of capital residually. But if profits fall as a result of a decline in the mark-ups in addition to lower capacity utilization, the reduction of the actual growth contribution from capital is overestimated.

5.3 Differences in the growth patterns between industries

We have already pointed out that the petroleum activities have very special characteristics with respect to productivity growth. We will now examine if the slow TFP-growth in the Mainland industries is a general phenomenon or if TFP growth patterns differ significantly between industries. Considering average growth rates for the whole period, a first general impression is that low TFP growth rates are a quite general phenomenon. The annual average growth rate for the whole period ranges from 2,0 percent in aggriculture to 0,4 percent in the service industries. Annual average TFP-growth in total manufacturing was 0,9 percent which equals the annual average for the mainland industries as a whole (net of producers of government services). With reference to the discussion in section 4 we believe the quality of the data and our results to be greater for the manufacturing industries than for the other industries. A second general impression of the disaggregated figures is that the growth contribution from labor, capital and TFP is far from constant over time. In particular, the tendency to slower overall TFP-growth seems to be a reflection of the development in the service industries mainly.

Also within manufacturing there are significant differences between industries. In sheltered manufacturing there has been a decline in productivity in most of the period, especially in the 1980s. Negative TFP-growth should remind us that our TFP measure has several weaknesses when used as a measure of technical change. The most rapid TFP-growth has taken place in the export-oriented manufacturing industries. This becomes even clearer if we exclude Petroleum refining. This industry is characterized by large fluctuations in investments, and the growth in inputs and outputs is likely to fit badly to our theoretical framework. The remaining export oriented industries include metal production, manufacturing of chemical raw materials and manufacturing of pulp and paper products which are all relatively energy intensive industries. These industries experienced an average annual TFP-growth equal to 3,5 percent. The output from these industries are of course heavily dependent on the business cycles on the international markets. Our figures indicate procyclical movements in the TFP-growth in these sectors indicating that effects of non-constant mark-ups and returns to scale influence the growth contribution from capital and thereby the TFP-growth.

With respect to the service industries, section 4 stressed that the data for these large industries in general are of poor quality with respect to productivity measurement. Especially, we discussed some aspects of the generation of National Account data that may provide a systematic negative bias of the TFP-growth. But it is more difficult to explain the productivity slowdown in the service industries by measurement problems. In fact TFP has declined in the 1980s. From our point of view this further indicates that there are substantial measurement errors in our figures of outputs and inputs, and that the marginal productivities of the inputs deviate from the observed factor prices.

In section 2 we discussed how market imperfections, decreasing returns to scale and factor incomes from subsidies may introduce biases in our estimates of the TFP-growth. Both these aspects are likely to be relevant when interpreting the TFP-growth in the primary industries. The available data probably understates the growth contribution from labour and overstates the TFP growth. In agriculture, the structural development is characterized by exit of farms. We should expect that it is the least efficient farms that go out of the industry thereby contributing to a rise in the average productivity. It may be disputed whether this should be interpreted as a scale effect or as technical progress.

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Figure 1. Contribution from capital, labour and total factor productivity to growth in value added in all industries excl. producers of government services, 1971 - 1990
Volume indices. 1971=100

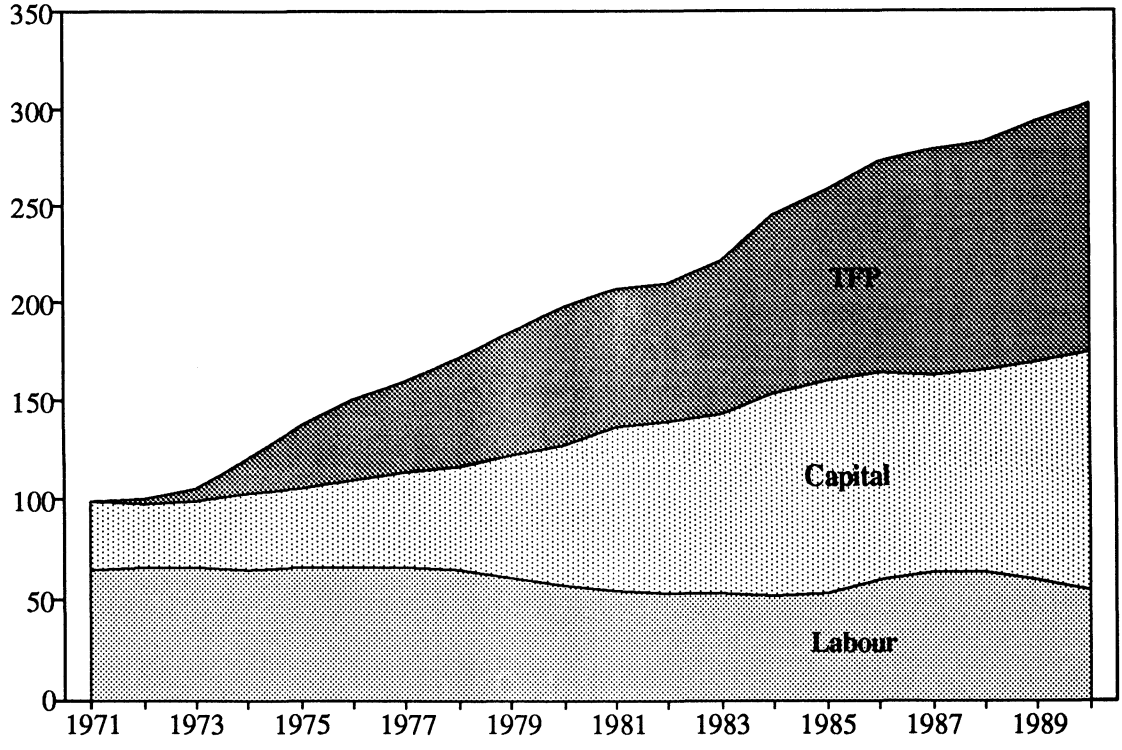


Figure 2. Contribution from capital, labour and total factor productivity to growth in value added in mainland industries excl. producers of government services, 1971 - 1990
Volume indices. 1971=100

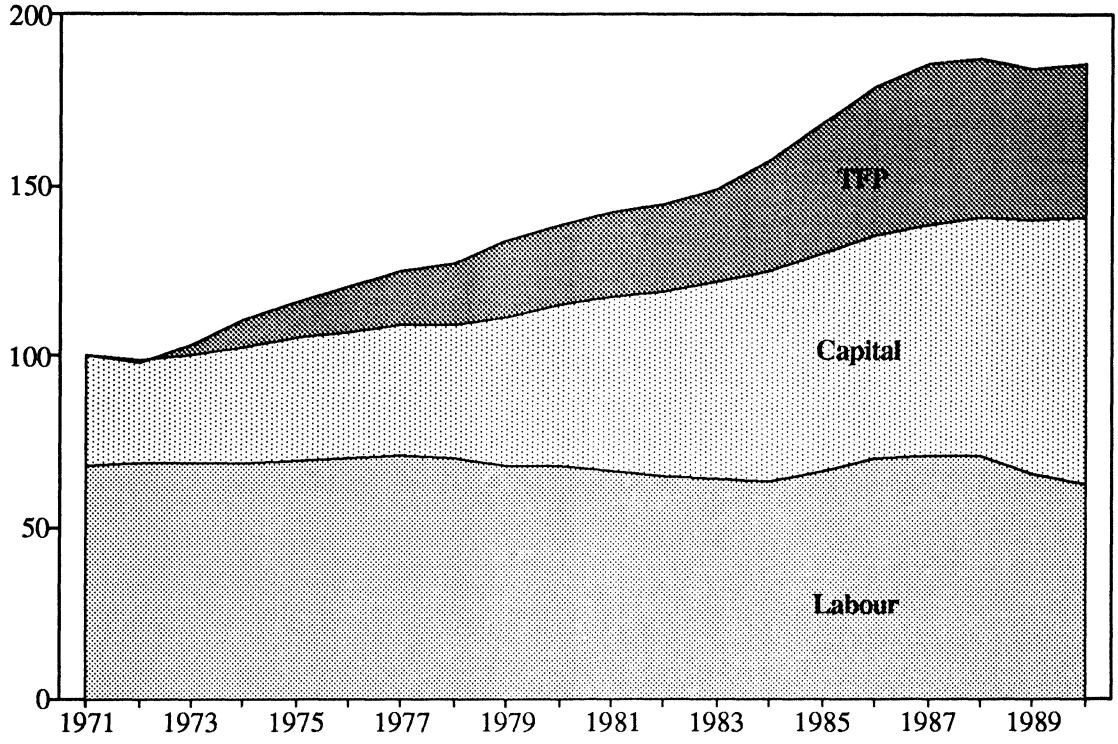


Figure 3. Contribution from capital, labour and total factor productivity to growth in value added in agriculture, forestry and fishing, 1971 - 1990
Volume indices. 1971=100

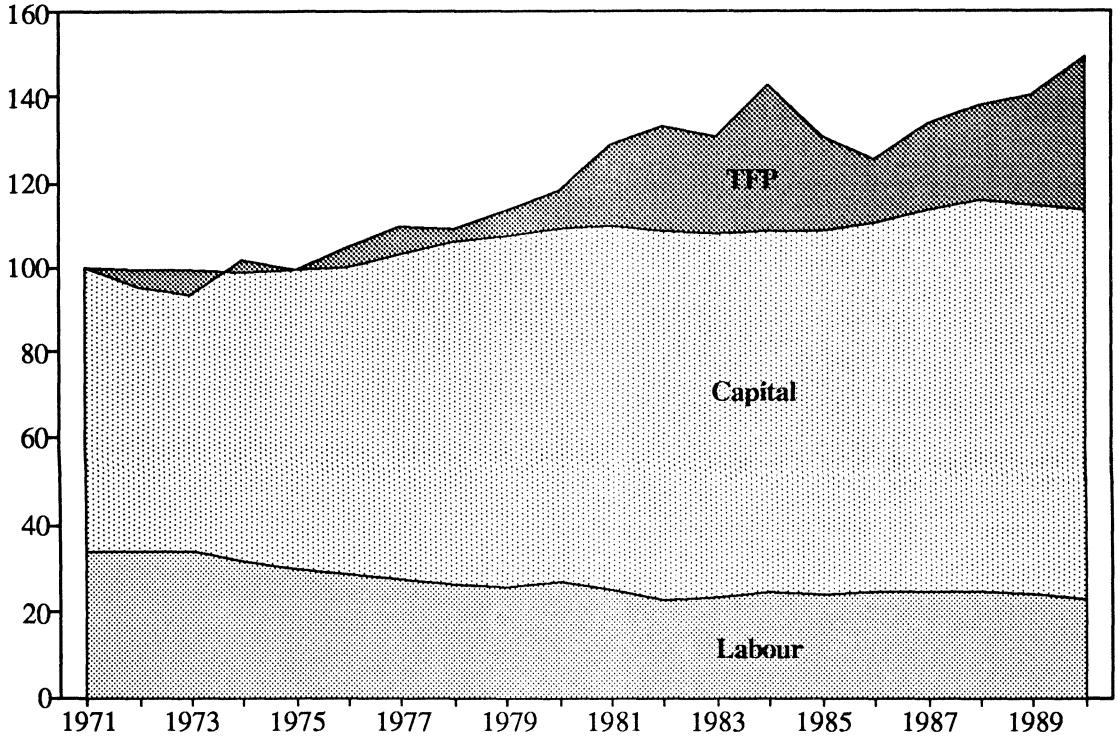


Figure 4. Contribution from capital, labour and total factor productivity to growth in value added in manufacturing, mining and quarrying, 1971 - 1990
Volume indices. 1971=100

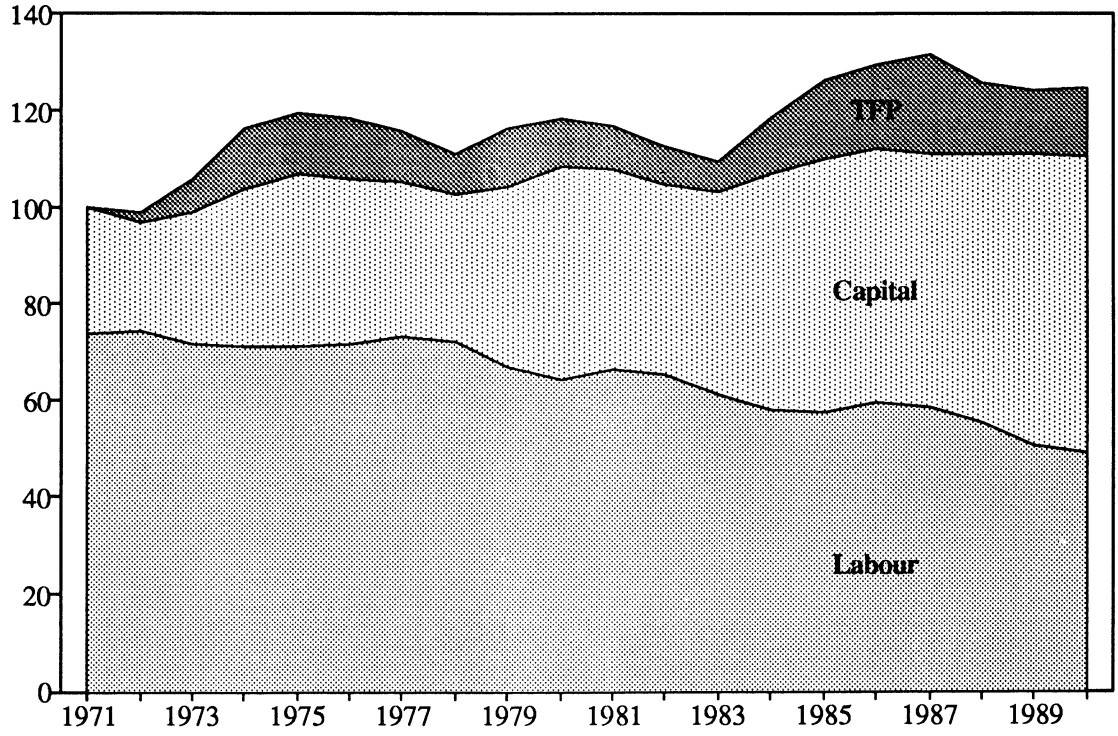
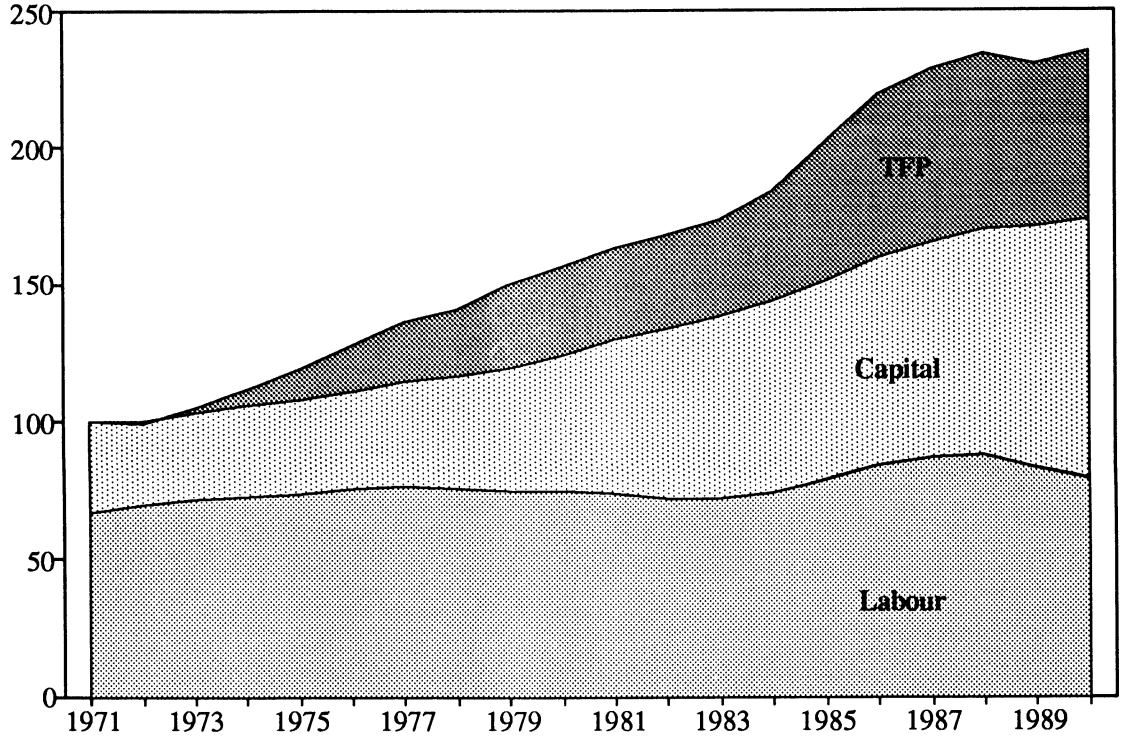


Figure 5. Contribution from capital, labour and total factor productivity to growth in value added in other services, 1971 - 1990
Volume indices. 1971=100



New Research Reports

DISCUSSION PAPER

Anne Brendemoen and Haakon Vennemo:
A CLIMATE CONVENTION AND THE NORWEGIAN ECONOMY: A CGE ASSESSMENT
Discussion Paper no. 64, 1991. 19 pages.

Using a multisector computable general equilibrium (CGE) model, the paper studies the impact of a climate convention on the Norwegian economy. A wide range of implications are discussed, including main macroeconomic indicators, economic growth, the market for energy, and the impact on emissions of other pollutants than CO2. Utilizing the consumer expenditure survey data base, we also assess the impact of the reform on the distribution of welfare in the regional, socioeconomic and income dimensions. The results indicate that a climate convention will not dramatically reduce economic growth and welfare in Norway. CO2 emissions will decrease, as will other emissions to air. Contrary to popular opinion, there are no particular impacts on redistribution in any of the dimensions studied.

Kjell Arne Brekke:
NET NATIONAL PRODUCT AS A WELFARE INDICATOR
Discussion Paper no. 65, 1991. 17 pages.

Weitzman (1976) claimed that in the case of linear utility, NNP is proportional to welfare, defined as the discount value of future utility. We first demonstrate that this theory only applies to economies with stationary economic policy and no technical progress. Furthermore Weitzman's result does not generalize to the case of nonlinear utility. We also prove that only under the assumption of unchanged economic policy and with constant shadow value of investment is marginal changes in NNP a measure of marginal changes in welfare. Thus the theory gives no justification of attempts to maximize NNP growth. Finally we point out that levels or growth rates of NNP for different countries, is no indicator of relative welfare or the relative success of economic policy. In the last part of the paper we discuss national wealth as a potential welfare measure. We point out that in a small open economy, welfare will be an increasing function of national wealth. Unfortunately, this will no longer be true if we relax the assumption that the economy is small and open.

Einar Bowitz and Erik Storm:
WILL RESTRICTIVE DEMAND POLICY IMPROVE PUBLIC SECTOR BALANCE?
Discussion Paper no. 66, 1991. 40 pages.

A policy simulation on the Norwegian macroeconomic model MODAG indicates that there are large automatic stabilizers in the system of government revenues and expenditure in Norway, especially in the short and medium term. A relatively large part of transfers (in addition to unemployment benefits) is found to be influenced by changes in unemployment. The consequence of this is that the potential for improving public sector balances means of a restrictive demand policy, may be more modest than usually believed. The paper also contains a long term projection of government expenditure, with special emphasis on effects of ageing of the population and the maturing of the pension system, implying increases in pension payment per beneficiary in the future. The government expenditure projections indicate that transfers (mainly old-age and disability pensions) will increase by 5 percentage-points of GDP from 1990 to 2030, given that unemployment returns to the estimated NAIRU in the future. In addition increased demand for medical care due to ageing, may be said to warrant additional increases in (public) health consumption of a somewhat smaller size. This work is part of the project "macroeconomics and the welfare state", financed by NORAS (Norwegian council for applied social research).

Ådne Cappelen:
MODAG. A MEDIUM TERM MACROECONOMIC MODEL OF THE NORWEGIAN ECONOMY
Discussion Paper no. 67, 1991. 41 pages.

This paper describes the main structure of the MODAG model, an annual macroeconomic model of the Norwegian economy. A short description of the main features of the model including forcasting performance is followed by a more detailed look at the various parts of the model.

Brita Bye:
MODELLING CONSUMERS' ENERGY DEMAND
Discussion Paper no. 68, 1992. 33 pages.

The modelling of consumers demand for energy in a general consumer demand system is discussed. Electricity, fuel-oil, the stock of electricity using durables and housing are assumed to be separable from other consumer commodities. This lower level demand system is modelled using a Gorman Polar form. The linear expenditure system is nested hypothesis of the more general Gorman Polar form and the two systems are estimates and tested against each other. A dynamic version of the linear expenditure system is also estimated. As expected the results indicate that the Engel elasticities for electricity and fuel-oil differ considerably, and that the stock of electricity using durables contributes to explain the use of electricity and fuel-oil over the period.

Knut H. Alfsen, Anne Brendemoen and Solveig Glomsrød:
BENEFITS OF CLIMATE POLICIES: SOME TENTATIVE CALCULATIONS
Discussion Paper no. 69, 1992. 35 pages.

Consequences for the Norwegian economy of an active policy against anthropogenic climate change can be analyzed by use of an economic model evaluating

the differences between a reference scenario without control policies and alternative paths using economic incentives to reduce emissions of greenhouse gases. In traditional economic models the effect of the new taxes usually appears as reduced growth in macroeconomic indicators such as GDP, gross production and private consumption. When measures against climate change nevertheless are contemplated, it is due to a belief that the benefits of a policy more than outweighs the costs. Many benefits are hard to quantify. This is true for instance for the effects associated with the general welfare of people under different climatic conditions. However, it is possible to associate some tentative figures with some of the benefits likely to emerge from an introduction of a vigorous climate policy.

In this paper we try to evaluate some usually neglected benefits associated with an introduction of a carbon tax. The benefits emerge from reduction in local pollution levels and the ensuing reduction in environmental damages to forests and lakes, health damages and damages to certain types of materials. In addition, benefits accruing from reduced traffic congestion, road damage, traffic accidents and noise levels are quantified. We find that the benefits thus accounted for go a long way toward compensating the economic loss measures as a reduction in GDP by the macroeconomic model MODAG. The uncertainty in the estimates of the benefits is assessed, and distributional consequences of the carbon tax are analysed.

Rolf Aaberge, Xiaojie Chen, Jing Li and Xuezeng Li:
THE STRUCTURE OF ECONOMIC INEQUALITY AMONG HOUSEHOLDS LIVING IN URBAN SICHUAN AND LIAONING, 1990
Discussion Paper no. 70, 1992. 45 pages.

This paper presents the results from a descriptive analysis of economic inequality among households living in urban regions of two Chinese provinces, Sichuan and Liaoning, in 1990. The results refer to distributions of households income, expenditure and savings and are based on data from the State Statistical Bureau's Urban Household Survey.

Knut H. Alfsen, Kjell Arne Brekke, Frode Brunvoll, Hilde Lurås, Karine Nyborg and Hans Viggo Sæbø:
ENVIRONMENTAL INDICATORS
Discussion Paper no. 71, 1992. 67 pages.

The report discusses logical structures and content of a set of environmental indicators for Norway. The emphasis is on structure; proposals for specific indicators and data presented are of a more preliminary nature.

Brita Bye and Erling Holmøy:
DYNAMIC EQUILIBRIUM ADJUSTMENT TO A TERMS OF TRADE DISTURBANCE
Discussion Paper no. 72, 1992. 45 pages.

This paper investigates how a fall in the price of imports will have dynamic effects in an open economy. We analyse the effects within an aggregated intertemporal equilibrium model with internationally mobile capital. We assume the domestic product to be an imperfect substitute for a foreign product. Hence, the model is characterized by an endogeneous domestic product price and a path dependent steady state solution. Using a numerical model calibrated to the Norwegian economy we study the effects of both anticipated and unanticipated changes in the import price.

REPRINTS

Knut Anton Mork, Hans Terje Mysen and Øystein Olsen:
BUSINESS CYCLES AND OIL PRICE FLUCTUATIONS: SOME EVIDENCE FOR SIX OECD COUNTRIES
Reprint no. 53, 1991.
ISBN 0-412-35340-7

Reprint from O. Bjerkholt, Ø. Olsen and Jon Vislie (eds.): Recent modelling approaches in applied energy economics, Chapman and Hall, Great Britain, 1990.

T.Ø. Kobila:
PARTIAL INVESTMENT UNDER UNCERTAINTY
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ISBN 0-444-88630-3

Reprint from Diderik Lund and Bernt Øksendal (editors): Stochastic Models and Option Values, North-Holland: Elsevier Science Publishers B.V., 1991.

Kjell Arne Brekke and Bernt Øksendal:
THE HIGH CONTACT PRINCIPLE AS A SUFFICIENCY CONDITION FOR OPTIMAL STOPPING
Reprint no. 55, 1991.
ISBN 0-444-88630-3

Reprint from Diderik Lund and Bernt Øksendal (editors): Stochastic Models and Option Values, North-Holland: Elsevier Science Publishers B.V., 1991.

Olav Ljones and Kyrre Aamdal:
DEMOGRAPHIC CHANGES AND LOCAL PUBLIC EXPENDITURE IN A MACROECONOMIC PERSPECTIVE. SOME NORWEGIAN EXAMPLES
Reprint no. 57, 1992.
ISSN 0167-8000

Reprint from G. Hinteregger (editor), Statistical Journal of the United Nations Economic Commission for Europe. Volume 8, number 1, 1991.

Lasse S. Stambøl:
MIGRATION PROJECTION IN NORWAY: A REGIONAL DEMOGRAPHIC-ECONOMIC MODEL
Reprint no. 58, 1992.
ISBN 1-85293-148-5

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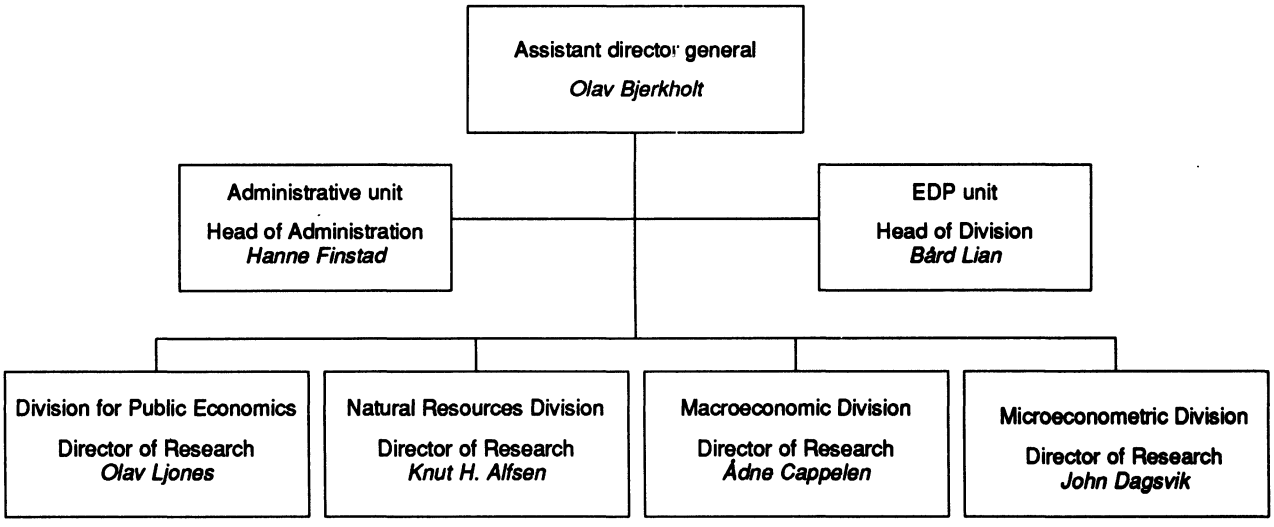

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