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A QUARTERLY MACROECONOMIC MODEL
FORMAL STRUCTURE AND EMPIRICAL CHARACTERISTICS

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PREFACE

The Norwegian quarterly macroeconomic model KVARTS, which has been developed in the Central Bureau of Statistics, has been in regular use in the Bureau's analysis of short-term economic movements for some time.

The model has been subject to considerable change over the last years, both with respect to the level of aggregation and to economic content. Accordingly, several documentations (in Norwegian) have been published. This report describes in some detail the structure and properties of the 1986 - version of KVARTS.

Central Bureau of Statistics, Oslo, 13 Desember 1988

Gisle Skancke

CONTENTS

1. INTRODUCTION

This report gives a description of the main features of the 1986 version of the Norwegian quarterly macroeconomic model KVARTS as well as a technical documentation of the behavioural equations. (For an earlier documentation in English, see (Biørn et.al. 1987)). This version of the model, KVARTS86, is to a considerable extent revised compared to the version documented in Biørn et.al. (1987). All econometric equations have been reestimated and some are based on a different specification because they performed very poorly in simulations outside the original estimation period. The model is now updated with 1986 as base year (volumes are measured in 1986-prices and the input-output coefficients are taken from national accounts figures from 1986). The base year is now changed every year and the econometric coefficients are adjusted accordingly (see appendix 3).

KVARTS86 is used regularly by the Central Bureau of Statistics (CBS) in the work on economic short-term movements and forecasts.

This report gives a relatively short description of the main features of the model in ch.2, while ch.3 contains a somewhat more detailed description of the different "blocks" in the model (e.g. consumption, exports, employment etc.). Ch.4 presents some numerical examples of the main characteristics of KVARTS86 by reporting some multiplier-experiments. Tracking performance of the whole model is analysed in ch.5, extending work done on earlier versions of the model (documented in Norwegian in Bowitz et.al (1987), Jore (1987) and Jensen and Knudsen (1985). The appendixes contains:

i) A detailed description of sectors, commodities and consumption categories.
ii) Matrices of the input-output-coefficients.
iii) Description of how the estimated coeffisients are adjusted when the base year is changed.
iv) Technical documentation of all behavioural equations in KVARTS.

2. MAIN FEATURES OF KVARTS

KVARTS86 contains about 1 300 equations and 600 exogenous variables. Its relatively large dimension, as far as the number of equations are concerned, is mainly due to the relatively disaggregate specification of sectors and commodities. There are 17 sectors and 26 commodities. Similar to Norwegian models developed in the Central Bureau of Statistics (CBS), KVARTS integrates the input - output structure of the national accounts into the model structure. A substantial part of the equations are input - output - equations and definitional relationships. About 100 equations can be called econometric, i.e. specified stochastically and estimated by econometric methods.

KVARTS endogenizes most variables in the real sphere of the economy as well as wages and prices. Import prices in local currencey are exogenous, also implying exogenous exchange rates. Furthermore various financial variables e.g. interest rates and supply of credit influencing households' demand are exogenous variables.

The national accounts imply the following basic equilibrium equation (balance equation) for each commodity:

Domestic production
+ imports
= intermediate comsumption
+ final domestic use (gross capital formation and private and public consumption)
+ exports
+ increase in inventories

This equation imposes a fundamental restriction on the modelling of demand and supply responses and the determination of market equilibrium for the different commodities. More precisely, considering intermediate consumption and final domestic use as endogenized by separate behavioural equations, we cannot introduce independent equations for domestic production, imports, exports and inventory change. At least one of the latter variables should be allowed to be implicitly determined from the rest of the model.

Each sector is the main producer of one commodity (except the oil and gas sector which is the main producer of 3 commodities), but the sectors also produce other commodities in fixed porportions to its main commodity. In addition there are 8 non-competing commodities which are not produced as main commodities in Norway.

Most quantity variables are determined endogenously either by behavioural relationships, definitional relations or by the input - output equations. Among these variables production in sector 10 - Primary industries, 65 - Oil production etc. and 71 - Power supply are exogenously given. Production in the public sectors is determined by exogenous employment and productivity. In appendix 1 a more detailed overview of the determination of the different variables is given.

There are specificed demand functions for private consumption and investment. The macro consumption function determines aggregate private consumption as a function of households' real disposable income and credit supply (due to the (previous) existence of credit rationing). Due to the liberalisation of the credit marked, the consumption function is not used in the current work with the model. In stead we have been using the saving ratio as an exogenous variable. A linear expenditure system distributes private consumption on 7 consumption categories, explained also by relative prices. Housing services (gross rents) is a function of the housing capital stock. Private investment is determined by sectoral investment functions. Explanatory variables here are increase in production and profitability (gross operating surplus) in the sector. Investment in housing is determined by households' real income, interest rates, relative prices on housing investment and credit supply.

The households' income consists of wage income, transfers, a share of net operating surplus and net interest income. The tax function, gives households' taxes a function of income.

Exports is determined by demand functions where indicators of foreign market size and relative export prices are explanatory variables. Exports prices are functions of domestic costs, competitors' prices and capacity utilization.

Inventory change is exogenous for most commodities, except 4 manufacturing commodities. When inventory change is exogenous, production is determined endogenously as a residual in the balancing equation (given imports). For 4 manufacturing sectors, production and stocks are simultaneously determined. A demand increase here only affects production modestly in the short run. The demand is satisfied by building down stocks. Production is fully demand-determined in the long run.

Imports is determined as a residual in the balancing equations for the non-competing commodities. For 4 manufacturing commodities import shares depend on relative prices, the other commodities have exogenous import shares.

The price indexes of the final demand components, e.g. the private consumption deflator, are determined in the price input - output equations. This means that they depend on the domestic prices and import prices (of in principle - all commodities). Most domestic prices are determined by price equations where variable unit costs, import prices and capacity utilization are explanatory variables. Wages are determined by sectoral wage equations where wages are explained by consumer and import price, unemployment, productivity and taxes. Employment is a function of production, capacity and relative factor prices. The employment equations imply that employment has increasing returns especially in the short run, but also in the long run.

3. INPUT - OUTPUT STRUCTURE AND ECONOMETRIC EQUATIONS

3.1. The input - output price and quantity relations. Value concepts

Like in other Norwegian planning models, KVARTS has a core of input - output quantity relations, with input - output price relations as a dual counterpart. These central parts of KVARTS do not deviate essentially from the other models of the Central Bureau of Statistics. In this section we will therefore only give a brief survey of the input - output structure of KVARTS. For more details see Jensen and Wahl (1985) for 75-version of KVARTS and the documentation of MODAG in Cappelen et.al. (1981) and MSG-4E in Longva et.al. (1980).

In modelling the input-output equations of KVARTS86, we distinguish between three value concepts for the commodity flows - basic value, producers' value and purchasers' value. Producers' value and purchasers' value are the only value concepts used in the national accounts publications, both for annual and quarterly data, and these concepts are thus the most relevant ones for the purpose of evaluating output from the model and presenting simulation results. However, as market values are influenced by variations in trade margins and indirect taxes (over time as well as between receivers of each commodity), the third concept, basic value, is also required. The basic value of a commodity flow is, in simple terms, defined as its market value stripped for (net) indirect taxes and trade margins. Hence, producers' value is equal to basic value plus value of net indirect taxes imposed on production, and purchasers' value is equal to producers' value plus trade margins and net indirect taxes imposed on the commodity flow.

The main elements of the input-output structure of KVARTS86 are, on the quantity side, equations balancing supply and demand of commodities, and on the price side an implicit representation of the dual price input-output structure in the form of equations determining the sector prices.

The balancing of supply and demand of each commodity in basic value is represented by the following quantity equations:

$$(3.1.1.) \quad t_i^I \cdot I_i + \sum_j \Lambda_{ij}^X \cdot X_j = \sum_j \Lambda_{ij}^M \cdot M_j + \sum_j \Lambda_{ij}^C \cdot C_j + \sum_j \Lambda_{ij}^J \cdot J_j + t_i^A \cdot A_i + L_i + V_i$$

where

I_i = Import of commodity i, constant prices

X_j = Gross production in sector j (or production activity j when the sector is devided into several activities), constant prices

M_j = Intermediate input in sector j, constant prices

C_j = Private consumption of category j, constant prices

J_j = Investment in new goods of kind j, constant prices

A_i = Exports of commodity i, constant prices

L_i = Increase in stocks of commodity i, constant prices

V_i = Residual in balancing of commodity i

t^I = Coefficient which transfers the market value of imports of commodity i to basic value, i.e. corrects for import tariffs.

t_i^A = Coefficient which transfers the market value of exports of commodity i to basic value

Λ^X_{ij} = input-output coefficient - which gives the output (production) of commodity i from sector j in basic value, per unit gross production in sector j in producers value.

Λ^M_{ij} = input-output coefficient - which gives the basic value of intermediate input of commodity i in sector j, per unit total intermediate input in sector j in purchasers' value.

Λ^C_{ij} = input-output coefficient which gives the basic value of commodity i in consumption categori j, per unit private consumption of category j in puchasers' value.

Λ^I_{ij} = input-output coefficient - which gives the basic value of the use of commodity i in investment of kind j, per unit total investment of kind j in puchasers' value.

The expression in (3.1.1.) are summed over respectively all production sectors, consumption categories and investment kinds. The different sectors (or activities when the sector is devided into several production activities - in KVARTS86 only the oil sector), commodities and categories are given in appendix 1. The input-output coefficients are estimated using the annual national accounts for the base year of the model - now 1986. When the correct annual 1986 values of the variables are inserted, equation (3.1.1) will be exactly fulfilled, by way of construction, with $V_i \equiv 0$. However, when we use the quarterly national account figures, this will not be the case neither in the different quarters of the base year nor in any other year. Therefore, we have, for each commodity, calculated the time serie V_i in such a way that equation (3.1.1) is satisfied when the actual time series for the other variables are inserted. The equation will then reproduce the correct commodity mix over the entire period of observation. The main reason for residuals to appear in equation (3.1.1) is the fact that the input-output structure changes over time. This is not explicitly reflected in the model since the input-output coefficients are estimated from the base year data only. When using KVARTS for forcasting purposes, we use the last four observations of the residuals as estimates of the coming values of these. By doing this we try to correct for seasonal variations and possible changes in these coefficients after the base year.

In the dual price block determining sector prices, we distinguish between three different prices (indices) for the (basic) value of each commodity - the import price, the price of domestically produced commodities delivered to the home market (the home price) and the export price. The price of the purchasers' value of intermediate input, investment and private consumption (acivities) is derived from the above mentioned basic prices and the determining equations have the following form:

$$(3.1.2)\quad P^A_j = \Sigma_i(1+R_i\cdot V^A_{ij})\cdot(1+F_i\cdot T^A_{ij})\cdot\Lambda^A_{ij}\cdot[(1-B^A_{ij}\cdot D^A_{ij})\cdot BH_i + B^A_{ij}\cdot D^A_{ij}\cdot PI_i]\cdot U^A_j$$

Where

P^A_j = purchasers' price, activity A and category (or kind or sector) j

$A \in [\,C,M,I\,]$ $\quad j \in [10, 20..\text{ etc.}]$

R_i = relative (current quarter to base year) VAT rate, commodity i

V^A_{ij} = base year VAT rate for commodity in category j of activity A

F_i = relative (current quarter to base year) rate of net indirect taxes excluding VAT, commodity i

T_{ij}^{A} = base year net indirect tax rate for commodity i in category j of activity A

Λ_{ij}^{A} = input-output coefficient (like those under 3.2) - which give the input of commody i in basic value per unit of output in category j of activity A in purchasers' value.

B_{ij}^{A} = relative (current quarter to base year) input of imported quantity of commodity i per unit output in category j of activity A.

D_{ij}^{A} = base year input of imported quantity of commodity i per unit output in category j of activity A.

BH_i = basic value home price of commodity i

PI_i = import price of commodity i

U_j^{A} = Residual in the price input-output equation

The domestic market price of demand category j of activity A is a weighted average of import - and basic home prices of the different commodities used in this way, corrected for taxes. The contents of the brackets in (3.1.2) is the average of the basic home price and the import price for commodity i weighted respectively with import share and one minus the import share of the commodity used in current activity and category at any time. The product of the first two parantheses is the factor which represents the net indirect taxes and VAT which one have to multiply with the average basic price to get the market price for this commodity. The input-output coefficient Λ_{ij}^{A} is used to weigh the importance of each commodity for the price of activity A's category j and also to transform the above mentioned factor to become one in the year the fixed prices are from.

3.2. Private consumption[1], income and taxes

The private consumption block of the model consists of three parts; one macro consumption function determining aggregate private consumption, one equation determining the consumption of housing services and an linear expenditure system which distributes total consumption minus housing-consumption on the remaining six consumption categories. The teoretical framework of the consumption model is a variant of the Extended Lineare Expenditure System (ELES). It is assumed that the housholds have the following intertemporal utility function:

$$(3.2.1)\quad U = \sum_{t=1}^{T} \mu^{t-1} \cdot U_t$$

where U_t - is the static utility function which is valid in every period until the planning horizont and μ is a discounting factor. It is assumed that the static utility function have the following properties:

$$(3.2.2)\quad U_t = \sum_{i=1}^{N} B_i \cdot \log (C_i - \gamma_i)$$

$$(3.2.3)\quad \sum_{i=1}^{N} B_i = 1$$

[1] The work on the private consumption block of the model is done on the basis of Biørn and Jensen (1983).

where C_i is consumption of commodity i at fixed prices and B_i an γ_i are constants. This design of U_t is the same as in Stones original simple Linear expenditure system (LES). In ELES (3.2.1) is maximized for a given expectation about the development in income, interest rates and relative prices. The formulation (3.2.1) to (3.2.3) implies that the households behave as follows: First they decide the distribution of the income between total consumption and saving, and then they distribute total consumption excl. housing services on the different categories by a linear expenditure system. Housing services is determined by the stock of housing capital.

As opposed to this LES only explain the composition of the consumption since the total consumption expenditure is taken for given.

So far we have been using the following specification of the macro consumption function:

(3.2.4) $C_t = [a(1)\cdot(RI_t/P_t) + b(1)\cdot(KR_t/P_t]\cdot(\text{seasonal factor})$

where

C_t = total consumption at fixed prices in period t

P_t = deflator for the total private consumption in period t

RI_t= the households disposable income in period t

KR_t= total increase in the household loans from banks in period t

a(1), b(1) are polynomic distributed lag coefficients.

The long run marginal propensity to consume is estimated to 0.922. The effect of a change in income, is distributed over eight quarters, and two thirds of the effect comes in the first year. A credit expansion would effect the consumption by a factor of 0.346 and is completed after 4 quarters.

In the macro consumption function, the dummy variables for season are included as a multiplicative component. The peak season is, not surprisingly, in the last quarter of the year. The relative differences between the fourth and the first quarter (which is the lowest) is estimated to about 14 per cent. The way the consumption model is formulated, the consumption of housing services may be considered as determined from the supply side. This is because it mainly follows from the stock of housing capital. Based on the conventions in the national accounts, the following equation has been estimated:

(3.2.5) $CH_t = c + d\cdot T_t + e\cdot JB_t + \text{seasonal factors}$

where

CH_t = consumption of housing services at fixed prices in period t

T_t = variable for the time (trendvariable) in period t

JB_t = cumulated housing investment from the first quarter of 1970 to the end of period t

c,d,f are coefficients

The constant term and the trend coefficient account for the services from the houses built before 1970. This stream of services decrease little by little as the old housing capital depreciate, therefore the coefficient d is negative. The next part of the equation take account for the services from houses built after 1970, when we, as in the national accounts, assume that the depreciation is replaced by repairs.

The value of total consumption exclusive the housing consumption is, as mentioned before, distributed on the other seven consumption categories by a linear expenditure system of the following kind:

$$(3.2.6)\quad C_{it} = \gamma_i + B_i/P_{it}(CE - \sum_{i=1}^{7} P_{it} \cdot \gamma_i) + \text{seasonal factors}$$

where

C_{it} = consumption of category i at fixed prices in period t

CE_t = the value of total consumption exclusive housing in period t

P_{it} = deflator of C_i in period t

γ_i, B_i are the same constants as those of equation (3.2.2)

By the estimation of (3.2.6), $\sum_{i=1}^{7} B_i = 1$ (3.2.3) has been imposed as a restricton. A corresponding restriction is imposed on the seasonal coefficient so the adding up condition of (3.2.7) applies.

$$(3.2.7)\quad \sum_{i=1}^{7} P_{it} \cdot C_{it} = CE_t$$

In table (3.2.1) the most important price - and income elasticities are given. The elasticities are calculated in the average point of the period of observation.

Table 3.2.1. Income and price elastisities and average budget shares.

Category of consumption	00 Food	10 Other non-durable goods	20 Semi-durable goods	30 Personal transport equipment	40 Other durable goods	60 Other services	66 Tourism abroad
Income elastisity	0.56	1.26	0.64	1.89	1.08	1.04	1.69
Direct price-elastisity	-0.348	-0.696	-0.400	-0.688	-0.532	-0.483	-0.890
Average budget-share	0.247	0.215	0.169	0.055	0.079	0.178	0.057

The housholds' real disposable income play an important role in the model through the determination of private consumption. The income consists of several components:

(1)	Total wage income
+ (2)	The housholds' share of net operating surplus
+ (3)	Interest income from bank deposits
- (4)	Interest expenditure on loans
+ (5)	Transfers from the public to the housholds
+ (6)	Interest on life insurance claims
= (7)	Disposable income before tax

In the tax function (7) the income tax is calculated as a function of disposable income before tax:

(3.2.8) $T = t' \cdot D - (t' - \bar{t}) \cdot (\tilde{D}/\tilde{N}) \cdot N + T_X$

where

T = direct tax on housholds
D = the housholds' disposable income before tax (7)
t' = macro marginal tax rate
$\bar{t}$ = macro average tax rate
$\tilde{D}$ = average of disposible income before tax (D) - the year before the present
$\tilde{N}$ = average of number of manyears the year before the present
N = manyears in the present quarter
T_X = exogenous tax amount which among other components consists of real estate tax.

(3.2.8) can be transformed to (3.2.9):

(3.2.9) $T = \{t' \cdot [(D/N) - (\tilde{D}/\tilde{N})] + \bar{t} \cdot (\tilde{D}/\tilde{N})\} \cdot N + T_X$

This equation is easier to interprete than (3.2.8): It says that the part of the quarterly income per manyear which exceeds the last years average, is taxed by the marginal tax rate. The last part of the income per manyear is to be taxed by the average tax rate. Then this tax per manyear is to be multiplied with the manyears in the current quarter - to get the total effect on the tax amount. Finally, exogenous taxes are added to the direct income related components.

3.3. Private real investment[1]

It is implemented investment relations for two kinds of capital, construction and machinary and equipment. The equations are all built upon the same framework, except the equation explaining housing investment. Let us start with the business investment:

Business investments are endogenous in the following sectors; (10) primary industries (15) food and clothing industries, (25) wood and printing industries, (30) mining and raw-material industries, (45) metal manufacturing industries, (50) shipbuilding and manufacture and repair of oil platforms, (70) domestic transport, (80) other services and (81) wholesale and retail trade. The formulation of the model is based on a variant of the socalled flexible accellerator model for a producers' adaption of desired capital stock. In this model it is assumed that there is a constant proportion between wanted capital stock and expected production. The equations below in principle apply for investments in all sectors. There are two equations for each sector - machinery and equipment and constructions respectively.

(3.3.1) $$K_t^* = \alpha \cdot X_t^E + \alpha_0$$

where

K_t^* = desired capital stock at the end of period t

X_t^E = expected production in period t

α, α_0 are constants

If only a part of the desired net investments ($K_t^* - K_{t-1}^*$), is realized in each period, and the longest time of delivery is k periods, you get:

(3.3.2) $$I_t = K_t - K_{t-1} = \sum_{i=1}^{k} \beta_i \cdot (K_{t-1}^* - K_{t-i-1}^*)$$

where

I_t = actual net investments in period t

K_t = actual capital stock at the end of period t

β_i = coefficients which give the share of the wanted investments i periods ago which is realized in period t.

Inserting (3.3.1) in (3.3.2), you get

(3.3.3) $$I_t = \sum_{i=1}^{k} \beta_i \cdot (\alpha \cdot X_{t-i}^* - \alpha \cdot X_{t-i-1}^*) = \alpha \cdot \sum_{i-1}^{k} \beta_i \cdot (X_{t-1}^* - X_{t-i-1}^*) = \alpha \cdot \beta(L) \cdot \Delta X_t^*$$

where $\beta(L)$ is a lag distribution over β_i. It is assumed that the expectations about future

[1] The estimation of the business investment equations is based on Jensen (1985). The 75-version of the housing investment equations is documented in Knudsen (1985).

production are generated by adaptive expectations:

(3.3.4) $X_t^* = \sum_{i=0}^{m} \lambda_i \cdot X_{t-i} = \lambda(L) \cdot X_t$

where

$\lambda(L)$ = a lag distribution over λ_i

X_t = gross production in period t.

m = the number of periods earlier realized production influence expectations for the current period.

Including seasonal factors and (3.3.4) in (3.3.3), we get the final basic version of the investment equation:

(3.3.5) $I_t = \alpha \cdot \beta(L) \cdot \lambda(L) \cdot \Delta X_t$ + seasonal factors = $\alpha(L) \cdot \Delta X_t$ + seasonal factors

The seasonal factors are restricted to add up to a zero annual average, which implies that the equation is without a constant term.

One might say that a condition for the accellerator model to apply is that the credit market is functioning like a free competition marked without regulation, which just to a small extent was the case in Norway in the estimation period. It is also possible to argue that different kinds of financing of investments, in fact have different costs and that the firms evaluate internal financing as the cheapest. Gross operating surplus is a variable which might indicate something about the possibilities of such financing in a sector. The empirical results indicate that this variable is important in many sectors, and then the following equation is implemented:

(3.3.6) $I_t = \alpha(L) \cdot \Delta X_t + \delta(L) \cdot Y_t$ + seasonal factors

where

Y_t = gross operating surplus divided with the price index of investments of the current kind.

$\delta(L)$ = lag distribution

In some sectors the change in gross operating surplus seemed to be the best indicator of the liquidity and a variant of (3.3.6) was implimented:

(3.3.7) $I_t = \alpha(L) \cdot \Delta X_t + \delta(L) \cdot \Delta Y_t$ + seasonal factors

One also might say that the rate of return of capital in the firms could influence the level of investment in a sector. The rate of return might be a criterion for the firms' level of investments.

It also might lead to better credit worthiness and therefore cheaper loans for the firms. The results for some of the sectors indicate that this variable influences investments. For these sectors equations of the following type are implemented:

$$(3.3.8)\quad I_t = \alpha(L)\cdot\Delta X_t + \gamma(L)\cdot Y_t^* + \text{ seasonal factors}$$

Where Y_t^* is the ratio of gross operating surplus to capital stock in the start of the quarter.

The empirical results also indicated that the gross production had no influence on investments in some sectors. In these cases it has been implemented variants of (3.3.6), (3.3.7) and (3.6.8) where the production term is left out.

When net investments is determined by the equations, the gross investments follows by adding the depreciation which is decided in a separate model.

Table 3.3.1. Calculated effects on gross investments of a permanent increase in all sectors' gross operating surplus of 100 mill. 1980-kroner from 1971.1. (The calculations are done by using the investment block alone.)

Effect on gross investment in million 1980-kroner in sector	Kind*	Quarter after change						
		1	2	4	8	12	16	20
(10) Primary industries	B	1,8	4,4	8,7	8,3	7,8	7,5	7,2
	M	8,7	18,1	40,1	42,7	36,6	20,7	13,7
(15) Food and clothing industries	B	0,7	1,7	6,0	12,2	14,8	15,2	15,5
	M	-	0,3	3,8	7,3	7,8	8,4	9,1
(25) Wood- and printing industries	B	-	-	9,9	10,1	10,3	10,6	10,8
	M	-	0,6	13,1	13,2	12,5	12,4	12,1
(30) Mining and raw materials industries	B	-	-	4,1	11,1	14,0	13,7	13,1
	M	0,7	1,9	8,0	17,4	21,1	20,9	20,7
(45) Metal manufacturing industries ...	B	-	-	-	-	-	-	-
	M	1,8	4,0	12,5	23,4	26,5	25,3	24,5
(50) Ship building and manufacture of oil platforms	B	-	4,2	18,6	23,4	20,3	18,1	14,4
	M	-	-	0,9	4,7	7,8	9,3	9,9
(70) Domestic transport	B	-	-	20,4	20,8	21,2	21,7	22,1
	M	4,2	11,7	25,5	27,8	31,0	34,3	38,3
(80) Production of various services ...	B	-	2,0	17,6	24,0	24,5	25,1	25,6
	M	-	-	5,9	9,6	10,9	12,2	13,7
(81) Wholesale and retail trade	M	-	-	-	-	-	-	-

*B = construction.
M = machinery and equipment.

Table 3.3.2. Calculated effects on gross investments of a permanent increase in gross production in all sectors of 100 mill. 1980-kroner from 1971.1. (The calculations are done by using the investment block alone.)

Effect on gross investment in million 1980-kroner in sector	Kind*	Quarter after change 1	2	4	8	12	16	20
(10) Primary industries	B	4,3	9,5	26,2	32,4	26,6	9,3	0,1
	M	-	-	-	-	-	-	-
(15) Food and clothing industries	B	-	-	-	-	-	-	-
	M	1,7	3,5	7,0	5,9	2,9	1,3	1,4
(25) Wood- and printing industries	B	-	0,0	1,9	3,0	2,4	0,2	0,2
	M	3,0	3,7	4,9	4,2	0,6	0,5	0,5
(30) Mining and raw materials industries	B	-	-	-	-	-	-	-
	M	-	-	-	-	-	-	-
(45) Metal manufacturing industries ...	B	2,4	4,9	9,6	8,4	6,0	2,3	0,6
	M	-	-	-	-	-	-	-
(50) Ship building and manufacture of oil platforms	B	-	-	-	-	-	-	-
	M	-	-	-	-	-	-	-
(70) Domestic transport	B	7,1	11,3	14,9	11,7	7,0	2,9	1,4
	M	21,0	18,8	0,8	1,9	1,9	2,0	2,1
(80) Production of various services ...	B	8,9	9,9	11,2	11,6	8,9	2,8	0,8
	M	4,5	6,9	7,2	0,9	1,1	1,1	1,1
(81) Wholesale and retail trade	M	1,5	4,1	6,7	7,2	2,5	2,3	2,5

* B = construction.
M = machinery and equipment.

Traditional firmoriented investment models must on many reasons be modified, when applied to housing investments. It is mainly the consumers that are demanding such capital, and therefore their behaviour in the market for housing services is of essential importance. As in the national accounts, we regard the housing capital as belonging to a production sector (the housing sector), which production mainly is the yield of the capital and this is the the main part of the housing services. The housing investments are thereby regarded as the way the consumers generate the wanted level of housing consumption. The different housing markets, are not treated separately, not only because of data difficulties, but also because it is desirable to keep the model aggregated. The price regulations in the housing market, which to a varying degree have been in force in the period of estimation, have not expliatly been taken in to consideration in the housing investment model.

In the housing investment model of KVARTS, the demand side of the economy determine the housing starts. The supply side comes in by the time aspect of the production process and by the price level of such investments.

Let us take the unobservable wanted housing consumption as a starting point. Assume that the outcome of an intertemporal utility maximization would be the following desired housing consumption function:

$$(3.3.9)\quad \log CH_t^* = a_1 \cdot \log\left(\frac{RI_t}{P_t}\right) + a_2 \cdot \log\left(\frac{PB_t}{P_t}\right) + a_3 \cdot \left(r_t - \frac{PB_t - PB_{t-4}}{PB_{t-4}}\right) + a_4 \cdot F_t$$

where

CH_t^* = desired consumption of housing services in period t

RI_t = the households real disposable income in period t

P_t = deflator of aggregate private consumption in period t

PB_t = deflator of housing investments in period t

r_t = nominal interest rate in period t

F_t = number of persons of age between 20 and 30 years in period t

a_1, a_2, a_3, and a_4 are coefficients.

Assuming that there is a proportional relationship between housing consumption and level of housing capital, we get the following relation between desired consumption and desired stock of housing capital:

$$(3.3.10)\quad KB_t^* = k \cdot CH_t^*$$

where

KB_t^* = desired housing capital at the end of period t

k = proportional factor

Assuming a constant depreciation rate and <u>forgetting</u> the production time we define desired housing starts as:

$$(3.3.11)\quad S_t^* = m \cdot [KB_t^* - (1-\delta) \cdot KB_{t-1}]$$

where

S_t^* = desired housing starts in square meters in period t

KB_{t-1} = stock of housing capital in the end of the last period

δ = depreciation rate

m = a factor transforming housing capital at 1986 kr to square meters.

The desired housing starts cover desired increase in stock and depreciation of the existing capital, when not taking the transformation of last period housing starts to investments and capital into consideration.

(3.3.11) can be transformed to:

(3.3.12) $S_t^*/KB_{t-1} = m\cdot[KB_t^*/KB_{t-1} - 1 + \delta]$

and if KB_t^* and KB_{t-1} are not too different (3.3.13) can be approximated to (3.3.12):

(3.3.13) $S_t^*/KB_{t-1} = m\cdot[\log KB_t^* - \log KB_{t-1} + \delta]$

Realized housing starts is assumed to be dependent of the desired housing stocks. We have chosen to specify a partial adjustment mechanism, so a particular part of the deviation between desired in this quarter and realized housing starts in last quarter, should be the increase in the realized housing starts in the present quarter:

(3.3.14) $S_t - S_{t-1} = a\cdot(S_t^* - S_{t-1})$

where S_t is the realized housing start at time t and a is a coefficient between 0 and 1.

Reasons behind this partial adjustment mechanism in (3.3.14) - could be the costs of changing the level of housing starts and to compensate for the time aspect in the production and planning.

To catch the effects of changes in the credit supply under the credit rationing regime we have added a laged credit variable as explaing factor in (3.6.14). It is also suitable to devide the variables in the equation against the housing capital in the previous quarter. Besides we have to correct for seasonal variations. After some transformation we get:

(3.3.15) $\frac{S_t}{KB_{t-1}} = b_1 \cdot \frac{S_t^*}{KB_{t-1}} + b_2 \cdot \frac{S_{t-1}}{KB_{t-1}} + b_3(L) \cdot \frac{G_t}{KB_{t-1}PB_t}$ + seasonal factor

where G is granted loans from the Govermental Bank of Housing, at time t and $b_3(L)$ a lag distribution. This addition is made on ad hoch basis, and it seems a little bit strange that the partial addition in housing starts caused by an increase in this credit supply should be independent of the level of desired housing starts. There is also a question of to what degree this is a good indicator for the credit supply to the credit-rationed people. The next problem is what to do, when we are simulating the model for forecasting purposes, since the credit marked has been liberalized after the estimation period. So far we have used the equation as it has been estimated.

By using (3.3.9), (3.3.10), (3.3.13) and (3.3.15) we get:

(3.3.16) $\frac{S_t}{KB_{t-1}} = \alpha_1\cdot \log \frac{RI_t}{P_t} + \alpha_2\cdot \log \frac{PB_t}{P_t} + \alpha_3\cdot (r_t - \frac{PB_t - PB_{t-4}}{PB_{t-4}}) + \alpha_4\cdot F_t$

$- \alpha_5 \cdot \log KB_{t-1} + b_2\cdot \frac{S_{t-1}}{KB_{t-2}} + b_3(L) \cdot \frac{G_t}{KB_{t-1}\cdot PB_t}$ + seasonal factors

By having dummies for all quarters, the equation is without any constant term. As in the quarterly national accounts, housing investment is determined by a lag distribution over housing starts in square meters in current and earlier quarters. The coeffisients in this lag distribution are calculated from data of housing starts and finish taken from the statistics of building floorage. The equation has the following form:

(3.3.17) $JB_t = \sum_{i=0}^{n} \beta_i \cdot S_{t-1}$

where JB_t is the housing investment in quarter t. The stock of housing capital by the end of quarter t is the sum of the (gross) investment and the capital at end of the last quarter minus the calculated depreciation:

(3.3.18) $KB_t = JB_t + KB_{t-1} - D_t$

where D_t is the depreciation in period t.

On the basis of the estimated parameters in the housing investment model, we are able to calculate some important structural coefficients. The income elasticity, that is relative change in desired housing consumption which follow from an increase in income of one per cent, becomes 0,6. The price elasticity is -2.0.

Table 3.3.3. Calculated effects on housing starts, housing investment and the stock of housing capital of a permanent increase of 1 000 mill. 1980-kroner in the households' real disposable income from 1973.1. The calculations are done by using the housing investment block alone

Effects on	Quarters after change						
	1	2	4	8	12	16	20
Housing starts in 1 000 m^2	20,0	21,1	19,5	19,4	18,9	17,3	17,0
Housing investment. Mill.kr	19,9	36,9	52,7	59,1	59,4	58,7	59,2
Stock of housing capital. Mill.kr	19,8	56,6	155,6	382,3	619,7	852,9	1 077,9

Table 3.3.4. Calculated effects on housing starts, housing investment and the stock of housing capital of a permanent increase of 1 000 mill. 1980-kroner in granted loans from the Governmental Bank of Housing from 1973.1. The calculations are done by using the housing investment block alone

Effects on	Quarters after change						
	1	2	4	8	12	16	20
Housing starts in 1 000 m^2	79,6	158,0	260,6	258,5	251,3	242,2	229,6
Housing investment. Mill.kr	79,0	216,8	539,7	761,6	788,0	798,9	797,9
Stock of housing capital. Mill.kr	78,8	294,8	1 215,0	4 002,3	7 127,8	10 253,7	13 293,6

Table 3.3.5. Calculated effects on housing starts, housing investment and the stock of housing capital of a permanent decrease of one of point per cent in the building loan interest rate from 1973.1. Thew calculations are done by using the housing investment block alone

Effects on	Quarters after change						
	1	2	4	8	12	16	20
Housing starts in 1 000 m^2	6,5	6,8	7,0	7,2	7,3	7,5	7,5
Housing investment. Mill.kr	6,4	11,9	17,9	21,1	22,6	24,2	25,6
Stock of housing capital. Mill.kr	6,4	18,3	51,8	130,5	218,4	311,0	406,7

3.4. Exports

Export volumes are endogenous for most of the commodities but the endogenous exports account for about 45 pct of total exports in 1986. Important exogenous export commodities are 10 (primary industry products), 50 (ships and drilling platforms), 60 (ocean transport services), 66 (crude oil) and 67 (natural gas). It is assumed that Norwegian producers face downward sloped demand curves in domestic and export market and that the firms distribute the production between them in order to maximize profits. In the export markets Norwegian and foreign products are assumed to be imperfect substitutes. The export market behaviour of Norwegian firms in KVARTS also consists of export price formation. Export prices are fixed by Norwegian firms, and are determined partly by domestic costs and partly by competitors' price. (See ch. 3.9 on prices).
Export demand then follows exogenously given market indicators and the (produce-determined) export prices. In general form, the export equation in KVARTS can consequently be written as:

(3.4.1) $E_i = E_i\ ({}^{PE}i/PI_i,\ MI_i,\ E_{i-1})$

where

E_i = export volume, commodity i

PE_i= export price, commodity i

PI_i= import price, commodity i

MI_i= export market indicator, commodity i

In (3.4.1) the Norwegian import price index is used proxy for the competitors' price index. Weighted are used averages of Norwegian trading partners' imports as export market indicators.

The elasticities (long run) of exports wrt. the market indicators vary substantilly between commodities. For commodity 15 (food, clothing, etc.) it is only 0,29, and it is 1,9 for foreigners' consumption in Norway. The price elasticities are more similar largely varying between -0,5 and -0,7, with the exception of 30 (raw materials from mining and manufacturing) where it is about twice as high.

Table 3.4.1. Per cent change in export volumes by 1 pct increase in export market indicators

Commodity	Quarter after increase					
	1	2	4	8	12	16
(15) Food, clothing, etc	0,15	0,23	0,28	0,29	0,29	0,29
(25) Wood products, printing etc.	0,87	0,87	0,87	0,87	0,87	0,87
(30) Raw materials from mining and manufacturing	0,18	0,29	0,42	0,48	0,50	0,50
(45) Machinery and metal products	0,22	0,39	0,62	0,76	0,76	0,76
(70) Domestic transport	0,32	0,56	0,81	0,81	0,81	0,81
(80) Various services	0,85	0,85	0,85	0,85	0,85	0,85
(81) Wholesale and retail trade ..	0,62	0,89	1,04	1,06	1,06	1,06
Foreigners' consumption in Norway	0,91	1,56	1,90	1,90	1,90	1,90

Table 3.4.2. Per cent change in export volumes by 1 pct increase in export prices

Commodity	Quarter after increase					
	1	2	4	8	12	16
(15) Food, clothing, etc	-0,11	-0,24	-0,43	-0,50	-0,50	-0,50
(25) Wood products, printing etc.	-0,35	-0,57	-0,68	-0,68	-0,68	-0,68
(30) Raw materials from mining and manufacturing	-0,42	-0,68	-0,94	-1,08	-1,10	-1,10
(45) Machinery and metal products	-0,03	-0,07	-0,20	-0,47	-0,54	-0,54
(70) Domestic transport	-0,21	-0,36	-0,51	-0,51	-0,51	-0,51
(80) Various services	-0,63	-0,63	-0,63	-0,63	-0,63	-0,63
Foreigners' consumption in Norway	-0,30	-0,49	-0,59	-0,59	-0,59	-0,59

3.5. Imports

Determination of imports is closely related to the input-output framework of the model. In the commodity balance equations (one for each commodity), supply equals demand (in basic value). (See equation (3.1.1.)). For the non-competing commodities (commodities not produced in Norway), one can simplified say that imports is determined in the commodity balancing equation. We can think of the other variables being determined in a first step and imports in the second.

For the other commodities imports is determined by import -input -output equations in addition to the commodity balancing equations.

(3.5.1.) $$t_i^I \cdot I_i - IE_i - LI_i = \sum_j D_{ij} \cdot A_{ij}^I \cdot F_j$$

where

t_i^I - Coefficient transferring market value to basic value (i.e. correcting for tarrifs), commodity i

IE_i - Re- exports, commodity i

LI_i - Increase in stocks of imported goods, commodity i.

F_j - Demand component j (consumption, investment and material inputs of the different sectors, kinds and categories).

A_{ij}^I - Input - output coefficients for imports, giving imports of commodityi delivered to demand component j.

The D_{ij} indexes (import shares) are determined by relative prices for 4 of the commodities.

The D_{ij}'s are determined by 99 equations such as

(3.5.2) $\log \tilde{X}_{ij} = a^{*}_{ij} + a^{i}_{1} \cdot \log (BH_i/PI_i) + a^{i}_{2} \cdot \text{lof } \tilde{X}^{ij}_{-1}$

where $\tilde{X}_{ij} = (\Lambda_{ij} - D_{ij} \cdot \Lambda^{I}_{ij})/\Lambda^{H}_{ij} \cdot D_{ij}$

Λ_{ij} - input-output coefficient. Amount of commodity i (in basic value) delivered to demand component j as a share of demand component j (in market value in the base year (j=consumption, investment, intermediate inputs).

Λ^{H}_{ij} - input-output coefficient from domestic (home) deliveries. Amount of commodity i from domestic produces (in basic value) delivered to demand component j as a share of demond component j (in market value) in the base year (j=consumption, investment, intermediate inputs).

Λ^{I}_{ij} - input-output coefficient for deliveries from imports. Constructed in the same way as the Λ^{H}_{ij}'s.

D_{ij} - Relative change in input-output coefficient for deliveries from imports of commodity i to demand component j.

PI_i - import price, commodity i

BH_i - domestic price, commodity i

a^{i}_{1}, a^{i}_{2} - estimated coefficients

a^{*}_{ij} - constant, determined such as the equation fits perfectly in the base year (on average).

Although we have 99 equations for determining the D_{ij}'s, only 4 substitution elasticities are utilized (one for each commodity). They are estimated by the following equations:

(3.5.3) $\log (I^i/XH^i) = a_0 \cdot a_1 \cdot W_i \cdot \log (BH^i/PI^i) + a_2 \cdot \log (I^i/XH)_t$ + seasonals

where: XH^i - domestic production of commodity i

W^i - a correction variable to account for shifts in the sectoral composition of the economy (see appendix).

The long-run substitution elasticities between imports and domestic production are estimated to 1,3, 3,5, 1,4 and 3,3 for the commodities 15, 25, 30 and 45 respectively.

The properties of the import block is documented more detailed in the impact analysis below. As base year coefficients and linear equations (input-output-equations) play a large role in the import block, the import elasticities will depend both on the base year and the reference simulation.

Table 3.5.1. Pct. change in imports when import prices rise by 1 pct.[1]

	Quarters after change					
Commodity	1	2	4	8	12	16
(15) Food, clothing, etc.	-0,05	-0,13	-0,28	-0,61	-0,68	-0,68
(25) Wood products, printing, etc.	-0,17	-0,50	-1,06	-1,77	-1,81	-1,81
(30) Raw materials from mining and manufacturing	-0,18	-0,34	-0,54	-0,66	-0,69	-0,64
(45) Metal products	-0,66	-1,08	-1,39	-1,38	-1,26	-1,15

[1] Based on a simulation from 1980. 1 on a model with input-output coefficients from 1986 national accounts.

The current account.

Having determined the trade balance as exports minus imports we have to determine interest payments and transfers from abroad to obtain the current account. Transfers to Norway from abroad, dividends to Norway from abroad and dividends from Norway are all exogenous.

Transfers from Norway is endogenized by assuming that it is a constant share of GDP (value).

Net interest payments from Norway to other countries is endogenized by the following equations. The variables are measured in kroner.

$$D = D_{-1} - CA + X$$

$$X = XF \cdot 0,5 \cdot (D + D_{-1})$$

$$NI = (IR \cdot 0,5 \cdot (D + D_{-1})$$

where:

D - net foreign debt at the end of the quarter.

CA - current account.

X - reassessment of the net foreign debt due to exchange rate changes etc.

XF - reassessment factor.

NI - net interest expenditure on the net foreign debt.

IR - interest rate on the net foreign debt.

The exogenous variables IR and XF (the interest rate and the reassessment factor) then determines net payments to abroad given the trade balance.

3.6. Adaption of inventories, orders and production in the manufacturing sectors

For the sectors (15) Food and clothing industries, (25) Wood and printing industries and (30) Mining and raw material industries there are equations determining production behaviour. Here production and inventory change are simultaneously determined so that a demand increase will be met partly by building down inventories and partly by increased production. In the long run, production follows demand.

In sector (45) Metal manufacturing industries, production is determined by (a lag distribution of) orders. Since the commodity balance equation applies (cf.ch. 2), inventory change also becomes endogenous.

Production and inventories

The production model for the three stock-producing sectors is based on an assumption that firms in these sectors have a short-run and a long-run strategy. The model distinguishes between decisions concerning factors that can only be changed slowly (long run decisions), such as choice of production capacity and long run optimal (desired) inventory stock. The already decided actions wrt. the long run factors are considered as given when firms decide whether to meet demand by increasing production or by reducing inventories.

The long run inventory stock, $\bar{S}_t$, is unobservable, and must be eliminated from the model. In KVARTS we have followed a common practice, namely to let desired inventory stock be a function of observable variables. According to works by Baumol (1952) and others, desired inventory stock can, given certain assumptions, be written as

$$(D_t/r_t)^{\frac{1}{2}}$$

where D_t - demand variable

r_t - interest rate

We assume that the firms' behaviour fullfill the equation

$$(3.6.1)\quad S_t^* - S_{t-1} = X_t^* - D_t$$

where S_t^* - planned inventory stock at the end of quarter t

S_{t-1} - inventory stock at the end of quarter t-1

X_t^* - planned production in quarter t

D_t - demand directed towards the sector in quarter t

Consider a production sector in the beginning of quarter t. Its production capacity will be fixed by previous investment decisions. We assume that the firms want to decide on production and inventory change in a way that minimizes the differences between

(a) production and capacity

(b) actual and long run optimal inventories

The solution must be a compromise between the wishes to minimize these discrepancies at the same time. If there is an initial imbalance in stocks, eg. $S_t^* - S_{t-1} \neq 0$, we assume that the weight on (a) is α and the weight on (b) is $(1-\alpha)$. When only a share, h, of the initial imbalance in stocks is eliminated in one quarter, we have

(3.6.2) $X_t = \alpha \cdot \overline{X}_{t-1} + (1-\alpha) \cdot [D_t + h(S_t^* - S_{t-1})]$

where

$\overline{X}_t$ - production capacity, quarter t

Inserting for S_t^*, we get

(3.6.3) $X_t = \alpha \cdot \overline{X}_{t-1} + (1-\alpha) \cdot \{D_t + h[(D_t/r_t)^{\frac{1}{2}} - S_{t-1}]\}$

Eqcuation (3.6.3) is called the production determination equation. This equation and the commodity balancing equation, saying that production and imports equal domestic demand and inventory change, will simultaneously determine production and inventory change. Thus the variables determining production and inventories are capacity, demand and the nominal interest rate. The quantitative properties are described more accurately in tables 3.6.1 and 3.6.2.

Production and orders

For sector 45, Metal manufacturing industries, we have implemented a production determination equation where production is determined by increases in orders and domestic demand. It is assumed that the sectors production is partly for orders and partly for inventories or direct sale. The equation is:

(3.6.4) $Q45 = a_1 \cdot DOH + a_2 \cdot DOF + a_3 \cdot [\sum_j \alpha_j \cdot D_j]$ + constant + seasonals

Q45 - Value added, sector 45

DOH - New orders from Norway

DOF - New orders from abroad

α_j - Input-output coefficient, amount of commodity 45 delievered to demand component j per unit of D_j

D_j - Demand component j (eg. material inputs in the different sectors, consumption categories).

a_1, a_2, a_3 are estimated (lag-)coefficients.

The two variables for new orders are assumed to account for the demand for investment goods, and the demand variables are supposed to take account of the demand for products not produced for orders (eg. material inputs to other sectors, private consumption). We have used value added (not gross production) as the production variable, because gross production is sensitive to the number of firms in the sector.

New orders from the home market and from abroad are modelled separately. They are, according to our theoretical assumptions, modelled as depending on the variables explaining investment. In the production sectors of KVARTS private investment is explained by gross operating surplus and increase in production in the sectors. Thus, home orders are explained by increase in production in all sectors except sector 45 (the one which production we are now endogenizing) and gross operating surplus in all sectors.

Since we do not have access to the same variables for our trading partners, new orders from abroad are assumed to depend on an indicator of world demand.

In both equations for new orders there are also relative price variables between domestic production and exports, respectively, and a competitor price index (here we have used the Norwegian import price.

The equations are:

(3.6.5): $DOH = b_1 \cdot (PI/BH) + b_2 \cdot \Delta_4 X95 + b_3 \cdot \Delta_4 (YK96/BH) + \text{seasonals}.$

(3.4.6): $DOF = c_0 + c_1 \cdot \log(\Delta_4 MI) + c_2 \cdot \log(PE/PI) + \text{seasonals}$

where:

YK96 - Gross operating surplus in private sectors (incl. sector 45)

X95 - Gross production in private sectors (excl. sector 45).

b_1, b_2, b_3, c_1, c_2 are lag-coefficients.

Δ_4 - fourth difference.

Orders, endogenized in equations (3.4.5) and (3.4.6) together with the demand components (D_j in equation (3.4.4), determine production in sector 45. Together with an equation relating gross production and gross product, and the commodity balancing equation, inventory change is also determined. Table 3.6.3. describes the effects on production in sector 45 of changed exogenous variables.

Table 3.6.1. Estimated effects on production and inventory change of a 100 mill 1980-kroner increase in demand directed to each sector from 1973.1.

Effects in million 1980-kroner		Quarters after change						
Sector	Variable	1	2	4	8	12	16	20
(15) Food- and clothing industries	Production	68,1	80,3	92,4	98,8	99,8	99,9	99,9
	Inventory change	-31,9	-19,7	-7,6	-1,2	-0,2	-0,1	-0,1
(25) Wood-, printing industries, etc.	Production	36,2	59,7	84,4	97,4	99,6	100,0	100,0
	Inventory change	-63,8	-40,3	-16,1	-2,1	-0,4	-0,1	-0,0
(30) Mining and raw materials industries	Production	58,5	69,0	82,7	94,6	98,3	99,5	99,9
	Inventory change	-41,5	-31,0	-17,4	-5,4	-1,7	-0,6	-0,2

Table 3.6.2. Estimated effects on production and inventory change of a 1 pct. point increase in nominal interest rates from 1973.1

Effects in million 1980-kroner		Quarters after change						
Sector	Variable	1	2	4	8	12	16	20
(15) Food- and clothing industries	Production	-13,8	-8,6	-3,9	-1,1	0,3	-0,4	0,3
	Inventory change	-11,0	-6,9	-3,1	-0,8	0,2	-0,3	0,2
(25) Wood-, printing industries, etc.	Production	-11,9	-7,9	-3,2	-0,9	0,6	0,0	0,5
	Inventory change	-9,4	-6,3	-2,4	-0,7	0,5	0,0	0,4
(30) Mining and raw materials industries	Production	-7,7	5,5	-3,4	-0,6	0,4	0,1	0,5
	Inventory change	-6,9	-4,9	-3,0	-0,6	0,3	0,1	0,4

Table 3.6.3. Effects* on gross production in sector 45 of an increase in exogenous variables

Effects of	Quarters after change						
	1	2	4	8	12	16	20
1. 100 mill in gross production in private sectors (mill. kr)	0,1	0,3	1,5	6,1	9,2	6,9	2,6
2. 100 mill in gross operating surplus in private sectors (mill. kr.)	0,4	1,3	4,2	9,3	9,5	5,0	1,5
3. Increasing world market demand by 1 % (%)	0	0	0,1	0,1	0,1	0	0
4. 1 % increased export prices (%)	0	0	0	-0,1	-0,1	-0,1	-0,1
5. 1 % increased domestic prices. (%) .	0	0	0	0	-0,1	-0,2	-0,2

* Based on a simulation from 1976. 1.

3.7. Employment

Man-hours and employed persons in most sectors are endogenously determined in KVARTS. The number of self-employed is exogenous.

It is assumed that the firms' long-term behaviour is based on a capacity production function with relations between capital, long term optimal employment and long term optimal intermediate inputs on the one side and capacity on the other. The function is assumed to be Cobb-Douglas.

Under the assumption of cost minimization given the level of production, the long term optimal employment can be derived as a function of capacity, user cost of capital and intermediate imputs' price (relative to the sector's wage cost rate).

In the short run, cyclial variations in production may cause actual employment differ from the long term optimal one. Actual demand for labour can therefore be expressed as:

$$(3.7.1)\ \text{Log}\ (L_j) = a_{0j} + a_{1j} \cdot \log\ (W_j/C_j) + a_{2j} \cdot \log\ (W_j/PM_j) + a_{3j} \cdot \log\ (X_j) + a_{4j} \cdot \log\ (XK_j) + a_{5j} \cdot T + \text{seasonals}$$

L_j - man hours, wage earners, sector j
W_j - wage costs per man-hour, sector j
C_j - user cost of real capital, sector j
PM_j - price of intermediate inputs to sector j
X_j - gross production, sector j
XK_j - production capacity, sector j
T - trend variable, 1 in 1966.1

a_{0j}, a_{1j}, a_{2j}, a_{3j}, a_{4j}, a_{5j} - estimated (lag-) coefficients.

The equations for two sectors in private services are somewhat differently specified (they are estimated at a later point of time due to disaggregation of the model). They differ from the equations of the other sectors by the fact that they do not contain the capacity variable. Furthermore, in order to account for substitution between labour and capital they have (lagged) capital stock as right-hand-side-variable (i.e. an equation slightly different from (3.7.1)).

The user cost of capital-variables did not enter significantly for any sectors, substitution between labour and capital only occur in the two sectors mentioned above where lagged capital stock accounts for this effect. But the coefficients a_{2j} were significantly (negative) in most sectors, indicating substitution between labour and intermediate inputs. But the long run coefficients are quite small in absolute value (around -0.2 to -0.3) for most sectors.

In the sectors were both production and capacity are right hand side variables, the coefficients a_{3j} are about 0.3 and 0.4. A coefficient less than unity means that labour productivity increases as production increases in the short run since the capacity variable XK only changes with a lag.

In the long run production and capacity will move pari passu. The sum of a_{3j} and a_{4j} will therefore express the long-term relationship between production and man-hours. In most sectors this sum is around 0.6 - 0.7. This implies increasing returns to scale.

But when considering the implications of returns to scale in the production model of KVARTS, one must also take account of the determination of capital and material inputs.

The trend terms representing autonomous techical progress are significant in most sectors. They indicate about 2.5 - 3 pct. autonomous productivity growth per year in the manufacturing sectors, but they are about zero or very small in the service sectors.

Labour input in man-hours can be separated in employed persons and hours time per employed person. A change in man-hours will in the first place largely affect the amount of overtime of those already employed. The firms are assumed to balance the costs of extra overtime against the costs of a rapid change in the number of employed persons. The number of employed persons is determined by a lag distribution of man-hours and normal working time (per quarter). The equations determining the number of employed persons are:

$$(3.7.2)\ \text{Log}\ (N_j/N_{j-1}) = b_j \cdot \log\ (L_j/(H \cdot N_{j-1}) + \text{seasonals}$$

H_j - normal working time, sector j
N_j - wage-earners, sector j
b_j - estimated coefficient

The adjustment speed parameter, b_j, varies from 0.4 - 0.5 in some manufacturing sectors to 0.2 - 0.3 in most of the others. A value of 0.5 means that half of the change in employment for a given change in man-hours or normal working time occurs in the first quarter.

The number of unemployed persons is determined by the equation

(3.7.2) $U = U_{-4} - 0,6 \cdot (NM-NM_{-4}) - 0,3 \cdot (NS-NS_{-4}) + 10$

where:

U - number of unemployed persons (1000)
NM - number of wage-earners in manufacturing and building and construction (1000)
NS - number of wage-earners in the rest of the economy (1000)

The unemployment rate is determined as

(3.7.3) $UR = (U/(U+N+S)) \cdot 100$

where UR - unemployment rate (%)
N - number of wageearners (1000)
S - number of self-employed (1000)

The equation for unemployed persons is determined by "qualified judgement" not on the basis of estimations. It implies that if no increase in employment occurs, unemployment will increase by 10 000 per year due to autonomous increase in the labour force. If manufacturing employment increases by 1 000, this reduces unemployment by 600. The corresponding figure for increased employment in the rest of the economy is 300. Thus the equation implies that a substantial part of an increase in labour demand is met by increased labour force participation rates. One can say that labour supply is demand - elastic. This effect is strongest outside manufacturing and building and construction, as female employment is consentrated in the service sector. Increased labour demand in sectors where the proportion of female labour is high is met by increased supply by increased participation rates, but increased labour demand from manufacturing, largely employing men, can not be met by significant increases in the labour force due to the fact that participation rates are already high for males. Thus the increase in employment here must be taken from the unemployed.

Table 3.7.1. Effects on man-hours, working time and employed persons of 1 prosent increase in production

Effect in pct. on		Quarters after change				
Sector	Variable	1	2	4	8	12
(10) Primary industries	Man-hours	1				
	Working time	0				
	Employed persons	1				
(15) Food and clothing industries	Man-hours	0.32				
	Working time	0.18	0.10	0.04	0.00	
	Employed persons	0.13	0.21	0.28	0.31	
(25) Wood and printing industries	Man-hours	0.33				
	Working time	0.18	0.10	0.03	0.00	
	Employed persons	0.15	0.23	0.30	0.33	
(30) Mining and materials industries	Man-hours	0.22				
	Working time	0.15	0.10	0.05	0.01	0.00
	Employed persons	0.07	0.12	0.17	0.21	0.22
(40) Refineries	Man-hours	1				
	Working time	0				
	Employed persons	1				
(45) Metal manufacturing industries	Man-hours	0.20				
	Working time	0.15	0.11	0.06	0.02	0.01
	Employed persons	0.05	0.09	0.14	0.18	0.20
(50) Shipbuilding and manufacture of oil platforms	Man-hours	0.41				
	Working time	0.27	0.17	0.07	0.01	0.00
	Employed persons	0.14	0.24	0.34	0.40	0.41
(55) Building and construction	Man-hours	0.30				
	Working time	0.16	0.09	0.03	0,00	
	Employed persons	0.14	0.21	0.27	0.30	
(60) Ocean transport	Man-hours	0.37				
	Working time	0				
	Employed persons	0.37				
(65) Oil production etc.	Man-hours	1				
	Working time	0				
	Employed persons	1				
(70) Domestic transport	Man-hours	0.25				
	Working time	0.18	0.13	0.07	0.02	0.01
	Employed persons	0.07	0.12	0.18	0.23	0.25
(71) Power supply	Man-hours	1				
	Working time	0				
	Employed persons	1				
(80) Various services	Man-hours	1.00				
	Working time	0.72	0.52	0.27	0.08	0.02
	Employed persons	0.28	0.48	0.73	0.92	0.98
(81) Wholesale and retail trade	Man-hours	0.06	0.17	0.48	1.0	
	Working time	0.05	0.12	0.27	0.34	0.11
	Employed persons	0.01	0.05	0.30	0.66	0.89
(83) Production of housing services	Man-hours	1				
	Working time	0				
	Employed persons	1				

Table 3.7.2. Effects on man-hours, working time and employed persons of 1 pct. increase in production capacity

Effect in pct. on		Quarters after change					
Sector	Variable	1	2	4	8	12	16
(15) Food and clothing industries	Man-hours	0.33					
	Working time	0.19	0.11	0.04	0.00		
	Employed persons	0.14	0.22	0.29	0.33		
(25) Wood and printing industries	Man-hours	0.36					
	Working time	0.20	0.11	0.03	0.00		
	Employed persons	0.16	0.25	0.33	0.36		
(30) Mining and raw materials industries	Man-hours	0.41					
	Working time	0.28	0.19	0.09	0.02	0.00	
	Employed persons	0.13	0.22	0.32	0.39	0.41	
(45) Metal manufacturing industries	Man-hours	0.49					
	Working time	0.57	0.28	0.15	0.05	0.02	0.00
	Employed persons	0.23	0.22	0.34	0.44	0.48	0.49
(50) Ship building and manufacture of oil platforms	Man-hours	0.08					
	Working time	0.05	0.03	0.01	0.00		
	Employed persons	0.03	0.04	0.06	0.07		
(55) Building and construction	Man-hours	0.19					
	Working time	0.11	0.06	0.02	0.00		
	Employed persons	0.09	0.14	0.18	0.19		
(60) Ocean transport	Man-hours	0.47					
	Working time	0					
	Employed persons	0.47					
(70) Domestic transport	Man-hours	0.05					
	Working time	0.04	0.03	0.01	0.00		
	Employed persons	0.01	0.02	0.04	0.05		

Table 3.7.3. Effects on man-hours, working time and employed persons of 1 prosent increase in the ratio between the wage cost rate and the price index of material inputs

Effect in pct. on		Quarters after change					
Sector	Variable	1	2	4	8	12	16
(15) Food and clothing industries	Man-hours	-0.17	-0.25				
	Working time	-0.10	-0.10	-0.21	-0.25		
	Employed persons	-0.07	-0.14	-0.21	-0.25		
(25) Wood and printing industries	Man-hours	-0.02	-0.04				
	Working time	-0.01	-0.01	-0.00			
	Employed persons	-0.01	-0.02	-0.03	-0.04		
(30) Mining and raw materials industries	Man-hours	-0.15	-0.22	-0.24			
	Working time	-0.11	-0.11	-0.06	-0.01	-0.00	
	Employed persons	-0.05	-0.10	-0.17	-0.22	-0.24	
(45) Metal manufacturing industries	Man-hours	-0.01	-0.04	-0.13	-0.20		
	Working time	-0.01	-0.03	-0.08	-0.05	-0.01	-0.00
	Employed persons	-0.00	-0.01	-0.06	-0.15	-0.18	-0.19
(50) Shipbuilding and manufacture of oil platforms	Man-hours	-0.06	-0.15	-0.29			
	Working time	-0.04	-0.08	-0.11	-0.02	-0.00	
	Employed persons	-0.02	-0.07	-0.18	-0.27	-0.29	
(55) Building and construction	Man-hours	-0.18	-0.27	-0.30			
	Working time	-0.10	-0.10	-0.04	-0.00		
	Employed persons	-0.08	-0.17	-0.26	-0.29		
(60) Ocean transport	Man-hours	-0.09	-0.18	-0.32	-0.46		
	Working time	0	0	0	0		
	Employed persons	-0.09	-0.18	-0.32	-0.46		
(70) Domestic transport	Man-hours	-0.05	-0.12	-0.25			
	Working time	-0.04	-0.08	-0.11	-0.03	-0.01	-0.00
	Employed persons	-0.01	-0.04	-0.13	-0.22	-0.24	-0.25
(80) Various services	Man-hours	-0.15	-0.14	-0.13	-0.12		
	Working time						
	Employed persons						

Table 3.7.4. Effects on man-hours, working time and employed persons of 1 pct. increase in the capital stock

Effect in pct. on		Quarters after change					
Sector	Variable	1	2	4	8	12	16
(80) Various services	Man-hours	0	0	-0.14	-0.22	-0.23	
	Working time	0	0	-0.08	-0.05	-0.02	
	Employed persons	0	0	-0.06	-0.17	-0.21	-0.23
(81) Wholesale and retail trade	Man-hours	0	-0.31				
	Working time	0	-0.23	-0.13	-0.04	-0.01	
	Employed persons	0	-0.08	-0.18	-0.27	-0.30	-0.31

3.8. Wage determination

Wages in the current version of KVARTS are determined by sector-specific wage equations. They are based on a wage leader-follower behaviour where the manufacturing sectors act as a leader and wages in the other sectors of the economy follow manufacturing wages (and to some extent consumer prices) with a lag.

Wages in the manufacturing sectors are determined by sector-specific "Phillips curve" equations as:

(3.8.1.) $\Delta W/W_{-1} = c_0 + c_1 \cdot \Delta PC/PC_{-1} + c_2 \cdot \Delta PI/PI_{-1} + c_3 \cdot \Delta Q/Q_{-1} + c_4 \cdot \Delta t_1 + c_5 \cdot \Delta t_2 +$

$c_6 \cdot (1/U)2$ + seasonals + dummies

where:

W - wage level in the sector.
PC - private consumption deflator
PI - import price, of the commodity of which the sector is the main producer
Q - value added per man-hour, in the sector
t_1 - (1 - average tax rate for households)
t_2 - (1 + employment tax in the sector, paid by the firm)
U - unemployment rate

$c_o, c_1, c_2, c_3, c_4, c_5, c_6$ are estimated (lag) coeffisients.

Homogeniety of degree 1 in prices is assumed for all the manucaturing sectors, i.e. the lag coefficients for import prices and consumer prices sum to unity. For manufacturing in average, import - and consumer prices have about equal impact on the wage level, but the import price effect has a longer time lag than the effect of changed consumer prices. (Up to 12 quarters and 2-3 quarters respectively.) The elasticity with respect to (1+ employment taxes) is about -1. In the wage leader equations personal taxes also have a modest impact on the wage level. The labour market conditions modelled by the unemployment rate, exert a considerable effect on manufacturing wages. A reduction of the unemployment rate from 3 to 2 pct. increases wage inflation by about 1 3/4 - 2 pct. annually in manufacturing as a whole.

Wages in the other sectors are determined by a modified wage follower mechanism.

(3.8.2.) $\log (W/W_{-1}) = b_o + b_1 \cdot \log (W51/W_{-1}) + b_2 \log (PC/W_{-1})$ + seasonals + dummies.

W - wage level in wage following sector
PC - private consumption deflator
W51 - average wage rate in manufacturing

b_o, b_1, b_2 - estimated coefficients.

Equation (3.8.2) ensures that the wage level in the wage following sectors increase 1 pct. if manufacturing wages and consumer prices simultaneously increase 1 pct. Manufacturing wages have the largest contribution to wages in the following sectors. The coefficients b_1 and b_2 express the relative importance of consumer prices and manufacturing wages as well as the speed of adjustment to changes in these variables. Generally 95 pct. of the long run effects on wages in the wage follower sectors has occurred within 4-6 quarters after a schock.

The tables 3.8.1 - 3.8.8. give a more detailed picture of the properties of the wage equations. Wage leading sectors are treated in tables 3.8.2 - 3.8.6 and the wage following sectors in tables 3.8.7 and 3.8.8. The tables are calculated by simulating the equations 1980.1 - 1986.4

Table 3.8.1. Effect on wages in the manufacturing sectors of 1 pct. increase in consumer prices

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(15) Food and clothing industries	-	0.37	0.75	0.75	0.75
(25) Wood and printing industries	-	0.43	0.43	0.43	0.43
(30) Mining and raw material industries	0.29	0.43	0.43	0.43	0.43
(45) Metal manufacturing industries	0.40	0.40	0.40	0.40	0.40
(50) Shipbuilding and production of oil platforms	0	0.24	0.55	0.62	0.62
(51) Manufacturing (average)	0.21	0.43	0.49	0.50	0.50

Table 3.8.2. Effect on wages in the manufacturing sectors of a 1 pct import price increase

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(15) Food and clothing industries	0.10	0.17	0.25	0.25	0.25
(25) Wood and printing industries	0	0	0.23	0.52	0.57
(30) Mining and raw material industries	0	0.10	0.28	0.52	0.58
(45) Metal manufacturing industries	0.14	0.25	0.44	0.62	0.62
(50) Shipbuilding and production of oil platforms	0	0	0.15	0.32	0.38
(51) Manufacturing (average)	0.05	0.11	0.28	0.47	0.50

Table 3.8.3. Effect on wages in the manufacturing of a 1 pct. increase in productivity

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(15) Food and clothing industries	0	0.06	0.18	0.34	0.43
(25) Wood and printing industries	0	0.16	0.33	0.64	0.80
(30) Mining and raw material industries	0	0.06	0.18	0.34	0.43
(45) Metal manufacturing industries	0	0.07	0.19	0.31	0.32
(50) Shipbuilding and production of oil platforms ...	0	0.04	0.11	0.21	0.23
(51) Manufacturing (average)	0	0.07	0.21	0.39	0.47

Table 3.8.4. Effect on wages in the manufacturing sectors of a 1 pct-point increase in average tax rate in the tax function for households

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(15) Food and clothing industries	0	0	0	0	0
(25) Wood and printing industries	0.22	0.22	0.22	0.22	0.22
(30) Mining and raw material industries	0	0.28	0.28	0.28	0.28
(45) Metal manufacturing industries	0	0.42	0.42	0.42	0.42
(50) Shipbuilding and production of oil platforms ...	0.53	0.53	0.53	0.53	0.53
(51) Manufacturing (average)	0.13	0.28	0.28	0.28	0.28

Table 3.8.5. Effect on wages in the manufacturing sectors of a 1 pct.-point increase in the employment tax rate

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(15) Food and clothing industries	0	-0.80	-0.80	-0.80	-0.80
(25) Wood and printing industries	0	-0.85	-0.85	-0.85	-0.85
(30) Mining and raw material industries	0	-0.80	-0.80	-0.80	-0.80
(45) Metal manufacturing industries	0	-0.80	-0.80	-0.80	-0.80
(50) Shipbuilding and production of oil platforms	-0.84	-0.84	-0.84	-0.84	-0.84
(51) Manufacturing (average)	-0.34	-0.82	-0.82	-0.82	-0.82

Table 3.8.6. Effect on wages in the manufacturing sectors of a 1 pct.-point increase in the unemployment rate[1]

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(15) Food and clothing industries	0	-0.9	-2.3	-4.3	-5.8
(25) Wood and printing industries	0	-0.5	-1.3	-2.5	-3.4
(30) Mining and raw material industries	0	-1.2	-3.0	-5.5	-7.4
(45) Metal manufacturing industries	0	0	0	-3.0	-4.9
(50) Shipbuilding and production of oil platforms	0	-0.9	-2.2	-4.1	-5.4
(51) Manufacturing (average)	0	-0.7	-1.6	-3.7	-5.2

[1] The effects of increased unemployment on wages are highly dependent upon the level of unemployment in the reference simulation due to the non-linearity of the way unemployment affects wages in the wage equations.

Table 3.8.7. Effect on followers' wages of a 1 pct. increase in manufacturing wages

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(55) Building and construction	0.71	0.86	0.89	0.89	0.89
(70) Domestic transport	0.42	0.66	0.88	0.99	1.00
(71) Power supply	0.51	0.76	0.94	1.00	1.00
(80) Various services	0.27	0.45	0.67	0.82	0.87
(81) Wholesale and retail trade	0.67	0.79	0.81	0.81	0.81
(90) Public sector (civilian)	0.34	0.48	0.55	0.56	0.56

Table 3.8.8. Effect on followers' wages of a 1 pct. increase in consumer prices

Effect in pct. on	Quarters after change				
Sector	1	2	4	8	12
(55) Building and construction	0.09	0.10	0.11	0.11	0.11
(70) Domestic transport	0	0	0	0	0
(71) Power supply	0	0	0	0	0
(80) Various services	0.04	0.07	0.10	0.12	0.13
(81) Wholesale and retail trade	0.15	0.17	0.19	0.19	0.19
(90) Public sector (civilian)	0.26	0.36	0.42	0.44	0.44

3.9. Prices (domestic and export)

Price equations are estimated both for domestic and export prices for most commodities. For (10) - Primary industry products, (71) - Power supply and (83) - Housing services the domestic prices are exogenous. The same applies to export prices for the same commodities and the price of crude oil. For each commodity two equations (one for deliveries to the home market and one for exports) determine the long run price level. Homogenity of degree one in prices and unit costs is assumed.

$$(3.9.1)\quad P_t^* = UC_t^{\alpha_1-\alpha_2 \cdot M_t} \cdot PI^{(1-(\alpha_1-\alpha_2 \cdot M_t))} \cdot e^{\alpha_3 \cdot KAP_t} \cdot e^{\alpha_4 \cdot KAP_t^2} \cdot B$$

where

P_t - domestic price (or export price in the export price equations)

UC_t - unit variable cost in the main producer sector

PI_t - import price (proxy for competitors' price)

M_t - import share (only the equations for domestic prices). Average of 4 quarters, lagged one quarter.

KAP_t - capacity utilization rate in the main producer sector

t - refers to period (quarter) t

* - refers to wanted (long run) value

B - constant

Equation (3.9.1) determines the wanted price level. We have chosen to model the price formation as a partial adjustment mechanism:

$$(3.9.2)\quad P_t/P_{t-1} = (P_t^*/P_{t-1})^{\lambda}$$

Equation (3.9.2) says that a share λ of the discrepancy between actual and wanted price level is eliminated each quarter. Taking logs we can calculate equation (3.9.3), which has been estimated.

$$(3.9.3)\quad \log(P/P_{-1}) = A + a_1 \cdot \log(UC/P_{-1}) + a_2 \cdot \log(PI/UC) + a_3 \cdot M_t \cdot \log(PI/UC)$$

$$a_4 \cdot KAP + a_5 \cdot KAP^2 + a_6 \cdot 0{,}25 \,.\, \log(UC_{-1}/UC_{-5}) + \text{seasonals}$$

a_1 in (3.9.3) is the same coefficient as the adjustment speed parameter λ in (3.9.2). The coefficient a_6 expresses a somewhat more complicated adjustment mechanism which is used in some equations. But this does not affect the long run proporties.

The elastisities of domestic prices wrt. import prices and unit variable costs will not be constant, but will depend on the actual import share. The elasticity wrt. changes in capacity utilisation will likewize depend on the level of the capacity utilisation initially. The reason for this is that this variable appears on level, not logaritmic, form, and that it also appears squared in the price equations for some commodities.

Equations for domestic prices

The estimation results indicate a relatively high adjustment speed; the parameter λ in (3.9.2) exceeds 0,5 for most commodities. Import prices only play a modest role in the price equations for domestic prices and are included only in 4 of these; (15) - Food, clothing, etc., (25) - Wood products, printing etc., (30) - Raw materials from mining and manufacturing and (40) - Refined oil products.

For 45 - Machinery and metal products, and 50 - Ships and drilling platforms, we did not get meaningful results from (3.9.3), so here we have implementet equations as

$$(3.9.4)\quad \log(P) = A + a_1 \cdot \log(UC) + a_2 \cdot KAP + a_3 \cdot KAP^2 + \text{seasonals.}$$

The lag-coefficients are restricted to sum to unity and the relative weights of the lags are determined on the basis of coefficients that came out of free estimation of (3.9.4). For commodity 81 (wholesale and retail trade), the equation is on the form:

(3.9.5) $\log(P) = A + a_1 \log(UC) + a_2 \cdot \log(P_{-1}) + a_3 \cdot \log(UC_{-1}/UC_{-2}) + a_4 \cdot KAP$ + seasonals + dummies.

Homogeniety of degree one in unit variable costs is assumed.

When looking at the tables, one must remember that some sectors use a great deal of imported intermediate inputs. The effects of price increases of imported material inputs will, in the price equations, materialize in high elastisities of prices wrt. unit variable costs.

Table 3.9.1. Pct. increase in domestic prices of 1 pct. increase in unit variable costs from 1973.1[1]

Commodity	Quarters after change				
	1	2	4	8	12
(15) Food, clothing, etc.	0,45	0,67	0,85	0,91	0,92
(25) Wood products, printing, etc.	0,49	0,69	0,79	0,81	0,81
(30) Raw materials from mining and manufacturing	0,42	0,66	0,86	0,95	0,96
(40) Refined oil products	0,29	0,44	0,56	0,60	0,60
(45) Machinery and metal products	0,62	0,86	0,98	1,00	1,00
(50) Ships and drilling platforms	0,40	0,70	0,90	1,00	1,00
(55) Building and construction	1,00	1,00			
(70) Domestic transport	0,20	0,45	0,82	0,98	1,00
(80) Various services	0,91	0,99	1,00		
(81) Wholesale and retail trade	0,39	0,73	0,90	0,98	1,00
(90) Public sector (civilian)	0,71	0,91	0,99		

[1] For commodities 30 and 40 the actual import share in 1984 was used in this simulation.

Table 3.9.2. Pct. increase in domestic prices of 1 pct. increase in import prices form 1973.1[1]

Commodity	Quarters after change				
	1	2	4	8	12
(15) Food, clothing, etc.	0,04	0,06	0,08	0,08	
(25) Wood products, printing, etc.	0,12	0,16	0,19	0,19	
(30) Raw materials from mining and manufacturing	0,02	0,03	0,04	0,04	
(40) Refined oil products	0,19	0,29	0,37	0,40	0,40

[1] See note table 3.9.1.

Table 3.9.3. Pct. increase in domestic prices of 1 pct-point increase in capacity utilization

Commodity	Quarters after change				
	1	2	4	8	12
(25) Wood products, printing, etc.	0,10	0,14	0,16	0,16	
(45) Machinery and metal products	0,16	0,22	0,24	0,25	0,25
(50) Ships and drilling platforms	0,0	0,36	0,36		
(55) Building and construction[1]	0,14	0,14			
(80) Various services	0,45	0,49	0,49		
(81) Wholesale and retail trade	0,20	0,33	0,44	0,50	0,51

[1] At historical average capacity utilization (85 pct.).

Export prices

The export price equations are identical to the domestic price equations, except the import-share variable, which is not a variable in the export price equations.

Export prices seem more sensitive to import prices (competitors' prices), than the domestic prices do. For 1 commodity export prices is determined as a lag distribution over unit variable costs. This is 45 - Machinery and metal products. But domestic costs have a significant impact on all export prices. Capacity utilization also significantly influence export prices.

The adjustment speed is somewhat lower in the export price equations than in the domestic price equations.

There is also estimated an export price equation for (67) - Natural gas following the price of crude oil with a lag. The export price of commodity 81 - Wholesale and retail trade is set equal to the export price of commodity 80 - Various services.

Table 3.9.4. Pct. increase in export prices when unit variable costs are increased by 1 pct.

Commodity	Quarters after increase					
	1	2	4	8	12	16
(15) Food, clothing, etc.	0,27	0,42	0,56	0,62	0,62	
(25) Wood products, printing, etc.	0,11	0,19	0,30	0,40	0,43	0,44
(30) Raw materials from mining and manufacturing	0,19	0,30	0,41	0,47	0,48	0,48
(40) Refined oil products	0,09	0,14	0,18	0,20	0,20	
(45) Machinery and metal products	0,69	0,91	0,99	1,00	1,00	
(50) Ships and drilling platforms	0,11	0,20	0,32	0,44	0,48	0,50
(70) Domestic transport	0,04	0,08	0,14	0,22	0,27	0,30
(80) Various services	0,52	0,68	0,75	0,75		

Table 3.9.5. Pct. increase in export prices when import prices increase by 1 pct.

Commodity	Quarters after change					
	1	2	4	8	12	16
(15) Food, clothing, etc.	0,16	0,25	0,33	0,37	0,37	
(25) Wood products, printing, etc.	0,14	0,24	0,38	0,50	0,53	0,55
(30) Raw materials from mining and manufacturing	0,20	0,33	0,45	0,51	0,52	
(40) Refined oil products	0,35	0,55	0,72	0,79	0,80	0,80
(50) Ships and drilling platforms	0,11	0,20	0,32	0,43	0,47	0,48
(70) Domestic transport	0,08	0,15	0,26	0,42	0,52	0,57
(67) Natural gas[1]	0	0	0,45	0,87	0,97	0,99
(80) Various services	0,17	0,22	0,25	0,25		

[1] The right-hand-side variable in the price equation for natural gas is the export price of crude oil.

Table 3.9.6. Pct. increase in export prices when capacity utilization increase by 1 pct.-point

Commodity	Quarters after change					
	1	2	4	8	12	16
(15) Food, clothing, etc.	0,29	0,46	0,61	0,67	0,68	0,68
(25) Wood products, printing, etc.	0,17	0,30	0,48	0,63	0,68	0,69
(30) Raw materials from mining and manufacturing[1]	0,13	0,21	0,29	0,34	0,34	
(70) Domestic transport	0,04	0,08	0,14	0,22	0,27	0,30

[1] At historical average capacity utilization (88 pct.).

4. MULTIPLIER ANALYSIS

In this chapter we report some multipliers calculated using the whole KVARTS model. They differ from the multipliers in chapter 3 in that we now consider all the different model blocks simultanously. It is important to note that the multiplier properties reported here in some cases are considerably influenced by the reference path. This is to a large part due to the non-linearity of the Phillips- curve wage equations, but these effects also occur in other model blocks. In the wage equations the effect of reduced unemployment on wages is much larger when unemployment is low than when unemployment is high.

The multipliers are calculated as deviations from the reference path when exogenous variables are changed. The simulation period is 1988.1 - 1992.4. In this simulation unemployment is at a fairly low level in 1988 (2½ pct.) rising to about 4 pct. in 1992.

Increased public employment increases households' disposable income, generating increased consumption and housing investment. The increased production resulting from this stimulate other private investments due to the accellerator mechanism in the investment equations. Investment reaches a peak after 8-10 quarters and then decline again. Private consumption, via the lags in the aggregate consumption function, increase steadily, though somewhat slower towards the end of the simulation period.

Imports increase gradually as domestic demand increases, but exports is barely affected. This is because export prices and wages are almost unchanged, which in turn can be traced back to the effect that unemployment is affected very little by this policy experiment.

In the long run imports increase by about 60 pct. of the initial expenditure increase. The GDP multiplier is around 1,6 after 2 years.

Decreased taxes increaces immediately households' incomes, but it takes time before this results in increased consumption. Thus it takes more time to obtain the long-run effects than in the case of increased public employment. The long-run GDP multiplier is near 1 and the import multiplier is almost 0,6. Consequently, in obtaining a given increase in GDP, imports will rise more when tax reductions are used than when increased public employment is utilized.

Increased world market demand works through the economy by increasing exports and thereby profitability and employment in the export sectors. Increased consumption and investment follow. Imports increase by around ½ of the export increase, but this is also due to the induced domestic demand growth (consumption and investment).

As a last experiment we have increased all import prices and exogenous export prices by 10 pct. This must not be considered as a simulation of a devaluation of the currency, since in that case several other model-exogenous variables would have to be changed as well.

The import price increase initially increases consumer prices of import goods. Consumer prices rise by 3 pct. already in the first quarter. This implies an immediate reduction of households' disposable income, making private consumption and housing investment fall.

Furthermore Norwegian firms gain market shares on the domestic market and foreign market due to the immediate shift in relative prices. The fall in import volumes resulting from increased market shares results in a short-term increase in production. But after a few quarters domestic demand falls further. At the same time domestic wages and prices start to increase as a result of the increased import and consumer prices. Then households' income starts to increase again, and at the same time Norwegian firms lose market shares again due to the loss in competitiveness. It takes 3-4 quarters before exports reaches its maximum, and then exports starts declining, also due to the increase in Norwegian export prices.

In the long run (i.e. in 1992) export prices of commodities increase by 9,5 pct. while the private consumption deflator increases by 6,5 pct. Wages increase by 9,1 pct. in the long run. These apparent non-homogeneity is largely due to the existence of exogenous domestic prices that are unchanged in the experiment.

Production starts to fall after 2-3 quarters, reaching about -2 bill. kr. after 5 years. The long-run consumption effect is zero.

It is a large negative multiplier on aggregate investment. It is the fall in housing investment that is the main factor behind this. It is here important to note that nominal credit supply is not changed, and the falling real credit supply contributes negatively to housing investments.

A general result from these simulations is that expansionary policies to a small degree crowds out other production during the simulation period. A crucial factor behind this effect (in addition to moderate price elasticities between norwegian and foreign products) is the modelling of labour supply which is highly "demand elastic". When labour demand rises, most of the increase is met by a supply response - resulting only in a modest fall in unemployment. This again leaves wages fairly unchanged. However this results may change in the very long run.

The fact that labour supply is modelled in such a crude way, not taking into account stock variables as population etc., makes it important to be aware of possible bottlenecks in labour supply when using the model.

Furthermore, the economies of scale embodied in the model, will counteract the - already small- wage effects on consumer prices and export prices.

Table 4.1. Effects in mill. 1986-kroner of increased public employment[1]

Effect on	Quarters after change					
	1	2	4	8	12	20
GDP	269	290	335	402	431	414
Private consumption	25	51	114	209	253	290
Public consumption	251	251	250	249	249	253
Gross investment	8	17	28	41	40	12
Exports	-1	-2	-6	-13	-20	-25
Imports	11	22	52	110	144	171
Employment (1000 persons)	7	7	7	8	8	8
Unemployment (1000 persons)	-2	-2	-2	-2	-2	-2
Wages (%)	0	0	0,1	0,2	0,4	0,5
Consumer prices (%)	0	0	0	0,1	0,1	0,1
Current account (value)	-15	-30	-66	-142	-198	-275

[1] Man-hours in the public sector is increased so that the wage cost bill increased by 1 bill. kroner in 1988. This amounts to about 7 300 persons.

Table 4.2. Effects in million 1986-kroner of a reduction of households' taxes by 250 mill. 1986-kroner each quarter from 1988.1

Effect on	Quarters after change					
	1	2	4	8	12	20
GDP	28	59	123	210	242	243
Private consumption	37	78	168	277	305	327
Gross investment	12	26	46	72	79	58
Exports	-1	-3	-6	-12	-15	-15
Imports	16	33	72	123	139	142
Employment (1000)	0	0	0	1	2	2
Current account (value)	-18	-39	-86	-159	-200	-248

Table 4.3. Effects in million 1986-kroner of increased world market demand from 1988.1[1]

Effect on	Quarters after change					
	1	2	4	8	12	20
GDP	42	70	104	148	172	161
Private consumption	3	7	21	51	74	90
Gross investment	8	15	31	45	49	31
Exports	79	113	136	140	142	148
Imports	16	29	48	72	86	76
Export prices[2] (%)	0,2	0,3	0,4	0,4	0,4	0,4
Current account (value)	76	106	127	120	122	164

[1] All market indicators increased by 1 pct. [2] Commodities.

Table 4.4. Effects in mill. 1986-kroner of 10% increase in import prices and exogenous export prices

Effect on	Quarters after change					
	1	2	4	8	12	20
GDP	246	298	162	-162	-294	-509
Private consumption	-204	-404	-719	-630	-216	-38
Gross investment	52	47	-224	-778	-992	-936
Exports	418	575	531	252	127	120
Imports	-762	-1152	-1510	-1262	-830	-526
Wages (%)	1,1	2,3	4,5	7,5	8,6	8,6
Export prices (%)	5,5	6,5	8,0	9,2	9,5	9,6
Consumer prices (%)	3,1	3,7	4,5	5,6	6,1	6,4
Employment (1000)	2	3	4	1	-2	-3
Unemployment (1000)	-1	-1	-2	-1	1	1
Current account (value)	-1 430	-581	446	825	507	298

5. TRACKING PERFORMANCE

In this chapter we shall report some of the results of the historical testing, which has been done on the 1986 version of the whole KVARTS model. Here we must mention that because of some data problems, we have used a model which is somewhat different from the "standard version". Some variables have changed exogenous/endogenous status. The only difference which has consequences for other variables, is that the gas price is exogenous in the testversion of the model.

The motivation behind this test are several. It tells us to what degree we can rely on the model generated results, and it helps to point out weak parts of the model. By using the whole model we get something new in relation to the normal single equation simulation, which is always done while choosing design and estimating. The "simultaneous" tracking shows how the equations work together, and it may for instance make us prefer a special design of an equation, in spite of others better single equation tracking performance. This may occur because the current equation works best in the model as a whole, or that it has more "reliable" right hand side variables.

We will present two different simulations; one post sampel, i.e. after the estimation period of almost all econometric equations, - with simulation from 1984.1 to 1986.4, and one both post- and in-sample-simulation from 1977.1 to 1986.4. Let us call the first simulation for "Post sample", and the second "Historical". Both simulations are done fully dynamic, so that all lagged endogenous variables have their model-generated values for observations after simulation start. A consequence of this is that a simulation over a long period not only get increse chances of the model getting off the histo-rival track, but use also relatively much more model generated values (for lagged endogenous variables). In this way one might say that a simulation over a smaller period, is less endogenized. This should partially lead to greater average error in the historical simulation.

On the other hand, there are two opposite effects: The post sampel period, which only covers a smaller part of the "historical" period, is normally believed to track worse than the in sample period, because the coefficients and design are made on the basis of these data. Secondly, the post sample period has been a much more turbulent period in the Norwegian economy than the 7 years before.

There are two main reasons behind making a separate test for the post sample period: First just that it is post sampel, and therefore is a more difficult test of the model. Second, of 3 years equals the "normal" forcasting period of the model. The reasons behind tracking the longer "historical" period, is to let the dynamics get time to develop.

The tools we are going to use in the evaluation of the simulations, are very simple: Except examining diagrams of the simulation results we are using the standard statistics; Root Mean Square Error (RMSE), a simple decomposition of RMSE and Relative Root Mean Square Error (RRMSE):

Let $\hat{Y}_t$ denote the model-calculated value of a variable and Y_t the historial value at time t, then the t model generated residual in quarter t is:

(5.1.) $e_t = Y_t - \hat{Y}_t$

The mean error could be defined as the average of the absolute value of e_t and that would have been one way to measure the simulation failure. But the standard basis of such measuring is the RMSE, which is defined as follows:

(5.2.) $$\text{RMSE} = [(1/T) \cdot \sum_{t=1}^{T} (Y_t - \hat{Y}_t)^2]^{\frac{1}{2}}$$

where T is the number of observations.

Some of the teoretical background of the common use of RMSE, is that it has been shown that under certain asumptions it would be optimal to minimize RMSE if you have a quadratic loss function (Theil 1964).

The RMSE can be decomposed in several ways, to investigate if or how the model misses in a systematic way. We are only going to decompose it in one way; into bias and standard deviation around the average error:

$$(5.3.)\quad (RMSE)^2 = (1/T)\ \Sigma(Y_t - \hat{Y}_t)^2 = (\bar{Y} - \bar{\hat{Y}})^2 + (1/T)\ \Sigma[(Y_t - \hat{Y}_t) - (\bar{Y} - \bar{\hat{Y}})]^2 = \bar{e}^2 + (1/T)\cdot\Sigma(e_t - \bar{e})^2$$

$$= (\text{bias})^2 + (\text{standard deviation})^2$$

A line over the variable means the aritmetric average value.
The Relative Root Mean Square Error (in pct), which is the statistic we mainly refer to in the following, is a normalization of RMSE, defined as:

$$(5.4.)\quad RRMSE = \frac{RMSE}{\bar{Y}} \cdot 100$$

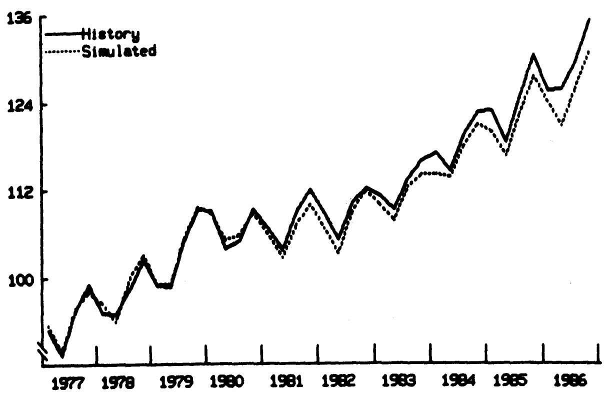
Before going any further it is to be said that the residuals of the input-output equations are given their historical values. This is because we try to reduce the failures caused by changes in input-output coefficients to a minimum. In the historical simulation, we want to test the econometric equations and the interplay between them, not input-output system in years far from the base year of the model.

The statistics for some of the variables are given in table 5.1 for the historical simulation and in table 5.2 for the post sample simulation.

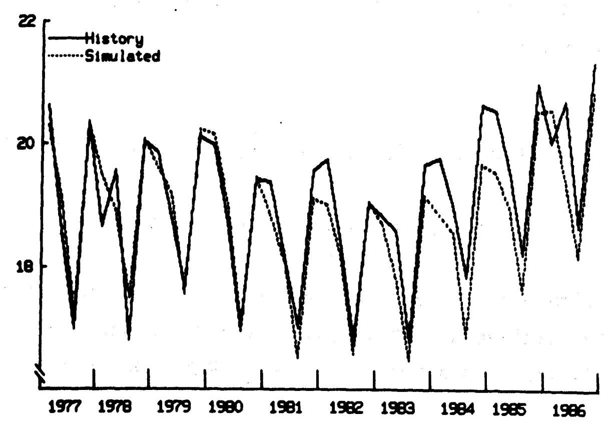
Let us first examine the historical test: We take GDP as our starting point. Diagram 5.2 shows that until 1980 the model generated series fits well, with small deviations on both sides from the historical path. From 1981 the model generates too small values. The good RRMSE statistics of 1.7 must be seen in the light of the growing errors over time, and the big exogenous elements. The exogenous parts of GDP accounts for about 30 pct. The production in private sector mainland, which is GDP minus the big exogenous sectors shipping, oil and public production, has a RRMSE of 2.2 Manufacturing production has a RRMSE which is a little bit worse, but the diagram shows that the simulation catches much of the cyclical movements. The seasonal pattern of the simulation seems to be relatively good compared to the history, and the variable is also going back on the track at the end of the period after lying under the historical values for some years.

Examination of the aggregate demand components shows that they all have a negative bias, but the bias of the private consumption is very much bigger than the other. The main reason behind this, is the very big errors in 1985 and 1986, which among other factors has to do with structural change caused by credit liberalization. The macro consumption function has not been able to deal with this. Comparing the tracking perfomance with the other aggregate demand components, measured by RRMSE, the only variable performing worse than private consumption is the changes in inventories. The RRMSE for these changes is extremely high, but this statistic is meaningless used on variables lying on both sides of zero, because the average then become so small. Comparing RMSE for changes in inventory with RMSE for the other aggregate demand components, shows that it is very high and that only private consumption fits worse. This, together with the fact that the changes in inventories is a relatively small demand component, imply that changes in inventories can be regarded as the worst tracking aggregate demand component. Ranking the tracking performance of this aggregate on the background of RRMSE and RMSE, is not very just to do, because of its different degree of endogenization. The "private sector mainland" - and "exclusive oil gas and shipping" - variables are mostly endogenous. Comparing this by the RRMSE statistic and leaving the inventory change out, it seems like these aggregate demand components have approximately equal tracking performance. Behind this, it is hiding very different performance of the different under-components, which we will return to.

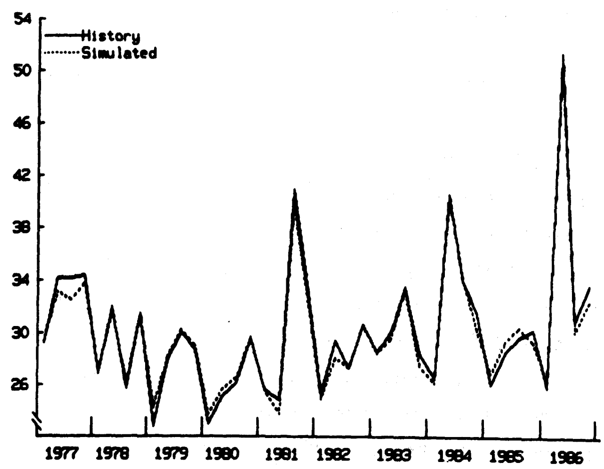
HISTORICAL SIMULATION
GDP in billion 1986 kr



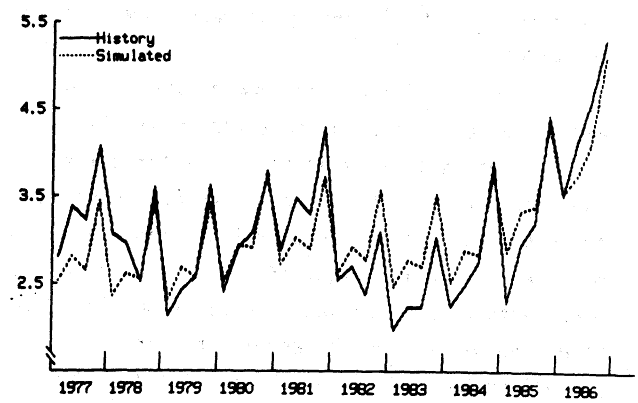
HISTORICAL SIMULATION
Manufacturing production in billion 1986 kr



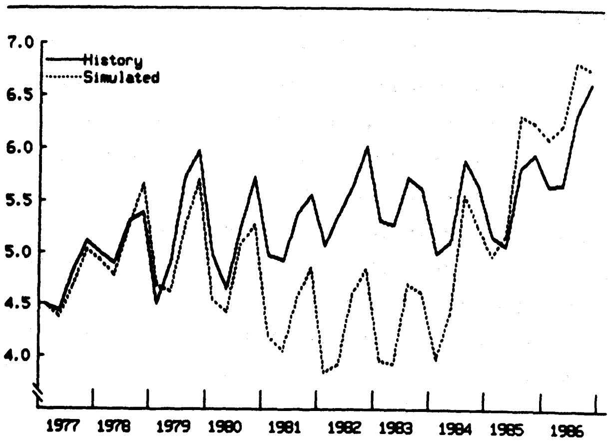
HISTORICAL SIMULATION
Total investment in billion 1986 kr



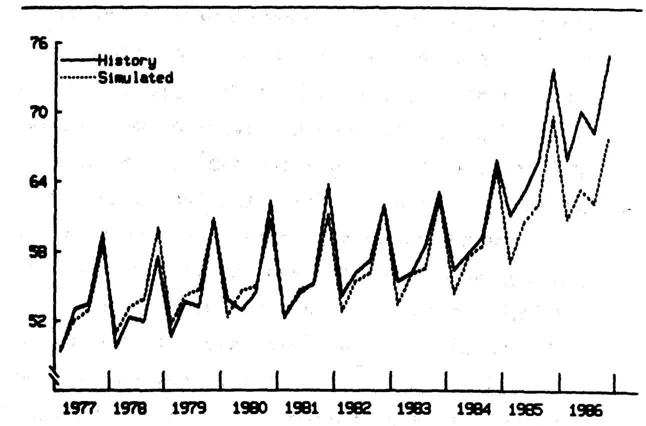
HISTORICAL SIMULATION
Investment in manufacturing in billion 1986 kr



HISTORICAL SIMULATION
Housing investment in billion 1986 kr



HISTORICAL SIMULATION
Private consumption in billion 1986 kr



Except private consumption, changes in inventories is the only aggregate demand component which to some degree explains the negative bias of GDP. Behind the negative bias of inventory change in the four endogenous sectors of 522 million kroner, there are three sectors with small bias on both sides, and one sector (metal manufacturing industries) with a negative bias even a little bit greater than the aggregate.

Summing up the bias on the demand side, there is a negative bias about twice as big as that of GDP. The reason is of course that also total imports have a big negative bias too. This follows from the underestimation of the demand components. Imports work in a sense as a stabilization factor; the error of the demand side does not affect GDP with full effect; a lot end up as errors in imports.

Looking at the trade balance, we have the same problem with the RRMSE as with the inventories, it is useless. What we can see is that the bias is positive, which implies that imports is more underestimated than exports in average. The main factor behind this is the big negative error in the last years of the period, caused by the underestimation of the domestic demand, while exports was not affected.

Let us now examine the investments more closely. Comparing investments in machinery and equipment with investments in building and construction shows that their biases have opposite signs, which make the total bias lower. It is also a tendency that overestimation in one of the two is counteracted by underestimation of the other, which leads to much better RRMSE in the total.

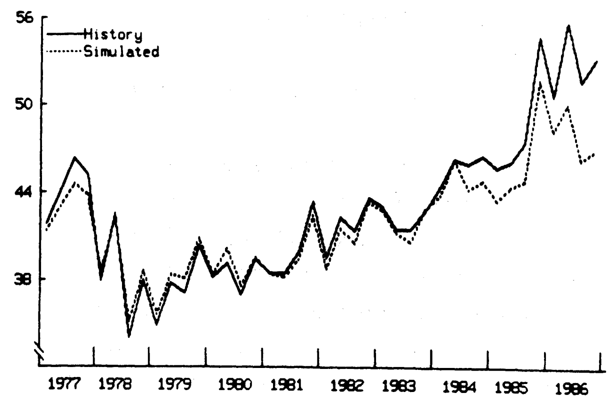
The negative bias in housing investments accounts for nearly the whole difference in bias between the two kinds of investments. Most of the different performance of the two kinds of capital is explained by the evolution in the prices of such investments. This is because the prices of machinery and equipment investments in general is more underestimated than the other price category.

Excluding housing investments from the total results in a small positive bias for the rest, a quite surprising fact, on the background of the flexible accellerator investment functions and the negative bias of the total production. The explanation is neither to find in the aggregate profits nor in the average prices, but in all the factors at the sector levels. This is possible because of different sensitivity of the explanatory variables combined with different performance for these variables in the various sectors, and because of high bias in "explaining" variables for sectors which have exogenous investments.

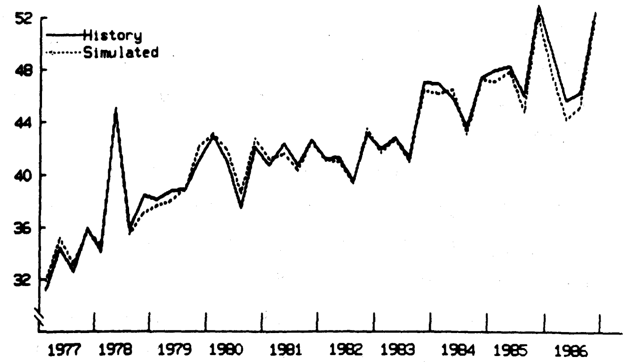
A closer look on the housing investments expose a peculiar development. It is tracking quite well until the beginning of the nineteen eighties. Then it is going completly out of the track on the under-side for about four years. After that it is nearly catching the track again, but now it misses on the upper side of the historical path. The overestimation in 1986 is some of the reason that the total investments are tracking so well in this very turbulent year. These big errors in the housing investment can be traced back to the relative price between total consumption and the housing investment. This last investment price has been over estimated every year - except the last two. In the first three years of the simulation period this has been counteracted by a corresponding overestimation in consumer prics, but after this, the consumer price has been tracking good for some years, but finally it has been underestimated for the last five years. In the simulation it is therefore relatively too expensive to invest in houses. The change around 1985 and the following overestimated has to do with the fact that the prices of housing investments are missing more on the underside than the consumer prices. The main reason behind the big error in the housing investment price, is that it has been set equal to the price of the total construction investment price, which obviously does not correspond to the history in this period. This is done correspondingly with the investment deflator of all the other sectors and kinds in the model and represent a weakness in the model.

The investments in the manufacturing sectors, are not tracking too well. The RRMSE is high, and the series is cutting through most of the cycles and on this background, the low bias is not too impressive. But there are some bright spots: The errors are not growing over time, the model has catched much of the investment boom in the last part of the period and finally the seasonal variation seems to be well treated by the model.

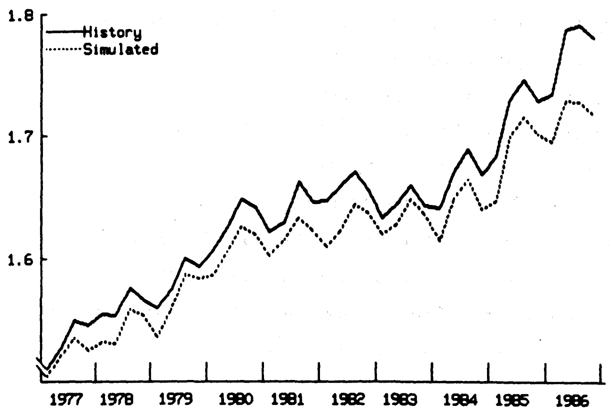
HISTORICAL SIMULATION
Total imports in billion 1986 kr



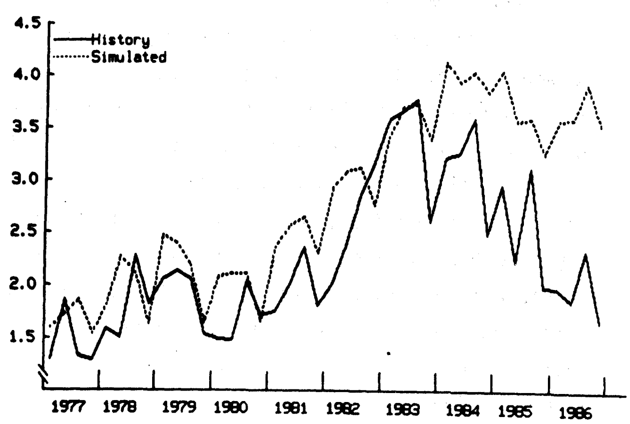
HISTORICAL SIMULATION
Total exports in billion 1986 kr



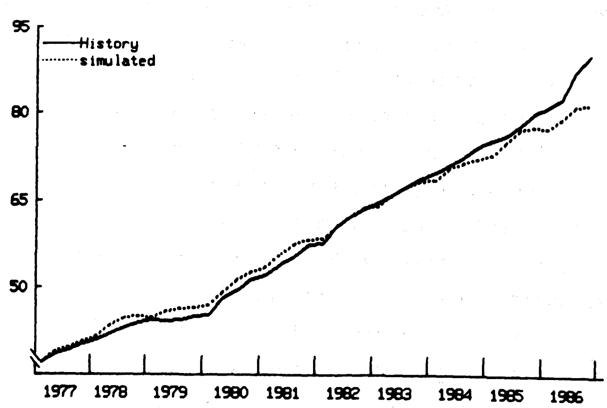
HISTORICAL SIMULATION
Total employment in million persons



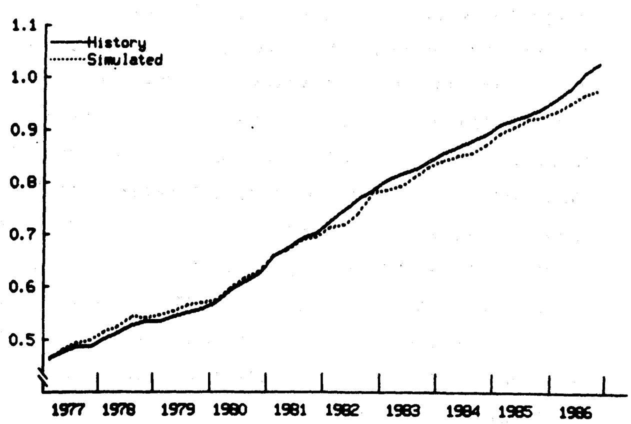
HISTORICAL SIMULATION
Unemployment rate



HISTORICAL SIMULATION
Hourly average wage rate in kr



HISTORICAL SIMULATION
Private consumption deflator



Let us now take a closer look at the prices. The close connection between wage rates and prices is easily illustrated by the diagrams of the private consumption deflator and the hourly average wage rate. We see that the errors normally are on the same side, but the series lies on the track in different periods. One reason behind the fact that the RRMSE of the consumption price is 50% less than the hourly average wage rate, is that the exogenous import prices have an important part in the determination of the prices. An important explaining factor in the wage formation equations is the unemployment rate, and it is almost always lying too high in the historical period, which partially would pull the wage rate down. The bias is relatively small in both series, because the systematic errors which are present, are at the upper side in the fist half of the period, and at the underside in the second. The reson why the wage rate takes off in the second quarter in 1978 may be a combination of overestimation of the consumption price, and that the equation fails. There is no mecanism in the Phillips equation itself that forces the wage rate back on track after an initial shift away from it. It seems from the simulation that the effects from other parts of the model normally are too weak to push the wage rate back on track again.

In 1982 however, the wage rate suddenly goes back on the track again for almost two years. This must be seen together with a corresponding movement in the calculated consumer price. Two factors behind this is the calculated decrease in both productivity and capacity utilization in many of the sectors. While the decrease in productivity influences the wage rate directly, the change in capacity utilization affect the consumer price and thereby the wage rate through the domestic price. Here we have an example where the other parts of the model has been able to push the wage rate back on the track again, but this is unfortunately the only time. After the nearly two years on the track, the wage rate leaves the track for the rest of the period of simulation. This is to be explained by the unemployment rate which from this point is greatly overestimated. The unemployment rate is without comparison the variable with the biggest RRMSE. Behind this sad chapter we got a total employment permanently out of the track and a too simple unemployment/labour supply function.

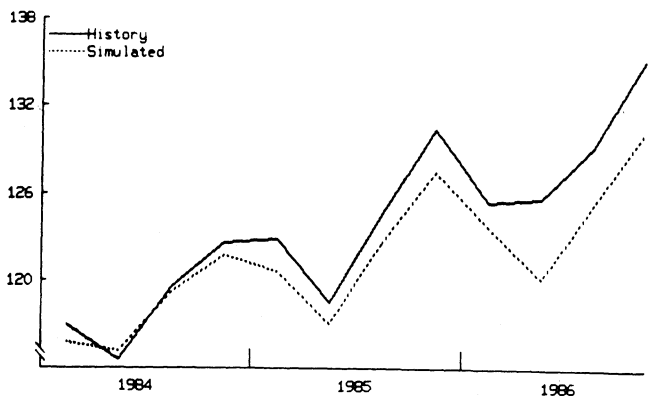
There are at least two explanations behind the error of employment in addition to the equations itself. From 1981 a large part can be attributed to the general underestimation of production. Beside this we have a coefficient adjustment problem (see appendix 3), especially affecting the man- hours in the sector of "wholesale and retail trade" in the fist half of the period.

Let us now examine the post sample simulation. This simulation is to a high degree affected of the turbulence in 1985 and 1986. Comparing the RRMSE statistics with those from the historical simulation, the historical simulation is the best for most of the variables. The deviations from this of some degree are the deflator of consumption and the investments in construction. The last is mainly caused by the improvement in the tracking of housing investment. Comparing the diagram for housing investment, we see that the main factor behind this is the absence of the, for the equation, difficult years 1981 to 1983. But apart from this, we also see an improvement in the tracking performance in the same period. In this period from 1984 to 1986, the historical simulation has a strong overprediction of the growth, while the postsample simulation almost catches it perfectly, even if the level between the start and stop point are a little bit too high. The reason behind this, besides the better starting point, is probably the shortage of time to stretch out the different variables in the last simulation. The deviation from the historical path in the relative price level between the consumption price and the price of housing investment, is for instance much smaller in the post sample simulation. Much of the same is to be said about the improvement in the deflator of consumption and in the average wage.

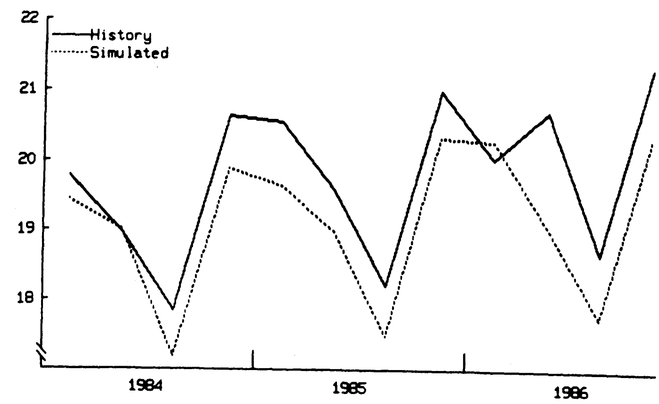
In this simulation it is easy to explain the continuing growth of deviation in employment with the same development in the production. Most of this is explained by the misses in privat consumption, but also the other aggregate demand components are mainly pulling in this direction. One little deviation from this picture, is the development in total investment, which is overestimated for the first three quarters of 1985, espesially caused by the housing investments, but also by the investments in manufacturing production.

The bias is in general much bigger in the post sample than in the historical simulation. This should not be surprising on the background of the continuous historical high level and growth rates of the demand components in this period. Therefore many of the variables fail on the same side for the whole period. Of course there are exceptions, for instance the consumption deflator and the housing investments, in other words, variables which have had a more normal performance in the post sample period.

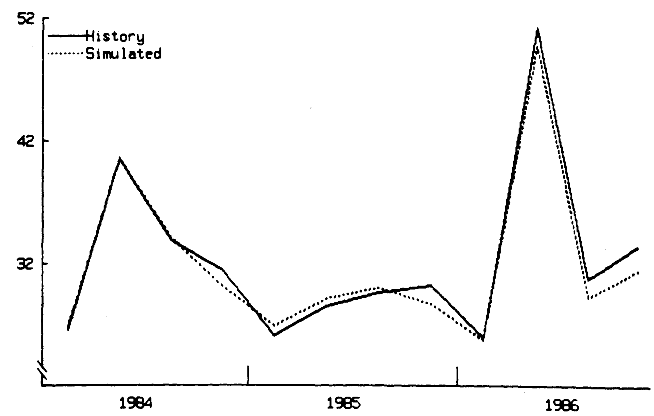
POST SAMPLE SIMULATION
GDP in billion 1986 kr



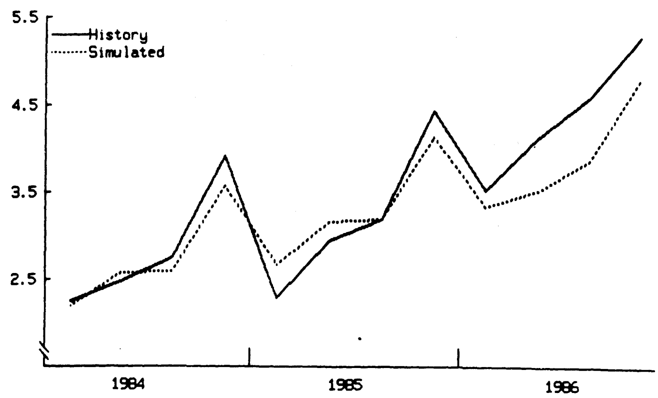
POST SAMPLE SIMULATION
Manufacturing production in billion 1986 kr



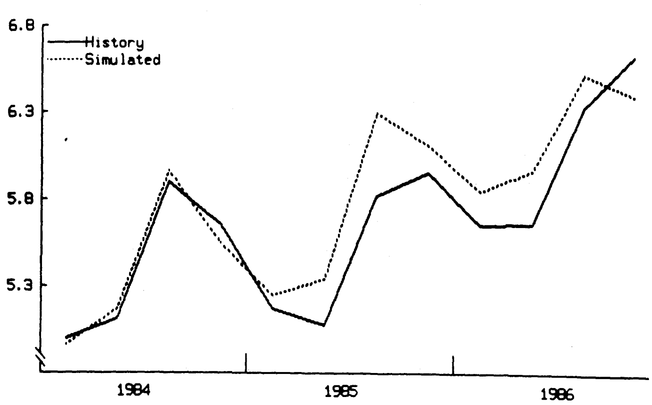
POST SAMPLE SIMULATION
Total investment in billion 1986 kr



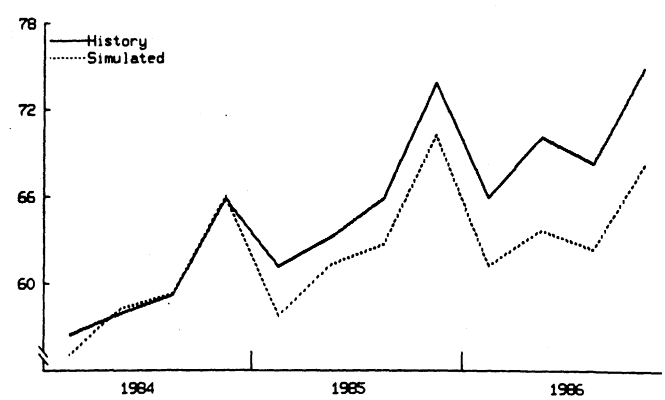
POST SAMPLE SIMULATION
Investment in manufacturing in billion 1986 kr



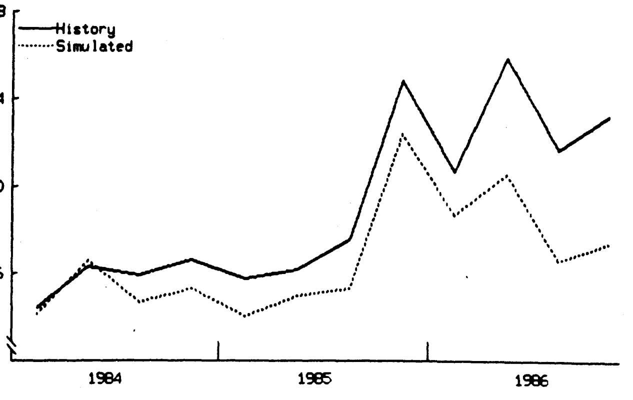
POST SAMPLE SIMULATION
Housing investment in billion 1986 kr



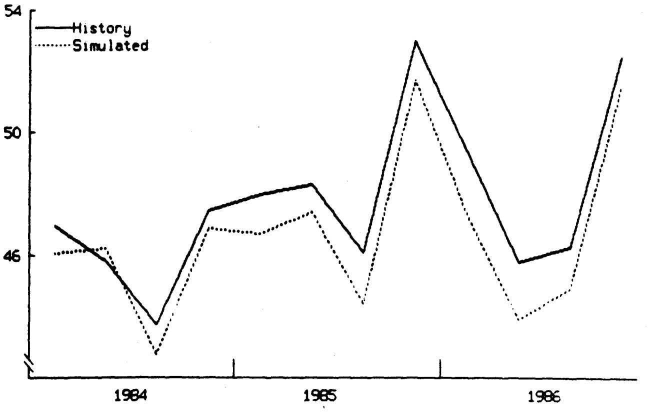
POST SAMPLE SIMULATION
Private consumption in billion 1986 kr



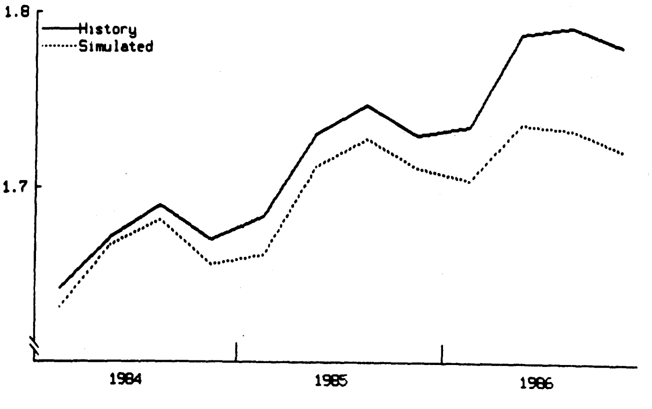
POST SAMPLE SIMULATION
Total imports in billion 1986 kr



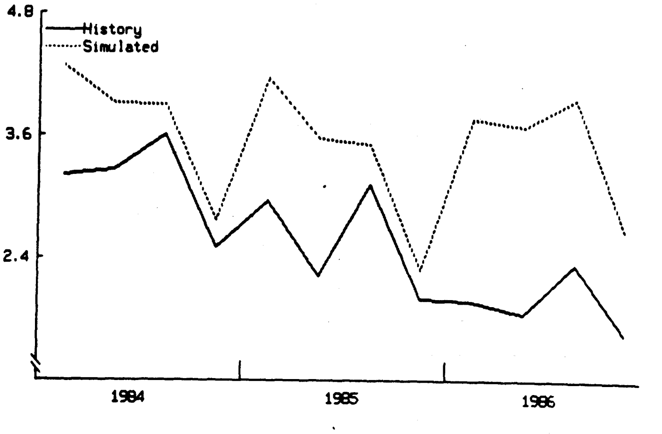
POST SAMPLE SIMULATION
Total exports in billion 1986 kr



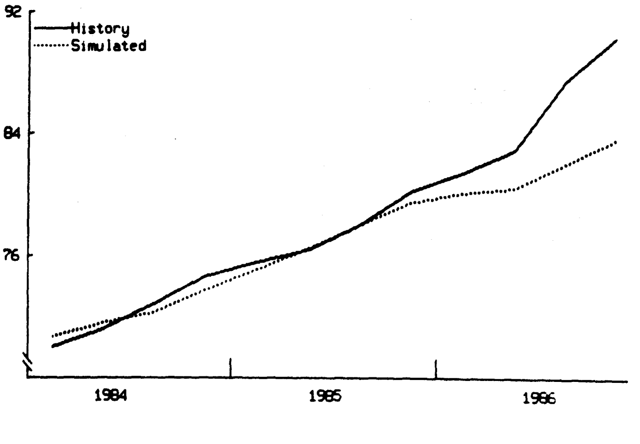
POST SAMPLE SIMULATION
Total employment in million persons



POST SAMPLE SIMULATION
Unemployment rate



POST SAMPLE SIMULATION
Hourly average wage rate in kr



POST SAMPLE SIMULATION
Private consumption deflator

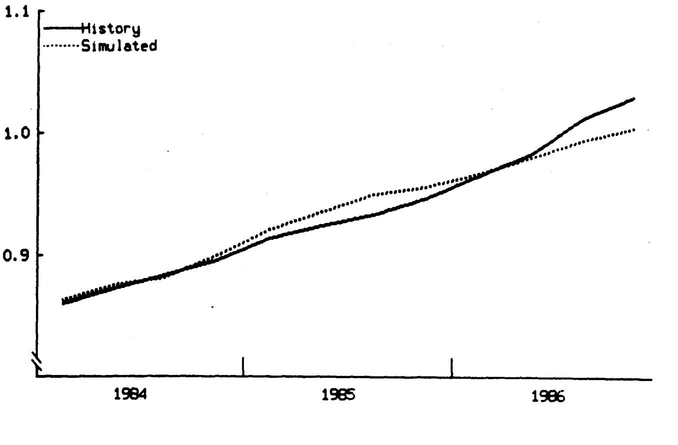


Table 5.1. Tracking statistics for the KVARTS-86 model.
Historical simulation 1977.1 to 1986.4

GDP	
AVERAGE	110 346
RMSE	1 830
BIAS	-1 049
ST. DEV.	1 500
RRMSE	1.659

GDP MAINLAND	
AVERAGE	97 048
RMSE	1 814
BIAS	-1 065
ST. DEV.	1 469
RRMSE	1.870

GDP MAINLAND PRIVAT SECTOR	
AVERAGE	81 002
RMSE	1 820
BIAS	-1 072
ST. DEV.	1 470
RRMSE	2.247

MANUFACTURING PRODUCTION	
AVERAGE	19 082
RMSE	545
BIAS	-252
ST. DEV.	483
RRMSE	2.858

TOTAL IMPORTS	
AVERAGE	43 036
RMSE	1 955
BIAS	-912
ST. DEV.	1 729
RRMSE	4.543

TRADITIONAL IMPORTS	
AVERAGE	27 839
RMSE	1 587
BIAS	-704
ST. DEV.	1 422
RRMSE	5.701

PRIVAT CONSUMPTION	
AVERAGE	58 607
RMSE	2 547
BIAS	-1 155
ST. DEV.	2 270
RRMSE	4.346

CONSUMPTION DEFLATOR	
AVERAGE	0.723
RMSE	0.018
BIAS	-0.007
ST. DEV.	0.016
RRMSE	2.441

TOTAL INVESTMENTS	
AVERAGE	30 296
RMSE	728
BIAS	-196
ST. DEV.	701
RRMSE	2.405

INVESTMENTS IN MACHINERY AND EQUPMENT	
AVERAGE	8 313
RMSE	743
BIAS	43
ST. DEV.	741
RRMSE	8.938

INVESTMENTS IN CONSTRUCTION	
AVERAGE	17 168
RMSE	797
BIAS	-378
ST. DEV.	701
RRMSE	4.644

INVESTMENTS MAINLAND	
AVERAGE	22 680
RMSE	728
BIAS	-196
ST. DEV.	701
RRMSE	3.212

INVESTMENTS IN PRIVATE SECTOR MAINLAND	
AVERAGE	18 788
RMSE	728
BIAS	-196
ST. DEV.	701
RRMSE	3.878

INVESTMENTS IN MANUFACTURING	
AVERAGE	3 123
RMSE	364
BIAS	-21
ST. DEV.	364
RRMSE	11.68

Table 5.1. (cont.). Tracking statistics for the KVARTS-86 model.
Historical simulation 1977.1 to 1986.4

HOUSING INVESTMENTS

AVERAGE	5 358
RMSE	672
BIAS	-379
ST. DEV.	554
RRMSE	12.55

TOTAL EXPORTS

AVERAGE	42 217
RMSE	718
BIAS	-187
ST. DEV.	693
RRMSE	1.702

EXPORTS EXLUSIVE OIL GAS AND SHIPPING

AVERAGE	42 217
RMSE	701
BIAS	-202
ST. DEV.	671
RRMSE	3.288

EXPORTS OF MANUFACTURING COMMODITIES

AVERAGE	15 837
RMSE	605
BIAS	-93
ST. DEV.	598
RRMSE	3.826

EXPORT DEFLATOR

AVERAGE	0.898
RMSE	0.010
BIAS	-0.001
ST. DEV.	0.010
RRMSE	1.118

EXPORT DEFLATOR TRADITIONAL COMMODITIES

AVERAGE	0.859
RMSE	0.025
BIAS	0.001
ST. DEV.	0.024
RRMSE	2.854

TOTAL EMPLOYMENT

AVERAGE	1 642
RMSE	27
BIAS	-24
ST. DEV.	13
RRMSE	1.689

EMPLOYMENT MAINLAND PRIVATE SECTOR

AVERAGE	1 164.96
RMSE	32.55
BIAS	-28.75
ST. DEV.	15.27
RRMSE	2.794

EMPLOYMENT MANUFACTURING

AVERAGE	355.62
RMSE	5.04
BIAS	-1.21
ST. DEV.	4.89
RRMSE	1.418

UNEMPLOYMENT RATE

AVERAGE	2.269
RMSE	0.793
BIAS	0.553
ST. DEV.	0.569
RRMSE	34.95

AVERAGE HOUERLY WAGE RATE

AVERAGE	59.35
RMSE	2.20
BIAS	-0.20
ST. DEV.	2.19
RRMSE	3.706

AVERAGE HOUERLY WAGE RATE MANUFACTURING

AVERAGE	63.38
RMSE	3.67
BIAS	-1.28
ST. DEV.	3.44
RRMSE	5.798

TRADE BALANCE

AVERAGE	3 601
RMSE	1 604
BIAS	565
ST. DEV.	1 501
RRMSE	44.55

INVENTORY CHANGES

AVERAGE	104
RMSE	1 119
BIAS	-522
ST. DEV.	990
RRMSE	1 071.9

Table 5.2. Tracking statistics for the KVARTS-86 model.
Post sample period 1984.1 to 1986.4

GDP

AVERAGE	123 901
RMSE	2 803
BIAS	-2 200
ST. DEV.	1 738
RRMSE	2.263

GDP MAINLAND

AVERAGE	107 299
RMSE	2 816
BIAS	-2 215
ST. DEV.	1 739
RRMSE	2.624

GDP MAINLAND PRIVAT SECTOR

AVERAGE	88 943
RMSE	2 821
BIAS	-2 222
ST. DEV.	1 738
RRMSE	3.172

MANUFACTURING PRODUCTION

AVERAGE	19 795
RMSE	807
BIAS	-659
ST. DEV.	465
RRMSE	4.079

TOTAL IMPORTS

AVERAGE	49 127
RMSE	3 038
BIAS	-2 358
ST. DEV.	1 916
RRMSE	6.185

TRADITIONAL IMPORTS

AVERAGE	34 441
RMSE	2 477
BIAS	-1 876
ST. DEV.	1 619
RRMSE	7.195

PRIVATE CONSUMPTION

AVERAGE	65 339
RMSE	3 917
BIAS	-3 066
ST. DEV.	2 438
RRMSE	5.995

CONSUMPTION DEFLATOR

AVERAGE	0.936
RMSE	0.011
BIAS	0.000
ST. DEV.	0.011
RRMSE	1.219

TOTAL INVESTMENTS

AVERAGE	32 483
RMSE	1 096
BIAS	-473
ST. DEV.	988
RRMSE	3.374

INVESTMENTS IN MACHINERY AND EQUPMENT

AVERAGE	9 728
RMSE	1 276
BIAS	-917
ST. DEV.	888
RRMSE	13.12

INVESTMENTS IN CONSTRUCTION

AVERAGE	13 379
RMSE	481
BIAS	325
ST. DEV.	355
RRMSE	2.621

INVESTMENTS MAINLAND

AVERAGE	24 561
RMSE	1 096
BIAS	-473
ST. DEV.	988
RRMSE	4.463

INVESTMENTS IN PRIVATE SECTOR MAINLAND

AVERAGE	20 703
RMSE	1 096
BIAS	-473
ST. DEV.	988
RRMSE	5.294

INVESTMENT IN MANUFACTURING

AVERAGE	3 497
RMSE	367
BIAS	-179
ST. DEV.	320
RRMSE	10.51

Table 5.2. (cont.). Tracking statistics for the KVARTS-86 model.
Post sample period 1984.1 to 1986.4

HOUSING INVESTMENTS

AVERAGE	5 669
RMSE	217
BIAS	118
ST. DEV.	182
RRMSE	3.843

TOTAL EXPORTS

AVERAGE	47 807
RMSE	1 274
BIAS	-1 111
ST. DEV.	624
RRMSE	2.665

EXPORTS EXLUSIVE OIL GAS AND SHIPPING

AVERAGE	23 319
RMSE	1 274
BIAS	-1 111
ST. DEV.	624
RRMSE	5.487

EXPORTS OF MANUFACTURING COMMODITIES

AVERAGE	17 034
RMSE	1 016
BIAS	-935
ST. DEV.	397
RRMSE	5.966

EXPORT DEFLATOR

AVERAGE	1.122
RMSE	0.017
BIAS	0.010
ST. DEV.	0.013
RRMSE	1.499

EXPORT DEFLATOR TRADITIONAL COMMODITIES

AVERAGE	1.035
RMSE	0.047
BIAS	0.030
ST. DEV.	0.036
RRMSE	4.491

TOTAL EMPLOYMENT

AVERAGE	1 722
RMSE	32
BIAS	-26
ST. DEV.	18
RRMSE	1.868

EMPLOYMENT MAINLAND PRIVATE SECTOR

AVERAGE	1 206.54
RMSE	37.60
BIAS	-32.27
ST. DEV.	19.29
RRMSE	3.116

EMPLOYMENT MANUFACTURING

AVERAGE	334.83
RMSE	4.15
BIAS	-0.48
ST. DEV.	4.12
RRMSE	1.241

UNEMPLOYMENT RATE

AVERAGE	2.57
RMSE	1.13
BIAS	0.97
ST. DEV.	0.56
RRMSE	43.92

AVERAGE HOUERLY WAGE RATE

AVERAGE	78.47
RMSE	2.62
BIAS	-1.44
ST. DEV.	2.19
RRMSE	3.348

AVERAGE HOUERLY WAGE RATE MANUFACTURING

AVERAGE	85.15
RMSE	4.86
BIAS	-4.04
ST. DEV.	2.70
RRMSE	5.716

TRADE BALANCE

AVERAGE	5 391
RMSE	2 568
BIAS	1 610
ST. DEV.	2 000
RRMSE	47.64

INVENTORY CHANGES

AVERAGE	1 977
RMSE	1 065
BIAS	-477
ST. DEV.	952
RRMSE	53.87

APPENDIX 1: LIST OF SECTORS AND COMMODITIES

Table A1.1 Commodity and sector classification, classification of consumption and investment, and determination of basic variables[1]

Commodities	Domestic production[1]	Inventory change	Exports	Imports	Domestic price	Export-price
10 Primary sector products	X	X	X	E	X	X
15 Food, clothing etc.	ER[2]	ER[2]	ER	ER	ER	ER
25 Wood products, printing etc.	ER[2]	ER[2]	ER	ER	ER	ER
30 Raw-materials from mining and manufacturing	ER[2]	ER[2]	ER	ER	ER	ER
40 Refined petroleum products	E	X	X	E	ER	ER
45 Machinery and metal products	ER[3]	ER[3]	ER	ER	ER	ER
50 Ships and drilling platforms	E	X	X	X	ER	ER
55 Buildings and constructions	E	-	-	-	ER	-
60 Ocean transport services	E	-	X	-	X	X
66 Crude oil	X	X	X	E	X	X
67 Natural gas	E	E	X	-	-	ER
68A Drilling and pipeline transport	E	X	X	E	X	X
70 Domestic transport	E	-	ER	E	ER	ER
71 Power supply	X	-	E	X	X	X
80 Various services	E	-	ER	E	ER	ER
81 Wholesale and retail trade	E	-	ER	E	ER	E
83 Housing services (gross rents)	E	-	-	-	X	-
90 Public goods, civilian	E	-	-	-	ER	ER
92 Public goods, military	E	-	-	-	E	E
Non-competing imports						
00 Food	-	X	-	E	-	-
01 Raw materials	-	X	-	E	-	-
02 Private transport requirement	-	X	-	E	-	-
05 Working expences in ocean transport	-	-	-	E	-	-
06 Oil production services	-	X	-	E	-	-
19 Other non-comp. imports	-	X	-	E	-	-
36 Norwegians' consumption abroad	-	-	-	E	-	

Note: X:exogenous varible; E: endogenous variable; ER: endogenous variable determined by an econometric relation; -: variable does not exist or has insignificant value.

[1] Most sectors produce other commodities than those of which it is the main producer (cf. table A2.1 in Appendix 2). This has not been taken into account in the classification above. [2] Inventory change and domestic production are determined simultaneously. (Se section 3.4). [3] Orders and domestic production are determined simultaneously.

Table 1 (cont.). Sectoral demand components[1]

Sector	Gross investment by kind					
	Ships	Oil platforms[2] M1	M2	M3	Buildings- and con- struction	Machinery and equip- ment
10 Primary industries	-	-	-	-	ER	ER
15 Food and clothing industries	-	-	-	-	ER	ER
25 Wood and printing industries	-	-	-	-	ER	ER
30 Mining and raw materials industries	-	-	-	-	ER	ER
40 Refineries	-	-	-	-	X	X
45 Metal manufacturing industries	-	-	-	-	ER	ER
50 Shipbuilding and manufacture of oil platforms	-	-	-	-	ER	ER
55 Building and construction	-	-	-	-	X	X
60 Ocean transport	X	-	-	-	-	-
65 Oil production etc.	-	X	X	X	X	E
70 Domestic transport	-	-	-	-	ER	ER
71 Power supply	-	-	-	-	X	X
80 Production of various services	-	-	-	-	ER	ER
81 Wholesale and retail trade	-	-	-	-	-	ER
83 Production of housing services	-	-	-	-	ER	-
90 Public sector, civilian	-	-	-	-	X	X
92 Public sector, military	-	-	-	-	-	-

Consumption category	
99 Total consumption	ER
00 Food	ER
10 Other non-durable goods	ER
20 Semi-durable goods	ER
30 Personal transport equipment	ER
40 Other durable goods	ER
50 Gross rents (housing services)	ER
60 Other services	ER
66 Norwegians' consumption abroad	ER

[1] Se note at first page of table 1.

[2] Oil investments in machinery and equipment, divided in M1: Machinery and metal products and services, M2: Ships and drilling platforms M3: Direct imports.

APPENDIX 2: INPUT-OUTPUT COEFFICIENTS

Table A2.1 OUTPUT COEFFICIENTS*

Commo-dity	Sector																	Import share	Export share
	10	15	25	30	40	45	50	55	60	65	70	71	80	81	83	90	92		
00 ...	x	x																	
01 ...																			
02 ...						x													
05 ...																			
06 ...										x									
19 ...																			
36 ...																			
10 ...	.85	x	x	x		x												.08	.06
15 ...	x	.79	x	x		x												.29	.17
25 ...		x	.79	.02	.05	.03	x			x	x							.40	.15
30 ...		x	.02	.85	x	x	x											.52	.61
40 ...			x	x	.83													.38	.39
45 ...		x	x	x	x	.81	.15			.08			x					.57	.23
50 ...		x	x	x		x	.78						x					.26	.07
55 ...	.02	x	x	.02	x	x	x	.86		.02	.03	.03	x					.00	.00
60 ...									.95			x						.00	.97
66 ...										.42								.25	.85
67 ...										.31								.00	1.00
68A ..										.12								.05	.39
70 ...									.05		.87							.03	.10
71 ...												.75						.01	.01
80 ...		x	x	x		x	x			.02		x	.92					.00	.03
81 ...		x	.02	.02	x	x	x							.58				.01	.09
83 ...															1.00			.00	.00
90 ...																1.00		.00	.00
92 ...																	1.00	.00	.05
∑	.88	.82	.86	.93	.89	.89	.95	.86	1.00	.98	.90	.79	.93	.58	1.00	1.00	1.00		

* The 17 first columns contain the values of the A^{x}_{ij} coefficients from equation 3.1.1, i.e. the value of output of each commodity in basic value as share of total gross production in producers' value in each sector. The last two columns show imports of each commodity as a share of total supply of the same commodity and exports of each commodity as a share of total domestic production of the commodity, respectively. Coefficients with values less than 0.02 are not reported, but denoted by x. The coefficients are calculated from data at current prices from the annual national accounts for 1986.

Table A2.2 INPUT COEFFICIENTS - intermediate inputs*

Commodity	Sector																
	10	15	25	30	40	45	50	55	60	65	70	71	80	81	83	90	92
00	x	.05	x	x			x						x			x	
01	x	x	x	x	x	x							x			x	
02	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	.03
05	x								.87		x						
06										.05							
19		x	x	x	x	x	x	x	x	x	.07		.02	.03	x	.02	x
36																	
10	.34	.34	.05	.03	x	x	x	x	x	x	x	x	x	x	x	x	x
15	.20	.28	.02	x	x	x	x	x	x	x	x	x	.04	x	x	.05	.02
25	.02	.03	.27	.11	.02	.07	.03	.33	x	x	.04	x	.06	.09	x	.14	.17
30	.06	.02	.16	.36	x	.16	.12	.07	x	x	x	x	x	.02	x	x	x
40	.04	x	x	x	.09	x	x	.02	x	x	.06	x	x	.02	x	.02	.02
45	.02	.03	.07	.06	x	.35	.31	.15	x	.34	.12	.02	.03	.04	x	x	.24
50	.04	x	x	x	x	x	.20	x	.06	.06	.02	x	x	x		x	x
55	.05	x	x	.02	x	x	x	.06	x	.06	.09	.04	.04	x	.61	.22	.18
60		x	x	x	x	x	x		x	x	x		x	x		x	x
66					.69												
67																	
68A										.02							
70	.02	.03	.07	.04	.02	.06	.03	.03	.02	.08	.23	x	.08	.20	.02	.10	.04
71	x	x	x	.08	x	.02	x	x		x	x	.72	.03	x	x	.06	x
80	.02	.03	.10	.04	x	.08	.13	.09	x	x	.18	.03	.53	.40	.11	.19	.05
81	.04	x	.05	.04	.03	.05	.03	.07	x	.21	.04	x	.04	.05	x	.07	.09
83																	
90	x	x	x	x	x	x	x	x	x	x	.02	x	.02	.03	.10	x	x
92	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
∑	.86	.82	.83	.83	.87	.85	.86	.83	1.00	.99	.88	.85	.92	.81	.85	.93	.89

* The table contains the value of the Λ^{M}_{ij} coefficients from equation 3.1.1, i.e. the input of each commodity at basic value as a share of total inputs at market value in each sector. Coefficients with values less than 0.02 are not reported, but denoted by x. The coefficients are calculated data at current prices from the annual national accounts for 1986.

Table A2.3 INPUT COEFFICIENTS - private consumption and investment*

Commodity	Consumption category								Kind of investment					
	00	10	20	30	40	50	60	66	JB	JS	JM	J01	J02	J03
00	.02													
01	x													
02				.24							.10			
05														
06									x					1.00
19														
36								1.00						
10	.07	x	.03				x		x					
15	.51	.07	.30		.10		x			x	x			
25	x	.06	.18		.20		.03		x	x	.09			
30		x	x				x		x	x	x	.02		
40		.04							x					
45	x	.02	.03	.05	.22		x		x	.08	.44	.43		
50			x		.05					.90	x		1.00	
55						x			.78			.09		
60							x							
66														
67														
68A									.04					
70			x				.22		x			.09		
71		.15												
80		.07	x		x		.57		.05	x	x	.34	x	
81	.26	.16	.31	.26	.26		.02		x	.02	.18	.03		
83						.96								
90		x	x		x	.04	.05							
92														
$\sum$	.84	.59	.85	.55	.81	1.00	.91	1.00	.90	1.00	.85	1.00	1.00	1.00

For investment, the following abbreviations are used:
JB: buildings
JS: ships
JM: machinery and equipment
JO: oil producing constructions

The table contains the value of the A_{ij}^{C} and A_{ij}^{J} coefficients from equation 3.1.1, i.e. the input of each commodity at basic value as shares of total use at market value in each category of consumption or kind of investment. Coefficients with values less than 0.02 are not reported, but denoted by x. The coefficients are calculated from data at current prices from the annual national accounts for 1986.

APPENDIX 3: COEFFICIENT ADJUSTMENT

All the behavioural equation in the KVARTS model are estimated on basis of 1980-fixed price figures. It is these "1980" coefficients which are reported in appendix 4. The model however, is normally used with fixed price data from the same year as the current Quarterly National Accounts. The coefficients in the KVARTS86 model are therefore adjusted from the outcome of the estimation, into what we could call 1986-coefficients. Let us give an example:
We have the following linear equation:

(A3.1) $^{80}X_t = {}^{80}a + {}^{80}b \cdot {}^{80}W_t$

where ^{80}a and ^{80}b are the estimated coefficients as result of regressing ^{80}X on ^{80}W, which both are 1980-fixed price variables. When we transfer the estimated coefficients ^{80}a and ^{80}b to 1986-coefficients, we take basis in that
$^{80}X \cdot k_x$ and $^{80}W \cdot k_w$ are the 1986-fixed price values of the two time series, assuming k_x and k_w to be constants. The equation (A3.1) can be transformed to

(A3.2) $k_x \cdot {}^{80}X_t = k_x \cdot [{}^{80}a + {}^{80}b \cdot (k_w/k_w) \cdot {}^{80}W_t]$

The equation (A3.2) is equivalent with:

(A3.3) $k_x \cdot {}^{80}X_t = k_x \cdot {}^{80}a + (k_x/k_w) \cdot {}^{80}b \cdot k_w \cdot {}^{80}W_t$

From (A3.3) we se that adjusting the two coefficients to

(A3.4) $^{86}a = k_x \cdot {}^{80}a$

(A3.5) $^{86}b = (k_x/k_w)\,{}^{80}a$

the equation

(A3.6) $^{86}X_t = {}^{86}a + {}^{86}b \cdot {}^{86}W_t$

will express the same as (A3.1) but in 1986-fixed prices. This is in principle the way all coefficients in the model are adjusted. The assumption that the linking factors k_x and k_w are constant is almost never exactly fullfiled. The reason behind this is that the linking of data in the Quarterly National Account is done at a more disaggregated level than the KVARTS sector level. Changes in the relative weights of the subsectors, will normally generate variations in the proportion between the fixed price figures in 1986- and 1980 prices overtime:

Assume the KVARTS variable X consists of the two variables X^1 and X^2 from the quarterly National Accounts, we have in 1980-prices:

(A3.7) $^{80}X_t = {}^{80}X_t^1 + {}^{80}X_t^2$

By multiplying with the current linking factors we get the same equation in 1986 prices:

(A3.8) $(k_x^{80} \cdot X_t) = (k_1^{80} \cdot X_t^1) + (k_2 \cdot {}^{80}X_t^2)$

The linking factors k_1 and k_2, for the Quarterly National Accounts variables are constant over time, as result of the way these fixed price variables are made. From (A3.8) we might get the following expression for the linking factor k_x:

$$\text{(A3.9)} \quad k_x = k_1 \cdot ({}^{80}X_t^1/{}^{86}X_t) + k_2 \cdot ({}^{80}X_t^2/{}^{86}X_t)$$

From (A3.9) we see that k_x is independent of time t only when:

a) $k_1 = k_2$

or

b) $\frac{{}^{80}X_t^i}{{}^{80}X_t}$ is constant for both i=1 and 2 at all points of time.

Neither a) or b) will normally be exactly fullfilled as long as the sector level are different, which is the case for most of the sectors. But as long as the prices at the subsector level develope similarly, or k_1 and k_2 do not differ much, the failure we are doing when assuming k to be constant, is negligible. This is however not always the case, and then we have an unsolved problem, when such time dependent linking factors are required in the coefficent adjustment.

The only way to solve this problem 100 prosent correctly, is to reestimate the equations with fixed prices from the base year by all changes in the base year. An easier way would be to reestimate only the equations with variations in the linking factors over a certain level. So far we have not used any of these sophisticated procedures, but used linking factors from a random period in the coefficient adjustment mentioned above.

APPENDIX 4: TECHNICAL DOCUMENTATION OF BEHAVIOURAL EQUATIONS

1. PRIVATE CONSUMPTION

Definitions:

C99 - Aggregate private consumption (volume)

VC99EB - Private consumption excl. housing (gross rents), value.

PC99 - Deflator private consumption.

PC99EB - Deflator private consumption excl. housing.

Ck - Consumption, category $k \varepsilon$ (00,10,20,30,40,50,60,66), volume.

JB83KUM - Accumulated housing investments - since 1970.1, volume.

PCk - Price index, consumption category k.

RHTOT - Households' disposable incomes, value.

LAAN - Households' gross debt to the banks and insurance companies, value.

DKVq - Dummy variable for quarter; 1 in quarter q, 0 otherwise.

DKVMOMS - Dummy variable for VAT. 1 in 1969.4, -1 in 1970.1, otherwise 0.

α_k - Share of C70 (foreigners' consumption in Norway) taken from consumption category k.

The macro consumption function

```
C99 = (A.CA01•DKV1+A.CA02•DKV2+A.CA03•DKV3+DKV4)•
      (SUM(I = -7 TO 0 : A.CA42(I)•RHTOT(I)/
      PC99(I))+SUM(I = -3 TO 0 : A.CA55(I)•(DEL(1 : LAAN(I))/
      PC99(I))+A.CA80•DKVMOMS+A.CA00)
```

Coefficient	Point estimate, st. deviation in parenthesis
A.CA01	0.8638 (0.00597)
A.CA02	0.9050 (0.00715)
A.CA03	0.9086 (0.055)
A.CA42	0.1674 (0.0697)
(-1)	0.1593 (0.0361)
(-2)	0.1475 (0.0104)
(-3)	0.1321 (0.0014)
(-4)	0.1130 (0.0230)
(-5)	0.0903 (0.0279)

(-6)	0.0639 (0.0258)
(-7)	0.0338 (0.0165)
Sum lag coef.	0.907 (0.034)
Mean lag	2.616 (0.541)
Restrictions on lag polynomial	2. degree tail.
A.CA55	0.0849 (0.0437)
(-1)	0.1195 (0.0558)
(-2)	0.1038 (0.0482)
(-3)	0.0377 (0.0753)
Sum lag coef.	0.346 (0.161)
Mean lag	1.272 (0.765)
Restrictions on lagpolynomial	2. degree head.
A.CA80	1488.52 (416.43)
A.CA00	3487.48 (693.25)
Estimation method	Non-linear least squares with almon lag.
Estimation period	1967.4-1984.4
SER	539.35
RVC	1.82
DW	1.64

The distributing equations.

$(Ck-\alpha_k \cdot C70)$ = A.CGk + A.CBk/PCk•(VC99EB/10000-(PC00•A.CG00 + PC10•A.CG10+PC20•A.CG20 + PC30•A.CG30 + PC40•A.CG40 + PC60•A.CG60 + PC66•A.CG66)) + (A.CDk1 + A.CNk1•DKVBRUDD)•(PC99EB/PCk)• DKV1/10 + (A.CDk2 + A.CNk2•DKVBRUDD)•(PC99EB/PCk)•DKV2/10 + (A.CDk3 + A.CNk3•DKVBRUDD)•PC99EB/PCk)• DKV3/10 + (A.CDk4 + A.CNk4•DKVBRUDD)•(PC99EB/PCk)•DKV4/10

for k = 00,10,20,30, 40 and 66 where one of A.CDk = A.CNk = 0 to fullfill the adding-up condition . This is indicated by 0 in the table below. For the last consumption category the following applies:

(C60+C70)/1000 = A.CG60 + ((1-A.CB00-A.CB20-A.CB30-A.CB40-A.CB50-A.CB66)/ PC60•(VC99EB/10000-(PC00•A.CG00 + PC10• A.CG10 + PC20•A.CG20 + PC30•A.CG30 + PC40•A.CG40 + PC60•A.CG60 + PC66•A.CG66)) + seasonals with similar adding-up conditions implemented in the coefficient expression.

The equations are renormed by dividing by 1000 due to estimation problems.

Coefficient	00 Food	10 Other non-durable goods	20 Semi-durable goods	30 Purchase of transport equipment	40 Other denable goods	60 Other services	66 Norwegians' consumption abroad
	Consumption category						
A.CBk	0.133	0.277	0.106	0.109	0.088	0.185	0.102
A.CGk	0.474	0.252	0.309	-0.056	-0.113	0.337	0.022
A.CDk1	-0.382	0.782	-0.228	0.172	0	0	0
A.CNk1	0.012	0.092	-0.133	0.029[1]	0	0	0
A.CDk2	0.019	-.137	0.126	0	-0.408	0.068	0.468
A.CNk2	-0.322	0.845	-0.161	0	-0.000	-0.197	-0.395
A.CDk3	0	0.624	0	-0.392	0.018	-0.155	1.153
A.CNk3	0	0.363	0	0.151	-0.021	-0.110[1]	0.603
A.CDk4	0.381	0	1.072	-0.854	0.318	0.839	-0.078
A.CNk4	0.110	0	-0.250	0.018	0.152	0.292[1]	-0.322
Engel-elastisiteter	0.56	1.26	0.64	1.89	1.08	1.04	1.69
Direkte priselastisiteter	-0.348	-0.696	-0.400	-0.688	-0.532	-0.482	-0.890
SER	0.0102	0.0262	0.0124	0.0206	0.2053	0.0227	0.020
RVC	1.67	4.63	2.83	13.80	10.22	4.44	11.89
DW	2.34	0.98	0.88	1.28	0.78	0.66	1.26

[1] The parameter follows as the sum of the other coeffisients in the same row, but of opposite sign.

Estimation period: 1966.1 - 1984.4

Estimation method: Full-information maximum likelihood.

Equation for consumption of housing services (gross rents):

C50 = A.GC50+A.GTC50•TID+A.GJB83•JB83KUM+B.G01C50.DKV1 + B.G02C50•DKV2 + B.G03C50•DKV3 + B.BRC50•BRUDDC50

Coefficient	Point estimate, standard deviations in parentheses
A.GD1C50	5376.25 590.09
A.GD2C50	-141.188 25.71
A.GD3C50	0.0514 0.0074
B.GDIC50	56.82 (6.86)
B.G02C50	50.48 (7.41)
B.G03C50	26.74 (6.81)
B.BRC50	12.88 (9.35)

Estimation method	OLS
Estimation period	1978.1-1985.4
SER	12.85
RVC	0.35
DW	0.72

2. REALINVESTMENTS

Variable definitions

Kaj - Stock of real capital of kind a in sector j

PIaj - Deflator gross investment of kind a in sector j

Xj - Gross production in sector j

YKj - Gross operating surplus in sector j

DKVq - Dummy variable for quarter q which are 1 in quarter q and 0 otherwize.

The equations are in general:

$$\text{DEL}(1: Kaj) = A.GXaj \cdot \text{DEL}(4: Xj) + A.GYaj \cdot (YKj/(\Sigma_\alpha PIaj \cdot Kaj_{-1})) + B.GD1aj \cdot DKV1 + B.GD2ak \cdot DKV2 + B.GD3aj \cdot DKV3 + (-B.GD1aj - B.GD2aj - B.GD3aj) \cdot DKV4$$

where $\text{DEL}(i:x_j) = X_j - X_{j-i}$

Investments in constructions

Coefficient	Sector 10	Sector 30	Sector 50
A.GYBj[1]	1591.650 (240.641)	-	-
(-1)	2387.470 (360.961)	-	-
(-2)	2387.470 (360.961)	316.997 (657.718)	190.325 (106.803)
(-3)	1591.650 (240.641)	421.068 (404.724)	168.848 (65.887)
(-4)		494.968 (207.797)	147.914 (35.492)
(-5)		538.697 (117.814)	127.524 (24.586)
(-6)		552.254 (174.722)	107.677 (33.704)
(-7)		535.640 (243.354)	88.373 (43.970)
(-8)		488.854 (278.448)	69.612 (48.938)
(-9)		411.898 (272.967)	51.394 (47.301)
(-10)		304.770 (225.107)	33.720 (38.682)
(-11)		167.471 (134.215)	16.588 (22.937)
Sum of lag-coef.	8 000 (1.200)	4 000 (925.680)	1 000 (193.173)
Mean lag.	1.500 (0.227	4.176 (1.897)	2.911 (1.448)
Restrictions on lagpolynomial	2. degree tailrestr.	2. degree tailrestr.	2. degree tailrestr.
A.GXBj	0.0379 (0.0479)		

Coefficient	Sector 10	30	50
(-1)	0.0478 (0.0396)		
(-2)	0.0561 (0.0342)		
(-3)	0.0627 (0.0317)		
(-4)	0.0677 (0.0316)		
(-5)	0.0711 (0.0328)		
(-6)	0.0728 (0.0345)		
(-7)	0.0729 (0.0359)		
(-8)	0.0713 (0.0365)		
(-9)	0.06815 (0.03623)		
(-10)	0.0633 (0.0349)		
(-11)	0.0569 (0.0323)		
(-12)	0.0488 (0.0285)		
(-13)	0.0390 (0.0234)		
(-14)	0.02765 (0.0169)		
(-15)	0.0147 (0.0091)		
The increase in Xj refer to	Last year		
Sum of lag.coef.	0.879 (0.406)		
Mean lag	6 899 (3 050)		
Restriction on lagpolynomial	2. degree tailrestr.		
B.GD1Bj	-199.405 (19.32)	-9.609 (8.556)	-1.892 (3.856)
B.GD2Bj	165.500 (19.170)	-17.153 (8.629)	-2.142 (3.810)
B.GD3Bj	201.389 (19.375)	-5.630 (8.547)	-4.333 (3.818)
RHO1	0.5347	0.7369	0.6600
Estimation periode	1970 4- 1983 4	1969 4- 1983 4	1969 4- 1983 4
Estimation method	CORC	CORC	CORC
SER	97.92	50.06	21.56
RVC	32.99	48.41	49.54
DW	1.68	2.21	2.08

[1] Gross operating surplus measured relative to the value of the total capital stock in the beginning of the quarter is the liquidity variable.

Coefficient	Sector 15	25	45	70	80
A.GYBj	0.0067 (0.0251)	-		-	0.0203 (0.0402)
(-1)	0.0100 (0.0167)	- -		- -	0.0704 (0.0143)
(-2)	0.0126 (0.0095	0.0513 (0.0182)		0.1138 (0.0512)	0.0837 (0.0234)
(-3)	0.0144 (0.0036)	0.0461 (0.0184)		0.1018 (0.0595)	0.0602 (0.0210)
(-4)	0.0156 (0.0021)				
(-5)	0.01605 (0.0056)				
(-6)	0.0158 (0.0082)				
(-7)	0.0149 (0.0097)				
(-8)	0.0133 (0.0100)				
(-10)	0.0081 (0.0073)				
(-11)	0.0044 (0.0042)				
Sum of lag-coef.	0.143 (0.012)	0.097 (0.013)		0.216 (0.078)	0.2348 (0,028)
Mean lag	5.289 (2.667)	0.473 (1.325)		0.472 (1.483)	1.350 (1.177)
Restrictions on lag polynomial	2. degree tailrestr.	2. degree tailrestr.		2. degree tailrestr.	2. degree tailrestr.
A.GXBj		-	0.0246 (0.0090)	0.2679 (0.0573)	0.0885 (0.0384)
(-1)		7.3129E-5 (0.0082)	0.0245 (0.0072)	0.2429 (0.0484)	0.0978 (0.0365)

Coefficient	Sector 15	25	45	70	80
(-2)		0.0074	0.0242	0.2190	0.1052
		(0.0075)	(0.0059)	(0.0471)	(0.0422)
(-3)		0.0138	0.0237	0.1962	0.1105
		(0.0080)	(0.0051)	(0.0513)	(0.0507)
(-4)		0.0190	0.0231	0.1745	0.1139
		(0.0091)	(0.0049)	(0.0578)	(0.0591)
(-5)		0.0232	0.0222	0.1540	0.1153
		(0.0103)	(0.0050)	(0.0643)	(0.0663)
(-6)		0.0264	0.0211	0.1345	0.1148
		(0.0113)	(0.0053)	(0.0696)	(0.0717)
(-7)		0.0285	0.0199	0.1161	0.1122
		(0.0120)	(0.0056)	(0.0732)	(0.0750)
(-8)		0.0295	0.0184	0.0988	0.1077
		(0.0124)	(0.0058)	(0.0747)	(0.0761)
(-9)		0.0295	0.0168	0.0826	0.1011
		(0.0124)	(0.0058)	(0.0740)	(0.0749)
(-10)		0.0285	0.0150	0.0675	0.0926
		(0.012)	(0.0056)	(0.0708)	(0.0714)
(-11)		0.0264	0.0130	0.0535	0.0822
		(0.0110)	(0.0053)	(0.0653)	(0.0655)
(-12)		0.0232	0.0108	0.0406	0.0697
		(0.0097)	(0.0047)	(0.0573)	(0.0572)
(-13)		0.0190	0.0084	0.0288	0.0552
		(0.0080)	(0.0039)	(0.0467)	(0.0465)
(-14)		0.0137	0.0058	0.0181	0.0388
		(0.0058)	(0.0028)	(0.0337)	(0.0334)
(-15)		0.0074	0.0030	0.0085	0.0204
		(0.0031)	(0.0015)	(0.0181)	(0.0179)
The increase in Xj refers to		last quarter	last year	last quarter	last year
Sum of lag coef.		0.296	0.274	1.903	1.4258
		(0.128)	(0.062)	(0.795)	
Mean lag		7.494	5.713	4.412	
		(1.731)	(1.116)	(3.123)	
Restrictions on lagpolynomial		2. degree tailrestr.	2. degree tailrestr.	2. degree tailrestr.	2. degree tailrestr.
B.GD1Bj	-19.001	-8.610	-22.895	5.146	15.134
	(5.718)	(6.446)	(4.290)	(22.092)	(19.283)
B.GD2Bj	-4.188	-4.237	-6.789	-18.355	3.237
	(6.509)	(5.642)	(4.276)	(21.393)	(14.755)
B.GD3Bj	15.408	-23.036	-8.714	17.625	-38.690
	(5.460)	(4.190)	(4.290)	(15.845)	(16.286)
B.BRBj[1]				-143.867	
				(68.050)	
RHO1	0.4844	0.6287	0.7692	0.6943	0.6367
Estimation period	1969.4-1983.4	1970.4-1983.4	1970.4-1983.4	1970.4-1983.4	1970.4-1985.4
SER	28.16	19.60	24.61	67.06	82.48
RVC	33.93	20.41	37.06	29.42	
DW	2.16	2.10	2.28	2.00	2.06

[1] Dummyvariable 1 in 1983.1, 0 else.

Investment in machinery and equipment

	Sector					
Coefficient	10	15	50	70	80	81
A.GYMj	0.0843 (0.0276)	-	-	0.0461 (0.0940)	0.0229 (0.0241)	
(-1)	0.0887 (0.0228)	0.0031 (0.0229)	-	0.0817 (0.0132)	0.0345 (0.0098)	
(-2)	0.0919 (0.0196)	0.0086 (0.0099)	-	0.0859 (0.0475)	0.0268 (0.0168)	
(-3)	0.0937 (0.0181)	0.0121 (0.0025)	-	0.0587 (0.0467)		
(-4)	0.0942 (0.0180)	0.0136 (0.0072)	0.0092 (0.0128)			
(-5)	0.0935 (0.0186)	0.0132 (0.0103)	0.0093 (0.0085)			
(-6)	0.0915 (0.0120)	0.0107 (0.0102)	0.0093 (0.0048)			
(-7)	0.0881 (0.0203)	0.0064 (0.0067)	0.0090 (0.0021)			
(-8)	0.0835 (0.0207)		0.0087 (0.0019)			
(-9)	0.0776 (0.0205)		0.0081 (0.0034)			
(-10)	0.0704 (0.0197)		0.0075 (0.0047)			
(-11)	(0.0619 (0.0183)		0.0067 (0.0054)			
(-12)	0.0521 (0.0616)		0.0056 (0.0055)			
(-13)	0.0410 (0.1323)		0.0044 (0.0050)			
(-14)	0.0286 (0.0096)		0.0031 (0.0039)			
(-15)	0.0150 (0.0052)		0.0016 (0.0023)			
The increase in YKj/PjMj refers to	last year	last quarter	last quarter	last quarter	last quarter	
Sum of lag-coef.	1.156 (0.230)	0.068 (0.014)	0.082 (0.014)	0.272 (0.044)	0.0842	
Mean lag	6,140 (1,361)	3.224 (3.072)	4.308 (2.447)	1.577 (0.944)		
Restrictions on lagpolynomial	2.degree tail	2.degree tail	2.degree tail	2.degree tail	2.degree tail	2.degree tail
A.GXMj		0.202 (0.0067)	0.0141 (0.0057)	0.2639 (0.0968)	0.0440 (0.0213)	0.0150 (0.0284)
(-1)		0.0203 (0.0058)	0.0216 (0.0042)	0.2325 (0.0982)	0.0220 (0.0107)	0.0437 (0.0197)
(-2)		0.0201 (0.0054)	0.0264 (0.0041)	0.1780 (0.1030)		0.0669 (0.0149)

Coefficient	Sector 10	15	50	70	80	81
(-3)		0.0196 (0.0055)	0.0286 (0.0045)	0.1005 (0.0730)		0.0848 (0.0146)
(-4)		0.0187 (0.0056)	0.0281 (0.0048)			0.0971 (0.0168)
(-5)		0.0175 (0.0057)	0.0250 (0.0045)			0.1041 (0.0192)
(-6)		0.0160 (0.0057)	0.0193 (0.0037)			0.1055 (0.0209)
(-7)		0.0142 (0.0054)	0.0110 (0.0022)			0.1016 (0.0212)
(-8)		0.0120 (0.0049)				0.0922 (0.0201)
(-9)		0.0095 (0.0042)				0.0773 (0.0175)
(-10)		0.0067 (0.0031)				0.0570 (0.0133)
(-11)		0.0035 (0.0017)				0.0312 (0.0074)
The increase in Xj refers to		last year	last year	last year	last year	last quarter
Sum of lag.coef.		0.178 (0.052)	0.174 (0.027)	0.775 (0.327)	0.0660	0.876
Mean lag		4.284 (0.521)	3.390 (0.423)	1.149 (0.237)		
Restrictions on lagpolynomial		2.degree tailrestr.	2.degree tailrestr.	2.degree tailrestr.	2.degree tailrestr.	2.degree tailrestr.
B.GD1Mj	-49.660 (18.007)	-35.903 (6.136)	-8.268 (5.320)	37.239 (44.058)	3.692 (11.047)	
B.GD2Mj	43.195 (17.915)	-4.327 (5.838)	-12.470 (4.573)	33.491 (33.256)	9.566 (11.179)	
B.GD3Mj	-28.987 (18.019)	-29.513 (6.740)	-5.207 (6.410)	-106.203 (37.212)	-38.471 (11.036)	
RHO1	0.5191	0.1781	0.2610	0.1475	0.5862	
Estimation period	1970.4- 1983.4	1969.4- 1983.4	1969.4- 1983.4	1969.4- 1983.4	1970.4- 1985.4	1970.4- 1985.4
Estimation method	CORC	CORC	CORC	CORC	CORC	CORC
SER	91.51	26.15	20.94	103.90	62.25	118.84
RVC	65.96	37.07	72.60	56.62		
DW	2.29	1.98	2.05	1.77	2.06	1.69

Coefficient	Sector 25	30	45
A.GYMj[1]	-	211.668 (70.998)	157.439 (282.923)
(-1)	90.260 (938.413)	388.058 (130.163)	201.746 (188.601)
(-2)	875.752 (376.537)	529.170 (177.495)	235.613 (107.591)
(-3)	845.666 (632.228)	635.005 (212.994)	259.038 (41.478)
(-4)		705.561 (236.660)	272.021 (25.814)
(-5)		740.839 (248.493)	274.563 (63.879)
(-6)		740.839 (248.493)	266.664 (92.919)
(-7)		705.561 (236.660)	248.324 (109.554)
(-8)		635.005 (212.994)	219.542 (113.421)
(-9)		529.171 (177.495)	180.318 (104.426)
(-10)		388.059 (130.163)	130.654 (82.534)
(-11)		211.669 (70.998)	70.548 (47.728)
Sum of lag.coef.	2000 (564.064)	6000 (2200)	3000 (169.502)
Mean lag	1.417 (0.895)	5.500 (1.845)	5.051 (1.760)
Restrictions on lagpolynomial	2.degree tailrestr.	2.degree tailrestr.	2.degree tailrestr.
A.GXMj	0.0340 (0.0188)		
(-1)	0.0415 (0.0202)		

Coefficient	Sector 25	30	45
(-2)	0.0472 (0.0247)		
(-3)	0.0510 (0.0292)		
(-4)	0.0529 (0.0328)		
(-5)	0.0529 (0.0349)		
(-6)	0.0510 (0.0353)		
(-7)	0.0472 (0.0340)		
(-8)	0.0415 (0.0309)		
(-9)	0.0340 (0.0259)		
(-10)	0.0245 (0.0191)		
(-11)	0.0132 (0.0105)		
The increase in Xj refers to	last quarter		
Sum of lag.coef.	0.491 (0.297)		
Mean lag	4.950 (2.2217)		
Restrictions on lagpolynomial	2.degree tailrestr.		
B.GD1Mj	-56.834 (11.314)	-82.531 (17.542)	-47.688 (7.945)
B.GD2Mj	-14.605 (11.880)	13.236 (17.511)	-4.850 (7.733)
B.GD3Mj	-4.695 (19.394)	-31.993 (17.541)	-1.805 (7.886)
RHO1	0.6309	0.7650	0.2687
Estimation period	1970.4-1983.4	1969.4-1983.4	1969.4-1983.4
Estimation method	CORC	CORC	CORC
SER	43.60	104.37	36.27
RVC	39.61	71.52	37.08
DW	2.22	2.40	2.14

[1] Gross operating surplus measured relative to the value of the total capital stock in the beginning of the quarter is the liquidity variable.

HOUSING INVESTMENT

Variable definitions:

BLAANHUS - Granted loans in the Governental Bank of Housing

FOLK20 - Number of people by the age between 20 and 30 years

KB83 - Stock of housing capital at fixed prices

PC99 - Deflator of private consumption

PJB83 - Deflator of gross investments in housing capital

RHTOT - Value of the households disposable income

TRBOL - Yearly interest on buildingloan

XSBOL - Housing starts in square meters

JB83 - Gross investment in housing capital at fixed prices

DKVq - Seasonal dummy for quarter q, 1 in quarter, 0 otherwise

DKVBRUDD - Dummyvariable for changed seasonal pattern, 1 in 1966.1 - 1977.4, 0 otherwise

Equation for housing starts in square meters:

```
XSBOL/KB83(-1)  =  A.DXSR • LOG(RHTOT/PC99) + A.DXSPJ•LOG(PJB83/PC99) + A.DXSTR • (TRBOL -
                   DEL(4:PJB83)/PJB83(-4)) + A.DXSK • LOG(KB83(-1)) + A.DXSXS • XSBOL(-1)/KB83(-2) +
                   SUM(I = -3 TO 0 : A.DXSLAL(I) • BLAANHUS(I)/(KB83    (I-1) • PJB83(I))) +
                   A.DXSGF20•FOLK20 + B.DXSD1•DKV1 + B.DXSD2•DKV2 + B.DXSD3•DKV3 + B.DXSD4•DKV4 +
                   B.DXSBR1•DKVBRUDD•DKV1 + B.DXSBR2•DKVBRUDD•DKV2 + B.DXSBR3•DKVBRUDD•DKV3 +
                   B.DXSBR4•DKVBRUDD•DKV4
```

Coefficient	Estimate
A.DXSR	3.2529 (3.1962)
A.DXSPJ	-11.0542 (4.9099)
A.DXSTR	-3.4331 (2.7631)
A.DXSK	-5.3835 (2.5754)
A.DXSXS	0.0392 (0.1139)
A.DXSLAL	79.6196 (43.3109)
(-1)	74.2825 (37.4025)
(-2)	59.2335 (36.8354)
(-3)	34.4727 (25.8565)
Sum lag-coef.	247.6083 (124.675)
Average lag	1.196 (0.742)
Restriction on lag polynomial	2. grad, tail restr.
A.DXSG	0.0355 (0.0311)
B.DXSD1	27.9470 (15.4303)
B.DXSD2	29.9398 (15.2809)
B.DXSD3	29.8439 (15.4677)
B.DXSD4	28.6824 (15.5060)
B.DXSBR1	-0.2273 (0.3550)
B.DXSBR2	0.0203 (0.3519)
B.DXSBR3	0.2702 (0.3511)
B.DXSBR4	1.2948 (0.3635)
Estimation method	OLS (with Almon-lag)
Estimation period	1968.1-1984.4
SER	0.4107
RVC	8.8
DW	1.75

Equation for housing investment:

JB83 = T.DVEKT • SUM(I = -10 TO 0 : A.DVEKT(I) • XSBOL(I))

A.DVEKT is a lag distribution of coefficients transferring housing starts to investments, calculated with basis in the building floorage statistics. Element j in A.DVEKT is the share of the total production of a house which was started in period t, that is finished in period t + j. T.DVEKT is an exogenouscorrection series. The coefficients in A.DVEKT are:

A.DVEKT (0)	0.323767
(-1)	0.291167
(-2)	0.184567
(-3)	0.1015
(-4)	0.051067
(-5)	0.0245
(-6)	0.011833
(-7)	0.0059
(-8)	0.003067
(-9)	0.0016
(-10)	0.0007

3. EXPORTS

Definitions

Ei - Exports, commodity i, volume.

PEi - Price index, exports of commodity i.

MIIi - Indicator of imports in Norway's main trading partners, volume, commodity i.

DKVq - Seasonal dummy, 1 in quarter q, 0 otherwise.

DKVBRUDD - Dummy for changed seasonal pattern. 1 from 1966.1 to 1977.4 0 thereafter.

PICIFi - Import price, commodity i

C70 - Foreigners' consumption in Norway

PC70 - Price index of foreigners' consumption in Norway

UTP70 - Index of foreign consumer prices, in Norwegian currency

UTV70 - Volume index for consumption in other countries

DUM6684 - Dummyvariable, 1 from 1966.1 - 1984.4, 0 thereafter

Demand equations:

log (Ei) = A.HKi + A.HPi • log (PEi/PICIFi) + A.HMi • log(MIIi) + A.HEi • log(Ei(-1))
+ A.HS1i • DKV1 + A.HS2i • DKV2 + A.HS3i • DKV3 + B.HB1i • DKVBRUDD • DKV1 + B.HB2i •
• DVKBRUDD • DKV2 + B.HB3i • DKVBRUDD • DKV3

Coefficient	Commodity 15	25	30	45
A.HKi	3.3402	3.0907	2.3542	4.1209
	(0.8218)	(0.2597)	(0.5904)	(0.3120)
A.HPi	-0.1137	-0.3692	-0.4503	-0.0263
	(0.0582)	(0.0656)	(0.1645)	(0.0095)
(-1)	-0.0853	-0.2461	-	-0.0474
	(0.0436)	(0.0437)	-	(0.0171)
(-2)	-0.0568	-0.1231	-	-0.0632
	(0.0291)	(0.0219)	-	(0.0227)
(-3)	-0.0284	-	-	-0.0738
	(0.0146)	-	-	(0.0265)
(-4)	-	-	-	-0.0791
	-	-	-	(0.0284)
(-5)	-	-	-	-0.0791
	-	-	-	(0.0284)
(-6)	-	-	-	-0.0738
	-	-	-	(0.0265)
(-7)	-	-	-	-0.0632
	-	-	-	(0.0227)
(-8)	-	-	-	-0.0474
	-	-	-	(0.0171)
(-9)	-	-	-	-0.0263
				(0.0095)
Sum lag coef.	-0.284	-0.738	-	-0.579
	(0.145	(0.131)	-	(0.209)
Mean lag	1.000	0.667	-	4.5
	(2.313)	(0.359)	-	(2.2404)
Restrictions on	1. degree	1. degree	-	1. degree
lag distribution	tailrestr.	tailrestr.	-	tailrestr.
A.HMi	0.1600	0.8803	0.1863	0.2246
	(0.0640)	(0.0568)	(0.0507)	(0.0661)
(-1)	-	-	-	0.1764
	-	-	-	(0.0338)
(-2)	-	-	-	0.1339
	-	-	-	(0.0127)
(-3)	-	-	-	0.0972
	-	-	-	(0.0173)
(-4)	-	-	-	0.0662
	-	-	-	(0.0270)
(-5)	-	-	-	0.0410
	-	-	-	(0.0308)
(-6)	-	-	-	0.0216
	-	-	-	(0.0277)
(-7)	-	-	-	0.0079
	-	-	-	(0.0174)
Sum of lag coef.	-	-	-	0.7689
	-	-	-	(0.0728)
Mean lag	-	-	-	1.8089
	-	-	-	(0.6867)
Restricsjons on	-	-	-	2. degree
lag distribution	-	-	-	tailrestr.
A.HEi	0.4741	-	0.6342	-
	(0.1200)	-	(0.0850)	-
A.HS1i	-0.2010	-0.0480	-0.0746	-0.1042
	(0.0329)	(0.0202)	(0.0265)	(0.0385)
A.HS2i	-0.0199	-0.0028)	-0.0278	-0.1222
	(0.0312)	(0.0203)	(0.0264)	(0.0388)
A.HS3i	-0.0876	-0.1014	-0.1801	-0.2154
	(0.0307)	(0.0201)	(0.0285)	(0.0392)
B.HB1i	0.0850	-0.0109)	0.0304	0.0158
	(0.084)	(0.0295)	(0.0317)	(0.0497)
B.HB2i	-0.0485	-0.0236	-0.0281	-0.0200
	(0.0392)	(0.0296)	(0.0314)	(0.0497)
B.HB3i	-0.0042	0.0236	0.0355	0.0218
	(0.0391)	(0.0303)	(0.0310)	(0.0497)
Estimation method	OLS	OLS	OLS	OLS
	Almon-lag	Almon-lag		Almon-lag
Estimation period	1970.1 - 1984.4	1974.1 - 1984.4	1968.1 - 1984.4	1970.1 - 1985.4
SER	0.0638	0.415	0.0541	0.0857
DW	1.98	1.97	1.89	1.67

The equations for commodities 70, 80, 81 are:

log (Ei) = A.HKi + A.HPi • log (PEi/PICIFi) + A.HMi • log (MII45) + A.HLAEi • log (Ei(-1)) + A.HS1i • DKV1 + A.HS2i • DKV2 + A.HS3i • DKV3 + B.HB1i • DKVBRUDD • DKV1 + B.HB2i • DKVBRUDD • DKV2 + B.HB3i • DKVBRUDD • DKV3 + B.HED1i • DUM6684

	Commodity		
Coefficient	70	80	81[1]
A.HKi	2.7915 (0.5018)	2.0775 (2.1339)	1.0239 (0.2710)
A.HPi	-2.2182 (0.1282)		
(-1)	-0.1637 (0.0961)		
(-2)	-0.1091 (0.0641)		
(-3)	-0.0546 (0.0321)		
Sum lag-coef.	-0.546 (0.320)		
Mean lag	1.000 (1.664)		
Restrictions on lag-distribution	1. degree tailrestr.		
A.HMi	0.3278 (0.0472)	0.8585 (0.4410)	0.6346 (0.1236)
(1)	0.2459 (0.0354)		
(2)	0.1639 (0.0236)		
(3)	0.0820 (0.0118)		
Sum lag-coef.	0.819 (0.118)		
Mean lag	1.000 (0.032)		
A.HLAEi	-	-	0.4025 (0.1069)

Commodity Coefficient	70	80	81
Restrictions on lag-distribution	1. degree tail		
A.HS1i	-0.0264		-0.0724
	(0.0302)		(0.0391)
A.HS2i	-0.0280		-0.1289
	(0.0342)		(0.0372)
A.HS3i	0.0450		-0.0959
	(0.0301)		(0.0381)
B.HB1i	-0.1265		
	(0.0393)		
B.HB2i	0.0059		
	(0.0440)		
B.HB3i	0.0265		
	(0.0389		
B.HED1i	-	-0.7284	0.2825
		(0.3960)	(0.0681)
RHO1	0.5832		
Estimation method	OLS, CORC	OLS	OLS
Estimation period	1968.1 - 1984.4	1971.1 - 1985.4	1968.1 - 1985.4
SER	0.077	0.6782	0.1051
DW	2.24	1.96	2.30

[1] Note that market indicator for KVARTS-commodity 15 has been used as export market indicator for commodity 81.

The equation for foreigners' consumption in Norway:

Log (-C70)= A.HKNUT + A.HPUT • log (PC70/UTP70) + A.HMUT • log (UTV70) + A.HS1UT•DKV1 + A.HS2UT • DKV2 + A.HS3UT • DKV3 + B.HB1UT • DKVBRUDD • DKV1 + B.HB2UT• DKVBRUDD • DKV2 + B.HB3UT • DKVBRUDD • DKV3

Coeffisient	
A.HKUT	-12.7903 (.1.4738)
A.HPUT	-0.3172 (0.0914)
(-1)	-0.2115 (0.0609)
(-2)	-0.1057 (0.0305)
Sum of lag-coef.	-0.634 (0.183)
Mean lag	0.667 (0.647)
Restrictions on lag-distribution	1. degree tail
A.HMUT	0.9112 (0.0679)
(-1)	0.6075 (0.0453)
(-2)	0.3037 (0.0226)
Sum of lag-coef.	1.822 (0.136)
Mean lag	0.667 (0.009)
Restrictions on lag-distribution	1. degree tail
A.HS1UT	-0.0867 (0.0283)
A.HS2UT	0.3286 (0.0283)
A.HS3UT	0.7376 (0.0283)
B.HB1UT	-0.0735 (0.0350)
B.HB2UT	-0.0118 (0.0347)
B.HB3UT	0.1086 (0.0340)
Estimations method	OLS with Almon-lag
Estimations period	1968.1 - 1984.4
SER	0.0600
DW	1.61

4. IMPORTS.

Definitions:

IAi - Proportion between supply of imported and domestically produced quantity of commodity i

PICIFi - Import price, commodity i

BHi - Domestic price of Norwegian production of commodity i

DKVq - Seasonal dummy; 1 in quarter q, 0 otherwise

DKVBRUDD - Dummyvariable, 1 until 1977.4, 0 thereafter

Lij - Delivery of commodity i to sector j as share of the activity level in sector j in the base year

LIij - Delivery of imported quantity of commodity i to sector j as share of the activity level in sector j in the base year

LHij - Delivery of Norwegian produced quantity of commodity i to sector j as share of the level of activity in sector j in the base year

w^I_{ik} - Delivery of imported quantity of commodity i to sector j as share of total import of commodity i in the base year

w^N_{ij} - Delivery of Norwegian produced quantity of commodity i to sector j as share of total Norwegian production of commodity i beyond delivery to export in the base year

s^I_{ij} - Delivery of imported quantity of commodity i to sector j as share of total delivery of commodity i to this sector in the base year

s^N_{ij} - Delivery of Norwegian produced quantity of commodity i as share of total delivery of this commodity to this sector

Aj - Activity level in sector j

DIij - Relative input-coefficient for imports, commodity i, sector j

IEi - Inventory change and reexport commodity i

Ii - Total imported quantity of commodity i

Estimation of the elasticity of substitution:

$$\log(IAi) = A.Iki + A.IPi \cdot \log(\sum_j (w^I_{ij}\, s^N_{ij} + w^N_{ij}\, s^I_{ij})) \cdot (BHi/PICIFi) + A.IEi \log(IAi(-1)) +$$

$$B.IS1i \cdot DKV1 + B.IS2i \cdot DKV2 + B.IS3i \cdot DKV3 + B.IB1i \cdot DKVBRUDD \cdot DKV1 +$$

$$B.IB2i \cdot DKVBRUDD \cdot DKV2 + B.IB3i \cdot DKVBRUDD \cdot DKV3 + \sum_j (w^I_{ij} - w^N_{ij}) \cdot \log(A_j)$$

Coefficient	Commodity 15	25	30	45
A.IKi[1]	-0.8277	-0.2553	0.0444	-0.3545
	(0.1174)	(0.0638)	(0.0435)	(0.0277)
A.IPi	0.1247	0.3354	0.4404	-1.5717
	(0.0807)	(0.0817)	(0.2054)	(0.3456)
(-1)	0.1200	0.2841	0.3581	1.0668
	(0.0634)	(0.0630)	(0.1336)	(0.2497)
(-2)	0.1152	0.2327	0.2758	0.5716
	(0.0482)	(0.0456)	(0.0721)	(0.2625)
(-3)	0.1104	0.1813	0.1935	0.0862
	(0.0376)	(0.0313)	(0.0651)	(0.3805)
(-4)	0.1056	0.1300	0.1111	-
	(0.0361)	(0.0261)	(0.1222)	-
(-5)	0.1009	0.0786	0.0288	-
	(0.0446)	(0.0344)	(0.1932)	-
(-6)	0.0961	0.0273	-	-
	(0.0588)	(0.0499)	-	-
(-7)	0.0913	0.0241	-	-
	(0.0757)	(0.0678)	-	-
Sum of lag-coef.	0.864	1.245	1.4076	3.296
	(0.284)	(0.216)	(0.342)	(0.234)
Average lag	3.268	1.768	1.477	0.749
	(1.189)	(0.708)	(1.000)	(0.308)
Lag-restriction	1. grad	1. grad	1. grad	2. grad
A.IEi	0.3669	0.6557	-	-
	(0.0946)	(0.0798)	-	-
B.IS1i[1]	0.0956	-0.0919	0.098)	-0.0378
	(0.0239)	(0.0219)	(0.0600)	(0.0420)
B.IS2i[1]	0.0078	0.0304	0.1256	0.0409
	(0.0240)	(0.0219)	(0.0598)	(0.0470)
B.IS3i[1]	0.1506	0.0679	0.0380	0.0447
	(0.0254)	(0.0217)	(0.0605)	(0.0412
B.IB1i[1]	0.0179	-0.0042	-0.0345	-0.1903
	(0.0283)	(0.0271)	(0.0846)	(0.0539)
B.IB2i[1]	0.0195	0.0010	-0.1911	0.1351
	(0.0278)	(0.0273)	(0.0868)	(0.054)
B.IB3i[1]	-0.0714	-0.0293	-0.0910	-0.1124
	(0.0274)	(0.0268)	(0.0912)	(0.0536)
Estimation method	OLS, Almon-lag	OLS, Almon-lag	OLS, Almon-lag	OLS, Almon-lag
SER	0.0519	0.0456	0.1205	0.0773
DW	2.14	2.33	1.59	1.48

[1] These coefficients are part of the estimation results, but because of the way the import model works, they are not implemented in KVARTS.

The implemented equation:

log ((Lij - DIij•LIij)/LHij•DIij) = A.Iij + SUM (I = -t TO 0: A.IPi(I) • LOG(BH(I)/PICIF(I)) + A.IEi • log ((Lij-DIij(-1)• LIij)/LIij • DIij(-1))

The coefficient A.Iij are calculated so that the equation fits perfectly in the base year.

Estimation of the seasonal variations in the import demand:

$$I_i = \sum_j DI_{ij} \cdot LI_{ij} \cdot A_j + IE_i + \sum_q B.Ij \cdot (DKVq - DKV4)$$

	Commodity			
	15	25	30	45
B.I1i	413.03	12.66	86.87	-143.51
B.I2i	-142.02	-111.13	123.73	175.69
B.I3i	89.99	-17.5	-38.36	-1.12
Estimation method	OLS	OLS	OLS	OLS

5. PRODUCTION, STOCKS, ORDERS IN MANUFACTURING

Definitions:

DKVq - Seasonal dummy; 1 in quarter q, 0 otherwise

DKVBRUDD - Dummyvariable for break in seasonal pattern - 1 in 1966.1 - 1977.4, 0 thereafter

RRUFB - Nominal interest rate of business banks' loans to firms

SSj - Stock of inventories, commodity j, j = 15, 25, 30

Xj - Gross production, sector j

XKj - Production capacity, sector j

DEL(1:X) means $X-X_{-1}$ etc.

Equation for adaption of production:

Xj = A.EjX1•XKj(-1)+A.EjX2•(((Xj-DEL(1:SSj))/RRUFB)0,5-SSj(-1)) + (1-A.EjX1)•
(Xj-DEL(1 : SSj)) + B.EjX1•DKV1 + B.EjX2•DKV2 +
B.EjX3•DKV3 + B.EjX4•DKV4 + B.EjX5.DKVBRUDD•DKV1 + B.EjX6•DKVBRUDD.DKV2 +
B.EjX7•DKVBRUDD•DKV3 + B.EjX8•DKVBRUDD•DKV4

Coefficient	Sector 15	Sector 25	Sector 30
A.EjX1	0.27744	0.58751	0.38276
	(0.06006)	(0.1109)	(0.0805)
A.EjX2	0.40935	0.42834	0.26825
	(0.08426)	(0.1255)	(0.0613)
B.EjX1	1092.27	2219.26	718.58
	(325.13)	(876.79)	(207.61)
B.EjX2	1156.95	2033.71	481.33
	(332.4380)	(928.19)	(216.67)
B.EjX3	1147.87	1931.95	259.28
	(337.1540)	(918.60)	(171.30)
B.EjX4	1798.59	3401.18	473.63
	(360.4110)	(801.92)	(208.45)
B.EjX5	66.5695	248.5690	-75.2265
	(106.40)	(214.76)	(129.16)
B.EjX6	344.7570	233.1980	76.1019
	(101.85)	(196.93)	(136.70)
B.EjX7	214.5220	-101.3130	150.5190
	(106.37)	(209.10)	(128.70)
B.EjX8	28.6309	-383.2540	211.9320
	(108.77)	(199.72)	(125.12)
OLS	OLS	OLS	OLS
Estimation periode	1967.4-1983.4	1973.4-1983.4	1967.4-1983.4
SER	193.9	302.5	242.3
RVC	1.9	3.2	2.9
DW	2.34	2.09	0.63

Adaption of orders and production sector 45.

Definitions:

Q45 - Value added, sector 45

C40 - Consumption of category 40

Mj - Intermediate inputs, sector j, j = 50, 55, 65

DORD45H - New orders from the home market

DORD45U - New orders from the foreign market

YK96 - Operating surplus in private sectors

X95 - Gross production in private sectors except sector 45

BH45 - Domestic price, commodity 45

PICIF45 - Import price, commodity 45

PE45 - Export price, commodity 45

DKVq - Dummy variable, 1 in quarter q, 0 in other quarters

Equation for determination of value added:

$$Q45 = A.EORDE \cdot (0.22 \cdot C40 + 0.37 \cdot M50 + 0.17 \cdot M55 + 0.35 \cdot M65) + A.EORDU \cdot DORD45U + A.EORDH \cdot DORD45H + \sum_{q=1}^{4} B.EORDq \; DKVq$$

Coefficient		Estimate
A.EORDE	(0)	0.09 (0.04)
	(-1)	0.06 (0.03)
	(-2)	0.04 (0.02)
	(-3)	0.02 (0.01)
Sum lag coef.		0.21 (0.09)
Restirictions on lag polynomial		1. degree, tail
A.EORDH	(0)	0.79 (0.54)
	(-1)	0.85 (0.43)
	(-2)	0.88 (0.36)
	(-3)	0.89 (0.34)
	(-4)	0.88 (0.34)
	(-5)	0.85 (0.36)
	(-6)	0.79 (0.37)
	(-7)	0.71 (0.36)
	(-8)	0.61 (0.33)
	(-9)	0.49 (0.29)
	(-10)	0.35 (0.21)
	(-11)	0.19 (0.12)
Sum lag-coef.		8.28 (3.22)
Restriction on lag polynomial		2. degree, tail
A.EORDU	(0)	0.45 (0.40)
	(-1)	0.63 (0.31)
	(-2)	0.77 (0.25)
	(-3)	0.86 (0.23)
	(-4)	0.92 (0.24)
	(-5)	0.95 (0.24)
	(-6)	0.93 (0.26)
	(-7)	0.87 (0.25)
	(-8)	0.77 (0.23)
	(-9)	0.64 (0.20)
	(-10)	0.46 (0.15)
	(-11)	0.25 (0.09)
Sum lag coef.		8.51 (2.19)
Restriction on lag polynomial		2. degree, tail
B.EORD1		-158.1 (661)
B.EORD2		-435.8 (660.3)
B.EORD3		-669.5 (653.1)
B.EORD4		-145.3 (660.7)
Method		OLS
Estimation period		1976.1 - 1985.4
$\bar{R}^2$		0.9993
SER		73.34
DW		2.04

[1] Standard deviations in parantheses.

Equation for determination of new orders from the domestic market.

$$DORD45H = A.EDORX \cdot (X95-X95(-4)) + A.EDORYK \cdot ((YK96/BH45) - (YK96(-4)/BH45(-4))) + A.DORP \cdot (PICIF45(-2)/BH45(-2)) + \sum_{q=1}^{3} B.EDORq \cdot (DKVq - DKV4)$$

Coefficient		Estimate[1]
A.EDORX	(0)	0.0004 (0.0005)
	(-1)	0.0008 (0.0004)
	(-2)	0.0011 (0.0004)
	(-3)	0.0013 (0.0004)
	(-4)	0.0014 (0.0003)
	(-5)	0.0015 (0.0004)
	(-6)	0.0015 (0.0004)
	(-7)	0.0015 (0.0004)
	(-8)	0.0013 (0.0003)
	(-9)	0.0011 (0.0003)
	(-10)	0.0008 (0.0002)
	(-11)	0.0004 (0.0001)
Sum lag coef.		0.013 (0.003)
Restriction on lag polynomial		2. degree, tail
A.EDORYK	(0)	0.0022 (0.0010)
	(-1)	0.0021 (0.0009)
	(-2)	0.0019 (0.0008)
	(-3)	0.0017 (0.0007)
	(-4)	0.0015 (0.0007)
	(-5)	0.0013 (0.0006)
	(-6)	0.0011 (0.0005)
	(-7)	0.0009 (0.0004)
	(-8)	0.0007 (0.0003)
	(-9)	0.0006 (0.0002)
	(-10)	0.0004 (0.0001)
	(-11)	0.0002 (0.0001)
Sum lag coef.		0.0146 (0.0064)
Restriction on lag polynomial		1. degree, tail
A.EDORP	(0)	3.20 (0.51)
	(-1)	5.76 (0.91)
	(-2)	7.67 (1.21)
	(-3)	8.95 (1.41)
	(-4)	9.59 (1.52)
	(-5)	9.59 (1.52)
	(-6)	8.95 (1.41)
	(-7)	7.67 (1.21)
	(-8)	5.76 (0.91)
	(-9)	3.19 (0.50)
Sum lag coef.		70.35 (11.14)
B.EDOR1		-5.12 (3.40)
B.EDOR2		-4.88 (3.40)
B.EDOR3		-11.76 (3.40)
Method		OLS
Estimation period		1970.1 - 1982.4
$\bar{R}^2$		0.9878
SER		14.16
DW		1.47

Equation for determination of new orders from the foreign market.

$$\log(DORD45U) = A.EKOR + A.EMOR \cdot \log(MII45-MII45(-4)+10) + A.EPOR \cdot \log(PE45/PICIF45)$$

$$+\sum_{q=1}^{3} B.EORq\ DKVq$$

Coefficient		Estimate[1]
A.EKOR		4.75 (0.15)
A.EMOR	(0)	0.05 (0.02)
	(-1)	0.04 (0.01)
	(-2)	0.02 (0.01)
	(-3)	0.01 (0.00)
Sum lag coef.		0.12 (0.04)
Restirictions on lag polynomial		1. degree, tail
A.EPOR	(0)	-0.10 (0.18)
	(-1)	-0.08 (0.13)
	(-2)	-0.05 (0.09)
	(-3)	-0.03 (0.04)
Sum lag coef.		-0.26 (0.46)
B.EOR1		-0.16 (0.06)
B.EOR2		-0.16 (0.06)
B.EOR3		-0.29 (0.06)
Method		OLS
Estimation period		1973.1 - 1982.4
$\bar{R}^2$		0.4575
SER		0.1338
DW		1.89

[1] Standard deviations in parentheses.

6. EMPLOYMENT

Definitions:

HSW_j - Normal working time, wage earners, sector j

LW_j - Man-hours (1000) by wage-earners, sector j

NW_j - Wage-earners (1000), sector j

PM_j - Price index of intermediate inputs to sector j

TID - Time variable, 1 in 1966. 1.

W_j - Wage costs per man-hour, sector j

X_j - Gross production sector j, volume

XK_j - Production capacity, sector j

K_j - Capital stock, sector j_n

DKV_q - Dummy variable, 1 in quarter q, otherwize 0.

DKVBRUDD - Dummy variable, 1 1966.1-1977.4, otherwize 0.

A. Adaption of man-hours

$$\log(LW_j) = A.iSL0_j + \sum_{s=0}^{7} A.iSL2_{j,-s} \cdot \log(W_{j,t-s}/PM_{j,t-s}) + A.iSL3_j \cdot \log(X_j) +$$

$$A.iSL4j.\log(XKj) + A.iSL5_j \cdot TID + \sum_{q=1}^{3} (B.iSL_{qj} + B.iLB_{qj} \cdot DKVBRUDD) \cdot DKV_q$$

i = E for sectors 15, 25, 30, 45 og 50

i = F for sector 55

i = G for sectors 60, 70

Estimation results: Man-hours, standard deviations in parentheses

Coefficient	Sector							
	15	25	30	45	50	55	60	70
A.iSL0j	5,71 (1,19)	4,73 (0,39)	5,78 (1,22)	5,37 (0,63)	7,08 (0,28)	7,59 (0,82)	5,21 (2,03)	9,20 (0,21)
A.iSL2j(0)	-0,17 (0,04)	-0,02 (0,04)	-0,15 (0,09)	-0,01 (0,06)	-0,06 (0,08)	-0,18 (0,10)	-0,09 (0,04)	-0,05 (0,09)
(-1)	-0,08 (0,02)	-0,01 (0,02)	-0,07 (0,04)	-0,03 (0,03)	-0,09 (0,03)	-0,09 (0,03)	-0,08 (0,02)	-0,08 (0,02)
(-2)	-	-	-0,02 (0,06)	-0,04 (0,02)	-0,09 (0,04)	-0,03 (0,06)	-0,08 (0,01)	-0,08 (0,05)
(-3)	-	-	-	-0,04 (0,05)	-0,06 (0,04)	-0,00 (0,05)	-0,07 (0,01)	-0,05 (0,05)
(-4)	-	-	-	-0,02 (0,02)	-	-	-0,06 (0,01)	-
(-5)	-	-	-	-	-	-	-0,04 (0,01)	-
(-6)	-	-	-	-	-	-	-0,03 (0,01)	-
(-7)	-	-	-	-	-	-	-0,02) (0,01)	-
Sum lag coef.	-0,25 (0,06)	-0,04 (0,06)	-0,24 (0,07)	-0,20 (0,09)	-0,29 (0,09)	-0,30 (0,09)	-0,46 (0,07)	-0,25 (0,07)
Mean lag	0,33 (1,02)	0,33 (44,3)	0,42 (1,61)	2,71 (3,30)	1,48 (1,56)	0,50 (1,71)	2,51 (0,68)	1,52 (1,76)
Restrictions on lag-polynomial	1. grad hale	1. grad hale	2. grad hale	2. grad hale	2. grad hale	2. grad hale	2. grad hale	2. grad hale
A.iSL3j	0,32 (0,10)	0,33 (0,07)	0,22 (0,06)	0,20 (0,12)	0,41 (0,06)	0,30 (0,13)	0,37 (0,11)	0,25 (0,19)
A.iSL4j	0,33 (0,11)	0,36 (0,08)	0,41 (0,14)	0,49 (0,14)	0,08 (0,06)	0,20 (0,13)	0,47 (0,27)	0,05 (0,19)
A.iSL5j	-0,0081 (0,0007)	-0,0070 (0,0005)	-0,0079 (0,0008)	-0,0051 (0,0008)	-0,0032 (0,0005)	-0,0044 (0,0010)	-0,0128 (0,0008)	-
B.iSL1j	-0,004 (0,011)	-0,012 (0,007)	-0,019 (0,010)	-0,015 (0,010)	-0,021 (0,012)	-0,091 (0,023)	-0,011 (0,017)	-0,010 (0,015)
B.iSL2j	-0,056 (0,011)	-0,063 (0,007)	-0,061 (0,010)	-0,053 (0,011)	-0,038 (0,012)	-0,019 (0,019)	-0,006 (0,017)	-0,049 (0,013)
B.iSL3j	-0,010 (0,024)	-0,011 (0,011)	-0,071 (0,012)	-0,026 (0,017)	-0,086 (0,012)	0,003 (0,029)	0,009 (0,017)	-0,095 (0,014)
B.iLB1j	-	-	-	-	0,024 (0,022)	-	0,004 (0,016)	
B.iLB2j	-	-	-	-	-	-0,073 (0,020)	-	-0,006 (0,016)
B.iLB3j	-	-	-	-	-	-0,077 (0,020)	-	-0,054 (0,017)
Estimation period	1967 4- 1983 4	1967 4- 1983 4	1967 4- 1985 4	1967 4- 1983 4	1967 4- 1983 4	1967 4- 1983 4	1967 4- 1983 4	1967 4- 1983 4
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
SER	0,022	0,019	0,030	0,030	0,033	0,033	0,048	0,025
RVC	0,22	0,18	0,29	0,29	0,33	0,31	0,47	0,24
DW	1,65	1,35	0,91	1,94	1,39	1,83	0,71	1,84

For sector 80 - various services - the man-hours equation is:

$$\log(LW80/X80) - \log(LW80(-1)/X80(-1)) = A.GSL080 + A.GSL680 \cdot \log((W80/PM80)/(W80(-1)/PM80(-1))$$

$$+ A.GSL280 \cdot \log(W80(-1)/PM80(-1)) + A.GSL780 \cdot \log(LW80(-1)/X80(-1)) + A.GSL880 \cdot \log(K80(-2))$$

$$+ \sum_{q=1}^{3} (B.GSLq80 + B.GLBq80 \cdot DKVBRUDD) \cdot DKVq$$

For sector 81 - wholesale and retail trade - the man-hours equation is:

$$\log(LW81) = A.GSL081 + SUM(i= 7 \text{ TO } 0: A.GSL381(i) \cdot \log(X81(i))) +$$

$$A.GSL881 \cdot \log(K81(-1)) + A.GSL581 \cdot TID + \sum_{q=1}^{3} (B.GSLq81 + B.GLBq81 \cdot DKVBRUDD) \cdot DKVk$$

Estimation results, man-hours. Standard deviations in parentheses

Coefficient		Sector 80	Sector 81
A.GSL0j		2.00 (0.55)	5.06 (0.44)
A.GSL2j		-0.05 (0.05)	-
A.GSL3j	(0)	-	0.06 (0.04)
	(-1)		0.11 (0.02)
	(-2)		0.15 (0.01)
	(-3)		0.17 (0.01)
	(-4)		0.17 (0.02)
	(-5)		0.15 (0.02)
	(-6)		0.12 (0.02)
	(-7)		0.07 (0.01)
Sum lag coef.			1.00[1]
Restriction on lag polynomial			2. degree, tail
A.GSL5j		-	-0.0024 (0.0005)
A.GSL6j		-0.16 (0.04)	-
A.GSL7j		-0.39 (0.12)	-
A.GSL8j		-0.10 (0.03)	-0.33 (0.05)
B.GSL1j		-0.039 (0.009)	0.150 (0.011)
B.GSL2j		0.031 (0.009)	0.091 (0.011)
B.GSL3j		-0.026 (0.009)	0.117 (0.012)
B.GLB1j		-0.013 (0.013)	0.044 (0.014)
B.GLB2j		0.036 (0.012)	0.038 (0.015)
B.GLB3j		-0.034 (0.013)	0.035 (0.014)
Estimation period		1970.1 - 1985.4	1970.1 - 1985.4
Estimation method		OLS	OLS
SER		0.017	0.022
DW		1.96	1.66

[1] Restriction

B. Adaption of employed persons (wage-earners)

$$\log(NW_{j,t}/NW_{j,t-1}) = A.iSN1_j \cdot \log(LW_{jt}/(HSW_{jt} \cdot NW_{j,t-1})) + \sum_{q=1}^{3} (B.iSNqj + B.iNBqj \cdot DKVBRUDD) \cdot (DKVq - DKV4)$$

i = E for sectors 15, 25, 30, 45 and 50

i = F for sector 55

i = G for sector 70, 80 and 81

Coefficient	Sector 15	25	30	45	50	55	70	80	81
A.iSN1j	0.42 (0.07)	0.45 (0.06)	0.31 (0.05)	0.25 (0.07)	0.35 (0.07)	0.45 (0.06)	0.27 (0.04)	0.27 (0.06)	0.24 (0.06)
B.iSN1j	-0.004 (0.004)	0.019 (0.003)	0.005 (0.003)	-0.006 (0.004)	0.018 (0.004)	0.037 (0.012)	- -	0.034 (0.005)	0.014 (0.009)
B.iSN2j	0.027 (0.003)	0.018 (0.003)	0.015 (0.002)	0.009 (0.004)	0.009 (0.004)	-0.023 (0.006)	- -	-0.004 (0.004)	-0.003 (0.003)
B.iSN3j	-0.006 (0.006)	-0.016 (0.005)	-0.014 (0.004)	-0.002 (0.005)	-0.008 (0.004)	-0.012 (0.011)	- -	-0.025 (0.009)	-0.010 (0.007)
B.iNB1j	-	-	-	-	-	-	-	-0.002 (0.005)	0.005 (0.005)
B.iNB2j	-	-	-	-	-	-	-	-0.001 (0.005)	-0.002 (0.004)
B.iNB3j	-	-	-	-	-	-	-	0.010 (0.003)	-0.008 (0.004)
Mean lag	1.4	1.2	2.2	3.0	1.9	1.2	2.7	1.2	1.2
Estimation-method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Estimation period	1966.2-1983.4	1966.2-1983.4	1966.2-1983.4	1966.2-1983.4	1966.2-1983.4	1966.2-1983.4	1966.2-1983.4	1966.2-1986.4	1966.2-1986.4
SER	0.016	0.012	0.011	0.019	0.020	0.017	0.014	0.013	0.011
DW	2.38	2.07	1.90	2.28	1.71	1.90	2.29	1.26	1.52

7. WAGE EQUATIONS

Definitions:

W_j	- Wage rate pr. man-hour, sector j
PC	- Deflator private consumption
PI_j	- Import price, commodity j
Q_j	- Value added per man-hour, sector j
t_1	- (1- average tax rate for households)
t_2	- (1+ employment tax, paid by the firm), sector j
U	- Unemployment rate
DKVq	- seasonal dummy, 1 in quarter q, 0 otherwise
DKVBRUDD	- dummy variable, 1 from 1966.1 - 1977.4, 0 thereafter. This variable is used to take account of break in seasonal pattern in 1977
DWSTOPP	- dummy variable to account for the wage and price controls in 1978/79
TOTUT	- dummy variable to account for (possible) catch-up effects after the wage and price controls
D8034	- dummy variable, -1 in 1980.3, 1 in 1980.4, 0 otherwise
BRQLW50	- dummy variable, 1 1966.1 - 1975.4, 0 otherwise
D7723	- dummy variable, -1 in 1977.2, 1 in 1977.3, 0 otherwise
Δ	- first difference in the variable, e.g. $\Delta X=X-X(-1)$

Wage equations for sectors 15, 25, 30, 45, 50:

$$\Delta Wj/Wj(-1) = A.JWKj + A.JWPCj \cdot (\Delta PC/PC(-1) + A.JWPIj \cdot (\Delta PIj/PIj(-1)) + A.JWUj \cdot (1/U(-1)^2 + A.JWTYj \cdot (\Delta t_2/t_2(-1)) + A.JWTTj \cdot (\Delta t_1/t_1(-1)) + A.JWQLj \cdot (\Delta Qj(-1)/Qj(-2)) + \sum_{q=1}^{3} B.JWSqj \cdot (DKVq-DKV4) + \sum_{q=1}^{3} B.JWBqj \cdot DKVBRUDD \cdot (DKVq-DKV4) + B.JWSTj \cdot DWSTOPP + B.JWVTj \cdot TOTUT + B.JW80j \cdot D8034 + B.JWDQj \cdot BRQLW50$$

Wage equations for sectors 55, 70, 71, 90:

$$\Delta Wj/Wj(-1) = A.JWKj + A.JWFj \cdot (W51/Wj(-1) + A.JWGj \cdot (PC/Wj(-1)-1) + \sum_{q=1}^{3} B.JWSqj \cdot (DKVq-DKV4) + \sum_{q=1}^{3} B.JWBqj \cdot DKVBRUDD \cdot (DKVq-DKV4) + B.JWSTj \cdot DWSTOPP + B.JWUTk \cdot TOTUT. + A.JWDUj \cdot D7723$$

Wage equations for sectors 80 and 81:

$$\log (Wj/Wj(-1) = A.JWKj + A.JWFj \cdot \log(W51/Wj(-1)) + A.JWGj \cdot \log (PC/Wj(-1)) + \sum_{q=1}^{3} B.JWSqj \cdot (DKVq-DKV4) + \sum_{q=1}^{3} B.JWBqj \cdot DKVBRUDD \cdot (DKVq-DKV4) + B.JWSTj \cdot DWSTOPP + B.JWUTj \cdot TOTUT.$$

Estimation results[3]. Standard deviations in parantheses

Coefficient.		Sector 15	25	30	45	50
A.JWKj		-0,006(0,007)	-0,001(0,007)	-0,012(0,009)	-0,005(0,008)	-0,008(0,007)
A.JWPCj	(0)			0,30 (0,13)	0,40 (0,18)	
	(-1)	0,37 (0,07)	0,43 (0,22)	0,15 (0,07)		0,25 (0,08)
	(-2)	0,25 (0,05)				0,18 (0,06)
	(-3)	0,12 (0,03)				0,12 (0,04)
	(-4)					0,06 (0,02)
Sum lag-coef.		0,75 (0,15)		0,45 (0,20)		0,62 (0,20)
Restrictions on lag polynomial		1.degree,tail		1.degree,tail		1.degree,tail
A.JWPIj	(0)	0,10 (0,06)			0,13 (0,04)	
	(-1)	0,08 (0,05)		0,10 (0,04)	0,12 (0,03)	
	(-2)	0,05 (0,03)	0,13 (0,05)	0,09 (0,03)	0,10 (0,03)	0,07 (0,04)
	(-3)	0,03 (0,02)	0,11 (0,04)	0,08 (0,03)	0,08 (0,02)	0,06 (0,03)
	(-4)		0,10 (0,04)	0,07 (0,03)	0,07 (0,02)	0,06 (0,03)
	(-5)		0,08 (0,03)	0,06 (0,02)	0,05 (0,01)	0,05 (0,03)
	(-6)		0,06 (0,02)	0,05 (0,01)	0,03 (0,01)	0,04 (0,02)
	(-7)		0,05 (0,02)	0,04 (0,01)	0,02 (0,00)	0,04 (0,02)
	(-8)		0,03 (0,01)	0,03 (0,01)		0,03 (0,02)
	(-9)		0,02 (0,01)	0,02 (0,01)		0,02 (0,01)
	(-10)			0,01 (0,00)		0,01 (0,01)
	(-11)					0,01 (0,00)
Sum lag-coef.		0,25 (0,15)	0,57 (0,22)	0,55 (0,20)	0,60 (0,18)	0,39 (0,20)
Restrictions on lag distribution		1.degree,tail	1.degree,tail	1.degree,tail	1.degree,tail	1.degree,tail
A.JWQLj	(0)	0,07 (0,05)	0,12 (0,06)	0,07 (0,03)	0,07 (0,05)	0,04 (0,04)
	(-1)	0,06 (0,04)	0,11 (0,06)	0,06 (0,03)	0,06 (0,04)	0,04 (0,04)
	(-2)	0,06 (0,04)	0,10 (0,05)	0,06 (0,03)	0,05 (0,04)	0,03 (0,03)
	(-3)	0,05 (0,03)	0,09 (0,05)	0,05 (0,02)	0,05 (0,03)	0,03 (0,03)
	(-4)	0,05 (0,03)	0,08 (0,04)	0,50 (0,02)	0,04 (0,03)	0,02 (0,02)
	(-5)	0,04 (0,03)	0,07 (0,04)	0,04 (0,02)	0,03 (0,02)	0,02 (0,02)
	(-6)	0,03 (0,02)	0,06 (0,03)	0,03 (0,02)	0,02 (0,01)	0,02 (0,02)
	(-7)	0,03 (0,02)	0,05 (0,03)	0,03 (0,01)	0,01 (0,01)	0,01 (0,01)
	(-8)	0,02 (0,02)	0,04 (0,02)	0,02 (0,01)		0,01 (0,01)
	(-9)	0,02 (0,01)	0,03 (0,02)	0,02 (0,01)		0,00 (0,00)
	(-10)	0,01 (0,01)	0,02 (0,01)	0,01 (0,01)		
	(-11)	0,01 (0,00)	0,01 (0,01)	0,01 (0,00)		
Sum lag-coef.		0,45 (0,30)	0,79 (0,40)	0,45 (0,21)	0,33 (0,23)	0,22 (0,23)
Restrictions on lag distribution		1.degree,tail	1.degree,tail	1.degree,tail	1.degree,tail	1.degree,tail
A.JWVj		0,035(0,019)	0,020(0,019)	0,045(0,020)	0,035(0,019)[1]	0,033(0,021)
A.UWTYj	(0)		-1[2]			-1[2]
	(-1)	-1[2]		-1[2]	-1[2]	
A.JWTTj	(0)	-				0,41 (0,37)
	(-1)		0,18 (0,41)	0,24 (0,44)	0,23 (0,28)	
	(-2)				0,11 (0,14)	
Sum lag-coef.					0,34 (0,43)	
Restrictions on lag distribution					1.degree,tail	
B.JWS1j		-0,016(0,006)	-0,016(0,006)	0,002(0,007)	-0,016(0,005)	-0,007(0,006)
B.JWS2j		0,020(0,006)	0,020(0,006)	0,025(0,007)	0,019(0,005)	0,020(0,006)
B.JWS3j		-0,011(0,006)	-0,007(0,006)	-0,026(0,007)	-0,004(0,005)	-0,006(0,006)
B.JWB1j		-0,008(0,007)	-0,008(0,008)	-0,030(0,009)	-0,011(0,007)	0,000(0,000)
B.JWB2j		0,021(0,007)	0,014(0,008)	0,014(0,009)	0,007(0,007)	-0,006(0,008)
B.JWB3j		0,010(0,007)	0,001(0,008)	-0,006(0,009)	-0,003(0,007)	0,002(0,007)
B.JWSTj		-0,013(0,008)	-0,009(0,009)	-0,018(0,009)	-0,025(0,007)	-0,003(0,009)
B.JWUTj		0,008(0,005)	0,004(0,006)	0,008(0,006)	0,005(0,004)	0,009(0,006)
B.JW80j		-0,072(0,011)	-	-	-	
B.JWDQj		-	-	-	-	0,008(0,005)
Method		OLS	OLS	OSL	OLS	
Estimation period		1969.1-1983.4	1969.2-1983.4	1969.2-1983.4	1969.2-1982.4	1969.1-1983.4
$\bar{R}^2$		0,7521	0,5938	0,6930	0,6849	0,36070
SER		0,0150	0,0171	0,0184	0,0133	0,0167
DW		1,94	2,01	2,17	1,88	2,31

[1] Lagged 4 quarters. [2] Fixed apriori. [3] Sum of coefficients of consumer prices and inport prices are restricted to unity.

Estimation results[1]. Standard deviations in parantheses

Coefficient.	Sector 55	70	71	80	81	90
A.JWKj	4,83 (0,75)	0,04 (0,00)	0,05 (0,008)	0,15 (0,08)	·0,49 (0,16)	12,23 (2,62)
A.JWFj	0,75 (0,08)	0,44 (0,12)	0,53 (0,16)	0,28 (0,07)	0,68 (0,12)	0,31 (0,08)
A.JWGj	4,87 (0,75)	-	-	·0,04 (0,02)	0,15 (0,04)	12,50 (2,68)
A.JWDU71	-	-	-0,16 (0,03)	-	-	-
B.JWS1j	-0,010(0,005)	-0,006(0,006)	-0,012(0,015)	-0,006(0,006)	-0,015(0,012)	-0,012(0,005)
B.JWS2j	0,001(0,005)	0,007(0,007)	0,013(0,015)	0,007(0,006)	0,016(0,013)	0,011(0,006)
B.JWS3j	-0,005(0,004)	0,002(0,006)	0,008(0,015)	0,004(0,006)	0,009(0,012)	0,007(0,006)
B.JWB1j	-0,012(0,006)	0,024(0,010)	-0,007(0,022)	0,053(0,009)	0,107(0,018)	-0,034(0,009)
B.JWB2j	0,009(0,006)	-0,005(0,010)	0,071(0,025)	-0,016(0,009)	0,036(0,023)	0,022(0,009)
B.JWB3j	-0,006(0,005)	-0,009(0,010)	-0,031(0,025)	0,031(0,009)	-0,137(0,018)	-0,006(0,009)
B.JWSTj	-	-	-	-0,022(0,010)	-	-
Method	OLS	OLS	OLS	OLS	OLS	OLS
Estimation period	1969.1-1983.4	1974.1-1983.4	1974.1-1983.4	1970.1-1985.4	1970.1-1985.4	1974.1-1983.4
$\bar{R}^2$	0,9051	0,3657	0,6296	0,7947	0,8299	0,8318
SER	0,0120	0,0176	0,0410	0,0203	0,0405	0,0156
DW	1,43	1,22	2,05	2,21	2,07	1,93

[1] See note table above.

8. PRICES

Domestic prices

BHi - Price (basic value) of Norwegian domestic delivery, commodity i

PICIF - Import price (c.i.f.), commodity i

UCi - Unit variable cost, sector i

KAPUTNi - Index for capacity utilization, sector i

IMPANDi - Imports as a share of home market, commodity i, moving average of last 4 quarters lagged one quarter

DUMMY701- Dummyvariable, 1 in 1970 1, othervise 0

DUM1970 - Dummyvariable, 1 before 1970, 1, otherwise 0

DKVq - Dummyvariable for season, 1 in quarter q, otherwise 0

DKVBRUDD- Dummyvariable, 1 before 1978 1, 0 thereafter

Domestic price equations for commodities 15, 25, 30, 40, 45, 80, 90:

$$\log(BHi/BHi(-1)) = A.JCOBi + A.JLABi \cdot \log(UCi/BHi(-1)) + A.JPIBi \cdot \log(PICIFi/UCi) + A.JK1Bi \cdot 0.25 \cdot \log(UCi(-1)/UCi(-5)) + A.JIABi \cdot IMPANDi \cdot \log(PICIFi/UCi) + A.JC1Bi \cdot KAPUTNi + A.JC2Bi \cdot (KAPUTNi)^2 + B.JS1Bi \cdot DKV1 + B.JS2Bi \cdot DKV2 + B.JS3Bi \cdot DKV3 + B.JB1Bi \cdot DKV1 \cdot DKVBRUDD + B.JB2Bi \cdot DKV2 \cdot DKVBRUDD + B.JB3Bi \cdot DKV3 \cdot DKVBRUDD + B.JD1Bi \cdot DUM1970 + B.JD2Bi \cdot DUMMY701$$

Domestic price equations for commodities 50, 55:

$$\log(BHi) = A.JCOBi + A.JXBi \cdot \log(UCi) + A.JC1Bi \cdot KAPUTNi + A.JC2Bi \cdot (KAPUTNi)^2 + B.JS1Bi \cdot DKV1 + B.JS2Bi \cdot DKV2 + B.JS3Bi \cdot DKV3 + B.JB1Bi \cdot DKV1 \cdot DKVBRUDD + B.JB2Bi \cdot DKV2 \cdot DKVBRUDD + B.JB3Bi \cdot DKV3 \cdot DKVBRUDD + B.JD1Bi \cdot DUM1970 + B.JD2Bi \cdot DUMMY701$$

Domestic price quation for commodity 81:

$$\log(BH81) = A.JKOB81 + A.JL1B81 \cdot \log(BH81(-1) + A.JU1B81 \cdot \log(UC81) + A.JU2B81 \cdot \log(UC81(-1)/UC81(-2)) + A.JKAB81 \cdot KAPUTN81 + B.JT1B81 \cdot (PSTOPINN(-1) - PSTOPINN(-2) + PSTOPUT(-1)) + B.JT2B81 \cdot (PSTOPINN+PSTOPUT) + \sum_{q=1}^{3} B.JSqB81 \cdot DKVq$$

Coefficient.	Commodity							
	15	25	30	40	45	70	80	90
A.JCOBi	0.0906 (0.0108)	0.0598 (0.0592)	0.0993 (0.0295)	0.0508 (0.0193)	-0.0245 (0.0928)	0.02756 (0.0115)	-0.2301 (0.1079)	0.0250 (0.0038)
A.JLABi	0.4868 (0.0614)	0.6142 (0.0786)	0.4448 (0.1017)	0.4766 (0.0760)	0.6231 (0.1368)	0.1966 (0.0797)	0.9081 (0.0571)	0.7100 (0.0877)
A.JPIBi	0.0404 (0.0338)	0.1189 (0.0328)	-1.4931 (0.4650)	0.2413 (0.2744)	-	-	-	-
A.JIABi	-	-	2.8244 0.8529	-0.1361 0.4688	-	-	-	-
A.JC1Bi	-	0.0009838 (0.0006449)	-	-	-0.0016 (0,0010)	-	0.0045 (0.0011)	-
A.JC2Bi	-	-	-	-		-	-	-
A.JK1Bi	-	-	-	-	-	0.3889 (0.2001)	-	-
B.JS1Bi	-0.0030 (0.0088)	-0.0002 (0.0081)	-0.0120 (0.0177)	-	0.0127 (0.0126)	0.0263 (0.0120)	0.0122 (0.0110)	0.0163 (0.0067)
B.JS2Bi	0.0051 (0.0089)	-0.0005 (0.0079)	0.0269 (0.0179)	-	0.0188 (0.0126)	0.0118 (0.0393)	0.0093 (0.0101)	0.0241 (0.0065)
B.JS3Bi	-0.0013 (0.0009)	0.0148 (0.0009)	-0.0116 (0.0175)	-	-0.0059 (0.0129)	0.0145 (0.0056)	-0.0023 (0.0082)	0.0173 (0.0065)
B.JB1Bi	0.0136 (0.0096)	0.0100 (0.0094)	0.0635 (0.0191)	-	0.0219 (0.0136)	- -	-0.0192 (0.0092)	0.0128 (0.0071)
B.JB2Bi	-0.0017 (0.0096)	0.0150 (0.0092)	0.0196 (0.0200)	- -	-0.0114 (0.0137)	-	-0.0286 (0.0088)	-0.0208 (0.0070)
B.JB3Bi	0.0252 (0.0097)	0.0177 (0.0094)	0.0351 (0.01934)	-	0.0084 (0.0136)	- -	-0.0275 (0.0089)	-0.0165 (0.0072)
B.JD1Bi	0.0820 (0.0138)	0.0332 (0.0090)	0.0855 (0.0276)	-	0.0104 (0.0092)	- -		
Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Estimation period	1967.1-1982.4	1967.1-1983.4	1967.1-1983.4	1967.1-1983.4	1967.1-1983.4	1974.1-1983.4	1971.1-1985.4	1967.1-1983.4
R^2	0.60	0.47	0.37	0.35	0.42	0,54	0.91	0.60
SER	0.0168	0.0156	0.0354	0.0799	0.0261	0.0154	0.0167	0.0136
DW	1.95	2.08	1.91	1.81	2.22	1.63	1.49	1.87

	Commodity	
Coefficient	50[1]	55[1]
A.JC0Bi	-0.2636	0.7132
	(0.1377)	(0.3464)
A.JXBi	0.4	1.0
	(-)	(-)
(-1)	0.3	-
	(-)	
(-2)	0.2	-
	(-)	
(-3)	0.1	-
	(-)	
A.JC1Bi	0.0036	-0.01246
	(0.0015)	(0.00824)
A.JC2Bi	-	0.00007912
		(0.00004910)
B.JS1Bi	0.0049	-0.0055
	(0.0394)	(0.0090)
B.JS2Bi	0.0481	-0.0050
	(0.0395)	(0.0082)
B.JS3Bi	-0.0115	-0.0369
	(0.0392)	(0.0166)
B.JB1Bi	0.0133	-0.0006
	(0.0420)	(0.0084)
B.JB2Bi	-0.0223	0.0200
	(0.0433)	(0.0082)
B.JB3Bi	-0.0578	0.0383
	(0.0422)	(0.0085)
B.JD1Bi	-	0.0941
		(0.0056)
B.JD2Bi	-	0.0580
		(0.0165
Method	OLS	OLS
Estimation period	1967.1 - 1983.4	1967.1 - 1983.4
R^2	0.97	0.99
SER	0.0827	0.0154
DW	1.92	1.29

[1] A.JXBi is determined apriori with basis in free estimation so that sum of lag coefficients equals unity.

	Commodity
Coefficient	81[1]
A.JKOB81	-0.0901 (0,1607)
A.JL1B81	0.6039 (0.1587)
A.JU1B81	0.3950 (0.1600)
A.JU2B81	0.1021 (0.1004)
A.JKAB81	0.0022 (0.0019)
B.JT1B81	0.0109 (0.0060)
B.JT2B81	-0.0153 (0.0067)
B.JS1B81	0.0477 (0.0204)
B.JS2B81	0.0173 (0.0122)
B.JS3B81	0.0264 (0.0286)
Method	OLS-instr.variables[1]
Estimation period	1970.2 - 1985.4
R^2	0.99
SER	0.0271
DW	2.24

[1] As instruments were used:
- all dummies
- all right-hand-side variables with lags
- aggregate private consumption (in lags)
- lagged capacity utilization (1 and 4 quarters)
- lagged unit variable costs (in lags)

Export prices

Eksport price equations for the commodities 15, 25, 30, 40, 45, 50, 70, 80:

log (PEi/PEi(-1))= A.JCOEi + A.JLAEi•log (UCi/BHi(-1)) + A.JPIEi•log (PICIFi/UCi) + A.JC1Ei•KAPUTNi
+A.JC2Ei•(KAPUTNi^2) + B.JS1Ei•DKV1 + B.JS2Ei•DKV2 + B.JS3Ei•DKV3
+B.JB1Ei•DKV1•DKVBRUDD + B.JB2Ei•DKV2•DKVBRUDD + B.JB3Ei•DKV3•DKVBRUDD
+B.JD1Ei•DUM1970 + B.JD2Ei•DUMMY701

Export price equation for commodity 67:

log (PE67) = A.JKE67 + A.JP1E67 • log (PE66(-2)) + A.JP2E67 • log (PE66(-3)) + A.JP3E67 • log(PE67(-1))

Estimations results. Standard deviations in parentheses

	Commodity							
Coefficient	15	25	30	40	45	50	70	80
A.JCOEi	-0.2369 (0.2188)	-0.1331 (0.1090)	0.5110 (0.3357)	0.0111 (0.0314)	0.2151 (0.0335)	0.0452 (0.0286)	-0.2862 (0.1695)	0.2893 (0.3698)
A.JLAEi	0.4280 (0.1556)	0.2480 (0.0874)	0.3890 (0.0611)	0.4425 (0.0917)	0.6941 (0.1054)	0.2260 (0.0752)	0.1214 (0.0362)	0.6873 (0.1195)
A.JPIEi	0.1606 (0.1117)	0.1373 (0.0685)	0.2032 (0.0752)	0.3538 (0.1145)	-	0.1118 (0.0832)	0.0799 (0.0633)	0.1679 (0.0511)
A.JC1Ei	0.0029 (0.0026)	0.0017) (0.0012)	-0.0148 (0.0079)	-	-	-	0.0032 (0.0018)	0.0044 (0.0038)
A.JC2Ei	-	-	0.000105 (0.000046)	-	-	-	-	-
B.JS1Ei	0.0360 (0.0183)	-	0.0093 (0.0116)	0.0224 (0.0461)	-0.0052 (0.0236)	-0.0947 (0.0331)	0.0074 (0.0127)	-0.0578 (0.0287)
B.JS2Ei	0.0341 (0.0147)	-	0.0015 (0.0115)	0.0132 (0.0461)	-0.0276 (0.0232)	-0.0200 (0.0357)	0.0208 (0.0111)	-0.0813 (0.0314)
B.JS3Ei	0.0114 (0.0255)	-	0.0533 (0.0136)	0.0341 (0.0458)	-0.0567 (0.0243)	0.0269 (0.0354)	-0.0072 (0,0114)	-0.0349 (0.0307)
B.JB1Ei	0.0179 (0.0205)	-	-0.0085 (0.0127)	-0.0327 (0.0512)	0.0382 (0.0261)	0.1059 (0.0379)	0.0357 (0.0121)	0.0842 (0.0340)
B.JB2Ei	0.0110 (0.0220)	-	0.0038 (0.0127)	-0.0544 (0.0493)	0.0482 (0.0252)	0.0400 (0.0401)	-0.0340 (0.0121)	0.0542 (0.0378)
B.JB3Ei	0.0443 (0.0205)	-	-0.0247 (0.0125)	-0.0694 (0.0496)	0.0930 (0.0259)	0.0240 (0.0391)	-0.0036 (0.0129)	0.0139 (0.0375)
B.JD1Ei	-	-	-	-0.1128 (0.0424)	0.0950 (0.0241)	- (0.0106)	0.0166	-
B.JD2Ei	-	-	-	-	-	-	-	-
Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Estimation period	1976.1-1983.4	1967.1-1983.4	1967.1-1983.4	1967.1-1983.4	1967.1-1983.4	1967.1-1983.4	1967.1-1983.4	1971.1-1976.1 1976.4-1985.4
$\bar{R}^2$	0.50	0.16	0.54	0.30	0.40	0.24	0.36	0.46
SER	0.0234	0.0361	0.0236	0.0933	0.0480	0.0672	0.0223	0.0544
DW	1.42	2.14	0.80	0.90	2.19	2.43	2.45	1.73

Estimation results, commodity 67. Standard deviations in parentheses

Coefficient	Estimate
A.JKE67	0.1293 (0.0237)
A.JP1E67	0.2052 (0.0675)
A.JP2E67	0.1014 (0.1123)
A.JP3E67	0.6933 (0.0645)
Method	OLS
Estimation period	1979.1-1986.4
$\bar{R}^2$	0,99
SER	0,0455
DW	2,00

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