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A Complete Description of the System of Equations

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Abstract

Erling Holmøy, Gunnar Nordén and Birger Strøm

MSG-5

A Complete Description of the System of Equations

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The Multi Sectoral Growth (MSG) model is an applied general equilibrium model of the Norwegian economy which has been regularly used in long-term planning by the Norwegian Ministry of Finance since 1968. However, the model structure and its empirical characteristics change more or less continuously. The current version of the model, MSG-5, differs significantly from its predecessor MSG-4 in that domestic products are imperfect substitutes for foreign products, import shares and exports of manufactured products have been endogenised by adopting the Armington approach, the impact of capital income taxation on the user cost of capital has been taken into account, the system of indirect taxation and the special characteristics of the Norwegian electricity market have been given more detailed descriptions, the sub-model of private consumption utilises micro-econometric estimates and determines consumer demand as the outcome of utility maximising behaviour in 14 specified household groups.

This report contains a complete and accurate description of the system of equations, including a thorough explanation of all the model variables and of how the model aggregation level corresponds to the classification system in the Norwegian National Accounts. In addition, the report offers both an informal overview of the model structure and an analytical discussion of an aggregated stylised version which is intended to facilitate the interpretation of model simulations.

Keywords: Applied General Equilibrium Models, Macroeconomic Planning.

Contents

1. Introduction*

1.1 Purpose and overview

The main purpose of this report is to give a complete technical description of the equation structure in the current version of the Multi Sectoral Growth model, MSG-5. MSG-5 is a large scale Applied General Equilibrium (AGE) model of the Norwegian economy. We believe that the report will be most useful for those at the Research Department at Statistics Norway and in the Ministry of Finance who develop the model and use it for simulations. Other builders of large scale models also may find it relevant. However, readers looking for a more comprehensive principal discussion of the theoretical content in the model should consult other sources. In addition to the original work by Leif Johansen, (Johansen (1960, 1974), we refer to Longva, Lorentsen and Olsen (1986) and Holmøy (1992). The latter includes a more analytical description of the working of MSG-5.

The report is organised as follows: Chapter 1 provides an overview of the recent developments of the MSG-model and the main structure of MSG-5. Section 1.2 lists the most important new developments in MSG-5 compared to its predecessor, MSG-4. It also contains references to literature related to the development and application of the model. Section 1.3 gives an informal overview of the main blocks in the model. Section 1.4 explains some national accounting concepts which are important in MSG-5. Section 1.5 presents an aggregate stylised model which has the same macroeconomic properties as MSG-5. The stylised model is used to show the implications of the different closure rules available to the model user and to illustrate and discuss some important characteristics of the working of MSG-5. Section 1.6 and 1.7 give some background information for two model blocks that have been included in MSG-5 but not in previous generations of MSG. Section 1.6 presents the basic theoretical framework leading to the user cost of capital formulas which enter the factor demand functions. The user cost formulas are relatively complex due to the integration of several details related to the system of capital income taxation in Norway. Section 1.7 gives a description of the main assumptions made about the electricity market and thus a better understanding of the implemented equations constituting the model block of the electricity market in MSG-5.

Chapter 2 contains the main part of the paper which is a complete listing of all the equations in MSG-5. The chapter is divided into several sections corresponding to different blocks in the model. A brief comment is given to each equation. Variables and parameters are defined the first time they appear in each section. In addition, variables are listed in alphabetic order and classified in Section 3.2.

In addition to the list of variables, and a section on parameter estimates, Chapter 3 also includes the sets of commodities, production sectors, production activities, input activities, consumption sectors, consumption activities, types of real capital, investment activities, investment sectors, types of transfers,

* We are grateful to Kari Anne Lysell for her expert help with the word processing.

indirect taxes and subsidies, direct taxes, institutional sectors, socio-economic and household groups. These lists also indicate the relation between the aggregation level in MSG-5 and the classifications in the Norwegian national accounts. Furthermore, the values of the econometric parameters in MSG-5 are included in Section 3.3.

1.2 Recent developments and applications

After Leif Johansen's development of the first generation of the MSG-model in 1960, it has later undergone four major revisions. The accumulated changes of the model are so substantial that it is quite misleading to associate the structure of MSG-5 with the original MSG-1, in spite of the similarity between the model names. With respect to the model structure, MSG-5 is more correctly described as a disaggregated AGE model, see the attempt to identify AGE models from other numerical models given by Shoven and Whalley (1984).

Compared to the previous version of the MSG-model, MSG-4 (see e.g. Bjerkholt, Longva, Olsen and Strøm (1983), Longva, Lorentsen and Olsen (1985) and Offerdal, Thonstad and Vennemo (1987)), the most important new developments in MSG-5 are the following:

- Most commodities are treated as composite goods consisting of domestic and foreign varieties being imperfect substitutes for each other. Prices of imports are exogenous since the Norwegian economy is small. However, prices of Norwegian products may differ from the corresponding world market prices. Exports and import shares for manufactured goods have been endogenised by adopting the Armington hypothesis which assumes that domestic and foreign products are imperfect substitutes. Whereas the previous MSG-models implicitly assumed prices of competing imports to be identical to the prices of the corresponding domestically produced goods, prices of imports are exogenous in MSG-5.

- The reformulation of the equations related to the foreign trade aspects was undertaken by Holmøy, Klette and Vennemo (Holmøy and Klette (1989)). The elasticities in the export demand functions and the import share functions have been taken from the econometric work by Lindquist (1993) and Naug (1994).

- The representation of indirect taxation and how the system of capital income taxation affects capital costs is much more detailed. As for indirect taxation, the model has become identical to the macroeconometric model MODAG described in Cappelen (1991).

- Holmøy and Vennemo incorporated the Norwegian system of capital income taxation into the user cost of capital model. The impact on the user cost of capital is reported in Holmøy and Vennemo (1991) and Holmøy, Larsen and Vennemo (1993).

- A new sub-model of household consumer behaviour has been developed by Aasness and Holtsmark (1993a, 1993b). In contradistinction to earlier editions of the model, the demand is derived from utility maximising households. The household sector is split into 14 household groups distinguished by socio-economic and demographic characteristics.

- Related to the integration of a more disaggregated model of private consumption, a sub-model which transforms demographic projections into projections for the number of each of the 14 household groups has been developed. Furthermore, the income flows and the budget constraints facing the institutional sectors are described in much more detail than in previous versions.

- The market for electricity has been specified in much greater detail. In MSG-5, electricity can be produced by both hydro power or thermal power (natural gas). Furthermore, the model distinguishes the production process from the transmission and the distribution of electricity. The expansion of the hydro power capacity is characterised by irreversible investments and decreasing returns to scale, and both these features are captured. The model has also been designed to study problems of price discrimination between consumers of electricity.

- The electricity market model was developed by Johnsen (1991). Birger Strøm incorporated it into MSG-5.

- 28 production sectors are specified in MSG-5. The production technology in most of the private industries was estimated by Torstein Bye and Petter Frenger (Ch. 3 in Alfsen, Bye and Holmøy (1994)). The substitutability between electricity and fuels within the energy aggregate was estimated by Mysen (1991).

Traditionally the MSG-model has been used to trace out long-run growth paths for the Norwegian economy. The latest example of using MSG for long-run projections, was in connection with the preparation of the Long Term Programme 1994-1997 (Ministry of Finance (1993)). This Long Term Programme also includes the results from simulations on MSG of changes in the labour force, average working time, prices of crude oil and natural gas and taxation of emissions of CO_2. Other recent examples of policy studies using MSG include the analysis of the impacts of a Climate Convention on the Norwegian economy, see Moum (1992), Brendemoen and Vennemo (1994) and Moum, Brendemoen, Bowitz, Storm and Vennemo (1991).

Internationally AGE-models are mostly used for quantitative welfare analysis of policy measures. In particular, assessing the welfare gains of tax reforms or trade liberalisation has been popular among AGE-analysts. This trend has also influenced the development and the use of the MSG-model. Examples of such welfare analyses are Holmøy and Vennemo (1991) who assesses the welfare gains of the suggested tax reform in Norway, and Vennemo (1991), who provides an AGE-analysis of the marginal costs of public funds in Norway. The social costs of stabilising emissions of CO_2 are assessed in Glomsrud, Johnsen and Vennemo (1992). The model was used by Førsund *et al.* (1991) in order to assess the potential welfare loss caused by inefficiency (interpreted in a broad sense) in the public sector.

1.3 The main structure of MSG-5

The classification of commodities

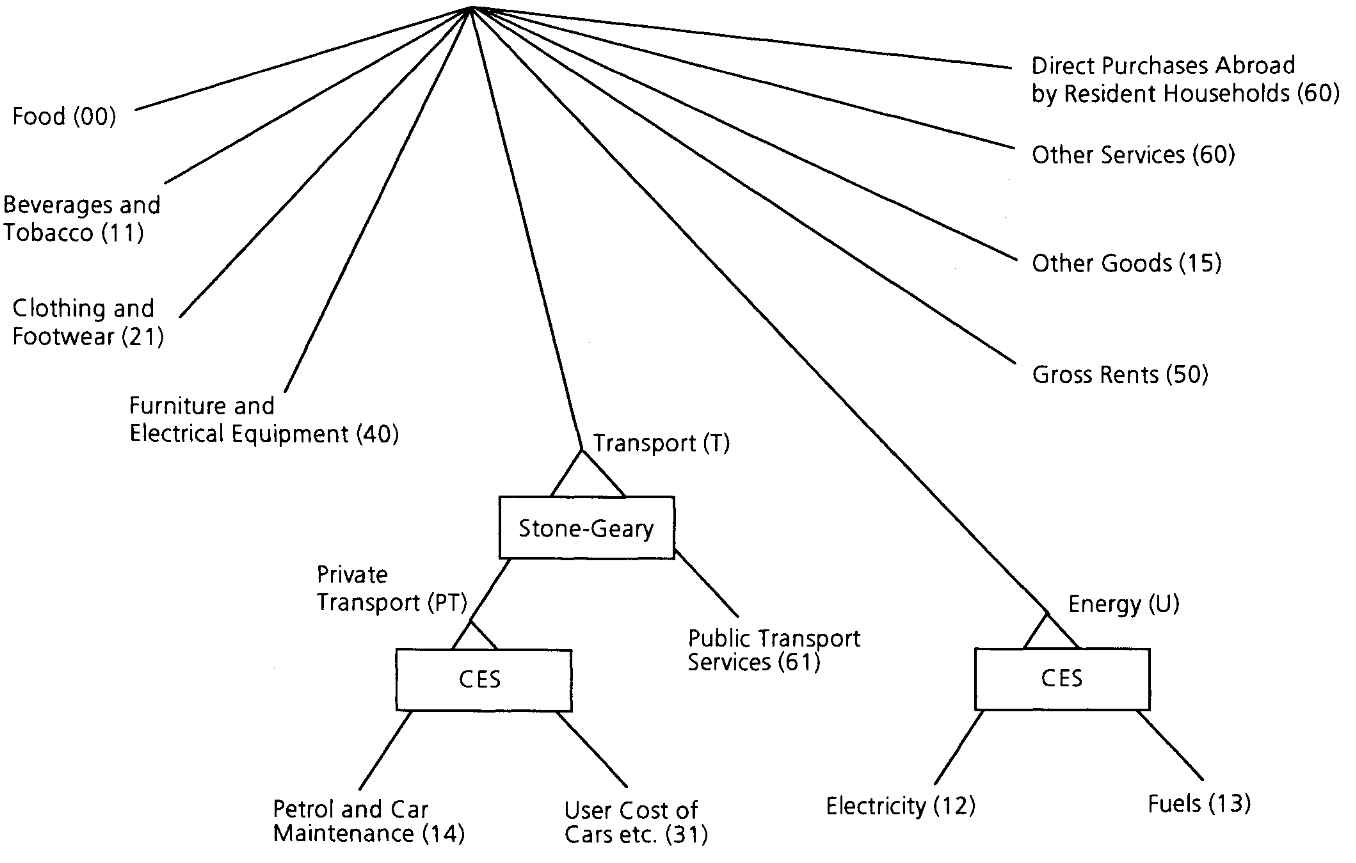
The model specifies 41 commodities, of which nine are non-competing imports and four are public goods. Except for commodities non-tradable by nature and for non-competing imports, each commodity is a composite good made up of a domestic and a foreign variety. This composition is independent of scale which means that the technology or preferences that determine the optimal composition is linearly homogeneous. In the base year, this composition is generally dependent on the use of the commodity.

Household consumption

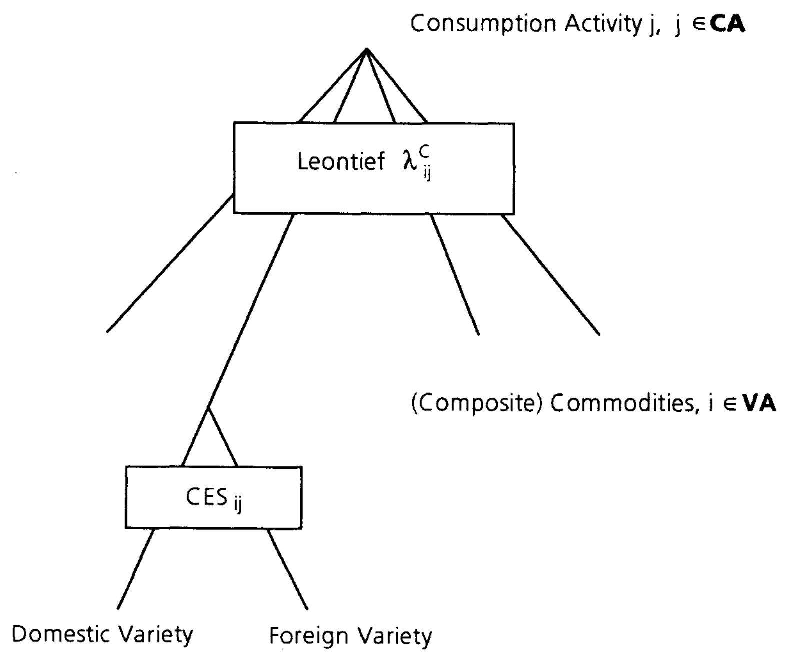
A system of household demand functions plays a central part in the model, determining the allocation of total consumption expenditure, *VCC*, among 13 different *consumption activities*. Substitution possibilities are introduced only between these aggregates. *Commodity demand* follows from the assumption of fixed commodity by activity coefficients (Leontief aggregation). Finally, distribution

Figure 1.3.1. The Structure of Demand

A. Utility Tree, Consumption Activities



B. Consumption Activities, (Composite) Commodities



between the domestic and foreign commodity varieties follows according to an activity specific CES aggregation function (see Figure 1.3.1).

In contradistinction to earlier editions of the model, the demand system of MSG-5 is derived from utility maximising households. The utility functions are household specific, allowing the model to capture the effect of both household size and household composition. There are 14 household groups in the model, distinguished by socio-economic and demographic characteristics. The mapping from various income categories to household income is generated by data from the Norwegian Income and Property Statistics. A separate sub-model transforms demographic projections into projections for each of the different household groups.

As for the structure of the utility functions, weakly separable non-homothetic preferences are introduced. At the top level, the households allocate total consumption expenditure to 10 consumption goods according to a non-homothetic linear expenditure system (LES) derived from Stone-Geary utility functions. At the intermediate level, consumption of transport services is allocated to private and public transport services according to a non-homothetic LES-system. At the bottom level, both private transport services and energy are linearly homogeneous CES-aggregates. A given level of private transport services requires services from the stock of cars and petrol and from car maintenance in proportions which are not necessarily fixed. The demand for energy can be satisfied by different combinations of electricity and fuels.

The parameters are transformed from the microeconometric work described in Aasness, Biørn and Skjerpen (1988). The concrete transformation procedure is discussed in Aasness and Holtsmark (1993a, 1993b), where the properties of the household demand system are also discussed in more detail.

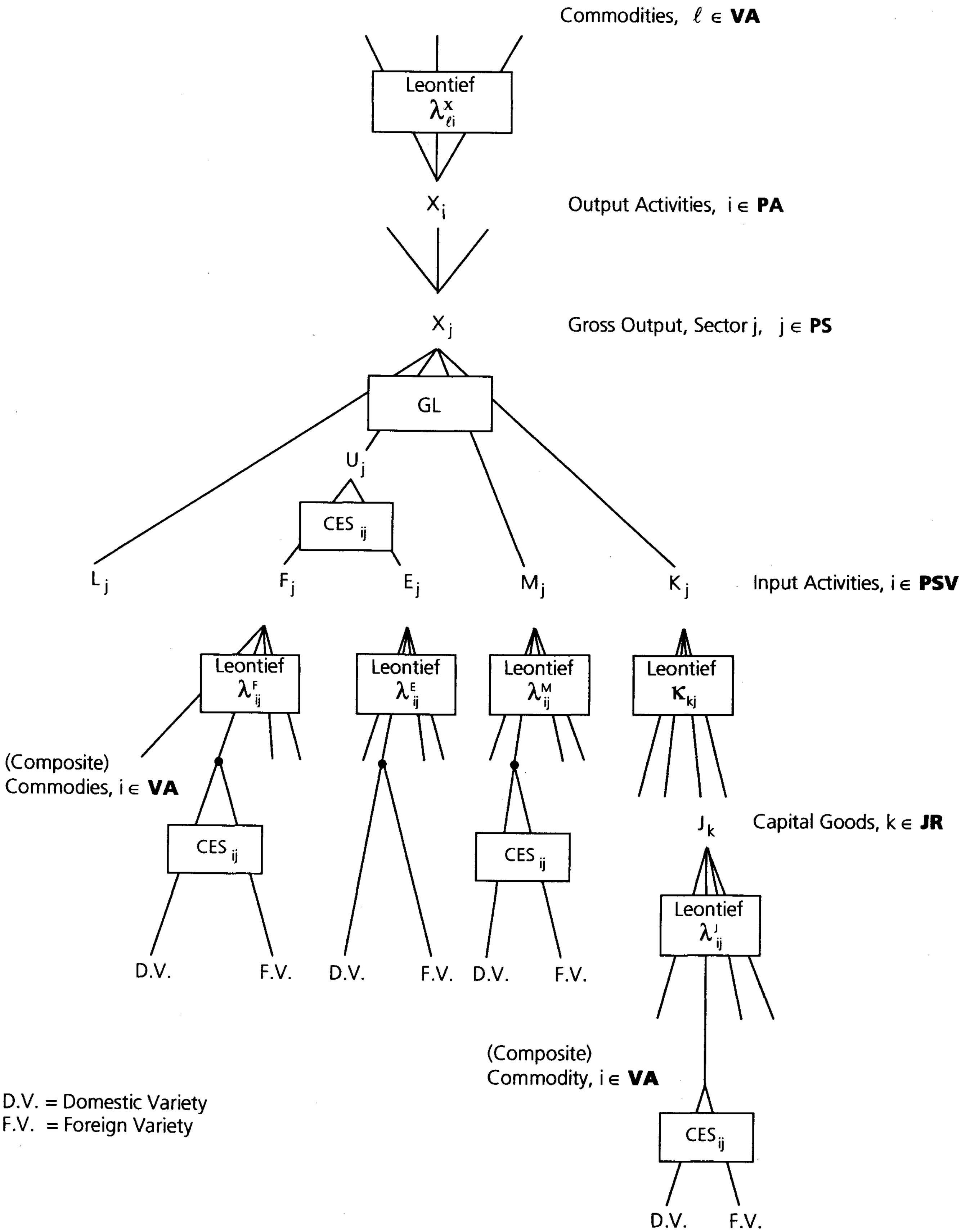
While the structure imposed implies strong restrictions on the Slutsky matrix and gives a recursive demand system, important features of the household's ability to substitute between specific activities are retained. In particular, it is intended to be relevant for studies of energy and environmental issues. Since the indirect utility function is a Gorman polar form, it also allows for perfect aggregation of the demand systems across households. Hence, aggregate consumer demand for each consumption good is a function of prices, aggregate consumption expenditure, the number of children, the number of adults less elderly in public institutions and the estimated levels of minimum consumption for the individual household types. This *level* of aggregate consumption expenditure is determined purely from supply conditions; there are no intertemporal aspects built into household behaviour. Total consumption expenditure adjusts such that full capacity utilisation is ensured (see Section 1.5).

The production structure and producer behaviour

28 productions sectors are specified. The firms within these sectors are assumed to behave competitively on both output and input markets. In general, each sector produces several activities which again may be associated with a main commodity. With some exceptions, this commodity composition is fixed corresponding to the description given by the National Accounts (NA) in the base year.

In most sectors, the demand for inputs follows a two stage budgeting procedure (see Figure 1.3.2). At the "top" level, there are four input factors: labour (man-hours), capital, energy and other material inputs. These factors are optimally combined according to a constant returns to scale technology which may shift over time through Hicks-neutral technical change. The technology is represented in dual terms by Generalised Leontief (GL) cost functions estimated by Bye and Frenger (Ch. 3 in Alfsen, Bye and Holmøy (1994)). At the "bottom" level, demand for energy is further divided into electricity and fuels according to a constant returns CES production function estimated by Mysen (1991).

Figure 1.3.2. The Structure of Production



The capital stock in each sector is a sector specific Leontief-aggregate of eight capital goods. Each of these capital goods is a Leontief-aggregate of the 41 basic composite commodities in the model. Also material inputs, electricity and fuels in each sector are sector specific Leontief-aggregates of the basic commodities.

However, several sectors are not described by endogenous producer behaviour. In the four government production sectors that are specified, all factor inputs are fixed exogenously. Except for the central government sector *Defence*, these sectors are further disaggregated into central and local government. Similarly, in the three sectors constituting the petroleum and shipping activity, employment and investment have to be given by the model user, whereas fixed Leontief coefficients determine the input per unit of production of the other factors. Fixed Leontief coefficients determine input of all factors relative to production in *Petroleum Refining*. In *Production of Electricity,* fixed Leontief coefficients determine input of all factors except capital relative to production. The input coefficient of capital in this sector is positively related to the capacity because of decreasing returns to scale when the hydro power capacity is expanded in an optimal way.

As for *Production of Electricity* the assumption of constant returns to scale is not realistic in the long run for resource based industries such as *Agriculture, Fishery, Production and Pipeline Transport of Oil and Gas*. In these sectors, the output level is exogenous, and the model user may use factor specific exogenous productivity parameters to adjust for decreasing returns to scale.

The determination of prices

The basic principle for the determination of the domestic prices in MSG is that in a long run equilibrium where all entry/exit incentives are eliminated, domestic producer prices have to equal total unit cost. Due to the assumption of constant returns of scale combined with exogenous output determination in those sectors where economies to scale is regarded essential, unit costs are independent of the scale of production. Total unit costs include both the user cost of capital and net taxes levied on the sector per unit of production. The relevant prices of commodities used as inputs are purchaser prices, which include indirect taxes and trade margins.

The pricing of electricity deviates from this basic principle. In each period the capacity in the electricity sector is predetermined by previous irreversible investment, which implies a vertical short-run supply curve. The market clearing price may then include pure profits. The default structure of MSG-5 is that the production capacity is expanded up to the level where price equals the long-run marginal costs. As explained in Section 1.7, the long-run marginal costs are increasing along an optimal expansion path.

The wage rates differ between sectors. Strictly, this is inconsistent with a definition of equilibrium in a model where a homogeneous labour force can be reallocated across sectors without cost. However, the model user has the option to control the relative wage differentials exogenously.

Another empirical fact is that real rates of return to capital also vary significantly across sectors. Part of these differentials is due to distortions caused by the Norwegian system of capital income taxation (see Holmøy and Vennemo (1991)). However, the effects of capital income taxation cannot account for all of the variance of the rates of return across sectors, and it is still an unsolved task to identify how much of the remaining variance is due to different risk premia and/or to different kinds of disequilibrium phenomena.

Through the price-cost relations in the model, all endogenous domestic prices become functions of what we call primary cost components. These are the sectoral wage rates, capital costs per Nkr invested, import prices, productivity parameters, indirect tax rates and domestic prices of public services. Due to decreasing returns in the electricity sector, the domestic prices are in principle also dependent on the activity level in the economy through the electricity demand. However, the practical importance of this quantity is small for most domestic prices.

The exchange rate is the numeraire in the model. Due to the assumption of domestic and foreign varieties being imperfect substitutes, domestic prices of tradeables need not be equal to the corresponding world market prices. Exceptions are the products *Crude Oil, Natural Gas, Oil and Gas pipeline Transport* and *Oil and Gas Exploration and Drilling, Leasing of Oil Drilling Rigs and Ocean Transport, all of* which face perfectly elastic demand on the export markets.

Foreign trade

The modelling of exports and imports is quite similar to what is implemented in the MODAG-model (see Cappelen (1991)). Export demand is endogenous for most of the manufactures and for some services, which jointly cover about fifty per cent of total exports. For these commodities, Norwegian firms face export demand curves which depend negatively on the ratio between the domestic price and the exogenous world market price. In addition, an index for world market demand can shift this demand function.

The export demand functions were estimated by Lindquist (1993). In MSG-5 the econometric relations are static and use the long-run parameters that can be deduced from the dynamic equations in MODAG. For the rest of the commodities, most notably *Crude Oil, Natural Gas, Oil and Gas pipeline Transport* and *Oil and Gas Exploration and Drilling, Leasing of Oil Drilling Rigs and Ocean Transport*, export demand is fixed by the model user. The same is true for exports of second-hand real capital.

Production of resource based commodities like primary industry products, *Crude Oil* and *Natural Gas*, is exogenous and assumed to be determined by supply side conditions. For these commodities, imports are determined residually as the difference between total demand and domestic supply. Except for non-competitive ones, imports of each of the remaining commodities are determined via import shares. The import shares are both commodity specific and, in general, depend on the demand component. For manufactured goods, which cover more than half of total imports, the import shares increase endogenously if the domestic price is raised relative to the corresponding import price. Formally, the import shares follow from Shephard's lemma as the derivative of the price of the composite good with respect to import price. However, the relative price dependence of the import shares is only commodity specific and does not vary across different kinds of domestic use. The substitution parameters are estimated by Naug (1994). For services, except *Domestic Transport Services*, the import shares are exogenous.

Correcting for disequilibrium

In an applied equilibrium model it is often imperative to pay attention to disequilibrium phenomena. MSG-5 , like most other AGE-models, is calibrated to a base year where general equilibrium may be far from an adequate description. The philosophy for MSG-users has been to try to identify and quantify the deviations from a hypothetical equilibrium. This is obviously a nearly impossible task as general equilibrium in a strict sense never has been, nor will be, observed. However, some information about the "order" of disequilibrium is often available, making it worthwhile to incorporate exogenous correction parameters for optional use by the model user.

One obvious example is information about unemployment. The time path generated by the model will, of course, depend heavily on how fast and to what extent the model user believes that unemployment will be eliminated. Moreover, the productive capital stock in each sector may be adjusted for slack in capacity utilisation. A third kind of disequilibrium arises if operative surplus is not equal to the pre-tax return to capital implied by an independent interest rate, risk premium, expected capital gains etc. Such a difference may be interpreted in several ways: it could be due to market power and pure profits, stochastic gains and losses, imperfect assessment of the risk premium, economic depreciation, expected capital gains etc. Though the model incorporates appropriate parameters capturing these phenomena, they are clearly very hard to assess quantitatively.

Another class of parameters is incorporated into the model in order to identify special characteristics of the base year. Energy demand for heating depends on the temperature, and the firm and household demand for energy are corrected for deviations from average temperature. Differences between simulated and actual base-year values in econometric equations also belong to this class of parameters.

1.4 Basic concepts in MSG-5[1]

With respect to both the definition of variables and data requirements, MSG-5 is closely connected to the Norwegian National Accounts. The aggregation level and the concepts *commodity*, *sector* and *activity* are identical in MSG-5 and in the medium term model MODAG. A complete list of sectors, commodities and activities is given in Chapter 3. Below, we give a brief review of these concepts. A more comprehensive account is found in Bjerkholt and Longva (1980).

Both commodities and sectors in MSG are aggregates of the corresponding concepts in the National Accounts. The sectoral concept is used to classify firms and similar units into production sectors. The basic principle determining this classification is that firms producing relatively similar kinds of products as their main output belong to the same production sector. The sectoral concept is also used to classify final demand and import into broad categories of goods and services classified by origin or use. There are 28 production sectors distinguished in MSG-5, of which seven produce government services. Private consumption is separated into 14 consumption sectors.

The commodities are classified according to the main producer principle, i.e. letting all goods and services with the same sector as the main producer form one (model) commodity. Thus, the classification of production sectors and commodities are closely related. MSG-5 specifies 41 commodities, of which nine are non-competing imports and four are public goods. The input-output structure of the economy is described in the model by two commodity-sector matrices. One input-matrix describes the commodity flows into functional sectors and an output-matrix describes the commodity flows delivered from functional sectors.

The real capital stock is, as in the National Accounts, partitioned into mutually exclusive and exhaustive *types* of real capital which are commodity aggregates. There are eight types of real capital in the model. The commodity composition within each type of real capital is common to all sectors. However, the composition of the various types of real capital differs in general between sectors.

The rather disaggregated representation of the commodity-by-sector flows makes it possible to focus both on the industrial and final demand structure and on the industrial interdependencies in a growth process. However, with respect to the specification of behavioural and technical relations in the model, it is hardly possible, nor essential for the quality of the model results, to introduce substitution possibilities between all inputs and outputs of each sector. To simplify, the detailed set of commodity and primary output flows of each sector is therefore partitioned into mutually exclusive and exhaustive subsets, called activities. Each activity defines an aggregate of input or output commodities or of

[1] This section is to a large extent based on Offerdal, Thonstad and Vennemo (1987). See also Dyvi *et al.* (1991) which in turn draws heavily on Cappelen *et al.* (1981).

primary inputs. Substitution possibilities are introduced only between these activities. Within each activity, fixed proportions are assumed, using commodity-by-activity coefficients.

Naturally, the classification of activities follows that of sectors. Most production sectors are assigned five input activities (*Labour, Capital, Electricity, Fuels* and *Other Material Inputs*) and one production activity each. No sector is assigned more than five input activities. Production sectors which are the main producers of more than one commodity are usually assigned two (and even three) production activities. In the latter sectors, the commodity composition of output may change. Regarding export and import, there is specified one activity for import and one for export for each commodity. Except for the capital type *Inputs to Construction of Oil Rigs, Platforms etc.*, there is one activity assigned to each different type of capital. Domestic households allocate their total consumption expenditure, net of exogenous *Medical Care and Health Expenses*, to 13 consumption activities.

All volumes, except those which are measured in physical units, are measured in constant base-year prices. However, the model employs different value concepts to evaluate commodity flows and activities. The principal concept for evaluating commodity flows is basic values. The basic value is equal to purchaser value less trade margins and net commodity taxes. This concept is preferred to producer or purchaser value because the trade margins (including transport charges) and commodity tax rates typically differ between receiving sectors for the same commodity. With such differentials, total demand for a commodity will depend on the composition of the demand and will cause a discrepancy between calculated total supply and total demand in producer and purchaser prices.

Because economic behaviour is motivated by market prices, they are the relevant prices in the behavioural relations in the model where activities are functions of prices. The market price of commodity outputs equals the producer price, and the market price of commodity inputs equals the purchaser price of inputs. The volume of the activity levels are accordingly evaluated in constant market values.

1.5 An aggregate picture of a stylised version of MSG-5

In order to facilitate the description of the various macroeconomic closure rules and the general equilibrium nature of the model, it is instructive to consider a one-sector version. For this purpose, we have also made the following simplifications relative to the actual MSG-5:

- all disequilibrium parameters are neglected
- all factor specific productivity parameters are neglected
- all indirect taxes and taxes on capital income are neglected
- demand for inventories, re-exports and exports of second-hand capital goods are neglected
- consumer demand is represented by one consumer only
- the single production sector produces one single commodity according to a constant returns to scale (CRTS) production technology
- the exogenous use of resources in public consumption and investment is omitted

Entry-exit equilibrium requires equality between the domestic producer price and the unit cost

$$(1.5.1) \qquad P^H = \frac{c(PL, PK, PU, PM)}{T}$$

$$(1.5.2) \qquad PU = PU(PE, PF)$$

P^H is the producer price of the domestic product. $c(.)$ is a CRTS unit cost function. *PL, PK, PU, PE, PF* and *PM* are prices of labour, capital services, energy, electricity, fuels and other material inputs, respectively. T is a parameter for Hicks-neutral technical change. Note that the technology is separable; energy is composed endogenously of electricity and fuels according to a CRTS technology. *PU*(.) is the dual cost function.

The domestic product and imports are used domestically for the following activities: consumption, electricity, fuels, other material inputs and investment. Additionally, the domestic product is exported. For all types of absorption the domestic and the imported product are combined according to a demand specific CRTS-aggregation function. The dual price functions are:

(1.5.3a-e) $Pi = Pi(P^H, P^I) \qquad i \in \{C, E, F, M, J\}$

P^I is the price of imports and *Pi* is the price of the (macro) commodity used in activity *i*.

The price of capital services has the form of the standard neo-classical user cost of capital where possible exogenous capital gains are included in the interest rate:

(1.5.4) $PK = Q(r+\delta)PJ$

r is the interest rate, δ is a rate of exponential depreciation of the capital stock, *Q* is a parameter which may be used to determine the price of capital services as a shadow price of the capital stock. We will return to this parameter later on in the discussion of the various macroeconomic closure rules.

From Shephard's lemma, factor demand is given by:

(1.5.5a) $L = \frac{c'_L X}{T}$

(1.5.5b) $K = \frac{c'_K X}{T}$

(1.5.5c) $M = \frac{c'_M X}{T}$,

(1.5.5d) $E = PU'_E \frac{c'_U X}{T}$

(1.5.5e) $F = PU'_F \frac{c'_U X}{T}$

c'_j and PU'_j are the partial derivatives of the cost functions *c*(.) and *PU*(.) w.r.t. the price of factor *j* (*j* = *K, L, U, M, E, F*). *X* is gross production.
Gross investment:

(1.5.6) $J = K(1+\delta) - K_{-1}$

Note that investment has full capacity effect in the same period (year) as investment takes place. Depreciation is calculated also on new capital.

Since the Norwegian product is assumed to be an imperfect substitute for foreign products, Norway faces a negatively sloped export demand curve:

$$(1.5.7) \qquad A = A\left(\frac{P^H}{P^I}\right)$$

where A is exports. Other exogenous arguments in the export demand function have been suppressed.

Product market equilibrium implies:

$$(1.5.8) \qquad X = PM_H'M + PE_H'E + PF_H'F + PJ_H'J + PC_H'C + A$$

where PM'_H etc. are the home shares of the components of the domestic demand.

Import is given by:

$$(1.5.9) \qquad I = PM_I'M + PE_I'E + PF_I'F + PJ_I'J + PC_I'C$$

Foreign net wealth, B, develops according to:

$$(1.5.10) \qquad B - B_{-1} = rB_{-1} + P^H A - P^I I$$

For simplicity we do not distinguish between the interest rate on net foreign wealth and the interest rate relevant for rational producer behaviour.

Closure rules

The stylised model consists of 18 equations in the following 25 variables: P^H, P^I, PL, PK, PU, PM, PE, PF, PJ, PC, r, δ, T, Q, X, M, L, K, E, F, J, C, A, I, B. P^I and r are exogenously determined on the international product and capital markets, T and δ are exogenous technology parameters. More controversial is the assumption that L is exogenous, which is a feature of all versions of the model. The rationale lies in the equilibrium nature of the model; the labour market is supposed to clear, and the supply of labour is exogenously given. This leaves us with 2 degrees of freedom.

A closure rule is formally nothing but choosing which two variables have to be determined exogenously. This should be regarded as a shortcoming of the model because we believe that all the remaining potential variables are endogenously determined in the real world. The fact that we have to choose a closure rule reflects that an intertemporal theory for the savings-consumption decision has not been incorporated in the model.

A more appealing model, at least from a theoretical point of view, would be an intertemporal model with perfect foresight. Since Norway has access to international markets for financial capital, such a model would typically treat Q as exogenous (equal to one in the absence of adjustment cost) . Moreover, a transversality condition should be imposed on the net foreign wealth. On the other hand, r should be separated into an exogenous nominal interest rate and an endogenous growth rate of the price of capital goods (PJ). The latter variable would reflect the assumption of perfect foresight. The properties of such an intertemporal perfect foresight model is analysed in Bye and Holmøy (1992)[2].

[2] The only difference from the structure of the stylised model presented in this section is that gross production has been replaced by value added as the production concept.

Note that the exchange rate is not an explicit variable in the model. The interpretation is that it is the numeraire and normalised to unity.

Closure rule 1
Exogenous: wage rate (PL), shadow price of capital (Q)
Endogenous: current account ($B - B_{-1}$), capital stock (K)

A closure rule which implies a recursive structure of the model is to assume that *PL* and *Q* are exogenous[3]. The model can then be solved in two stages. (1.5.1) - (1.5.4) determine simultaneously all prices and the optimal combination of inputs per unit of production, represented by the partial derivatives of the cost and price functions. These variables are functions of the "primary" cost components *PL*, $Q(r + \delta)$, P^I and T. For given input coefficients, gross production follows from (1.5.5a). Hence, we might say that production is determined from the supply side of the economy. Having found gross production, factor demand follow recursively from (1.5.5a) - (1.5.5b). Investment follows from (1.5.6) since K_{-1} is predetermined. Exports follow from (1.5.7). It is then easy to see that there is no room for an independent demand schedule for total consumption, *C*. (1.5.8) gives *C* as a residual left when the other kinds of demand have been met. Imports and net foreign wealth are computed in (1.5.9) and (1.5.10).

This particular closure rule was applied in an earlier version of the model labelled MSG-4E. Longva, Lorentsen and Olsen (1986) discuss both this model version and the closure rule. For long-run projections, probably the most serious problem is that the absolute value of the stock of net foreign wealth eventually explodes, which reflects that a transversality condition on this state variable is missing. The intertemporal budget constraint is violated. Thus, there is no feed-back mechanism adjusting any of the variables that influence the current account.

Closure rule 2
Exogenous: current account ($B - B_{-1}$), shadow price of capital (Q)
Endogenous: wage rate (PL), capital stock (K)

This choice of closure rule can be considered as a natural response to the weaknesses related to closure rule 1. The model now becomes simultaneous in prices and quantities. However, a fixed current account balance in each period (year) is obviously a poor substitute for a transversality condition on net foreign wealth. The possibility for an open economy to smooth consumption and welfare through "trade in time" is excluded. The closure rule often has been chosen when the model user wants to "fine-tune" the time path for the economy that is necessary/consistent with a specific target for the development of the external economy. The closure rule has also been frequently used in normative policy studies of welfare and resource allocation. The rationale is that one wants to exclude welfare gains that are financed by increasing foreign debt. Such gains may be suspected to be illusionary because future generations have to pay for them.

Closure rule 3
Exogenous: wage rate (PL), capital stock (K)
Endogenous: current account ($B - B_{-1}$), shadow price of capital (Q)

This closure rule is the original one presented by Johansen (1960). The model now answers questions about how the economy, especially the industry structure and the composition of demand, adjusts along

[3]As mentioned in Section 1.3, in the actual MSG-5 this recursiveness is broken by the decreasing returns to scale technology in production of electricity. This effect, however, is of small order.

a growth path which is mainly exogenously determined through the growth in the labour force, the capital stock and productivity. A choice of this closure rule may be justified by the same arguments as those mentioned for closure rule 2.

Closure rule 4
Exogenous: current account (B - B_{-1}), capital stock (K)
Endogenous: wage rate (PL), shadow price of capital (Q)

This closure rule permits feedback from both state variables to the prices. The service price of capital is endogenised in order to clear the market for physical capital. Hence the service price may deviate from the price of new capital goods. The closure rule has been used mostly in normative analyses, e.g. the effects of tax reforms. In the absence of an intertemporal model, one restricts the analysis to focus on effects of intratemporal reallocations. In order to identify these, welfare effects caused by a reduction of future consumption possibilities through increased foreign debt and/or a lower capital stock should be excluded. In other words; one does not want the normative results to be tainted by contributions from changes in savings behaviour.

The reduced form of the stylised model

Logarithmic differentiation of the equations (1.5.1) - (1.5.4) makes it possible to write the relative change in the domestic price as:

$$(1.5.11) \qquad p^H = \frac{\alpha_I p^I + \theta^K q + \theta^L pl - t}{1 - \alpha_H}$$

where small letters indicate logarithmic derivatives (w.r.t. time).

$$\alpha_H = \theta^K \theta_H^J + \theta^M \theta_H^M + \theta^U \left(\theta^{UE} \theta_H^E + \theta^{UF} \theta_H^F \right)$$

$$\alpha_I = \theta^K \theta_I^J + \theta^M \theta_I^M + \theta^U \left(\theta^{UE} \theta_I^E + \theta^{UF} \theta_I^F \right)$$

θ^j is the cost share of factor j ($j = K, M, U$). θ^{Ui} is the cost share of energy carrier i ($i = E,F$) in the price of the energy aggregate. θ_H^j is the budget share of the domestic product in the price of factor j ($j = K, M, U$). $\theta_I^j = 1 - \theta_H^j$ is the corresponding import share.

Any changes in r will enter (1.5.11) in the same way as the relative change in the shadow price variable, q. The "primary" cost components are clearly identified in the numerator. The denominator is less than unity and has the effect of magnifying the price effects of cost impulses. It enters because the domestic product is needed in the production process as capital good, energy and other material input. For example, while θ^L measures the direct cost share of labour in the production sector, $\theta^L/(1-\alpha_H)$ measures the total or input-output corrected cost share of labour.

From (1.5.5a) we find the growth in gross production:

$$(1.5.12) \qquad x = l + t - \frac{dc_L'}{c_L'}$$

(1.5.12) has an obvious interpretation. The last term is a factor substitution effect that summarises the impacts of changes in relative factor prices upon the input coefficient for labour. Changes in relative prices which induce substitution away from labour have the same impact on gross production as has an increase in the labour force. Factor substitution is the channel through which capital accumulation contributes to growth in gross production.

The effect of Hicks-neutral technical change is both direct and indirect. The direct effect is explicitly accounted for in (1.5.12). The indirect effect works through the factor substitution term. From (1.5.11) it is seen that a higher T will reduce costs and the price of the domestic product. Depending on the mix of imports and domestic product in the factors, the price of produced factors (*K, M, E* and *F*) will go down relative to wages and imports. With a multi factor technology, no general conclusions about the substitution effects can be drawn, but it is at least an empirical characteristic of MSG-5 that the net effect is reduced labour demand per unit of production.

Combining (1.5.5) and (1.5.8) we have the following relationship between the final demand components:

$$(1.5.13) \quad \left(\frac{T-\beta_H}{c'_L}\right)L = PC'_H C + PJ'_H J + A$$

$$\beta_H = PM'_H c'_M + \left(PE'_H PU'_E + PF'_H PU'_F\right)c'_U.$$

(1.5.13) can be interpreted as a resource constraint on consumption and savings. Savings consist of real investment and financial investment abroad. The latter is equal to the surplus on the current account which can be increased through more exports. Using (1.5.6) and (1.5.7) the relationship between consumption and supply side variables can be further explored:

$$(1.5.14) \quad C = \frac{\frac{T-\beta^*_H}{c'_L}L + PJ'_H K_{-1} - A}{PC'_H}$$

$$\beta^*_H = \beta_H + PJ'_H(1+\delta)c'_K$$

If closure rule 1 is used to determine the model, all input coefficients (partial derivatives) and exports can be considered as fixed variables in (1.5.14). Since K_{-1} is predetermined, (1.5.14) yields the full general equilibrium solution for consumption. Note that the inherited capital stock K_{-1} may be "eaten up". There is nothing that prevents investment from being negative in MSG-5. The numerator reflects what is left for consumption of domestic production after having produced the means of production (including capital) and having satisfied foreign demand.

(1.5.14) is a dynamic (backward-looking) relation. Contrary to the determination of gross production, a shift in an exogenous variable will in general have dynamic effects on consumption. This is, of course, due to the capacity effect of investment. Consider, as an example, the impact of an increase in the labour supply in period t=0 when closure rule 1 applies. Then all prices will be unaffected, and the immediate change in consumption, dC^0, becomes:

$$(1.5.15) \quad dC^0 = \frac{\left(t-\beta^*_H\right)}{c'_L PC'_H}dL$$

The immediate effect is computed by treating K_{-1} as exogenous because it is predetermined in the period when L changes. This immediate response deviates from the long-run stationary response, which accounts for the adjustment of the capital stock. When all exogenous variables are constant through time, the optimal capital stock will stay at the new constant level in the periods 0,1,2,...The stationary response in consumption, dC^S, is therefore reached in period 1 and becomes

$$(1.5.16) \qquad dC^S = \frac{t-\tilde{\beta}_H}{c'_L PC'_H} dL$$

$$\tilde{\beta}_H = \beta_H + PJ'_H \delta c'_K = \beta^*_H - PJ'_H c'_K$$

While the stationary effect is positive, the short-run effect may well be negative. The reason is, of course, that the investments needed for keeping the capital/labour ratio constant have to be undertaken within the first period. Since prices are constant, investments can not be financed through a reduction of net exports; crowding out of consumption is the only way of getting resources.

In this stylised model, the dynamics are of a "bang-bang" nature; only one period of adjustment is required before the new stationary solution is reached. In the actual MSG-5, the existence of many sectors differing in factor intensities generates a longer "transition" period. Usually stationary multipliers are reached after 10 - 15 years if the exogenous shift is permanent and constant over time (see Holmøy (1992) and Longva, Lorentsen and Olsen (1986) for a further discussion of the dynamics in the MSG model).

However, it should be stressed that the reason why it takes a longer period of adjustment to reach stationary multipliers in the actual MSG model than in the stylised model has nothing to do with an ambitious modelling of dynamic adjustments. The dynamic structure in the actual MSG model is also related to the stock-flow relationship between capital and investment. The explanation is the level of disaggregation in MSG. The sectors differ in their factor intensities; there are several capital goods with different rates of depreciation. Hence, the aggregate capital/labour ratio will depend on the allocation of labour between production sectors, and this allocation varies during an investment "boom". Initially there will be relatively high activity in the sectors producing capital goods. When capital goods are less capital intensive than consumption goods, taking account of the input-output effects, the reallocation from the former to the latter requires investment by itself. Therefore, the activity in the sectors producing capital goods will not fall back to the level where gross investment is just sufficient to replace scrapped capital.

For many purposes it is also instructive to take a closer look at the dependence of the current account on exogenous variables. Since interest on foreign wealth is predetermined as long as r is constant, changes in the current account must be due to (capitalised) changes in the trade balance defined as $D = P^H A - P^I I$. We confine the discussion to stationary effects. Then $J=\delta K$ and $K=K_{-1}$. From (1.5.9) and (1.5.14), it can be verified that the stationary imports is:

$$(1.5.17) \qquad I = \frac{PC'_I}{PC'_H}(X-A) + \tilde{\beta}_I X\left(1 - \frac{\tilde{\beta}_H}{\beta_I}\frac{PC'_I}{PC'_H}\right)$$

The stationary trade balance becomes:

$$(1.5.18) \qquad D = P^H\left[A - \frac{\theta^C_I}{\theta^C_H}(X-A)\right] - P^I\tilde{\beta}_I X\left(1 - \frac{\tilde{\beta}_H}{\tilde{\beta}_I}\frac{PC'_I}{PC'_H}\right)$$

Recall that X is given by (1.5.5a). Note that the last term on the r.h.s. of (1.5.18) vanishes if the import shares are equal for all kinds of demand. Thus, this term is a measure of the skewness w.r.t. the content of import in the different demand categories. The effect of this skewness is proportional to gross production. This is because an increase in X requires more intermediate inputs. The corresponding import value is $P^I\beta_I$ per unit of X. The production of intermediates crowds out consumption and thereby also import of products for consumption. The net effect on the trade balance is positive if the overall import share in the intermediates is less than the import share in consumption.

The first term on the r.h.s. of (1.5.18) is equal to the trade balance provided that the import shares of all intermediate factors are equal to the import share of consumption. X - A is the supply of domestic products available for consumption and intermediate factor demand. $(X-A)\theta_I^C/\theta_H^C$ is the corresponding import.

Now, consider the effects on the trade balance of a partial positive shift in the export demand function, $dA > 0$, when the model is determined according to closure rule 1. Then, no prices and optimal shares are affected and X remains constant. Let us disregard the effects of demand specific import shares. The direct effect is obviously $P^H dA$. The indirect effect is $\theta_I^C/\theta_H^C\ dA$ and is due to crowding out of other demand needing imports.

Next, consider the effects of a partial increase in the wage rate (exogenous when closure rule 1 is adopted). First, there is a positive price effect due to an improvement in the terms-of-trade. The increase in P^H follows from (1.5.11). Second, the increase in the relative price of the domestic product causes a negative effect through the reduction in A. Third, the import share will increase for the same reason. Finally, there is a negative effect working through growth in the demand for intermediates and consumption (X - A). This effect is brought about by factor substitution; a higher wage rate causes substitution away from labour which means that the same labour force is able to increase gross production. This production growth must be offset by higher demand for intermediates and consumption. But an increase in these demand components also leads to higher imports. Therefore, the net effect is ambiguous because of the positive terms-of-trade effect. However, in MSG-5 the stationary effect is negative. One might say that a general equilibrium analogy to the "Marshall-Lerner" condition is satisfied.

An exogenous increase in the service price of capital (e.g. through Q) will have the same qualitative effects on the trade balance as an increase in the wage rate, except for the effect caused by factor substitution. Producers will now substitute capital and other produced factors for labour. The result is a decline in X which in turn has a positive effect on the trade balance. If the possibilities for factor substitution are large relative to the possibilities for substitution between the domestic and foreign varieties, the trade balance may be improved by this kind of positive shift in costs.

1.6 Producer behaviour and the user cost of capital

The focus in the subsequent exposition is to describe how the Norwegian tax system influences the input of capital via the user cost of capital. The model has been designed to capture the changes in the tax rules imposed by the tax reform which was implemented in 1992.

The user cost of capital is only relevant to those sectors where the capital stock is assumed to adjust endogenously to changes in factor prices. In important production sectors such as *Production and Pipeline Transport of Oil and Gas*, *Ocean Transport*, *Oil and Gas Exploration and Drilling* and in government production sectors, this is not the case. Furthermore, the user cost of capital in *Dwelling*

Services is taken from Berg (1989) and is not derived by the model presented in this section. The same applies to the user cost of capital in *Production of Electricity* which is taken from Johnsen (1991).

The taxation of capital income differs between incorporated enterprises and personal enterprises. Both cases are considered in the following.

Incorporated enterprises

The starting point is the fundamental arbitrage condition from a representative shareholder's point of view concerning the uncertain return from investing a given amount in shares and the certain return from investing the same amount in a bank.

$$(1.6.1)\quad (1 - t_g)\frac{(V_{t+1} - V_t) - S_t;V_t}{} + (1 - t_d)\frac{D_t;V_t}{} = (1 - t_i)\, i^i + \theta$$

t_g = personal tax rate on capital gains accrued on the share value
t_d = discounted personal tax rate on dividends
t_i = personal tax rate on interest income
V = the market value of the firm (= value of the shares)
S = emissions of new share
D = dividends received by the shareholder
i^i = interest rate on bank deposits
θ = risk premium on returns from share holding; $\theta > 0$ when the shareholder is risk averse

The left hand side of (1.6.1) is the rate of return from investing in shares in period *t*. It decomposes into net-of-tax capital gains and net-of-tax dividends. The right hand side is the return from bank deposits plus the risk premium. The specification of the risk premium is similar to that in Goulder and Summers (1989). It is implicitly assumed that dividends are non-negative and cannot exceed the value of accounting profit net of corporate and wealth tax. Emissions of shares are non-negative. Solving the difference equation (1.6.1) and ruling out bubbles so that the sum converges, the fundamental equation for the value of the firm becomes:

$$(1.6.2)\qquad V_\tau = \sum_{t=\tau}^{\infty}\left(\frac{1 - t_d}{1 - t_g}D_t - S_t\right)\left(\frac{1}{1 + r}\right)^{t-\tau+1}$$

The value of the firm in period τ is equal to the present value of the net-of-tax cash flow received by the shareholder. The relevant discount rate is:

$$(1.6.3)\qquad r = \frac{(1 - t_i)\, i^i + \theta}{1 - t_g}$$

The manager of the firm maximises the value of the firm with respect to output level, the input of factors and the financial structure. The last decision involves the debt/equity ratio and whether equity financing takes place through retained profits or issues of new shares. The maximisation must take the following constraints into account:

$$(1.6.4)\qquad D_t = \Pi_t(K_{t-1}) - iB_{t-1} - q_tJ_t + Q_t + S_t - T_t$$

$\Pi_t(K_{t-1})$ = restricted profit function[4]
K = capital stock
i = interest rate on corporate debt
B = corporate debt
q = price of the capital good
J = gross investment
Q = net corporate borrowing
T = total corporate tax expenditure

(1.6.4) relates dividends distributed to the shareholders to the decision variables J, Q and S. The restricted profit function is the result of maximisation of profits with respect to outputs and to all inputs except capital. The capital stock at the end of period $t-1$ is productive in period t. Corporate debt and the stock of real capital evolve according to:

(1.6.5) $$Q_t = B_t - B_{t-1}$$

(1.6.6) $$K_t = (1 - \hat{\delta})K_{t-1} + J_t$$

$\hat{\delta}$ = rate of physical depreciation

The incorporated enterprise pays taxes both to the central and the local government and also a tax on corporate wealth. The basis for these taxes are:

(1.6.7) $$TB^S = \Pi_t - iB_{t-1} - A_t^T - F_t - D_t$$

(1.6.8) $$TB^K = \Pi_t - iB_{t-1} - A_t^T - F_t$$

(1.6.9) $$TB^V = VK^A - B$$

TB^S = basis for corporate tax paid to the central government
TB^K = basis for corporate tax paid to the local government
TB^V = basis for tax on corporate wealth
A = depreciation allowances
F = various legal deductions from the tax base to various funds
VK^A = report value of capital for tax purposes

The rules for the deductions denoted by F is explained in detail in Holmøy, Larsen and Vennemo (1993). In order to simplify the exposition, these deductions have been aggregated. They are related to the corporate tax base:

(1.6.10) $$F = f(TB^K + F)$$

where f is a fixed rate. According to the tax rules, the tax bases lag one year. Using the definitions of the tax bases in (1.6.7) and (1.6.7), the corporate profit tax, T^O, can be decomposed into a tax on retained profits and a tax on dividends paid to the shareholders:

(1.6.11) $$T_t^O = u_{t-1}'\left(\Pi_{t-1} - iB_{t-2} - A_{t-1}^T - D_{t-1}\right) + u_d D_{t-1}$$

[4] Figure 1.3.2 provides some insights as to the structure of this function.

u^S = formal tax rate on corporate profits for taxes paid to the central government.
u^K = formal tax rate on corporate profits for taxes paid to the local government.
$u' = (u^S + u^K)(1 - f)$ is a tax rate on corporate profits adjusted for deductions to various funds.
$u_d = u' - u^S$

Depreciation allowances and the report value of capital for tax purposes are:

(1.6.12) $A_t^T = L_t + A_t^O = hq_{t+1}J_{t+1} + aVK_t^A$

(1.6.13) $VK_t^A = (1\text{-}h) \sum_{i=0}^{\infty} (1\text{-}a)^i \, q_{t-i}J_{t-i}$

A^T = total depreciation allowances
A^O = ordinary depreciation allowances
L = immediate write off
a = rate of ordinary depreciation allowances
h = rate of immediate write off

The description of the rules for depreciation allowances is somewhat simplified compared to the actual Norwegian system (see Holmøy, Larsen and Vennemo (1993) for more details.) The tax on corporate wealth is:

(1.6.14) $T_t^V = v_{t-1} \, (VK_{t-1}^A - B_{t-1})$

v = tax rate on corporate wealth

Debt financing is cheaper than equity financing under the Norwegian Tax Code. However, corporate net debt is assumed to be effectively restricted by an exogenous maximum debt-equity ratio, β:

(1.6.15) $B_t = \beta q_t K_t$

The source of the residual equity financing is either retained profits or issues of new shares depending on which is the cheapest alternative.

In order to obtain the first order condition for optimal capital stock, and thereby an expression for the user cost of capital, (1.6.3) - (1.6.15) are inserted into (1.6.2). The market value of the firm is maximised with respect to gross investments, J, and to issues of new shares, S. In Holmøy, Larsen and Vennemo (1993), the f.o.c. implies the following user cost expression:

(1.6.16) $PK^C = \beta d + (1\text{-}\beta)e + \delta - c$

where PK^C is the user cost of capital for an incorporated enterprise. d and e are the interest cost of debt financing and equity financing respectively defined by:

(1.6.17) $d = i - \frac{v}{1 - u^*}$

(1.6.18) $$e = min\,\{\frac{(1-t_i)+\theta}{(1-t_g)(1-u^*)}, \frac{(1-t_i)i^i+\theta}{(1-t_d)(1-t_u)}\}$$

$u^* = \frac{u'}{1+r}$ = effective tax rate on retained corporate profits

t_u can be interpreted as the effective tax rate on corporate profits distributed to the shareholders as dividends. It can be shown that this tax rate can be written:

$$t_u = \frac{u^* - \frac{u^S + u^K}{1+r}}{1 - \frac{u^S + u^K}{1+r}}$$

δ is the actual rate of economic depreciation defined by:

$$\delta = \hat{\delta} - (1-\hat{\delta})\,\dot{q}$$

where $\dot{q}$ is the relative growth in the price of the capital good from period t to t+1. c is the tax credit implied by the rules of depreciation allowances and taxation of capital gains. It can be written:

(1.6.19) $$c = \frac{Z'(r+\hat{\delta}) - u^*\hat{\delta}}{1-u^*}$$

where Z' is the present value of the deductions due to depreciation allowances per Nkr defined by:

$$Z^{C'} = u'h + a(1-h)\left(u' - \frac{v}{a}\right)\left(\frac{1}{r+a}\right).$$

The first term on the right hand side is the value of the immediate write off. The second term is the present value related to ordinary depreciation allowances. After the immediate write off, the share (1-h) is subject to ordinary depreciation allowances.

Personal enterprises

The derivation of the user cost of capital is, in several respects, similar to the derivation of the user cost for incorporated enterprises. Therefore, the subsequent description only points out the main differences compared to the derivation above for incorporated enterprises. These are due to differences in the deductions from the tax base to various funds, to the fact that personal enterprises cannot issue shares, and to the fact that personal enterprises pay taxes on the current tax base - not the tax base of the previous year.

The relevant discount rate for the owner of a personal enterprise is:

(1.6.20) $$r = (1-t_{ip})\,i^i + \theta - v_p$$

t_{ip} = tax rate on interest
v_p = tax rate on personal wealth

The cash flow is:

(1.6.21) $D_t = \Pi(K_{t-1}) - iB_{t-1} - q_t J_t + Q_t - T_t$

The stock-flow relations (1.6.5), (1.6.6) and the debt-equity constraint (1.6.15) also apply to personal enterprises. Retained profits is the only alternative to debt financing. Hence, the capital costs implied by equity financing is equal to the discount rate which reflects the opportunity cost of the investment.

Owners of personal enterprises pay tax on profits, T^N, and on wealth, T^V:

(1.6.22) $T = T^V + T^N$

(1.6.23) $T_t^V = v^P (VK^A - B)$

Personal enterprises pay taxes in the same year as the tax base is earned. The taxes on profits paid to central and local governments are levied on the same tax base. The deductions to various funds, F, are related to the tax base in the same way as in (1.6.10). However, due to different tax rules the coefficient f takes on different values for incorporated and personal enterprises. Taxes on profits can be written (see Holmøy, Larsen and Vennemo (1993) for details):

(1.6.24) $T^N = (1-f)[\, t^*(\Pi(K_{t-1}) - A) - t_i^* iB_{t-1}$

t_i^* = the relevant marginal tax rate on interest for owners of personal enterprises.
t^* = the relevant effective tax rate on profits for the owner of a personal enterprise after corrections due to the division of profits into a salary part and a capital income part.

Under reasonable assumptions (before the tax reform was implemented in 1992), $t_i^* < t^*$. Note that t_i^* differs from t_{ip}. The rules determining the book value of the capital stock and the depreciation allowances apply to both incorporated and personal enterprises.

The objective of the owner of the personal enterprise is to maximise the present value of the after-tax cash flow. Using the same notation as for the incorporated enterprise, this present value, V_τ, becomes:

(1.6.25) $$V_\tau = \sum_{t=\tau}^{\infty} \left(\frac{1}{1+r}\right)^{t-\tau+1} D_t$$

Maximising V_τ with respect to gross investment subject to the constraints implied by (1.6.5), (1.6.6), (1.6.10), (1.6.12), (1.6.13), (1.6.14), (1.6.15), (1.6.20), (1.6.21), (1.6.22), (1.6.23), (1.6.24) and (1.6.25) leads to the following user cost of capital expression:

(1.6.26) $$PK^P = \beta\left(\frac{i(1-t_i.) - v_p;1-t^*}{}\right) + (1-\beta)\,\frac{r;1-t^*}{} + \delta - \frac{Z'(r+\delta) - t^*\delta;1-t^*}{}$$

As above, Z' defines the present value of the deductions due to depreciation allowances on the marginal capital unit corrected for the wealth tax:

$$Z^{P\prime} = \left(t^* h + a(1-h)\,(t^* - \frac{v_p}{a})\frac{1}{r+a}\right)(1+r)$$

(See Appendix 6 in Holmøy, Larsen and Vennemo (1993) for the derivation of this term). The components of the user cost of capital, and their interpretation, are similar for the personal and the incorporated enterprises.

1.7 The electricity market

Background[5]

Today, nearly all of the electricity consumed in Norway is supplied by domestic hydro power stations. Approximately 80 percent of the total available hydro power reserves are already utilised. Expansion of the hydro power system is characterised by increasing long term marginal costs when the waterfalls are developed in the optimal order. Contrary to the short term marginal costs, long term marginal costs include the capital costs related to the development of marginal waterfalls. Another important economic aspect of expanding the hydro power capacity, is the irreversibility of the investment: the structures and machinery required for hydro power production have no alternative use. The electricity block in MSG-5 takes into account both the decreasing returns to scale and the irreversibility of the investments.
The combination of the long term perspective of an AGE model such as MSG-5, and the decreasing returns to scale aspect of further expansion of the hydro power production capacity necessitates that the model specifies alternative potential energy producing technologies. The most realistic alternative in Norway is thermal power based on natural gas. Consequently, electricity production based on gas power has been specified as a potential, but not necessarily active, production sector in MSG-5.

A brief overview of the structure of the electricity market is given in Figure 1.7.1 below (taken from Johnsen (1991)). The individual hydro power producers sell their electricity (competitively) to the regional distribution companies and to some large firms in energy intensive industries. These firms are directly connected to the national transmission grid that connects the producers of hydro power[6] to the distribution network. Except for these large firms, all final users have to buy distribution services from the regional distribution companies which are natural monopolies in supplying distribution services. However, the pricing of the distribution services was regulated by government authorities until 1992. According to this description, the supply of electricity to final users is modelled by disaggregating the national account sector *Production of Electricity* into the four production sectors *Production of Hydro-Power, Production of Gas-Power, Transmission Services* and *Distribution Services.*

Norway's electricity market has traditionally been strongly regulated. It is widely recognised that the regulations have resulted in excess hydro power capacity compared to the socially optimal policy[7]. In addition, price regulation has resulted in price discrimination of electricity between different groups of consumers. Price discrimination between consumers is defined as price differentials that cannot be accounted for by corresponding cost differentials. Johnsen (1991) and Bye and Johnsen (1991) show that large price differentials exist in the Norwegian electricity market. According to these studies, the most important kind of price discrimination on hydro power electricity has taken place through long-term contracts between producing plants and energy intensive industries. Thus, large quantities of electricity have been distributed to firms in the production sectors *Manufacture of Metals, Manufacture of Industrial Chemicals* and *Manufacture of Pulp and Paper Articles* at prices considerably below the prices paid by other sectors. This kind of imperfection cause efficiency losses. It is taken into account in MSG-5.

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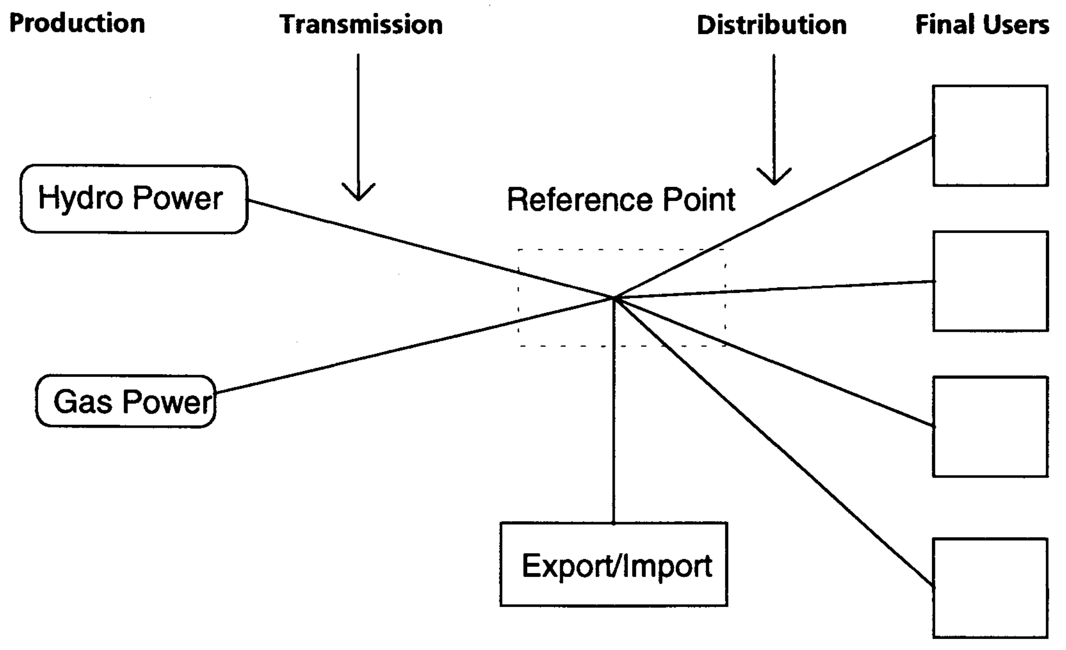
[5] This section draws extensively on the exposition by T.A. Johnsen in Alfsen, Bye and Holmøy (1994).
[6] More than 99 percent of domestic electricity consumption is produced by hydro power plants.
[7] Export of electricity is restricted according to Johnsen *op. cit.*

Figure 1.7.1: The electricity market



In short, the method used to quantify price discrimination is to decompose the purchaser prices of electricity into different cost components and a residual price-cost margin. The differences in these margins are interpreted as a measure of price discrimination. More precisely, in order to obtain a meaningful measure of price discrimination, the observed differentials in the purchaser prices of electricity paid by different sectors are corrected for the following qualitative differences: First, energy intensive industries have a higher utilisation time than other users. The Norwegian Water Resources Administration (NVE) has calculated that the long-run marginal cost on deliveries of hydro power to energy intensive industries equals 89 percent of the average long-run marginal cost on deliveries to other sectors. Second, the distribution cost (including power losses) differs between sectors according to distance between producer and consumer. Third, the composition of hydro power electricity with respect to the security of delivery differs between sectors. Prices of surplus power are considerably lower than prices of contracted deliveries. Price differentials between sectors attributable to different composition with respect to the security of delivery have been eliminated in the estimation of price discrimination in the electricity market. Fourth, indirect taxation on use of electricity differs between sectors.

Accounting for the cost differentials makes it possible to treat electricity as a homogeneous commodity with a uniform equilibrium price. In the model, this equilibrium price is determined at a reference point somewhere between the distribution and the transmission system (see Figure 1.7.1). The equilibrium price reflects both the marginal willingness to pay for hydro and thermal power on the one hand, and the short-run marginal cost of production on the other. If the willingness to pay exceeds long-run marginal cost of production, the capacity expands. However, the model also specifies "policy variables" which can be used when simulating a pricing and investment policy which deviate from these (partially) optimal rules.

While the commodity prices in MSG-5 are, in general, price indices normalised to unity in the base year, electricity prices, including the equilibrium price, are denominated in Nkr per physical unit (kWh). The model block of the electricity market calculates the flows of electricity between sectors in both physical units and constant prices. The base year figures of the physical flows are taken from the Energy

Accounts, while the corresponding constant price flows are taken from the National Accounts. Several equations in the electricity block relate these sets of flows to each other. Transforming flows denominated in physical units into corresponding constant price volume indices is necessary in order to incorporate the energy flows in the input-output structure of MSG-5. As mentioned above, the input-output matrices are taken from the National Accounts, where flows are measured in constant basic values. However, the use of two sets of units to measure electricity volumes adds considerably to the formal complexity of the electricity block described in Section 2.16. The stylised model presented below is intended to clarify the essentials.

A stylised version of the electricity block

The purchaser prices are related to the basic prices, indirect taxes and price discrimination by:

(1.7.1) $$PE_i = \left[t_i^V + \left(1 + H_i^{VE}\right)\left(\lambda_{Ei} B_E + \lambda_{Di} B_D\right)\right]\left(1 + t_i^M\right) \qquad i = 1,\ldots,n$$

PE_i = purchaser price of electricity in sector i
B_E = equilibrium basic price of electricity
B_D = basic price of distribution services
λ_{Di} = distribution services per unit of power delivered to sector i
λ_{Ei} = homogeneous power per unit of power delivered to sector i
t_i^V = net tax on electricity used by sector i
t_i^M = value added tax on electricity used by sector i
H_i^{VE} = coefficient for price discrimination in sector i

The differences in λ_{Ei} between sectors reflect different composition of firm and surplus power and differences in using time. B_D is determined by the unit costs in the distribution sector. These are basically determined outside the electricity market and will be treated as exogenous in this exposition.

The demand for electricity in each sector is a function of the purchaser price which is derived from the behaviour of producers and consumers. Aggregate demand for homogeneous electricity, E, is:

(1.7.2) $$E = \sum_j E_j\left(PE_j\right)$$

where $E_j(PE_j)$ is the demand function for electricity in sector j, where j counts all demanding sectors. The demand functions also take into account sector specific losses of power in the transmission and the distribution system. Equilibrium in the market for the homogeneous electricity implies:

(1.7.3) $$E = X_V + X_G + I^E$$

X_V = supply of homogeneous electricity from the hydro power production sector
X_G = supply of homogeneous electricity from the gas power production sector
I^E = net imports of homogeneous electricity

The equilibrium price of the homogeneous electricity is independent of the technology producing it. Neglecting transmission cost differences between hydro and gas power due to different average location, B_E satisfies:

(1.7.4a) $$B_E = B_V + B_T$$

(1.7.4b) $B_E = B_G + B_T$

B_V = basic price of hydro power
B_G = basic price of gas power
B_T = basic price of transmission services

B_D, as B_T, will be treated as exogenous in this exposition because it is determined by the unit cost in the transmission sector which is essentially determined outside the electricity market.

Short run marginal costs in hydro and gas power production, KTG_V and KTG_G respectively, consist of wages and expenditures on intermediates. In hydro power production, these costs are independent of scale and are treated as exogenous in this exposition. In gas power production, the input of natural gas per marginal unit of production depends on the predetermined production capacity in the sector. Disregarding slack in capacity utilisation, KTG_G can be written:

(1.7.5) $$KTG_G = k_G + [\alpha_G + \beta_G X_G(-1)]P_N$$

where k^G summarises the other short run cost components, α_G and β_G are technology parameters and P_N the price of natural gas (exogenous).

Long run marginal costs are:

(1.7.6) $$LTG_i = KTG_i + ZZK_i PK_i \quad i = V,G$$

LTG_i = long run marginal cost in sector i
ZZK_i = input of capital per marginal unit of production in sector i
PK_i = user cost of capital in sector i

The input coefficient for capital is constant and exogenous in gas power production. In hydro power production, ZZK_V is an increasing function of the predetermined production capacity. Disregarding slack in the capacity utilisation, the relationship is:

(1.7.7) $$ZZK_V = \alpha_V + \beta_V X_V(-1) - \gamma_V[X_V(-1)]^2 \quad \text{when } X_V(-1) < XR_V$$

where α_V, β_V and γ_V are technology parameters. XR_V is the remaining water resources possible to develop. The model ensures that this constraint is not violated.

The willingness to pay for marginal power, $BKNY_i$, is defined as:

(1.7.8) $$BKNY_i = B_i + \frac{\sum_j t_j^V E_j(PE_j)}{X_V + X_G} \quad i = V, G$$

where the last term is an average tax rate on use of electricity; j counts all consuming sectors.

The basic principle in the model is that expansion of production capacity takes place if the marginal willingness to pay exceeds the long-run marginal cost. However, the model user may use a dummy variable to simulate scenarios where the government follows other exogenous policy rules. To simplify the exposition, the dummy variables are omitted in the stylised model. That production equals capacity in the hydro power sector is then determined by:

(1.7.9a) $X_V = X_V(-1)$ when $BKNY_V < LTG_V$

(1.7.9b) $[\alpha_V + \beta_V X_V - \gamma_V (X_V)^2]PK_V + KTG_V = BKNY_V$, when $BKNY_V \geq LTG_V$

(X_V is the largest root in the second order equation). The term in the square brackets is similar to ZZK_V in (1.7.7) except that the current value of X_V has replaced the lagged one. Thus the left hand side of (1.7.9b) equals the long run marginal cost of expanding the hydro power capacity from the new level determined by (1.7.9b).

That production equals capacity in the gas power sector is determined in the same way:

(1.7.10a) $X_G = X_G(-1)$ when $BKNY_G < LTG_G$

(1.7.10b) $k_G + (\alpha_G + \beta_G X_G)P_N + ZZK_G PK_G = BKNY_G$ when $BKNY_G \geq LTG_G$

where the sum of the first two terms on the left hand side of (1.7.10b) equals KTG_G defined in (1.7.5), except that the current value of X_G has replaced the lagged one. Thus the left hand side of (1.7.9b) equals the long run marginal cost of expanding the gas power capacity from the new level determined by (1.7.10b).

This stylised model has n + 12 equations which determine the following n + 12 endogenous variables: $PE_1,..,PE_n, B_E, E, X_V, X_G, B_V, B_G, KTG_G, LTG_V, LTG_G, ZZK_V, BKNY_V, BKNY_G$.

(1.7.1) and (1.7.2) give total electricity demand, E, as a function of the equilibrium price, B_E. Define this function as $E = E(B_E)$. In each period, short and long run marginal costs are exogenous (partly predetermined) in the gas and hydro power producing sectors. (1.7.8), (1.7.4a) and (1.7.4b) give the marginal willingness to pay for both kinds of power as a function of B_E. The equilibrium solution can now be found by first finding the marginal willingness to pay given the capacity inherited from the previous period, adjusted for exogenous net imports. From (1.7.3) this value of B_E* is determined by

$$E(B_E^*) = X_V(-1) + X_G(-1) + I^E$$

Inserting B_E* into (1.7.4) and using (1.7.8), the marginal willingness to pay for each kind of power is found given the existing capacity. The comparison of these values with the corresponding long run marginal costs (predetermined) determines whether the capacity is expanded in the two sectors. If $BKNY_V < LTG_V$ and $BKNY_G < LTG_G$, no sector expands capacity. If the opposite case is true for both sectors, the equilibrium solution is found by inserting the relation between the marginal willingness to pay and B_E into (1.7.9b) and (1.7.10b). X_V and X_G then become (supply) functions of B_E. Substituting the aggregate demand function and the supply functions into (1.7.3) then determines B_E.

2. MSG-5 Equation structure

THE PRICE SUB-MODEL

2.1 The user cost of capital model

This section describes the various elements constituting the capital costs relevant to incorporated and personal enterprises. The underlying theoretical model of producer behaviour is laid out in Section 1.6.

Interest cost for incorporated enterprises

(2.1.1) $RENG = RENU + RISK$

Symbols
RENG = nominal annual interest rate on debt issued to finance investment in physical capital.
RENU = nominal annual interest rate on positive financial investment in the international capital market.
RISK = risk premium normalised to an adjustment of the nominal interest rate.

RENU is exogenous and fixed to the long-term interest on bank deposits. The difference between the interest on debt and bank deposits is assumed to equal the risk premium. Transaction costs are ignored (or included in *RENU*).

(2.1.2) $$REFFC = \frac{(1-TAXPR)RENU + RISK}{1-TAXPG}$$

New symbols
REFFC = effective discount rate for an incorporated firm.
TAXPR = (marginal) personal tax rate on interest income for a shareholder.
TAXPG = effective personal tax rate on capital gains related to trade in shares for a shareholder.

REFFC can be shown to be the relevant discount rate for the calculation of the present value of the after tax cash-flow received by the shareholder. The valuation of the company is derived from a non-arbitrage condition between saving in company shares and bank deposits. A transversality condition that rules out eternal speculative bubbles is imposed. The value of the company is equal to the equity.

(2.1.3) $$UEFF_j = \frac{UB(1-KFOND-DFOND_j)}{1+REFFC} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols
$UEFF_j$ = effective tax rate on corporate profit, sector *j*.
UB = formal tax rate on corporate profit according to the Norwegian tax code.
$KFOND$ = the maximum share of the corporate profit tax base that can be deducted for appropriations to the "consolidation fund".
$DFOND_j$ = the maximum share of the corporate profit tax base that can be deducted according to special tax laws for investments in rural areas, sector *j*.

The effective tax rate is discounted since incorporated firms pay taxes with one year lag.

(2.1.4) $$UDEFF_j = 1 - \frac{1-UEFF_j}{1-\frac{UBS}{1+REFFC}} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols
$UDEFF_j$ = effective corporate tax on dividends, sector *j*.
UBS = formal state corporate tax rate on corporate profit.

(2.1.5) $$TGEFF_j = 1-(TAXPG)(1-UEFF_j) \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols
$TGEFF_j$= effective *total* tax rate on retained profits, sector *j*.

By *total* it is meant that this tax rate summarises the effective taxation at both the corporate and the personal levels. At the corporate level, retained profits are effectively taxed at the rate *UEFF*. Retaining this net-of-tax profit increases the share value by the same amount. The capital gains related to the increase in the share value is effectively taxed at the rate *TAXPG*.

(2.1.6) $$TDEFF_j = 1-\left(1-\frac{TAXPD}{1+REFFC}\right)(1-UDEFF_j) \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols
$TDEFF_j$ = effective total tax rate on dividends, sector *j*.
$TAXPD$ = personal tax rate on dividends.

TDEFF summarises the effective taxation of profits, when distributed as dividends to the share holder, at both the corporate and the personal levels. The formula accounts for the fact that in practice the personal tax on received dividends is paid with one year lag.

(2.1.7) $$GJELDC_j = RENG - \frac{V}{1-UEFF_j} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols
$GJELDC_j$ = effective interest cost on corporate debt, sector *j*.
V = formal tax rate on corporate wealth.

Corporate debt is deducted when calculating the base for taxation of corporate wealth. This has the effect of reducing the interest paid on corporate debt. The denominator accounts for the fact that, contrary to interest payments, the wealth tax cannot be deducted from the tax base of the corporate profit tax. *GJELDC* can therefore be interpreted as the effective capital cost for the share holder of financing corporate investment in physical capital by increased corporate debt.

(2.1.8) $$TILBHC_j = \frac{REFFC}{1-UEFF_j} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols

$TILBHC_j$ = effective interest cost for the share holder of financing corporate investment in physical capital by retained profits, sector *j*.

(2.1.9) $$AKSJEC_j = REFFC\frac{1-TAXPG}{1-TDEFF_j} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols

$AKSJEC_j$ = effective interest cost for the share holder of financing corporate investment in physical capital by issuing new shares, sector *j*.

(2.1.10) $$EGENC_j = \min\{TILBHC_j, AKSJEC_j\} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols

$EGENC_j$ = effective interest cost for the share holder of equity financing corporate investment in physical capital, sector *j*.

Interest cost for personal enterprises

(2.1.11) $$REFFN_j = (1-TAXPRN_j)RENU + RISK \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols

$REFFN_j$ = effective discount rate for a non-corporate firm sector *j*.

$TAXPRN_j$ = (marginal) personal tax rate on interest income for a person owning a firm in sector *j*.

(2.1.12) $$TPNEFF_j = TAXPN_j(1-KFOND-DFOND_j)+\frac{TAXPN_j \cdot KFOND}{(1+REFFN_j)^3}$$

$$j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols

$TPNEFF_j$ = effective tax rate on non-corporate profit, sector *j*.

$TAXPN_j$ = formal tax rate on non-corporate profit, sector *j*.

Eq. (2.1.12) reflects that the tax treatment of appropriations to the "consolidation fund" differs between the corporate and the non-corporate firms. In the latter, deductions appropriated to the "consolidation fund" are tax-free for three years only. In (2.1.12) it is implicitly assumed that the tax system is constant over the relevant time period.

(2.1.13) $$GJELDN_j = RENG\frac{(1-TAXPRN_j)}{1-TPNEFF_j} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols
$GJELDN_j$ = effective interest cost on non-corporate debt, sector j.

The difference between *GJELDN* and *RENG* reflects the possible difference between the taxation of personal interest income and the taxation of capital income earned in non-corporate firms.

(2.1.14) $$EGENN_j = \frac{REFFN_j}{1 - TPNEFF_j} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$$

New symbols
$EGENN_j$ = effective interest cost of equity financing non-corporate investment in physical capital, sector j.

In the non-corporate sector equity financing must, of course, take place through retained profits.

The tax treatment of capital allowances and capital gains related to resale of used capital goods

(2.1.15) $$GTC_i = \frac{\alpha_i \left(\frac{1+INFL}{1+REFFC} \right)^{\tau_i}}{1 - \left(\frac{1+INFL}{1+REFFC} \right)^{\tau_i}} \qquad i \in \mathbf{JR}$$

New symbols
GTC_i = correction factor that appears in the calculation of the present value of the effective taxation of capital gains achieved through resale of physical assets, incorporated firms, capital type i.
α_i = tax depreciation rate, capital type i.
$INFL$ = nominal expected price growth of the capital goods.
τ_i = 1 + length of the tax free period of the so called negative balance according to the Norwegian tax code, capital type i.

GTC_i is the following present value: $\alpha \sum_{s=1}^{\infty} \left[\left(\frac{1+INFL}{1+REFFC} \right)^{\tau_i+1} \right]^s$ where the sum is assumed to converge.

(2.1.16) $$GTN_{ij} = \frac{\alpha_i \left(\frac{1+INFL}{1+REFFN_j} \right)^{\tau_i}}{1 - \left(\frac{1+INFL}{1+REFFN_j} \right)^{\tau_i}}$$

$i \in \mathbf{JR} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$

New symbols
GTN_{ij}= correction factor that appears in the calculation of the present value of the effective taxation of capital gains achieved through resale of physical assets, non-corporate firms, capital type i, sector j.

$$
\begin{aligned}
SLIT_{ij} &= SALG_{ij}\{\delta_{ij}(1-FALL_{ij})+FALL_{ij} \\
&- [1-(\delta_{ij}(1-FALL_{ij})+FALL_{ij})]INFL\} \\
&+ (1-SALG_{ij})[\delta_{ij}-(1-\delta_{ij})INFL]
\end{aligned} \tag{2.1.17}
$$

$i \in \mathbf{JR} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$

New symbols

$SLIT_{ij}$ = total revaluation of a physical capital unit due to physical depreciation, economic depreciation and an increase in the price of the capital commodity, capital type *i*, sector *j*.

$SALG_{ij}$ = the fraction of the investment acquired in the previous year that is sold in the second-hand market, capital type *i*, sector *j*.

δ_{ij} = rate of actual physical depreciation, capital type *i*, sector *j*.

$FALL_{ij}$ = rate of actual economic depreciation, capital type *i*, sector *j*.

SLIT is the average of the revaluation in the case of resale of the capital and revaluation in the case when the capital goods are not resold. Compared to formulas based on a continuous time formulation (which are often found in the theoretical literature), second order effects are not neglected.

$$
\begin{aligned}
H_{ij} &= \max\{0, (I+INFL)[1-(\delta_{ij}(1-FALL_{ij})+FALL_{ij})] \\
&- [1-(KOAV_{ij}+IMAV_{ij})](1-ORAV_{ij})\}
\end{aligned} \tag{2.1.18}
$$

$i \in \mathbf{JR} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$

New symbols

H_{ij} = the capital gain from reselling physical capital goods that affects the taxation of the firm, capital type *i*, sector *j*.

$KOAV_{ij}$ = immediate write-off based on the tax rules for depreciation allowances "on contract", capital type *i*, sector *j*.

$IMAV_{ij}$ = other immediate write-offs, capital type *i*, sector *j*.

$ORAV_{ij}$ = rate of ordinary tax depreciation, capital type *i*, sector *j*.

If *H* is positive it means that the tax depreciation overestimates the true revaluation of the physical asset. The positive value of *H* is equal to the *negative balance* for these units.

$$SKC_{ij} = \frac{1}{1-UEFF_j}\{UEFF_j(1+REFFC\ SALG)(IMAV_{ij} + (1+REFFC)KOAV_{ij})(SALG_{ij}+(1-SALG_{ij})(SLIT_{ij} + REFFC)) + (UEFF_j(1+REFFC)ORAV_{ij} - V)(1-KOAV_{ij} - IMAV_{ij})\left[\frac{(1-SALG_{ij})(SLIT_{ij}+REFFC)}{REFFC+ORAV_{ij}} + SALG_{ij}(1-(GAMMEL \cdot GTC_i + NY\frac{GEVT}{REFFC+GEVT})\frac{H_{ij}}{ORAV_{ij}})\right] - UEFF_j\, SLIT_{ij}\} \tag{2.1.19}$$

$i \in \mathbf{JR}$ $\quad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$

New symbols

SKC_{ij} = non-neutrality factor for an incorporated firm summarising the difference between the actual revaluation of the physical capital unit, and the total deduction from the corporate tax base due to various depreciation allowances and the taxation of capital gains from reselling physical assets. Present value of the tax-credit caused by the rules for tax depreciation and taxation of capital gains, capital type *i*, sector *j*.

GAMMEL = dummy parameter equal to 1 before 1992, equal to 0 after 1992.

NY = dummy parameter equal to 0 before 1992, equal to 1 after 1992.

GEVT = share of gains from resale of used capital goods which is taxed as profits according to the tax code after 1992.

$$\begin{aligned} SKN_{ij} \;=\; & \frac{1}{1-TPNEFF_j}\Big\{TPNEFF_j(1+REFFN_j \cdot SALG_{ij})(IMAV_{ij} \\ +\; & KOAV_{ij}(1+REFFN_j))(SALG_{ij}+(1-SALG_{ij})(SLIT_{ij} \\ +\; & REFFN_j)) + TPNEFF_j(1+REFFN_j)ORAV_{ij}(1-KOAV_{ij} \\ -\; & IMAV_{ij})\Big[(1-SALG_{ij})(1+REFFN_j)\frac{REFFN_j+SLIT_{ij}}{REFFN_j+ORAV_{ij}} \\ +\; & SALG_{ij}\Big[1-(1+REFFN_j)\Big(GAMMEL \cdot GTN_{ij} \\ +\; & NY\frac{GEVT}{REFFN_j+GEVT}\Big)\frac{H_{ij}}{ORAV_{ij}}\Big]\Big] - TPNEFF_j\, SLIT_{ij}\Big\} \end{aligned} \tag{2.1.20}$$

$i \in \mathbf{JR}$ $\quad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$

New symbols

SKN_{ij} = non-neutrality factor for a non-corporate firm summarising the difference between the actual revaluation of the physical capital unit, and the total deduction from the corporate tax base due to various depreciation allowances and the taxation of capital gains from reselling physical assets. Present value of the tax-credit caused by the rules for tax depreciation and taxation of capital gains, capital type i, sector j.

(2.1.21)
$$\begin{aligned} BP_{ij} &= SELC_j(SLIT_{ij} + DEBTC_j\, GJELDC_j \\ &+ (1-DEBTC_j)EGENC_j - SKC_{ij}) \\ &+ (1-SELC_j)(SLIT_{kj} + DEBTN_j\, GJELDN_j \\ &+ (1-DEBTN_j)EGENN_j - SKN_{ij}) \end{aligned}$$

$i \in \mathbf{JR} \qquad j \in \mathbf{PP} \setminus \{64,65,71,83,89\}$

(2.1.22)
$$\begin{aligned} BP_{10\,83} &= (1-TAXPR)RENG - INFL - TAXWN \\ &+ BOLT\big((BOLI)TAXPR + TAXWN + TAXE\big) + \delta_{10\,83} \end{aligned}$$

New symbols

BP_{ij} = user cost of capital pr Nkr invested, capital type i, sector j.
$SELC_j$ = faction of firms in sector j which are incorporated.
$DEBTC_j$ = ratio between the nominal debt in a corporate firm and the value of its capital stock, sector j.
$DEBTN_j$ = ratio between the nominal debt in a non-corporate firm and the value of its capital stock, sector j.
PJ_i = purchaser price index of investment activity i.
$TAXWN$ = personal wealth tax rate
$TAXE$ = personal property tax rate
$BOLT$ = tax value of dwellings relative to the market value.
$BOLI$ = imputed rate of capital income from dwellings.

Eq. (2.1.22) applies to *Buildings (10)* in *Dwelling Services (83)* and is taken from Berg (1989).

2.2 Indirect taxes and subsidies

Accrued indirect commodity taxes.

Commodity taxes and subsidies are specified according to information on the tax base, tax rate and tax payer. There are volume and *ad valorem* production and trade taxes. Production taxes are indirect taxes levied on the importing or producing sector for each commodity. Trade taxes are commodity taxes levied on the wholesale or retail trade sector. The composition of the different tax rates in each net commodity tax rate is fixed in the model and equal to the description given by the National Accounts in the base year.

(2.2.1)
$$TPV_i = \left(\sum_{l\in\mathbf{PV}} t_{il}^{PV} TART_l\right) TAXJUST$$

(2.2.2)
$$TVV_i = \left(\sum_{l\in\mathbf{VV}} t_{il}^{VV} TART_l\right) TAXJUST$$

(2.2.3) $$TPX_i = \left(\sum_{l \in \mathbf{PX}} t_{il}^{PX} TART_l \right) TAXJUST$$

(2.2.4) $$TVX_i = \left(\sum_{l \in \mathbf{VX}} t_{il}^{VX} TART_l \right) TAXJUST$$

$i \in \mathbf{VA}$

Symbols

TVV_i = change in the *ad valorem* tax rate on commodity i collected from wholesale and retail trade.
TPV_i = change in the *ad valorem* tax rate on commodity i collected from producers.
TPX_i = change in the volume tax rate on commodity i collected from producers.
TVX_i = change in the volume tax rate on commodity i collected from wholesale and retail trade.
$TART_l$ = change in tax, type l.
$TAXJUST$ = proportional adjustment factor.
t_{il}^{θ} = base year tax coefficient calculated as accrued commodity tax/subsidy of type l on commodity i divided by net commodity tax on commodity i ($\theta = PV, VV, PX, VX$).

Sectorial tax rates

Indirect taxes not related to commodities are assumed to be proportional to the value of sectorial output and are calculated on an *ad valorem* basis (see Eq. (2.3.4)). The sectorial tax rates are formed in the same way as the commodity tax rates; a weighted average of the different indirect taxes.

(2.2.5) $$TSV_j = \left(\sum_{l \in \mathbf{SA} \cup \mathbf{SU}} t_{jl}^{SV} TART_l \right) TAXJUST \qquad j \in \mathbf{PS}$$

New symbols

TSV_j = net sectorial tax rate (volume) in production sector j.
t_{jl}^{SV} = base year tax coefficient calculated as tax/subsidy of type l in production sector j divided by production in the sector in the base year.

2.3 The model of producer behaviour and prices

Entry/exit equilibrium

Except for non-competing imports and commodities that are naturally sheltered, each commodity is a linearly homogeneous composite of a domestically produced variety and an imperfect foreign substitute. Thus, the prices of domestic commodities differ in general from the corresponding world prices.

The equilibrium concept that is used to determine the domestic prices in the model, is that there should be no incentive for firms to enter or exit the sector. This implies that the sectorial basic price is equal to total unit cost where capital costs and net sectorial taxes are included.

The model specifies two possible deviations from such a long-run equilibrium condition. First, capital costs may not be calculated on the complete stock of physical capital. The model assumes that capital costs are only calculated on that part of the capital stock that is employed, and the divergence between actual and full capacity utilisation is measured by the exogenous variable *GAMK*.

Second, the exogenous variable *GAMP* corrects for (short-term) deviations in the base year between the sectorial basic price and estimated total unit costs. These deviations may occur because the unit cost of capital is computed using estimated (equilibrium) rates of return to capital (see Eqs. (2.1.1) - (2.1.22) combined with (2.3.4), (2.3.20) and (2.3.21) for details), which may differ from the actual rate in the base year.

Correction for short-term deviations from the theoretical equilibrium is perhaps the most obvious interpretation of *GAMK* and *GAMP*, but these variables may of course be used to obtain particular characteristics of the solution of the model in a more *ad hoc* way. For instance *GAMP* may be used to account for decreasing returns to scale. In MSG-5 no scale elasticity is specified explicitly, contrary to the previous versions of MSG where decreasing returns could be specified in the primary sectors.

(2.3.1) $$\lambda^I_{ii} BI_i = PI_i + (\lambda^I_{ii} - 1) TT_i PI_i \qquad i \in \mathbf{VA}$$

(2.3.2) $$BH_i = BI_i \qquad i \in \{02,03,06,07,08,09,19,35,36\} \subset \mathbf{VA}$$

(2.3.3) $$BH_i = BH_j$$

$$(i,j) \in \{(17,16),(18,16),(42,41),(47,46),(49,48),(89,63).\} \subset \mathbf{VA} \times \mathbf{VA}$$

Symbols

BI_i = price index of import activity i, basic value including customs duty.
PI_i = price index of import activity i c.i.f.
BH_i = basic price index of the domestically produced commodity i.
TT_i = change in customs duty, import activity i.
λ^I_{ij} = coefficient calculated as import of activity i in basic value over import activity i in c.i.f. value. (λ^I_{ij}-1) is the rate of customs duty of import activity i.

For several sectors, two production activities are specified corresponding to the two main commodities being produced by the sector. Since these commodities are assumed to be produced by the same technology, their basic prices are assumed to develop identically. This explains the equations in (2.3.3).

(2.3.4) $$GAMP_j \left(\sum_{i \in \mathbf{VA}} \lambda^X_{ij} BH_i \right) = GAMK_j PK_j ZK_j + PL_j ZL_j + PU_j ZU_j + PM_j ZM_j + BHS_j TSV_j$$

$$j \in \mathbf{PP} \setminus \{64,65,71,89\}$$

New symbols

$GAMP_j$ = price deviation coefficient for basic prices, production sector j.
$GAMK_j$ = capacity utilisation index, production sector j.
Pf_j = price index of "top level" input f in production sector j, f=K,L,U,M (see Eqs. (2.3.21), (2.3.22), (2.3.16) - (2.3.19) and (2.3.10), respectively).
Zf_j = unit demand for input f, f = K, L, M, U, M (see Eqs. (2.3.6) - (2.3.9)).
BHS_j = weighted price index of commodities produced in production sector j, basic value.

TSV_j = net sectorial tax rate (volume) in production sector j constructed as a weighted average of the various indirect taxes in the sector.

λ^X_{ij} = output coefficient; the share of the delivery of commodity i, measured in basic value, in the total deliveries from production activity j, measured in net-seller value in the base year.

The weighted price indices, *BHS*, used to inflate the sectorial tax rates, *TSV*, are given by:

$$(2.3.5) \qquad BHS_j = \left(\sum_{i \in \mathbf{VA}} \lambda^X_{ij} BH_i \right) / \sum_{i \in \mathbf{VA}} \lambda^X_{ij} \qquad j \in \mathbf{PS} \setminus \{71\}$$

Unit coefficients for factor demand

These functions are derived from the underlying hypothesis that the linear homogeneous cost functions are all of the Generalised Leontief (GL) form in those production sectors where the factor demand at the *upper level* is endogenous. By *levels* we refer to the three step cost minimisation procedure taking place in the sectors when factor demand is adjusted (see Figure 1.3.2).

At the upper level, the representative firm is adjusting the capital stock *(K)*, labour *(L)*, energy *(U)* and other material inputs *(M)*. At the second level, the cost of the energy aggregate is minimised by optimal adjustment of the input of electricity *(E)* and fuels *(F)*. At the third level, the composition of specified commodities within these five aggregate input activities is determined. However, this composition is exogenously fixed equal to the value of the coefficients in the base year.

For capital, we might identify an aggregation level between level two and three, since the aggregate capital stock is composed by eight capital types. This composition is sector specific but fixed according to the base year coefficients. Each capital type is also a fixed Leontief aggregate with base year coefficients. The composition of each of the eight capital commodities is, however, not sector specific. The equations in (2.3.6) - (2.3.9) describe the upper level adjustment only.

We might talk about a fourth level of input adjustment. Each commodity may be a domestic variety or an imported imperfect substitute, according to the Armington hypothesis. The composition is endogenous depending on relative prices. This composition generally depends on how the commodity is used and is thus sector specific. However, the change in the composition is only related to the commodity and is common to all categories on the demand side. We therefore postpone commenting further on this adjustment to the equations which determine the import shares (Eqs. (2.5.4)-(2.5.7)).

In Eqs. (2.3.6) - (2.3.9), *EPS* is an exogenous variable for the *level* of technical change common to all factors. It is normalised to one in the base year. However, this will only be a Hicks-neutral technical change if the factor specific calibration coefficients, *ETA*, are equal to zero. The *ETA*s are calibrated so that the econometric equations fit the base year. They may be used to meet an assumption of factor specific technical progress or factor substitution deviating from what follows endogenously. Note that the technical change given by *EPS* also affects the effective magnitude of the calibration coefficients if they are not set to zero.

GAMK was introduced in Eq. (2.3.4). *GAMU* is an exogenous aggregate temperature correction coefficient assumed to not affect the composition of the energy aggregate.

The Cff_j coefficients have been estimated by T. Bye and P. Frenger (see Chapter 3 in Alfsen, Bye and Holmøy (1994)). In the public production sectors unit coefficients do not exist at the top level as inputs are determined exogenously. This also applies for the inputs labour *(L)* and capital *(K)* in the production sectors *Production and Pipeline Transport of Oil and Gas (64)* and *Ocean Transport, Oil and Gas Exploration and Drilling (65)*. Here, the unit coefficients for other material input *(M)* and electricity *(E)* are exogenous.

The input coefficients in *Production of Electricity (71)* are determined in the model block for electricity (see Section 2.16).

(2.3.6) $$GAMK_j ZK_j = \frac{1}{EPS_j}\left[ETAK_j + \sum_f C.Kf_j \left(\frac{Pf_j}{PK_j}\right)^{1/2}\right]$$

(2.3.7) $$ZL_j = \frac{1}{EPS_j}\left[ETAL_j + \sum_f C.Lf_j \left(\frac{Pf_j}{PK_j}\right)^{1/2}\right]$$

(2.3.8) $$ZU_j = \frac{GAMU_j}{EPS_j}\left[ETAU_j + \sum_f C.Uf_j \left(\frac{Pf_j}{PU_j}\right)^{1/2}\right]$$

(2.3.9) $$ZM_j = \frac{1}{EPS_j}\left[ETAM_j + \sum_f C.Mf_j \left(\frac{Pf_j}{PM_j}\right)^{1/2}\right]$$

$j \in \mathbf{PP} \setminus \{64,65,71,89\}$
$f = K,L,U,M$

New symbols
$ETAf_j$ = calibration variable in production sector j, f=K,L,U,M.
EPS_j = variable measuring the *level* of technical change in production sector j.
$GAMU_j$ = exogenous aggregate temperature correction coefficient.
$C.ff_j$ = generalised Leontief substitution coefficients, $f', f = K,L,U,M$.

Sector/activity specific purchaser prices

Other material input:

(2.3.10) $$PM_j = \sum_{i \in \mathbf{VA} \setminus \{42,71\}} \left(1 + HTM_{ij}^H TM_i\right)\left[\left(1 + HTVV_{ij} TVV_i + HTPV_{ij} TPV_i\right) \cdot \lambda_{ij}^M \left[\left(1 - \lambda_{ij}^{HI} DI_i\right) BH_i + \lambda_{ij}^{HI} DI_i BI_i + HTVX_{ij} TVX_i + HTPX_{ij} TPX_i\right]\right]$$

$j \in \mathbf{PSV}$

New symbols
PM_j = net-purchaser price index of other material input in input activity j.
λ_{ij}^M = the ratio between input of commodity i measured in basic value and the total value of other material inputs in sector j measured in net purchaser prices (net refundable VAT) in the base year.

λ_{ij}^{HI} = sector specific import share, the ratio between imports of commodity i measured in basic value delivered for material input to sector j and the total deliveries of commodity i measured in basic value to sector j in the base year.
DI_i = change in the import share of commodity i.
HTM_{ij}^{H} = rate of non-refunded value added tax (VAT) on commodity i delivered to sector j in the base year.
TM_i = change in the VAT-rate on commodity i.
$HTVV_{ij}$ = trade tax rate levied on the value of commodity i delivered to sector j in the base year.
$HTPV_{ij}$ = production tax rate levied on the value of commodity i delivered to sector j in the base year.
$HTVX_{ij}$ = trade tax rate levied on the volume of commodity i delivered to sector j in the base year.
$HTPX_{ij}$ = production tax rate levied on the volume of commodity i delivered to sector j in the base year.

For each commodity the basic price index is a price function dual to the linearly homogeneous function that aggregates the domestic and the imported foreign variant into a composite commodity. This holds in general and is thus also the case when commodity i is delivered to the activity other material input *(M)* in sector j as in Eq. (2.3.10).

It is clear from Eq. (2.3.10) that it is only whether the indirect taxes are levied on volumes or values that matters for the determination of the purchaser prices in the input-output model of prices. The main point for distinguishing between production and trade taxes is that the model can calculate the sectorial distribution of accrued indirect taxes. This is done in the model block for recursive calculations.

Fuels:

(2.3.11)
$$PF_j = \sum_{i\in \mathbf{VA}\setminus\{42,81\}} \left(1+HTM_{ij}^{H}TM_i\right)\left\{\left(1+HTVV_{ij}TVV_i+HTPV_{ij}TPV_i\right)\cdot\lambda_{ij}^{F}\left[\left(1-\lambda_{ij}^{HI}DI_i\right)BH_i+\lambda_{ij}^{HI}DI_iBI_i+HTVX_{ij}TVX_i+HTPX_{ij}TPX_i\right]\right\}$$

$j \in \mathbf{PSV}$

PF_j = net purchaser price index of fuels in input activity j.
λ_{ij}^{F} = the ratio between input of commodity i measured in basic value and the total value of input of fuels in sector j measured in net purchaser prices (net refundable VAT) in the base year.

The price indices of electricity by input activity (PE_j) are determined in the model block for electricity (see Section 2.16).

Investment:

(2.3.12)
$$PJ_j = \left(1+HSJ_jTPV_{81}\right)\sum_{i\in\mathbf{VA}}\left(1+HTM_{ij}^{J}TM_i\right)\left\{\left(1+HTVV_{ij}TVV_i+HTPV_{ij}TPV_i\right)\cdot\lambda_{ij}^{J}\left[\left(1-\lambda_{ij}^{JI}DI_i\right)BH_i+\lambda_{ij}^{JI}DI_iBI_i+HTVX_{ij}TVX_i+HTPX_{ij}TPX_i\right]\right\}$$

$j \in \mathbf{JA}$

New symbols
PJ_j = purchaser price index of investment activity j.
HSJ_j= investment levy on new capital commodities, investment activity j.
HTM_{ij}^J = base year VAT rate on commodity i when it is used in investment activity j.
λ_{ij}^J = the ratio between input of commodity i measured in basic value and the total value of investment of activity j measured in purchaser prices in the base year.
λ_{ij}^{JI} = activity specific import share; the ratio between imports of commodity i measured in basic value delivered to investment activity j and the total deliveries of commodity i measured in basic value to activity j in the base year.

For the investment type *Inputs to Construction of Oil Rigs, Platforms etc. (70),* which is broken down into several investment activities, a weighted price index is constructed, comprised of the corresponding investment activity indices.

(2.3.13) $$PJ_{70} = \frac{\sum_j PJ_j J_j}{\sum_j J_j} \qquad j \in \{72,73,74,75,76\} \subset \mathbf{JA}$$

Private consumption:

(2.3.14) $$PC_j = \sum_{i \in \mathbf{VA}} \left(1 + HTM_{ij}^C TM_i\right)\left[\left(1 + HTVV_{ij}TVV_i + HTPV_{ij}TPV_i\right) \cdot \lambda_{ij}^C\left[\left(1 - \lambda_{ij}^{CI}DI_i\right)BH_i + \lambda_{ij}^{CI}DI_iBI_i + HTVX_{ij}TVX_i + HTPX_{ij}TPX_i\right]\right]$$

$j \in \mathbf{CP} \setminus \{12\}$

New symbols
PC_j = purchaser price index, consumption sector j.
HTM_{ij}^C = base year VAT rate on commodity i when it is used in consumption activity j.
λ_{ij}^C = the ratio between input of commodity i measured in basic value and the total value of private consumption of consumption sector j measured in purchaser prices in the base year.
λ_{ij}^{CI} = activity specific import share; the ratio between imports of commodity i measured in basic value delivered to consumption sector j and the total deliveries of commodity i measured in basic value to sector j in the base year.

PC_{12}, the consumer price of *Electricity (12)*, is determined in the model block for electricity (see Section 2.16).

Export:

(2.3.15) $$PA_j = \sum_{i \in \mathbf{VA}} \lambda_{ij}^A BH_i \qquad j \in \mathbf{VA} \setminus \{71\}$$

New symbols
PA_j = price index of export activity j, f.o.b.
λ_{ij}^A = the ratio between the content of export activity i measured in basic value and the total value of export activity j in the base year.

PA_{71}, the price of *Electricity (71)*, is determined in the model block for electricity (see Section 2.16).

Energy:

(3.2.16) $$PU_j = \left[\left(1+\alpha_j^E\right)^{-1}\left(\alpha_j^E PE_j^{1-\sigma._j^u} + \left(1-\alpha_j^E\right)PF_j^{1-\sigma._j^u}\right)\right]^{\frac{1}{1-\sigma._j^u}}$$

$$\left.\begin{aligned} \text{where}\quad \alpha_j^E &= e^{\left(\frac{E.L1T_j\, TIDE - E_j}{E.L1E_j}\right)} \\ \sigma._j^u &= -\frac{E.L1P_j}{E.L1E_j} \end{aligned}\right\} \quad for\ \ j \in \{11,15,25,37,50,55,81,85\} \subset \mathbf{PSV}$$

$$\left.\begin{aligned} \alpha_j^E &= e^{E.j + E.T_j\, TIDE} \\ \sigma._j^u &= -E.P_j \end{aligned}\right\} \quad for\ \ j \in \{34,45\} \subset \mathbf{PSV}$$

(2.3.17) $$PU_j = PF_j ZFU_j + PE_j\left(1 - ZFU_j\right)$$

$$j \in \{12,13,40,43,64,74\} \subset \mathbf{PSV}$$

(2.3.18) $$PU_j = PE_j \qquad j \in \{63,83\} \subset \mathbf{PSV}$$

(2.3.19) $$PU_{65} = PF_{65}$$

New symbols

$E._j$ = estimated constant, sector *j*.
$E.L1T_j$ = estimated constant associated with a time trend in favour of electricity, sector *j*.
$E.L1E_j$ = estimated constant associated with the error correction specification, sector *j*.
$E.L1P_j$ = estimated constant associated with the substitution possibilities between electricity and fuels, sector *j*.
$TIDE$ = time index.
ZFU_j = input coefficient, input of fuels per unit of energy, sector *j*.
PE_j = net-purchaser price index of electricity in production sector *j*.

The sector specific energy price function is the dual to the linearly homogeneous CES-function that aggregates electricity and fuels into a volume concept of energy. The CES-function is more complicated than the simplest form because the econometric specification is an error correction model with time trends. For *Manufacture of Pulp and Paper Articles (34)* and *Manufacture of Metal Products, Machinery and Equipment (45)*, the error correction terms are omitted. The time index may be used to impose exogenous changes in the composition of energy. The econometric work is described in Mysen (1991).

In the production sectors *Finance and Insurance (63)* and *Dwelling Services (83)* energy consisted solely of electricity in the base year and this is also assumed to be the case along the solution path. Similarly for production sector *Ocean Transport, Oil and Gas Exploration and Drilling (65)* where energy consisted solely of fuels in the base year.

User cost of capital:

(2.3.20) $$PKN_j = \sum_k \kappa_{kj} BP_{kj} PJ_k$$

$k \in \mathbf{JR} \qquad j \in \mathbf{PP} \setminus \{64,65,71,89\}$

(2.3.21) $$PK_j = PKN_j PKJUST + PKX_j \qquad j \in \mathbf{PP} \setminus \{64,65,71,89\}$$

New symbols

PK_j = user cost of capital, production sector j.
PKN_j = user cost of capital based on financial and tax variables, sector j.
$PKJUST$ = scale parameter adjusting all sectorial capital costs proportionally.
PKX_j = correction term.
κ_{kj} = capital structure coefficient, content of capital type k in the total capital stock in production sector j in the base year.
BP_{kj} = user cost per Nkr of capital type k in production sector j.

The sectorial structure of the capital stock is a Leontief aggregate (fixed coefficients) of the different capital types specified in the model. The user cost of capital is the dual price function to this aggregation function weighting together the sector specific user costs for the various capital goods.

The user cost per Nkr is calculated in the sub-model for tax corrected capital costs (see Section 2.1). However, the result of this model will generally deviate from the user cost calculation derived from the *ex post* rates of return observed in the National Accounts. In the estimation of the cost function, the same method as in the previous versions of the MSG-model is used to estimate the user cost of capital.

Central to this method is that the sectorial rates of return in the ordinary user cost formula are estimated as a five-year moving average of the ratio between sectorial operating surplus, corrected for estimated remuneration to self-employed, and the value of the sectorial capital stock. In the base year the user cost is calculated by this method and the additive correction variable *PKX* is calibrated to account for the difference between the theoretical user cost, *PKN*, and the base year value. The existence of a non-zero *PKX* introduces another source of sectorial differences in social pre-tax rates of return to capital in addition to those caused by different effective tax rates. Such differences imply possible gains in aggregate efficiency from reallocations of capital between sectors.

Wages:

(2.3.22) $$PL_j = RELPL_j \; PLJUST \qquad j \in \mathbf{PS}$$

New symbols

PL_j = *wage cost* per hour in production sector j.
$PLJUST$ = index measuring economy wide level of wage cost.
$RELPL_j$ = sector specific wage cost rate.

The sectorial wage rate is split into two components: a common index of the economy-wide level of wage cost, *PLJUST* (normalised to unity in the base year) and an exogenous sector specific rate, *RELPL*, that equals the wage rate in the base year. Since the model treats labour as a homogeneous input which can be reallocated between sectors without friction or costs, differences between sectorial wage rates are inconsistent with an absence of arbitrage equilibrium. Benefits from reallocation of labour reflect possible gains in aggregate efficiency.

The relationship between the sectorial (gross) wage rates, *PL*, and the corresponding wage rates net of employer's tax is given by:

(2.3.23) $$PL_j = \left(1 + \tau_j^{YWT} TF_j\right) WW_j \qquad j \in \mathbf{PS} \setminus \{71\}$$

New symbols
WW_j = wage per hour in production sector *j* net of social taxes.
TF_j = shift variable for change in employers' contribution to social security and National Insurance in production sector *j* in current prices.
τ_j^{YWT} = sector specific base year coefficient for the rate of employers' contribution to social security and National Insurance.

THE QUANTITY SUB-MODEL

2.4 Commodity market equilibrium

The commodity balance equations constitute the core of the quantity sub-model. The balance equation for each commodity, except *Electricity (71)*, is given by:

(2.4.1) $$\begin{aligned} &\sum_{j \in \mathbf{VA}} \lambda_{ij}^I I_j + \sum_{j \in \mathbf{PA} \setminus \mathbf{PO} \cup \{71\}} \lambda_{ij}^X X_j + \sum_{j \in \mathbf{PO}} \lambda_{ij}^{XG} XG_j + X_{70i} + X_{72i} + X_{73i} \\ &= \sum_{j \in \mathbf{PSV}} \left(\lambda_{ij}^M M_j + \lambda_{ij}^F F_j\right) + \sum_{j \in \mathbf{CP} \setminus \{30\}} \lambda_{ij}^C C_j + \lambda_{i30}^C \left(C_{30} - CK_{30}\right) \\ &+ \sum_{j \in \mathbf{JA}} \lambda_{ij}^J J_j + \sum_{j \in \mathbf{VA}} \lambda_{ij}^A A_j + DSI_i + DSH_i + \psi_i \end{aligned}$$

$$\textit{where } \psi_i = \begin{cases} ZZG_{710} GWHX_{710} & \text{for } i = 67 \\ ZZR_{710} GWHX_{710} & \text{for } i = 69 \\ 0 \textit{ otherwise} \end{cases}$$

$i \in$ VA\{71}

Symbols
λ_{ij}^I = the ratio between the basic value of imports of commodity *i* (including customs) and import activity *j* measured in c.i.f.-value (i.e. basic value net of customs tariff) in the base year.
I_j = import activity *j* measured in constant prices, c.i.f.
λ_{ij}^X = output coefficient, the share of the delivery of commodity *i*, measured in basic value, in the total deliveries from production activity *j*, measured in net-seller value in the base year.
X_j = gross production in production activity *j*, measured in constant net-seller prices.
XG_j = goods and services provided in exchange of a fee in government production activity *j* measured in constant prices.

λ_{ij}^{XG} = output coefficient, the share of the delivery of commodity i, measured in basic value, in the total deliveries from government production activity j, measured in net-seller value in the base year.

λ_{ij}^{M} = the ratio between input of commodity i measured in basic value and the total value of other material input in sector j measured in net purchaser prices (net refundable VAT) in the base year.

M_j = other material inputs in production sector j measured in constant net-purchaser prices.

λ_{ij}^{F} = the ratio between input of commodity i measured in basic value and the total value of input of fuels in sector j measured in net purchaser prices (net refundable VAT) in the base year.

F_j = input of fuels in production sector j measured in constant net-purchaser prices.

λ_{ij}^{C} = the ratio between input of commodity i measured in basic value and the total value of private consumption sector j measured in purchaser prices in the base year.

C_j = private consumption of consumption sector j measured in constant net-purchaser prices.

CK_{30} = *Households'* purchase of second hand cars from the domestic production sectors in constant purchaser prices.

λ_{ij}^{J} = the ratio between input of commodity i measured in basic value and the total value of investment of activity j measured in purchaser prices in the base year.

J_j = new investment of investment activity j, measured in constant net-purchaser prices.

λ_{ij}^{A} = the ratio between the content of commodity i measured in basic value and the total value of export activity j in the base year.

A_j = exports, export activity j, measured in constant purchaser prices.

DSH_i = changes in inventories, domestic production of commodity i, measured in constant basic prices.

DSI_i = changes in inventories, imports of commodity i, measured in constant basic prices.

ZZG_{710} = average input coefficient for natural gas in *Production of Gas-Power (710)*, (Nkr/kWh).

ZZR_{710} = pipeline transport services per unit of production in *Production of Gas-Power (710)*, (Nkr/kWh).

$GWHX_{710}$ = production of gas power measured in GWh.

The commodity balance equation for *Electricity (71)* is given special treatment in the model block for electricity (see Section 2.16).

The λ's are commodity-by-activity/sector coefficients giving commodity flows in basic values relative to corresponding activity levels in market values. They are all calculated from the base year National Accounts. The matrices $[\lambda_{ij}^{F}]$, $[\lambda_{ij}^{I}]$ and $[\lambda_{ij}^{A}]$ all have a fairly simple structure. In fact, $\lambda_{ij}^{F} = 0$ when $i \neq 42$ *(Fuel Oils etc.)*. $[\lambda_{ij}^{I}]$ is a diagonal matrix where the elements are coefficients transforming imports in market prices (c.i.f.) into imports in basic prices net of customs tariffs. $[\lambda_{ij}^{A}]$ is a diagonal matrix transforming exports in seller values, f.o.b., into exports in basic prices.

The production activity list is named **PA**. **PA** includes more elements than the list of production sectors, **PS**, since some sectors produce more than one output activity which may be associated with a main commodity. Therefore it should be noted that the activity coefficients λ_{ij}^X in Eq. (2.4.1) is not identical to the λ_{ij}^X's in Eq. (2.3.4) which run over the production sectors only.

For the sectors with more than one output activity we have the following equations:

(2.4.2) $$X_{15} = X_{1516} + X_{1517} + X_{1518}$$

(2.4.3) $$X_{40} = X_{4041} + X_{4042}$$

(2.4.4) $$X_{45} = X_{4546} + X_{4547}$$

(2.4.5) $$X_{50} = X_{5045} + X_{5048} + X_{5049}$$

(2.4.6) $$X_{63} = X_{6363} + X_{6389}$$

(2.4.7) $$X_{64} = X_{6447} + X_{6466} + X_{6467} + X_{6469}$$

(2.4.8) $$X_{89} = 0$$

The basic effect of introducing production activities is that the composition of the multi-commodity output of these sectors becomes endogenous.

The level of the production activities are determined endogenously except for *Production of Agricultural Commodities (11)*, *Production of Commodities from Fishery (13)*, *Production of Repair Services in Building of Ships and Oil Platforms (5045)*, *Imputed Service Charges from Financial Institutions in Finance and Insurance (6389)*, *Production of Repair Services in Production and Pipeline Transport of Oil and Gas (6447)*, *Production of Crude Oil in Production and Pipeline Transport of Oil and Gas (6466)* and *Production of Natural Gas in Production and Pipeline Transport of Oil and Gas (6467)*.

On the left hand side of Eq. (2.4.1), the λ's are combined with activity levels of imports *(I)* and domestic production *(X)* to give the total supply of each commodity in basic values. The right hand side gives the total demand for each commodity in the same set of prices as a sum of demand for other material input *(M)*, fuels *(F)*, purchases of new capital *(J)*, private consumption *(C-CK)*, exports *(A)* and changes in inventories of domestically produced and imported commodities *(DSH+DSI)*.

Sales and purchases of second-hand capital goods between domestic sectors is not included in the commodity balance equations. Therefore it is new investment and not gross investment that has to be met by domestic production or imports. Moreover, the consumption levels are adjusted by the (net) purchases of second-hand capital from the government sector and firms *(CK)*. In the present version of MSG, cars is the only type of second-hand capital specified.

It should be noted that commodities used for public consumption are taken care of by the input activities *M*, *E* and *F* as the government production sectors are included in the list of production sectors. Output from government production sectors should be interpreted as privately paid output of public services. Goods and services provided against a fee by government production sectors *(XG)* and government consumption/expenditure *(G)* are defined in Eq. (2.4.1) and (2.24.1), respectively.

The output from the government sectors are exogenously distributed to central *(S)* and local *(L)* government:

(2.4.9) $$XG_{jS} = \mu_j \left(XG_{jS} + XG_{jK} \right) \qquad j \in \{93,94,95\}$$

New symbols

μ_j = base year distribution parameter for central and local government production of goods and services in exchange of a fee.

2.5 Import by activity

Imports of commodity *i* is a share of the domestic demand for each commodity. For non-competing imports these shares are equal to one by definition:

(2.5.1) $$DI_i = 1 \qquad i \in \{02,03,07,35,19,36\} \subset \mathbf{VA}$$

For some sheltered commodities imports are completely excluded:

(2.5.2) $$I_i = 0 \qquad i \in \{55,67,69,83,89,92,93,94,95\} \subset \mathbf{VA}$$

For the remaining commodities, import is given by:

(2.5.3) $$\sum_{j \in \mathbf{VA}} \lambda_{ij}^{I} I_j - DSI_i = \Bigg[\lambda_i^{IA} A_i + \sum_{j \in \mathbf{PSV}} \left(m_{ij}^{M} M_j + m_{ij}^{E} E_j + m_{ij}^{F} F_j \right) + \sum_{j \in \mathbf{CP} \setminus \{30\}} m_{ij}^{C} C_j + m_{i30}^{C} \left(C_{30} - CK_{30} \right) + \sum_{j \in \mathbf{JA}} m_{ij}^{J} J_j \Bigg] DI_i$$

Symbols

λ_{ij}^{I} = the ratio of the basic value of import of commodity *i* (inclusive customs) and import activity *j* measured in c.i.f.-value (i.e. basic value net of customs tariff) in the base year.

I_j = import activity *j* measured in constant prices, c.i.f.

DI_i = (multiplicative) change in the import share of commodity *i*.

λ_i^{IA} = share of re-export of commodity *i* in total export of the commodity in the base year.

A_j = export, export activity *i*, in constant purchaser prices.

m_{ij}^{M} = the ratio between import of commodity *i* used as material input in sector *j*, measured in basic value, and the total value of other material input in sector *j* measured in net purchaser prices (net refundable VAT) in the base year.

M_j = other intermediate material inputs in production sector *j* measured in constant net-purchaser prices.

m_{ij}^{E} = the ratio between imports of commodity *i* used as electricity input in sector *j*, measured in basic value, and the total value of input of electricity in sector *j* measured in net purchaser prices (net refundable VAT) in the base year.

E_j = Input of electricity in production sector *j* measured in constant net-purchaser prices.

m_{ij}^{F} = the ratio between imports of commodity *i* used as fuel input in sector *j*, measured in basic value, and the total value of input of fuels in sector *j* measured in net purchaser prices (net refundable VAT) in the base year.

F_j = Input of fuels in production sector *j* measured in constant net-purchaser prices.
m_{ij}^C = the ratio between imports of commodity *i* used in consumption sector *j*, measured in basic value, and the total value of private consumption of consumption sector *j* measured in purchaser prices in the base year.
C_j = private consumption sector *j* measured in constant purchaser prices.
CK_{30} =*Households'* purchase of second hand cars from domestic production sectors in constant purchaser prices.
m_{ij}^J = the ratio between imports of commodity *i* used in investment activity *j*, measured in basic value, and the total value of investment of activity *j* measured in purchaser prices in the base year.
J_j = new investment of investment activity *j*, measured in constant net-purchaser prices.
DSI_i= change in inventories, import of commodity *i*, measured in constant basic prices.

According to the definitions above, the import shares, *m*, differ both between commodities and kind of use. They are related to the commodity activity coefficients, λ: $m_{ij}^M = \lambda_{ij}^{HI}\lambda_{ij}^M$, $m_{ij}^E = \lambda_{ij}^{HI}\lambda_{ij}^E$, $m_{ij}^F = \lambda_{ij}^{HI}\lambda_{ij}^F$, $m_{ij}^C = \lambda_{ij}^{CI}\lambda_{ij}^C$, $m_{ij}^J = \lambda_{ij}^{JI}\lambda_{ij}^J$. However, the change in the import shares are specified *by commodity* only through the parameter *DI*.

For those commodities where the level of the corresponding sectorial gross production is given exogenously, import is determined by the commodity balance equations and the change in the import shares are determined residually by Eq. (2.5.3).

Endogenous change in the import shares

(2.5.4)
$$\log\left(\frac{1-DI_i MB_i.0}{DI_i MB_i.0}\right) = KDI._i + (PDI._i\ SUBSTI)\log\left(\frac{BI_i}{BH_i}\right) + DIE_i$$

$i \in \{16,17,25,37\} \subset \mathbf{VA}$

(2.5.5)
$$\log\left(\frac{1-DI_i MB_i.0}{DI_i MB_i.0}\right) = KDI._i + TDI._i\ TIDI + (PDI._i\ SUBSTI)\log\left(\frac{BI_i}{BH_i}\right) + DIE_i$$

$i \in \{34,46\} \subset \mathbf{VA}$

(2.5.6)
$$\log\left(\frac{1-DI_{18}\ MB_{18}.0}{DI_{18}\ MB_{18}.0}\right) = KDI._{18} + TDI._{18}\ TIDI + (PDI._{18}\ SUBSTI)\log\left(\frac{BI_{18}}{\psi_{18}}\right) + DIE_{18}$$

where $\psi_{18} = PM_{15}ZM_{15} + PU_{15}ZU_{15} + PL_{15}ZL_{15} + BHS_{15}TSV_{15}$

(2.5.7)
$$\log\left(\frac{1-DI_{43}\ MB_{43}.0}{DI_{43}\ MB_{43}.0}\right) = KDI._{43} + (PDI._{43}\ SUBSTI)\log\left(\frac{BI_{43}}{\psi_{43}}\right) + DIE_{43}$$

where $\psi_{43} = PM_{43}ZM_{43} + PU_{43}ZU_{43} + PL_{43}ZL_{43} + BHS_{43}TSV_{43}$

New symbols
BI_i = price index of the imported commodity *i*, basic value including customs duty.
BH_i = basic price index of the domestically produced commodity *i*.
$KDI._i$ = estimated distribution parameter in the CES function aggregating the Norwegian and foreign variety of commodity *i*.
$TDI._i$ = estimated time trend for the change in the import share of commodity *i*.
$TIDI$ = shift parameter for the time trends.
$PDI._i$ = estimated elasticity of substitution between the Norwegian and the imported variety of commodity *i*.
$MB_i.0$ = import share of commodity *i* in the base year.
DIE_i = calibration parameter, commodity *i*.
$SUBSTI$ = shift parameter for the elasticity of substitution.
Pf_j = net-purchaser price index of input f in production sector $j, f = M, U, L$.
Zf_j = unit demand for "top level" input f in production sector $j, f = M, U, L$.
BHS_j = weighted basic price index for commodities delivered from production sector *j*.
TSV_j = net sectorial tax rate (volume) in production sector *j* constructed as a weighted average of the various indirect taxes in the sector.

Except for non-competing imports and commodities that are naturally sheltered, each commodity is a composite of a domestically produced variety and an imperfect foreign substitute (the Armington hypothesis). Each composite commodity is aggregated by *CES* aggregation function which is homogeneous of degree one. The econometric estimation of the distribution parameters and the substitution elasticities is described in Naug (1994).

For some tradable commodities the import shares are exogenously determined due to lack of reliable econometric estimates of the parameters in the CES function.

2.6 Export and re-export

(2.6.1) $$A_i = \left(\frac{PA_i}{BI_i}\right)^{AO.M_i.SUBSTA} \cdot MII_i^{AO.MII_i} AE_i$$

$i \in \{16,17,18,25,34,37,43,46,47,74\} \subset \mathbf{VA}$

(2.6.2) $$A_{69} = e^{A.69} A_{67}^{A.A6769} AE_{69}$$

(2.6.3) $$A_{24} = \left(\frac{PC_{70}}{PC_{66}}\right)^{AO.M_{24}.SUBSTA} \cdot MII_{24}^{AO.MII_{24}} AE_{24} \qquad 24 \notin \mathbf{VA}$$

Symbols
A_i = exports, export activity *i*, measured in constant purchaser prices.
PA_i = purchaser price index, export of commodity *i*, f.o.b.
AE_i = calibration parameter, commodity *i*.
BI_i = basic price of imports of commodity *i*.
$AO.M_i$ = estimated export price elasticity, commodity *i*.
$SUBSTA$ = shift parameter for the price elasticity of exports.
MII_i = index of world market demand for commodity *i*.

$AO.MII_i$ = estimated "market elasticity", commodity i.
$A._{69}$ = estimated multiplicative coefficient.
$A.A6769$ = estimated coefficient.
PC_{70} = price index of *Direct Purchases in Norway by Non-Resident Households (70).*
PC_{66} = price index of *Direct Purchases Abroad by Resident Households (66).*

The export demand functions specified in Eq. (2.6.1) apply to most of the manufactures and the service *Domestic Transport Services (74)* (includes tourism). They follow from the Armington approach which implies that domestic producers face downward sloping demand functions. In the present version of the model long-run elasticities estimated on national account time series by Lindquist (1993) are implemented. All estimated elasticities may be adjusted by exogenous parameters.

Export of *Oil and Gas Pipeline Transport (69)* follows *Natural Gas (67).* Export activity 24, comprised of direct purchases in Norway by non-resident households (see Eqs. (2.12.5) - (2.12.7)), is given special treatment in Eq. (2.6.3). The remaining export demand quantities are exogenously determined.

(2.6.4) $$IA_i = \lambda_i^{IA} DI_i A_i \qquad i \in \mathbf{VA}$$

Symbols
IA_i = re-export of commodity i measured in constant prices.
λ_i^{IA} = share of re-export of commodity i in total export of the commodity in the base year.
DI_i = (multiplicative) change in the import share of commodity i.

2.7 Factor demand

Input demand for primary factors

Capital:

(2.7.1) $$K_j = ZK_j X_j \qquad j \in \mathbf{PP} \setminus \{64,65,71,89\}$$

(2.7.2) $$K_j = \frac{K_j(-1) + JKS_j}{1+\delta_j} \qquad \delta_j = \sum_{k \in \mathbf{JR}} DEP_{kj} \delta_{kj} \kappa_{kj}$$

$$j \in \mathbf{PO} \setminus \{92S\}$$

(2.7.3) $$K_{kj} = \frac{K_{kj}(-1) + JK_{kj}}{1 + DEP_{kj}\delta_{kj}}$$

$$(k,j) \in \{(10,64),(20,64),(70,64),(30,65)\} \subset \mathbf{JR} \times \mathbf{JS}$$

(2.7.4) $$K_{kj} = \frac{K_{kj}(-1) + JKD_{kj}}{1 + DEP_{kj}\delta_{kj}}$$

$$(k,j) \in \{(50,64),(60,65)\} \subset \mathbf{JR} \times \mathbf{JS}$$

(2.7.5) $K_j = \sum_{k \in \mathbf{JR}} K_{kj} \qquad j \in \{64,65\} \subset \mathbf{JS}$

(2.7.6) $K_{89} = K_{92S} = 0$

Symbols

K_j = real capital stock by the end of the year in production sector *j* measured in constant net-purchaser prices.

ZK_j = unit coefficient for real capital.

X_j = total gross production in production sector *j*, measured in constant net-seller prices.

JKS_j = gross investment in production sector *j*, measured in constant net-seller prices.

δ_j = average rate of physical depreciation of the total capital stock in production sector *j*.

δ_{kj} = rate of physical depreciation of the stock of capital type *k* in production sector *j*.

DEP_{kj} = shift parameter related to the rate of physical depreciation of the stock of capital type *k* in production sector *j*.

JK_{kj} = gross investment of capital type *k* in production sector *j*, measured in constant net-seller prices.

JKD_{kj} = gross investment in capital type k in production sector *j* measured in constant prices. The variable is introduced to facilitate calculation of capital depreciation in a way consistent with the National Accounts.

K_{kj} = real capital stock by the end of the year in production sector *j*, capital type *k*, measured in constant net-purchaser prices.

κ_{kj} = capital structure coefficient. Content of capital type *k* in the total capital stock in production sector *j*.

In the government production sectors the capital stock evolves according to exogenously specified sectorial gross investments. The same is true in the sectors *Production and Pipeline Transport of Oil and Gas (64)* and *Ocean Transport, Oil and Gas Exploration and Drilling (65)*, but here gross investment is specified exogenously for each capital type.

The capital stock in *Production of Electricity (71)* is determined in the model block for electricity (see Section 2.16).

Labour:

(2.7.7) $L_j = ZL_j X_j \qquad j \in \mathbf{PP} \setminus \{64,65,71\}$

(2.7.8) $L_{89} = 0$

(2.7.9) $LW_j = \gamma_j^{LS} L_j \qquad j \in \mathbf{PS}$

(2.7.10) $LS_j = L_j - LW_j \qquad j \in \mathbf{PS}$

New symbols

L_j = man-hours in production sector *j*.

ZL_j = unit coefficient for real capital.

LW_j = number of hours worked by wage earners in production sector sector *j*.

γ_j^{LS} = base year distribution parameter for wage earners/self employed by production sector.

LS_j = number of hours worked by self-employed in production sector sector j.

In the government production sectors and in *Production and Pipeline Transport of Oil and Gas (64)* and *Ocean Transport, Oil and Gas Exploration and Drilling (65)*, input of labour is determined exogenously.

Input demand for intermediate factors

Energy:

(2.7.11) $$\frac{ZHU_jH_j}{GAMU_j} = \left\{\left(1+\alpha_j^E\right)^{-(1+\beta_j)}\left[\left(\alpha_j^E\right)^{1+\beta_j} E_j^{-\beta_j} + \left(1-\alpha_j^E\right)^{1+\beta_j} F_j^{-\beta_j}\right]\right\}^{-1/\beta_j} UX_j$$

$$where\ \alpha_j^E = \frac{e^{(-E._j+E.L1T_j\ TIDE)/E.L1E_j}}{1+e^{(-E._j+E.L1T_j\ TIDE)/E.L1E_j}} \qquad \beta_j = -\left\{1+E.L1E_j/E.L1P_j\right\}$$

$j \in \mathbf{PO} \cup \{92C, 92U\} \setminus \{92S\} \subset \mathbf{PSV}$

(2.7.12) $$ZU_jX_j = \left\{\left(1+\alpha_j^E\right)^{-(1+\beta_j)}\left[\left(\alpha_j^E\right)^{1+\beta_j} E_j^{-\beta_j} + \left(1-\alpha_j^E\right)^{1+\beta_j} F_j^{-\beta_j}\right]\right\}^{-1/\beta_j} UX_j$$

$j \in \{11,15,25,37,50,55,81,85\} \subset \mathbf{PSV}$

(2.7.13) $$ZU_jX_j = \left\{\left(1+\tilde{\alpha}_j^E\right)^{-(1+\beta_j)}\left[\left(\tilde{\alpha}_j^E\right)^{1+\beta_j} E_j^{-\beta_j} + \left(1-\tilde{\alpha}_j^E\right)^{1+\beta_j} F_j^{-\beta_j}\right]\right\}^{-1/\beta_j} UX_j$$

$$where\ \tilde{\alpha}_j^E = \frac{e^{E._j+E.T_j\ TIDE}}{1+e^{E._j+E.T_j\ TIDE}}$$

$j \in \{34, 45\} \subset \mathbf{PSV}$

(2.7.14) $$\frac{E_j}{F_j} = \frac{\alpha_j^E}{1-\alpha_j^E}\left(\frac{PE_j}{PF_j}\right)^{-\left(\frac{1}{1+\beta_j}\right)} \cdot UEFX_j$$

$j \in \{11,15,25,37,50,55,81,85,92C,93S,94S,95S,93K,94K,95K\} \subset \mathbf{PSV}$

(2.7.15) $$\frac{E_j}{F_j} = e^{E._j+E.T_j\ TIDE}\left(\frac{PE_j}{PF_j}\right)^{E.P_j} UEFX_j$$

$j \in \{34,45\} \subset \mathbf{PSV}$

(2.7.16) $F_j = ZFU_j ZU_j X_j \quad j \in \{12,13,40,43,64,65,74\} \subset \mathbf{PSV}$

(2.7.17) $F_j = 0 \quad j \in \{63,83,89,92U\} \subset \mathbf{PSV}$

(2.7.18) $E_j = (1 - ZFU_j) ZU_j X_j \quad j \in \{12,13,40,43,64,71,74\} \subset \mathbf{PSV}$

(2.7.19) $E_j = ZU_j X_j \quad j \in \{63,83\} \subset \mathbf{PSV}$

(2.7.20) $E_j = 0 \quad j \in \{65,89,92U\} \subset \mathbf{PSV}$

New symbols

H_j = intermediate material input in production sector *j* measured in constant net-purchaser prices.
E_j = input of electricity in production sector *j* measured in constant net-purchaser prices.
PE_j = net-purchaser price index of electricity input in production sector *j*.
F_j = input of fuels in production sector *j* measured in constant net-purchaser prices.
PF_j = net purchaser price index on fuel input in sector *j*.
UX_j = calibration variable.
ZHU_j = share of energy in the intermediate material input in government production sector *j*.
ZU_j = input of energy per unit of total gross production in production sector *j*.
ZFU_j = input of fuel per unit of the energy aggregate.
$UEFX_j$ = calibration variable.
$GAMU_j$ = sector specific rate of temperature deviation.
$E._j$ = estimated coefficient.
$E.L1T_j$ = estimated coefficient related to a time trend in the adjustment of the energy mix.
$E.L1E_j$ = estimated coefficient related to the error correction specification of the econometric model.
$E.L1P_j$ = estimated coefficient related to the substitution possibilities between *E* and *F*.
$TIDE$ = time index.

The composition of the energy aggregate *U* is, with some exceptions, assumed to be determined as the cost minimising mix of electricity and fuels. This includes the government sectors. The underlying aggregation- or production function for the energy aggregate is supposed to be of *CES* type. The econometric specification allows for both a trend in the E_j/F_j ratio and error-correction behaviour in the adjustment process in addition to the substitution possibilities between electricity and fuels.

Note that the econometric specification of the CES-function is slightly different in the production sectors *Manufacture of Pulp and Paper Articles (34)* and *Manufacture of Metal Products, Machinery and Equipment (45)*. Note also that the energy use in *Defence* is related to H_{92C} which does not include purchases of submarines and F16 fighter planes. The reason is that purchases of these commodities fluctuate and have a strong influence on the total military budget. Therefore, the stability of the input coefficient is assumed to reflect a more stable underlying structure when such spending is netted out.

In the input activities *Agriculture (11), Fishing and Breeding of Fish etc. (13), Petroleum Refining (40), Manufacture of Metals (43), Finance and Insurance (63), Production and Pipeline Transport of Oil and Gas (64), Ocean Transport, Oil and Gas Exploration and Drilling (65), Production of Electricity (71), Domestic Transport (74)* and *Dwellings Services (83)*, the input of electricity and fuels is related to the level of sectorial gross production by exogenous input coefficients.

Other material input:

(2.7.21) $M_j = ZM_j \cdot X_j \qquad j \in \mathbf{PP} \setminus \{71,89\} \subset \mathbf{PSV}$

(2.7.22) $M_j = H_j - E_j - F_j \qquad j \in \mathbf{PO} \cup \{92C, 92U\} \setminus \{92S\} \subset \mathbf{PSV}$

New symbols
M_j = other material input in production sector j measured in constant net-purchaser prices.
ZM_j = unit input coefficient for other material input.

In most production sectors the unit input coefficients ZM are determined endogenously according to Eq. (2.3.9). In the government production sectors and in the sectors *Production and Pipeline Transport of Oil and Gas (64), Ocean Transport* and *Oil and Gas Exploration and Drilling (65)*, the coefficients ZM are determined exogenously. No econometric work thus far has attempted to describe production behaviour in these sectors (see Chapter 3 in Alfsen, Bye and Holmøy (1994)). Unit coefficients in *Production of Electricity (71)* are determined in the model block for electricity (see Section 2.16).

2.8 Investment

For most productions sectors an optimal composition of the capital stock is embodied in the cost function formulation of producer behaviour (see Section 2.3). Investment demand and commodity demand from producers follow residually. With exception of the production sectors *Production and Pipeline Transport of Oil and Gas (64)* and *Ocean Transport, Oil and Gas Exploration and Drilling (65)*, the composition of the capital stock is a sector specific Leontief aggregate of different capital activities.

Investments have full capacity effect in the same period as they take place. Capital depreciation is calculated also on new capital.

(2.8.1) $$J_k = \sum_{j \in \mathbf{PS} \setminus \{64,65,71\}} \left[\left(DEP_{kj} \delta_{kj} + 1 \right) K_j - K_j(-1) \right] \kappa_{kj} + \sum_{j \in \{64,65,71\}} JK_{kj} + JE_k + JR_k$$

$k \in \mathbf{JR}$

(2.8.2) $$JK_{10\,71} = JK_{11\,71} + JK_{12\,71}$$

Symbols
J_k = aggregate new investment, capital type k / investment activity k in constant purchaser prices.
K_j = gross real capital stock in production sector j in constant prices.
JK_{kj} = gross real investment in capital type k / investment activity k in production sector j.

JE_k = sales of used real capital, type k, in constant purchaser prices.
JR_k = base year correction term (exogenous calibration variable).
DEP_{kj} = shift parameter related to the rate of physical depreciation of the stock of capital type k in production sector j.
δ_{kj} = rate of physical depreciation of the stock of capital of type k in production sector j.
κ_{kj} = capital structure coefficient; content of capital type k in the total capital stock in production sector j.

In the production sectors *Production and Pipeline Transport of Oil and Gas (64)* and *Ocean Transport, Oil and Gas Exploration and Drilling (65),* the capital formation is dominated by the construction of large single units (e.g. oil rigs), which require several years for completion. The composition of these large capital units varies significantly during the different stages of the construction period. Hence, the kind of commodities demanded through the investment process in these sectors vary significantly over time and so does the effect on the output in other sectors. This is why the model gives a rather detailed treatment of the capital commodities constituting the capital stock in these two sectors. Additionally, it is probably very difficult to identify structural behavioural parameters governing the investment process in these sectors. So far, the capital composition in these two sectors is exogenously determined through the following equations:

(2.8.3) $$JE_{30\,65} = JE_{30} JE_{30\,65} DE$$

(2.8.4) $$JE_{30\,13} = JE_{30} - JE_{30\,65}$$

(2.8.5) $$JK_{kj} = J_{kj}$$

$$(k,j) \in \begin{Bmatrix} (10,64),(40,64),(50,64),(72,64),(73,64) \\ (75,64),(76,64),(10,65),(40,65),(50,65) \end{Bmatrix} \subset \mathbf{JA} \times \mathbf{PS}$$

(2.8.6) $$JK_{kj} = J_{kj} - JE_k \qquad (k,j) \in \{(20,64),(60,65)\} \subset \mathbf{JA} \times \mathbf{PS}$$

(2.8.7) $$JK_{74\,64} = J_{74\,64} - JE_{70}$$

(2.8.8) $$JK_{30\,65} = J_{30\,65} - JE_{30\,65}$$

(2.8.9) $$J_k = J_{k64} \qquad k \in \{72,73,74,75,76\} \subset \mathbf{JA}$$

(2.8.10) $$JK_{70\,64} = JK_{72\,64} + JK_{73\,64} + JK_{74\,64} + JK_{75\,64} + JK_{76\,64}$$

(2.8.11) $$JKD_{50\,64} = JK_{40\,64} + JK_{50\,64}$$

(2.8.12) $$JKD_{60\,65} = JK_{10\,65} + JK_{40\,65} + JK_{50\,65} + JK_{60\,65}$$

(2.8.13) $$JKS_{64} = JK_{10\,64} + JK_{20\,64} + JKD_{50\,64} + JK_{70\,64}$$

(2.8.14) $JKS_{65} = JK_{30\,65} + JKD_{60\,65}$

New symbols

$JE_{30\,65}$ = sales of second-hand capital, capital activity 30 *(Ships, Fishing Boats etc.)* from production sector 65 *(Ocean Transport, Oil and Gas Exploration and Drilling)* in constant market prices.

$JE_{30\,13}$ = sales of second-hand capital, capital activity 30 *(Ships, Fishing Boats etc.)* from production sector 13 *(Fishing and Breeding of Fish etc.)* in constant market prices.

J_{kj} = new investment (including installation costs) in capital activity k in production sector *j* in constant prices.

JKD_{kj}= measures, as JK_{kj}, gross real investment in capital type *k* in production sector *j* in constant prices. *JKD* is introduced to facilitate calculations of capital depreciation in a way consistent with the National Accounts.

JKS_j = gross real investment in production sector *j* in constant purchaser prices.

2.9 Balance equations for primary factors

Total employment in the production sectors is set equal to the exogenously given supply of labour. Employment by sector is determined by the model with exception for the government production sectors, *Production and Pipeline Transport of Oil and Gas (64)* and *Ocean Transport, Oil and Gas Exploration and Drilling (65)*, where employment is given exogenously.

Similarly, the allocation of capital is model determined in all production sectors with exception for the government production sectors and sector (64) and (65). The closure rule chosen determines the status of the total supply of capital (*K*) as endogenous or exogenous (see Section 1.5).

(2.9.1) $K = \sum_{j \in \mathbf{PS}} K_j$

(2.9.2) $L = \sum_{j \in \mathbf{PS}} L_j$

Symbols

K = gross real capital stock measured in constant prices.

K_j = gross real capital stock in production sector *j*.

L = total (exogenous) labour supply (man-hours).

L_j = employment (man-hours) in production sector *j*.

2.10 Inventories

Equations describing inventory investment by commodity are included in the model structure. Changes in inventories are related to changes in supply by a vector of fixed coefficients.

Eq. (2.10.1) describes changes in inventory investment of non-competing import-commodities as proportional to changes in imports. Similarly, (2.10.2) determines changes in inventory investment of the other commodities as a proportion of the change in gross production. However, changes in inventories are set equal to zero for most commodities (and in particular for all services), see (2.10.3).

(2.10.1) $DSI_i + DSH_i = \sigma\lambda^I_{ii}\left(I_i - I_i(-1)\right) + DSE_i \qquad i \in \{02, 08, 09\} \subset \mathbf{VA}$

(2.10.2) $$DSI_i + DSH_i = \sigma \sum_{j \in PA} \lambda_{ij}^X (X_j - X_j(-1)) + DSE_i$$

$$i \in \{11,12,13,16,17,18,25,34,37,41,42,43,46,48,49,66\} \subset \mathbf{VA}$$

(2.10.3) $$DSI_i + DSH_i = 0$$

$$i \in \{03,06,07,19,35,36,47,55,63,65,67,71,74,81,83,85,89,92,93,94,95\} \subset \mathbf{VA}$$

New symbols

DSI_i = total change in inventories of the imported commodity i in constant prices.
DSH_i = change in inventories of the domestically produced commodity i in constant prices.
I_i = import activity i measured in constant prices.
λ_{ij}^X = coefficient calculated as import of activity i in basic value over import activity i in c.i.f. value.
σ = parameter relating the size of inventory investment to change in supply.
DSE_i = base year correction of inventories (exogenous calibration variable).
X_j = gross production in current basic prices, production activity j.
λ_{ii}^X = activity share coefficient; the share of the delivery of commodity i, measured in basic value, in the total deliveries from production activity j, measured in net-seller value in the base year.

2.11 Consumer demand by households

For this section it might be helpful consult Figure 1.3.1.

Price indices

(2.11.1) $$PC_U = \left\{O.U(PC_{12})^{1-SU.U} + (1-O.U)(PC_{13})^{1-SU.U}\right\}^{\frac{1}{1-SU.U}}$$

Symbols

PC_U = purchaser price index for the *CES* aggregate for *Energy (U)* aggregating prices for *Electricity (12)* and *Fuels (13)*.
$O.U$ = distribution parameter in the demand for energy.
$SU.U$ = elasticity of substitution between *Electricity (12)* and *Fuels (13)*.

PC_U is the price index dual to a *CES* sub-utility function in electricity and fuels. Since the *CES* function is homogeneous of degree one, we have homothetic separability along this branch of the utility tree implying equal Engel elasticity for electricity and fuels.

(2.11.2) $$PC_{PT} = \left\{O.PT(PC_{14})^{1-SU.PT} + (1-O.PT)(PC_{31})^{1-SU.PT}\right\}^{\frac{1}{1-SU.PT}}$$

New symbols

PC_{PT} = purchaser price index for the CES aggregate for *Private Transport (PT)* aggregating prices for *Petrol and Car Maintenance (14)* and *User Cost of Cars etc. (31)*.

O.PT = distribution parameter in the demand for *Private Transport (PT).*
SU.PT = elasticity of substitution between *Petrol and Car Maintenance (14)* and *User Cost of Cars etc. (31).*

The comments to (2.11.1) apply to (2.11.2).

(2.11.3) $$PC_T = (PC_{PT})^{BE.PT}(PC_{61})^{BE.61}$$

New symbols
PC_T = purchaser price index for *Transport (T)* in the intermediate *LES* system for *Private Transport (PT)* and *Public Transport Services (61).*
BE.i = (conditional) marginal budget share of consumption activity *i* (a parameter of the intermediate utility function).

The intermediate sub-utility function of Stone-Geary type is not linearly homogeneous and hence allows for varying Engel elasticities between private and public transport.

Household and aggregate minimum expenditures

(2.11.4) $$VCMIN_{Tj} = PC_{PT}GA._{PTj} + PC_{61}GA._{61j} \qquad j = H0, Z1, Z2$$

New symbols
$VCMIN_{Tj}$ = constant minimum household cost of *Transport (T)* in current prices at the intermediate *LES* level when $j = H0$. For $j = Z1, Z2$, $VCMIN_{Tj}$ is *additional* household cost with one more child and one more adult, respectively.
$GA._{ij}$ = fixed minimum household consumption of consumption aggregate/activity *i* at the intermediate LES level when $j = H0$. For $j = Z1, Z2$, $GA._{ij}$ is *additional* household consumption with one more child and one more adult, respectively.

(2.11.5) $$\begin{aligned} VCMIN_T &= VCMIN_{TH0}(NH - NH_{364}) + VCMIN_{TZ1}NB_{0019} \\ &+ VCMIN_{TZ2}(NB_{20} - NH_{364}) \end{aligned}$$

New symbols
$VCMIN_T$ = fixed aggregate (top level) minimum expenditure on *Transport (T)* in current prices.
NH = number of households in the economy.
NH_{364} = number of people living in institutions.
NB_{0019} = number of children (age 0-19).
NB_{20} = number of adults (age 20+).

(2.11.6) $$VCMIN_j = \sum_i PC_i GA._{ij} + VCMIN_{Tj}$$

$$j = H0, Z1, Z2 \qquad i \in \mathbf{CA} \cup \{U, T\} \setminus \{12, 13, 14, 15, 31, 61\}$$

(2.11.7) $$\begin{aligned} VCMIN &= VCMIN_{H0}(NH - NH_{364}) + VCMIN_{Z1}NB_{0019} \\ &+ VCMIN_{Z2}(NB_{20} - NH_{364}) \end{aligned}$$

New symbols
$VCMIN$ = aggregate fixed minimum consumption expenditure (top level) in current prices.
$VCMIN_j$ = total fixed minimum household costs in current prices for $j = H0$ (top level). For $j = Z1, Z2$, $VCMIN_j$ is *additional* household total fixed costs with one more child and one more adult, respectively.

Aggregate expenditures

(2.11.8)
$$\begin{aligned} VC_T &= (VCMIN_{TH0} + PC_T GA._{TH0})(NH - NH_{364}) \\ &+ (VCMIN_{TZ1} + PC_T GA._{TZ1}) NB_{0019} \\ &+ (VCMIN_{TZ2} + PC_T GA._{TZ2})(NB_{20} - NH_{364}) \\ &+ BE.T(VCC - VCMIN) \end{aligned}$$

New symbols
VC_T = aggregate expenditure on *Transport* (T) in current prices.
VCC = aggregate consumption expenditure in current purchaser prices.

VCC is determined by "supply conditions" (see Section 1.5). In contradistinction to VC (see Eq. (2.12.10)), VCC is exclusive of *Medical Care and Health Expenditures (62)* and *Purchase of Cars (30)*, but imputed rent from the stock of cars, *User Cost of Cars etc. (31)*, is included. Hence, in current prices, $VCC = VC\text{-}VC_{62}\text{-}VC_{30} + VC_{31}$. *Medical Care and Health Expenditures (62)* is determined exogenously in MSG-5.

Aggregate consumption demand

(2.11.9)
$$\begin{aligned} C_i &= GA._{iH0}(NH - NH_{364}) + GA._{iZ1} NB_{0019} + GA._{iZ2}(NB_{20} - NH_{364}) \\ &+ BE.i(VCC - VCMIN)/PC_i - a_i C_{70} + CE_i \end{aligned}$$

$$a_i = 0 \text{ for } i = 40, 50 \qquad CE_U = 0$$
$$i \in \mathbf{CA} \cup \{U\} \setminus \{12, 13, 14, 31, 61\}$$

(2.11.10)
$$\begin{aligned} C_i &= GA._{iH0}(NH - NH_{364}) + GA._{iZ1} NB_{0019} + GA._{iZ2}(NB_{20} - NH_{364}) \\ &+ BE.i(VC_T - VCMIN_T)/PC_i - a_i C_{70} + CE_i \end{aligned}$$

$$a_{PT} = 0 \qquad CE_{PT} = 0$$
$$i \in \{61, PT\}$$

New symbols
C_i = aggregate consumption of consumption activity/aggregate i in constant purchaser prices.
PC_i = purchaser price index of consumption activity/aggregate i.
C_{70} = direct purchases in Norway by non-resident households. C_{70} is measured negatively.
a_i = distribution parameter for direct purchases in Norway by non-resident households.
CE_i = exogenous calibration variable.

Next, the (bottom level) aggregate demand for the consumption activities *Electricity (12)*, *Fuels (13)*, *Petrol and Car Maintenance (14)* and *User Cost of Cars etc. (31)*, follow:

(2.11.11) $C_{12} = C_U O.U(PC_U / PC_{12})^{SU.U} + CE_{12}$

(2.11.12) $C_{13} = C_U(1 - O.U)(PC_U / PC_{13})^{SU.U} + CE_{13}$

(2.11.13) $C_{14} = C_{PT} O.PT(PC_{PT} / PC_{31})^{SU.PT} - a_{14}C_{70} + CE_{14}$

(2.11.14) $C_{31} = C_{PT}(1 - O.PT)(PC_{PT} / PC_{31})^{SU.PT} + CE_{31}$

$\{12,13,14,31\} \subset \mathbf{CA}$

C_{31} has the interpretation of a flow of services from the stock of cars in constant prices. The aggregate purchase of cars follows residually:

(2.11.15) $C_{30} = \frac{1}{K.31}((1 + D.ELB)C_{31} - C_{31}(-1)) \qquad 30 \in \mathbf{CP}$

New symbols
$D.ELB$ = depreciation rate of the stock of cars.
$K.31$ = a transformation constant.
C_{30} = the aggregate purchase of cars.

Miscellaneous

(2.11.16) $PC_{31} = \frac{1}{K.31}\frac{PKJUST}{C_{30}}(D.ELB + RB)((C_{30} - CK_{30}) \cdot PC_{30} + CK_{30}PJ_{40})$

New symbols
PC_{31} = purchaser price index for the user cost of cars.
RB = (exogenous) interest rate; rate of return of investment in cars.
$PKJUST$ = index reflecting average user cost of capital.
CK_{30} = *Households'* purchase of second hand cars from domestic production sectors in constant purchaser prices.
PJ_{40} = purchaser price index of the investment activity *Cars (40)*.

(2.11.17) $HC_{30} = (C_{30} + HC_{30}(-1))/(1 + D.ELB)$

New symbols
HC_{30} = *Households'* stock of cars in constant prices.

(2.11.18) $PC_{70} = \sum_i a_i PC_i \qquad i \in \{00,11,14,20,21,60,61\} \subset \mathbf{CA}$

Symbols
PC_{70} = price index of direct purchases in Norway by non-resident households.
a_i = distribution parameter of direct purchases in Norway by non-resident households.

2.12 The current account

Foreign aid from Norway is given as a fraction of the gross national product. Accordingly, the various income components of the gross national product is calculated below.

The surplus of the current account, RS_{500}, is an essential variable in the model. The closure rule chosen determines its status as endogenous or exogenous (see Section 1.5). The computation of RS_{500} requires explicit consideration of interest payments, dividends and transfers between domestic and foreign institutional sectors.

The components of the gross national product and foreign aid

Export of used real capital:

(2.12.1) $$AJ_k = JE_k \qquad k \in \mathbf{JR} \setminus \{40\}$$

(2.12.2) $$AJ_{40} = JE_{40} - CK_{30}$$

(2.12.3) $$VAJ_k = PJ_k JE_k \qquad k \in \mathbf{JR} \setminus \{40\}$$

(2.12.4) $$VAJ_{40} = PJ_{40}(JE_{40} - CK_{30})$$

Symbols
AJ_k = export of used real capital, type k, in constant prices.
JE_k = sales of used real capital, type k, in constant prices.
CK_{30} = *Households'* purchase of second hand cars from domestic production sectors in constant purchaser prices.
VAJ_k = export of used real capital, type k, in current prices.
PJ_k = purchaser price index of capital type k.

Foreigners' consumption in Norway:

(2.12.5) $$VC_{70} = C_{70} PC_{70}$$

(2.12.6) $$A_{24} = -C_{70}$$

(2.12.7) $$VA_{24} = -VC_{70}$$

New symbols
VC_{70} = direct purchases in Norway by non-resident households in current prices. VC_{70} is measured negatively.
C_{70} = VC_{70} in constant prices.
PC_{70} = price index for C_{70}.
A_{24} = export activity 24 in constant prices, comprised of direct purchases in Norway by non-resident households.
VA_{24} = A_{24} in current prices.

The trade balance *(VAVI):*

(2.12.8) $$VAVI = \sum_{k \in \mathbf{JR}} VAJ_k + \sum_{i \in \mathbf{VA}} (PA_i A_i - PI_i I_i) + VA_{24}$$

New symbols
$VAVI$ = the trade balance in current prices.
A_i = export activity i in constant prices.
PA_i = price index of export activity i f.o.b.
I_i = import activity i in constant prices c.i.f.
PI_i = c.i.f. price index of import activity i.

Aggregate change in inventories:

(2.12.9) $$VDS = \sum_{i \in \mathbf{VA}} \left(BH_i DSH_i + BI_i DSI_i \right)$$

New symbols
VDS = aggregate change in inventories in current basic prices.
BH_i = basic price index of the domestically produced commodity i.
DSH_i = change in inventory investment in constant prices of the domestically produced commodity i.
DSI_i = change in inventory investment in constant prices of import activity i.

Aggregate consumption expenditure:

(2.12.10) $$VC = \sum_{i \in \mathbf{CP} \setminus \{30\}} PC_i C_i + PC_{30}\left(C_{30} - CK_{30}\right) + VC_{70}$$

New symbols
VC = aggregate consumption expenditure in current purchaser prices.
C_i = consumption sector i in constant purchaser prices.
PC_i = purchaser price index for consumption sector i.

Note that VC differs from VCC (see Section 2.11) in that $VC = VCC + VC_{62} + VC_{30} - VC_{31}$. VC_{62} is *Medical Care and Health Expenditures (62)* and VC_{30} *Purchase of Cars (30)*, both in current prices. VC_{31}, *User Cost of Cars etc. (31)*, is a measure of the flow of services from the stock of cars in current prices.

Aggregate gross real investment:

(2.12.11) $$JK_k = J_k - JE_k \qquad \textit{where} \quad JE_{74} = JE_{70}$$

$$k \in \mathbf{JA}$$

(2.12.12) $$VJK = \sum_{k \in \mathbf{JA}} PJ_k JK_k$$

New symbols
JK_k = gross real investment of capital activity k.
J_k = new investment, capital activity k, in constant purchaser prices.
VJK = aggregate gross real investment in current prices.
PJ_k = purchaser price index of investment activity k.

Foreign aid:

$$RV_{015\,500} = RATRVUHJ[(VC + VJK + VAVI + VDS + \sum_{j \in PO} \{PL_j LW_j + YD_j + BHS_j TSV_j H_j + VH_j - BS_j XG_j\}] \tag{2.12.13}$$

New symbols
$RV_{015\,500}$ = foreign aid from Norway.
$RATRVUHJ$ = coefficient giving foreign aid as a fraction of gross national product.
LW_j = number of hours worked by wage earners in production sector *j*.
PL_j = price index of LW_j.
YD_j = capital depreciation in production sector *j* in current prices.
TSV_j = industry *j* output tax.
H_j = total material input in production sector *j* in constant prices.
VH_j = total material inputs in production sector *j* in current purchaser prices.
BHS_j = weighted basic price index for commodities delivered from domestic production sector *j*.
BS_j = average basic price index for the domestically produced commodity *j*.
XG_j = goods and services provided in exchange of a fee in government production sector *j* in constant prices.

Interest payments, dividends, transfers and the surplus on the current account

Dividends which go abroad:

$$RAM_{500} = \sum_{i \in INS} RAB_i - \sum_{i' \in INS \setminus \{500\}} RAM_{i'} \tag{2.12.14}$$

New symbols
RAM_{500} = dividends to *Abroad (500)*.
RAB_i = dividends paid by institutional sector *i*.
$RAM_{i'}$ = dividends received by institutional sector *i'*.

Transfers, dividends and interest from abroad:

$$RRVB_{500} = RRB_{500} + RAB_{500} + RV_{500\,309} + RV_{500\,300} + RV_{500\,999} + YP_{500\,309} + YW_{500\,300} \tag{2.12.15}$$

New symbols
$RRVB_{500}$ = transfers, interest and dividends from *Abroad (500)*.
RRB_{500} = interest and dividends to *Abroad (500)*.
RV_{ki} = transfers from institutional sector *k* to institutional sector *i*.
$YP_{500\,i}$ = income from patents, rent etc. from *Abroad (500)* to institutional sector *i*.
$YW_{500\,300}$ = wage payments from *Abroad (500)* to *Households (300)*.

Transfers, interest and dividends which go abroad:

$$RRVM_{500} = RRM_{500} + RAM_{500} + RV_{015\,500} + RV_{309\,500} + RV_{300\,500} + RV_{999\,500} + YP_{309\,500} + YW_{300\,500} \tag{2.12.16}$$

New symbols
$RRVM_{500}$ = transfers, interest and dividends to *Abroad (500)*.
RRM_{500} = interest and dividends which to *Abroad (500)*.
$YW_{300\,500}$ = wage payments from *Households (300)* to *Abroad (500)*.

Net interest payments and transfers from abroad *(RRV)*:

(2.12.17) $RRV = RRVB_{500} - RRVM_{500}$

Surplus on the current account *(RS_{500})*:

(2.12.18) $RS_{500} = VAVI + RRV$

Net national debt:

(2.12.19) $NGU = NGU(-1) - RS_{500} - OMV_{500}$

New symbols
NGU = net national debt.
OMV_{500} = net change in assets and liabilities due to change in the exchange rate.

Interest and dividends which go abroad:

(2.12.20) $RARRU = RENU\left(\frac{NGU - NGU(-1)}{2}\right) + RARRUX$

(2.12.21) $RRB_{500} = -RARRU + RRM_{500} - RAB_{500} + RAM_{500} + RAM_{500} - RA_{307\,500} + RA_{500\,307}$

New symbols
$RARRU$ = net interest and dividends which go abroad, except net dividends from petroleum activities.
$RENU$ = world market nominal interest rate.
$RARRUX$ = base year correction of *RARRU* (calibration variable).
RRB_{500} = interest and dividends from Norway which to *Abroad (500)*.
RA_{ki} = dividends from institutional sector *k* to institutional sector *i*.

2.13 Export market shares and sector prices

(2.13.1) $MA_i = \frac{\sum_{j\in\mathbf{VA}} \lambda_{ij}^A A_j - IA_i}{\sum_{j\in\mathbf{PA}} \lambda_{ij}^X X_j} \qquad i \in \mathbf{VA} \setminus \{71\}$

$MA_{02} = 1 \quad MA_i = 0 \quad i \in \{03, 07, 19, 35, 36, 55, 83, 89, 94\} \subset \mathbf{VA}$

Symbols
MA_i = export share of the domestically produced commodity *i* adjusted for re-export.
A_j = export of export activity *j* in constant prices.
IA_i = re-export of import commodity *i* in constant prices.
X_j = gross production in constant net-seller prices, production activity *j*.

λ_{ij}^{A} = activity share coefficient; the ratio between the content of commodity *i* measured in basic value and the total value of export activity *j* in the base year.
λ_{ij}^{X} = activity share coefficient; the share of the delivery of commodity *i*, measured in basic value, in the total deliveries from production activity *j*, measured in net-seller value in the base year.

The export share of *Electricity (71)* is determined in the model block for electricity (see. Section 2.16).

(2.13.2) $$BS_i = MA_i \cdot PA_i + (1 - MA_i) BH_i \qquad i \in \mathbf{VA}$$

New symbols
BS_i = average basic price for the domestically produced commodity *i*.
BH_i = basic price of the domestically produced commodity *i*.
PA_i = purchaser price index of export activity *i* f.o.b.

2.14 Capital depreciation

Capital depreciation in constant prices

(2.14.1) $$FD_j = \left(\sum_{k \in \mathbf{JR}} \kappa_{kj} DEP_{kj} \delta_{kj} \right) K_j \qquad j \in \mathbf{PS} \setminus \{64, 65, 71, 89, 92S\}$$

(2.14.2) $$FD_j = \sum_{k \in \mathbf{JR}} DEP_{kj} \delta_{kj} K_{kj} \qquad j = 64, 65$$

(2.14.3) $$FD_{71} = FD_{11\,71} + FD_{12\,71} + FD_{40\,71} + FD_{50\,71}$$

(2.14.4) $$FD_j = 0 \qquad j = 92S, 89.$$

Symbols
FD_j = capital depreciation in production sector *j* in constant prices.
FD_{i71} = capital depreciation, capital type *i*, in the *Production of Electricity (71)* in constant prices.
K_j = real capital stock by the end of year in production sector *j* measured in constant net-purchaser prices.
K_{kj} = real capital of type *k* in production sector *j* in constant prices.
δ_{kj} = average rate of physical depreciation of the total capital stock of type k in production sector *j*.
DEP_{kj} = shift parameter related to the rate of physical depreciation of the stock of capital type *k* in production sector *j*.
κ_{kj} = capital structure coefficient; content of capital activity *k* in the total capital stock in production sector *j*.

Capital depreciation in current prices

(2.14.5) $$YD_j = \left(\sum_{k \in \mathbf{JR}} \kappa_{kj} DEP_{kj} \delta_{kj} PJ_k \right) K_j \qquad j \in \mathbf{PS} \setminus \{64, 65, 71, 89, 92S\}$$

(2.14.6) $YD_j = \sum_{k \in \mathbf{JR}} DEP_{kj} \delta_{kj} PJ_k K_{kj} \qquad j = 64,65$

(2.14.7) $YD_{71} = \left(FD_{11\,71} + FD_{12\,71}\right)PJ_{10} + FD_{40\,71}PJ_{40} + FD_{50\,71}PJ_{50}$

(2.14.8) $YD_j = 0 \qquad j = 92S, 89.$

New symbols
YD_j = capital depreciation in production sector j in current prices.
PJ_k = purchaser price index of capital type k.

2.15 Total material input

To facilitate computation of gross national product, which determines foreign aid from Norway, $RV_{015\,500}$, we need to calculate current material input spending in the government production sectors (see Eq. (2.12.13)). Hence, total material input is treated in the main part of the model.

(2.15.1) $H_j = M_j + E_j + F_j \qquad j \in \mathbf{PP} \setminus \{71,89\}$

$H_{89} = M_{89}$

(2.15.2) $VH_j = PM_j M_j + PE_j E_j + PF_j F_j \qquad j \in \mathbf{PSV} \setminus \{71,89,92U\}$

$VH_{89} = PM_{89} M_{89}$

Symbols
H_j = total material input in production sector j in constant net-purchaser prices.
VH_j = total material input in production sector j in current net-purchaser prices.
M_j = other material input in production sector j in constant net-purchaser prices.
PM_j = net-purchaser price index of other material input in production sector j.
E_j = input of electricity in production sector j in constant net-purchaser prices.
PE_j = net-purchaser price index of electricity in production sector j.
F_j = input of fuels in production sector j in constant net-purchaser prices.
PF_j = net-purchaser price index of fuels in production sector j.

The following equations summarise material input in *Defence (92S)*, comprised of *Military Submarines and Aircraft (92U)* and *Defence Exclusive of Military Submarines and Aircraft (92C)*.

(2.15.3) $VH_{92U} = PM_{92U} M_{92U}$

(2.15.4) $M_{92S} = M_{92C} + M_{92U}$

(2.15.5) $E_{92S} = E_{92C} + E_{92U}$

(2.15.6) $F_{92S} = F_{92C} + F_{92U}$

(2.15.7) $H_{92S} = M_{92S} + E_{92S} + F_{92S}$

(2.15.8) $VH_{92S} = VH_{92C} + VH_{92U}$

2.16 The model block for electricity

The reader is referred to Section1.7 for a simplified exposition of the structure and working of this model block.

The supply of electricity is modelled by disaggregating the national account sector *Production of Electricity (71)* into the four distinct production sectors *Production of Hydro-Power (70), Production of Gas-Power (710), Transmission Services (72)* and *Distribution Services (73).*

The demand for electricity measured in physical units

The electricity demand measured in constant base year prices is derived in the equations describing the producer and consumer behaviour. The following equations transform the demand into physical units. The data source for physical energy flows is the Norwegian Energy Accounts.

(2.16.1) $$GWH_j = GWH_j.0 \ \frac{E_j}{E_j.0} \qquad j \in \mathbf{PSV} \setminus \{71\}$$

(2.16.2) $$GWH_C = GWH_C.0 \ \frac{E_C}{E_C.0}$$

Symbols
GWH_j = electricity demand from input activity *j* measured in GWh.
E_j = electricity demand from activity *j* measured in constant base year prices (mill. Nkr).
E_C = electricity demand from private consumption measured in constant base ear prices (mill Nkr).
GWH_C = private consumption of electricity measured in GWh.
C_{12} = private consumption of electricity measured in constant base year prices (mill. Nkr).

Distribution services per delivered kWh by type of delivery

(2.16.3) $$GA_{73k} = \frac{TAU_{73k} / (1 - TAU_{73k})}{TAU_{7311} / (1 - TAU_{7311})} \qquad k \in \{11, 12, 41\}$$

New symbols
$TAU_{73\,k}$ = power losses in the distribution net in percent of delivered power to the net for deliveries of type *k*.
$GA_{73\,k}$ = distribution services per delivered kWh of deliveries of type *k*.
k = *11* deliveries for ordinary consumption.
k = *12* deliveries of surplus power.

k = *41* deliveries to electricity intensive industries *(Manufacture of Pulp and Paper Articles (34), Manufacture of Industrial Chemicals (37)* and *Manufacture of Metals (43)).*

Distribution services per delivered kWh

(2.16.4) $GAM_{73\,j} = FK_j\, GA_{73\,11} + (1\text{-}FK_j)GA_{73\,12} \quad j \in \mathbf{PSV}\backslash\{34,37,43,71\}$

(2.16.5) $GAM_{73\,34} = FK_{34}\, GA_{73\,12} + (1\text{-}FK_{34})GA_{73\,12}$

(2.16.6) $GAM_{73\,j} = FK_j\, GA_{73\,41} + (1\text{-}FK_j)GA_{73\,12} \quad j \in \{37,43\}$

(2.16.7) $GAM_{73\,A} = FK_A\, GA_{73\,12} + (1\text{-}FK_A)GA_{73\,12}$

(2.16.8) $GAM_{73\,C} = FK_C\, GA_{73\,11} + (1\text{-}FK_C)GA_{73\,11}$

New symbols

$GAM_{73\,j}$ = distribution services per delivered kWh to input activity j.
$GAM_{73\,C}$ = distribution services per delivered kWh to private consumption.
$GAM_{73\,A}$ = distribution services per delivered kWh to exports.
FK_j = the share of firm power in the deliveries to input activity j.
FK_C = the share of firm power in the deliveries to private consumption.
FK_A = the share of firm power in the deliveries to exports.

Electricity demand corrected for losses in the distribution net

(2.16.9) $$EE_j = \left\{\frac{FK_j}{1-TAU_{7311}} + \frac{1-FK_j}{1-TAU_{7312}}\right\}GWH_j \qquad j \in \mathbf{PSV} \setminus \{34,37,43,71\}$$

(2.16.10) $$EE_{34} = \left\{\frac{FK_{34}}{1-TAU_{7312}} + \frac{1-FK_{34}}{1-TAU_{7312}}\right\}GWH_{34}$$

(2.16.11) $$EE_j = \left\{\frac{FK_j}{1-TAU_{7341}} + \frac{1-FK_j}{1-TAU_{7312}}\right\}GWH_j \qquad j \in \{37,43\}$$

(2.16.12) $$EE_A = \left\{\frac{FK_A}{1-TAU_{7312}} + \frac{1-FK_A}{1-TAU_{7312}}\right\}GWH_A$$

(2.16.13) $$EE_C = \left\{\frac{FK_C}{1-TAU_{7311}} + \frac{1-FK_C}{1-TAU_{7312}}\right\}GWH_C$$

New symbols

EE_j = use of electricity in input activity j corrected for power losses in the distribution net.

EE_C = private consumption of electricity corrected for power losses in the distribution net.
EE_A = export of electricity corrected for power losses in the distribution net.
GWH_A = export of surplus power measured in GWh.

Demand for surplus power

(2.16.14) $$ETT = \sum_j \left(1 - FK_j\right)GWH_j \qquad j \in \mathbf{PSV} \cup \{C, A\} \setminus \{71\}$$

New symbols
ETT= total use of surplus power.

Indirect taxes and purchaser prices

The indirect tax on electricity is levied on firm power only. Surplus power is excempted from this tax. The model takes account to the fact that the VAT on electricity in previous years was differentiated between users due to geographic differentiation and differences in the deductibility of VAT payments. Deductible VAT is not to be included in the purchaser price.

The price of surplus power is lower than the corresponding price of firm power. The model interprets this difference as a result of quality differences between the two types of power deliveries. The purchaser prices on electricity accounts for the sector specific composition of firm and surplus power by assuming that the price of surplus power, measured at the reference point, is a constant fraction of the price of firm power. Without such a correction, the price discrimination coefficient would be influenced by the sectorial composition of firm and surplus power.

For deliveries to the electricity intensive industries *(Manufacture of Pulp and Paper Articles (34), Manufacture of Industrial Chemicals (37)* and *Manufacture of Metals (43)),* the model takes into account that these industries have a cost advantage compared to other users due to longer "using time". Hence, differences in using time can not account for the differences in the price discrimination. The price discrimination is implemented as an indirect tax levied on the purchaser price net of VAT and the tax on electricity.

(2.16.15) $$TVPX_{71} = TPX_{71}\, HV_{70XX} \left\{ \sum_{j \in \mathbf{PSV} \cup \{C\} \setminus \{71\}} TVE_j FK_j GWH_j \right\}$$

(2.16.16) $$TMT_{71} = HR_{70XX} \left\{ \sum_{j \in \mathbf{PSV} \cup \{C\} \setminus \{71\}} \gamma_j TME_j GWH_j \left[TVE_j TPX_{71} HV_{70XX} FK_j + \left(FK_j + TK\left(1 - FK_j\right)\right)\left(1 + HVE_j\right)BE + GAM_{73j} B_{73} \right] \right\}$$

$$\text{where} \quad \gamma_j = \begin{cases} 1 \ \ \textit{if} \ \ j \in \{63, 83, 85, 92C, 93S, 94S, 95S, 93K, 94K, 95K, C\} \\ 0.5 \ \ \textit{if} \ \ j = 74 \\ 0 \ \ \textit{otherwise} \end{cases}$$

(2.16.17)
$$PGWH_j = \left(1+\gamma_j HR_{70XX} TME_j\right)\left[TVE_j TPX_{71} HV_{70XX} FK_j + \left(FK_j + TK\left(1-FK_j\right)\right)\left(1+HVE_j\right)BE + GAM_{73j}B_{73}\right]$$

where γ_j *is as defined in* (2.6.16)

$j \in \mathbf{PSV} \cup \{A, C\} \setminus \{37, 43, 71\}$

(2.16.18)
$$PGWH_j = \left[TVE_j TPX_{71} HV_{70XX} FK_j + KLEVKK\left(FK_j + TK\left(1-FK_j\right)\right)\left(1+HVE_j\right)BE + GAM_{73j}B_{73}\right]$$

$j \in \{37, 43\} \subset \mathbf{PSV}$

New symbols

$TVPX_{71}$ = accrued net volume taxes on electricity collected from producers.
TPX_{71} = change in the volume tax rate on electricity.
TMT_{71} = accrued VAT on electricity, current prices.
$PGWH_j$ = net purchaser price of electricity used in input activity j measured in (Nkr/kWh).
$PGWH_C$ = net purchaser price of electricity used in private consumption measured in(Nkr/kWh).
$PGWH_A$ = net purchaser price of electricity which is exported measured in (Nkr/kWh).
TME_j = change in the VAT rate on electricity used in input activity j.
TME_A = change in the VAT rate on electricity which is exported.
TME_C = change in the VAT rate on electricity used in private consumption.
TVE_j = change in the tax rate on electricity used in input activity j.
TVE_A = change in the tax rate on electricity which is exported.
TVE_C = change in the rate on electricity used in private consumption.
HVE_j = coefficient for price discrimination on electricity used in input activity j.
HVE_C = coefficient for price discrimination on electricity used in private consumption.
HVE_A = coefficient for price discrimination on electricity which is exported.
HV_{70XX} = base year tax rate on electricity (Nkr/kWh). Calibrated in the base year.
HR_{70XX} = base year VAT rate on electricity (Nkr/kWh). Calibrated in the base year.
TK = indicator for the quality of surplus power.
$KLEVKK$ = quality correction of hydro power delivered to electricity intensive industries.
BE = electricity price in the reference point (Nkr/kWh).
B_{73} = basic price of distribution services (Nkr/kWh).

Factor demand in electricity production

(2.16.19)
$$ZZK_{70} = \begin{cases} \alpha_{70} + \beta_{70}\left(GWHX_{70PP}(-1) - \delta_{70}\right) & \\ -\xi_{70}\left(GWHX_{70PP}(-1) - \delta_{70}\right)^2 & \text{when } GWHX_{70PP}(-1) < GWHX_{70MX} \\ \text{"a sufficiently high number"} & \text{when } GWHX_{70PP}(-1) \geq GWHX_{70MX} \end{cases}$$

(2.16.20)
$$ZZK_{70T} = \frac{GWHX_{70PP}(-1)}{GWHX_{70PP}} ZZK_{70T}(-1) + \left(1 - \frac{GWHX_{70PP}(-1)}{GWHX_{70PP}}\right)\left(ZZK_{70} + ZZK_{70}(-1)\right)$$

(2.16.21) $ZZK_j = ZZK_j = \sum_{i\in\{11,12,40,50\}} ZZK_{ij} \qquad j \in \{710,72,73\}$

(2.16.22) $ZZG_{710} = \alpha_{710} + \beta_{710}\, GWHX_{710}(-1)$

(2.16.23) $ZZYTS_j = ZZYTS_j.0 \dfrac{TSV_{71}}{TSV_{71}.0} \dfrac{B_j}{B_j.0} \qquad j \in \{70,72,73\}$

(2.16.24) $ZZYTS_{710} = ZZAVG_{710}\, TAXJUST$

New symbols

ZZK_{70} = marginal input coefficient for (real) capital in *Production of Hydro-Power (70)*, Nkr/kWh.

ZZK_{70T} = average input coefficient for (real) capital in *Production of Hydro-Power (70)*, Nkr/kWh.

ZZK_j = average input coefficient for (real) capital in sector *j*, Nkr/kWh.

ZZG_{710} = average input coefficient for natural gas in *Production of Gas-Power (710)*, Nkr/kWh.

$ZZYTS_j$ = net sector taxes per unit of gross production in sector *j*, Nkr/kWh.

TSV_{71} = rate of net sector taxes for the National Account sector *Production of Electricity (71)*.

$GWHX_{70PP}$ = average (over years) production capacity in the hydro power system measured in kWh.

$GWHX_{70MX}$ = remaining water resources possible to develop measured in kWh.

ZZK_{ij} = average input coefficient for (real) capital of type *i* in sector *j*, Nkr/kWh.

$GWHX_{710}$ = production of gas power measured in GWh.

$ZZAVG_{710}$ = net sector taxes, excl. CO_2-taxes, in *Production of Gas-Power (710)*, Nkr/kWh.

$TAXJUST$ = proportional adjustment factor of the net sector taxes.

B_i = Basic price of commodity *j*, Nkr/kWh.

α_{70}, β_{70}, ξ_{70}, δ_{70} = technology parameters in *Production of Hydro-Power (70)*.

α_{710}, β_{710} = technology parameters in *Production of Gas-Power (710)*.

With a "sufficiently high number" in (2.16.19) we understand that ZZK_{70} takes such a high value that there is no expansion of the production capacity in the sector *Production of Hydro-Power (70)*, i.e. $GWHX_{70}$ remains fixed.

Note that in the power producing sectors {70,710,72,73} the capital type *Dwellings, Cottages and Non-Residential Buildings etc. (10)* $\in$ **JR** is split into *Buildings (11)* and *Constructions (12)* (see Eq. (2.16.20)).

The technology parameters in *Production of Hydro-Power (70)*, α_{70}, β_{70}, ξ_{70}, δ_{70}, are quantified by fitting a second order polynom to the long-run marginal cost curve estimated by the Norwegian Water Resources Administration (NVE).

The (positive) technology parameter β_{710} is introduced to force a deviation from constant returns to scale in production of gas power. It is, however, small in value.

Factor prices

(2.16.25) $$PK_{70} = \left\{ \sum_{i\in\{11,12,40,50\}} \frac{ZZK_{i70}.0}{ZZK_{70}.0}(R_{70} + DPR_{i70})PJ_i \right\} PKJUST$$

(2.16.26) $$PK_j = \left\{ \sum_{i\in\{11,12,40,50\}} \frac{ZZK_{ij}}{ZZK_j}(R_j + DPR_{ij})PJ_i \right\} PKJUST \qquad j \in \{710,72,73\}$$

(2.16.27) $$PJ_k = PJ_{10} \qquad k \in \{11,12\}$$

(2.16.28) $$PL_j = PL_j.0\frac{PL_{71}}{PL_{71}.0} \qquad j \in \{70,710,72,73\}$$

(2.16.29) $$PM_j = PM_{71} \qquad j \in \{70,710,72,73\}$$

(2.16.30) $$PF_{70} = PF_{71}$$

(2.16.31) $$PH_{70} = \frac{PM_{70}M_{70} + PF_{70}F_{70}}{M_{70} + F_{70}}$$

New symbols

PK_j = user cost of capital in production sector *j*.
PJ_k = purchaser price index of capital type *i*.
PL_j = wage cost per hour in production sector *j*.
$ZZK_{70}.0$ = base year input coefficieient calculated as the input of total capital services per unit of gross production in *Production of Hydro-Power (70).*
R_j = real rate of return in power producing sector *j*.
DPR_{ij} = rate of depreciation of capital type *i* in power producing sector *j*.
M_{70} = other material input in *Production of Hydro-Power (70)* in constant net-purchaser prices.
PM_j = net purchaser price index of other material input in production sector *j*.
F_{70} = input of fuels in *Production of Hydro-Power (70)* in constant net-purchaser prices.
PF_j = net purchaser price index of input of fuels in production sector *j*.
PH_{70} = purchaser price index of total material input in *Production of Hydro-Power (70).*

Prices and costs related to future capacity

The calculation of the marginal willingness to pay for electric power takes into account that a tax on the use of electricity represents a wedge between social and the private value of a marginal unity of electric power. *BE* is the price of electric power measured at the reference point and equals production costs plus transmission costs. Since electric power is a homogeneous commodity at the reference point, the sum of production costs and transmission costs in hydro power and gas power production have to be equalised. The marginal cost expressions also take into account that the relevant sectors may produce other commodities than electric power.

(2.16.32) $$TE = \frac{TVPX_{71}}{GWHX_{70} + GWHX_{710}}$$

(2.16.33) $BKNY_j = B_j + TE \quad j \in \{70,710\}$

(2.16.34) $BE = B_{70} + B_{72}$

(2.16.35) $BE = B_{710} + MU_{710} B_{72}$

(2.16.36) $KTG_{70} = \sum_{j \in \{L,H\}} ZZj_{70} Pj_{70} + ZZYTS_{70} - \sum_{k \in \{55,85\} \subset VA} ZZA_{70k} BH_k$

(2.16.37) $KTG_{710} = \sum_{j \in \{L,M\}} ZZj_{710} Pj_{710} + ZZYTS_{710} + ZZR_{710} BH_{69} + ZZG_{710} BH_{67}$

(2.16.38) $LTG_i = KTG_i + ZZK_i PK_i \quad i \in \{70,710\}$

New symbols

TE = average tax rate on use of electric energy, Nkr/kWh.
$GWHX_{70}$ = virtual production of hydro power measured in GWh.
$GWHX_{710}$ = production of gas power measured in GWh.
$BKNY_{70}$ = marginal willingness to pay for hydro power including tax on use of electric energy, Nkr/kWh.
$BKNY_{710}$ = marginal willingness to pay for gas power including tax on use of electric energy, Nkr/kWh.
MU_{710} = parameter indicating the location of the gas power plant. $MU_{710} = 0$ if the location is in central areas, $MU_{710} = 1$ if the location is along the coast.
KTG_{70} = short-run marginal cost in *Production of Hydro-Power (70)*, Nkr/kWh.
LTG_{70} = long-run marginal cost in *Production of Hydro-Power (70)*, Nkr/kWh.
KTG_{710} = short-run marginal cost in *Production of Gas-Power (710)*, Nkr/kWh.
LTG_{710} = long-run marginal cost in *Production of Gas-Power (710)*, Nkr/kWh.
ZZL_j = input of man hours per unit of production in production sector *j*, Nkr/kWh.
ZZH_{70} = total material inputs per unit of production in *Production of Hydro-Power (70)*, Nkr/kWh.
ZZM_j = other material inputs per unit of production in production sector *j*, Nkr/kWh.
ZZR_{710} = pipeline transport services per unit of production in *Production of Gas-Power (710)*, Nkr/kWh.
ZZA_{jk} = input coefficient for production of commodity *k* delivered from production sector *j*.
BH_k = basic price index for the domestically produced commodity *k*.

Production of hydro power

The basic principle in the model is that expansion of the production capacity in hydro power production takes place if the willingness to pay exceeds the long-run marginal cost. With willingness to pay we understand the price of hydro power electricity measured at the hydro power plant including the indirect tax on electricity. However, the model user may use a dummy variable to simulate scenarios where the government follows other exogenous policy rules.

(2.16.39) $GWHX_{70PP} = GWHX_{70BA} + GWHX_{70DA}$

(2.16.40) $GWHX_{70} = ALP_{70}\, GWHX_{70PP}$

(2.16.41) $GWHX_{70DA} = DUM_{70}\, GWHX_{70DA}(-1) + (1 - DUM_{70}) GWHX^*_{70DA}$

$$\text{where } GWHX^*_{70DA} = \begin{cases} GWHX_{70DA}(-1) & \text{if } BKNY_{70} < LTG_{70} \\ GWHX^{**}_{70DA} & \text{if } BKNY_{70} \geq LTG_{70} \end{cases}$$

and $GWHX^{**}_{70DA}$ *is the largest root in the second order equation*

$$PK_{70}\left\{-\xi_{70}\left(GWHX_{70DA}\right)^2 + \beta_{70}GWHX_{70DA} + \alpha_{70}\right\} + KTG_{70} - BKNY_{70} = 0$$

New symbols

$GWHX_{70BA}$ = developed capacity in *Production of Hydro-Power (70)* in the base year, measured in GWh.

$GWHX_{70DA}$ = developed capacity in *Production of Hydro-Power (70)* after the base year, measured in GWh.

ALP_{70} = virtual production of hydro power measured as the share of the capacity in the hydro power system.

DUM_{70} = dummy variable. $DUM_{70} = 1$ in years with exogenous hydro power capacity, $DUM_{70} = 0$ in years with endogenous hydro power capacity.

Production of gas power

The capacity in gas power production is in principle determined in the same way as the capacity in hydro power production. In practice, the share of variable costs in the total costs is larger in gas power production than in hydro power production, implying that the virtual production of gas power will adjust more to variations in demand than the virtual production of hydro power. Accordingly, no adjustments for occasional (surplus) power is required in the model of gas power production.

(2.16.42) $GWHX_{710} = DUM_{710}\, GWHX_{710}(-1) + (1 - DUM_{710})GWHX^*_{710}$

$$\text{where } GWHX^*_{710} = \begin{cases} 0 & \text{if } BKNY_{710} < KTG_{710} \\ GWHX_{710}(-1) & \text{if } BKNY_{710} < LTG_{710} \\ GWHX^{**}_{710} & \text{if } BKNY_{710} \geq LTG_{710} \end{cases}$$

and $GWHX^{**}_{710}$ *is the largest root in*

$$\sum_{j\in\{K,L,M\}} ZZj_{710}Pj_{710} + ZZYTS_{710} + ZZR_{710}BH_{69}$$
$$+\left(\alpha_{710} + \beta_{710}GWHX_{710}\right)BH_{67} - BKNY_{710} = 0$$

New symbols

DUM_{710} = dummy variable. DUM_{710} equals 1 in years with exogenous gas power capacity, DUM_{710} equals 0 in years with endogenous gas power capacity.

Equilibrium in the market for electric power

A flexible price of electricity measured at the reference point, *BE*, ensures that supply equals demand at the reference point. Recall that at this point, the price is independent of whether the electricity has been produced by hydro power or by gas power.

(2.16.43) $EE = \sum_{j\in PSV\setminus\{71\}} EE_j + EE_C + EE_A$

(2.16.44) $EE = (GWHX_{70} + GWH_I)(1 - TAU_{72}) + GWHX_{710}(1 - TAU_{72}MU_{710})$

New symbols

EE = demand for electric power measured at the reference point in GWh.

GWH_I = import of electric power measured in GWh.

TAU_{72} = power losses in the transmission net (*Transmission Services (72)*) per unit of delivered power measured in kWh.

Power transmission

Unit costs in the production sector *Transmission Services (72)* is adjusted downwards when the power is occasional or delivered to power intensive industries (*Manufacture of Pulp and Paper Articles (34), Manufacture of Industrial Chemicals (37)* and *Manufacture of Metals (43)*). Unit costs in gas power production accounts for the location of the plant relative to the rural areas with high population density.

(2.16.45)
$$\left[1-\frac{(1-KLEVKK)(EE_{37}+EE_{43})+(1-TK)ETT}{GWHX_{72}}\right]B_{72}=$$
$$\sum_{j\in\{K,L,M\}} ZZj_{72}Pj_{72}+ZZYTS_{72}+\frac{TAU_{72}}{1-TAU_{72}}B_{70}-\sum_{k\in\{55,85\}\subset VA} ZZA_{72k}BH_k$$

(2.16.46) $$GWHX_{72} = (GWHX_{70} + GWH_I)(1 - TAU_{72}) + GWHX_{710}(1 - TAU_{72}MU_{710})$$

New symbols

$GWHX_{72}$ = production of transmission services measured in GWh.

Power distribution

(2.16.47) $$B_{73}=\sum_{j\in\{K,L,M\}} ZZj_{73}Pj_{73}+ZZYTS_{73}+\frac{TAU_{7311}}{1-TAU_{7311}}BE-\sum_{k\in\{55,85\}\subset VA} ZZA_{73k}BH_k$$

(2.16.48) $$GWHX_{73}=\sum_{j\in PSV\setminus\{71\}} GAM_{73j}GWH_j+GAM_{73C}GWH_C+GAM_{73A}GWH_A$$

New symbols

$GWHX_{73}$ = production of distribution services measured in GWh.

Losses and input of electric power in the power producing sectors

(2.16.49) $$GWH_{70}=\frac{GWHX_{70}}{GWHX_{70}.0}GWH_{70}.0$$

(2.16.50) $$GWH_{72}=\frac{TAU_{72}}{1-TAU_{72}.0}GWHX_{72}$$

(2.16.51) $$GWH_{73}=\frac{TAU_{7311}}{1-TAU_{7311}}GWHX_{73}$$

(2.16.52) $$ET_{70} = GWH_{70}B_{70}.0$$

(2.16.53) $$ET_{72} = GWH_{72}B_{70}.0$$

(2.16.54) $ET_{73} = GWH_{73} BE.0$

(2.16.55) $VET_{70} = GWH_{70} B_{70}$

(2.16.56) $VET_{72} = GWH_{72} B_{70}$

(2.16.57) $VET_{73} = GWH_{73} BE$

New symbols

GWH_{70} = input/losses of hydro power in *Production of Hydro-Power (70)* measured in GWh.
GWH_{72} = losses in the transmission net (*Transmission Services (72)*) measured in GWh.
GWH_{73} = losses in the distribution net (*Distribution Services (73)*) measured in GWh.
ET_{70} = input of hydro power in *Production of Hydro-Power (70)* measured in constant prices.
ET_{72} = losses in the transmission net (*Transmission Services (72)*) measured in constant prices.
ET_{73} = losses in the distribution net (*Distribution Services (73)*) measured in constant prices.
VET_{70} = input of hydro power in *Production of Hydro-Power (70)* measured in current prices.
VET_{72} = losses in the transmission net (*Transmission Services (72)*) measured in current prices.
VET_{73} = losses in the distribution net (*Distribution Services (73)*) measured in current prices.

Electricity accounting

It follows from the equations below that gross supply is equal to gross absorption, $GWH_X + GWH_I = GWH_H + GWH_C + GWH_A + BETAGWH$. The variable *BETAGWH* is introduced due to discrepancies between supply and absorption in the Energy Accounts in the base year.

(2.16.58) $GWH_{71} = GWH_{70} + GWH_{72} + GWH_{73}$

(2.16.59) $GWH_{92S} = GWH_{92C} + GWH_{92U}$

(2.16.60) $GWH_H = \sum_{j \in PS} GWH_j$

(2.16.61) $GWHX = GWHX_{70} + GWHX_{710} + GWH_{70} + BETAGWH$

New symbols

GWH_{71} = input and losses of electric power in the National Account sector *Production of Electricity* (71) measured in GWh.
GWH_{92S} = input and losses of electric power in the production sector *Defense (92S)* measured in GWh.
GWH_H = total input of electric power in the production sectors measured in GWh.
GWHX = gross production of electric power measured in GWh.
BETAGWH = statistical difference between supply and absorbtion in the base year in the Energy Accounts measured in GWh.

Gross production in hydro- and gas power production

Firm power is modelled as qualitatively superior to occasional (surplus) power. Differences in "using time" between users of electricity are also transformed to quality differences between the power units. Since also the composition of firm and occasional power varies between the different users of electric power, changes in the composition of demand cause changes in the aggregate volume of effective power units (i.e. power of equivalent quality). Conceptually, the gross production value in constant prices should change only due to changes in the production volume and/or changes in the quality of output. Therefore, gross production of hydro power in constant prices (X_{70}) reflects such changes in the average "using time" and composition of firm and occasional power. Moreover, the gains from resale of imported power have been included in the gross production concept.

Since prices of electric power may differ between users because of price discrimination, changes in the composition of demand has a separate effect on the value of gross production of electric power. The model variable measuring this effect is *VKORR* in the equations below. This is a price effect which is included in the value of gross production measured in current prices, but not in the constant price gross production concept. The effect is zero in the base year. Together with the net commodity taxes it has been distributed to the hydro- and gas power production sectors in proportion to the production levels in these sectors.

(2.16.62)
$$\begin{aligned} VKORR_{70} = \; & B_{70}\Big\{ \sum_{j\in PSV\setminus\{37,43,71\}} HVE_j\big[FK_j + TK(1-FK_j)\big]GWH_j \\ & + \sum_{j\in\{37,43\}\subset PSV} KLEVKK\ HVE_j\big[FK_j + TK(1-FK_j)\big]GWH_j \\ & + HVE_C\big[FK_C + (1-FK_C)\big]GWH_C + HVE_A\big[FK_A + (1-FK_A)\big]GWH_A \Big\} \end{aligned}$$

(2.16.63)
$$\begin{aligned} VKORR_{72} = \; & B_{72}\Big\{ \sum_{j\in PSV\setminus\{37,43,71\}} HVE_j\big[FK_j + TK(1-FK_j)\big]GWH_j \\ & + \sum_{j\in\{37,43\}\subset PSV} KLEVKK\ HVE_j\big[FK_j + TK(1-FK_j)\big]GWH_j \\ & + HVE_C\big[FK_C + (1-FK_C)\big]GWH_C + HVE_A\big[FK_A + (1-FK_A)\big]GWH_A \Big\} \end{aligned}$$

(2.16.64) $$VKORS_{710} = (VKORR_{70} + VKORR_{72})\frac{GWHX_{710}}{GWHX_{70} + GWHX_{710}}$$

(2.16.65) $$VKORS_{70} = VKORR_{70} + VKORR_{72} - VKORS_{710}$$

(2.16.66) $$YTV_{710} = (TVPX_{71} - TVPI_{71})\frac{GWHX_{710}}{GWHX_{70} + GWHX_{710}}$$

(2.16.67) $$YTV_{70} = TVPX_{71} - TVPI_{71} - YTV_{710}$$

(2.16.68)
$$VX_{70} = YTV_{70} + VKORS_{70} + [1 - \frac{(EE_{37} + EE_{43})(1 - KLEVKK) + (1 - TK)ETT}{GWHX_{70}}]GWHX_{70}B_{70} + GWH_{70}B_{70} + \sum_{k \in \{55,85\} \subset VA} BH_k ZZA_{70k} GWHX_{70} + (B_{70} - PGWH_I)GWH_I + GWHX_{70R}B_{70}$$

(2.16.69)
$$X_{70} = (1 + ZPXEL.0) + [1 - \frac{(EE_{37} + EE_{43})(1 - KLEVKK) + (1 - TK)ETT}{GWHX_{70}}]GWHX_{70}B_{70}.0 + GWH_{70}B_{70}.0 + \sum_{k \in \{55,85\} \subset VA} ZZA_{70k} GWHX_{70} + (B_{70}.0 - PGWH_I.0)GWH_I + GWHX_{70R}B_{70}.0$$

(2.16.70) $VX_{710} = YTV_{710} + VKORS_{710} + B_{710}\,GWHX_{710}$

(2.16.71) $X_{710} = (1 + ZPXEL.0)\,B_{70}.0\,GWHX_{710}$

New symbols

$VKORR_k$ = term correcting the value of gross production in the production sector k (*Production of Hydro-Power* when $k=70$ and *Transmission Services* when $k=72$) as a result of changes in the price discrimination coefficients.

$VKORS_j$ = the share of the correction term $VKORR_k$ distributed to production sector j.

$TVPI_{71}$ = net commodity taxes accrued on import of *Electricity (71)*.

$TVPX_{71}$ = net volume tax on the commodity *Electricity (71)* collected from producers.

YTV_j = net commodity taxes assigned to power producing sector j.

VX_j = gross production in power producing sector j measured in current net-seller prices.

X_j = gross production in power producing sector j measured in constant net-seller prices.

$PGWH_I$ = import price of electric power measured in Nkr/kWh.

$ZPXEL.0$ = indirect taxes on electricity per unit of production in the base year.

$GWHX_{70R}$ = residual equal to the statistical difference between the production figures in the National Accounts and the Energy Accounts, measured in GWh.

Gross production in the sectors producing transmission and distribution services of electric power

The gross production of transmission- and distribution services has been adjusted for changes in the average composition of firm and occasional power and average "using time" in the same way as for gross production of hydro- and gas power.

(2.16.72)
$$VX_{72} = [1 - \frac{(EE_{37} + EE_{43})(1 - KLEVKK) + (1 - TK)ETT}{GWHX_{72}}]GWHX_{72}B_{72} + \sum_{k \in \{55,85\} \subset VA} BH_k ZZA_{72k} GWHX_{72}$$

$$(2.16.73)\quad X_{72} = [1 - \frac{(EE_{37} + EE_{43})(1 - KLEVKK) + (1 - TK)ETT}{GWHX_{72}}]GWHX_{72}\, B_{72}\,.0 + \sum_{k \in \{55,85\} \subset \mathbf{VA}} ZZA_{72k} GWHX_{72}$$

$$(2.16.74)\quad VX_{73} = B_{73} GWHX_{73} + \sum_{k \in \{55,85\} \subset \mathbf{VA}} BH_k ZZA_{73k} GWHX_{73}$$

$$(2.16.75)\quad X_{73} = B_{73}.0\, GWHX_{73} + \sum_{k \in \{55,85\} \subset \mathbf{VA}} ZZA_{73k} GWHX_{73}$$

Production of other commodities in the power producing sectors

In the sectors producing (mainly) hydro- and gas power, there is also some production of *Construction (55)* and *Other Private Services (85).*

$$(2.16.76)\quad X_{ji} = ZZA_{ji} GWHX_j$$

$$j \in \{70,72,73\} \quad i \in \{55,85\} \subset \mathbf{VA}$$

New symbols

X_{ji} = gross production of commodity *i* by power producing sector *j* measured in constant seller prices.

Inputs in the power producing sectors

$$(2.16.77)\quad K_{i70} = \frac{ZZK_{i70}.0}{ZZK_{70}.0} ZZK_{70T} GWHX_{70PP} \quad i \in \{11,12,40,50\}$$

$$(2.16.78)\quad K_{ij} = ZZK_{ij} GWHX_j$$

$$i \in \{11,12,40,50\} \quad j \in \{710,72,73\}$$

$$(2.16.79)\quad K_{70} = ZZK_{70T}\, GWHX_{70PP}$$

$$(2.16.80)\quad K_j = ZZK_j\, GWHX_j \quad j \in \{710,72,73\}$$

$$(2.16.81)\quad L_{70} = ZZL_{70}\, GWHX_{70PP}$$

$$(2.16.82)\quad L_j = ZZL_j\, GWHX_j \quad j \in \{710,72,73\}$$

$$(2.16.83)\quad H_{70} = ZZH_{70}\, GWHX_{70PP} + ET_{70}$$

$$(2.16.84)\quad H_{710} = (ZZM_{710} + ZZG_{710} + ZZR_{710})\, GWHX_{710}$$

$$(2.16.85)\quad H_j = ZZM_j\, GWHX_j + ET_j \quad j \in \{72,73\}$$

$$(2.16.86)\quad M_j = H_j - F_j - ET_j, \quad j \in \{70,72,73\}$$

(2.16.87) $M_{710} = ZZM_{710}\, GWHX_{710}$

(2.16.88) $F_{70} = ZF_{70} X_{70}$

$F_j = 0 \quad j \in \{710,72,73\}$

(2.16.89) $VH_j = PM_{71} M_j + PF_{71} F_j + VET_j \quad j \in \{70,72,73\}$

(2.16.90) $VH_{710} = (PM_{710} ZZM_{710} + BH_{67} ZZG_{710} + BH_{69} ZZR_{710})\, GWHX_{710}$

New symbols

K_{ij} = input of real capital of type *i* in power producing sector *j* measured in constant prices.
K_j = input of real capital in power producing sector *j* measured in constant prices.
L_j = input of labour in power producing sector *j* measured in man hours.
VH_j = total material input of in power producing sector *j* measured in current purchaser prices.
H_j = total material input in power producing sector *j* measured in constant purchaser prices.
M_j = other material input in power producing sector *j* measured in constant net-purchaser prices.
F_j = input of fuels in power producing sector *j* measured in constant net-purchaser prices.
ZF_{70}= input of fuels per unit of production in *Production of Hydro-Power (70)* measured in constant prices.

Value added in constant and current prices

(2.16.91) $Y_j = VX_j - VH_j$

(2.16.92) $Q_j = X_j - H_j$

$j \in \{70,710,72,73\}$

New symbols

Y_j, Q_j = gross product (value added) in power producing sector *j* measured in current and constant prices, respectively.

Depreciation of real capital in constant prices

(2.16.93) $$FD_{70} = \left\{ \sum_{i \in \{11,12,40,50\}} \frac{ZZK_{i70}.0}{ZZK_{70}.0} ZZK_{70T} DPR_{i70} \right\} GWHX_{70PP}$$

(2.16.94) $$FD_j = \left\{ \sum_{i \in \{11,12,40,50\}} ZZK_{ij} DPR_{ij} \right\} GWHX_j \quad j \in \{710,72,73\}$$

New symbols

FD_j = depreciation of real capital in power producing sector *j* measured in constant prices.

Net sectorial taxes

(2.16.95) $YTS_{70} = ZZYTS_{70} GWH_{70PP}$

(2.16.96) $YTS_j = ZZYTS_j GWHX_j \quad j \in \{710,72,73\}$

New symbols
YTS_j= et tax on output in power producing sector *j* measured in current prices.

The following equations concern variables at the aggregate national account level:

Investment, capital depreciation and real capital in *Production of Electricity (71)*

(2.16.97)
$$FD_{i\,71} = \frac{ZZK_{i70}.0}{ZZK_{70}.0} ZZK_{70T} DPR_{i70} GWHX_{70PP} + \sum_{j\in\{710,72,73\}} ZZK_{ij} DPR_{ij} GWHX_j$$

$i \in \{11,12,40,50\}$

(2.16.98) $K_{i71} = \sum_{j\in\{70,710,72,73\}} K_{ij} \quad i \in \{11,12,40,50\}$

(2.16.99) $K_{71} = \sum_{j\in\{11,12,40,50\}} K_{i71}$

(2.16.100) $JK_{i\,71} = K_{i\,71} + FD_{i\,71} - K_{i\,71}(-1) \quad i \in \{11,12,40,50\}$

(2.16.101) $JKS_{71} = \sum_{j\in\{11,12,40,50\}} JK_{i71}$

(2.16.102) $VJKS_{71} = \sum_{i\in\{11,12,40,50\}} JK_{i71} PJ_i$

(2.16.103)
$$PK_{71} = \frac{\sum_{j\in\{70,710,72,73\}} PK_j K_j}{\sum_{j\in\{70,710,72,73\}} K_j}$$

New symbols
$FD_{i\,71}$ = depreciation of real capital of type *i* in *Production of Electricity* (71) measured in constant prices.
$JK_{i\,71}$ = gross investment in real capital of type *i* in *Production of Electricity* (71) measured in constant prices.
JKS_{71} = gross investment in real capital in *Production of Electricity* (71) measured in constant purchaser prices.
$VJKS_{71}$ = gross investment in real capital in *Production of Electricity* (71) measured in current purchaser prices.

Gross production and material inputs in *Production of Electricity (71)*

(2.16.104) $VX_{71} = \sum_{j\in\{70,710,72,73\}} VX_j$

(2.16.105) $X_{71} = \sum_{j\in\{70,710,72,73\}} X_j$

(2.16.106) $M_{71} = \sum_{j\in\{70,710,72,73\}} M_j$

(2.16.107) $E_{71} = \sum_{j\in\{70,72,73\}} ET_j$

(2.16.108) $F_{71} = F_{70}$

(2.16.109) $H_{71} = M_{71} + E_{71} + F_{71} + (ZZG_{710} + ZZR_{710})GWHX_{710}$

(2.16.110) $$\begin{aligned} VH_{71} &= PM_{71}M_{71} + PE_{71}E_{71} + PF_{71}F_{71} \\ &+ (BH_{67}ZZG_{710} + BH_{69}ZZR_{710})GWHX_{710} \end{aligned}$$

(2.16.111) $PU_{71} = \dfrac{PE_{71}E_{71} + PF_{71}F_{71}}{E_{71} + F_{71}}$

(2.16.112) $PE_{71} = \dfrac{\sum_{j\in\{70,72,73\}} VET_j}{\sum_{j\in\{70,72,73\}} ET_j}$

New symbols
PU_{71} = net-purchaser price index of use of energy in *Production of Electricity (71).*
PE_{71} = net-purchaser price index of use/loss of electricity in *Production of Electricity (71).*

Employment and wage payment in *Production of Electricity (71)*

(2.16.113) $L_{71} = \sum_{j\in\{70,710,72,73\}} L_j$

(2.16.114) $WW_{71} = \dfrac{\sum_{j\in\{70,710,72,73\}} L_j \ PL_j.0}{\left(1+\tau_{71}^{YWT}TF_{71}\right)L_{71}} \dfrac{PL_{71}}{PL_{71}.0}$

New symbols
L_{71} = input of labour in *Production of Electricity (71)* measured in man hours.
WW_{71} = wage per hour to wage earners net of social taxes in *Production of Electricity (71)* in current prices.
τ_{71}^{YWT} = base year coefficient for the rate of employers' contribution to social sequrity and National Insurance in *Production of Electricity (71)* in current prices.
TF_{71} = shift variable for change in employers' contribution to social sequrity and National Insurance in *Production of Electricity (71)* in current prices.

Export, import and import duty

(2.16.115) $A_{71} = \frac{GWH_A}{GWH_A.0} A_{71}.0 \qquad 71 \in \mathbf{VA}$

(2.16.116) $I_{71} = \frac{GWH_I}{GWH_I.0} I_{71}.0 \qquad 71 \in \mathbf{VA}$

(2.16.117) $TVPI_I = TVE_I HVI_{70XX} GWH_I$

New symbols

HVI_{70XX} = base year tax rate on import of electricity measured in Nkr/kWh.
TVE_I = relative change in the tax rate on import of electricity.
A_{71} = export of *Electricity (71)* measured in constant purchaser prices.
I_{71} = import of *Electricity (71)* measured in constant prices c.i.f. (basic value exclusive of customs).

Export share of electricity

The export share of electricity is computed as the ratio between the exports of electricity (commodity 71) measured in constant prices and the gross production of electricity measured in constant basic prices. The latter is obtained by subtracting indirect taxes and production of other commodities from gross production measured in constant seller prices in production sector 71.

(2.16.118) $MA_{71} = \frac{A_{71}}{X_{71} - \psi}$

where

$$\psi = ZPXEL.0\left[1 - \frac{\left((EE_{37} + EE_{43})(1 - KLEVKK) + (1 - TK)ETT\right)}{GWHX_{70}}\right] GWHX_{70} B_{70}.0$$
$$+ZPXEL.0\ GWHX_{710} B_{70}.0 + \sum_{j \in \{70,72,73\}} \left(ZZA_{j55} + ZZA_{j85}\right) GWHX_j$$

$71 \in \mathbf{VA}$

New symbols

MA_{71} = the ratio between export and domestic production of electricity adjusted for re-export.

Basic price indices of deliveries of electricity to the domestic market

In words, the price index is computed as the ratio between the current and constant price value of gross production minus indirect taxes, production of other commodities and exports.

(2.16.119) $$BH_{71} = \frac{VX_{71} - YTV_{70} - YTV_{710} - PA_{71}A_{71}}{X_{71} - \psi - A_{71}} - \frac{\sum_{j\in\{70,72,73\}} \left(BH_{55}ZZA_{j55} + BH_{85}ZZA_{j85}\right) GWHX_j}{X_{71} - \psi - A_{71}}$$

where ψ *is defined as in* (2.16.118)

$71 \in \mathbf{VA}$

The model also computes the weighted average of the basic prices of deliveries to the domestic market of all commodities produced by the National Account sector *Production of Electricity (71)*. In words, this price index is computed as the ratio between the current and fixed price value of gross production minus indirect taxes and exports.

(2.16.120) $$BHS_{71} = \frac{VX_{71} - YTV_{70} - YTV_{710} - PA_{71}A_{71}}{X_{71} - \psi - A_{71}}$$

where ψ *is defined as in* (2.16.118)

$71 \in \mathbf{PS}$

New symbols

BH_{71} = basic price index for deliveries of *Electricity (71)* to the domestic market.

BHS_{71} = weighted basic price index for deliveries to the domestic market of all commodities produced by the production sector *Production of Electricity (71)*.

Indexation of electricity prices

(2.16.121) $$PE_j = \frac{PGWH_j}{PGWH_j.0} \quad j \in \mathbf{PSV}\backslash\{71\}$$

(2.16.122) $$PC_{12} = \frac{PGWH_C}{PGWH_C.0} \quad 12 \in \mathbf{CP}$$

(2.16.123) $$PA_{71} = \frac{PGWH_A}{PGWH_A.0} \quad 71 \in \mathbf{VA}$$

(2.16.124) $$PI_{71} = \frac{PGWH_I}{PGWH_I.0} \quad 71 \in \mathbf{VA}$$

New symbols

PE_j = net-purchaser price of input of electricity used in production sector j.

PC_{12} = purchaser price index of private consumption of *Electricity (12)*.

PA_{71} = purchaser export price index of *Electricity (71)* f.o.b.

PI_{71} = import price c.i.f. of *Electricity (71)*.

RECURSIVE CALCULATIONS

2.17 Specific and general commodity taxes

Revenue from indirect taxes

(2.17.1)
$$TVPV_i = \Big\{ \sum_{j\in\mathbf{PSV}} HTPV_{ij}\lambda_{ij}^{M}\big[(1-\lambda_{ij}^{HI}DI_i)BH_i + \lambda_{ij}^{HI}DI_iBI_i\big]M_j + \sum_{j\in\mathbf{CP}} HTPV_{ij}\lambda_{ij}^{C}\big[(1-\lambda_{ij}^{CI}DI_i)BH_i + \lambda_{ij}^{CI}DI_iBI_i\big](C_j - CK_j) + \sum_{j\in\mathbf{JA}} HTPV_{ij}\lambda_{ij}^{J}\big[(1-\lambda_{ij}^{JI}DI_i)BH_i + \lambda_{ij}^{JI}DI_iBI_i\big]J_j + \sum_{j\in\mathbf{VA}} HTPV_{ij}\lambda_{ij}^{A}PA_jA_j \Big\} TVP_i$$

(2.17.2)
$$TVVV_i = \Big\{ \sum_{j\in\mathbf{PSV}} HTVV_{ij}\lambda_{ij}^{M}\big[(1-\lambda_{ij}^{HI}DI_i)BH_i + \lambda_{ij}^{HI}DI_iBI_i\big]M_j + \sum_{j\in\mathbf{CP}} HTVV_{ij}\lambda_{ij}^{C}\big[(1-\lambda_{ij}^{CI}DI_i)BH_i + \lambda_{ij}^{CI}DI_iBI_i\big](C_j - CK_j) + \sum_{j\in\mathbf{VA}} HTVV_{ij}\lambda_{ij}^{A}PA_jA_j \Big\} TVV_i$$

(2.17.3)
$$TVPX_i = \Big\{ \sum_{j\in\mathbf{PSV}} HTPX_{ij}\lambda_{ij}^{M}M_j + \sum_{j\in\mathbf{CP}} HTPX_{ij}\lambda_{ij}^{C}(C_j - CK_j) \Big\} TPX_i$$

(2.17.4)
$$TVVX_i = \Big\{ \sum_{j\in\mathbf{PSV}} HTVX_{ij}\lambda_{ij}^{M}M_j + \sum_{j\in\mathbf{PSV}} HTVV_{ij}\lambda_{ij}^{F}F_j + \sum_{j\in\mathbf{CP}} HTVX_{ij}\lambda_{ij}^{C}(C_j - CK_j) \Big\} TVX_i$$

$i \in \mathbf{VA}\backslash\{71\}$

Symbols

TPV_i = change in the *ad valorem* tax rate on commodity *i* collected from producers.
TPX_i = change in the volume tax rate on commodity *i* collected from producers.
TVV_i = change in the *ad valorem* tax rate on commodity *i* collected from wholesale and retail trade.
TVX_i = change in volume tax rate on commodity *i* collected from wholesale and retail trade.
$TVPV_i$ = net *ad valorem* taxes on commodity *i* collected from producers.
$TVPX_i$ = net volume taxes on commodity *i* collected from producers.
$TVVV_i$ = net *ad valorem* taxes on commodity *i* collected from wholesale and retail trade.
$TVVX_i$ = net volume taxes on commodity *i* collected from wholesale and retail trade.
$HTPV_{ij}$ = base year net *ad valorem* tax rates collected from producers. $HTPV_{ij}$ is calculated as net *ad valorem* taxes on commodity *i* delivered to activity *j* relative to the basic value of the deliveries.

$HTPX_{ij}$ = base year volume tax rates collected from producers. $HTPX_{ij}$ is calculated as net volume taxes on commodity *i* delivered to activity *j* relative to the basic value of the deliveries.

$HTVV_{ij}$ = base year value added tax rate collected from wholesale and retail trade. $HTVV_{ij}$ is calculated as net *ad valorem* taxes on commodity *i* delivered to activity *j* relative to the basic value of the deliveries.

$HTVX_{ij}$ = base year volume tax rate collected from wholesale and retail trade. $HTVX_i$ is calculated as net volume taxes on commodity *i* delivered to activity *j* relative to the basic value of the deliveries.

BH_i = basic price index for the domestically produced commodity *i*.

BI_i = price index of import activity *i*, basic value including customs duty.

DI_i = change in the import share of commodity *i*.

M_j = other material input in input activity *j* in constant net-purchaser prices.

C_j = private consumption sector *j* in constant purchaser prices.

CK_j = net purchase of second hand capital in consumption sector *j* in constant purchaser prices.

PA_j = purchaser price index of export activity *j*, f.o.b.

A_j = export activity *j* in constant purchaser prices.

J_j = new investment in capital activity *j* in constant purchaser prices.

λ_{ij}^{M} = the ratio between input of commodity *i* measured in basic value and the total value of other material inputs in sector *j* measured in net purchaser prices (net refundable VAT) in the base year.

λ_{ij}^{HI} = sector specific import share, the ratio between imports of commodity *i* measured in basic value delivered to other material input in sector *j* and the total deliveries of commodity *i* measured in basic value to sector *j* in the base year.

λ_{ij}^{C} = the ratio between input of commodity *i* measured in basic value and the total value of private consumption of consumption sector *j* measured in purchaser prices in the base year.

λ_{ij}^{CI} = activity specific import share; the ratio between imports of commodity *i* measured in basic value delivered to consumption sector *j* and the total deliveries of commodity *i* measured in basic value to sector *j* in the base year.

λ_{ij}^{J} = the ratio between input of commodity *i* measured in basic value and the total value of investment of activity *j* measured in purchaser prices in the base year.

λ_{ij}^{JI} = activity specific import share; the ratio between imports of commodity *i* measured in basic value delivered to investment activity *j* and the total deliveries of commodity *i* measured in basic value to activity *j* in the base year.

λ_{ij}^{A} = the ratio between the content of export activity *i* measured in basic value and the total value of export activity *j* in the base year.

λ_{ij}^{F} = the ratio between input of commodity *i* measured in basic value and the total value of input of fuels in sector *j* measured in net purchaser prices (net refundable VAT) in the base year.

Note that $TVPX_{71}$, which is net volume taxes on *Electricity (71)*, is given a special treatment in the model block for electricity (see Section 2.16).

Accrued non-refunded value added taxes

$$(2.17.5)\quad TMT_i = \Big\{ \sum_{j\in \mathbf{PSV}} HTM_{ij}^{H}\big[(1+HTVV_{ij}TVV_i + HTPV_{ij}TPV_i)\big[(1-\lambda_{ij}^{HI}DI_i)BH_i + \lambda_{ij}^{HI}DI_iBI_i\big] + HTVX_{ij}TVX_i + HTPX_{ij}TPX_i\big](\lambda_{ij}^{M}M_j + \lambda_{ij}^{F}F_j)$$
$$+ \sum_{j\in \mathbf{CP}} HTM_{ij}^{C}\big[(1+HTVV_{ij}TVV_i + HTPV_{ij}TPV_i)\big[(1-\lambda_{ij}^{CI}DI_i)BH_i + \lambda_{ij}^{CI}DI_iBI_i\big] + HTVX_{ij}TVX_i + HTPX_{ij}TPX_i\big]\lambda_{ij}^{C}(C_j - CK_j)$$
$$+ \sum_{j\in \mathbf{JA}} HTM_{ij}^{J}\big[(1+HTVV_{ij}TVV_i + HTPV_{ij}TPV_i)\big[(1-\lambda_{ij}^{JI}DI_i)BH_i + \lambda_{ij}^{JI}DI_iBI_i\big] + HTVX_{ij}TVX_i + HTPX_{ij}TPX_i\big]\lambda_{ij}^{J}J_j\Big\}TM_i$$

$i \in \mathbf{VA} \setminus \{71\}$

$$(2.17.6)\quad XMT_i = \sum_{j\in \mathbf{PSV}} HTM_{ij}^{H}(1+HTVV_{ij}+HTPV_{ij}+HTVX_{ij}+HTPX_{ij})(\lambda_{ij}^{M}M_j + \lambda_{ij}^{E}E_j + \lambda_{ij}^{F}F_j) + \sum_{j\in \mathbf{CP}} HTM_{ij}^{C}(1+HTVV_{ij}+HTPV_{ij}+HTVX_{ij} + HTPX_{ij})\lambda_{ij}^{C}(C_j - CK_j) + \sum_{j\in \mathbf{JA}} HTM_{ij}^{J}(1+HTVV_{ij}+HTPV_{ij} + HTVX_{ij}+HTPX_{ij})\lambda_{ij}^{J}J_j$$

$i \in \mathbf{VA}$

New symbols

TM_i = change in the VAT rate on commodity i.
TMT_i = VAT accrued on commodity i.
XMT_i = constant-price index of VAT accrued on commodity i.
HTM_{ij}^{H} = base year VAT rate on commodity i when it is used as an input in input activity j.
HTM_{ij}^{C} = base year VAT rate on commodity i when it is used in consumption activity j.
HTM_{ij}^{J} = base year VAT rate on commodity i when it is used in investment activity j.

Investment levy

$$(2.17.7)\quad TIT_i = HSJ_iJ_i\Big\{\sum_{j\in \mathbf{VA}}(1+HTM_{ij}^{J}TM_j)\big[(1+HTVV_{ij}TVV_j + HTPV_{ij}TPV_j)\big[(1-\lambda_{ij}^{JI}DI_j)BH_j + \lambda_{ij}^{JI}DI_jBI_j\big] + HTVX_{ij}TVX_j + HTPX_{ij}TPX_j\big]\lambda_{ij}^{J}\Big\}TPV_{81}$$

$i \in \mathbf{JA}$

(2.17.8) $$XIT_i = HSJ_iJ_i\left[\sum_{j\in \mathbf{VA}}(1+HTM_{ij}^J)(1+HTVV_{ij}+HTPV_{ij}+HTVX_{ij}+HTPX_{ij})\lambda_{ij}^J\right]$$

$i \in \mathbf{JA}$

New symbols
TIT_i = accrued investment levy on investment activity *i*.
XIT_i = fixed-price index of accrued investment levy on investment activity *i*.
HSJ_i= rate of investment levy on investment activity *i*.

Tax on import

(2.17.9) $$TVPI_i = (HPVB_iBI_iTPV_i + HPXB_iTPX_i)\lambda_{ii}^I I_i \qquad i \in \mathbf{VA}\setminus\{02,34\}$$

(2.17.10) $$TVPI_i = TVPX_i + TVPV_i \qquad i \in \{02,34\}$$

New symbols
$TVPI_i$ = *ad valorem* tax on import of commodity *i*.
$HPVB_i$ = base year *ad valorem* excise tax rate on commodity *i*, collected from producers.
$HPXB_i$ = base year volume excise tax rate on commodity *i*, collected from producers.
λ_{ii}^I = coefficient calculated as import activity *i* in basic value over import activity *i* in c.i.f. value.

2.18 Production and income in tax collecting sectors

(2.18.1) $$Q_{51} = \sum_{i\in \mathbf{VA}} HTB_i\lambda_{ii}^I I_i$$

(2.18.2) $$Y_{51} = \sum_{i\in \mathbf{VA}} HTB_i\lambda_{ii}^I I_iTT_iPI_i$$

$51 \in \mathbf{KORR}$

Symbols
Q_j, Y_j= gross product (value added) in production sector *j* in constant and current prices, respectively.
TT_i = change in the tariff rate on commodity *i*.
I_i = import activity *i* measured in constant prices, c.i.f.
PI_i = price index of import activity *i* c.i.f..
HTB_i = base year tariff rate calculated as total customs duty accrued on commodity *i* relative to the basic value of the commodity.
λ_{ii}^I = coefficient calculated as import activity *i* in basic value over import activity *i* in c.i.f. value.

Production sector 51 is a correction sector collecting customs duty. The production in this sector is calculated as the total income from customs duty paid on the import activities. Customs duty is treated as a volume tax since the tariff rate is multiplied by the volume of imports measured by the value of imports in constant basic prices. Note that basic prices on imports include customs duty.

(2.18.3) $$Q_{54} = \sum_{i \in \mathbf{JA}} XIT_i$$

(2.18.4) $$Y_{54} = \sum_{i \in \mathbf{JA}} TIT_i$$

$54 \in \mathbf{KORR}$

New symbols
XIT_i = fixed-price index of accrued investment levy on investment activity *i*.
TIT_i = accrued investment levy on investment activity *i* in current prices.

Production sector 54 is a correction sector collecting investment levy. The production in this sector is calculated as the total income from investment levies on the investment activities.

(2.18.5) $$Q_{57} = \sum_{i \in \mathbf{VA}} (HPVB_i + HPXB_i)\lambda^I_{ii} I_i$$

(2.18.6) $$Y_{57} = \sum_{i \in \mathbf{VA}} TVPI_i$$

$57 \in \mathbf{KORR}$

New symbols
$HPVB_i$ = base year *ad valorem* excise tax rate on commodity *i* collected from producers.
$HPXB_i$ = base year volume excise tax rate on commodity *i* collected from producers.
$TVPI_i$ = *ad valorem* excise tax rate on import of commodity *i*.

Production sector 57 is a correction sector collecting excise taxes on imports. The production in this sector is calculated as the total income from these taxes.

(2.18.7) $$Q_{59} = \sum_{i \in \mathbf{VA}} XMT_i$$

(2.18.8) $$Y_{59} = \sum_{i \in \mathbf{VA}} TMT_i$$

$59 \in \mathbf{KORR}$

New symbols
XMT_i = fixed price index of VAT accrued on commodity *i*.
TMT_i = VAT accrued on commodity *i*.

Production sector 59 is a correction sector collecting VAT. The production in this sector is calculated as the total income from non-refunded VAT paid on the commodities.

Common for the correction sectors is that the gross product consists of net indirect taxes accrued on commodities only. Thus, gross production in seller prices is equal to value added. Gross production measured in basic prices would be zero. Accordingly there is no factor input and no factor income.

(2.18.9) $$YTS_j = 0$$

(2.18.10) $YTV_j = Y_j$

(2.18.11) $YT_j = Y_j$

(2.18.12) $YE_j = YF_j = 0$

(2.18.13) $H_j = VH_j = 0$

(2.18.14) $X_j = Q_j$

(2.18.15) $VX_j = Y_j$

(2.18.16) $FD_j = YD_j = 0$

$j \in \{51,54,57,59\} \subset \mathbf{PSK}$

New symbols
YTS_j = net taxes levied on output from production sector *j*.
YTV_j = net commodity tax assigned to production sector *j*.
YE_j = operating surplus in production sector *j* in current prices.
YF_j = factor income production sector *j* in current prices.
H_j, VH_j = total material input in production sector *j* in constant and current purchaser prices, respectively.
X_j = gross production in production sector *j* in constant net-seller prices.
VX_J = gross production in production sector *j* in current purchaser prices.
FD_j, VD_j = capital depreciation in production sector *j* in constant and current prices, respectively.

2.19 Commodity taxes by type

Indirect tax by type

Value added tax, customs and tax on new investment:

(2.19.1) $YTART_{225} = Y_{59}$

(2.19.2) $YTART_{400} = Y_{51}$

(2.19.3) $YTART_{231} = Y_{54}$

Symbols
$YTART_{225}$, Y_{59} = value added tax (VAT).
$YTART_{400}$, Y_{51} = customs.
$YTART_{231}$, Y_{54} = net indirect tax on new investment.

The remaining indirect taxes are given by the following equations:

(2.19.4) $$YTART_l = \sum_{i \in \mathbf{VA}} \left\{ t_{il}^{PV} \frac{TVPV_i}{TPV_i} \right\} TART_l \, TAXJUST \qquad l \in \mathbf{PV} \setminus \{231\}$$

(2.19.5) $$YTART_l = \sum_{i \in \mathbf{VA}} \left\{ t_{il}^{VV} \frac{TVVV_i}{TVV_i} \right\} TART_l \, TAXJUST \qquad l \in \mathbf{VV}$$

(2.19.6) $$YTART_l = \sum_{i \in \mathbf{VA}} \left\{ t_{il}^{PX} \frac{TVPX_i}{TPX_i} \right\} TART_l \, TAXJUST \qquad l \in \mathbf{PX}$$

(2.19.7) $$YTART_l = \sum_{i \in \mathbf{VA}} \left\{ t_{il}^{VX} \frac{TVVX_i}{TVX_i} \right\} TART_l \, TAXJUST \qquad l \in \mathbf{VX}$$

(2.19.8) $$YTART_l = \left\{ \sum_{j \in \mathbf{PS} \setminus \{71\}} t_{jl}^{SV} BHS_j X_j + \left[ZZYTS_{70}.0 \frac{B_{70}}{B_{70}.0} GWHX_{70PP} + \sum_{i \in \{72,73\}} ZZYTS_i.0 \frac{B_i}{B_i.0} GWHX_i \right] \frac{t_{71\,l}^{SV}}{TSV_{71}.0} \right\} TART_l \, TAXJUST + \theta_l$$

$$\text{where } \theta_l = \begin{cases} ZZAVG_{710} GWHX_{710} TAXJUST \text{ for } l = 577 \\ 0 \text{ for } l \neq 577 \end{cases}$$

$l \in \mathbf{SA} \cup \mathbf{SU}$

Symbols

$YTART_l$ = net indirect taxes, type l.
$TVPV_i$ = net *ad valorem* tax on commodity i collected from producers.
$TVVV_i$ = net *ad valorem* tax on commodity i collected from wholesale and retail trade.
$TVPX_i$ = net volume taxes on commodity i collected from producers.
$TVVX_i$ = net volume taxes on commodity i collected from wholesale and retail trade.
t_{il}^{θ} = base year tax coefficient calculated as accrued commodity tax/subsidy of type l on commodity i divided by net commodity tax on commodity i ($\theta = PV, VV, PX, VX$).
X_j = gross production in production sector j in constant net-seller prices.
BHS_j = weighted basic price index of commodities delivered from sector j.
$TART_l$ = change in indirect tax or subsidy, type l.
$TAXJUST$ = proportional factor of adjustment of indirect taxes or subsidies.
$YTART_{71j}$ = net indirect taxes, type j, in *Production of Electricity (71)*.
$ZZAVG_{710}$ = net sector taxes, exclusive of CO_2 taxes, in *Production of Gas-Power (710)* measured in (Nkr/kWh)..
$ZZYTS_i.0$ = net sector taxes per unit of gross product in power producing sector i in Nkr/kWh (*Production of Hydro-Power (70), Production of Gas-Power (710), Transmission Services (72)* and *Distribution Services (73)*, respectively).
B_i = basic price of power, type i.
$GWHX_{70PP}$ = average (over years) production capacity in the hydro power system measured in GWh.
$GWHX_i$ = (*de facto*) production in power producing sector i measured in GWh.

$TSV_{71}.0$ = net sectorial tax rate (volume) in *Production of Electricity (70)* in the base year, constructed as a weighted average of the various indirect taxes in the sector.

2.20 Gross production

Gross product by production sector/activity

(2.20.1) $VXB_j = X_j \sum_{i \in \mathbf{VA}} \lambda_{ij}^X BS_i \qquad j \in \mathbf{PA} \setminus \{\{71\} \cup \mathbf{PO}\}$

(2.20.2) $VXB_j = XG_j \sum_{i \in \mathbf{VA}} \lambda_{ij}^X BS_i \qquad j \in \mathbf{PO}$

(2.20.3) $VXB_{15} = VXB_{1516} + VXB_{1517} + VXB_{1518}$

(2.20.4) $VXB_{40} = VXB_{4041} + VXB_{4042}$

(2.20.5) $VXB_{45} = VXB_{4546} + VXB_{4547}$

(2.20.6) $VXB_{50} = VXB_{5045} + VXB_{5048} + VXB_{5049}$

(2.20.7) $VXB_{63} = VXB_{6363} + VXB_{6389}$

(2.20.8) $VXB_{64} = VXB_{6447} + VXB_{6466} + VXB_{6467} + VXB_{6469}$

(2.20.9) $VXB_{71} = VX_{71} - YTV_{71}$

Symbols

VXB_j = gross production in production sector\activity j in current basic prices.
X_j = gross production in production sector\activity j in constant net seller prices.
XG_j = commodities and services provided in exchange of a fee in government production sector j in constant prices.
VX_j = gross production in production sector j in current producer prices.
YTV_j = net commodity tax assigned to production sector j.
BS_i = average basic price of commodity i from domestic producers.
λ_{ij}^X = activity share coefficient; the share of the delivery of commodity i, measured in basic value, in the total deliveries from production activity j, measured in net seller value, in the base year.

(2.20.10) $VX_j = VXB_j + YTV_j \qquad j \in \mathbf{PS} \setminus \{\{71\} \cup \mathbf{PO}\}$

(2.20.11) $VXG_j = VXB_j \qquad j \in \mathbf{PO}$

New symbols

VXG_j = commodities and services provided in exchange of a fee in government production sector j in current prices.

Gross production in *Production of Electricity (71)*, VX_{71}, is determined in the model block for electricity (see Section 2.16).

2.21 The components of gross product

Gross product in constant prices

(2.21.1) $Q_j = X_j - H_j \qquad j \in \mathbf{PP}$

(2.21.2) $Q_j = OMEGA_j PL_j.0\ L_j + FD_j + TSV_j H_j \qquad j \in \mathbf{PO}$

Symbols

Q_j = gross *product* (value added) in production sector *j* in constant prices.
X_j = gross production in production sector *j* in constant net-seller prices.
H_j = total material input in production sector *j* measured in constant purchaser prices.
$PL_j.0$ = wage cost per hour in production sector *j* in the base year.
L_j = labour input in production sector *j*.
FD_j = capital depreciation in production sector *j* in constant prices.
TSV_j = net commodity tax rate in production sector *j*.
$OMEGA_j$ = productivity index in the public sector.

Gross product in current prices

(2.21.3) $Y_j = VX_j - VH_j \qquad j \in \mathbf{PP}$

(2.21.4) $Y_j = YW_j + YD_j + YT_j \qquad j \in \mathbf{PO}$

New symbols

Y_j = gross *product* in production sector *j* in current prices.
VX_j = gross production in production sector *j* in current producer prices.
YW_j = total *wage cost* in production sector *j* in current prices.
VH_j = total material input in production sector *j* in current purchaser prices.
YD_j = capital depreciation in production sector *j* in current prices.
YT_j = net indirect tax levied on production sector *j* in current prices.

Capital depreciation is determined in Section 2.14.

Commodity taxes

(2.21.5) $YTV_j = \sum_{i \in \mathbf{VA}} HTF_{ij}(TVPV_i + TVPX_i - TVPI_i)$

$j \in \mathbf{PS} \setminus \{81\}$

(2.21.6) $YTV_{81} = \sum_{i \in \mathbf{VA}} (TVVV_i + TVVX_i)$

New symbols

YTV_j = net commodity taxes assigned to production sector *j* (production sector 81 is *Wholesale and Retail Trade*).

HTF_{ij} = base year coefficient calculated as the value of net commodity taxes accrued on production of commodity *i* in production sector *j* relative to the total commodity taxes accrued on the Norwegian production of commodity *i*.
$TVPV_i$ = net *ad valorem* taxes on commodity *i* collected from producers.
$TVPX_i$ = net volume taxes on commodity *i* collected from producers.
$TVPI_i$ = net commodity taxes accrued on import of commodity *i*.
$TVVV_i$ = net *ad valorem* taxes on commodity *i* collected from wholesale and retail trade.
$TVVX_i$ = net volume taxes on commodity *i* collected from wholesale and retail trade.

Taxes levied on production sectors

(2.21.7) $YTS_j = BHS_j TSV_j X_j \qquad j \in \mathbf{PP}$

(2.21.8) $YTS_j = BHS_j TSV_j H_j \qquad j \in \mathbf{PO}$

New symbols
YTS_j = net taxes levied on output from production sector *j*.
BHS_j = weighted basic price index for commodities delivered from production sector *j*.

Net indirect taxes

(2.21.9) $YT_j = YTS_j + YTV_j \qquad j \in \mathbf{PS} \setminus \{71\}$

New symbols
YT_j = net indirect taxes levied on production sector *j*.

Factor income by production sector (YF_j)

(2.21.10) $YF_j = Y_j - YD_j - YT_j \qquad j \in \mathbf{PP}$

(2.21.11) $YF_j = YW_j \qquad j \in \mathbf{PO}$

Wage cost by production sector

(2.21.12) $YWW_j = LW_j WW_j \qquad j \in \mathbf{PS} \setminus \{89\}$

(2.21.13) $YWW_{89} = 0$

(2.21.14) $YWT_j = \tau_j^{YWT} TF_j WW_j \qquad j \in \mathbf{PS}$

(2.21.15) $YW_j = YWW_j + YWT_j \qquad j \in \mathbf{PS}$

New symbols
YWW_j = wage payments and salaries in production sector *j* in current prices.
LW_j = number of hours worked in production sector *j* by wage earners.
WW_j = wage per hour in production sector net of social taxes.
YWT_j = employers' contribution to social security and the National Insuranse in production sector *j* in current prices.
TF_j = shift variable for changes in YWT_j.

τ_j^{YWT} = sector specific base year coefficient for the rate of employers' contribution to the National Insuranse.

YW_j = total *wage cost* in production sector *j* in current prices.

Operating surplus by production sector *(YE_j)*

(2.21.16) $YE_j = YF_j - YW_j \qquad j \in \mathbf{PP}$

(2.21.17) $YE_j = 0 \qquad j \in \mathbf{PO}$

2.22 Gross real investment and capital stock by production sector

(2.22.1) $JKS_j = \sum_{k \in \mathbf{JR}} \{\kappa_{kj}(DEP_{kj}\delta_{kj}K_j + K_j - K_j(-1))\} \qquad j \in \mathbf{PP}\backslash\{64,65,71,89\}$

(2.22.2) $JKS_{89} = 0$

Symbols

JKS_j = gross real investment in production sector *j* in constant purchaser prices.

K_j = real capital stock by the end of the year in production sector *j* measured in net-purchaser prices.

DEP_{kj} = shift parameter related to the rate of physical depreciation of the stock of capital of type k in production sector *j*.

δ_{kj} = rate of physical depreciation of the stock of capital type *k* in production sector *j*.

κ_{kj} = capital structure coefficient; content of capital type *k* in in the total capital stock in production sector *j*.

JKS_{64} and JKS_{65} are given special treatment in Eqs. (2.8.13) and (2.8.14).
JKS_{71} is determined in the model block for electricity (see Section 2.16).

(2.22.3) $VJKS_j = \sum_{k \in \mathbf{JR}} \{\kappa_{kj}(DEP_{kj}\delta_{kj}K_j + K_j - K_j(-1))PJ_k\} \qquad j \in \mathbf{PS}\backslash\{64,65,71,89,92S\}$

(2.22.4) $VJKS_j = \sum_{k \in \mathbf{JA}} JK_{kj}PJ_k \qquad j = 64,65$

(2.22.5) $VJKS_{89} = 0$

(2.22.6) $VJKS_{92S} = 0$

New symbols

$VJKS_j$ = gross real investment in production sector *j* in current purchaser prices.

PJ_k = purchaser price index of investment activity *k*.

JK_{kj} = gross real investment in capital activity *k* in production sector *j* in constant purchaser prices.

$VJKS_{71}$ is determined in the model block for electricity (see Section 2.16).

(2.22.7) $$VK_j = \sum_{k \in \mathbf{JR}} (\kappa_{kj} PJ_k) K_j \qquad j \in \mathbf{PS} \setminus \{64,65,71\}$$

(2.22.8) $$VK_j = \sum_{k \in \mathbf{JR}} K_{kj} PJ_k \qquad j = 64,65$$

(2.22.9) $$VK_{71} = (K_{11\,71} + K_{12\,71}) PJ_{10} + K_{40\,71} PJ_{40} + K_{50\,71} PJ_{50}$$

New symbols
VK_j = real capital stock in production sector j measured in current prices.
K_{kj} = real capital of type k in production sector j in constant prices.

2.23 Employment by sector

The number of employed persons follows by dividing the working hours by the average number of working hours per employed person. The latter ratio is exogenous and sector specific. It also depends on the composition of the employment in the sector with respect to wage earners and self-employed. The default value of this ratio is equal to the base year value, but it can be used in studies of the effects of changes in the working hours.

(2.23.1) $$NW_j = \frac{LW_j}{HW_j}$$

(2.23.2) $$NS_j = \frac{LS_j}{HS_j}$$

(2.23.3) $$NT_j = NW_j + NS_j$$

$j \in \mathbf{PS}$

Symbols
NW_j = number of wage earners in production sector j.
NS_j = number of self-employed in production sector j.
NT_j = number of employed persons in production sector j.
HW_j = average number of working hours per wage earner in production sector j.
HS_j = average number of working hours per self-employed in production sector j.
LW_j = employment measured in hours per year of wage earners in production sector j.
LS_j = employment measured in hours per year of self-employed in production sector j.

2.24 Import and deliveries for final use

General government final consumption expenditure

(2.24.1) $$G_j = Q_j + H_j - XG_j \qquad j \in \mathbf{PO}$$

(2.24.2) $$VG_j = Y_j + VH_j - VXG_j \qquad j \in \mathbf{PO}$$

Symbols

G_j, VG_j = government consumption/expenditure in government production sector *j* in constant and current prices, respectively.

H_j, VH_j = total material input in production sector *j* in constant and current prices, respectively.

Q_j, Y_j = gross product (value added) in production sector *j* in constant andcurrent prices, respectively.

XG, *VXG* = goods and services provided in exchange of a fee in government production sector *j* in constant and current prices, respectively.

Change in inventories by commodity

(2.24.3) $DS_i = DSH_i + DSI_i \qquad i \in \mathbf{VA}$

New symbols

DS_i = total change in inventories of commodity *i* in constant basic prices.

DSH_i = change in inventories of the domestically produced commodity *i* in constant prices.

DSI_i = change in inventories of the imported commodity *i* in constant prices.

(2.24.4) $VDS_i = BH_iDSH_i + BI_iDSI_i \qquad i \in \mathbf{VA}$

New symbols

VDS_i = total change in inventories of commodity *i* in current basic prices.

BH_i = basic price of the domestically produced commodity *i*.

BI_i = basic price of the imported commodity *i*.

Import and export by commodity

(2.24.5) $VI_i = PI_iI_i \qquad i \in \mathbf{VA}$

(2.24.6) $VA_i = PA_iA_i \qquad i \in \mathbf{VA}$

New symbols

VI_i = import activity *i* in current prices c.i.f.

PI_i = price index of import activity *i* c.i.f.

I_i = import activity *i* measured in constant prices (c.i.f).

VA_i = export activity *i* in current purchaser prices.

PA_i = purchaser price index of export activity *i* f.o.b.

A_i = export activity *i* measured in constant purchaser prices.

Consumption by sector

(2.24.7) $VC_i = PC_iC_i \qquad i \in \mathbf{CP} \setminus \{30\}$

(2.24.8) $VC_{30} = PC_{30}(C_{30} - CK_{30}) + PJ_{40}CK_{30}$

New symbols

VC_i = consumption sector *i* measured in current purchaser prices.

PC_i = purchaser price index of consumption sector *i*.

C_i = consumption sector *i* measured in constant prices.

CK_{30} = *Households'* purchase of second hand cars from domestic production sectors in constant purchaser prices.
PJ_{40} = purchaser price index of the investment activity *Cars (40)*.

2.25 Calculation of aggregate variables

Export of used real capital

(2.25.1) $$AJ = \sum_{k \in \mathbf{JR}} AJ_k$$

(2.25.2) $$VAJ = \sum_{k \in \mathbf{JR}} VAJ_k$$

Symbols
AJ, VAJ = total export of used real capital in constant and current prices, respectively.
AJ_k, VAJ_k = export of used real capital of type k in constant and current prices, respectively.

Export

(2.25.3) $$A = \sum_{i \in \mathbf{VA}} A_i + AJ + A_{24}$$

(2.25.4) $$VA = \sum_{i \in \mathbf{VA}} VA_i + VAJ + VA_{24}$$

New symbols
A, VA = total exports in constant and current prices (c.i.f.), respectively.
A_{24}, VA_{24} = direct purchases in Norway by non-resident households in constant and current prices, respectively.

Import

(2.25.5) $$I = \sum_{i \in \mathbf{VA}} I_i$$

(2.25.6) $$VI = \sum_{i \in \mathbf{VA}} VI_i$$

New symbols
I, VI = total import in constant and current prices, respectively.

Change in inventories

(2.25.7) $$DS = \sum_{i \in \mathbf{VA}} DS_i$$

New symbols
DS = total change in inventories in constant basic prices.
DS_i = change in inventories of commodity i in constant basic prices.

VDS, total change in inventories in current prices, is determined in Eq. (2.12.9).

Fixed gross capital formation

(2.25.8) $JKS = \sum_{j \in \mathbf{PS}} JKS_j$

(2.25.9) $VJKS = \sum_{j \in \mathbf{PS}} VJKS_j$

(2.25.10) $JK = \sum_{k \in \mathbf{JA}} JK_k$

New symbols

- JKS, $VJKS$ = total gross real investment in constant and current purchaser prices, respectively.
- JKS_j, $VJKS_j$ = gross real investment in production sector j in constant and current purchaser prices, respectively.
- JK = total gross real investment in constant purchaser prices.
- JK_k = gross real investment in capital activity k in constant purchaser prices.

VJK, aggregate gross real investment in current prices, is determined in Eq. (2.12.12).

Government and private final expenditure

(2.25.11) $G = \sum_{j \in \mathbf{PO}} G_j$

(2.25.12) $VG = \sum_{j \in \mathbf{PO}} VG_j$

(2.25.13) $C = \sum_{i \in \mathbf{CP}} C_i + C_{70}$

New symbols

- G, VG = total government consumption/expenditure in constant and current prices, respectively.
- G_j, VG_j = government consumption/expenditure in government production sector j in constant and current prices,respectively.
- C = total private consumption in constant purchaser prices.
- C_i = consumption sector i in constant purchaser prices.

VC, total private consumption in current purchaser prices, is determined in Eq. (2.12.10).

Gross national product

(2.25.14) $QHJ = \sum_{j \in \mathbf{PSK} \setminus \{58\}} Q_j$

(2.25.15) $YHJ = \sum_{j \in \mathbf{PSK} \setminus \{58\}} Y_j$

(2.25.16) $Q_{58} = -I - QHJ + C + G + JK + A + DS$

(2.25.17) $Y_{58} = -VI - YHJ + VC + VG + VJK + VA + VDS$

(2.25.18) $Q = QHJ + Q_{58}$

(2.25.19) $Y = YHJ + Y_{58}$

New symbols

Q_j, Y_j = gross *product* in production sector j in constant and current prices, respectively.
Q_{58}, Y_{58} = shift effects/circular flow differences in constant and current prices, respectively.
QHJ, *YHJ* = gross national *product* net of shift effects/circular flow differences in constant and current prices, respectively.
Q, *Y* = gross national *product* in in constant and current prices, respectively.

Gross production

(2.25.20) $XHJ = \sum_{j \in \mathbf{PSK} \setminus \{58\}} X_j$

(2.25.21) $X_{58} = Q_{58}$

(2.25.22) $X = XHJ + X_{58}$

(2.25.23) $VXHJ = \sum_{j \in \mathbf{PSK} \setminus \{58\}} VX_j$

(2.25.24) $VX_{58} = Y_{58}$

(2.25.25) $VX = VXHJ + VX_{58}$

New symbols

XHJ = gross national production in constant prices exclusive of shift effects.
X_j, VX_j = gross production in production sector j in constant and current net-seller prices, respectively.
X = gross national production in constant prices inclusive of shift effects.
VXHJ = gross national production in current prices exclusive of circular flow differences.
VX = gross national production in current prices inclusive of circular flow differences.

Total material input

(2.25.26) $H = \sum_{j \in \mathbf{PS}} H_j$

(2.25.27) $VH = \sum_{j \in \mathbf{PS}} VH_j$

New symbols

H, *VH* = total material input in constant and current purchaser prices, respectively.
H_j, VH_j = material input in production sector j in constant and current prices, respectively.

Capital depreciation

(2.25.28) $FD = \sum_{j \in PS} FD_j$

(2.25.29) $YD = \sum_{j \in PS} YD_j$

New symbols
FD, YD = total capital depreciation in constant and current prices, respectively.
FD_j, YD_j = capital depreciation in production sector j in constant and current prices, respectively.

Indirect taxes and subsidies

(2.25.30) $YT = \sum_{j \in PSK \setminus \{58\}} YT_j$

(2.25.31) $YTSA = \sum_{l \in SA} YTART_l$

(2.25.32) $YTSU = \sum_{l \in SU} YTART_l$

(2.25.33) $YTART = \sum_{l \in AVG} YTART_l + \sum_{l' \in \{225,400\}} YTART_{l'}$

(2.25.34) $YTVU = \sum_{l=610}^{618} YTART_l + \sum_{l \in \{621,622,624\}} YTART_l \qquad l \in AVG$

(2.25.35) $YTU = YTVU + YTSU$

(2.25.36) $YTA = YT - YTU$

(2.25.37) $YTVA = YTA - YTSA$

New symbols
YT = total net indirect taxes in current prices.
YT_j = net indirect tax levied on production sector j.
$YTSA$ = total sectorial indirect taxes.
$YTART_l$ = net indirect taxes, type l.
$YTSU$ = total sectorial subsidies.
$YTART$ = total net indirect taxes.
$YTVU$ = total commodity subsidies.
YTU = total subsidies.
YT = total net indirect taxes (YT=$YTART$).
YTA = total gross indirect taxes.
$YTVA$ = total commodity taxes.

Factor income

(2.25.38) $YFHJ = \sum_{j \in PSK \setminus \{58\}} YF_j$

(2.25.39) $YF_{58} = Y_{58}$

(2.25.40) $YF = YFHJ + YF_{58}$

New symbols
$YFHJ$= total factor income in current prices exclusive of circular flow differences.
YF_j = factor income in production sector j in current prices.
YF_{58} = circular flow differences measured in current prices.
YF = total factor income in current prices inclusive of circular flow differences.

Wage payment and wage cost

(2.25.41) $YWW = \sum_{j \in \mathbf{PS}} YWW_j$

(2.25.42) $YWT = \sum_{j \in \mathbf{PS}} YWT_j$

(2.25.43) $YW = \sum_{j \in \mathbf{PS}} YW_j$

New symbols
YWW = total wage payment in current prices.
YWW_j = wage payments in production sector j.
YWT = employers' total contribution to social security and the National Insurance in current prices.
YWT_j = social security and national insurance contribution from production sector j.
YW = total *wage cost* in current prices.
YW_j = *wage cost* in production sector j.

Operating surplus

(2.25.44) $YEHJ = \sum_{j \in \mathbf{PSK} \setminus \{58\}} YE_j$

(2.25.45) $YE_{58} = Y_{58}$

(2.25.46) $YE = YEHJ + YE_{58}$

New symbols
$YEHJ$= total operating surplus in current prices exclusive of circular flow differences.
YE_j = operating surplus in production sector j in current prices.
YE_{58} = circular flow differences measured in current prices.
YE = total operating surplus in current prices inclusive of circular flow differences.

Employment

(2.25.47) $LW = \sum_{j \in \mathbf{PS}} LW_j$

(2.25.48) $LS = \sum_{j \in PS} LS_j$

(2.25.49) $NW = \sum_{j \in PS} NW_j$

(2.25.50) $NS = \sum_{j \in PS} NS_j$

(2.25.51) $NT = \sum_{j \in PS} NT_j$

New symbols
LW = total number of hours worked by wage earners.
LW_j = number of hours worked in production sector *j* by wage earners.
LS = total number of hours worked by self employed.
LS_j = number of hours worked by self employed in production sector *j*.
NW = total number of wage earners.
NW_j = number of wage earners in production sector *j*.
NS = total number of self employed.
NS_j = number of self employed in production sector *j*.
NT = total employment.
NT_j = employment in production sector *j*.

THE SUB-MODEL FOR INCOME, OUTLAY AND CAPITAL ACCOUNTS

2.26 Investment, capital depreciation and operating surplus by institutional sector

Gross real investment

Gross real investment in *Central Government and Social Security (015)*:

(2.26.1) $VJKI_{015} = VJKS_{93S} + VJKS_{94S} + VJKS_{95S}$

Symbols
$VJKI_i$ = gross real investment in institutional sector *i* in current prices.
$VJKS_j$ = gross real investment in production sector *j* in current purchaser prices.

Gross real investment in *Local Government (040)*:

(2.26.2) $VJKI_{040} = VJKS_{93K} + VJKS_{94K} + VJKS_{95K}$

Gross real investment in *General Government (006)*:

(2.26.3) $VJKI_{006} = VJKI_{015} + VJKI_{040}$

Total gross real investment in Manufacturing Sectors, $VJKS_3$, is introduced to facilitate computation of gross real investment in *Public Financial Institutions (101)*:

(2.26.4) $VJKS_3 = \sum_j VJKS_j \qquad j \in \{15,25,34,37,40,43,45,50\} \subset \mathbf{JS}$

Gross real investment in *Public Financial Institutions (101)*:

(2.26.5) $VJKI_{101} = (\gamma^{VJK}_{3\,101} VJKS_3 + \gamma^{VJK}_{63\,101} VJKS_{63}) VJKIR_{101}$

New symbols
γ^{VJK}_{ji} = institutional sector *i*'s share of the gross real investment in production sector *j*.
$VJKIR_i$ = exogenous adjustment variable, institutional sector *i*.

Gross real investment in *Private Financial Institutions (102)*:

(2.26.6) $VJKI_{102} = (\gamma^{VJK}_{63\,102} VJKS_{63} + \gamma^{VJK}_{85\,102} VJKS_{85}) VJKIR_{102}$

Gross real investment in *Households (300)*:

(2.26.7) $VJKI_{300} = (\sum_{j \in \mathbf{JS}} \gamma^{VJK}_{j\,300} VJKS_j) VJKIR_{300}$

Gross real investment in *Ocean Transport and Drilling (306)*:

(2.26.8) $VJKI_{306} = \gamma^{VJK}_{65\,306} VJKS_{65} VJKIR_{306}$

Gross real investment in *Production and Pipeline Transport of Oil and Gas (307)*:

(2.26.9) $VJKI_{307} = VJKS_{64}$

Gross real investment in *Private Incorporated Enterprises (309)*:

(2.26.10) $VJKI_{309} = VJK - \sum_i VJKI_i \qquad i \in \mathbf{INS} \setminus \{309,500\}$

New symbols
VJK = total gross real investment in current purchaser prices.

Net real investment

(2.26.11) $VJNI_i = VJKI_i - YDI_i \qquad i \in \mathbf{INS} \setminus \{015,040,500\}$

(2.26.12) $VJNI_{015} = VJKI_{015} - \sum_j YD_j \qquad j \in \{93S,94S,95S\} \subset \mathbf{PO}$

(2.26.13) $VJNI_{040} = VJKI_{040} - \sum_j YD_j \qquad j \in \{93K,94K,95K\} \subset \mathbf{PO}$

(2.26.14) $VJNI_{006} = VJKI_{015} + VJNI_{040}$

New symbols
$VJNI_i$ = net real investment in institutional sector *i* in current prices.

YDI_j = capital depreciation in institutional sector i in current prices.
YD_j = capital depreciation in productoion sector i in current prices.

Capital depreciation

Capital depreciation in *Central Government and Social Security (015)*:

(2.26.15) $YDI_{015} = YD_{93S} + YD_{94S} + YD_{95S}$

Capital depreciation in *Local Government (040)*:

(2.26.16) $YDI_{040} = YD_{93K} + YD_{94K} + YD_{95K}$

Total capital depreciation in Manufacturing Sectors, YD_3, is introduced to facilitate computation of capital depreciation in *Public Financial Institutions (101)*:

(2.26.17) $YD_3 = \sum_j YD_j \qquad j \in \{15,25,34,37,40,43,45,50\} \subset \mathbf{JS}$

Capital depreciation in *Public Financial Institutions (101)*:

(2.26.18) $YDI_{101} = (\gamma^{YD}_{3\,101} YD_3 + \gamma^{YD}_{63\,101} YD_{63}) YDIR_{101}$

New symbols
γ^{YD}_{ji} = institutional sector i's share of capital depreciation in production sector j.
$YDIR_i$ = exogenous correction variable, institutional sector i.

Capital depreciation in *Private Financial Institutions (102)*:

(2.26.19) $YDI_{102} = (\gamma^{YD}_{63\,102} YD_{63} + \gamma^{YD}_{85\,102} YD_{85}) YDIR_{102}$

Capital depreciation in *Households (300)*:

(2.26.20) $YDI_{300} = (\sum_{j \in \mathbf{JS}} \gamma^{YD}_{j300} YD_j) YDIR_{300}$

Capital depreciation in *Ocean Transport and Drilling (306)*:

(2.26.21) $YDI_{306} = \gamma^{YD}_{65\,306} YD_{65} YDIR_{306}$

Capital depreciation in *Production and Pipeline Transport of Oil and Gas (307)*:

(2.26.22) $YDI_{307} = YD_{64}$

Capital depreciation in *Private Incorporated Enterprises (309)*:

(2.26.23) $YDI_{309} = YD - \sum_i YDI_i \qquad i \in \mathbf{INS} \setminus \{309, 500\}$

New symbols
YD = total capital depreciation in current prices.

Operating surplus

Operating surplus in *Public Financial Institutions (101)* and *Private Financial Institutions (102)*:

(2.26.24) $YEI_i = \gamma^{YE}_{63i}(YE_{63} + YE_{89})YEIR_i \qquad i \in \{101,102\} \subset \textbf{INS}$

New symbols
YEI_i = operating surplus in institutional sector i in current prices.
YE_j = operating surplus in production sector j in current prices.
γ^{YE}_{ji} = institutional sector i's share of the operating surplus and capital depreciation in production sector j.
$YEIR_i$= exogenous correction variable.

Operating surplus in *Households (300)*:

(2.26.25) $YEI_{300} = \sum_{j \in \textbf{PP}} \left\{ \gamma^{YE}_{j300}(YE_j + YD_j) \right\} + YEIR_{300} - YDI_{300}$

Operating surplus in *Ocean Transport and Drilling (306)*:

(2.26.26) $YEI_{306} = \gamma^{YE}_{65\,306}(YE_{65} + YD_{65}) + YEIR_{306} - YDI_{306}$

Operating surplus in *Production and Pipeline Transport of Oil and Gas (307)*:

(2.26.27) $YEI_{307} = YE_{64}$

Operating surplus in *Private Incorporated Enterprises (309)*:

(2.26.28) $YEI_{309} = YE - \sum_i YEI_i \qquad i \in \{101,102,300,306,307\} \subset \textbf{INS}$

New symbols
YE = total operating surplus in current prices.

2.27 Income and capital account for households

The structure of the relationship between the variables in the model block calculating income and expenditure flows may be difficult to grasp from the list of equations and symbol explanations alone. It may therefore be useful to use Table 2.27.1 below as a supplement.

Table 2.27.1 Income and Capital Account for Households ($i = 300$)

	Income and outlay by type	Symbol in MSG-5
A	Total income	$YEH_{W+S+T} + RA_{W+S+T} + RU + RRM_i + RV_{102\,i} + RV_{500\,i} + YWW_{W+S+T} + YWT + YSP_i$
	1. Wages and salaries	YWW_{W+S+T}
	2. Employers' contribution to social security schemes etc.	YWT
	3. Operating surplus	YEH_{W+S+T}
	4. Transfers from government	RU
	5. Income from interest	RRM_i
	6. Dividends and transfers from other domestic institutional sectors	$RA_{W+S+T} + RV_{102\,i} + YSP_i$
	7. Transfers from abroad	$RV_{500\,i}$
B	Total expenditure	$RRB_i + RV_{i\,015} + RV_{i\,500} + YWT + YSP_i + RTN_{W+S+T}$
	1. Direct taxes and contributions to social security	$RTN_{W+S+T} + YWT$
	1.a) Employers' contribution to social security schemes etc.	YWT
	1.b) Other direct taxes and contribution to social security	RTN_{W+S+T}
	2. Interest payments	RRB_i
	3. Other expenditure	$RV_{i\,015} + RV_{i\,500} + YSP_i$
C	Disposable income for consumption	RD_i
	1. Medical care and health expenses	$RU_{621+622}$
	2. Consumption-motivating income	RC
D	Private consumption	VC
E	Net savings (C - D)	RS_i
F	Net fixed capital formation	$VJNI_i$
	Gross fixed capital formation	$VJNI_i + YDI_i$
	Depreciation	YDI_i
G	Net financial investment (E - F)	NFI_i
H	Gross financial assets held by households at the end of the year	BF_i
I	Gross liabilities held by households at the end of the year	BG_i
J	Net financial assets held by households at the end of the year	$BF_i - BG_i$

Wages and salaries by socio-economic group

(2.27.1) $$YWW_k = \gamma_k^{YWW}(YWW + YW_{500\,300} - YW_{300\,500}) \qquad k \in \text{SOS}$$

Symbols

YWW_k = wages and salaries to socio-economic group net of social taxes.
YWW = total wages and salaries net of social taxes.
$YW_{500\,300}$ = wages and salaries earned abroad by domestic households.
$YW_{300\,500}$ = wages and salaries earned by non-domestic households in Norway.
γ_k^{YWW} = socio-economic group k's share of total wages and salaries to *Households (300)*.

Operating surplus by socio-economic group

(2.27.2) $$YEH_k = \gamma_{300k}^{YEI} YEI_{300} \qquad k \in \text{SOS}$$

New symbols

YEH_k = operating surplus to *Households (300)* by socio-economic group.
YEI_{300} = operating surplus in *Households (300)*.
γ_{300k}^{YEI} = socio-economic group k's share of operating surplus in *Households (300)*.

Wages to wage earners

(2.27.3) $$WW = \frac{YWW}{LW}$$

(2.27.4) $$WWA = \frac{YWW}{NW}$$

New symbols

WW = average wage per hour, net of social taxes, to wage earners.
LW = total number of hours worked per year by wage earners.
WWA = average wage per man-year for wage earners.
NW = total number of wage earners employed.

National account price index of aggregate private consumption

(2.27.5) $$PC = \frac{VC}{C}$$

New symbols

PC = national account price index of aggregate private consumption.
VC = aggregate private consumption in current purchaser prices.
C = aggregate private consumption in constant purchaser prices.

A measure of the number of old age pensions

(2.27.6) $$APGB = APGBPP\left\{\frac{NB_{65} + NB_{65}(-1)}{2}\right\}$$

New symbols

$APGB$ = number of old age pensions measured in number of so called *basic amounts* from the National Insurance.
$APGBPP$ = old age pension in number of *basic amounts* per person of age 65+.
NB_{65} = number of persons of age 65+.

Inflatation of the *basic amount*

$$\frac{GB}{GB(-1)} = GBE\left\{SUMO\frac{PC}{PC(-1)} + (1-SUMO)\frac{WWA}{WAA(-1)}\right\} \quad (2.27.7)$$

New symbols
GB = *basic amount* in the national insurance.
GBE = correction of the *basic amount.*
$SUMO$ = dummy variable; $SUMO = 0$ implies that the basic amount follows the annual wage growth, $SUMO = 1$ implies that it follows the consumer price index.

Transfers from *General Government* to by type

$$RU_r = RATR_r GB\left\{\frac{NB + NB(-1)}{2}\right\} \quad (2.27.8)$$

$r \in \{609, 611, 619, 621, 622, 659,\} \subset \mathbf{RU}$

$$RU_{612} = APGBGB \quad (2.27.9)$$

$$RU_{613} = UPGBGB \quad (2.27.10)$$

$$RU_{630} = RATR_{630}YWW \quad (2.27.11)$$

$$RU_{640} = RATR_{640}GB\left\{\frac{NB_{0014} + NB_{0014}(-1)}{2}\right\} \quad (2.27.12)$$

$$RU_{650} = RATR_{650}YWW \quad (2.27.13)$$

$$RU_{658} = RATR_{658}RU_{613} \quad (2.27.14)$$

$$RU_{666} = XRU_{666}PC \quad (2.27.15)$$

New symbols
RU_r = transfers of type r from *General Government (006)* to *Households (300).*
$UPGB$ = number of recipients of disability benefit, measured in number of *basic amounts.*
$RATR_r$ = rate related to the development of population and income for transfers of type r.
XRU_{666} = *Other Transfers* in *Local Government* in constant prices.
NB_{0014} = number of persons in the age group *0-14.*
NB = total population measured in number of persons.

Consumption motivating transfers, and transfers liable to tax, by socio-economic group

$$RUK_k = \sum_r \gamma_{rk}^{RU} RU_r \quad (2.27.16)$$

$k \in \mathbf{SOS} \qquad r \in \mathbf{RU} \setminus \{621, 622\}$

(2.27.17) $RUS_k = \sum_r \gamma_{rk}^{RU} RU_r$

$k \in \mathbf{SOS} \qquad r \in \mathbf{RU} \setminus \{621, 622, 640, 659, 666\}$

New symbols
RUK_k = consumption motivating transfers to socio-economic group k.
γ_{rk}^{RU} = share of transfers of type r to socio-economic group k.
RUS_k = transfers liable to tax to socio-economic group k.

Total consumption motivating transfers *(RUK)*

(2.27.18) $RUK = \sum_{k \in \mathbf{SOS}} RUK_k$

Total transfers from *General Government (RU)*

(2.27.19) $RU = \sum_{r \in \mathbf{RU}} RU_r$

Net disposable income and savings

(2.27.20) $RD_{300} = \sum_{k \in \mathbf{SOS}} RC_k + RU_{621} + RU_{622}$

(2.27.21) $RS_{300} = RD_{300} - VC$

New symbols
RD_{300} = net disposable income for *Households (300)*.
RC_k = consumption motivating income for socio-economic group k.
RS_{300} = net savings in *Households (300)*.

Net financial investment

(2.27.22) $NFI_{300} = RS_{300} + YDI_{300} - VJKI_{300}$

New symbols
NFI_{300} = net financial investments in *Households (300)*.
YDI_{300} = capital depreciation in *Households (300)* in current prices.
$VJKI_{300}$= gross real investment in *Households (300)* in current prices.

Gross financial assets and liabilities

(2.27.23) $BF_{300} = FRATE_{300} RD_{300}$

(2.27.24) $BG_{300} = BG_{300}(-1) + BF_{300} - BF_{300}(-1) - NFI_{300} - BGX_{300}$

New symbols
BF_{300} = gross financial assets held by *Households (300)* by the end of the year.
$FRATE_{300}$= ratio of gross claims and net disposable income in *Households (300)*.
BG_{300} = gross liabilities held by *Households (300)* by the end of the year.
BGX_{300} = correction variable for BG_{300}.

Income from interest

(2.27.25) $RRM_{300} = RENU\frac{1}{2}(BF_{300} + BF_{300}(-1)) + RRMX_{300}$

New symbols
RRM_{300} = *Households'* income from interest.
$RENU$ = nominal annual interest rate on positive financial investment in the international capital market.
$RRMX_{300}$ = correction variable for RRM_{300}.

Interest payments

(2.27.26) $RENBG_{300} = RENG\,AGPF_{300} + RENOF_{300}(1 - AGPF_{300})$

(2.27.27) $RRB_{300} = RENBG_{300}\frac{1}{2}(BG_{300} + BG_{300}(-1)) + RRBX_{300}$

New symbols
$RENBG_{300}$ = average interest rate on debts for *Households (300).*
$RENG$ = nominal annual interest rate on debt issued to finance investment in physical capital.
$AGPF_{300}$ = *Private Financial Institutions'* share of *Households'* gross debt.
$RENOF_{300}$ = interest rate, *Households'* debt to *Public Financial Institutions (102).*
RRB_{300} = *Households'* interest payments.
$RRBX_{300}$ = correction variable for RRB_{300}.

Net wealth

(2.27.28) $NF_{300} = \tau_{83}^{VK} VK_{83} + PC_{30}HC_{30} + BF_{300} - BG_{300} - \rho PC$

New symbols
NF_{300} = net wealth in *Households (300).*
VK_{83} = stock of real capital in the production sector *Dwelling Services (83)* in current prices.
HC_{30} = *Households'* stock of cars in constant prices.
PC_{30} = purchaser price index of new cars.
τ_{83}^{VK} = base year parameter determining the share of the value of dwelling services which is taxable.
ρPC = a deductable price adjusted basic amount (*PC* is the national account price index defined in (2.27.5)).

Net income from interest by socio-economic group

(2.27.29) $RR_k = \gamma_k^{RRI} RRM_{300} - \gamma_k^{RRU} RRB_{300} \qquad k \in \mathbf{SOS}$

New symbols
RR_k = net income from interest, socio-economic group *k*.
γ_k^{RRI} = socio-economic group *k*'s share of *Households'* income from interest.
γ_k^{RRU} = socio-economic group *k*'s share of *Households'* interest payments.

Income from dividends by socio-economic group

(2.27.30) $RA_k = \gamma_k^{RA} RAM_{300} \qquad k \in \mathbf{SOS}$

New symbols
RA_k = income from dividends, socio-economic group k.
RAM_{300} = *Households'* total income from dividends.
γ_k^{RA} = socio-economic group k's share of *Households'* total income from dividends.

Net income from interest and dividends by socio-economic group *(RRA_k)*

(2.27.31) $RRA_k = RR_k + RA_k \qquad k \in \mathbf{SOS}$

Net other transfers to and from socio-economic group *k*

(2.27.32) $RV_k = \gamma_k^{VI}(RV_{500\,300} + RV_{102\,300}) - \gamma_{500k}^{VU} RV_{300\,500} - \gamma_{015k}^{VU} RV_{300\,015} \qquad k \in \mathbf{SOS}$

New symbols
RV_k = net other transfers to socio-economic group k.
$RV_{ii'}$ = transfers from institutional sector i to institutional sector i'.
γ_k^{VI} = socio-economic group k's share of other transfers to *Households (300).*
γ_{ik}^{VU} = socio-economic group k's share of other transfers from *Households (300)* to institutional sector i.

Net non-life insurance premium by socio-economic group

(2.27.33) $YSP_{300k} = \gamma_{300k}^{YSP} YSP_{300} \qquad k \in \mathbf{SOS}$

New symbols
YSP_{300k} = net non-life insurance premium from socio-economic group k.
YSP_{300} = net non-life insurance premium from *Households (300).*
γ_{300k}^{YSP} = socio-economic group k's share of YSP_{300}.

Change in size of the socio-economic groups

(2.27.34) $LY_T = \dfrac{NTRYGD}{NTRYGD.0}$

(2.27.35) $LY_W = \dfrac{NW}{NW.0}$

(2.27.36) $LY_S = \dfrac{NS}{NS.0}$

New symbols
LY_k = index measuring growth in socio-economic group k relative to the base year.
NW = total number of wage earners.
$NTRYGD$ = number of national insurance recipients.
NS = total employment, self employed.

Growth in income by socio-economic group

$$(2.27.37)\quad MY_k = \frac{WW(-1)}{WW.0} + \frac{WW(-1)}{WW(-2)} - 1 + MYR_k \qquad k \in \mathbf{SOS}$$

New symbols
MY_k = growth in income for socio-economic group k relative to the base year.
MYR_k= exogenous calibration variable.

Model-based calculation of net income by socio-economic group *(NINSMOD$_k$)*

$$(2.27.38)\quad NINSMOD_k = \frac{(YWW_k + YEH_k + RR_k + RA_k + RUS_k)}{LY_k} \qquad k \in \mathbf{SOS}$$

Adjusted net income by socio-economic group in the base year *(NINSREF$_k$)*

$$(2.27.39)\quad NINSREF_k = (YWW_k.O + YEH_k.0 + RR_k.0 + RA_k.0 + RUS_k.0)MY_k \qquad k \in \mathbf{SOS}$$

Model-based calculation of gross income by socio-economic group *(BRINMOD$_k$)*

$$(2.27.40)\quad BRINMOD_k = \frac{(YWW_k + YEH_k + RUS_k)}{LY_k} \qquad k \in \mathbf{SOS}$$

Adjusted gross income by socio-economic group in the base year

$$(2.27.41)\quad BRINREF_k = (YWW_k.0 + YEH_k.0 + RUS_k.0)MY_k \qquad k \in \mathbf{SOS}$$

New symbols
$BRINREF_k$ = gross income in the base year, socio-economic group k, adjusted by MY_k, the growth in income relative to the base year.

Direct taxes by type and by socio-economic group

$$(2.27.42)\quad RT_{406k} = \gamma^{RT}_{406k}(RATRT_{411}PCHC_{30} + RATRTNF_S NF_{300})$$

$$(2.27.43)\quad RT_{407k} = \gamma^{RT}_{407k}(RATRTNF_K NF_{300})$$

$$(2.27.44)\quad RT_{rk} = (TRTG_{rk}NINSREF_k + TRTM_{rk}(NINSMOD_k - NINSREF_k))LY_k + RTE_{rk}MY_k$$

$$(2.27.45)\quad RT_{r'k} = (TRTG_{r'k}BRINREF_k + TRTM_{r'k}(BRINMOD_k - BRINREF_k))LY_k + RTE_{r'k}MY_k$$

$$(2.27.46)\quad RT_{508k} = \gamma^{RT}_{508k}\left(RATRT_{508}\left(YWW_{92S} + YWW_{93S} + YWW_{94S} + YWW_{95S}\right)\right)$$

$$k \in \mathbf{SOS} \qquad r \in \{421, 422, 425\} \subset \mathbf{RT} \qquad r' \in \{429, 511\} \subset \mathbf{RT}$$

New symbols
RT_{rk} = accrued direct tax, type r, socio-economic group k.
$RATRT_r$ = tax rate of type r on miscellaneous income components.
$RATRTNF_\theta$ = tax rate related to net wealth in *Households (300)* for calculation of property tax to *Central Government* (θ=*S*) and *Local Government* (θ=*K*).

$TRTG_{rk}$ = average macro tax rate, tax type r, socio-economic group k.
$TRTM_{rk}$ = marginal macro tax rate, tax type r, socio-economic group k.
RTE_{rk} = correction variable for tax type r, socio-economic group k.
γ^{RT}_{rk} = base year tax coefficient, tax type r, socioeconomic group k.
YWW_j = wage and salary payment net of social taxes in production sector j.

Accrued direct taxes by socio-economic group *(RTN_k)*

(2.27.47) $RTN_k = \sum_r RT_{rk}$

$k \in \mathbf{SOS}$ $\quad r \in \{406, 407, 421, 422, 425, 429, 508, 511\} \subset \mathbf{RT}$

Accrued direct taxes *(RTN)*:

(2.27.48) $RTN = \sum_{k \in \mathbf{SOS}} RTN_k$

Consumption motivating income by socio-economic group *(RC_k)*:

(2.27.49) $RC_k = YWW_k + YEH_k + RUK_k + RR_k + RA_k + RV_k - RTN_k \qquad k \in \mathbf{SOS}$

Consumption motivating income for *(RC)*:

(2.27.50) $RC = \sum_{k \in \mathbf{SOS}} RC_k$

Savings ratio for *(SPARERAT)*

(2.27.51) $SPARERAT = RS_{300}/RD_{300}$

Net debt ratio for *(NIFRAT)*

(2.27.52) $NFIRAT = NFI_{300}/RD_{300}$

New symbols
$NFIRAT$ = net debt ratio for *Households (300)*.
NFI_{300} = net financial investment in *Households (300)*.

Average tax rate

(2.27.53) $TRTN = RTN/(RD_{300} + RTN)$

New symbols
$TRTN$ = average tax rate for *Households (300)*.
RTN = accrued direct taxes and contribution to social security paid by *Households (300)*.

2.28 Income account for central government and social security

The structure of the relationship between the variables in the model block calculating income and expenditure flows may be difficult to grasp from the list of equations and symbol explanations alone. It may therefore be useful to use Table 2.28.1 below as a supplement.

Table 2.28.1 Income Account for Central Government and Social Security ($i = 015$)

Income and outlay by type			Symbol in MSG-5
A	Total income		RI_i
	1.	Property income	RRV_i
		1.a) Income from interest	RRM_i
		1.b) Income from dividends	RAM_i
		1.c) Income from central government petroleum enterprises (-)	$VJ_{53\ 040}$
		1.d) Central government enterprise surplus	YEN_{210}
		1.e) Transfers from Norges Bank	$RV_{110\ i}$
	2.	Taxes and social security contributions	$RYTB_i$
		2.a) Direct taxes	RT_{307}
		2.b) Taxes on extraction of petroleum	$YTART_{521}+YTART_{522}$
		2.c) Other accrued direct taxes	$RTS\text{-}RT_{307}$
		2.d) Other accrued indirect taxes	$YTAS\text{-}YTART_{521}\text{-}YTART_{522}+RV_{300\ i}+RV_{309\ i}$
		2.e) Social security contributions	$RYWT$
	3.	Transfers from other government sectors	$RV_{040\ i}$
	4.	Income from central government petroleum enterprises	$VJ_{53\ 040}$
B	Total expenditure		RUT_i
	1.	Interest	RRB_i
	2.	Transfers	$RV_{i\ 500}\text{-}YTUS+RU_i$
		2.a) Transfers which go abroad	$RV_{i\ 500}$
		2.b) Subsidies	$YTUS$
		2.c) Transfers to households	RU_i
	3.	Transfers to other government sectors	$RV_{i\ 040}$
	4.	Central final consumption expenditure	$VG_{92S}+VG_{93S}+VG_{94S}+VG_{95S}$
		4.a) Net indirect taxes	$YT_{92S}+YT_{93S}+YT_{94S}+YT_{95S}$
		4.b) Wages and salaries	$YW_{92S}+YW_{93S}+YW_{94S}+YW_{95S}$
		4.c) Cost of goods and services	$VH_{92S}+VH_{93S}+VH_{94S}+VH_{95S}$
		4.d) Consumption of fixed capital	$YD_{92S}+YD_{93S}+YD_{94S}+YD_{95S}$
		4.e) Government fees (-)	$VXG_{92S}+VXG_{93S}+VXG_{94S}+VXG_{95S}$
	5.	Current expenses in central government petroleum activities	$VJ_{53\ 030}$
	6.	Net fixed capital formation	$VJNI_i+VJNE_i$
		6.a) Net fixed capital formation	$VJNI_i$

	6.2b)Net purchase of real property	$VJNE_i$
	7. Increase in capital deposits in central government enterprises (net)	$VJ_{53\,050}+VJNI_{210}$
	7.a) Central government petroleum enterprises	$VJ_{53\,050}$
	7.b) Miscellaneous	$VJNI_{210}$
C	Surplus before financial transactions (A - B)	RSK_i
D	Disposable income	RD_i
E	Net savings (D - B4)	RS_i
F	Net financial investment (E - B6)	NFI_i

Income and expenses in central government petroleum activities

(2.28.1) $VJ_{53\,070} = VJ_{53\,060} - VJ_{53\,050}$

Symbols

$VJ_{53\,070}$ = consumption of fixed capital in central government petroleum enterprises.
$VJ_{53\,060}$ = gross capital formation in central government petroleum enterprises.
$VJ_{53\,050}$ = net capital formation in central government petroleum enterprises.

Employers' contribution to the National Insurance:

(2.28.2) $YWW_{90S} = YWW_{92S} + YWW_{93S} + YWW_{94S} + YWW_{95S}$

(2.28.3) $YWTA = RATYWTA\ YWW_{90S}$

(2.28.4) $YWTF = YWT - YWTA$

New symbols

$YWTF$ = employers' contribution to the National Insurance.
$YWTA$ = employers' contribution to social security except National Insurance.
YWT = employers' contribution to social security and the National Insurance.
$RATYWTA$ = rate for calculation of employers' contribution to social security and the National Insurance.
YWW_j = wages and salaries net of social taxes in central government production sector *j*.
YWW_{90S} = wages and salaries net of social taxes in central government production sectors.

Income from indirect taxes and subsidies

(2.28.5) $YTA_S = YTA - YTA_K$

(2.28.6) $YTU_S = YTU - YTU_K$

New symbols
YTA_K = gross indirect taxes to *Local Government.*
YTA_S = gross indirect taxes to *Central Government.*
YTA = total gross indirect taxes.
YTU_K = gross subsidies from *Local Government.*
YTU_S = gross subsidies from *Central Government.*
YTU = total subsidies.

Transfers to *Households*

(2.28.7) $$RU = \sum_{j \in \mathbf{RU}} RU_j$$

(2.28.8) $$RU_{015} = RU - RU_{040}$$

New symbols
RU_{040} = total transfers to *Households (300)* from *Local Government (040).*
RU_{015} = total transfers to *Households (300)* from *Central Government and Social Security (015).*
RU = total transfers to *Households (300)* from *General Government (006).*
RU_j = total transfers of type *j* to *Households (300)* from *General Government (006).*

Transfers to Incorporated Enterprises

(2.28.9) $$RV_{015\,210} = -YFN_{210} + \left(VJ_{53\,030} - RV_{015\,309}\right)$$

(2.28.10) $$RV_{210\,015} = -YFN_{210} + YEN_{210}$$

New symbols
$RV_{015\,210}$ = transfers from *Central Government and Social Security (015)* to *Central Government Enterprises (210).*
$RV_{210\,015}$ = transfers to *Central Government and Social Security (015)* from *Central Government Enterprises (210).*
$RV_{015\,309}$ = transfers from *Central Government and Social Security (015)* to *Other Private Incorporated Enterprises (309).*
YFN_{210} = accounted net surplus in *Central Government Enterprises (210).*
YEN_{210} = net surplus in *Central Government Enterprises (210).*
$VJ_{53\,030}$ = current expenses in central government petroleum enterprises.

Accrued direct taxes by type

(2.28.11) $$RT_i = \sum_{k \in \mathbf{SOS}} RT_{ik} \qquad i \in \mathbf{RT} \setminus \{438, 439, 451, 452\}$$

New symbols
RT_i = accrued direct taxes of type *i*.
RT_{ik} = accrued direct taxes of type *i* collected from socio-economic group *k*.

Direct taxes collected from Mainland Incorporated Enterprises

Mainland Incorporated Enterprises *(Sectors where source or recipient is unknown* (999)) consists of all incorporated enterprises except those included in *Ocean Transport and Drilling (306)* and *Production and Pipeline Transport of Oil and Gas (307).*

(2.28.12)
$$RT_{i\,999} = RATRT_i\big[YEI_{309} + RV_{000\,309} - RV_{309\,000} + RV_{015\,210} - RV_{210\,015} + YP_{500\,309} - YP_{309\,500} - YEN_{230} - VJ_{53\,030}\big] + TRTREN\,\gamma\big[RRM_{309} - RRB_{309} + RAM_{309} - RAB_{309} + VJ_{53\,040}\big]$$

$i \in \{438, 451, 452\} \subset \mathbf{RT}$

(2.28.13) $RT_{999} = \sum_i RT_{i\,999} - RV_{500\,309} \qquad i \in \{438, 451, 452\} \subset \mathbf{RT}$

(2.28.14) $RT_{500} = RV_{500\,309}$

New symbols

$RT_{i\,999}$ = direct taxes of type i collected from Mainland Incorporated Enterprises *(Sectors where source or recipient is unknown* (999)).
RT_{999} = total direct taxes collected from Mainland Incorporated Enterprises *(Sectors where source or recipient is unknown* (999)).
RT_{500} = total direct taxes collected from *Abroad (500).*
$RATRT_i$ = tax rates of type i on Mainland Incorporated Enterprises *(Sectors where source or recipient is unknown* (999)).
$TRTREN$ = tax rate on firms' net income from interest and dividends.
RV_{ij} = transfers from institutional sector i to institutional sector j.
YP_{ij} = patent and rental income from institutional sector i to institutional sector j.
YEN_{230} = net surplus in *Local Government Enterprises (230).*
$VJ_{53\,040}$ = expenses in central government petroleum enterprises in current prices.
RRM_{309} = income from interest in *Other Private Incorporated Enterprises (309).*
RRB_{309} = interest payments in *Other Private Incorporated Enterprises (309).*
RAM_{309} = dividends received by *Other Private Incorporated Enterprises (309).*
RAB_{309} = dividends payed by *Other Private Incorporated Enterprises (309).*
YEI_{309} = operating surplus in *Other Private Incorporated Enterprises (309).*
γ = tax base coefficient (see Storm (1993)).

Ordinary tax on petroleum enterprises collected from *Production and Pipeline Transport of Oil and Gas*

(2.28.15) $$\frac{RT_{439\,307}}{YE_{64}} = \tau_1 + \tau_2 \frac{YE_{64}}{Y_{64}} + RTE_{439}PC$$

New symbols

$RT_{439\,307}$ = ordinary tax on petroleum enterprises (tax type 439) collected from the institutional sector *Production and Pipeline Transport of Oil and Gas (307).*
YE_{64} = operating surplus in the production sector *Production and Pipeline Transport of Oil and Gas (64).*

Y_{64} = gross product in current prices in the production sector *Production and Pipeline Transport of Oil and Gas (64).*
RTE_{439} = correction term related to the ordinary tax on petroleum enterprises (tax type 439) collected from the institutional sector *Production and Pipeline Transport of Oil and Gas (307).*
PC = price index of aggregate private consumption (national account definition).
τ_1, τ_2 = estimated coefficients in the tax function (see Storm (1993)).

Accrued direct taxes by type collected from *Ocean Transport and Drilling (306)* and *Production and Pipeline Transport of Oil and Gas (307)*

(2.28.16) $RT_i = RT_{i306} + RT_{i999} \qquad i \in \{438, 451, 452\} \subset \mathbf{RT}$

(2.28.17) $RT_{439} = RT_{439\,307}$

(2.28.18) $RT_{306} = \sum_i RT_{i306} \qquad i \in \{438, 451, 452\} \subset \mathbf{RT}$

(2.28.19) $RT_{307} = RT_{439\,307}$

New symbols
RT_i = accrued direct taxes of type *i*.
RT_{ir} = accrued direct taxes of type *i* collected from institutional sector *r*.
RT_r = accrued direct taxes collected from institutional sector *r*.

Total direct taxes collected from *Incorporated Enterprises* (RT_{200})

(2.28.20) $RT_{200} = RT_{306} + RT_{307} + RT_{500} + RT_{999}$

Total direct taxes collected from *Public Financial Institutions*

(2.28.21) $RT_{101} = \tau_3 RT_{438\,999} RTR_{101}$

New symbols
RT_{101} = total direct taxes collected from *Public Financial Institutions (101).*
RTR_{101} = correction term related to total direct taxes collected from *Public Financial Institutions (101).*
τ_3 = estimated tax coefficient (see Storm (1993)).

Total direct taxes collected from *Private Financial Institutions*

(2.28.22) $RT_{102} = \left(\tau_4 RT_{438\,999} + RT_{451\,999} + \tau_5 RT_{452\,999}\right) RTR_{102}$

New symbols
RT_{102} = total direct taxes collected from *Private Financial Institutions (102).*
RTR_{102} = correction term related to total direct taxes collected from *Private Financial Institutions (102).*
τ_4, τ_5 = estimated tax coefficients (Storm *op. cit.*).

Total direct taxes collected from *Other Incorporated Enterprises* (RT_{309})

(2.28.23) $RT_{309} = RT_{200} - \sum_i RT_i \qquad i \in \{101,102,306,307\} \subset \text{INS}$

Total contributions to social security

(2.28.24) $RYWT = YWTF + YWTA + RT_{511} + RT_{508}$

New symbols
$RYWT$ = total contributions to social security.
$YWTF$ = employers' contribution to the National Insurance.
$YWTA$ = employers' contribution to social security except national insurance.
RT_{511} = membership contribution to the National Insurance, health part.
RT_{508} = membership contribution to the National Insurance exclusive of the health part.

Total direct taxes and contributions to social security *(RTYWT)*

(2.28.25) $RTYWT = RTN + RT_{200} + YWTF + YWTA$

Total direct taxes exclusive of contributions to social security *(RT)*

(2.28.26) $RT = RTYWT - RYWT$

Total direct taxes received by *Central Government*

(2.28.27) $RT_S = RT - RT_K$

New symbols
RT_S = total direct taxes received by *Central Government.*
RT_K = total direct taxes received by *Local Government.*

Total taxes received by *General Government*

(2.28.28) $RYTB = RTYWT + YTA + RV_{300\ 015} + RV_{309\ 015}$

New symbols
$RYTB$ = total taxes received by *General Government (006).*
YTA = total gross indirect taxes.

Gross accrued tax income

(2.28.29) $RYTB_{015} = YTA_S + \sum_i RV_{i015} + RT_S + RYWT \qquad i \in \{300,309\} \subset \text{INS}$

New symbols
$RYTB_{015}$ = gross accrued tax income to *Central Government and Social Security (015).*
$RV_{i\,015}$ = other transfers from institutional sector *i* to *Central Government and Social Security (015).*
RT_S = accrued direct taxes to *Central Government.*

Property income

(2.28.30) $RRV_{015} = RRM_{015} + RAM_{015} + YEN_{210} + RV_{110\,015} - VJ_{53\,040}$

New symbols

RRV_{015} = total property income to *Central Government and Social Security (015).*

RRM_{015} = income from interest received by *Central Government and Social Security (015).*

RAM_{015} = dividends received by *Central Government and Social Security (015).*

$RV_{110\,015}$ = other transfers from *Norges Bank (110)* to *Central Government and Social Security (015).*

Transfers

(2.28.31) $RVB_{015} = RRB_{015} + \sum_{i \in INS \setminus \{015\}} RV_{015i} + RU_{015} - YTU_S + VJ_{53\,030} - RV_{015\,309}$

New symbols

RVB_{015} = transfers from *Central Government and Social Security (015).*

RRB_{015} = interest paid by *Central Government and Social Security (015).*

$RV_{015\,i}$ = other transfers from *Central Government and Social Security (015)* to institutional sector *i*.

Total income

(2.28.32) $RI_{015} = RYTB_{015} + RRV_{015} + RV_{040\,015} + VJ_{53\,040}$

New symbols

RI_{015} = total income to *Central Government and Social Security (015).*

$RV_{040\,015}$ = other transfers from *Local Government (040)* to *Central Government and Social Security (015).*

Total disposable income

(2.28.33) $RD_{015} = RI_{015} - RVB_{015}$

Net savings

(2.28.34) $VG_{90S} = \sum_{j \in \{92,93,94,95\}} VG_{jS}$

(2.28.35) $RS_{015} = RD_{015} - VG_{90S}$

New symbols

RS_{015} = net savings in *Central Government and Social Security (015).*

VG_{90S} = total expenditure/consumption in central government production sectors in current prices.

VG_{jS} = expenditure/consumption in central government production sector *j* in current prices.

Net lending

(2.28.36) $NFI_{015} = RS_{015} - VJNI_{015} - VJNE_{015}$

New symbols
NFI_{015} = net lending (equals net financial investment) in *Central Government and Social Security (015).*
$VJNI_{015}$ = net fixed capital formation in *Central Government and Social Security (015).*
$VJNE_{015}$ = net purchase of real property by *Central Government and Social Security (015).*

Changes in total financial assets and liabilities

(2.28.37) $BF_{015} = BF_{015}(-1) + ZALFA_{015} NFI_{015}$

(2.28.38) $BG_{015} = BG_{015}(-1) + BF_{015} - BF_{015}(-1) - NFI_{015} - OMV_{015} + BGX_{015}$

(2.28.39) $$ZALFA_{015} = \begin{cases} 1 \text{ if } BF_{015}(-1) - ALFA_{015} NFI_{015} < 0 \\ 0 \text{ if } BF_{015}(-1) + ALFA_{015} NFI_{015} < 0 \\ ALFA_{015} \quad \text{elsewhere} \end{cases}$$

New symbols
BF_{015} = total financial assets held by *Central Government and Social Security (015)* by the end of the year.
BG_{015} = total liabilities held by *Central Government and Social Security (015)* by the end of the year.
OMV_{015} = revaluation of net liabilities held by *Central Government and Social Security (015).*
BGX_{015} = correction variable for total liabilities held by *Central Government and Social Security (015).*
$ALFA_{015}$ = the proportion of the change in total financial assets to the change in total liabilities held by *Central Government and Social Security (015).*
$ZALFA_{015}$ = the proportion of the change in total financial assets to the change in total liabilities held by *Central Government and Social Security (015)* when the value of the total financial assets is negative.

Average interest rates on debt and deposits

(2.28.40) $RENBG_{015} = RENG + RENGX_{015}$

(2.28.41) $RENBF_{015} = RENU + RENFX_{015}$

New symbols
$RENBG_{015}$ = average interest rate on debt for *Central Government and Social Security (015).*
$RENBF_{015}$ = average interest rate on deposits for *Central Government and Social Security (015).*
$RENG$ = nominal interest rate on debt issued to finance investment in physical capital.

$RENU$ = nominal annual interest rate on positive financial investment in the international capital market.
$RENGX_{015}$ = difference between the average interest rate on debt for *Central Government and Social Security (015)* and the nominal interest rate on debt.
$RENFX_{015}$ = difference between the average interest rate on deposits for *Central Government and Social Security (015)* and the nominal interest rate on deposits.

Income from interest and dividends

(2.28.42) $$RRAM_{015} = RENBF_{015}\frac{BF_{015} + BF_{015}(-1)}{2} + RRAMX_{015}$$

(2.28.43) $$RRM_{015} = RRAM_{015} - RAM_{015}$$

(2.28.44) $$RRB_{015} = RENBG_{015}\frac{BG_{015} + BG_{015}(-1)}{2} + RRBX_{015}$$

New symbols
$RRAM_{015}$ = income from interest and dividends received by *Central Government and Social Security (015).*
$RRAMX_{015}$ = correction variable for Income from interest and dividends received by *Central Government and Social Security (015).*
$RRBX_{015}$ = correction variable for outlays to interest and dividends from *Central Government and Social Security (015).*

Surplus before financial transactions

(2.28.45) $$RSK_{015} = RS_{015} - \sum_i VJNI_i - VJNE_{015} - VJ_{53\,050} \qquad i \in \{015, 210\} \subset \mathbf{INS}$$

New symbols
RSK_{015} = surplus before financial transactions in *Central Government and Social Security (015).*
$VJNI_i$ = net fixed capital formation in institutional sector i in current prices.
$VJ_{53\,050}$ = net capital formation in central government petroleum enterprises in current prices.

Total expenditure *(RUT_{015})*

(2.28.46) $$RUT_{015} = RVB_{015} + VG_{90S} + \sum_i VJNI_i + VJNE_{015} + VJ_{53\,050} \qquad i \in \{015, 210\} \subset \mathbf{INS}$$

2.29 Income account for local government

The structure of the relationship between the variables in the model block calculating income and expenditure flows may be difficult to grasp from the list of equations and symbol explanations alone. Table 2.29.1 below may therefore serve as a supplement.

Table 2.29.1 Income Account for Local Government ($i = 040$)

	Income and outlay by type	Symbol in MSG-5
A	Total income	RI_i
	1. Property income	RRV_i
	1.a) Income from interest	RRM_i
	1.b) Income from dividends	RAM_i
	1.c) Local government enterprise surplus	YEN_{230}
	2. Taxes and social security contributions	$RYTB_i$
	2.a) Direct taxes	RTK
	2.b) Other accrued indirect taxes	$YTAK$
	3. Transfers from other government sectors	$RV_{015\,i}$
B	Total expenditure	RUT_i
	1. Interest	RRB_i
	2. Transfers	RU_i-$YTUK$
	2.a) Transfers to households	RU_i
	2.b) Subsidies	$YTUK$
	3. Transfers to other government sectors	$RV_{040\,i}$
	4. Local final consumption expenditure	$VG_{93K}+VG_{94K}+VG_{95K}$
	4.a) Net indirect taxes	$YT_{93K}+YT_{94K}+YT_{95K}$
	4.b) Wages and salaries	$YW_{93K}+YW_{94K}+YW_{95K}$
	4.c) Cost of goods and services	$VH_{93K}+VH_{94K}+VH_{95K}$
	4.d) Consumption of fixed capital	$YD_{93K}+YD_{94K}+YD_{95K}$
	4.d) Local government fees (-)	$VXG_{93K}+VXG_{94K}+VXG_{95K}$
	5. Net capital formation	$VJNI_i+VJNE_i$
	5.a) Net fixed capital formation	$VJNI_i$
	5.b) Net purchase of real property	$VJNE_i$
C	Surplus before financial transactions (A - B)	RSK_i
D	Disposable income	RD_i
E	Net savings (D - B4)	RS_i
F	Net financial investment (E - B5)	NFI_i

Income from indirect taxes and subsidies

(2.29.1) $YTA_K = YTART_{582} + YTART_{583}$

(2.29.2) $YTU_K = YTART_{794}$

Symbols

YTA_K = gross indirect taxes to *Local Government (040)*.
$YTART_i$ = net indirect taxes of type *i*.
YTU_K = subsidies from *Local Government (040)*.

Total direct taxes received by *(RT_K)*

(2.29.3) $RT_K = \sum_i RT_i \qquad i \in \{422, 407, 452\} \subset \mathbf{RT}$

Gross accrued tax income to (*$RYTB_{040}$*)

(2.29.4) $RYTB_{040} = YTAK + RTK$

Property income

(2.29.5) $RRV_{040} = RRM_{040} + RAM_{040} + YEN_{230}$

New symbols

RRV_{040} = total property income to *Local Government (040)*.
RRM_{040} = income from interest received by *Local Government (040)*.
RAM_{040} = dividends received by *Local Government (040)*.
YEN_{230} = surplus in *Local Government Enterprises (040)*.

Transfers from *Local Government*

(2.29.6) $RU_{040} = \sum_j RU_j \qquad j \in \{619, 622, 666\} \subset \mathbf{RU}$

(2.29.7) $RVB_{040} = RRB_{040} + RU_{040} - YTUK + RV_{040\,015}$

New symbols

RU_{040} = total transfers to *Households (300)* from *Local Government (040)*.
RU_j = total transfers of type *j* to *Households (300)* from *General Government (006)*.
RVB_{040} = transfers from *Local Government (040)*.
RRB_{040} = interest paid by *Local Government (040)*.
$RV_{040\,i}$ = other transfers from *Local Government (040)* to institutional sector *i*.

Total income

(2.29.8) $RI_{040} = RYTB_{040} + RRV_{040} + RV_{015\,040}$

New symbols

RI_{040} = total income to *Local Government (040)*.
$RV_{015\,040}$ = other transfers from *Central Government and Social Security (015)* to *Local Government (040)*.

Total disposable income ***(RD_{040})***

(2.29.9) $$RD_{040} = RI_{040} - RVB_{040}$$

Net savings

(2.29.10) $$RS_{040} = RD_{040} - VG_{90K}$$

(2.29.11) $$VG_{90K} = VG_{93K} + VG_{94K} + VG_{95K}$$

Net lending

(2.29.12) $$NFI_{040} = RS_{040} - VJNI_{040} - VJNE_{040}$$

New symbols

NFI_{040} = net lending (or net financial investment) in *Local Government (040).*
$VJNI_{040}$ = net fixed capital formation in *Local Government (040).*
$VJNE_{040}$ = net purchase of real property by *Local Government (040).*

Change in total financial assets and liabilities

(2.29.13) $$BF_{040} = BF_{040}(-1) + ZALFA_{040}NFI_{040}$$

(2.29.14) $$BG_{040} = BG_{040}(-1) + BF_{040} - BF_{040}(-1) - NFI_{040} - OMV_{040} + BGX_{040}$$

(2.29.15) $$ZALFA_{040} = \begin{cases} 1, \text{ if } BF_{040}(-1) - ALFA_{040}NFI_{040} < 0 \\ 0, \text{ if } BF_{040}(-1) + ALFA_{040}NFI_{040} < 0 \\ \quad ALFA_{040} \quad \textit{elsewhere} \end{cases}$$

New symbols

BF_{040} = total financial assets held by *Local Government (040)* by the end of the year.
NFI_{040} = net lending (or net financial investment) in *Local Government (040).*
BG_{040} = total liabilities held by *Local Government (040)* by the end of the year.
OMV_{040} = revaluation of net liabilities held by *Local Government (040).*
BGX_{040} = correction variable for total liabilities held by *Local Government (040).*
$ALFA_{040}$ = the proportion of the change in total financial assets to the change in total liabilities held by *Local Government (040).*
$ZALFA_{040}$ = the proportion of the change in total financial assets to the change in total liabilities held by *Local Government (040)* when the value of the total financial assets is negative.

Average interest rates on debt and deposits

(2.29.16) $$RENBG_{040} = RENG + RENGX_{040}$$

(2.29.17) $$RENBF_{040} = RENU + RENFX_{040}$$

New symbols

$RENBG_{040}$= average interest rate on debt for *Local Government (040).*
$RENBF_{040}$= average interest rate on deposits for *Local Government (040).*

RENG = nominal annual interest rate on debt issued to finance investment in physical capital.
RENU = nominal annual interest rate on positive financial investment in the international capital market.
$RENGX_{040}$ = difference between the average interest rate on debt for *Local Government (040)* and the nominal interest rate on debt.
$RENFX_{040}$ = difference between the average interest rate on deposits for *Local Government (040)* and the nominal interest rate on deposits.

Income from interest and dividends

(2.29.18) $$RRAM_{040} = RENBF_{040} \frac{BF_{040} - BF_{040}(-1)}{2} + RRAMX_{040}$$

(2.29.20) $$RRM_{040} = RRAM_{040} - RAM_{040}$$

(2.29.21) $$RRB_{040} = RENBG_{040} \frac{BG_{040} - BG_{040}(-1)}{2} + RRBX_{040}$$

New symbols
$RRAM_{040}$ = income from interest and dividends received by *Local Government (040).*
$RRAMX_{040}$ = correction variable for income from interest and dividends received by *Local Government (040).*
$RRBX_{040}$ = correction variable for outlays to interest and dividends from *Local Government (040).*

Surplus before financial transactions *(RSK_{040})*

(2.29.22) $$RSK_{040} = RS_{040} - VJNI_{040} - VJNE_{040}$$

Total expenditure *(RUT_{040})*

(2.29.23) $$RUT_{040} = RVB_{040} + VG_{90K} + VJNI_{040} + VJNE_{040}$$

2.30 Income account for other institutional sectors

Income from interest received by *Other Private Incorporated Enterprises (309)*

(2.30.1) $$RRM_{309} = \sum_{i \in \text{INS}} RRB_i - \sum_{i \in \text{INS} \setminus \{309\}} RRM_i$$

Symbols
RRM_j = income from interest received by institutional sector *i*.
RRB_i = interest paid by institutional sector *i*.

Net income from interest and dividends received by *Ocean Transport and Drilling (306)* and *Production and Pipeline Transport of Oil and Gas (307)*

(2.30.2) $$RRA_i = RRM_i + RAM_i - RRB_i - RAB_i \qquad i \in \{306,307\} \subset \text{INS}$$

New symbols
RRA_i = net income from interest and dividends received by institutional sector *i*.
RAM_i = dividends received by institutional sector *i*.
RAB_i = dividends paid by institutional sector *i*.

Net interest and dividends from *Abroad*

(2.30.3) $$RRAU_i = RR_{500\,i} + RA_{500\,i} - RR_{i\,500} - RA_{i\,500} \qquad i \in \{306,307\} \subset \text{INS}$$

New symbols
$RRAU_i$ = net interest and dividends from *Abroad (500)* received by institutional sector *i*.
RR_{ij} = interest paid by institutional sector *i* to institutional sector *j*.
RA_{ij} = dividends paid by institutional sector *i* to institutional sector *j*.

Net disposable income

(2.30.4) $$RD = Y + RRV - YD$$

New symbols
RD = net disposable income for Norway.
Y = gross national product in current prices.
RRV = net interest payments and transfers from abroad.
YD = depreciation of fixed capital in current prices.

Disposable income by institutional sector

(2.30.5) $$\begin{aligned} RD_i = \; & YEI_i + RRM_i + RAM_i + \sum_{j \in \text{INS} \setminus \{i\}} RV_{ji} \\ & -(RRB_i + RAB_i + \sum_{j \in \text{INS} \setminus \{i\}} RV_{ij} + RT_i \end{aligned}$$

$i \in \{101,102\} \subset \text{INS}$

(2.30.6) $$RD_{306} = YEI_{306} + RRA_{306} - RT_{306}$$

(2.30.7) $$RD_{307} = YEI_{307} + RRA_{307} - RT_{307} - VJ_{53\,040} + VJ_{53\,030}$$

(2.30.8) $$RD_{999} = RD - \sum_i RD_i \qquad i \in \{006, 015, 040, 300, 306, 307\} \subset \mathbf{INS}$$

(2.30.9) $$RD_{309} = RD_{999} - \sum_i RD_i \qquad i \in \{101, 102\} \subset \mathbf{INS}$$

New symbols

RD_i = net disposable income for institutional sector *i*.
$RV_{kk'}$ = other transfers from institutional sector *k* to institutional sector *k'*.
RT_i = accrued direct taxes, institutional sector *i*.
YEI_i = operating surplus in institutional sector *i* in current prices.
$VJ_{53\,030}$ = current expenses in central government petroleum enterprises.
$VJ_{53\,040}$ = income from interest received by central government petroleum enterprises.

Gross savings by institutional sector

(2.30.10) $$RSB = Y + RRV - VC - VG$$

(2.30.11) $$RSB_{015} = RD_{015} + YDI_{015} - VG_{90S}$$

(2.30.12) $$RSB_{040} = RD_{040} + YDI_{015} - VG_{90K}$$

(2.30.13) $$RSB_i = RD_i + YDI_i \qquad i \in \{300, 306, 307\} \subset \mathbf{INS}$$

(2.30.14) $$RSB_{999} = RSB - \sum_i RSB_i \qquad i \in \mathbf{INS} \setminus \{015, 040, 300, 306, 307\}$$

New symbols

RSB = gross savings in Norway.
RSB_i = gross savings in institutional sector *i*.
VC = aggregate private consumption in current purchaser prices.
VG = total expenditure/consumption in the government production sectors in current prices.
VG_{90S} = expenditure/consumption in central government production sectors in current prices.
VG_{90K} = expenditure/consumption in local government production sectors in current prices.
YDI_i = depreciation of fixed capital owned by institutional sector *i*.

Note that in contradistinction to *VCC*, *VC* is inclusive of *Medical Care and Health Expenditures (62)* and *Purchase of cars (30)*, but the imputed rent from the stock of cars, *User Cost of Cars etc. (31)*, is excluded (see the comments to Eqs. (2.11.8) and (2.12.10)).

Net savings in Norway *(RS)*

(2.30.15) $$RS = RSB - YD$$

Price index of domestic absorption

(2.30.16) $$PANV = \frac{VC + VG + VJK + VDS}{C + G + JK + DS}$$

New symbols

$PANV$ = price index of domestic absorption.
C = aggregate private consumption in constant prices.
G = expenditure/consumption in the government production sectors in constant prices.
VJK = gross capital formation in current prices.
JK = gross capital formation in constant prices.
VD, VDS = total change in inventories in constant and current prices, respectively.

Disposable real income for Norway *(XRD)*

(2.30.17) $$XRD = RD / PANV$$

MISCELLANEOUS

2.31 Distribution of income by household group

There are 14 household groups in the model which are distinguished by socio-economic and demographic characteristics. A sub-model distributes total household income to the different household groups.

The coefficient $F_{\cdot ih}$ is the fraction of income/expenditure of type *i* which is distributed to household group *h*. The distribution keys are calculated with data from the Norwegian Income and Property Statistics. $F_{\cdot ih}$ is adjusted with $K_{\cdot i\,300}$ in order to modify the effects on the income distribution caused by demographic changes.

(2.31.1) $$K_{\cdot i300} = \sum_{h \in \mathbf{HH}} F_{\cdot ih} NH_h \qquad i \in \mathbf{IH}$$

(2.31.2) $$\begin{aligned} YH_h = \theta_h \Bigg\{ & \frac{F_{\cdot 010h}}{K_{\cdot 010\,300}} YWWC + \frac{F_{\cdot 100h}}{K_{\cdot 100\,300}} YEI_{300} + \frac{F_{\cdot 220h}}{K_{\cdot 220\,300}} RAM_{300} \\ & + \frac{F_{\cdot 295h}}{K_{\cdot 295\,300}} RRN_{300} + \frac{F_{\cdot 640h}}{K_{\cdot 640\,300}} RU_{640} + \frac{F_{\cdot 695h}}{K_{\cdot 695\,300}} (RUK - RU_{640}) \\ & + \frac{F_{\cdot TAXh}}{K_{\cdot TAX300}} (RVR_{300} - RTN_{300}) - \frac{F_{\cdot Nh}}{K_{\cdot N300}} RV_{300\,015} \Bigg\} \end{aligned}$$

$$h \in \mathbf{HH} \qquad \theta_h = \begin{cases} 0.25 & when \quad h = 364 \\ 1 & when \quad h \neq 364 \end{cases}$$

(2.31.3) $$VCCH_h = CRH_h CRE\ YH_h \qquad h \in \mathbf{HH}$$

(2.31.4) $$VCC = \sum_{h \in \mathbf{HH}} NH_h VCCH_h$$

(2.31.5) $$CREH_h = CRH_h CRE \qquad h \in \mathbf{HH}$$

Symbols

$K_{\cdot i\,300}$ = variable adjusting the income distribution key for demographic changes, income/expenditure type *i*.
NH_h = number of households in household group *h*.
$F_{\cdot i\,h}$ = coefficient distributing income/expenditure of type *i* to household group *h*.
YH_h = total income received by household group *h*.
YEI_{300} = operating surplus received by *Households (300)*.
$YWWC$ = wages and salaries net of social taxes received by domestic wage earners.
RAM_{300} = dividends received by *Households (300)*.
RRN_{300} = net income from interest received by *Households (300)*.
RU_{640} = family allowances (child benefits).
RUK = consumption-motivating transfers to *Households (300)*.
RVR_{300} = net other transfers to *Households (300)* exclusive of transfers from *Households (300)* to *Central Government and Social Security (015)*.

$RV_{300\,015}$ = other transfers from *Households (300)* to *Central Government and Social Securiy (015).*
RTN_{300} = accrued direct taxes collected from *Households (300).*
$VCCH_h$ = private consumption expenditure in household *h*.
CRH_h = savings ratio for household *h*.
CRE = parameter adjusting proportionally the savings ratio for all household groups.
VCC = aggregate consumption expenditure in current purchaser prices.
$CREH_h$ = adjusted savings ratio for household *h*.

Note that in contradistinction to *VC, VCC* is exclusive of *Medical Care and Healt Expenditures (62)* and *Purchase of Cars (30),* but imputed rent from the stock of cars, *User Cost of Cars etc. (31),* is included, see Sec. 2.11 and Eq. (2.12.10).

Wages and salaries to domestic wage earners

(2.31.6) $$YWWC = \sum_{j \in SOS} YWW_j$$

New symbols
YWW_j = wages and salaries net of social taxes received by socio-economic group *j*.

Net income from interest to *Households*

(2.31.7) $$RRN_{300} = \sum_{j \in SOS} RR_j$$

New symbols
RRN_{300} = net income from interest received by *Households (300).*
RR_j = net income from interest received by socio-economic group *j*.

Other transfers to *Households*

(2.31.8) $$RVR_{300} = RV_{500\,300} + RV_{102\,300} - RV_{300\,500}$$

New symbols
RVR_{300} = net other transfers to *Households (300)* exclusive of transfers from *Households (300)* to *Central Government and Social Security (015).*
RV_j = net other transfers received by socio-economic group *j*.
$RV_{300\,015}$ = other transfers from *Households (300)* to *Central Government and Social Security (015).*

2.32 Use of oil products

In principle the use of oil products measured in physical units should be found by dividing the constant price value by the price of a physical unit. A parameter which may be interpreted as such a price can be derived by dividing the value flows in the National Accounts by the corresponding physical flows reported in the Energy Accounts. However, the resulting figures ($OL_{41j}.0$ and $OL_{42j}.0$, where the index *j* indicates the kind of use) are strongly influenced by statistical differences between the two data sources, and they will deviate substantially from observed market prices of oil products. Hence, the price concept is not employed when explaining the ratios below.

Import of gasoline and fuel oils

(2.32.1) $$OL_{iI} = \lambda^{I}_{ii} \frac{I_i}{OL_{iI}.0} \qquad i \in \{41,42\} \subset \mathbf{VA}$$

Symbols

OL_{iI} = imports of commodity i (*Gasoline (41)* and *Fuel Oils etc. (42)*) measured in thousand tonnes.

λ^{I}_{ii} = base year value of the ratio between imports of commodity i in basic value and the c.i.f.-value of import activity i.

I_i = import activity i measured in constant prices c.i.f (basic value exclusive of customs).

$OL_{iI}.0$ = base year value of the ratio between the imports of commodity i measured in constant c.i.f.-prices (national account-figure) and imports of commodity i measured in thousand tonnes (energy account-figure).

Net production of gasoline and fuel oils

(2.32.2) $$OL_{41X} = \frac{\sum_{j \in \mathbf{PA}} \lambda^{X}_{41j} X_j - \lambda^{M}_{4141} M_{41}}{OL_{41X}.0}$$

(2.32.3) $$OL_{42X} = \frac{\sum_{j \in \mathbf{PA}} \lambda^{X}_{42j} X_j - \lambda^{F}_{4242} F_{42}}{OL_{42X}.0}$$

$\{41,42\} \subset \mathbf{VA}$

New symbols

OL_{iX} = net production of commodity i (*Gasoline (41)* and *Fuel Oils etc. (42)*) measured in thousand tonnes.

λ^{X}_{ij} = base year output coefficient calculated as the ratio between the deliveries of commodity i measured in basic value and the total deliveries from production activity j measured in constant net seller prices.

λ^{M}_{ij} = base year input coefficient calculated as the ratio between the input of commodity i measured in basic value and the total input of other material inputs in production sector j measured in constant net purchaser prices.

λ^{F}_{ij} = base year input coefficient calculated as the ratio between the input of commodity i measured in basic value and the total input of fuels in production sector j measured in constant net purchaser prices.

X_j = gross production in production activity j measured in constant net seller prices.

M_j = other material input in production sector j measured in constant net purchaser prices

F_j = input of fuels in production sector j measured in constant net purchaser prices

$OL_{iX}.0$ = base year value of the ratio between the net production of commodity i measured in net seller prices (national account-figure) and net production of commodity i measured in thousand tonnes (energy account figure).

Consumption of gasoline and fuel oils by *Households*

(2.32.4) $$OL_{iC} = \frac{\sum_{j \in \mathbf{CP}} \lambda_{ij}^{C} C_j}{OL_{iC}.0} \qquad i \in \{41,42\} \subset \mathbf{VA}$$

New symbols

OL_{iC} = private consumption of commodity i (*Gasoline (41)* and *Fuel Oils etc. (42)*) measured in thousand tonnes.

λ_{ij}^{C} = base year input coefficient calculated as the ratio between the deliveries of commodity i, measured in basic value, and the total consumption of sector j, measured in constant purchaser prices.

C_j = consumption sector j measured in constant purchaser prices.

$OL_{iC}.0$ = base year value of the ratio between the private consumption of commodity i measured in purchaser prices (national account-figure) and private consumption of commodity i measured in thousand tonnes (energy account-figure).

Export of gasoline and fuel oils

(2.32.5) $$OL_{iA} = \lambda_{ii}^{A} \frac{A_i}{OL_{iA}.0} \qquad i \in \{41,42\} \subset \mathbf{VA}$$

New symbols

OL_{iA} = export of commodity i (*Gasoline (41)* and *Fuel Oils etc. (42)*) measured in thousand tonnes.

λ_{ij}^{A} = base year value of the ratio between the export of commodity i measured in basic value and the total export of activity j measured in seller prices, f.o.b.

A_j = export activity j measured in constant purchaser prices.

OL_{iA} = base year value of the ratio between the export of commodity i measured in purchaser prices (national account-figure) and export of commodity i measured in thousand tonnes (energy account-figure).

Input of gasoline and fuel oils by input activity

(2.32.6) $$OL_{41j} = \lambda_{41j}^{M} \frac{M_j}{OL_{41 \cdot j}} \qquad j \in \mathbf{PSV}$$

(2.32.7) $$OL_{42j} = \lambda_{42j}^{F} \frac{F_j}{OL_{42 \cdot j}} \qquad j \in \mathbf{PSV}$$

(2.32.8) $$OL_{i\,92S} = OL_{i\,92C} + OL_{i\,92U} \qquad i \in \{41,42\} \subset \mathbf{VA}$$

(2.32.9) $$OL_{iH} = \sum_{j \in \mathbf{PSV}} OL_{ij} \qquad i \in \{41,42\} \subset \mathbf{VA}$$

New symbols

OL_{ij} = input of commodity i (*Gasoline (41)* and *Fuel Oils etc. (42)*) in input activity j measured in thousand tonnes.

$OL_{ij}.0$ = base year value of the ratio between the input of commodity i in production sector j measured in purchaser prices (national account-figure) and input of commodity i in input activity j measured in thousand tonnes (energy account figure).

$OL_{i\,92C}$ = input of commodity i in the activity *Defence Exclusive of Military Submarines and Aircraft (92C)* measured in thousand tonnes.

$OL_{i\,92U}$ = input of commodity i in the activity *Military Submarines and Aircraft (92U)* measured in thousand tonnes.

$OL_{i\,92S}$ = input of commodity i in the sector *Defence (92S)* measured in thousand tonnes.

$OL_{i\,H}$ = total input of commodity i in the domestic production sectors measured in thousand tonnes.

Difference in the physical account of oil products *($BETAOL_i$)*

The difference defined by $BETAOL_i$ can be attributed to changes in inventories and statistical discrepancies between the National Accounts and the Energy Accounts.

(2.32.10) $$BETAOL_i = OL_{i\,I} = OL_{i\,X} + OL_{i\,H} - OL_{i\,C} - OL_{i\,A}$$

$i \in \{41, 42\} \subset \mathbf{VA}$

Allocation of energy between electricity and oil products

(2.32.11) $$ZUE_j = \frac{E_j}{E_j + F_j} \qquad j \in \mathbf{PSV}$$

(2.32.12) $$ZUF_j = 1 - ZUE_j \qquad j \in \mathbf{PSV}$$

New symbols

ZUE_j = the share of electricity in constant prices in the constant price energy aggregate in input activity j.

ZUF_j = the share of fuel oil in constant prices in the constant price energy aggregate in input activity j.

E_j = input of electricity in constant prices used by input activity j.

2.33 Average rate of return to capital

(2.33.1) $$RPP_j = \frac{YE_j - YW_j\left(\dfrac{LS_j.0}{LW_j.0}\right)}{VK_j} \qquad j \in \mathbf{PP}$$

(2.33.2) $$RPP = \frac{\sum_{j \in \mathbf{PP}} \left\{ YE_j - YW_j\left(\dfrac{LS_j.0}{LW_j.0}\right)\right\}}{\sum_{j \in \mathbf{PP}} VK_j}$$

Symbols

RPP_j = average rate of return to capital in private production sector j.

RPP = economy-wide weighted average rate of return to capital in the private production sectors.

YE_j = operating surplus in production sector j in current prices.
YW_j = total wage cost in production sector j in current prices.
$LS_j.0$ = self employed in production sector j, man hours in the base year.
$LW_j.0$ = wage earners in production sector j, man hours in the base year.
VK_j = value of the real (fixed) capital stock in production sector j in current prices.

3 Aggregation level and variables

3.1 Document lists

VA	List of Commodities
PSK	List of All Production Sectors
PS	Production Sectors
KORR	Sectors Collecting Indirect Taxes
PP	Private Production Sectors
PO	Government Production Sectors
PA	List of Production Activities
PSV	List of Input Activities
CP	List of Consumption Sectors
CA	List of Consumption Activities
JR	List of Real Capital by Type
JA	List of Investment Activities
JS	List of Investment Sectors
RU	List of Transfers by Type
AVG	List of Indirect Taxes and Transfers by Type
PX	Indirect Volume Taxes and Subsidies Collected from Producers
VX	Indirect Volume Taxes and Subsidies Collected from Wholesale and Retail Trade
PV	*Ad Valorem* Taxes Collected from Producers
PV	*Ad Valorem* Taxes Collected from Wholesale and Retail Trade
SA	Sectorial Taxes
SU	Sectorial Subsidies
RT	List of Direct Taxes by Type
TP	Personal Tax-Payers
TS	Corporate Tax-Payers
INS	List of Institutional Sectors
SOS	List of Socio-Economic Groups
HH	List of Household Groups
IH	List of Components of Households' Income and Expenditure

VA
List of Commodities

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Commodity Code	National Accounts Commodity Code
	Commodities from Industries		**Type of Account 10,11,12,13,14,15**
11	Agricultural Commodities (Jordbruksprodukter)	21,22	101-105,108,110,113-118, 127,134,136,138-140
12	Commodities from Forestry (Skogbruksprodukter)	12	143,144,146,147
13	Commodities from Fishery (Fiskeprodukter)	13	151-157
16	Processed Commodities from Agriculture and Fishery (Foredlete jordbruks- og fiskeprodukter)	16	200,205,211-213,215,220,225, 230,235,240,245,250,255,260, 266,270
17	Beverages and Tobacco (Drikkevarer og tobakk)	17	275,280,285,290
18	Textiles and Wearing Apparels (Tekstil- og bekledningsvarer)	18	295,300,305,310,315,320, 325,331,332,335,340,345,350
25	Various Manufacturing Products (Diverse industriprodukter)	26,27,28,31	160,171,172,175,181,355,360,365, 370,375,406,407,409,411,412,416, 417,435,440,445,450,455,468,470, 475,480,485,490,495,500,505,665, 670,675,680
34	Pulp and Paper Articles (Treforedlingspodukter)	34	380,385,390,395,400
37	Industrial Chemicals (Kjemiske råvarer)	37	420,425,430
41	Gasoline (Bensin)	41	461
42	Fuel Oils etc. (Fyringsolje mv.)	42	462,463
43	Metals (Metaller)	43	510,515,520,525,530,535
46	Metal Products, Machinery and Equipment (Verkstedprodukter)	46	085,090,091,540,545,550,555,560, 565,570,576,577,580,585,590,600, 605,610,615,620,625,636,640,652, 653
47	Repair (Leiearbeid og reparasjoner)	47	070-072,075,595,596,598,632,637 638,647,663,664
48	Ships (Skip)	48	630,631,634,639
49	Oil Production Platforms (Oljeutvinningsplattformer)	49	582-584
71	Electricity (Elektrisitet)	71	686
55	Construction (Bygg og anlegg)	55	082,083,131-133,148,149, 158,159,683,684,688,689, 701-716,718,719,803, 804,862,863,957,958

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Commodity Code	National Accounts Commodity Code
81	Wholesale and Retail Trade (Varehandel)	81	079,720,14xxx, where xxx runs over all 3 digit NA commodity codes
66	Crude Oil (Råolje)	66	166,168
67	Natural Gas (Naturgass)	67	167
69	Oil and Gas Pipeline Transport (Olje- og gasstransport med rør)	69	824
65	Oil and Gas Exploration and Drilling, Leasing of Oil Drilling Rigs and Ocean Transport (Boring etter olje og gass, utleie av borerigger og fraktinntekter fra skip)	60,68	717,831,832,906
74	Domestic Transport Services (Transporttjenester innenlands)	75,76,61	801,802,806,807,811,816,820,826, 827,833,836,837,842-844,846, 847,851,852,856,857,858,861
63	Finance and Insurance Services (Bank og forsikringstjenester mv.)	63	866,871,874,875,881,882
83	Dwelling Services (Boligtjenester)	83	885
85	Other Private Services (Annen privat tjenesteyting)	77-79,86-88	690,696,761,762,890,895,901,902, 905,921,926,927,931,932,936,940, 946,951,952,956,960,965,971,972, 900
89	Imputed Service Charges from Financial Institutions (Frie banktjenester)	89	867,872
	Commodities from Government Production Sectors		
92	Defence (Forsvar)	92	916,917
93	Education, Research and Scientific Institutes (Undervisning og forskningsvirksomhet)	93	928,929
94	Health and Veterinary Services etc. (Helse- og veterinærtjenester)	94	933,934,937,938
95	Other Public Services (Annen offentlig tjenesteyting)	95	137,145,687,828,838,841,848,949, 870,903,904,911,912,922,923,947, 948,953,954
	Non-Competing Imports		
09	Food and Raw Materials (Matvarer og råvarer)	00,01	106.107,109,267,173,182
02	Cars, Tractors etc. (Biler traktorer mv.)	02	061,578,651,
08	Aircraft (Fly)	08	045,661,662
03	Military Submarines and Aircraft (U-båter og F16-fly)	03	908,909

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Commodity Code	National Accounts Commodity Code
35	Operating Expenditure Abroad, Fishing and Shipping (Skipsfartens drifts-utgifter i utlandet)	05,04	056,053,599,633
06	Imports of Services in Connection with Oil Activities (Oljeutvinning, diverse tjenesteimport)	06	048,057,063,064,597
07	Import of Goods in Connection with Oil Activities (Oljevirksomhet, diverse vareimport)	07	046,060,062
19	Other Non-Competing Imports (Annen ikke-konkurrerende import)	19	051,055,058,059,913,915,918
36	Direct Purchases Abroad by Resident Households (Nordmenns konsum i utlandet)	36	066-069

PSK

List of All Production Sectors

PSK = PS∪KORR = PP∪PO∪KORR

PS Production Sectors

KORR Sectors Collecting Indirect Taxes

PP Private Production Sectors

PO Government Production Sectors

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector Code
PS	**Production Sectors**		**Type of Account 23**
PP	**Private Production Sectors**		
11	Agriculture (Jordbruk)	21,22	100,120,130,135,140
12	Forestry (Skogbruk)	12	145
13	Fishing and Breeding of Fish etc. (Fiske og fangst, innkl. fiskeoppdrett)	13	150,155
15	Manufacture of Consumption Goods (Produksjon av konsumvarer)	16,17,18	200,205,210,215,220,225,230, 235,240,245,250,255,260,265, 270,275,280,285,290,295,300, 305,310,315,320,325,330,335, 340,345,350
25	Manufacture of Intermediate Inputs and Capital Goods (Produksjon av vareinnsats- og investeringsvarer)	26,27,28,31	355,360,365,370,375,160,170, 175,435,440,445,450,455,465, 470,475,480,485,490,495,500, 505,665,670,675,680,180,405, 410,415
34	Manufacture of Pulp and Paper Articles (Produksjon av treforedlingsprodukter)	34	380,385,390,395,400
37	Manufacture of Industrial Chemicals (Produksjon av kjemiske råvarer)	37	420,425,430
40	Petroleum Refining (Raffinering av jordolje)	40	460
43	Manufacture of Metals (Produksjon av metaller)	43	510,515,520,525,530,535
45	Manufacture of Metal Products, Machinery and Equipment (Produksjon av verkstedprodukter)	45	540,545,550,555,560,565, 570,575,580,585,590,595, 600,605,610,615,620,625, 645,650,660
50	Building of Ships and Oil-Platforms (Prod. av skip og plattformer)	48,49	582,630,635,640
71	Production of Electricity (Elektrisitetsproduksjon)	71	685,691
55	Construction, excl. Oil Well Drilling (Bygge- og anleggsvirksomhet)	55	700
81	Wholesale and Retail Trade (Varehandel)	81	720
64	Production and Pipeline Transport of Oil and Gas (Råolje og naturgass, utvinning og transport)	66,69	165,824

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector Code
65	Ocean Transport, Oil and Gas Exploration and Drilling (Utenriks sjøfart og oljeboring)	60,68	717,830
74	Domestic Transport (Innenriks samferdsel)	61,75,76	800,805,810,815,820,825,835,840,845,850,855,860,
63	Finance and Insurance (Bank- og forsikringsvirksomhet)	63	865,870,874,875,880
83	Dwelling Services (Boligtjenester)	83	885
85	Other Private Services (Annen privat tjenesteproduksjon)	77,78,79,86, 87,88	690,695,760,890,895,900,905,920,925,930,935,940,945,950, 955,960,970,965
89	Imputed Service Charges from Financial Institutions (Hjelpesektor for frie banktjenester)	89	869,873
PO	**Government Production Sectors**		
	Central Government		**Type of Account 21**
92S	Defence (Forsvar)	92S	915
93S	Central Government Education and Research (Statlig undervisning)	93S	925
94S	Central Government Health-Care and Veterinary Services etc. (Helsetjeneste m.v., stat)	94S	930,935
95S	Other Central Government Services (Annen statlig tjenesteproduksjon)	95S	135,145,825,840,845,870,900, 910,945,950
	Local Government		**Type of Account 22**
93K	Local Government Eucation and Research (Kommunal undervisning)	93K	925
94K	Local Government Health-Care and Veterinary Services (Helsetjenester m.v., kommuner)	94K	930,935
95K	Other Local Government Services (Annen kommunal tj.produksjon)	95K	825,910,920,945,950
KORR	**Sectors Collecting Indirect Taxes**		**Type of account 23**
51	Collection of Customs Duty (Innkreving av toll)	51	750
54	Collection of Investment Levy on Fixed Capital Formation (Innkreving av investeringsavgift på investeringer)	54	753
57	Collection of Import Taxes (Innkreving av særavgifter på import)	57	756
59	Collection of Value Added Tax (Påløpt merverdiavgift)	59	758

MSG Code	**Full Name** (Norwegian name in parenthesis)	**Quarterly NA-Sector Code**	**National Accounts Sector Code**
58	Estimated Gain at Constant Prices due to Shift Effects between Exports and Domestic Uses etc./Circular Flow Difference in Current Prices (Beregnede skiftvirkninger)	58	759

PA

List of Production Activities

PA Code*	Full Name** (Norwegian name in parenthesis)	Main Commodity in the Activity (VA Code)
	Private Production Activities	
11	Production of Agricultural Commodities (Produksjon av jordbruksvarer)	Agricultural Commodities (11)
12	Production of Commodities from Forestry (Produksjon av skogbruksprodukter)	Commodities from Forestry (12)
13	Production of Commodities from Fishery (Produksjon av fiskeprodukter)	Commodities from Fishery (13)
1516	Production of Processed Commodities from Agriculture and Fishery (Produksjon av foredlete jordbruks- og fiskeprodukter)	Processed Commodities from Agriculture and Fishery (16)
1517	Production of Beverages and Tobacco (Produksjon av drikkevarer og tobakk)	Beverages and Tobacco (17)
1518	Production of Textiles and Wearing Apparels (Produksjon av tekstil- og bekledningsvarer)	Textiles and Wearing Apparels (18)
25	Production of Various Manufacturing Products (Produksjon av diverse industriprodukter)	Various Manufacturing Products (25)
34	Production of Pulp and Paper Articles (Produksjon av treforedlingsprodukter)	Pulp and Paper Articles (34)
37	Production of of Industrial Chemicals (Produksjon av kjemiske råvarer)	Industrial Chemicals (37)
4041	Refining of Gasoline (Raffinering av bensin)	Gasoline (41)
4042	Refining of Fuel Oils etc. (Raffinering av fyringsolje m.v.)	Fuel Oils etc. (42)
43	Production of Metals (Produksjon av metaller)	Metals (43)
4546	Production of of Metal Products, Machinery and Equipment (Produksjon av verkstedprodukter)	Metal Products, Machinery and Equipment (46)
4547	Production of Repair Services in Manufacture of Metal Products, Machinery and Equipment (Leiearbeid og reperasjoner i Produksjon av verkstedsprodukter)	Repair (47)
5045	Production of Repair Services, Metal Products and Machinery Equipment in Building of Ships and Oil-Platforms (Leiearbeid og reperasjoner i Produksjon av skip og plattformer)	Repair (47) Metal Products, Machinery and Equipment (46)
5048	Production of Ships in Building of Ships and Oil-Platforms (Produksjon av skip i Produksjon av skip og plattformer)	Ships (48)
5049	Production of Oil Production Platforms in Building of Ships and Oil-Platforms (Produksjon av oljeutvinningsplattformer i Produksjon av skip og plattformer)	Oil Production Platforms (49)
71	Production of Electricity (Elektrisitetsproduksjon)	Electricity (71)
55	Construction, excl. Oil Well Drilling (Bygge- og anleggsvirksomhet)	Construction (55)
81	Wholesale and Retail Trade (Varehandel)	Wholesale and Retail Trade (81)

PA Code*	Full Name** (Norwegian name in parenthesis)	Main Commodity in the Activity (VA Code)
6447	Production of Repair Services in Production and Pipeline Transport of Oil and Gas (Leiearbeid og raparasjoner i Råolje og naturgass, utvinning og transport)	Repair (47)
6466	Production of Crude Oil in Production and Pipeline Transport of Oil and Gas (Produksjon av råolje i Råolje og naturgass, utvinning og transport)	Crude Oil (66)
6467	Production of Natural Gas in Production and Pipeline Transport of Oil and Gas (Produksjon av naturgass i Råolje og naturgass, utvinning og transport)	Natural Gas (67)
6469	Production of Oil and Gas Pipeline Transport inProduction and Pipeline Transport of Oil and Gas (Olje og gasstransport med rør i Råolje og naturgass, utvinning og transport)	Oil and Gas Pipeline Transport (69)
65	Ocean Transport, Oil and Gas Exploration and Drilling (Utenriks sjøfart og oljeboring)	Oil and Gas Exploration and Drilling, Leasing of Oil Drilling Rigs and Ocean Transport (65)
74	Production of Domestic Transport Services (Produksjon av innenlandske transporttjenester)	Domestic Transport Services (74)
6363	Production of Finance and Insurance Services (Produksjon av bank- og forsikringstjenester)	Finance and Insurance Services (63)
6389	Imputed Service Charges from Financial Institutions in Finance and Insurance (Frie banktjenester i Bank- og forsikringsvirksomhet)	Imputed Service Charges from Financial Institutions (89)
83	Production of Dwelling Services (Produksjon av boligtjenester)	Dwelling Services (83)
85	Production of Other Private Services (Annen privat tjenesteproduksjon)	Other Private Services (85)
89	Imputed Service Charges from Financial Institutions (Hjelpesektor for frie banktjenester)	Imputed Service Charges from Financial Institutions (89)
	Central Government Production Activities	
92S	Defence (Forsvar)	Defence (92)
93S	Central Government Education and Research (Statlig undervisning)	Education, Research and Scientific Institutes (93)
94S	Central Government Health-Care and Veterinary Services etc. (Helsetjeneste m.v., stat)	Health and Veterinary Services (94)
95S	Other Central Government Services (Annen statlig tjenesteproduksjon)	Other Public Services (95)
	Local Government Production Activities	
93K	Local Government Education and Research (Kommunal undervisning)	Education, Research and Scientific Institutes (93)
94K	Local Government Health-Care and Veterinary Services (Helsetjenester m.v., kommuner)	Health and Veterinary Services (94)
95K	Other Local Government Services (Annen kommunal tj.produksjon)	Other Public Services (95)

* The first two numbers in the PA code refer to the producing sector.

** The classification of the production activities follows the main commodity produced as is given by the input - output matrices in the base year.

PSV

List of Input Activities

MSG Code **PSV** = MSG Code **PS**∪{92C,92U}\{92S}

PSV Code	Full Name (Norwegian name in parenthesis)	Input Activity (M, E, F)	Main Commodity in the Activity (VA Code)*
	Private Input Activities		
11	Agriculture (Jordbruk)	*M* *E* *F*	Agricultural Commodities (11) Electricity (71) Fuel Oils etc. (42)
12	Forestry (Skogbruk)	*M* *E* *F*	Construction (55) Electricity (71) Fuel Oils etc. (42)
13	Fishing and Breeding of Fish etc. (Fiske og fangst, inkl. fiskeoppdrett)	*M* *E* *F*	Processed Commodities from Agriculture and Fishery (16) Electricity (71) Fuel Oils etc. (42)
15	Manufacture of Consumption Goods (Produksjon av konsumvarer)	*M* *E* *F*	Processed Commodities from Agriculture and Fishery (16) Electricity (71) Fuel Oils etc. (42)
25	Manufacture of Intermediate Inputs and Capital Goods (Produksjon av vareinnsats- og investeringsvarer)	*M* *E* *F*	Various Manufacturing Products (25) Electricity (71) Fuel Oils etc. (42)
34	Manufacture of Pulp and Paper Articles (Produksjon av treforedlingsprodukter)	*M* *E* *F*	Pulp and Paper Articles (34) Electricity (71) Fuel Oils etc. (42)
37	Manufacture of Industrial Chemicals (Produksjon av kjemiske råvarer)	*M* *E* *F*	Industrial Chemicals (37) Electricity (71) Fuel Oils etc. (42)
40	Petroleum Refining (Raffinering av jordolje)	*M* *E* *F*	Crude Oil (66) Electricity (71) Fuel Oils etc. (42)
43	Manufacture of Metals (Produksjon av metaller)	*M* *E* *F*	Metals (43) Electricity (71) Fuel Oils etc. (42)
45	Manufacture of Metal Products, Machinery and Equipment (Produksjon av verkstedprodukter)	*M* *E* *F*	Metal Products, Machinery and Equipment (46) Electricity (71) Fuel Oils etc. (42)
50	Building of Ships and Oil-Platforms (Prod. av skip og plattformer)	*M* *E* *F*	Metal Products, Machinery and Equipment (46) Electricity (71) Fuel Oils etc. (42)
71	Production of Electricity (Elektrisitetsproduksjon)	*M* *E* *F*	Construction (55) Electricity (71) Fuel Oils etc. (42)
55	Construction, excl. Oil Well Drilling (Bygge- og anleggsvirksomhet)	*M* *E* *F*	Various Manufacturing Products (25) Electricity (71) Fuel Oils etc. (42)
81	Wholesale and Retail Trade (Varehandel)	*M* *E* *F*	Other Private Services (85) Electricity (71) Fuel Oils etc. (42)
64	Production and Pipeline Transport of Oil and Gas (Råolje og naturgass, utvinning og transport)	*M* *E* *F*	Repair (47) Electricity (71) Fuel Oils etc. (42)

PSV Code	Full Name (Norwegian name in parenthesis)	Input Activity (M, E, F)	Main Commodity in the Activity (VA Code)*
65	Ocean Transport, Oil and Gas Exploration and Drilling (Utenriks sjøfart og oljeboring)	*M* *F*	Operating Expenditure Abroad, Fishing and Shipping (35) Fuel Oils etc. (42)
74	Domestic Transport (Innenriks samferdsel)	*M* *E* *F*	Domestic Transport Services (74) Electricity (71) Fuel Oils etc. (42)
63	Finance and Insurance (Bank- og forsikringsvirksomhet)	*M* *E*	Other Private Services (85) Electricity (71)
83	Dwelling Services (Boligtjenester)	*M* *E*	Construction (55) Electricity (71)
85	Other Private Services (Annen privat tjenesteproduksjon)	*M* *E* *F*	Other Private Services (85) Electricity (71) Fuel Oils etc. (42)
89	Imputed Service Charges from Financial Institutions (Hjelpesektor for frie banktjenester)	*M*	Imputed Service Charges from Financial Institutions (89)
	Government Input Activities		
	Central Government		
92C	Defence Exclusive of Military Submarines and Aircraft (Forsvar unntatt u-båter og F16-fly)	*M* *E* *F*	Construction (55) Electricity (71) Fuel Oils etc. (42)
92U	Military Submarines and Aircraft (U-båter og F16-fly)	*M*	Military Submarines and Aircraft (03)
93S	Central Government Education and Research (Statlig undervisning)	*M* *E* *F*	Other Private Services (85) Electricity (71) Fuel Oils etc. (42)
94S	Central Government Health-Care and Veterinary Services etc. (Helsetjeneste m.v., stat)	*M* *E* *F*	Various Manufacturing Products (25) Electricity (71) Fuel Oils etc. (42)
95S	Other Central Government Services (Annen statlig tjenesteproduksjon)	*M* *E* *F*	Construction (55) Electricity (71) Fuel Oils etc. (42)
	Local Government		
93K	Local Government Education and Research (Kommunal undervisning)	*M* *E* *F*	Various Manufacturing Products (25) Electricity (71) Fuel Oils etc. (42)
94K	Local Government Health-Care and Veterinary Services (Helsetjenester m.v., kommuner)	*M* *E* *F*	Various Manufacturing Products (25) Electricity (71) Fuel Oils etc. (42)
95K	Other Local Government Services (Annen kommunal tj.produksjon)	*M* *E* *F*	Construction (55) Electricity (71) Fuel Oils etc. (42)

* As given by the input - output matrices in the base year.

CP

List of Consumption Sectors

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector Code
			Type of Account 33
00	Food (Matvarer)	00	001-004,011,012,021-026,031-034,041,042,051-056,061,062, 071,081-083,091-093
11	Beverages and Tobacco (Drikkevarer og tobakk)	11	111-113,121-124
12	Electricity (Elektrisitet)	12	321
13	Fuels (Brensel)	13	322-325
14	Petrol and Car Maintenance (Driftsutgifter til egne transportmidler)	14	621-624
21	Clothing and Footwear (Klær og skotøy)	21	211-216,221-223,231-234
40	Furniture and Electrical Equipment (Møbler, elektriske husholdningsart. og varige fritidsgoder)	41,42	411-413,421-422,431-436,711-714
62	Medical Care and Health Expenditures (Helsepleie)	62	511-516
50	Gross Rents (Bolig)	50	311
30	Purchase of Cars etc. (Kjøp av egne transportmidler)	30	611,612
61	Public Transport Services (Bruk av off.transportmidler, post og teletjenester)	68,69	631-637,641,642
15	Other Goods (Andre varer)	15,22,23	811-814,821-825,441-445, 451, 452, 715-718, 731-733
60	Other Services (Andre tjenester)	24,67,63,64	721-726, 741, 453, 454, 461, 471, 831, 832, 841, 851-853
66	Direct Purchases Abroad by Resident Households (Nordmenns konsum i utlandet)	66	991

CA

List of Consumption Activities

MSG Code **CA** = MSG Code **CP**$\cup$\{31\}\\{30,62\}

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector code
			Type of Account 33
00	Food (Matvarer)	00	001-004,011,012,021-026,031-034, 041,042,051-056,061,062, 071,081-083,091-093
11	Beverages and Tobacco (Drikkevarer og tobakk)	11	111-113,121-124
12	Electricity (Elektrisitet)	12	321
13	Fuels (Brensel)	13	322-325
14	Petrol and Car Maintenance (Driftsutgifter til egne transportmidler)	14	621-624
21	Clothing and Footwear (Klær og skotøy)	21	211-216,221-223,231-234
40	Furniture and Electrical Equipment (Møbler, elektriske husholdningsart. og varige fritidsgoder)	41,42	411-413,421-422,431-436,711-714
50	Gross Rents (Bolig)	50	311
31	User Cost of Cars etc. (Bilhold)		
61	Public Transport Services (Bruk av off.transportmidler, post og teletjenester)	68,69	631-637,641,642
15	Other Goods (Andre varer)	15,22,23	811-814,821-825,441-445, 451, 452, 715-718, 731-733
60	Other Services (Andre tjenester)	24,67,63,64	721-726, 741, 453, 454, 461, 471, 831, 832, 841, 851-853
66	Direct Purchases Abroad by Resident Households (Nordmenns konsum i utlandet)	66	991

JR
List of Real Capital by Type

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector Code
			Type of Account 20
10	Dwellings, Cottages and Non-Residental Buildings etc. (Bolig-,fritids- og driftsbygg m.v.)	B1	101,111,113,121-136,211-236,311-336
20	Oil Constructions etc. (Oljeanlegg m.v.)	B2	137,138,237,238,337,338
30	Ships, Fishing Boats etc. (Skip,fiskebåter etc.)	M1	141,142,241,242,341,342
40	Cars (Biler)	M2	161-170,261-270,361-370
80	Aircraft (Fly)	80	150,250,350
50	Machinery excl. Oil Drilling Rigs etc. (Maskiner m.v. ekskl. oljeboreplattformer)	M3	181-186,281-286,381-386
60	Ships, Oil Drilling Rigs, Platforms etc. (Oljeborerigger og skip)	M4	187
70	Inputs to Construction of Oil Rigs, Platforms etc. (Innsatsvarer i bygging av oljeboreplattformer m.v.)	70	188

JA

List of Investment Activities.
MSG Code **JA** = MSG Code **JR**$\cup$\{70\}\\{72,73,74,75,76\}

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector Code
			Type of Account 20
10	Dwellings, Cottages and Non-Residental Buildings etc. (Bolig-,fritids- og driftsbygg m.v.)	B1	101,111,113,121-136,211-236,311-336
20	Oil Constructions etc. (Oljeanlegg m.v.)	B21,B22, B23,B24	137,138,237,238,337, 338
30	Ships, Fishing Boats etc. (Skip,fiskebåter etc.)	M11,M12	141,142,241,242,341, 342
40	Cars (Biler)	M2	161-170,261-270,361-370
80	Aircraft (Fly)	80	150,250,350
50	Machinery excl. Oil Drilling Rigs etc. (Maskiner m.v. ekskl. oljeboreplattformer)	M3	181-186,281-286,381-386
60	Ships, Oil Drilling Rigs, Platforms etc. (Oljeborerigger og skip)	M4	187
	Inputs to Construction of Oil rigs, Platforms etc.		
72	Inputs to Construction of Oil rigs, Platforms etc., Commodity 46 (Verkstedprod. m.v, vare 46)	M51	part of 188
73	Repairs of Oil Rigs, Platforms etc., Commodity 47 (Leiearbeid m.v, vare 47)	M55	part of 188
74	Oil Production Plattforms, Commodity 49 (Oljeutv.plattformer, vare 50)	M52	part of 188
75	Business Services, Commodity 85 (Forretningsm. tj., vare 85)	M56	part of 188
76	Oil Activity, Various Imports, Commodity 06, 07, 08 (Oljevirks. div. imp., vare 06 07 08)	M53,M54	part of 188

JS

List of Investment Sectors
MSG Code **JS** = MSG Code **PS**\{89,92S}

MSG Code	**Full Name** (Norwegian name in parenthesis)	**Quarterly NA-Sector Code**	**National Accounts Sector Code**
	Private Investment Sectors		**Type of Account 59**
11	Agriculture (Jordbruk)	11	100
12	Forestry (Skogbruk)	12	140
13	Fishing and Breeding of Fish etc. (Fiske og fangst, innkl. fiskeoppdrett)	13	150,155
15	Manufacture of Consumption Goods (Produksjon av konsumvarer)	16,17,18	200,205,210,215,220,225,230, 235,240,245,250,255,260,265, 270,275,280,285,290,295,300, 305,310,315,320,325,330,335, 340,345,350
25	Manufacture of Intermediate Inputs and Capital Goods (Produksjon av vareinnsats- og investeringsvarer)	26,27,28,31	355,360,365,370,375,160,170, 175,435,440,445,450,455,465, 470,475,480,485,490,495,500, 505,665,670,675,680,180,405, 410,415
34	Manufacture of Pulp and Paper Articles (Produksjon av treforedlingsprodukter)	34	380,385,390,395,400
37	Manufacture of Industrial Chemicals (Produksjon av kjemiske råvarer)	37	420,425,430
40	Petroleum Refining (Raffinering av jordolje)	40	460
43	Manufacture of Metals (Produksjon av metaller)	43	510,515,520,525,530,535
45	Manufacture of Metal Products, Machinery and Equipment (Produksjon av verkstedprodukter)	45	540,545,550,555,560,565,570, 575,580,585,590,595,600,605, 610,615,620,625, 645,650,660
50	Building of Ships and Oil-Platforms (Prod. av skip og plattformer)	48,49	582,630,635,640
71	Production of Electricity (Elektrisitetsproduksjon)	71	685,691
55	Construction, excl. Oil Well Drilling (Bygge- og anleggsvirksomhet)	55	700
81	Wholesale and Retail Trade (Varehandel)	81	720
64	Production and Pipeline Transport of Oil and Gas (Råolje og naturgass, utvinning og transport)	66,69	165,824
65	Ocean Transport, Oil and Gas Exploration and Drilling (Utenriks sjøfart og oljeboring)	60,68	717,830
74	Domestic Transport (Innenriks samferdsel)	61,75,76	800,805,810,815,835, 840,845,850,855
63	Finance and Insurance (Bank- og forsikringsvirksomhet)	63	870

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector Code
83	Dwelling Services (Boligtjenester)	83	885
85	Other Private Services (Annen privat tjenesteproduksjon)	78,86,87,88	695,760,890, 955
	Central Government Investment Sectors		**Type of Account 57**
93S	Central Government Education and Research (Statlig undervisning)	93S	925
94S	Central Government Health-Care and Veterinary Services etc. (Helsetjeneste m.v., stat)	94S	930,935
95S	Other Central Government Services (Annen statlig tjenesteproduksjon)	95S	825,840,845,910,945,950,997
	Local Government Investment Sectors		**Type of Account 58**
93K	Local Government Eucation and Research (Kommunal undervisning)	93K	925
94K	Local Government Health-Care and Veterinary Services (Helsetjenester m.v., kommuner)	94K	930,935
95K	Other Local Government Services (Annen kommunal tj.produksjon)	95K	825,920,998

RU
List of Transfers by Type

MSG Code	Full Name (Norwegian name in parenthesis)	Data Base Code	National Accounts Sector Code
			Type of Account 48
611	Old-Age Pension from the Central Government Pension Fund (Alderspensjon fra statens pensjonskasse)	611	611
612	Other Old-Age Pension (Annen alderspensjon)	610	612
613	Disability Pension (Uførepensjon)	613	613
619	Social security Benefits from Local Government (Kommunale trygdeordninger m.v.)	619	619
630	Sickness Benefits etc. (Sykepenger mv.)	630	630
640	Familly Allowances (Child Benefits) (Barnetrygd)	640	640
621	Transfers to Central Government Health Institutions (Stønader til helseinstitusjoner, stats- og trygdeforv.)	621	621
622	Transfers to Local Government Health Institutions (Stønader til helseinstitusjoner, kommuneforvaltn.)	622	622
650	Unempoyment Benefits (Dagpenger)	650	650
658	Rehabilitation Benefits (Attføringsstønad m.v.)	658	662,663
659	Other Transfers, Central Government (Øvrige stønader, statsforvaltningen)	659	661,664,665
666	Other Transfers, Local Government (Øvrige stønader, kommuneforvaltn.)	666	666
609	Other Transfers, Central Government (Diverse stønader, statforvaltn.)	609	614,615,616,617,618

AVG

List of Indirect Taxes and Subsidies by Type

AVG = PX∪VX∪PV∪VV∪SA∪SU

PX Indirect Volume Taxes and Subsidies Collected from Producers

VX Indirect Volume Taxes and Subsidies Collected from Wholesale and Retail Trade

PV *Ad Valorem* Taxes Collected from Producers

VV *Ad Valorem* Taxes Collected from Wholesale and Retail Trade

SA Sectorial Taxes

SU Sectorial Subsidies

MSG Code	Full Name (Norwegian name in parenthesis)	National Accounts Sector code
	Commodity Taxes and Commodity Subsidies	
225	Value Added Tax (Merverdiavgift)	221,222
PX	**Indirect Volume Taxes and Subsidies Collected from Producers**	
	Volume Taxes	
312	Excise on chocolate and sweets (Sjokolade- og sukkeravgift)	312
321	Excise on non-alcoholic beverages (Avgift på alkoholfrie drikkevarer)	321
322	Excise on beer (Avgift på øl)	322
323	Tax on serving of alcoholic beverages (Skjenkeavgift)	323
331	Excise on tobacco (Tobakksavgift)	331
341	Tax on use of electric energy (until 1971) (Avgift på forbruk av elektrisk energi (inntil 1971))	341
342	Tax on use of electric energy (from 1971) (Avgift på forbruk av elektrisk kraft (fra 1971))	342
362	Kilometre-tax, hired motor lorry (Kilometeravgift, leietransport)	362
363	Tax on boat engines (Avgift på båtmotorer)	363
374	Various environment taxes (Diverse miljøvernavgifter)	374
	Volume Subsidies	
611	Compensation of value added tax on food (Kompensasjon for merverdiavg. på matvarer)	611
612	Consumer subsidies on milk and milk products (Forbrukersusidier på melk og melkeprodukter)	612
613	Price subsidies on margarine (Pristilskudd til margarin)	613
618	Consumer subsidies on meat (Forbrukssubsidier på kjøtt)	618
621	Subsidies on fertilizers (Tilskudd til kunstgjødset)	621
624	Consumer subsidies on fuel (Forbrukersubsidier på brensel og drivstoff)	part of 622
VX	**Indirect Volume Taxes and Subsidies Collected from Wholesale and Retail Trade**	
	Volume Taxes	

MSG Code	Full Name (Norwegian name in parenthesis)	National Accounts Sector code
325	Purchase tax on spirits and wine (Omsetningsavgift på brennevin og vin)	325
343	Tax on mineral oil etc. (Avgift på mineralolje m.v.)	343
361	Petrol-tax (Avgift på bensin)	361
	Volume Subsidies	
610	Compensation of value added tax on food (Kompensasjon for merverdiavg. på matvarer)	610
614	Other consumer subsidies on food (Andre pristilskudd, matvarer)	614
615	Subsidies from the Concentrated Feeds Fund (Tilskudd over Kraftforfondet)	615
616	Subsidies from the funds of the Price Directorate (Tilskudd over Prisdirektoratets fond)	616
617	Subsidies on fish (Subsudier på fisk)	617
622	Consumer subsidies on fuel (Forbrukersubsidier på brensel og drivstoff)	part of 622
PV	***Ad Valorem* Taxes Collected From Producers**	
231	Investment levy on gross fixed capital formation (Investeringsavgift på nyinvesteringer)	231
351	Tax on motor vehicles (Avgift på motorvogner)	351
371	Tax on jewellery and related articles (Avgift på gull-, sølv- og platinavarer)	371
372	Special duty on radio and television (Avgift på radio- og fjernsynsmateriell m.v.)	372
373	Tax on cosmetics (Avgift på kosmetikk)	373
375	Tax on pharmaceutical products (Avgift på farmasøytiske spesialpreparater)	375
376	Tax on recording equipment (Avgift på opptaksutstyr for lyd og bilde)	376
381	Surplus of Norwegian Pools Limited (Overskott i Norsk Tipping A/S)	381
382	Excise on race-tracks (Totalisatoravgift)	382
383	Tax on lotteries (Lotteriavgift)	383
391	Special export duties (Spesielle eksportavgifter)	part of 391
VV	***Ad Valorem* Taxes Collected from Wholesale and Retail Trade**	
311	Tax on fish etc. for price regulation (Avgift på fisk m.v. for prisregulering)	311
313	Tax on concentrated feeds (Kraftforavgift)	313
324	Purchase tax on spirits and wine (Omsetningsavgift på brennevin og vin, verdiavgift)	324
392	Special export duties (Spesielle eksportavgifter)	part of 391

MSG Code	Full Name (Norwegian name in parenthesis)	National Accounts Sector code
	Customs Duty	
400	Customs Duty (Toll)	400
SA	**Sectorial Taxes**	
232	Investment levy on repairs, auxilliary materials etc. (Investeringsavgifter, reparasjoner, hjelpestoffer mv.)	232
521	Tax on production of crude petroleum and natural gas (Avgift på utvinning av jordolje og naturgass)	521
522	Repayment of control expences etc. (Refusjon av kontrollutgifter mv. Oljedirektoratet)	522
531	Stamp duty on cards (Stempelavgift, spillekort)	532
532	Fees on patents and weights and measures (Patent- og justergebyr indirekte skatter)	532
560	Surplus of the Norwegian Wine and Spirit Monopoly (Overskudd i A/S Vinmonopolet)	560
561	Kilometre-tax, transport on own-account (Kilometeravgift, egentransport)	561
562	Annual tax on motor cars and motor cycles (Årsavgift på personbiler og motorsykler i næringslivet)	562
563	Excise on pharmacies (Apotekavgift)	563
564	Fees to police and judicial services (Gebyr til politi og rettsvesen indirekte skatter)	564
565	Advances and deposits (Forskudd, deposita)	565
566	Tax to the Norwegian Grain Corporation (Avgift til Statens Kornforretning)	566
567	Tax through special funds administered by the Ministry of Finance (Avgift over Finansdepartementets fond)	567
568	Special tax for fishermen administered by the Social Insurance Administration (Sektoravgift, trygdeforvaltningen angående fiskere)	568
569	Special tax administered by the Trade Council, other taxes on wholesale and retail trade (Avgift, Omsetningsrådet m.m.)	569
571	Weight tax on petrol-driven lorries (Vektavgift på lastebiler, bensindrevne)	571
572	Weight tax on non-petrol-driven lorries (Vektavgift på lastebiler, ikke bensindrevne)	572
573	Tax on motor vehicle certificates (Avgift på prøvenummer)	573
574	Loading fees and lighthouse dues (Laste- og Fyravgift)	574
575	Fees to the Shipping Control (Gebyrer til Skipskontrollen indirekte skatter)	575
576	Passenger fees, civil air transport (Passasjeravgifter sivil luftfart)	576
577	Other fees to Central Government (Andre statlige gebyrer, indirekte skatter)	577

MSG Code	Full Name (Norwegian name in parenthesis)	National Accounts Sector code
578	Registration duty on motor vehicles (Registreringsavgift)	578
579	Tax on charter flights (Charteravgift)	579
581	Duties on documents (Dokumentavgift)	581
582	Tax on real property (Eiendomsskatt)	582
583	Other indirect taxes to Local Government (Andre kommunale avgifter)	583
591	Excise on licences to sell and serve spirits (Avgift på salgs- og sjenkerettigheter)	591
592	Entertainment tax (Skatt på inngangspenger)	592
593	Entertainment tax on foreign artists (Honoraravgift)	593
594	Tax on the Norwegian Broadcasting Corporation (Avgift av NRK)	594
SU	**Sectorial Subsidies**	
711	Subsidies for grain growing (Korntrygd)	711
713	Investment subsidies (Investeringstilskudd)	713
714	Subsidies from special funds administered by the Ministry of Finance (Tilskudd til Finansdepartementets fond)	714
731	Refund of customs duties to shipyards etc. (Tollrefusjoner til skipsbyggeriene mv.)	731
732	Price subsidies on milk and milk products (Pristilskudd til melk og melkeprodukter)	732
761	Subsidies from the Concentrated Feeds Fund (Tilskudd over Kraftforfondet, sektorsubsidier)	761
762	Subsidies from the funds of the Price Directorate (Tilskudd over Prisdirektoratets fonds, sektorsubsidier)	762
763	Advances and depocits (Forskudd, deposita)	763
764	Other subsidies from the Social Insurance Administration (Sektorsubsidier trygdeforvaltningen)	764
765	Price subsidies on Norwegian grain and flour (Pristilskudd til norsk korn og matmel)	765
766	Freight subsidies on fertilizers (Tilskudd til kunstgjødsel, frakttilskudd)	766
767	Subsidies on fish (Subsidier på fisk)	767
768	Subsidies administered by the Trade Council (Tilskudd, Omsetningsrådet)	768
771	Other price subsidies scheduled transport on roads and in coastal waters, publishing of newspapers, political parties etc. (Andre pristilskudd bil- og kystruter, pressen, politiske partier m.m.)	771
781	Unemployment insurance national reserve fund (Arbeidsløshetstrygdens riksreservefond)	781

MSG Code	**Full Name** (Norwegian name in parenthesis)	**National Accounts Sector code**
791	Other subsidies from the appropriation account (Andre pristilskudd over bevilgningsregnskapet)	791
792	Contributions by the Norwegian Pools Limited (Tilskudd fra Norsk Tipping)	792
793	Contributions to the Norwegian Broadcasting Corporation (Tilskudd til NRK)	793
794	Subsidies paid by Local Government (Kommunale subsidier)	794

RT
List of Direct Taxes by Type
RT = **TP**$\cup$**TS**
TP Personal Tax-Payers
TS Corporate Tax-Payers

MSG Code	Full Name (Norwegian name in parenthesis)	Data Base Code	National Accounts Sector Code Type of Account 48
TP	**Personal Tax-Payers**		
421	Ordinary Income tax, Central Government, Fiscal Account (Ordinær inntektsskatt, stat)	421	421
425	Joint Tax, Other Central Government Accounts (Fellesskatt)	425	425
422	Income tax, Local Government (Inntektsskatt, kommune)	422	422
429	Top Tax, Central Government (Toppskatt)	429	429
511	Member's Premium to the National Insurance Scheme (Sickness) (Medlemspremie til folketrygden, helsedel)	511	511
406	Other Direct Taxes, Central Government (Andre direkte skatter, stat)	426,428,431, 411,412,423, 461	426,428,431,411,412,423, 461
407	Other Direct Taxes, Local Government (Andre direkte skatter, kommune)	427,424,462	427,424,462
508	Member's Premium to the National Insurance Scheme (sickness), Seamen and Others (Medlemspremie folketrygd og andre trygdeord., sjøfolk og andre)	512,514,515, 516	512,514,515,516
TS	**Corporate Tax-Payers**		
438	Ordinary Income Tax, Central Government Fiscal Account (Ordinær formues- og inntektsskatt, stat)	442,445	442,445
438306	Ordinary Income Tax, Central Government, Fiscal Account, Ocean Transport and Drilling (Sjøfart og oljeboring)		
438999	Ordinary Income Tax, Central Government, Fiscal Account, Other Industries (Andre inst. sektorer)		
439	Ordinary Income Tax, Special Income Tax and Property Taxes on Oil Extraction, Central Government, Fiscal Account, (Ordinær skatt og særskatt, oljevirksomhet, stat)	441,443,444	441,443,444
439307	Oil Extraction and Drilling (Oljeutvinning og rørtransport)		
451	Ordinary Income Tax and Joint Tax, Central Government, Fiscal Account (Felles- og andre direkte skatter, stat)	446,471	446,471
451306	Ocean Transport and Drilling (Sjøfart og oljeboring)		

MSG Code	Full Name (Norwegian name in parenthesis)	Data Base Code	National Accounts Sector Code
451999	Other Institutional Sectors (Andre institusjonelle sektorer)		
452	Ordinary Income Tax, Joint Tax and Property Tax, Local Government (Formue- inntekts- og andre direkte skatter, kommune)	447,448,472	447,448,472
452306	Ocean Transport and Drilling (Sjøfart og oljeboring)		
452999	Other Institutional Sectors (Andre inst. sektorer)		

INS

List of Institutional Sectors

MSG Code	Full Name (Norwegian name in parenthesis)	Quarterly NA-Sector Code	National Accounts Sector Code
			Type of Account 49
006	General Government (Offentlig forvaltning totalt)	006	010,020,030,040,011,021,031, 041
015	Central Government and Social Security (Stats- og trygdeforvaltningen)	015	010,020,030,011,021,031
040	Local Government (Kommuneforvaltningen)	040	040,041
101	Public Financial Institutions (Offentlige finansinstitusjoner	101	110,120,140
110	Norges Bank (Norges bank)	110	110
102	Private Financial Institutions (Private finansinstitusjoner)	102	135,155,165,175,185
306	Ocean Transport and Drilling (Utenriks sjøfart og oljeboring)	306	(23) 717, (23) 830
307	Production and Pipeline Transport of Oil and Gas (Råolje og naturgass, utvinning og rørtransport)	307	(23) 165,824
309	Other Private Incorporated Enterprises (Øvrige ikke-personlige foretak)	309	210,220,230,245 except (23) 717,830
210	Central Government Enterprises (Statens forretningsdrift)	210	210
230	Local Government Enterprises (Kommunale foretak)	230	230
300	Households (Husholdninger)	300	300
500	Abroad (Utlandet)	500	(74) 000
	Other Sectors:		
000	Sectors where source or recipient is not specified (Sektorer hvor leverandør eller mottaker ikke er spesifisert)		
999	Sectors where source or recipient is unknown (Sektorer hvor leverandør eller mottaker er ukjent)		

SOS

List of Socio-Economic Groups

MSG Code	Full Name (Norwegian name in parenthesis)	Data Base Code	National Accounts Sector Code
			Type of Account 49
W	Employees (Lønnstakere)	315 and W	315
S	Personal Enterprises and Self-Employed (Personlig næringsdrivende)	325 and S	325
T	Social Security Recipients, Pensioners etc. (Pensjoninster, trygdede o.a.)	335 and T	335

HH

List of Household Groups

MSG Code	Full Name (Norwegian name in parenthesis)
351	Single people of age 65+ (Enslige personer på 65 år eller mer)
352	Single persons below 65 (Enslige personer under 65 år)
353	Two people at least one of whom is 65 or older (To personer hvor minst en er 65 år eller eldre)
354	Two people who both are below 65 (To personer hvor begge er under 65 år)
355	Single parents with one child (Aleneforeldre med ett barn)
356	Single parents with to or more children (Aleneforeldre med to eller flere barn)
357	Couples with one child (Par med ett barn)
358	Couples with two children (Par med to barn)
359	Couples with three or more children (Par med tre eller flere barn)
360	Three adults without children (Tre voksne uten barn)
361	Three adults with one child (Tre voksne og ett barn)
362	Three adults with two or more children (Tre voksne og to eller flere barn)
363	Four adults with or without children (Fire voksne med eller uten barn)
364	People in institutions (Personer på institusjon)

IH

List of Components of Households' Income and Expenditure

MSG Code	Full Name (Norwegian name in parenthesis)	National Accounts Sector Code
		Type of Account 48
010	Wages and salaries (Lønn)	010
100	Operating surplus (Driftsresultat)	100
220	Dividends (Aksjeutbytte)	220
295	Net income from interest (Netto renteinntekter)	210,219
640	Family allowances (child benefits) (Barnetrygd)	640
695	Total consumption motivating transfers excl. of family allowances (Konsummotiverende overføringer i alt unntatt barnetrygd)	611-619,630,650,661-666
TAX	Direct taxes and net other transfers excl. of transfers to Central Government and Social Security (015) (Netto andre overføringer unntatt overføringer til stats- og trygdeforvaltn.)	411,412,421-429,431,461,462, 511-516,700,808,809
N	Transfers to Central Government and Social Security (015) (Overføringer til stats- og trygdeforvaltn.)	801

3.2 List of variables and variable classification

The text to the equations may give further information as to the content/interpretation of the variables. Parameters (constant over time) are defined in the main text only.

In the model, variables (and parameters) are denoted *..0* and *..(-t)* when they are measured in the base year or are lagged with *t* periods, respectively.

Below, the variables *PKJUST, K,* RS_{500} and *PLJUST* are classified as *-variables as their status as exogenous or endogenous is determined by the closure rule chosen for the model. Exogenous variables are labelled *X*, the remaining are endogenous.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
A		Total export in constant purchaser prices.
A_i	*X* for $i \in$ {02,03, 06,07,08,09,11,12, 13,19,35,36,41,42, 48,49,55,63,65,66, 81,83,85,92,93,94, 95}	Export, export activity *i*, in constant purchaser prices. $i \in$ **VA**
A_{24}		Direct purchases in Norway by non-resident households in constant prices.
AE_i	*X*	Calibration variable in the export demand equations, commodity *i*. $i \in$ {16,17,18,24,25,34,37,43,46,47,69,74} $\subset$ **VA**
$AGPF_{300}$	*X*	*Private Financial Institutions'* share of *Households'* gross liabilities.
AJ		Total export of used real capital in constant prices.
AJ_i		Export of used real capital of type *i* in constant prices. $i \in$ **JR**
$AKSJEC_j$		Effective interest cost for the share holder of financing corporate investment in physical capital by issuing new shares in production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
$ALFA_k$	*X*	The proportion of the change in total financial assets to the change in total liabilities held by institutional sector *k*. $k \in$ {015,040} $\subset$ **INS**
ALP_{70}	*X*	Virtual production of hydro-power measured as the share of the capacity in the hydro power system.
$APGB$		Number of old age pensions measured in number of so called *basic amounts*.
$APGBPP$	*X*	Old age pension in number of *basic amounts* per person of age 65+.
B_i		Basic price, power producing sector *i*, Nkr/KWh. $i \in$ {70,710,72,73}
BE		Electricity price in the reference point (Nkr/kWh).
$BETAGWH$	*X*	Statistical difference between supply and absorption in the base year in the Energy Accounts measured in GWh.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
BF_k		Gross financial assets held by institutional sector *k* by the end of the year. $k \in \{300,015,040\} \subset$ **INS**
BG_k		Gross liabilities held by institutional sector *k* by the end of the year. $k \in \{300,015,040\} \subset$ **INS**
BGX_k	*X*	Correction variable for gross liabilities held by institutional sector *k*. $k \in \{300,015,040\} \subset$ **INS**
BH_i	*X* for $i \in \{65,66, 67,69,92,93,94,95\}$	Basic price index for the domestically produced commodity *i*. $i \in$ **VA**
BHS_i		Weighted basic price index for commodities delivered from domestic production sector *j*. $j \in$ **PS**
BI_i		Price index of import activity *i*, basic value including customs duty. $i \in$ **VA**
$BKNY_{70}$		Marginal willingness to pay for hydro power including tax on use of electric energy (Nkr/kWh).
$BKNY_{710}$		Marginal willingness to pay for gas power including tax on use of electric energy (Nkr/kWh).
BOLI	*X*	Imputed rate of capital income from dwellings.
BOLT	*X*	Tax rate of dwellings relative to the market value.
BP_{ij}		User cost of capital, capital type *i*, production sector *j*. $i \in$ **JR** $j \in$ **PP**$\setminus\{64,65,71,89\}$
$BRINMOD_k$		Model based calculation of gross income by socio-economic group. $k \in$ **SOS**
$BRINREF_k$		Gross income in the base year by socio-economic group, adjusted by growth in income MY_k. $k \in$ **SOS**
BS_i		Average basic price index for deliveries from domestic producers by commodity. $i \in$ **VA**
C		Total private consumption in constant prices.
C_i	*X* for $i = 62$	Private consumption of consumption activity/sector *i* in constant purchaser prices. $i \in$ **CA,CP**
C_U		Private consumption of energy in constant prices.
C_{31}		Flow of services from the stock of cars in constant prices.
C_{70}		Direct purchases in Norway by non-resident households in constant prices. C_{70} is measured negatively.
C_{PT}		*Private Transport (PT)* in constant prices.
CE_i	*X*	Calibration variable in equations for private consumption. $i \in$ **CP**
CK_j	*X*	Net purchase of second hand capital in consumption sector *j* in constant purchaser prices. $j \in$ **CP**

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
CK_{30}	*X*	*Households'* purchase of second hand cars from the production sectors in constant purchaser prices.
CRE		Parameter adjusting proportionally the savings rate for all household groups.
$CREH_i$		Adjusted savings rate by household. $j \in$ **HH**
CRH_i	*X*	Savings rate by household. $j \in$ **HH**
$DEBTC_i$	*X*	Ratio between the nominal debt in a corporate firm and the value of its capital stock, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
$DEBTN_i$	*X*	Ratio between the nominal debt in a non-corporate firm and the value of its capital stock. $j \in$ **PP**\{64,65,71,83,89}
DEP_{ki}	*X*	Shift parameter related to the rate of physical depreciation of the stock of capital of type *k* in production sector *j*. $k \in$ **JR** $j \in$ **PS**
$DFOND_i$	*X*	The maximum share of the corporate profit tax base that can be deducted according to tax laws for investment in rural areas. $j \in$ **PP**\{64,65,71,83,89}
DI_i	X for $i \in$ {12,41, 42,47,48,49,63,65, 74,81,85,}	Change (multiplicative) in import share, commodity *i*. $i \in$ **VA**
DIE_i	*X*	Calibration variable in equations for endogenous import shares, commodity *i*. $i \in$ {16,18,25,34,37,43,46} $\subset$ **VA**
DPR_{ii}	*X*	Rate of capital depreciation in power producing sector *j*, capital type *i*. $i \in$ {11,12,40,50} $j \in$ {70,710,72,73}
DS		Total change in inventory investment in constant basic prices.
DS_i		Total change in inventory investment by commodity. $i \in$ **VA**
DSE_i	*X*	Calibration variable in equations for change in inventory investment, commodity *i*. $i \in$ **VA**
DSI_i	*X*	Change in inventories of the imported commodity *i* in constant prices. $i \in$ **VA**
DSH_i		Change in inventories of the domestically produced commodity *i* in constant prices. $i \in$ **VA**
DUM_k	*X*	Dummy variable. $DUM_k = 1$ in years with exogenous hydro power capacity, $DUM_k = 0$ in years with endogenous hydro power capacity. $k \in$ {70,710}

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
E_j		Input of electricity in constant net-purchaser prices by sector/activity. $j \in$ **PS,PSV**
EE		Demand for electric power measured in the reference point in GWh.
EE_i		Use of electricity in input activity *i* corrected for power losses in the distribution net. $j \in$ **PSV**
EE_A		Exports of electricity corrected for power losses in the distribution net.
EE_C		Private consumption of electricity corrected for power losses in the distribution net.
$EGENC_j$		Effective interest cost for the share holder of financing corporate investment in physical capital, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
$EGENN_j$		Effective interest cost of equity financing non-corporate investment in physical capital, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
EPS_j	*X*	Variable measuring the *level* of technical change, production sector *j*. $j \in$ **PP**\{64,65,71,89}
$ETAK_j$	*X*	Calibration variable in the equations for demand for capital, production sector *j*. $j \in$ **PP**\{64,65,71,89}
$ETAL_j$	*X*	Calibration variable in the equations for demand for labour, production sector *j*. $j \in$ **PP**\{64,65,71,89}
$ETAM_j$	*X*	Calibration variable in the equations for demand for other material input, production sector *j*. $j \in$ **PP**\{64,65,71,89}
$ETAU_j$	*X*	Calibration variable in the equations for demand for energy, production sector *j*. $j \in$ **PP**\{64,65,71,89}
ET_{70}		Input of hydro power in *Production of Hydro-Power (70)* measured in constant prices.
ET_{72}		Losses in the production sector *Transmission Services (72)* measured in constant prices.
ET_{73}		Losses in the production sector *Distribution Services (73)* measured in constant prices.
ETT		Total use of surplus power.
F_j		Input of fuels in constant net-purchaser prices by sector/activity. $j \in$ **PS,PSV**,{70,710,72,73}
$FALL_{ij}$	*X*	Rate representing decline in market value per physical capital unit per year by capital type and production sector. $i \in$ {10,30,40,50,80} $\subset$ **JR** $j \in$ **PP**\{64,65,71,89}
FD		Total capital depreciation in constant prices.
FD_j		Capital depreciation in constant prices by sector. $j \in$ **PSK**,{70,710,71,72}

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
$FD_{i\,71}$		Capital depreciation, capital type *i*, in the National Account production sector *Production of Electricity (71)* in constant prices. $i \in$ {11,12,40,50} $\subset$ **JR**
FK_j	*X*	The share of firm power in the deliveries to input activity *j*. $j \in$ **PSV**
FK_A	*X*	The share of firm power in the deliveries to exports.
FK_C	*X*	The share of firm power in the deliveries to private consumption.
$FRATE_{300}$	*X*	Ratio between gross assets and disposable income in *Households (300)*.
G		Total government consumption/expenditure in constant prices.
G_j		Government consumption/expenditure in government production sector *j* in constant prices. $j \in$ **PO**
$GA_{73\,11}$		Distribution services per delivered kWh of deliveries for ordinary consumption.
$GA_{73\,12}$		Distribution services per delivered kWh of deliveries of surplus power.
$GA_{73\,41}$		Distribution services per delivered kWh of deliveries to electricity intensive production sectors.
$GAM_{73\,j}$		Distribution services per delivered kWh to input activity *j*. $j \in$ **PSV**
$GAM_{73\,A}$		Distribution services per delivered kWh to exports.
$GAM_{73\,C}$		Distribution services per delivered kWh to private consumption.
$GAMK_j$	*X*	Capacity utilisation index by production sector. $j \in$ **PP**\{64,65,71,89}
$GAMMEL$	*X*	Dummy variable in the user cost of capital model. $GAMMEL = 1$; new tax system. $GAMMEL = 0$; old tax system.
$GAMP_j$	*X*	Price deviation coefficient for basic prices by production sector. $j \in$ **PP**\{64,65,71,89}
$GAMU_j$	*X*	Coefficient measuring rate of temperature deviation by sector.
GB		*Basic amount* in the national insurance.
GBE	*X*	Correction of *the basic amount.*
$GEVT$	*X*	Share of gains from resale of used capital goods which is taxed as profits according to the tax code after 1992.
$GJELDC_j$		Effective interest cost of corporate debt, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
$GJELDN_j$		Effective interest cost on non-corporate debt, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
GTC_i		Correction factor that appears in the calculation of the present value of the effective taxation of capital gains achieved through resale of physical assets, incorporated firms, capital type *i*. $i \in$ **JA**

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
GTN_{ij}		Correction factor that appears in the calculation of the present value of the effective taxation of capital gains achieved through resale of physical assets, non-corporate firms, capital type *i*, production sector *j*. $i \in$ **JA** $j \in$ **PP**\{64,65,71,83,89}
GWH_j	*X* for $i \in$ {37,43}	Electricity demand from input activity/production sector *j* measured in GWh. $j \in$ **PSV,PS**
GWH_{70}		Input/losses of hydro power in *Production of Hydro-Power (70)* measured in GWh.
GWH_{72}		Losses in the production sector *Transmission Services (72)* measured in GWh.
GWH_{73}		Losses in the production sector *Distribution Services (73)* measured in GWh.
GWH_A	*X*	Export of power measured in GWh.
GWH_C		Private consumption of electricity measured in GWh.
GWH_H		Total input of electric power in the production sectors measured in GWh.
GWH_I	*X*	Import of electric power measured in GWh.
$GWHX$		Gross production of electric power measured in GWh.
$GWHX_{70}$		Virtual production of hydro power measured in GWh.
$GWHX_{710}$		Production of gas power measured in GWh.
$GWHX_{72}$		Production of transmission services measured in GWh.
$GWHX_{73}$		Production of distribution services measured in GWh.
$GWHX_{70BA}$	*X*	Developed capacity in *Production of Hydro-Power (70)* in the base year, measured in GWh.
$GWHX_{70DA}$		Developed capacity in *Production of Hydro-Power (70)* after the base year, measured in GWh.
$GWHX_{70MX}$	*X*	Remaining water resources possible to develop measured in kWh.
$GWHX_{70PP}$		Average (over years) production capacity in the hydro power system measured in kWh.
$GWHX_{70R}$	*X*	Residual equal to the statistical difference between the production figures in the National Accounts and the Energy Accounts measured in GWh.
H		Total material input in constant purchaser prices.
H_j	*X* for $i \in$ {92C, 92U,93K,93S,94K, 94S,95K,95S}	Total material input in constant purchaser prices in sector/activity *j*. $j \in$ **PSK,PSV**
H_{ij}		The capital gain from reselling physical capital that affects the taxation of the firm, capital type *i*, production sector *j*. $i \in$ **JA** $j \in$ **PP**\{64,65,71,83,89}
HC_{30}		*Households'* stock of cars in constant prices.
HR_{70XX}	*X*	Base year VAT rate on electricity (Nkr/kWh).
HS_j	*X*	Average number of man-hours per self employed in production sector *j*. $j \in$ **PS**

MSG Variable	Exogenous variables are labelled (X)	Content/Interpretation
HV_{70XX}	X	Base year tax rate on electricity (Nkr/kWh).
HVE_i	X for $i \in$ {11,15, 25,40,45,50,55,63, 64,74,81,81,83,92C, 93K,93S,94K,94S, 95K,95S}	Coefficient for price discrimination on electricity used in input activity j. $j \in$ **PSV**\{34,37,43}
HVE_A	X	Coefficient for price discrimination of electricity which is exported .
HVE_C	X	Coefficient for price discrimination of electricity used in private consumption.
HVI_{70XX}	X	Base year tax rate on import of electricity measured in (Nkr/kWh).
HW_i	X	Average number of man-hours per wage earner in production sector j. $j \in$ **PS**
I		Total import measured in constant prices c.i.f. (basic value exclusive of customs).
I_i	X for $i \in$ {55,67, 69,83,89,92,93,94, 95}	Import activity i measured in constant prices c.i.f. (basic value exclusive of customs). $i \in$ **VA**
IA_i		Re-export of commodity i in constant prices. $i \in$ **VA**
$IMAV_{ij}$	X	Effective immediate write-offs, capital type i, production sector j. $i \in$ **JA** $j \in$ **PP**\{64,65,71,83,89}
$INFL$	X	Expected nominal price growth on capital goods.
J_i		New investment, investment activity/capital type i in constant purchaser prices. $i \in$ **JA,JR**
$J_{i\,64}$	X	New investment in investment activity i in the production sector *Production and Pipeline Transport of Oil and Gas (64)* in constant purchaser prices. $i \in \{10,20,40,50,72,73,74,75,76\} \subset$ **JA**
$J_{i\,65}$	X	New investment in investment activity i in the production sector *Ocean Transport, Oil and Gas Exploration and Drilling (65)* in constant purchaser prices. $i \in \{10,30,40,50,60\} \subset$ **JA**
JE_i	X	Sales of used real capital, type i, in constant purchaser prices. $i \in$ **JR**
$JE_{30\,65}$		Sales of used real capital, type (30), *Ships and Fishing Boats etc.*, from the production sector *Ocean Transport, Oil and Gas Exploration and Drilling (65)* in constant purchaser prices.
$JE_{30\,13}$		Sales of used real capital, type (30), *Ships and Fishing Boats etc.*, from production sector (13), *Fishery*, in constant purchaser prices.
$JE_{30\,65}DE$	X	*Ocean Transport, Oil and Gas Exploration and Drilling (65)*'s share of sales of used real capital, type (30), *Ships and Fishing Boats etc.*
JK		Total gross real investment in constant purchaser prices.
JK_i		Total gross real investment in capital activity/type i in constant purchaser prices. i $\in$ **JA,JR**

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
$JK_{i\,64}$		Gross real investment in capital activity *i* in the production sector *Production and Pipeline Transport of Oil and Gas (64)* in constant prices. $i \in \{10,20,40,50,72,73,74,75,76\} \subset$ **JA**
$JK_{i\,65}$		Gross real investment in capital activity *i* in production sector (65), *Ocean Transport and Drilling,* in constant prices. $i \in \{10,30,40,50,60\} \subset$ **JA**
$JK_{i\,71}$		Gross real investment in capital activity *i* in National Account production sector (71), *Production of Electricity,* in constant prices. $i \in \{11,12,40,50\}$
$JKD_{50\,64}$		Gross real investment in capital type 40 and 50 in the production sector *Production and Pipeline Transport of Oil and Gas (64)* in constant prices. The variable is introduced to facilitate calculation of capital depreciation in a way consistent with the National Accounts..
$JKD_{60\,65}$		Gross real investment in capital type 10, 40, 50 and 60 in the production sector *Ocean Transport, Oil and Gas Exploration and Drilling (65)* in constant prices. The variable is introduced to facilitate calculation of capital depreciation in a way consistent with the National Accounts.
JKS		Total gross real investment in constant purchaser prices.
JKS_i	*X* for $i \in$ {92S, 93K,93S,94K,94S, 95K,95S}	Gross real investment in production sector *j* in constant purchaser prices. $j \in$ **PS,JS**
JR_i	*X*	Calibration variable in equations for gross real investment by activity. $i \in$ **JR**
K	*	Total real capital stock in constant prices.
K_i		Real capital stock in production sector *j* in constant prices. $j \in$ **PS**,{70,710,72,73}
K_{ii}		Real capital stock of type *i* in power producing sector *j* in constant prices. $i \in \{11,12,40,50\}$ $j \in \{70,71,710,72,73\}$
$K_{i\,64}$		Real capital stock of type *i* in the production sector *Production and Pipeline Transport of Oil and Gas (64)* in constant prices. $i \in \{10,20,50,70\} \subset$ **JR**
$K_{i\,65}$		Real capital stock of type *i* in the production sector *Ocean Transport, Oil and Gas Exploration and Drilling (65)* in constant prices. $i \in \{30,60\} \subset$ **JR**
$K._{i\,300}$		Parameter adjusting the distribution of income and expenditure, by type, between household groups. $i \in$ {*N,TAX*,010,100,220,295,640,695}
KFOND	*X*	The maximum share of the corporate profit tax base that can be deducted for appropriations to the "consolidation fund".
KLEVKK	*X*	Quality correction of hydro power delivered to electricity intensive industries.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
$KOAV_{ij}$	X	Immediate write-off based on the tax rules for depreciation allowances "on contract", capital type *i*, production sector *j*. $i \in$ {10,30,40,50,80} $j \in$ **PS**\{64,65,89}
KTG_{70}		Short run marginal cost in *Production of Hydro-Power (70)*, (Nkr/kWh).
KTG_{710}		Short run marginal cost in *Production of Gas-Power (710)*, (Nkr/kWh).
L	X	Total number of man-hours.
L_j	X for $i \in$ {64,65, 92S,93K,93S,94K, 94S,95K,95S}	Man-hours in sector *j*. $j \in$ **PS**,{70,710,72,73}
LS		Total number of hours worked by self employed.
LS_j		Number of hours worked by self employed in production sector *j*. $j \in$ **PS**
LTG_{70}		Long run marginal cost in *Production of Hydro-Power (70)*, (Nkr/kWh).
LTG_{710}		Long run marginal cost in *Production of Gas-Power (710)*, (Nkr/kWh).
LW		Total number of hours worked by wage earners.
LW_j		Number of hours worked by wage earners in production sector *j*. $j \in$ **PS**
LY_k		Index measuring growth in socio-economic group *k* relative to the base year. $k \in$ **SOS**
M_j		Other material input in activity/sector *j* in constant net-purchaser prices. $j \in$ **PSV**,**PS**,{70,710,72,73}
MA_i		Export market share of export activity *i* adjusted for re-export. $i \in$ **VA**
MII_i	X for $i \in$ {16,17, 18,24,25,34,46,47, 74}	Index for world market demand for commodity *i*. $i \in$ {16,17,18,24,25,34,37,43,46,47,74} $\subset$ **VA**
MU_{710}	X	Dummy variable indicating the location of a gas power plant. *MU = 0* if the location is in central areas, *MU = 1* if the location is along the coast.
MYR_k	X	Calibration variable in the equations for growth in income by socio-economic group. $k \in$ **SOS**
NB	X	Total population measured in number of persons.
NB_{kj}	X	Population; number of persons in the interval from year *k* to year *j*. $(k,j) \in$ ***NB***,{(00,15),(00,19)}
NB_{20}	X	Number of adults (age 20+).
NB_{65}	X	Number of persons of age 65+.
NB_{80}	X	Number of persons of age 80+.
NF_{300}	X	Net wealth in *Households*.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
NFI_k		Net financial investments institutional sector *k*. $i \in$ {006,015,040,300} $\subset$ **INS**
NFIRAT		Net debt ratio for *Households (300).*
NGU		Net national debt.
NH	*X*	The total number of households.
NH_i	*X*	Number of households by group. $j \in$ **HH**
$NINSMOD_k$		Model based calculation of net income by socio-economic group. $k \in$ **SOS**
$NINSREF_k$		Net income in the base year, socio-economic group *k*, adjusted by MY_k. $k \in$ **SOS**
NS		Total number of self-employed.
NS_i		Number of self-employed in production sector *j*. $j \in$ **PS**
NT		Total employment.
NT_i		Employment in production sector *j*. $j \in$ **PS**
NTRYGD	*X*	Number of national insurance recipients.
NW		Total number of wage earners.
NW_i		Number of wage earners in production sector *j*. $j \in$ **PS**
NY	*X*	Dummy variable in the user cost of capital model. *NY* = *0*; old tax system. *NY* = *1*; new tax system.
OL_{ii}		Use of *Oil (i=42)* and *Gasoline (i=41)* in production sector *j*. $j \in$ **PS**
OL_{ik}		Production (*k=X*), import (*k=I*), export (*k=A*), material input (*k=H*) and consumption (*k=C*) of *Fuel Oils etc. (i=42)* and *Gasoline (i=41)*, respectively.
$OMEGA_i$	*X*	Change in labour productivity in government production sector *j*. $j \in$ **PO**
OMV_k	*X*	Revaluation of net liabilities in institutional sector *k*. $k \in$ {015,040,500}
$ORAV_{ii}$	*X*	Rate of ordinary tax depreciation, capital type *i*, production sector *j*. $i \in$ {10,30,40,50,80} $\subset$ **JR** $j \in$ **PP**\{64,65,71,83,89}
PA_i		Purchaser price index of export activity *i*, f.o.b. $i \in$ **VA**
PANV		Price index of domestic absorption.
PC		National Account price index of aggregate private consumption, *C*.
PC_i		Purchaser price index of consumption activity *i*. $i \in$ **CP**
PC_{31}		Purchaser price index of the user cost of cars.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
PC_{70}		Price index of direct purchases in Norway by non-resident households.
PC_U		Purchaser price index of *Energy (U)*.
PC_{PT}		Purchaser price index of *Private Transport (PT)*.
PC_T		Purchaser price index of *Transport (T)*.
PE_i		Net-purchaser price index of electricity, sector/activity *j*. $j \in$ **PSV,PS**
PF_i		Net purchaser price index of fuels, sector/activity *j*. $j \in$ **PSV,PS**,{70}
$PGWH_i$	*X* for $i \in$ {34,37, 43}	Net purchaser prices of electricity, activity *j* (Nkr/kWh). $j \in$ **PSV**
$PGWH_A$		Net purchaser price of electricity, exports (Nkr/kWh).
$PGWH_C$		Net purchaser price of electricity, private consumption (Nkr/kWh).
$PGWH_I$	*X*	Import price of electric power measured in (Nkr/kWh).
PH_{70}		Purchaser price index of material input in *Production of Hydro-Power (70)*.
PI_i	*X*	Price index of import activity *i*, c.i.f. $i \in$ **VA**
PJ_i		Purchaser price index of investment activity/type *i*. $i \in$ **JA,JR**,{11,12}
$PJKS_i$		Price index of gross real investment, production sector *j*. $j \in$ **PS**
PK_i		User cost of capital in production sector *j*. $j \in$ **PP**\{64,65,83,89},{70,710,72,73}
PKN_i		User cost of capital calculated in the user cost of capital model, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
PKJUST	*	Scale variable adjusting all sectorial capital costs proportionally/shadow cost of capital.
PKX_i	*X*	Correction term for price deviations for user cost of capital, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
PL_i		*Wage cost* per hour in production sector *j*. $j \in$ **PS**,{70,710,72,73}
PLJUST	*	Index measuring economy wide level of *wage cost*.
PM_i		Net-purchaser price index of other material input, sector/activity *j*. $j \in$ **PSV,PS**,{70,710,72,73}
PU_i		Net-purchaser price index of energy, production sector/activity *j*. $j \in$ **PP**\{64,65,89}
Q		Gross national product in constant prices.
Q_i		Gross product (value added) in production sector *j* in constant prices. $j \in$ **PSK**,{70,710,72,73}
Q_{58}		Shift effects/circular flow differences in constant prices.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
QHJ		Gross national product in constant prices exclusive of shift effects or adjustment for circular flow differences.
R_j	*X*	Real rate of return in power producing production sector *j*. $j \in$ {70,710,72,73}
RA_k		Income from dividends by socio-economic group. $k \in$ **SOS**
$RA_{i\,500}$	*X*	Dividends from institutional sector *i* to *Abroad (500)*. $i \in$ {306,307} $\subset$ **INS**
$RA_{500\,i}$	*X*	Dividends from *Abroad (500)* to institutional sector *i*. $i \in$ {306,307} $\subset$ **INS**
RAB_i	*X*	Dividends paid by institutional sector *i*. $i \in$ **INS**
RAM_i	*X*	Dividends received by institutional sector *i*. $i \in$ **INS**
RARRU		Net interest and dividends which go abroad, except net dividends from petroleum activities.
RARRUX	*X*	Base year correction of *RARRU* (calibration variable).
$RATRT_r$	*X*	Tax rate of type r on miscellaneous income components. $r \in$ {411,438,451,452,508} $\subset$ **RT**
$RATRTNF_i$	*X*	Tax rate related to net wealth in *Households* for calculation of property tax to *Central Government (i = S)* and *Local Government (i = K)*.
$RATR_r$	*X*	Rate related to the development of population and income for transfers of type r. $r \in$ {609,611,619,621,622,630,640,650,658,659} $\subset$ **RU**
RATRVUHJ	*X*	Coefficient giving foreign aid as a fraction of net national product.
RATYWTA	*X*	Rate for calculation of employers' contribution to social security and the National Insurance. It is related to wages and salaries in *Central Government.*
RB	*X*	Exogenous interest rate; rate of return on investment in *Cars*.
RC		Consumption motivating income for *Households (300)*.
RC_k		Consumption motivating income, socio-economic group *k*. $k \in$ **SOS**
RD		Net disposable income for Norway.
RD_i		Net disposable income by institutional sector. $i \in$ {006,015,040,101,102,300,306,307,309,999} $\subset$ **INS**
REFFC		Effective discount rate for an incorporated firm.
$REFFN_j$		Effective discount rate for a non-corporate firm, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
$RELPL_j$	*X*	Sector specific wage cost rate. $j \in$ **PS**
$RENBF_k$		Interest rate, gross assets, institutional sector *k*. $k \in$ {015,040} $\subset$ **INS**

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
$RENBG_k$		Interest rate, gross debt, institutional sector *k*. $k \in$ {015,040,300} $\subset$ **INS**
$RENFX_k$	*X*	Correction of interest rate on gross assets in *General Government*. $k \in$ {015,040} $\subset$ **INS**
RENG		Nominal annual interest rate on debt issued to finance investment in physical capital.
$RENGX_k$	*X*	Correction of the interest rate of gross debts in *General Government*. $k \in$ {015,040} $\subset$ **INS**
$RENOF_{300}$	*X*	Interest rate on *Households'* debt to Public Financial Institutions.
RENU	*X*	Nominal annual interest rate on positive financial investment in the international capital market.
RI_f		Total income in institutional sector *f*. $f \in$ {006,015,040} $\subset$ **INS**
RISK	*X*	Risk premium normalised to an adjustment of the nominal interest rate.
RPP		Economy-wide weighted average return to capital.
RPP_i		Average rate of return to capital in private production sector *j*. $j \in$ **PP**
RR_k		Net income from interest, socio-economic group *k*. $k \in$ **SOS**
$RR_{i\,500}$	*X*	Interest from institutional sector *i* to *Abroad (500)*. $i \in$ {306,307} $\subset$ **INS**
$RR_{500\,i}$	*X*	Interest from *Abroad (500)* to institutional sector *i*. $i \in$ {306,307} $\subset$ **INS**
RRA_k		Net income from interest and dividends to socio-economic group *k*. $k \in$ **SOS**
RRA_i		Net income from interest and dividends to institutional sector *i*. $i \in$ {300,306,307 $\subset$ **INS**}
$RRAU_i$		Net interest and dividends which go abroad, institutional sector *i*. $i \in$ {306,307} $\subset$ **INS**
$RRAB_{006}$		Interest and dividend payments, *General Government (006)*.
$RRAM_i$		Received interest and dividends, institutional sector *i*. $i \in$ {006,015,040} $\subset$ **INS**
$RRAMX_i$	*X*	Correction variable in the equations for received interest and dividends by institutional sector. $i \in$ {015,040} $\subset$ **INS**
RRB_i	*X* for $i \in$ {101, 102,306,307,309}	Institutional sector *i*'s interest payments. $i \in$ **INS**
$RRBX_i$	*X*	Correction variable in the equations for interest payments by institutional sector. $i \in$ {015,040,300} $\subset$ **INS**
RRM_i	*X* for $i \in$ {101, 102,306,307,500}	Institutional sector *i*'s income from interest. $i \in$ **INS**

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
$RRMX_{300}$	*X*	Correction variable in the equations for received interest in *Households (300).*
RRN_{300}		*Households'* net income from interest.
RRV		Net interest payments and transfers from abroad.
RRV_f		Total property income to institutional sector *f*. $f \in$ {006,015,040} $\subset$ **INS**
$RRVB_{500}$		Transfers, interest and dividends from abroad.
$RRVM_{500}$		Transfers, interest and dividends which go abroad.
RS		Norway's net savings.
RS_i		Net savings by institutional sector. $i \in$ {006,015,040,300,500} $\subset$ **INS**
RS_{500}	*	Surplus on the current account.
RSB_i		Gross savings by institutional sector. $i \in$ {015,040,300,306,307,999} $\subset$ **INS**
RSK_f		Surplus before financial transactions in institutional sector *f*. $f \in$ {006,015,040} $\subset$ **INS**
RT		Total direct taxes exclusive of contributions to social security.
RT_i		Accrued direct taxes, institutional sector *i*. $i \in$ {101,102,306,307,309} $\subset$ **INS**
RT_f		Total accrued direct taxes to *General Government (f = S)* and *Local Government (f = K).*
RT_r		Accrued direct tax of type r. $r \in$ {406,407,421,422,425,429,438,439,451,452,500,508,511} $\subset$ **RT**
RT_{ri}	*X* for $(i,j) \in$ {(438,306), (451,306), (452,306)}	Accrued direct tax of type r, institutional sector *i*. $(r,i) \in$ {(438,306)(438,999)(439,307)(451,306)(451,999)(452,306) (452,999)} $\subset$ **RT×INS**
RT_{rk}		Accrued direct tax of type r, socio-economic group *k*. $r \in$ {406,407,421,422,425,429,508,511} $\subset$ **RT** $k \in$ **SOS**
RTE_{439}	*X*	Correction variable for tax type *439* $\in$ **RT**
RTE_{rk}	*X*	Correction variable for tax type r, socio-economic group *k*. $r \in$ {421,422,425,429,511} $\subset$ **RT** $k \in$ **SOS**
RTN		Accrued direct taxes, *Households (300).*
RTN_k		Accrued direct taxes by socio-economic group. $k \in$ **SOS**
RTR_i	*X*	Correction variable for accrued direct taxes by institutional sector. $i \in$ {101,102} $\subset$ **INS**
$RTYWT$		Total accrued direct taxes and national insurance contributions.
RU		Total transfers from *General Government (006)* to *Households (300).*
RU_f		Transfers from *Central Government and Social Security (f = 015)* and *Local Government (f = 040)* to *Households (300).*
RUr		Transfers from *General Government (006)* to *Households (300)*, type *r*. $r \in$ ***RU***

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
RUK		Total consumption motivating transfers.
RUK_k		Consumption motivating transfers by socio-economic group. $k \in$ **SOS**
RUS_k		Transfers liable to tax to socio-economic group *k*. $k \in$ **SOS**
RUT_f		Total expenditure in institutional sector *f*. $f \in \{006,015,040\} \subset$ **INS**
RV_k		Net other transfers to socio-economic group *k*. $k \in$ **SOS**
$RV_{i\,000}$	*X*	Transfers to institutional sector *(000)* from institutional sector *i*. $i \in \{101,102,309\}$
$RV_{000\,i}$	*X*	Transfers from institutional sector *(000)* to institutional sector *i*. $i \in \{101,102,309\} \subset$ **INS**
$RV_{i\,500}$	*X* for $i \in \{300,309,999\}$	Transfers to *Abroad (500)* from institutional sector *i*. $i \in \{000,015,300,309,999\} \subset$ **INS**
$RV_{500\,i}$	*X* for $i \in \{300,309,999\}$	Transfers from *Abroad (500)* to institutional sector *i*. $i \in \{000,300,309,999\} \subset$ **INS**
RV_{ki}	*X* for $i \in \{(015,040), (015,309),(040,015), (102,300),(110,015), (300,015),(309,015)\}$	Other transfers from institutional sector *k* to institutional sector *i*. $(k,i) \in \{(015,040),(015,210),(015,309),(040,015),(102,300), (110,015)\ (210,015),(300,015),(309,015)\} \subset$ **INS×INS**
RVB_f		Total transfers from institutional sector *f*. $f \in \{006,015,040\} \subset$ **INS**
RVR_{300}		Net other transfers to *Households (300)* exclusive of transfers from *Households (300)* to *Central Government and Social Security (006)*.
$RYTB_f$		Gross accrued tax revenue to institutional sector *f*. $f \in \{006,015,040\} \subset$ **INS**
$RYWT$		Total contribution to social security.
$SALG_{ij}$	*X*	The fraction of the investment acquired in the previous year that is sold in the second-hand market, capital type *i*, production sector *j*. $i \in \{10,30,40,50,80\} \subset$ **JR** $j \in$ **PP**$\backslash\{64,65,71,83,89\}$
$SELC_j$	*X*	The fraction of firms in production sector *j* which are incorporated. $j \in$ **PP**$\backslash\{64,65,71,83,89\}$
SKC_{ij}		Non-neutrality factor for an incorporated firm summarising the difference between the actual revaluation of the physical capital unit, and the total deduction from the corporate tax base due to various depreciation allowances and the taxation of capital gains from reselling physical assets. Present value of the tax-credit caused by the rules for tax depreciation and taxation of capital gains, capital type *i*, production sector *j*. $i \in$ **JR** $j \in$ **PP**$\backslash\{64,65,71,83,89\}$

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
SKN_{ij}		Non-neutrality factor for a non-corporate firm summarising the difference between the actual revaluation of the physical capital unit, and the total deduction from the corporate tax base due to various depreciation allowances and the taxation of capital gains from reselling physical assets. Present value of the tax-credit caused by the rules for tax depreciation and taxation of capital gains, capital type *i*, production sector *j*. $i \in$ **JR** $j \in$ **PP**\{64,65,71,83,89}
$SLIT_{ij}$		Correction factor that appears in the calculation of the present value of the effective taxation of capital gains achieved through resale of physical assets, non-corporate firms, capital type *i*, production sector *j*. $i \in$ **JR** $j \in$ **PP**\{64,65,71,83,89}
SPARERAT		Savings rate in *Households (300).*
SUBSTA	*X*	Shift parameter for the price elasticity of exports.
SUBSTI	*X*	Shift parameter for the price elasticity of imports.
SUMO	*X*	Dummy variable in inflatation of the *basic amount (GB). SUMO = 0* implies that the basic amount follows the annual wage growth, *SUMO = 1* implies that it follows the consumer price index.
$TART_r$	*X*	Change in indirect tax, type r. $r \in$ **PV,PX,SA,SU,VV,VX**
TAU_{72}	*X*	Power losses in the transmission net per unit of delivered power measured in kWh.
$TAU_{73\,11}$	*X*	Power losses in the distribution net in percent of delivered power to the net, deliveries for ordinary consumption.
$TAU_{73\,12}$	*X*	Power losses in the distribution net in percent of delivered power to the net, deliveries of surplus power.
$TAU_{73\,41}$	*X*	Power losses in the distribution net in percent of delivered power to the net, deliveries to electricity intensive production sectors.
TAXE	*X*	Personal property tax rate.
TAXJUST	*X*	Proportional adjustment factor of tax rates by type.
TAXPD	*X*	Personal tax rate on dividends.
TAXPG	*X*	Effective personal tax rate on capital gains related to trade in shares for a shareholder.
$TAXPN_j$	*X*	Formal tax rate on non-corporate profit, production sector *j*. $j \in$ **PP**\{64,65,71,89}
TAXPR	*X*	(Marginal) personal tax rate on interest income for a share holder.
$TAXPRN_j$	*X*	(Marginal) personal tax rate on interest income for a person owing a firm in production sector *j*.
TAXWN	*X*	Personal wealth tax rate.
$TDEFF_j$		Effective total tax rate on dividends, production sector *j*. $j \in$ **PP**\{64,65,71,89}
TE		Average tax rate on use of electric energy (Nkr/kWh).

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
TF_j	*X*	Change in the rate of employers' contribution to social security and National Insurance by production sector. $j \in$ **PS**
$TGEFF_j$		Effective *total* tax rate on retained profits, production sector *j*. $j \in$ **PP**\{64,65,71,89}
$TIDE$	*X*	Trend parameter in the equations for energy.
$TIDI$	*X*	Trend parameter in the import share equations.
$TILBHC_j$		Effective interest cost for the share holder of financing corporate investment in physical capital by retained profits, production sector *j*. $j \in$ **PP**\{64,65,71,89}
TIT_i		Accrued investment levy on investment activity *i* in current prices. $i \in$ **JA**
TK	*X*	Index for the quality of surplus power.
TM_i	*X*	Change in the VAT rate on commodity *i*. $i \in$ **VA**
TME_j	*X*	Change in the VAT rate on electricity used in input activity *j*. $j \in$ **PSV**
TME_A		Change in the VAT rate on electricity which is exported.
TME_C	*X*	Change in the VAT rate on electricity which is used in private consumption.
$TPNEFF_j$		Effective tax rate on non-corporate profit, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
TPV_i		Change in the *ad valorem* tax rate on commodity *i* collected from producers. $i \in$ {02,16,25,46,81,85} $\subset$ **VA**
TPX_i		Change in the volume tax rate on commodity *i* collected from producers. $i \in$ {09,16,17,25,34,46,71,74} $\subset$ **VA**
$TRTG_{rk}$	*X*	Average macro tax rate, tax type r, socio-economic group *k*. $r \in$ {421,422,425,429,511} $\subset$ **RT** $k \in$ **SOS**
$TRTM_{rk}$	*X*	Marginal macro tax rate, tax type r, socio-economic group *k*. $r \in$ {421,422,425,429,511} $\subset$ **RT** $k \in$ **SOS**
$TRTN$		Average tax rate for *Households (300)*.
$TRTREN$	*X*	Tax rate on firms' net income from interest and dividends.
TSV_j		Net sectorial tax rate (volume) in production sector *j* constructed as a weighted average of the various indirect taxes in the sector. $j \in$ **PS**
TT_i	*X*	Change in the tariff rate on commodity *i*. $i \in$ **VA**
TVE_j	*X*	Change in the tax rate on electricity used in input activity *j*. $j \in$ **PSV**
TVE_A		Change in the tax rate on electricity which is exported.
TVE_C	*X*	Change in the tax rate on electricity used in private consumption.
TVE_I	*X*	Relative change in the tax rate on import of electricity.

MSG Variable	Exogenous variables are labelled (X)	Content/Interpretation
$TVPI_i$		Net commodity tax accrued on import of commodity *i*. $i \in$ **VA**
$TVPV_i$		Net *ad valorem* taxes on commodity *i* collected from producers. $i \in \{02,16,17,25,46,85\} \subset$ **VA**
$TVPX_i$		Net volume tax on commodity *i* collected from producers.
TVV_i		Change in the *ad valorem* tax rate on commodity *i* collected from wholesale and retail trade. $i \in \{09,11,13,16,17\} \subset$ **VA**
$TVVV_i$		Net *ad valorem* taxes on commodity *i* collected from *Wholesale and Retail Trade.* $i \in \{09,11,13,16,17\} \subset$ **VA**
TVX_i		Change in the volume tax rate on commodity *i* collected from *Wholesale and Retail Trade.* $i \in \{09,11,17,25,41,42\} \subset$ **VA**
UB	*X*	Formal tax rate on corporate profit according to the Norwegian tax code.
UBS	*X*	Formal state corporate tax rate on corporate profits.
$UDEFF_j$		Effective corporate tax on dividends, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
$UEFF_j$		Effective tax rate on corporate profit, production sector *j*. $j \in$ **PP**\{64,65,71,83,89}
$UEFX_j$	*X*	Calibration variable in the energy substitution equations, sector *j*. $j \in$ {11,15,25,34,37,45,50,55,81,85,92C,93S,95S,93K} $\subset$ **PSV**
UPGB	*X*	The number of recipients of disability benefit, measured in number of *basic amounts.*
UX_j	*X*	Calibration variable in the equations for energy input by sector. $j \in$ {11,15,25,34,37,45,50,55,81,85,92C,93S,95S,93K}
V	*X*	Formal tax rate on corporate wealth.
VA		Total export in current purchaser prices.
VA_i		Export activity *i* in current purchaser prices. $i \in$ **VA**
VAJ		Total export of used real capital in current prices.
VAJ_i		Export of used real capital, type *i*, in current prices. $i \in$ **JR**
VAVI		The trade balance in current prices.
VA_{24}		Export activity 24, comprised of direct purchases in Norway by non-resident households, in current prices;
VC		Aggregate private consumption in current purchaser prices.
VC_j		Consumption activity/sector *j* in current purchaser prices. $j \in$ **CP**
VCC		Aggregate private consumption in current purchaser prices. In contradistinction to *VC*, *VCC* is exclusive of *Medical Care and Health Expenditures (62)* and *Purchase of Cars etc. (30)*, but imputed rent from the stock of cars, *User Cost of Cars etc. (31)*, is included.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
$VCCH_j$		Consumption expenditure in current prices by household. $j \in$ **HH**
$VCMIN$		Aggregate constant minimum consumption expenditure (top level) in current prices.
$VCMIN_j$		Total constant minimum household costs in current prices for $j = H0$ (top level). For $j = Z1,Z2$, $VCMIN_j$ is *additional* household total constant costs with one more child and one more adult, respectively.
$VCMIN_T$		Fixed aggregate (top level) minimum expenditure on *Transport (T)* in current prices.
$VCMIN_{Tj}$		Fixed minimum household cost of *Transport (T)* in current prices at the intermediate LES level when $j = H0$. For $j = Z1,Z2$, $VCMIN_{Tj}$ is *additional* household cost with one more child and one more adult, respectively.
VC_T		Aggregate expenditure on *Transport (T)* in current prices.
VC_{70}		Non-resident households' consumption in Norway.
VDS		Total change in inventories in current prices.
VDS_i		Total change in inventories of commodity *i* in current prices. $i \in$ **VA**
VET_{70}		Input of hydro power in *Production of Hydro-Power (70)* in current prices.
VET_{72}		Losses in the production sector *Transmission Services (72)* in current prices.
VET_{73}		Losses in the production sector *Distribution Services (73)* in current prices.
VG		Total expenditure/consumption in government production sectors in current prices.
VG_j		Expenditure/consumption in government production sector *j* in current prices. $j \in$ **PO**
VG_{90K}		Expenditure in local government production sectors in current prices.
VG_{90S}		Expenditure in central government production sectors in current prices.
VH		Total material input in current purchaser prices.
VH_j		Total material input in activity/sector *j* in current purchaser prices. $j \in$ **PSV**,**PSK**,{70,710,72,73}
VI		Total imports in current prices (c.i.f.).
VI_i		Import activity *i* in current prices (c.i.f.). $i \in$ **VA**
$VJ_{53\,030}$	*X*	Expenses in central government petroleum enterprises in current prices.
$VJ_{53\,040}$	*X*	Income from interest received by central government petroleum enterprises in current prices.
$VJ_{53\,050}$	*X*	Net capital formation in central government petroleum enterprises in current prices.

MSG Variable	Exogenous variables are labelled (*X*)	Content/Interpretation
$VJ_{53\,060}$	*X*	Gross capital formation in central government petroleum enterprises in current prices.
$VJ_{53\,070}$		Consumption of fixed capital in central government petroleum enterprises in current prices.
VJK		Aggregate gross real investment in current purchaser prices.
VJK_i		Gross real investment, capital activity *i*. $i \in$ **JA**
$VJKI_i$	*X* for *i = 230*	Gross real investment in institutional sector *i* in current prices. $i \in \{006,015,040,101,102,230,300,306,307,309\} \subset$ **INS**
$VJKIR_i$	*X*	Correction variable for gross real investment by institutional sector. $i \in \{101,102,300,306\} \subset$ **INS**
VJKS		Total gross real investment in current purchaser prices.
$VJKS_j$		Gross real investment in production sector *j* in current purchaser prices. $j \in$ **PS**
$VJKS_3$		Gross real investment in manufacturing sectors in current purchaser prices.
$VJNE_{015}$	*X*	Net purchase of real property by *Central Government (015)* in current prices.
$VJNE_{040}$	*X*	Net purchase of real property by *Local Government (040)* in current prices.
$VJNI_i$	*X* for *i = 210*	Net fixed capital formation in institutional sector *i* in current prices. $i \in \{006,015,040,101,102,210,300,306,307,309\} \subset$ **INS**
$VKORR_k$		Term correcting the value of gross production in power producing sector *k* as a result of changes in the price discrimination coefficients. $k \in \{70,72\}$
$VKORS_j$		The share of the correction term $VKORR_k$ distributed to production sector *j*. $j \in \{70,710\}$
VK_j		Real capital stock in production sector *j* measured in current prices. $j \in$ **PS**
VX		Gross national production in current prices inclusive of circular flow differences.
VX_j		Gross production in production sector *j* in current producer prices. $j \in$ **PSK**,$\{70,710,72,73\}$
VXB_j		Gross production in production activity/sector *j* in current basic prices. $j \in$ **PA,PSK**
VXG_j		Goods and services provided in exchange of a fee in government production sector *j* in current prices. $j \in$ **PO**
VXHJ		Gross national production in current prices inclusive of circular flow differences.
WW		Average wage per hour to wage earners in current prices and net of social taxes.

MSG Variable	Exogenous variables are labelled (X)	Content/Interpretation
WW_j		Wage per hour to wage earners in production sector j in current prices and net of social taxes. $j \in$ **PS**
WWA		Average wage per man-year for wage earners.
X		Gross national production in constant prices inclusive of shift effects.
X_j	X for $i \in$ {11,13,5045,6389, 6447,6466,6467}	Gross production in production activity/sector j in constant net-seller prices. $j \in$ **PA**,**PSK**,{70,710,72,73}
X_{ij}		Gross production of commodity i by power producing sector j measured in constant seller prices. $j \in$ {70,72,73} $i \in$ {55,85} $\subset$ **VA**
XG_j		Goods and services provided in exchange of a fee in government production sector j in constant prices. $j \in$ **PO**
XHJ		Gross national production in constant prices exclusive of shift effects.
XIT_i		Fixed-price index of accrued investment levy on activity i. $i \in$ **JA**
XMT_i		Fixed-price index of VAT accrued on commodity i. $i \in$ **VA**
XRD		Disposable real income for Norway.
XRU_{666}	X	*Other Transfers (666)* in *Local Government* in constant prices.
Y		Gross national product in current prices.
Y_j		Gross product (value added) in production sector j in current prices. $j \in$ **PSK**,{70,710,72,73}
Y_{58}		Shift effects/circular flow differences in current prices.
YD		Total capital depreciation in current prices.
YD_j		Capital depreciation in production sector j in current prices. $j \in$ **PSK**
YD_{210}	X	Capital depreciation in *Central Government Enterprises (210)* in current prices.
YD_{230}	X	Capital depreciation in *Local Government Enterprises (230)* in current prices.
YD_3		Total capital depreciation in manufacturing sectors.
YDI_i		Capital depreciation in institutional sector i in current prices. $i \in$ {015,040,101,102,300,306,307,309} $\subset$ **INS**
$YDIR_i$	X	Correction variable for capital depreciation by institutional sector. $i \in$ {101,102,300,306} $\subset$ **INS**
YE		Total operating surplus in current prices inclusive of circular flow differences.
YE_j		Operating surplus in production sector j in current prices. $j \in$ **PSK**
YE_{58}		Shift effects/circular flow differences measured in current prices.
YEH_k		Operating surplus to *Households (300)* by socio-economic group. $k \in$ **SOS**

MSG Variable	Exogenous variables are labelled (X)	Content/Interpretation
$YEHJ$		Total operating surplus in current prices exclusive of circular flow differences.
YEI_i		Operating surplus in institutional sector i in current prices. $i \in \{101,102,300,306,307,309\} \subset$ **INS**
$YEIR_i$	X	Correction variable for operating surplus by institutional sector. $i \in \{101,102,300,306\} \subset$ **INS**
YEN_{210}	X	Net surplus in *Central Government Enterprises (210).*
YEN_{230}	X	Net surplus in *Local Government Enterprises (230).*
YF		Total factor income measured in current prices.
YF_i		Factor income in production sector j in current prices. $j \in$ **PSK**
$YFHJ$		Total factor income net of circular flow differences in current prices.
YF_{58}		Shift effects/circular flow differences measured in current prices inclusive of circular flow differences.
YFN_{210}	X	Accounted net surplus in *Central Government Enterprises (210).*
YH_i		Total income received by household group j. $j \in$ **HH**
YHJ		Gross national product net of shift effects/circular flow difference in current prices.
YP_{ki}	X	Flow of patent and rental income from institutional sector i to institutional sector i. $(k,i) \in \{(309,309)(309,500)(500,309)\} \subset$ **INS×INS**
YSP_i	X for $i \in \{015,300,309\}$	Net non-life insurance premium by institutional sector. $i \in \{015,102,300,309\} \subset$ **INS**
$YSP_{300\,k}$		Non-life insurance premium by socio-economic group. $k \in$ **SOS**
YT		Total net indirect taxes in current prices.
YT_i		Net indirect taxes levied on production sector j in current prices. $j \in$ **PSK**
YTA		Gross indirect taxes.
YTA_K		Gross indirect taxes to *Local Government.*
YTA_S		Gross indirect taxes to *Central Government.*
$YTART$		Total net indirect taxes.
$YTART_r$		Net indirect taxes of type r. $r \in \{225,400\}$,**PV,PX,SA,SU,VV,VX**
YTS_i		Net tax levied on output from production sector j measured in current prices. $j \in$ **PSK**,$\{70,710,72,73\}$
$YTSA$		Total sectorial indirect taxes.
$YTSU$		Total sectorial subsidies.
YTU		Total subsidies.
YTU_K		Gross subsidies from *Local Government.*
YTU_S		Gross subsidies from *Central Government.*

MSG Variable	Exogenous variables are labelled (X)	Content/Interpretation
YTV_j		Net commodity tax assigned to production sector j. $j \in$ **PSK**,{70,710}
$YTVA$		Total commodity taxes.
$YTVU$		Total commodity subsidies.
YW		Total wage cost in current prices.
YW_j		Total wage cost in production sector j in current prices. $j \in$ **PS**
$YW_{300\,500}$	X	Wage payments and salaries from *Households (300)* to *Abroad (500)*.
$YW_{500\,300}$	X	Wage payments and salaries from *Abroad (500)* to *Households (300)*.
YWT		Employers' contribution to social security and National Insurance.
YWT_j		Employers' contribution to social security and National Insurance, production sector j. $j \in$ **PS**
$YWTA$		Employers' contribution to social security except National Insurance.
$YWTF$		Employers' contribution to the National Insurance.
YWW		Total wage and salary payments net of social taxes.
YWW_j		Wage and salary payment net of social taxes in production sector j. $j \in$ **PS**
YWW_k		Wages and salaries net of social taxes to socio-economic group k. $k \in$ **SOS**
$YWWC$		Wages and salaries net of social taxes received by domestic wage earners.
YWW_{90S}		Wages and salaries net of social taxes from *Central Government.*
$ZALFA_{015}$		The proportion of the change in total financial assets to the change in total liabilities held by *Central Government and Social Security* (015) when the value of the total financial assets is negative.
$ZALFA_{040}$		The proportion of the change in total financial assets to the change in total liabilities held by *Local Government (040)* when the value of the total financial assets is negative.
ZFU_j	X	Input of fuels per unit of the energy aggregate. $j \in$ {12,13,40,43,64,74} $\subset$ **PSV**
ZF_{70}	X	Import of fuels per unit of production in *Production of Hydro-Power (70)* measured in constant prices.
ZHU_j	X	Share of energy in total material inputs in government production sector/activity j. $j \in$ {92C,93S,94S,95S,93K,94K,95K} $\subset$ **PSV**
ZK_j		Unit input demand coefficient for real capital, sector j. $j \in$ **PP**\{60,64,71,89}
ZL_j		Unit input demand coefficient for labour, sector j. $j \in$ **PP**\{60,64,71,89}
ZM_j	X for $i \in$ {64,65}	Unit input demand coefficient for other material input, sector j. $j \in$ **PP**\{60,71,89}
ZU_j	X for $i \in$ {64,65}	Unit input demand coefficient, energy, sector j. $j \in$ **PP**\{60,71,89}

MSG Variable	**Exogenous variables are labelled (*X*)**	**Content/Interpretation**
ZUE_j		The share of electricity in constant prices in the fixed price energy aggregate in production sector *j*. $j \in$ **PS**
ZUF_j		The share of fuels in constant prices in the fixed price energy aggregate in production sector *j*. $j \in$ **PS**
ZZA_{ij}	*X*	Input coefficient for production of commodity *i* delivered from power producing sector *j*. $i \in \{55,85\} \subset$ **VA** $j \in \{70,72,73\}$
$ZZAVG_{710}$	*X*	Net sector taxes, exclusive of CO_2 taxes, in *Production of Gas-Power (710)* measured in (Nkr/kWh)..
ZZG_{710}		Average input coefficient for natural gas in *Production of Gas-Power (710)*, (Nkr/kWh).
ZZH_{70}	*X*	Total material input per unit of production in *Production of Hydro-Power (70)*, (Nkr/kWh).
ZZK_j		Average input coefficient for (real) capital in power producing sector *j*, (Nkr/kWh). $j \in \{710,72,73\}$
ZZK_{ij}	*X*	Average input coefficient for (real) capital type *i* in power producing sector *j*, (Nkr/kWh). $i \in \{11,12,40,50\}$ $j \in \{710,72,73\}$
ZZK_{70}		Marginal input coefficient for (real) capital in *Production of Hydro-Power (70)*, (Nkr/kWh).
ZZK_{70T}		Average input coefficient for (real) capital in *Production of Hydro-Power (70)*, (Nkr/kWh).
ZZL_j	*X*	Input of man-hours per unit of production in power producing sector *j*, (Nkr/kWh). $j \in \{70,710,72,73\}$
ZZM_j	*X*	Other material input per unit of production in power producing sector *j*, (Nkr/kWh). $j \in \{710,72,73\}$
ZZR_{710}	*X*	Pipeline transport services per unit of production in *Production of Gas-Power (710)*, (Nkr/kWh).
$ZZYTS_j$		Net sector taxes per unit of gross product in power producing sector *j*, (Nkr/kWh). $j \in \{70,710,72,73\}$

3.3 Parameter estimates

Several of the parameters in MSG-5 have been estimated by econometric methods. For the sake of completeness, these parameter values and some important elasticities are included in this document (see also the studies referred to below).

Production technology

As described in Section 1.3, the technology in MSG-5 is separable in those sectors where factor intensities are endogenous. The optimal inputs of Capital (K), Labour, (L), Energy (U) and Other Material Inputs (M) are determined at the upper level. At this level the technology is described by a CRTS Generalised Leontief (GL) unit cost function. Table 3.3.1 reports the corresponding estimated GL-parameters at the upper level. This estimation was carried out by T. Bye and P. Frenger, and a comprehensive presentation of their econometric work is given in Alfsen, Bye and Holmøy (1994). It should be noted that in connection with the updating of the MSG-5 model to a new base year, the GL-parameters are revised according to changes in relative factor prices between the old and the new base year. Bye and Frenger (1987) explain the rationale and the procedure for this revision. The parameters reported in Table 3.3.1 are estimated with 1989 as the base year for the normalisation of the factor prices.

Table 3.3.2 reports the Shadow Elasticities of Substitution (SES) corresponding to the estimated technology. The SES between two factors in a flexible multifactor function is defined as the negative of the elasticity of the ratio between the input of these factors with respect to changes in the corresponding price ratio holding output, all other prices and total costs constant (see McFadden (1978)).

Table 3.3.1: Parameters in the Generalised Leontief (GL) Cost Function, Upper Level

Production sectors with price dependent factor demand	C.MM	C.MU	C.ML	C.MK	C.UU	C.UL	C.UK	C.LL	C.LK	C.KK
11 Agriculture	0.48	-0.02	1.14	0.00	0.00	0.21	0.05	-22.23	9.26	0.21
12 Forestry	0.11		0.03	0.09				6.34	-0.64	2.23
13 Fishing and Breeding of Fish Etc.	-0.25		2.94	0.31				-6.01	-2.44	1.43
15 Manufacture of Consumption Goods	0.45	0.01	1.03	-0.12	0.00	0.03	-0.01	-3.00	0.74	0.27
25 Manufacture of Intermediate Inputs and Capital Goods	0.17	0.03	1.50	-0.14	-0.04	0.20	-0.05	-4.02	1.10	0.34
34 Manufacture of Pulp and Paper Articles	0.31		0.91	0.15	0.06			-2.51	1.14	-0.75
37 Manufacture of Industrial Chemicals	0.53	0.15	-0.01	0.07	-0.44	0.44	-0.08	-3.58	1.09	-0.06
43 Manufacture of Metals	0.46	0.08	0.19	-0.12	-0.09	0.40	-0.08	-1.88	1.31	0.25
45 Manufacture of Metal Products, Machinery and Equipment	0.08	0.03	1.63	-0.12	0.00	0.02	-0.04	-3.12	0.94	0.18
50 Building of Ships and Oil-Platforms	-0.35	0.01	2.84	0.39	0.00	0.01	-0.01	-6.17	-0.40	-0.27
55 Construction, excl. Oil Well Drilling	0.15		1.94	-0.20	0.00			-3.96	0.69	0.13
81 Wholesale and Retail Trade	0.01	0.02	1.16	-0.08	-0.02	0.15	-0.03	-1.11	0.56	0.14
63 Finance and Insurance	0.24		0.33	-0.22				0.05	1.56	-0.29
83 Dwelling Services	0.09	0.00	0.06	0.51	0.00	0.00	0.00	-0.06	-0.03	15.19
85 Other Private Services	0.06	0.02	0.98	-0.09	-0.02	0.11	-0.04	-0.64	1.05	0.54

Table 3.3.2: Shadow Elasticities of Substitution, Upper Level.

Production sectors with price dependent factor demand	σ_{MU}	σ_{ML}	σ_{MK}	σ_{UL}	σ_{UK}	σ_{LK}
11 Agriculture	0.55	1.43	0.31	0.82	0.62	1.94
12 Forestry	0.01	0.09	0.06	0.00	0.01	0.13
13 Fishing and Breeding of Fish Etc.	0.09	2.36	0.37	0.52	0.03	0.42
15 Manufacture of Consumption Goods	0.41	1.99	0.20	0.66	0.33	1.33
25 Manufacture of Intermediate Inputs and Capital Goods	0.96	1.68	0.23	1.24	0.68	1.02
34 Manufacture of Pulp and Paper Articles	0.02	1.71	0.89	0.44	0.33	1.69
37 Manufacture of Industrial Chemicals	2.15	2.04	0.50	4.12	1.25	1.95
43 Manufacture of Metals	0.97	1.04	0.22	1.61	0.62	1.37
45 Manufacture of Metal Products, Machinery and Equipment	0.67	1.48	0.30	0.68	0.46	0.80
50 Building of Ships and Oil-Platforms	0.62	3.33	1.11	0.70	0.56	1.07
55 Construction, excl. Oil Well Drilling	0.00	1.62	0.08	0.02	0.02	0.61
81 Wholesale and Retail Trade	1.06	1.05	0.18	1.14	0.70	0.51
63 Finance and Insurance	0.00	0.30	0.36	0.01	0.04	0.86
83 Dwelling Services	0.16	1.05	0.38	0.22	0.16	0.98
85 Other Private Services	1.10	0.91	0.24	1.15	0.91	0.56

At the lower level, energy is a composite of electricity (E) and Fuels (F) and the technology is described by a linearly homogeneous, Constant Elasticity of Substitution (CES) function. The econometric work is documented in Mysen (1991). Table 3.3.3 presents the substitution parameters (see Eq. (3.2.16)).

Table 3.3.3: Parameters in the CES Energy Aggregation Function

Production sectors with price dependent composition of energy	*E.L1P*	*E.P*	*E.L1E*	$\sigma.^{U}$
11 Agriculture	0.14		-0.58	0.24
15 Manufacture of Consumption Goods	0.41		-1.71	0.24
25 Manufacture of Intermediate Inputs and Capital Goods	0.45		-0.61	0.74
34 Manufacture of Pulp and Paper Articles		-1.21		1.21
37 Manufacture of Industrial Chemicals	0.07		-0.63	0.11
43 Manufacture of Metals				
45 Manufacture of Metal Products, Machinery and Equipment		-0.23		0.23
50 Building of Ships and Oil-Platforms	0.04		-0.83	0.05
55 Construction, excl. Oil Well Drilling	0.18		-1.33	0.14
81 Wholesale and Retail Trade	0.20		-0.85	0.24
85 Other Private Services	0.07		-0.48	0.15

Consumer demand

As described in Section 1.3.1 and 2.11, the consumer demand is derived from perfect aggregation of the demand systems in 14 household groups. In 13 of these groups, the consumption expenditure is endogenously allocated to 13 consumption activities according to a three-level, separable utility structure (see Figure 1.3.1). At the top level, a Linear Expenditure System (LES) is employed. At the intermediate level, expenditure on *Transport* is allocated to *Private Transport* and *Public Transport* according to a LES. At the bottom level, *Private Transport* is a linearly homogeneous CES composite of *Petrol and Car Maintenance* and *User Cost of Cars etc.*, whereas *Energy* is a linearly homogeneous CES composite of *Electricity* and *Fuels*. The derivation of the parameter values from the econometric work by Aasness, Biørn and Skjerpen (1993) is described in Aasness and Holtsmark (1993a). Table 3.3.4 - 3.3.10 are taken from the latter.

Table 3.3.4: Parameter Values in the Top Level LES

Consumption Activity		Minimum consumption[a] Fixed $GA._{THO}$	Extra child $GA._{TZ1}$	Extra adult $GA._{TZ2}$	Marginal budget share BE.
00	Food	6503	8776	10026	0.0621
11	Beverages and Tobacco	3557	1389	1292	0.0701
U	Energy[b)]	7058	1082	1537	0.0175
T	Transport[c)]	-7841	2283	10613	0.1684
15	Other goods	1246	2927	3809	0.0989
21	Clothing and Footwear	-1386	2836	3926	0.0626
40	Furniture and Electrical Equipment.	1741	937	978	0.0802
50	Gross Rents	8199	3689	-1171	0.1715
60	Other services	-895	2196	4339	0.1282
66	Direct Purchases Abroad by Resident Households	-2143	56	1102	0.1405
	Sum	16039	26170	36452	1.000

a) Measured in 1991 Nkr.
b) A CES aggregate (see Table 3.3.6).
c) Based on the intermediate level LES in table 3.3.5 and the bottom level CES in Table 3.3.6. Note that minimum consumption at the intermediate level comes in addition to those tabulated here.

Table 3.3.5: Parameters in the Intermediate Level LES for Transport

Consumption Activity		Minimum consumption[a] Fixed $GA._{HO}$	Extra child $GA._{Z1}$	Extra adult $GA._{Z2}$	Marginal budget share BE.
PT	Private Transport	-4100	1388	349	0.7754
61	Public Transport Services	3498	-1070	-69	0.2246
	Sum	-602	318	280	1.000

a) Measured in 1991 Nkr.

Table 3.3.6: Parameters in the Bottom Level CES Functions for Energy and Private Transport

Energy (U)			Private Transport (PT)		
Distribution parameters (*O.*)		Elasticity of	Distribution parameter (*O.*)		Elasticity of
Electricity (12)	Fuels (13)	substitution (*SU.U*)	Petrol and Car Maintenance (14)	User Cost of Cars etc. (31)	substitution (*SU.U*)
0.865	0.135	0.5	0.456	0.544	0.1

Table 3.3.7: Elasticities in the Complete Consumer Demand System[a)]

Consumption Activity		Budget share	Engel elasticity	Household elasticity	Child elasticity	Adult elasticity	Direct Slutsky elasticity	Direct Cournot elasticity
12	Electricity	0.054	0.279	0.571	0.123	0.178	-0.186	-0.201
13	Fuels	0.008	0.279	0.571	0.123	0.178	-0.451	-0.453
14	Petrol and Car Maintenance	0.046	1.290	-0.636	-0.037	0.468	-0.360	-0.420
31	User Cost of Cars etc.	0.055	1.290	-0.636	-0.037	0.468	-0.410	-0.481
61	Public Transport Services	0.047	0.804	0.129	-0.415	0.246	-0.622	-0.659
00	Food	0.185	0.336	0.158	0.483	0.525	-0.157	-0.219
11	Beverages and Tobacco	0.070	1.007	0.188	-0.084	-0.231	-0.467	-0.537
15	Other Goods	0.100	0.988	-0.015	0.038	0.022	-0.444	-0.543
21	Clothing and Footware	0.069	0.905	-0.179	0.213	0.294	-0.423	-0.486
40	Furniture and Electrical Equipment	0.061	1.316	0.044	-0.244	-0.404	-0.603	-0.684
50	Gross Rents	0.129	1.327	0.227	-0.083	-0.724	-0.548	-0.720
60	Other Services	0.106	1.209	-0.143	-0.142	-0.044	-0.525	-0.653
66	Direct Purchases Abroad by Resident Households	0.069	2.030	-0.329	-0.663	-0.734	-0.870	-1.010
	Sum [b)]	1.000	1.000	0.000	0.000	0.000	-	-

a)Elasticities for the average household and macro demands.

b)The elasticities are weighted with the budget shares.

Table 3.3.8: Slutsky Elasticities in the Complete Consumer Demand System[a)]

	Consumption Activity	s_{j12}	s_{j13}	s_{j14}	s_{j31}	s_{j61}	s_{j00}	s_{j11}	s_{j20}	s_{j21}	s_{j40}	s_{j50}	s_{j60}	s_{j66}	Sum b)
12	Electricity	-0.186	0.049	0.008	0.010	0.005	0.009	0.010	0.014	0.009	0.011	0.024	0.018	0.020	0.000
13	Fuels	0.314	-0.451	0.008	0.010	0.005	0.009	0.010	0.014	0.009	0.011	0.024	0.018	0.020	0.000
14	Petrol and Car Maintenance	0.010	0.002	-0.360	-0.309	0.134	0.040	0.045	0.064	0.040	0.052	0.110	0.082	0.090	0.000
31	User Cost of Cars etc.	0.010	0.002	-0.260	-0.410	0.134	0.040	0.045	0.064	0.040	0.052	0.110	0.082	0.090	0.000
61	Public Transport Services	0.006	0.001	0.132	0.157	-0.622	0.025	0.028	0.040	0.025	0.032	0.069	0.051	0.056	0.000
00	Food	0.003	0.000	0.010	0.012	0.006	-0.157	0.012	0.017	0.010	0.013	0.029	0.021	0.024	0.000
11	Beverages and Tobacco	0.008	0.001	0.030	0.036	0.019	0.031	-0.467	0.050	0.031	0.040	0.086	0.064	0.070	0.000
15	Other Goods	0.007	0.001	0.029	0.035	0.019	0.031	0.035	-0.444	0.031	0.039	0.084	0.063	0.069	0.000
21	Clothing and Footware	0.007	0.001	0.027	0.032	0.017	0.028	0.032	0.045	-0.423	0.036	0.077	0.058	0.063	0.000
40	Furniture and Electrical Equipment	0.010	0.002	0.039	0.047	0.025	0.041	0.046	0.065	0.041	-0.603	0.112	0.084	0.092	0.000
50	Gross Rents	0.010	0.002	0.039	0.047	0.025	0.041	0.046	0.065	0.041	0.053	-0.548	0.085	0.093	0.000
60	Other Services	0.009	0.001	0.036	0.043	0.023	0.037	0.042	0.060	0.038	0.048	0.103	-0.525	0.085	0.000
66	Direct Purchases Abroad by Resident Households	0.015	0.002	0.060	0.072	0.038	0.063	0.071	0.100	0.063	0.081	0.173	0.130	-0.870	0.000
	Sum c)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

a) Elasticities for the average household and macro demands in the base year, 1991.

b) We apply that $\Sigma_j s_{ij}=0$, i.e. homogeneity of demands, for control.

c) We apply that adding up condition, for control.

Table 3.3.9: Cournot Elasticities in the Complete Demand System[a)]

Consumption Activity	e_{j12}	e_{j13}	e_{j14}	e_{j31}	e_{j61}	e_{j00}	e_{j11}	e_{j20}	e_{j21}	e_{j40}	e_{j50}	e_{j60}	e_{j66}	Sum[b)]
12 Electricity	-0.201	0.047	-0.005	-0.005	-0.008	-0.043	-0.010	-0.014	-0.011	-0.006	-0.012	-0.012	0.000	0.000
13 Fuels	0.299	-0.453	-0.005	-0.005	-0.008	-0.043	-0.010	-0.014	-0.011	-0.006	-0.012	-0.012	0.000	0.000
14 Petrol and Car Maintenance	-0.060	-0.009	-0.420	-0.380	0.073	-0.198	-0.045	-0.066	-0.049	-0.027	-0.056	-0.054	0.001	0.000
31 User Cost of Cars etc.	-0.060	-0.009	-0.319	-0.481	0.073	-0.198	-0.045	-0.066	-0.049	-0.027	-0.056	-0.054	0.001	0.000
61 Public Transport Services	-0.038	-0.006	0.095	0.113	-0.659	-0.124	-0.028	-0.041	-0.031	-0.017	-0.035	-0.034	0.001	0.000
00 Food	-0.016	-0.002	-0.006	-0.007	-0.009	-0.219	-0.012	-0.017	-0.013	-0.007	-0.015	-0.014	0.000	0.000
11 Beverages and Tobacco	-0.047	-0.007	-0.017	-0.020	-0.028	-0.155	-0.537	-0.051	-0.038	-0.021	-0.044	-0.042	0.001	0.000
15 Other Goods	-0.046	-0.007	-0.016	-0.019	-0.028	-0.152	-0.034	-0.543	-0.038	-0.021	-0.043	-0.042	0.001	0.000
21 Clothing and Footware	-0.042	-0.007	-0.015	-0.018	-0.026	-0.139	-0.031	-0.046	-0.486	-0.019	-0.040	-0.038	0.001	0.000
40 Furniture and Electrical Equipment	-0.061	-0.010	-0.022	-0.026	-0.037	-0.202	-0.046	-0.067	-0.050	-0.684	-0.058	-0.055	0.001	0.000
50 Gross Rents	-0.062	-0.010	-0.022	-0.026	-0.037	-0.204	-0.046	-0.067	-0.050	-0.028	-0.720	-0.056	0.001	0.000
60 Other Services	-0.056	-0.009	-0.020	-0.024	-0.034	-0.186	-0.042	-0.061	-0.046	-0.025	-0.053	-0.653	0.001	0.000
66 Direct Purchases Abroad by Resident Households	-0.095	-0.015	-0.033	-0.040	-0.057	-0.312	-0.070	-0.103	-0.077	-0.043	-0.089	-0.086	-1.010	0.000
Sum[c)]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

a) Elasticities for the average household and macro demands in the base year (1991).

b) We apply that $\Sigma_j e_{ij}+E_i=0$, i.e. homogeneity of demands, for control (E_j is the Engel elasticity of commodity j).

c) We apply the adding up condition, for control.

Trade elasticities

Export demand is endogenous for most of the manufactures and for some services. For these commodities, Norwegian firms face export demand curves which depend negatively on the ratio between the domestic price and the exogenous world market price. In addition, an index for world market demand can shift this demand function. In MSG-5 the export demand functions are static and use the long-run values of the elasticities that can be deduced from the dynamic equations estimated by Lindquist (1993). These long-run elasticities are reported in Table 3.3.11.

For most manufactured goods, the import shares increase endogenously if the domestic price is raised relative to the corresponding import price in accordance with the estimated elasticities of substitution between the Norwegian and corresponding foreign varieties. The elasticities of substitution are only commodity specific and do not vary across different kinds of domestic use. In MSG-5, the import share relations are static and use the long-run values of the elasticities of substitution that can be deduced from the dynamic equations estimated by Naug (1994). These long-run values are reported in Table 3.3.12.

Table 3.3.10: Elasticities in the Export Demand Functions

Commodities for which export is endogenous		Market growth (*A0.MII.*)	Relative price (*A0.M*)
16	Processed Commodities from Agriculture and Fishery	1.00	-3.68
17	Beverages and Tobacco	2.21	-3.36
18	Textiles and Wearing Apparels	2.02	-3.62
25	Various Manufacturing Products	1.29	-1.37
34	Pulp and Paper Articles	1.0	-1.62
37	Industrial Chemicals	1.0	-2.12
43	Metals	1.0	-1.84
46	Metal Products, Machinery and Equipment	1.86	-2.77
47	Repair	1.86	-2.77
74	Domestic Transport	0.83	-1.11
81	Wholesale and Retail Trade	2.97	-1.91
24	Direct Purchases in Norway by Non-Resident Households	0.79	-0.62

Table 3.3.11: Elasticities of Substitution (*PDI.*) in the Import Share Functions

Commodities for which import shares are endogenous		*PDI.*
16	Processed Commodities from Agriculture and Fishery	1.66
17	Beverages and Tobacco	1.00
18	Textiles and Wearing Apparels	0.23
25	Various Manufacturing Products	2.53
34	Pulp and Paper Articles	2.35
37	Industrial Chemicals	1.0
43	Metals	0.81
46	Metal Products, Machinery and Equipment	1.00

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