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A Macroeconomic Model for Saudi Arabia

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Abstract:
This report gives a documentation of the Implementation Model, developed by the Research Department of Statistics Norway as part of the construction of a system of macroeconomic models for the use of the Ministry of Planning in Saudi Arabia. The main purpose of the model is to serve as a tool for assisting in the preparation and monitoring of the five-year development plans carried out by the Ministry, as well as providing a basis for analyses of fiscal and monetary policies and shocks from the oil sector and abroad. The model is a demand oriented, macroeconometric model based on national account data and built over an input-output core. The focus of the model is the private non-oil sector of the economy, but it also contains a description of the petroleum sector and the government sector. The report contains a presentation of the model structure, its main properties as described by simulation exercises as well as the historical tracking performance (1980-91). In addition, the construction of the input-output core and estimation of econometric equations is documented.

Keywords: Saudi Arabia, macroeconomic model, macroeconomic planning

JEL classification: O53, O21, E17

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1. Introduction

The general background for the development and use of macroeconomic models in the Ministry of Planning is given in UN/DDSMS Project Document *Support for Economic Planning, Modelling and Management Information Systems* (SAU/94/001/A701/01, pp. 1-4). An earlier macroeconomic module and the data system built around it has been intensively utilized and played an important role in the preparation of the macroeconomic parts of the 5th and 6th Development Plans and in the monitoring of the economy in the corresponding period. It was recognized to have serious limitations with regard to a more policy oriented use of models (p.4). The UN/DDSMS document outlines, partly based on Bjerkholt (1993), a system of four models, among those "a short run forecasting model".

The model presented here adheres in name and content closely to the proposals for a model system in Bjerkholt (1993), which included a short-to-medium term *Implementation Model* for monitoring the plan implementation and for ad hoc use in forecasting and policy analysis. The *Implementation Model* as developed will also fill the need for an ad hoc short-term macroeconomic model for economic policy analysis. The *Implementation Model* is an annual model (quarterly national account data are not yet available in Saudi Arabia).

This report documents the *Implementation Model* as handed over in June 1995 with revisions of January 1996. The model has been constructed over an input-output core and includes features commonly found in short-to-medium term models in other countries. The specification of the model is based on a thorough study of available data sources. Input-output tables integrated with the National Accounts system are not available in Saudi Arabia at present. The input-output core of the model is tentatively estimated from other data sources made available by the Ministry, adjusted to the National Accounts data for 1989, the base year of the current version of the model.

A brief review of the model is given in chapter 2, while chapter 3 offers a more detailed description of the economic content of the different submodels, relegating technical details to annexes. Chapter 4 examines the tracking performance of the model, and chapter 5 demonstrates a multiplier analysis of the model. The concluding chapter 6 offers some thoughts on the further development on the model. The annexes comprise a complete list of the variables, a documentation of the establishment of I/O-coefficients, estimation results, and equations of the model. The Implementation model operates under Portable TROLL, developed by Intex Solutions Inc. A detailed description of the procedures for updating and simulating the model in TROLL is given in Choudhury and Magnussen (1996).

2. Main features of the Implementation Model

2.1. Outline and scope of the model

The *Implementation Model* may be characterized as a short-to-medium term demand-oriented annual econometric model built over an input-output framework. Its behavioural relationships are centred on the private non-oil sector, reflecting economic consequences of fiscal or monetary policy actions taken by the Government in pursuance of plan targets, as well as impulses from the oil sector or from abroad. These properties brings the model in line with the mainstream of policy oriented macroeconomic forecasting models in industrialized market economies, see e.g. Bergman and Olsen (1992) for a review of Nordic models, Wallis et al. (1987) for analyses of British models and Fair (1994) for a multicountry model, including the US. The short-to-medium term horizon may generally be understood to mean projections from one to 5-6 years ahead.

Although a main purpose of the model is to monitor the plan implementation, it may be found useful at the plan preparatory stage as well. By utilizing the preliminary indicators of the economic development available in the Kingdom, the model may provide an updated picture - corresponding to the macroeconomic framework adhered to in the Development Plan (DP) - of the state of the economy. The model may also be used for analyses of external "shocks" and policy analyses on an ad hoc basis. Hence, the model may become a very central tool both for monitoring the economic development, for better understanding of the functioning of the economy, and for carrying out short-term policy analysis within the Ministry of Planning (MOP).

2.1.1. Model structure

The *Implementation Model* is in terms of specifications fairly closely related to the macroeconomic model formerly used in the MOP. The sector specification is the same, and in a broad sense the same type of macroeconomic relationships appear. The ambition level is, however, considerably higher, especially when it comes to modelling prices and variables closely connected to prices. A major difference is also that the *Implementation Model* incorporates an input/output core which improves the model significantly, in particular when simulating the effects of changes in governmental instrument variables, e.g. purchases of goods and services, subsidies, and administrated prices.

The input/output approach implicitly balance supply and demand for goods and services at sector levels, hence ensuring a more correct distribution of production between industries than a more aggregate approach, with ad hoc disaggregation. The input-output structure, although weakly based, brings into the model a larger information set than the National Accounts (NA) time series alone.

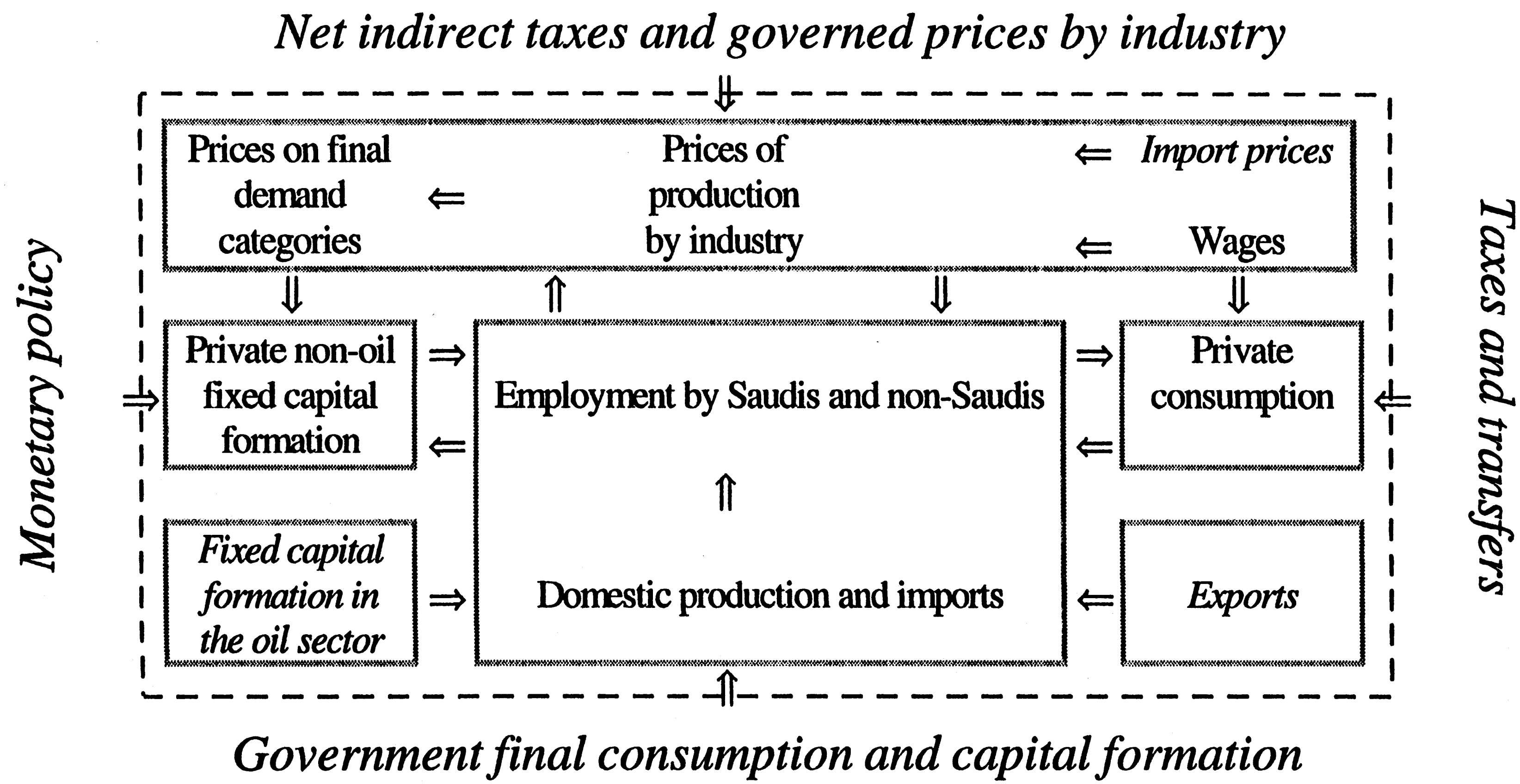
The input/output approach enables us to model relationships between prices on production (value added by industry), and final demand. In the macroeconomic module used by MOP in preparation of the 5th DP, there was no true price module and prices were defined implicitly by running the model in both constant and current prices. This was clearly unsatisfactory.

The input/output framework, furthermore, enables us to specify how changes in fiscal instruments such as government expenditures on consumption and capital formation, subsidies on commodities, and administrated prices on petroleum products, public utilities, etc. affect the private sector of the economy. At the same time this will improve the accuracy of the estimated macroeconomic effects.

A brief overview of the model is exposed in Chart 2.1: Structure of the *Implementation Model*. In the chart the different equations in the model are separated into four blocks (the two remaining blocks in the charts showing exogenous variables only). The first block consists of wage equations and price equations. This block may be called the price-block. The second consists of the equations for production, employment by Saudi and non-Saudi, and productivity, and is called the production/employment block. It is connected to the consumption block, including equations for private consumption by consumption categories, and the fixed capital formation block, including equations for private non-oil gross fixed capital formation and private non-oil capital stock. As may be seen from the chart, the four blocks are connected to each other in a big loop, making the model highly simultaneous.

There are 177 equations (and endogenous variables) in the model, of which 37 equations are part of the input/output core and 14 equations are econometrically estimated from time series, in general covering the period 1970-1991. The remaining endogenous variables are either determined by use of calibrated coefficients or by definitional relationships. There are 123 exogenous variables.

Chart 2.1 Structure of the Implementation Model



2.1.2. Data

As for the macroeconomic module formerly used in the Ministry of Planning, the main data source for the *Implementation Model* is the annual National Accounts (NA), including estimates of GDP by expenditure in constant prices, etc. calculated within the MOP. Due to the lag in publication of NA figures, the model may be used for updating intermediate years. Other statistical sources, e.g. the Cost of Living Index and the Trade Statistics, may be used for this purpose, either as input or to evaluate the results.

The reason for basing the model on NA data is that these data are designed to give a comprehensive and consistent description of the economy and provide a platform for macroeconomic analysis. Such considerations are not always well taken care of by other statistical sources. The danger of basing a model on unreconciliated statistical sources, if at all available, is that serious inconsistencies may arise. (All macroeconomic short-to-medium term combined forecasting and policy analysis models in the OECD countries, are firmly based on NA concepts, often on a quarterly basis.)

The well acknowledged deficiencies in the National Accounts (NA) figures for Saudi Arabia, will necessarily spill over to estimates and forecasts made by the Ministry. While use of the identities embedded in the NA concepts secures a formally consistent description of the Saudi economy, there is no guarantee that the series are economically consistent. The poor quality of some data sources and the lack of others limit the possibility of establishing econometrically based structural relationships. The confrontation of the NA time series and the structure of the Saudi economy embedded in the I/O-matrix - albeit such a matrix as well has to be established on a weak empirical footing - will enlarge the information set available to make qualified judgements on both recent history (estimates) and the future (forecasts).

Another major data source for the model is the government budget. This part of the model may still need further corroborations and will benefit from a more detailed specification of the financial flows of the budget. However, if found convenient for the planning/policy analysis process, the input specification of these items may be even more detailed.

The year 1989 was chosen as the *base year* for the model. This implies that all constant price variables are calculated in 1989 prices, price indices are equal to 1 in 1989, and all input-output coefficients refer to the year 1989.

2.2. Policy measures included in the model

The policy instrument variables incorporated in the model are displayed along the frame of Chart 2.1 above. The instrument variables enters different parts of the model: Net taxes and controlled prices enters directly into the price equations. Disbursement of investment credits affects capital formation in the non-oil sector directly. Government transfers to households and a household income tax rate influences private consumption[1]. Government consumption and gross fixed capital formation directly affects final demand, production and employment. Through the interdependence of the different blocks of the model, government policy instruments influence in principle all endogenous variables.

2.3. The modelling of private sector behaviour

While Chart 2.1 outlines the overall structure and interrelations of the model, it does not give a detailed description of the economic relationships between the variables of the model. A more precise description of these relationships is given in Chart 2.2: Economic relationships of the *Implementation Model*. In this chart the different blocks of Chart 2.1 are broken down to groups of equations. A more complete description of the equations is given in Chapter 3, with full documentation of the equations in Annex D.

[1] The tax rate is, however, equal to zero.

The price block

The core of the price block is the equations for value added price indices by industry at factor cost (derived from producer values excluding net indirect commodity taxes), and market prices of the final demand categories. For half of the industries the production prices are exogenous (e.g. determined by the Government), while for the other half the prices are modelled by econometric equations in wage costs and import prices. The latter variable reflects both competition from imported goods and the cost of imported intermediate consumption. Import prices are exogenous in the model, but may be changed to depend on exogenous assumptions about the world market prices of corresponding goods (measured in US$) and the exchange rate for Saudi Riyals. The real private wage rate is determined by productivity and government wages, while the price equations implicitly determine the mark-up for operating surplus.

Final demand consists partly of imports and partly of domestically produced goods. Hence, prices of final demand will depend upon import prices, prices of domestic production and the market share between imports and domestic production. Final demand prices are determined in the input/output part of the price block, by weighting together prices of all products that directly or indirectly are delivered to each category of final demand, including prices in sectors with governed prices and prices on imported products. In order to arrive at prices in purchasers' value, net indirect taxes are added. (The reason for modelling producer prices exclusive of net indirect taxes, is that such taxes may depend on the final use of the product.)

The average change in market shares for imports is included in the model as an exogenous variable. It may be adjusted to take account of structural changes (e.g. in competition) between imported and domestically produced goods. As a default it is set equal to zero, implying import shares for every commodity are equal to their values in the model's base year.

The gross fixed capital formation block

With prices, wages and net indirect taxes determined in the price block, and production determined by the production/employment block, operating surplus in the private non-oil sector may be calculated. Together with governmental investment credits, and household disposable income, operating surplus determines private gross fixed capital formation, as a component of total final demand. It indirectly also determines (an estimate for) the capital stock in the private non-oil sector.

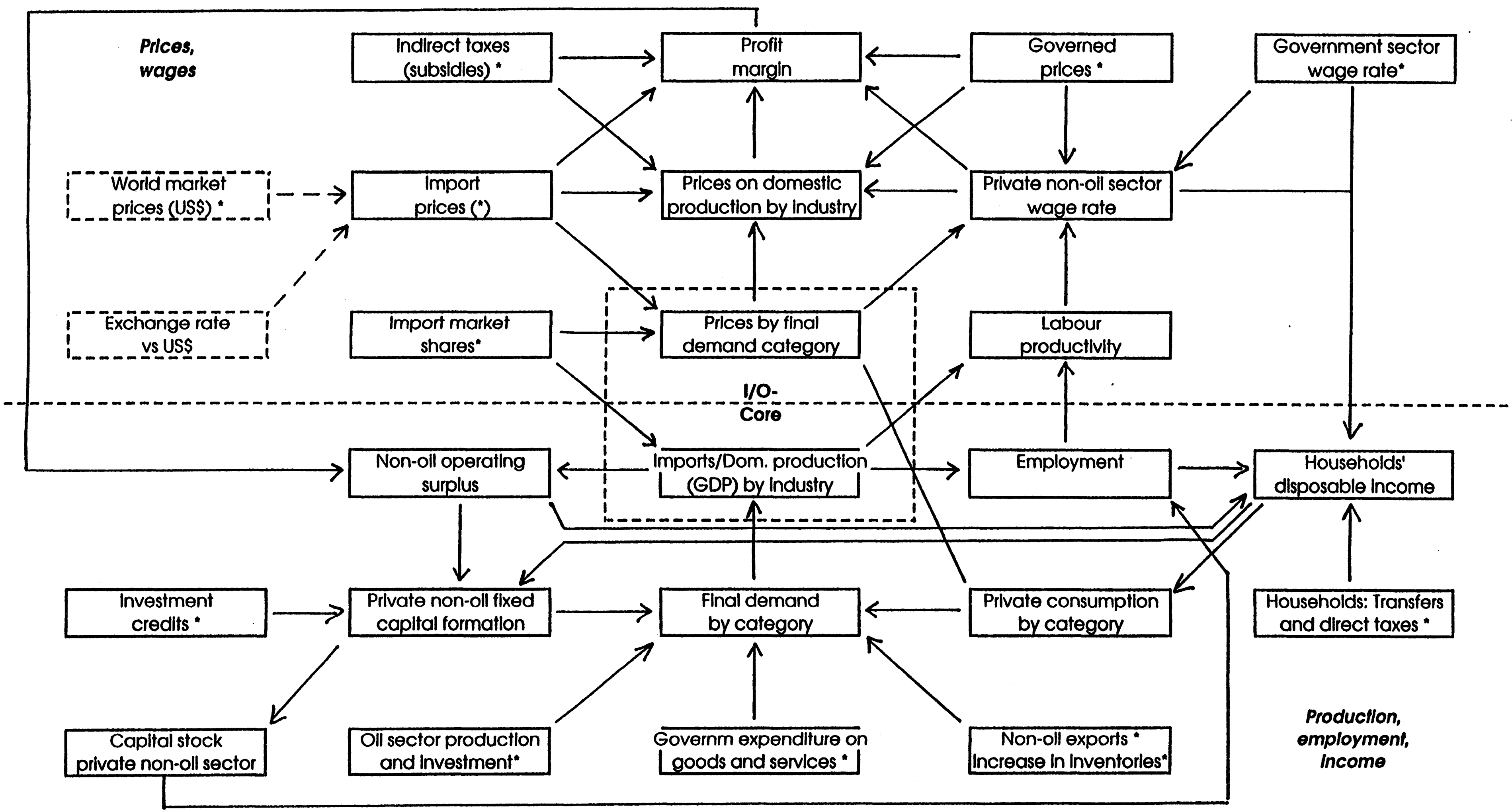
The production/employment block

From given total final demand, the market shares (based on input/output information) determine both the volume of imports and domestic production by industry. Domestic production, together with the capital stock from the gross fixed capital formation block, determines total employment, and hence productivity, through an inverted macro production function for the private non-oil sector. Total employment is divided into Saudi/non-Saudi employment.

The private consumption block

Combining the employment level with the wage rate estimates (from the price block) wage income is obtained. Adding households' share of operating surplus and governmental transfers to households (incl. a household income tax, currently set equal to zero) we arrive at an indicator for households' disposable income. Through the macro consumption function, also including a wealth variable, and the linear expenditure system, private consumption by item is determined as another component of total final demand.

Chart 2.2: Economic Relationships of the *Implementation Model*



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Model simultaneity
Both the private consumption block and the gross fixed capital formation block have two-way links with the production/employment block: Private consumption affects production (final demand effect), and production affects private consumption (through employment, operating surplus and income). Production also affects gross fixed capital formation (through operating surplus and households' income), while gross fixed capital formation affects production (final demand effect), the capital stock, and employment. Through productivity, changes in production and employment affect wages, prices, operating surplus, and households' income, and hence private consumption and gross fixed capital formation.

Outside these four endogenous blocks exogenous estimates of non-oil exports, capital formation in the oil sector, government expenditures on goods and services, and increases in stocks add to total final demand, non-oil domestic production and total imports. Combined with exogenous estimates for oil production and the results from the price block, GDP can now be determined both at constant and current prices, as well as the distribution of GDP by industries, by final demand components, and by factor remuneration.

With additional assumptions about net factor income and transfers from abroad, the current account of the balance of payments can then be determined. Revenues from government companies, plus direct and indirect taxes, minus government consumption and investment, and transfers to the household sector gives the net financial investment for the government sector. The difference between the balance of current account and the net financial investments by government, is by definition the net financial investments of the private sector.

2.4. Aggregation level

The industries specified in the *Implementation Model* are the same as used in the latest Development Plan.

Production sectors: (abbreviations in parenthesis)

1. Agriculture, forestry and fishing (AG)
2. Other mining, quarrying (MI)
3. Petrochemicals (PS)
4. Other manufacturing (MA)
5. Electricity, gas and water (EW)
6. Construction (CN)
7. Wholesale and retail trade (TD)
8. Transport and communication (TC)
9. Real estate (RE)
10. Finance, insurance (FI)
11. Community services (CS)
12. Government services (GS)
13. Imputed bank charges (BC)
14. Crude oil and natural gas (OG)
15. Petroleum refining (PR)
16. Import duties (ID)

Private consumption expenditures are in the model allocated to nine consumer groups by means of a linear expenditure system. The consumption groups are those defined in the National Accounts. The composition of consumption groups also coincides with those in the Cost of Living Index.

Consumption items: (abbreviations in parenthesis)
1. Food, beverage, tobacco (FOO)
2. Clothing and footwear (CLO)
3. Rent, fuel and power (REN)
4. Furniture and household equipment (FUR)
5. Medical health care (MED)
6. Transport and communication (TRA)
7. Entertainment and education (ENT)
8. Other goods and services (OTH)
9. Resident direct purchase abroad (ABR)

Gross fixed capital formation is not specified by industry in the National Accounts, only by institutional sector, i.e. Government (G), Oil (O) and the Private, non-oil sector (P). For the Government and the Oil sector two categories of investments are defined (categories 2 and 3 below), while the Private, non-oil sector investments also include residential buildings.

Categories of gross fixed capital formation: (abbreviations in parenthesis)
1. Residential buildings (H)
2. Non-residential buildings (B)
3. Transport and Machinery equipment (TM)

Exports is divided into five categories, which are all exogenous in the present version of the model.

Export categories: (abbreviations in parenthesis)
1. Crude oil and natural gas (OG)
2. Petroleum refining (PR)
3. Petrochemicals (PS)
4. Non-resident direct purchase (CPN)
5. Other exports (XX)

3. A closer look at the submodels

In this chapter each class of equations included in the model is presented. If not otherwise stated, all national account variables mentioned (production, consumption, exports, etc.) are in constant prices, cf. the complete list of variables given in Annex A.

3.1. Private consumption

The determination of private consumption in the model is in two parts; the macro consumption function in the households' disposable income and wealth, and the linear expenditure system (LES) which splits total consumption by residents into nine items of expenditure.

3.1.1. The macro consumption function

The macro consumption function determines total consumption by resident households as a function of real disposable income and real net financial wealth. Consumption of non-residents is by national accounting conventions considered as exports and not included in the consumption function. The modelling approach can be seen as based on the life-cycle hypotheses, a widely used framework for empirical analysis of consumer demand.

The definition of disposable income in the model includes wage-income, households' share of operating surplus and social security benefits. Financial income is missing due to lack of time series data. In particular there are no interest rate data, which is necessary to determine financial income, for years prior to 1987 in the Saudi Arabian Monetary Agency (SAMA) publications. (Interest rate data for Bahrain are available from IMF statistics, but for deposit rates only. These rates do not fit well with SAMA rates for Saudi Arabia for the period 1987-92 and has been disregarded as a data source.) For the operating surplus it is necessary to determine the households' share, and the source utilized for this is Coopers&Lybrand (1981). The weights, which are constant over time, are as follow;

Table 3.1. Household shares of operating surplus by sector

Sector	Household share
Agriculture, forestry and fishing	1.00
Other mining, quarrying	0.24
Petrochemicals	0.00
Other manufacturing	0.47
Electricity, gas and water	0.10
Construction	0.11
Wholesale and retail trade	0.59
Transport and communication	0.70
Real estate	0.58
Finance, insurance	0.03
Community services	0.67

Net financial wealth is included as an explanatory variable along with disposable income. Data for domestic financial wealth was provided from SAMA publications, and was found to be an important determinant of consumption. The real oil price and a dummy for the Gulf-war were also found to contribute to the explanation of private consumption. An income tax rate is included in the macro consumption function, as a potential but not yet utilized policy instrument.

The macro consumption function in general form can be written as

CPR = f (HR/PCPR , HW/PCPR, POIL/PCPR, D9091)

where
CPR = private consumption by residents
PCPR = the price index for CPR
HR = household disposable income
HW = household net financial wealth
POIL = crude oil price, Arabian light
D9091 = a Gulf-war dummy

The definitions of disposable income and financial wealth are as follows

HR = VYW + VYSH + GESS

HW = (M2 - M0) - LIABP

where
VYW = wage income
VYSH = households' share of operating surplus
GESS = (Government expenditures on) social security services
M2 = money supply; currency outside banks, demand and time deposits
M0 = money supply; currency outside banks
LIABP = liabilities (i.e. banks' claims on private sector)

In the long run the sum of the elasticities of disposable income and wealth is equal to 1; the elasticity wrt. disposable income is estimated to 0.85 while the wealth elasticity accordingly is equal to 0.15. In the short run the effect of an increase in income is, however, considerably larger. The real oil price has a relatively small positive impact on consumption - a 1 percent increase in the oil price lifts consumption by 0.2 percent.

Data limitations prevented the separation of households' income (i.e. wage income) between Saudis and non-Saudis, and therefore consumption is not divided between the two groups of residents.

3.1.2. The linear expenditure system

Total consumption by resident households, which is determined in the macro consumption function outlined above, is divided into nine consumer items (in accordance with the National Accounts), by a linear expenditure system (LES). The important feature of this system is that it takes account of both income and direct and indirect price effects.

A price increase for one of the consumer groups, e.g. due to an increase in indirect taxes, will affect both the consumption of the respective group negatively and consumption of all other groups positively. This means that all groups are regarded as substitutes by the consumer, an assumption which is viewed as reasonable for groups at the aggregation level in the national accounts because complementary goods will tend to be included within the respective groups. The income effect shows which of the consumption groups that can be characterized as «luxury goods» i.e. with an elasticity above 1, and which can be seen as «necessity goods» with elasticities below 1.

The coefficients in this system have not been estimated (due to lack of genuine time series data), but calibrated based on information from an international study of consumer behaviour, see Theil et al. (1989). Direct price elasticities were taken from this study for countries where budget shares seem to coincide with those in Saudi Arabia, and income elasticities were calculated in order to force the LES system to reproduce actual consumption for each category in the base year, 1989. The coefficients should therefore be viewed as preliminary estimates.

A representative equation can be written

$$CPR_i = g_i(VCPR\ ,\ PCP_j),\quad i,j = 1,\ldots,9$$

where CPR_i = consumption by residents of consumption item i
$VCPR$ = value of total consumption by residents
PCP_j = price index for consumption item j

These equations determine consumption for eight of the groups, while the remaining (consumption abroad) is determined by summing up.

The table below shows the direct price elasticities (Cournot elasticities) and expenditure elasticities (Engel elasticities) for each of the consumer groups. Cross price elasticities can also be derived from the linear expenditure system.

As can be seen from the table, only two items can be seen as necessity goods: Food, beverage and tobacco, and Clothing and footwear. The other items are to different degrees luxury items.

The LES system determines consumption for resident households by item. By adding consumption by non-residents for each item, total consumption by item, which is needed in the Input-Output value added determination, is obtained. Consumption by non-residents is divided into five of the consumer items by using (fixed) weights taken from Coopers&Lybrand (1981). The weights show that 7 percent of non-residential consumption is Food, beverage and tobacco, 6 percent is Clothing and footwear, 22 percent is Furniture and household equipment, 1 percent is Transport and communication and the remaining 64 percent is Other goods and services. Although these weights build on information from 1976, they are used until better estimates can be provided.

Table 2. Elasticities of the linear expenditure system

Consumer group	Expenditure elasticities	Direct price elasticities
1. Food, beverage, tobacco	0.64	-0.60
2. Clothing and footwear	0.90	-0.70
3. Rent, fuel and power	1.10	-0.85
4. Furniture and household equipment	1.17	-0.90
5. Medical health care	1.30	-1.00
6. Transport and communication	1.33	-1.00
7. Entertainment and education	1.17	-0.90
8 Other goods and services	1.32	-1.00
9 Resident direct purchase abroad	1.33	-1.00

3.2. Private Non-Oil Gross Fixed Capital Formation

Total private investment is divided by category and determined by three separate equations; one for housing investment, one for non-residential buildings and one for transport and machinery.

Housing investment is determined by households' disposable income and disbursement of investment credit relevant for residential buildings. The investment function can be written

$JPH = h_1 (HR/PJPH , ICH/PJPH)$

where JPH = investment in Residential buildings
PJPH = price index for JPH
HR = households' disposable income (see 3.1.1)
ICH = investment credit issued by Saudi Credit Bank, Ministry of Finance (Local loans) and Real Estate Fund

The long-run elasticities are 0.55 for disposable income and 0.27 for investment credit. In the short run the credit effect is somewhat larger.

Investment in non-residential buildings is determined by private sector operating surplus (excl. of household's share) and disbursement of investment credit. The long run elasticity of operating surplus is 0.83, while the credit elasticity is equal to 0. However, there is a credit effect in the short run. The investment function can be written

$JPB = h_2 (VYSC/PJPB, ICB/PJPB)$

where JPB = investments in Non-residential buildings
PJPB = price index for JPB
VYSC = operating surplus private non-oil sector (excl. of households' share)
ICB = investment credit from Ministry of Finance (Local loans), Industrial Development Fund and Real Estate Fund.

Investments in machinery and transport equipment are also determined by the operating surplus in the private sector (excl. of households' share) and disbursement of investment credit. The long-run elasticity of operating surplus is 0.78, while the credit elasticity is estimated to 0.11. The investment function can be written

$JPTM = h_3 (VYSC/PJPTM, ICTM/PJPTM)$

where JPTM = investments in Transport and machinery
PJTM = price index for JPTM
VYSC = operating surplus private non-oil sector (excl. of households' share)
ICTM = investment credit from Saudi Agricultural Bank, Saudi Credit Bank, Ministry of Finance (Local loans), Public Investment Fund and Industrial Development Fund.

Operating surplus is thus the main explanatory variable in both the two latter equations.

3.3. Exports

Exports have been separated on five categories in the model: Consumption by non-residents, plus four categories which enter the I/O part of the model; Crude oil and natural gas, Petroleum refining, Petrochemicals and Other exports. Exports of crude and refined oil are endogenous in the model (determined by assuming production to be exogenously given), while other exports are exogenous.

3.4. Imports

Total imports is determined by weighting together all final demand components by use of the import shares for each category in the base year (1989), adjusted for the average change in import shares from the base year. The import equation can be written

$$M = MS \cdot m(CP_j, CG, J_k, X_m, DS),$$

where
M = total imports
CP_j = private resident and non-resident consumption by item (j=1,...,9)
CG = government final consumption
J_{kl} = gross fixed capital formation, k = G, P, O, l = H, B, TM
X_m = exports by category, m = OG, PS, PR, XX
DS = increase in inventories
MS = the average import market share relative to the shares in the base year

The function $m(\cdot)$ gives total imports as the sum of actual demand by category multiplied by each category's import share in the base year. The import shares in the base year are defined by the input/output coefficients between imports and final demand, cf. annex 2 which gives a detailed overview of the I/O concepts underlying the model. Hence the function $m(\cdot)$ is the same as the input/output equation for imports.

The average change in the import share is aimed at taking account of changes in imports that is not caused by changes in the composition of final demand, i.e. effects arising from changes in import prices relatively to prices of domestically produced goods. The reason for MS to enter outside the $m(\cdot)$ function is that all import shares are assumed to change proportionately.

The aggregate import share is treated as exogenous, an assumption which seems reasonable since a large degree of imports in the Saudi-Arabian economy is non-competitive. However, Doroodian et al. (1994) found prise effect in an import equation for Saudi Arabia.

3.5. Production by industry

Correspondingly to imports, value added by industry is determined by the I/O equations - weighting together all final demand components by use of the input/output coefficients

$$Y_i = y_i(CP_j, CG, J_{kl}, X_m, DS, MS)$$

where Y_i = value added by sector (i=1,...16), and other symbols as for the import equations.

Just as each I/O coefficient for imports is adjusted for changes in import shares, the I/O coefficients for domestic production by industry are changed in the opposite direction, so obviously MS has to enter these equations. However, this time we have entered MS *inside* the function symbol. Since the I/O coefficients for imports and domestic production have to add up to 1 for each category of final demand, this adjustment must be made for every final demand component, i.e. every I/O coefficient. The adjustment is distributed to each industry by the industry's share of deliveries to each final demand category.

3.6. Employment and labour supply

Both employment in private non-oil and government sectors are determined endogenously in the model. Employment by industry has not been modelled, but is a possible future extensions of the model. There are no time series data available for oil sector employment.

The determination of private employment is based on a production function approach, with the capital stock and employment as main factors of production. Thus there is a relationship between employment, production and the fixed capital stock. An increase in production implies that more employment has to be utilized, while an increase in the capital stock has the opposite effect due to substitutability of capital and employment. In general the relationship can be written as follows

$$EP = e(YP, KP)$$

where EP = employment in the private non-oil sector
YP = value added in the private non-oil sector
KP = capital stock in the private non-oil sector

In the long-run, there is a unit elasticity between employment and production, while the effect from the capital stock is estimated to approximately -0.15. There are no additional short term effects from these variables.

Labour productivity (QP) in the private non-oil sector is defined as

$$QP = YP/EP$$

where YP and EP are as above. For the government sector, exogenous labour productivity (QG) is used to determine employment (EG)

$$EG = YG/QG$$

where YG = value added in government sector

Employment of Saudis (ES) is determined by assuming non-Saudi employment (EN) as exogenous

$$ES = (EP+EG)-EN$$

Data for Saudi labour supply by gender are included in the model. Based on information from the 5th Development Plan, which incorporates labour supply estimates for the years 1989 and 1994, we have extended the series backwards to 1969 by assuming a constant growth rate of 4 percent both for men and women. This should be viewed as preliminary data that could be improved by providing more information. The labour supply data LS enables a «labour market indicator» for Saudis (US) to be calculated in the model

US = LS-ES

3.7. Wages

Real wages are a function of productivity and government wages. This means workers are not compensated for price increases unless it can be substantiated from productivity gains. The influence from public sector wages goes through the integrated labour market - the higher the public wage rates, higher salaries are needed for preventing workers from leaving the private labour market.

The chosen wage equation can be written as follows

WP/PCP = w(QP, WG, D9091)

where	WP	=	the wage rate for the private non-oil sector
	PCP	=	price index, private consumption
	WG	=	the wage rate for the public sector
	QP	=	labour productivity in the private non-oil sector
	D9091	=	Gulf war dummy (same as in 3.1.1)

In the long run an increase in productivity will give the same percentage increase in real wages, while the short run effect is larger than the long run effect. A dummy variable is also added to the wage formation equation, due to what seems to be a special development in 1990 and 1991, possibly connected to the Gulf war period. The dummy is identical to the one used in the consumption function, taking the values 1 in 1990 and 0.5 in 1991.

3.8. Producer prices by industry

For eight production sectors factor prices, exclusive of indirect taxes, are modelled econometrically, while factor prices are exogenous in the remaining sectors. In the model, indirect taxes are added to the above factor prices in the determination of the final demand prices through the input-output equations.

The modelling of factor prices is based on the notion that prices generally can be affected by two cost components; import prices and wage costs. Import prices may also influence prices due to competition on product markets between imported and domestically produced products. Ideally both import prices and wage costs should be sector specific variables. As such data are not available, we use aggregate import prices and wages in the private sector or government sector as substitutes. A general equation for the private sectors can thus be written as follows

$PYF_i = p_i(PM, WP)$

where	PYF_i	=	factor price, excl. of indirect taxes (*i* = AG, CN, CS, MI, MA, TD, TC)
	PM	=	import price index
	WP	=	the wage rate for the private sector

For most sectors there is no impact from import prices. This may indicate that imported intermediate inputs or competition from abroad are of little significance. It may also, however, indicate that average import prices is not a good enough indicator for sector specific costs or competition from abroad. No demand side effects are included in the price model. Demand side effects were tested for some sectors by including money supply, but this did not improve the relations.

For Government services, the only explanatory variable is the wage rate

$PYFGS = p_g(WG)$

where PYFGS = factor price, excl. of indirect taxes, Government services
WG = the wage rate for the government sector

According to National Accounts rules, value added in current prices for government services is equal to wage costs (depreciation is set equal to zero by definition). The estimated equation for PYFGS is therefore partly reflecting productivity developments in Government sector.

Table 3.3. Producer price elasticities

Sector	Wage costs	Import prices
Agriculture	1.00	0.00
Construction	0.57	0.43
Community services	1.00	0.00
Mining and quarrying	1.00	0.00
Manufacturing	0.71	0.29
Wholesale and retail trade	1.00	0.00
Transport and communication	1.00	0.00
Government services	1.00	0.00

In general we aimed at obtaining homogeneity in the long run for all sectors, i.e. that the sum of the long run elasticities should be equal to 1. For two of the industries, Trade and Transport, this was not possible. However for the aggregate of these two sectors we obtained homogeneity and this result was implemented for each of the two sectors. Table 3.3 displays the long run coefficient for all sectors with endogenous prices.

3.9. Prices of final demand

Prices of final demand components are determined by I/O-equations which corresponds to the value added equations presented in 3.5. As in the value added equations, the aggregate import share enters the price equations, adjusting each I/O coefficient. Consumer prices, price indices for private investment by institutional sector, the prices index for government consumption and export prices are all dependent on import prices and value added prices in all production sectors. These equations therefore contains the same explanatory variables and can thus be written in the following manner

$PCP_i = a_1 (MS, PM, PY_j)$

$PJ_{kl} = a_2 (MS, PM, PY_i)$

$PCG = a_3 (MS, PM, PY_i)$

$PX_m = a_4 (MS, PM, PY_i)$, m = OG, PS, PR, X

where PCP_i = price index for consumption item i = FOO, CLO, REN, FUR, MED, TRA, ENT, OTH, ABR
MS = aggregate import share
PM = import price index
PY_j = value added price indices for all industries (j = 1,...,16)
PJ_{kl} = price index for gross fixed capital formation, k = P, G, O , l= B, H, TM
PCG = price index for government consumption
PX_m = price index of exports by category

The price index of change in stocks is determined by utilizing the fact that change in stocks is one component of aggregate demand, that should be equal to the sum aggregate production (GDP) and imports. This relationship holds not only in volume terms but also in value terms, and the price index is therefore defined as

PDS = (VY + VM - VCP - VJ - VX)/DS

where
- DS = change in stocks, at constant prices
- PDS = price index for DS
- VY = value of GDP
- VM = value of imports
- VCP = value of final consumption
- VJ = value of total gross fixed capital formation
- VX = value of total exports

The last price index to be determined is the one for consumption by non-residents, and here the estimates of the composition of non-resident consumption on consumption items are utilized. The five relevant price indices are given weights equal to the ones used when adding non-resident consumption by item to resident consumption by item, and the weighted sum is an estimate of the price index of non-resident consumption

PCPN = 0.07*PCPFOO + 0.06*PCPCLO + 0.22*PCPFUR + 0.01*PCPTRA + 0.64*PCOTH

where
- PCPN = price index for consumption by non-residents
- PCFOO = price index for Food etc.
- PCCLO = prices index for Clothing etc.
- PCFUR = price index for Furniture etc.
- PCTRA = price index for Transport etc.
- PCOTH = price index for other goods and services

4. Model performance

A model's performance is often judged on the basis of its forecasts of endogenous variables compared with the actual outcome as it emerges. However, the result of such a test does not only depend on the model, but also of the estimates made by the model user for exogenous variables - and time is needed for collecting observed variables. An alternative and possibly better test of the model itself is to see how well simulations track the history, where actual values for the exogenous variables are used. Errors will not be due to mistakes in forecasting exogenous variables as these are known for the period considered - i.e. it is solely the model properties that are tested.

A historical test should preferably be done as a «post sample» test, i.e. for a historic period after the period used for estimating the model's equations. However, since we have used all available information in the estimation procedure, the test of the model has to be an «in sample» test, i.e. simulation outcome is compared to the historical data within the estimation period.

The use of an «in sample» rather the «post sample» test means that we assist the model in tracking the outcome for the endogenous variables by eliminating possibilities for structural breaks in econometric equations. On the other side, the model is simulated *dynamically*, which means that actual numbers for endogenous variables are used only for lagged variables in the years before the simulation period starts. For «in period» years, only *simulated* values of endogenous variables are utilized. In this way, accumulation of simulation errors can take place and the simulation is therefore a test of the ability of the model to keep on track. This test is also consistent with the actual forecasting situation, where endogenous variables are (at most) known up to the year when the simulation starts.

While all residuals in econometric equations are set equal to zero, residuals in Input-Output equations and other calibrated equations are kept in place in order to take care of the effects of constant coefficients. The latter residuals are included partly because the period covered (10 years) is longer than would normally be the case for a forecasting or plan period (5 years), i.e. we find it to be a too strong test to require that I/O coefficients from 1989 should be applicable to the economy in 1980. Errors due to I/O coefficients (or other calibrated parameters) would probably be smaller when simulating let say 1995 than 1980. In addition one would normally tend to update the coefficients regularly and with a considerably larger degree of knowledge about the economy than underlies the present coefficients.

The simulation period is chosen to start in 1980, the first estimation period for investment equations, and the end year is 1991. Results of the simulation, i.e. simulated and historical values, are shown for six aggregate variables; GDP for private non-oil sector, employment, private consumption, private capital formation, wages and prices. In general the results can be regarded as highly satisfactory for most variables.

Figure 4.1. GDP-Private sector. Mill. 1989-SR

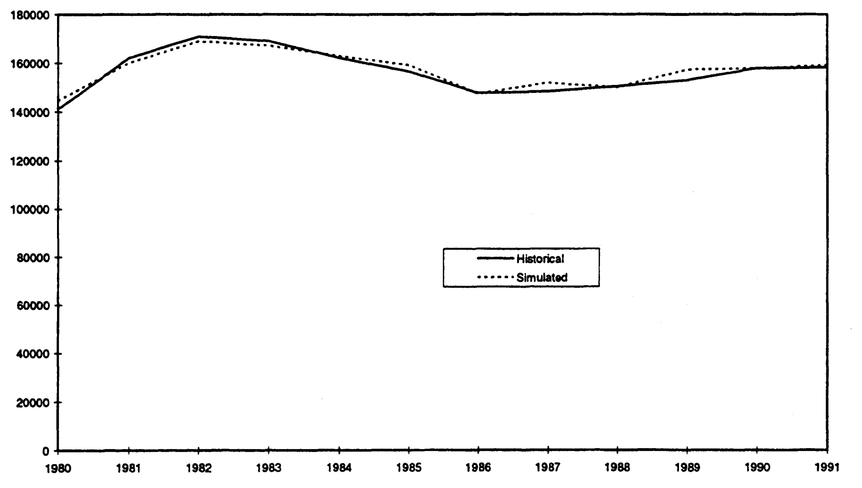
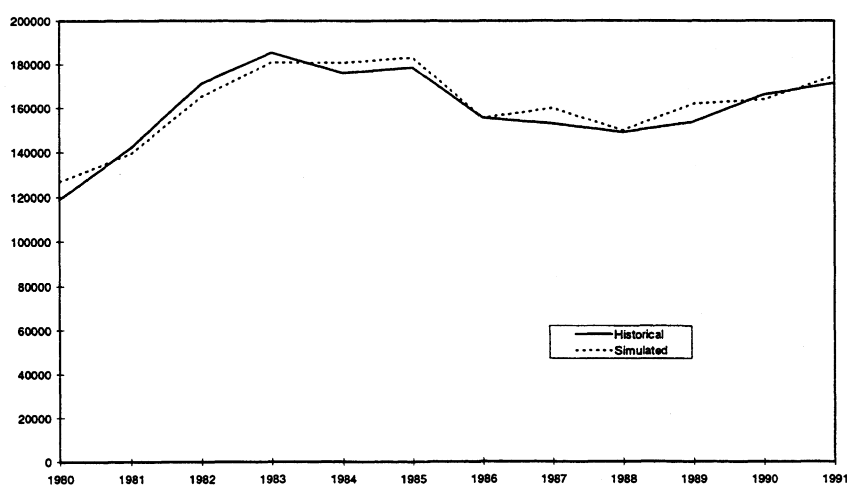


Figure 4.2. Private consumption, Mill. 1989-SR



The simulated values for GDP, see chart 4.1, track the historical values well through the entire simulation period, with some positive and some negative discrepancies. The deviations between actual and simulated values stem from estimated equations only, e.g. the macro consumption function and investments functions. The errors which would normally follow from the use of constant I/O coefficients in equations determining production by sector, are eliminated by the use of historical residuals.

Figure 4.3. Private non-oil investment, Mill. 1989-SR

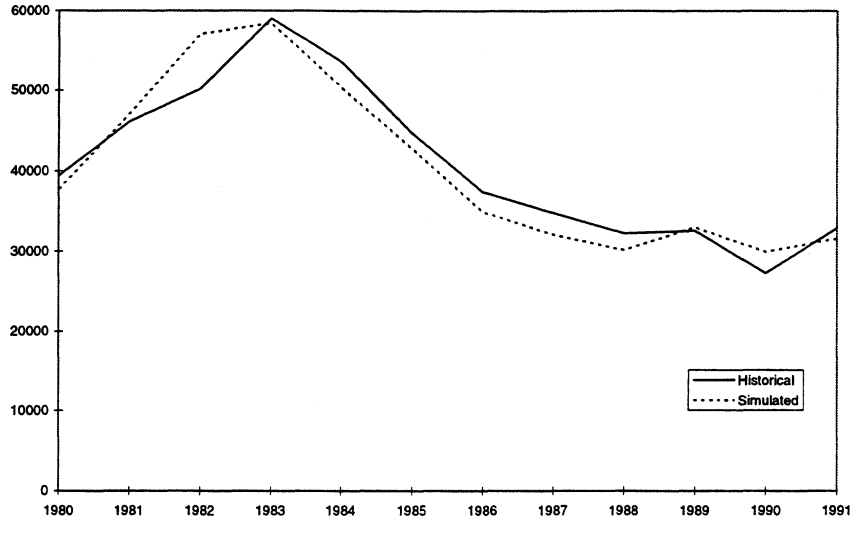
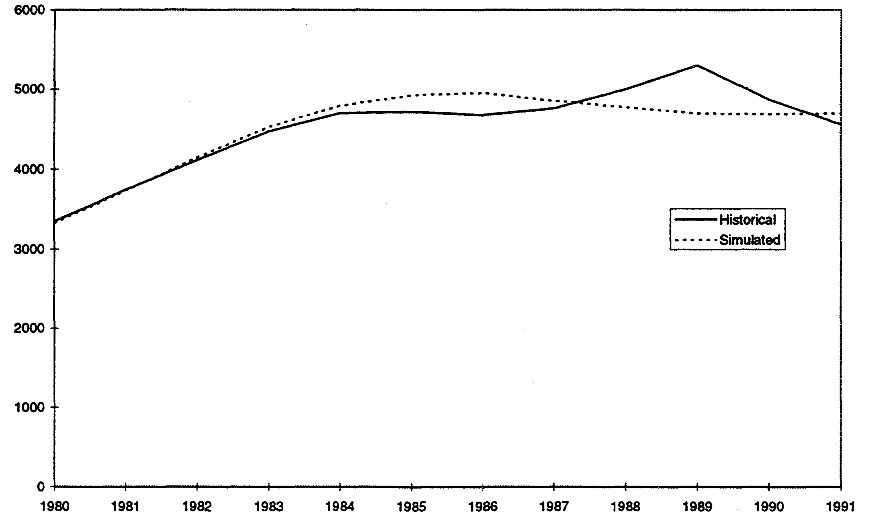


Figure 4.4. Employment (1000)



Private consumption also shows good tracking performance, see chart 4.2. To some degree this reflects that the consumption function includes a nominal wealth term which is exogenous and that households' part of operating surplus is not determined as a function of sectoral profits, both factors contributing to reduce the errors. On the other hand real wages, the main income component, is endogenous. The errors are rather small also for private sector investments, see figure 4.3, in particular when realizing that the volatility of investments is usually high and difficult to fit by econometric models. The most pronounced overshooting is for 1982, while the simulated level is below actual in the period 1984-88.

The properties regarding employment are also good, see chart 4.4. Apart from the peak in 1989, which could be caused by poor data quality or other unexplained factors, the tracking is very good for the other years, and in particular we find it satisfying that 1991 is tracked so well. The deviation in 1989 spill over to private sector wages, which is overestimated (caused by too high productivity) in 1989 and 1990, see chart 4.5. Wages are also considerably underestimated in the period 1985-87, and this is partly related to the errors in the price determination, see chart 4.6. Prices are determined in several equations and for some of them there are substantial residuals. This may be a result of using aggregate variables (wages, import prices) to determine sectoral prices. For the remaining period prices track relatively well.

Figure 4.5. Wage rate private sector. (1000 SR/Year)

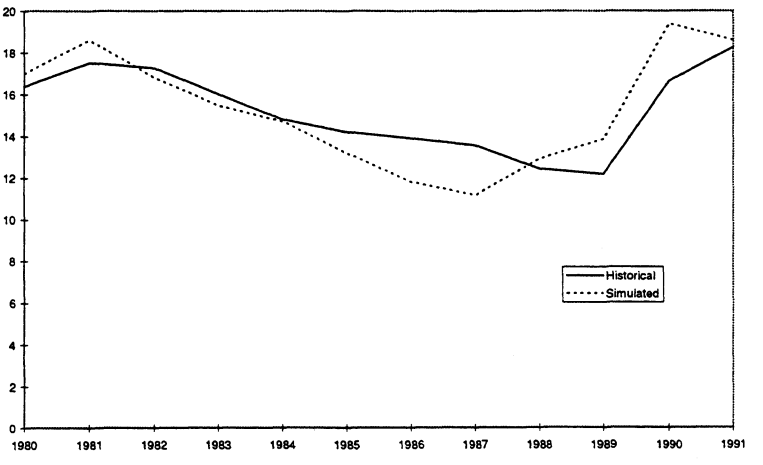
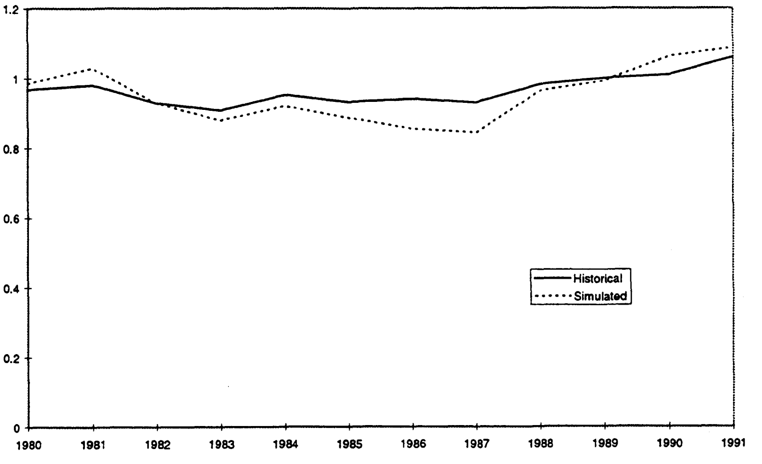


Figure 4.6. Prices private consumption (1989=1.00)



5. Multiplier Analyses

In a highly simultaneous model as the *Implementation Model*, it is important to investigate multiplier analyses, i.e. the effects on endogenous variables of shocks to exogenous variables. Only one or a few variables should be considered at a time, in order not to mix effects of different variables. In this chapter we report one set of multipliers, changing the level of government expenditure on consumption and fixed capital formation. Because we change policy variables, the analysis may also be seen as one example of policy analyses that may be carried out with the model.

If analyses are undertaken with the historical simulation as a reference path, the multiplier effects could be distorted by the actual development in the exogenous variables. In order to avoid this problem, the multiplier analysis was undertaken by extending all the exogenous variables from 1991 to 2010, while keeping the 1991-level constant over this period, and the corresponding series for endogenous variables were simulated by the model. (All econometric residuals are equal to 0). Government consumption and investment were reduced by 10 percent from 1995 to 2010, and effects on endogenous variables studied. By changing the exogenous variable on a flat reference path, the 10 per cent change is equal in terms of money for the whole simulation period. Some results are reported in charts 5.1 - 5.4.

Figure 5.1. Deviations from base scenario in per cent

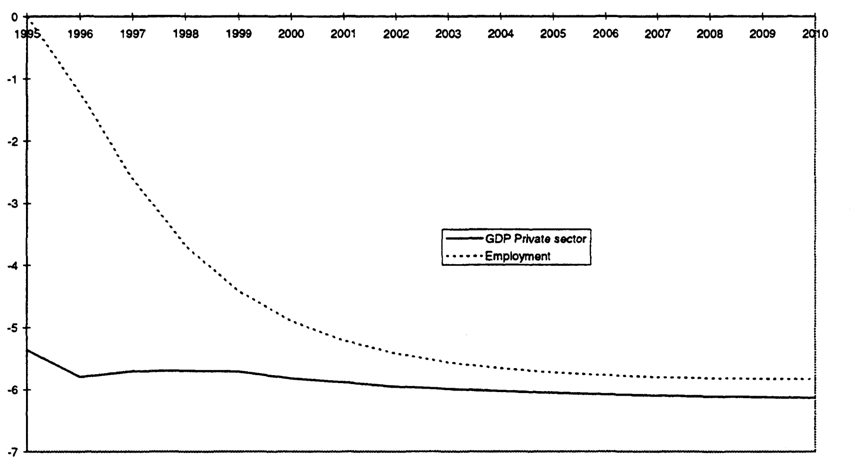
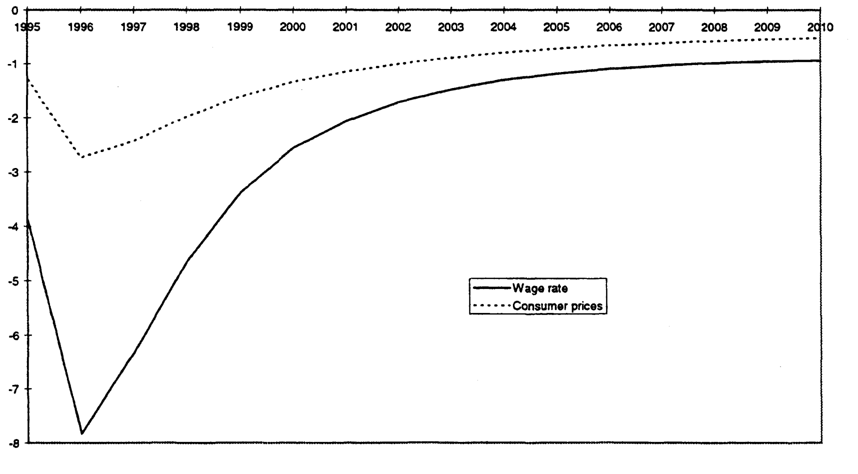


Figure 5.2. Deviations from base scenario in per cent



A drop in governmental consumption and fixed capital formation immediately reduces GDP for private sector and employment, see chart 5.1. For private non-oil GDP (value added) the immediate effect is close to the long run effect, while employment is adjusted only gradually to the drop in production and reaches the long run path after around 10 years. This means there is a considerably loss of productivity in the short run, and also a small long run loss since the reduction in employment is smaller than for production. The reason is that employment is somewhat substituted by capital, which is less reduced than production due to the properties of the investment determination.

The sharp fall in productivity causes a drop in the wage rate, but after two years this development is reversed as the productivity loss becomes smaller, see chart 5.2. In the long run wages are reduced by 1 percent, in accordance with the same effects for productivity (see above). Prices follow wages but the magnitude of the effect is considerably smaller, particularly in the short run.

Figure 5.3. Deviations from base scenario in per cent

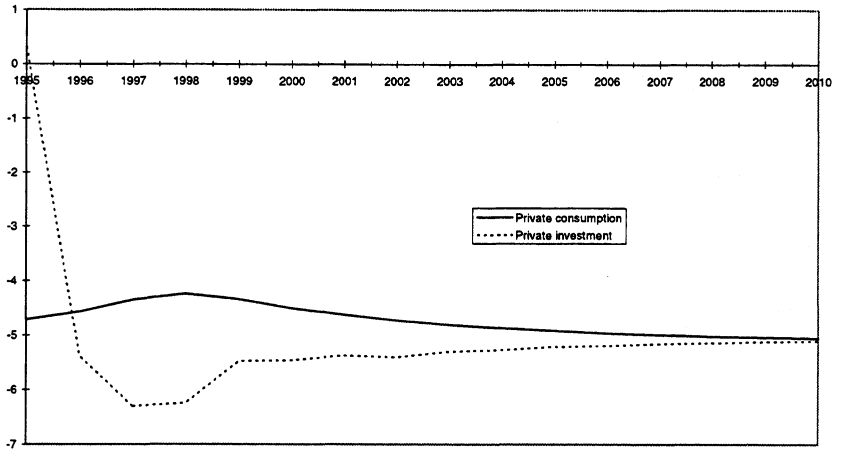


Figure 5.4 Devations from base scenario

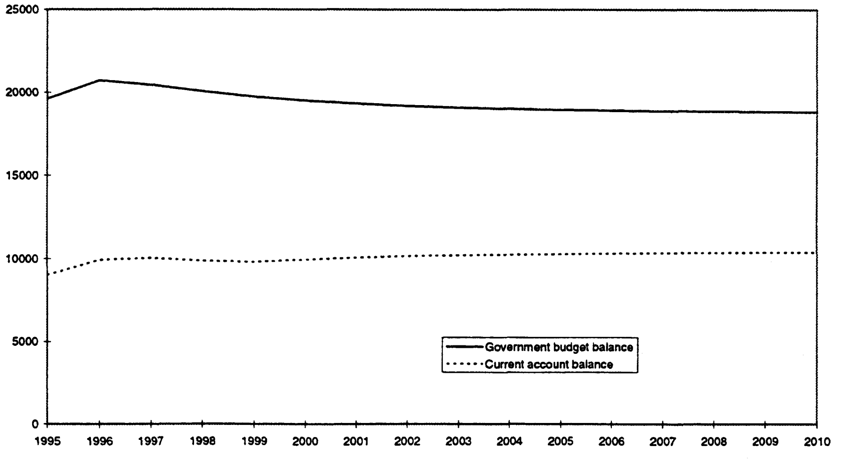


Chart 5.3. displays the negative effects on private consumption and fixed capital formation in the private sector. The immediate drop in consumption is around 4.7 percent. Then the negative effect is somewhat reduced (until 1998) before a gradual approach towards the long run effect of 5 percent. This path has to be seen in the light of wage income which is influenced of both employment (chart 5.1) and the wage rate (chart 5.2). Investment falls more gradually than consumption but within two

years the drop is around 6 percent. Then there is a gradual process towards the long run equilibrium effect which is about the same as for consumption.

Reducing government expenditure has two unambiguously positive effects, both the surplus on current account and government budgets are clearly improved according to chart 5.4. The effects on the budget balance do not only reflect lower expenditure on consumption and capital formation; also reduced activity in the private sector contributes somewhat, since the demand for products directly or indirectly subsidized by government is reduced. This is the opposite effect that can be found in countries where government income is based on taxes on private sector and where a reduction in government expenditures will partially be counteracted by lower income on taxes from the private sector (an automatic stabilizer effect).

Reduced government expenditure affects imports and the current account through lower demand for goods and services in both the government and the private sector.

The way these variables are defined in the national accounts system, and hence in the Implementation Model, the current account surplus is equal to net financial investment for Saudi Arabia, while the government budget balance is equal to net financial investment for the government. The difference between these two variables is the net financial investment for the private sector. According to chart 5.4, lower government expenditure increases government net financial investment, but decreases private net financial investment. This reflects that households only adjust their expenditures partially as income is reduced.

6. Concluding remarks

The model has been developed within short time and limited data resources. Accordingly, the model should be developed further through a fine tuning process and could also be extended as more data become available in the future. Here we point at some possibilities for desirable improvements of the model.

The coefficients in the input-output core of the model are calibrated based on data from 1976. As important structures of the economy may have changed considerably since then, a thorough investigation and adjustment of these coefficients would be highly desirable. The ultimate goal, however, should be to include an entirely new input-output table based on recent information i.e. the establishment survey, in the model. The new I-O table should be based on production and intermediaries (rather than value added), and ought to be constructed in a way that corresponds with the NA-figures from CDS.

The labour market is modelled in a rather superficial way in the model and could be extended to include employment and wages by labour category and industries. The distinction between Saudis and non-Saudis is also of great importance in the labour market and data for the separate groups are needed for improvements of the model in this area. It should also be an aim to build a more complete population model to secure consistency between the growth of the population and supply of labour.

The modelling of demand from government sector is at present very aggregate and it would be a clear advantage if government consumption is divided on demand for labour and for intermediary goods and services respectively. Such an extension would also demand an adjustment of the input-output core of the model, with respect to the specification of production and intermediate consumption.

Regarding the demand side of the model, private consumption may be divided on Saudi and non-Saudi households when income data for the two groups become available. The parameters of the linear expenditure system should be evaluated and adjusted based on knowledge of the Saudi economy. Gross fixed capital formation and capital stock by industry would also improve the model.

References

Bergman, L. and Ø. Olsen, eds. (1992): *Economic Modeling in the Nordic Countries*. Contributions to Economic Analysis 210. North-Holland.

Bjerkholt, O. (1993): Review of the Macroeconomic Modelling Needs of the Ministry of Planning of the Kingdom of Saudi Arabia. Ministry of Planning/UNDDSMS, August 1993.

Choudhury, R. and K.A. Magnussen (1996): The Implementation Model. Technical Documentation of Computer Programs and Procedures. Documents 96/9. Statistics Norway.

Coopers&Lybrand (1981): A Social Accounting Matrix for the Kingdom of Saudi Arabia 1396/97. Ministry of Planning.

Doroodian, K., R.K. Koshal and S. Al-Muhanna (1994): An examination of the traditional aggregate import demand function for Saudi Arabia. *Applied Economics*, 1994, 909-915.

Fair, R.C. (1994): *Testing Macroeconometric Models*. Harvard University Press.

Lecomber, J.R.C. (1975): A Critique of Methods of Adjusting, Updating and Projecting Matrices. In Allen, R.I.G. and W.F. Gossling: *Estimating and Projecting Input-Output Coefficients*. Input-Output Publishing Company.

Looney, R.E. (1990): *Economic development in Saudi-Arabia: Consequences of the oil price decline*. Contemporary studies in economic and financial analysis. Volume 66. Jai Press Inc.

Theil, H., C-F. Chung and J.L. Seale Jr. (1989): *International Evidence on Consumption Patterns*. Jai Press Inc. London.

Wallis, K.F. (ed.), P.G. Fisher, J.A. Longbottom, D.S. Turner and J.D. Whitley (1987): *Models of the UK Economy: A Fourth Review by the ESRC Macroeconomic Modelling Bureau*. Oxford University Press.

Annex A: A complete list of variables

This list includes variables based on the National Accounts from spreadsheets provided by the Ministry of Planning, used either directly in the model or for calculation of model variables. Model residuals and some unutilized variables are also included. We differentiate between variables in constant prices, in current prices, price indices and other variables.

A.1. Variables in constant 1989-prices

A.1.1. GDP by economic activity

	Name in model/databank
- Private, non-oil sector	YP
- Agriculture, forestry and fishing	YAG
- Other mining, quarrying	YMI
- Petrochemicals	YPS
- Other manufacturing	YMA
- Electricity, gas and water	YEW
- Construction	YCN
- Wholesale and retail trade	YTD
- Transport and communication	YTC
- Finance, insurance, real estate	YFR
- Real estate	YRE
- Finance, insurance	YFI
- Community services	YCS
- Imputed bank charges	YBC
- Government sector	YG
- Government services	YGS
- Oil sectors	YO
- Crude oil and natural gas	YOG
- Petroleum refining	YPR
- Import duties	YID
- GDP	Y

A.1.2. GFCF by sector and type of capital, capital stock and depreciation

- Private non-oil private investment	JP
- Private non-oil, residential building	JPH
- Private non-oil, non-residential building	JPB
- Private non-oil, transport and machinery equipment	JPTM
- Government investment	JG
- Government investment, non-residential building	JGB
- Government investment, transport and machinery equipment	JGTM
- Oil-sector investment	JO
- Oil-sector investment, non-residential building	JOB
- Oil-sector investment, transport and machinery equipment	JOTM
- GFCF, total	J
- Capital stock, private non-oil sector	KP
- Depreciation	DKP
- Depreciation rate	DKPRATE

A.1.3. Private consumption by object of expenditure

- Food, beverage, tobacco	CPFOO
- Clothing and footwear	CPCLO
- Rent, fuel and power	CPREN
- Furniture and household equipment	CPFUR
- Medical health care	CPMED
- Transport and communication	CPTRA
- Entertainment and education	CPENT
- Other goods and services	CPOTH
- Non-resident direct purchase	CPN
- Resident direct purchase abroad	CPABR
- Private final consumption	CP

A.1.4. Private resident consumption by object of expenditure

- Food, beverage, tobacco	CPRFOO
- Clothing and footwear	CPRCLO
- Rent, fuel and power	CPRREN
- Furniture and household equipment	CPRFUR
- Medical health care	CPRMED
- Transport and communication	CPRTRA
- Entertainment and education	CPRENT
- Other goods and services	CPROTH
- Resident direct purchase abroad	CPRABR
- Resident, total	CPR

A.1.5. GDP by type of expenditure n.e.s

- Imports of goods and services	M
- Import share	MS
- Exports of goods and services	X
- Exports of oil and gas	XOG
- Exports of refined products	XPR
- Exports of petrochemicals	XPS
- Exports of goods and services, less export of oil and gas, refined products, petrochemicals and non-resident direct purchase	XX
- Government final consumption	CG
- Increase in stocks	DS
- Domestic absorption	DA

A.2. Variables in current prices

A.2.1. Value of GDP by economic activity

- Private non-oil sector	VYP
- Agriculture, forestry and fishing	VYAG
- Other mining, quarrying	VYMI
- Petrochemicals	VYPS
- Other manufacturing	VYMA
- Electricity, gas and water	VYEW
- Construction	VYCN
- Wholesale and retail trade	VYTD
- Transport and communication	VYTC

- Finance, insurance, real estate	VYFR
- Real estate	VYRE
- Finance, insurance	VYFI
- Community services	VYCS
- Imputed bank charges	VYBC
- Government sector	VYG
- Government services	VYGS
- Oil sector	VYO
- Crude oil and natural gas	VYOG
- Petroleum refining	VYPR
- Import duties	VYID
- GDP	VY

A.2.2. Operating surplus by economic activity

- Gross operating surplus, private non-oil sector	VYSP
- Agriculture, forestry and fishing	VYSAG
- Other mining, quarrying	VYSMI
- Petrochemicals	VYSPS
- Other manufacturing	VYSMA
- Electricity, gas and water	VYSEW
- Construction	VYSCN
- Wholesale and retail trade	VYSTD
- Transport and communication	VYSTC
- Finance, insurance, real estate	VYSFR
- Real estate	VYSRE
- Finance, insurance	VYSFI
- Community services	VYSCS
- Imputed bank charges	VYSBC
- Government sector	VYSG
- Government services	VYSGS
- Oil sectors	VYSO
- Crude oil and natural gas	VYSOG
- Petroleum refining	VYSPR
- Total operating surplus	VYS
- Gross operating surplus, household sector	VYSH
- Household share of VYSP	VYSSHARE
- Gross operating surplus, corporate sector	VYSC

A.2.3. Compensation of employees by economic activity

- Private non-oil sector	VYWP
- Agriculture, forestry and fishing	VYWAG
- Other mining, quarrying	VYWMI
- Petrochemicals	VYWPS
- Other manufacturing	VYWMA
- Electricity, gas and water	VYWEW
- Construction	VYWCN
- Wholesale and retail trade	VYWTD
- Transport and communication	VYWTC
- Finance, insurance, real estate	VYWFR
- Real estate	VYWRE
- Finance, insurance	VYWFI

- Community services	VYWCS
- Imputed bank charges	VYWBC
- Government sector	VYWG
- Government services	VYWGS
- Oil sectors	VYWO
- Crude oil and natural gas	VYWOG
- Petroleum refining	VYWPR
- Total compensation of employees	VYW

A.2.4. Indirect taxes less subsidies by economic activity

- Private non-oil sector	VYTP
- Agriculture, forestry and fishing	VYTAG
- Other mining, quarrying	VYTMI
- Petrochemicals	VYTPS
- Other manufacturing	VYTMA
- Electricity, gas and water	VYTEW
- Construction	VYTCN
- Wholesale and retail trade	VYTTD
- Transport and communication	VYTTC
- Finance, insurance, real estate	VYTFR
- Real estate	VYTRE
- Finance, insurance	VYTFI
- Community services	VYTCS
- Imputed bank charges	VYTBC
- Government sector	VYTG
- Government services	VYTGS
- Oil sectors	VYTO
- Crude oil and natural gas	VYTOG
- Petroleum refining	VYTPR
- Total net indirect taxes	VYT

A.2.5. GDP by type of expenditure n.e.s

- Private consumption	VCP
- Private consumption, non-residential	VCPN
- Private consumption, residential	VCPR
- Government final consumption	VCG
- Total investment	VJ
- Investment, government sector	VJG
- Investment, oil sector	VJO
- Investment, private non-oil sector	VJP
- Imports of goods and services	VM
- Exports of goods and services	VX
- Exports of oil and gas	VXOG
- Exports of petrochemicals	VXPS
- Exports of refined products	VXPR
- Exports of goods and services, less export of oil and gas, refined products petrochemicals, and non-resident direct purchase	VXX

A.3. Price indices (1989=1)

- Crude oil price, Arabian light	POIL

A.3.1. GDP by economic activity

- Private non-oil sector	PYP
- Agriculture, forestry and fishing	PYAG
- Other mining, quarrying	PYMI
- Petrochemicals	PYPS
- Other manufacturing	PYMA
- Electricity, gas and water	PYEW
- Construction	PYCN
- Wholesale and retail trade	PYTD
- Transport and communication	PYTC
- Finance, insurance, real estate	PYFR
- Real estate	PYRE
- Finance, insurance	PYFI
- Community services	PYCS
- Imputed bank charges	PYBC
- Government sector	PYG
- Government services	PYGS
- Oil sectors	PYO
- Crude oil and natural gas	PYOG
- Petroleum refining	PYPR
- Import duties	PYID
- Total GDP	PY

A.3.2. GDP by type of expenditure

- Imports	PM
- Exports	PX
- Exports of oil and gas	PXOG
- Exports of petrochemicals	PXPS
- Exports of refined products	PXPR
- Exports of goods and services, less export of oil and gas, refined products petrochemicals and non-resident direct purchase	PXX
- Government final consumption	PCG
- Increase in stocks	PDS

A.3.3. GFCF by sector and type of capital

- Private non-oil investment	PJP
- Private non-oil, residential building	PJPH
- Private non-oil, non-residential building	PJPB
- Private non-oil, transport and machinery equipment	PJPTM
- Government investment	PJG
- Government investment, non-residential building	PJGB
- Government investment, transport and machinery equipment	PJGTM
- Oil-sector investment	PJO
- Oil-sector investment, non-residential building	PJOB
- Oil-sector investment, transport and machinery equipment	PJOTM
- GFCF, total	PJ

A.3.4. Private consumption by object of expenditure

- Food, beverage, tobacco	PCPFOO
- Clothing and footwear	PCPCLO
- Rent, fuel and power	PCPREN

- Furniture and household equipment	PCPFUR
- Medical health care	PCPMED
- Transport and communication	PCPTRA
- Entertainment and education	PCPENT
- Other goods and services	PCPOTH
- Non-resident direct purchase	PCPN
- Resident direct purchase abroad	PCPABR
- Private final consumption	PCP
- Resident , total	PCPR

A.3.5. Factor prices, excl. of net indirect taxes

- Agriculture, forestry and fishing	PYFAG
- Other mining, quarrying	PYFMI
- Petrochemicals	PYFPS
- Other manufacturing	PYFMA
- Electricity, gas and water	PYFEW
- Construction	PYFCN
- Wholesale and retail trade	PYFTD
- Transport and communication	PYFTC
- Real estate	PYFRE
- Finance, insurance	PYFFI
- Community services	PYFCS
- Government services	PYFGS
- Imputed bank charges	PYFBC
- Crude oil and natural gas	PYFOG
- Petroleum refining	PYFPR

A.4. Other variables

A.4.1. Employment, labour supply, wage rates and productivity

- Employment, Saudis	ES
- Employment, Saudis, private non-oil sector	ESP
- Employment, Saudis, government sector	ESG
- Employment, non-Saudis	EN
- Employment, non-Saudis private non-oil sector	ENP
- Employment, non-Saudis government sector	ENG
- Employment, private non-oil sector	EP
- Employment, government sector	EG
- Employment total	E
- Labour supply, total	LS
- Labour supply, men	LSW
- Labour supply, women	LSM
- Unemployment rate, Saudis	US
- Wage rate private non-oil sector	WP
- Wage rate government sector	WG
- Productivity, private non-oil sector	QP
- Productivity, government sector	QG

A.4.2. Household sector etc.

- Disposable income, households	HR

- Tax-rate, household income	THR
- Net financial wealth, households	HW
- Money supply, currency outside banks	M0
- Money supply, M0 + demand and time deposits	M2
- Banks claims on private sector	LIABP
- Dummy variable, equal to 1 in 1990, 0.5 in 1991, 0 elsewhere	D9091
- Private sector net financial investment	ZP

A.4.3. Net indirect taxes

- Agriculture, forestry and fishing	TAG
- Other mining, quarrying	TMI
- Petrochemicals	TPS
- Other manufacturing	TMA
- Electricity, gas and water	TEW
- Construction	TCN
- Wholesale and retail trade	TTD
- Transport and communication	TTC
- Real estate	TRE
- Finance, insurance	TFI
- Community services	TCS
- Government services	TGS
- Imputed bank charges	TBC
- Crude oil and natural gas	TOG
- Petroleum refining	TPR

A.4.4. Government sector

- Government budget surplus	ZG
- Government, total revenues	GRTOT
- Government, oil revenues	GROIL
- Governmnet, other revenues	GROTH
- Government, oil revenues as share of VYSO	GROSHARE
- Government, total expenditure	GETOT
- Government expenditure, chapter 1	GECH1
- Government expenditure, chapter 2	GECH2
- Government expenditure, chapter 3	GECH3
- Government expenditure, social security services	GESS
- Government expenditure, chapter 4	GECH4
- Investment credit, Saudi Agricultural Bank	ICSAB
- Investment credit, Saudi Credit Bank	ICSCB
- Investment credit, Ministry of Finance, Local Loans	ICMOF
- Investment credit, Public Investment Fund	ICPIF
- Investment credit, Industrial Development Fund	ICIDF
- Investment credit, Real Estate Fund	ICREF
- Investment credit, Non-residential buildings	ICH
- Investment credit, Residential buildings	ICB
- Investment credit, Transport and machienery	ICTM

A.4.5. Current account balance

- Current account balance	Z
- Net transfers and primary income	ZR

A.4.6. Residuals in I-O equations and econometric equations etc.

GDP by economic activity	
- Agriculture, forestry and fishing	RYAG
- Other mining, quarrying	RYMI
- Petrochemicals	RYPS
- Other manufacturing	RYMA
- Electricity, gas and water	RYEW
- Construction	RYCN
- Wholesale and retail trade	RYTD
- Transport and communication	RYTC
- Finance, insurance, real estate	RYFR
- Real estate	RYRE
- Community services	RYCS
- Government services	RYGS
- Imputed bank charges	RYBC
- Crude oil and natural gas	RYOG
- Petroleum refining	RYPR
- Import duties	RYID
Prices, private and government consumption	
- Food, beverage, tobacco	RPCPFOO
- Clothing and footwear	RPCPCLO
- Rent, fuel and power	RPCPREN
- Furniture and household equipment	RPCPFUR
- Medical health care	RPCPMED
- Transport and communication	RPCPTRA
- Entertainment and education	RPCPENT
- Other goods and services	RPCPOTH
- Resident direct purchase abroad	RPCPABR
- Government final consumption	RPCG
Private consumption	
- Consumption by non-residents	RPCPN
- Value of private consumption by residents	RVCPR
- Private consumption by residents	RCPR
- Food, beverage, tobacco	RCPRFOO
- Clothing and footwear	RCPRCLO
- Rent, fuel and power	RCPRREN
- Furniture and household equipment	RCPRFUR
- Medical health care	RCPRMED
- Transport and communication	RCPRTRA
- Entertainment and education	RCPRENT
- Other goods and services	RCPROTH
Gross fixed capital formation	
- Government investment, non-residential building	RPJGB
- Government investment, transport and machinery equipment	RPJGTM
- Oil-sector investment, non-residential building	RPJOB
- Oil-sector investment, transport and machinery equipment	RPJOTM
- Non-oil private, residential building	RPJPH
- Non-oil private, non-residential building	RPJPB
- Non-oil private, transport and machinery equipment	RPJPTM

- Non-oil private, residential building	RJPH
- Non-oil private, non-residential building	RJPB
- Non-oil private, transport and machinery equipment	RJPTM
Current account	
- Exports of oil and gas	RPXOG
- Exports of petrochemicals	RPXPS
- Exports of refined products	RPXPR
- Exports of goods and services, less export of oil, gas, petrochemicals, refined products and non-resident direct purchase	RPXX
Wage and employment	
- Wage rate private sector	RWP
- Employment private sector	REP
Factor prices, excl. of net indirect taxes	
- Agriculture, forestry and fishing	RPYFAG
- Other mining, quarrying	RPYFMI
- Other manufacturing	RPYFMA
- Construction	RPYFCN
- Wholesale and retail trade	RPYFTD
- Transport and communication	RPYFTC
- Community services	RPYFCS
- Government services	RPYFGS
Government balance	
- Governmnet, other revenues	RGROTH
- Government expenditure, chapter 1	RGECH12
- Government expenditure, chapter 3	RGECH3
- Government expenditure, chapter 4	RGECH4
Not utilized variables:	
- Exports of merchandise, fob	VXMER
- Transport and communication	VXTRC
- Territorial bodies direct purchase	VXTDP
- Non-resident direct purchases	VXNDP
- Imports of merchandise, cif	VMMER
- Miscellaneous commodities	VMMIS
- Resident household direct purchase abroad	VMHDP
- Government direct purchase abroad	VMGDP
- Property income received	ZRPI
- Property income paid	ZEPI
- Compensation of employees paid	ZECO
- Other current transfers net	ZNCT

Annex B: Establishing the input/output matrix of the model

The purpose of this annex is twofold. First, we analytically derive the input/output matrix to be used in the Implementation Model. Second, we describe how to update a corresponding input/output matrix from a study by Coopers&Lybrand (1981) to be consistent to the National Accounts figures for 1989, the base year of the model, using the so called RAS technique.

B.1. Deriving the Input/Output submodel analytically

There are alternative ways of formulating a macroeconomic Input/Output model. The main idea of integrating an I-O structure in a macroeconomic model is to account for the product flows in the economy, using the assumption of fixed proportions between elements in these flows, e.g. between inputs of intermediate consumption and total production in each sector. Such assumptions allow a differentiated and compact description of the effects of impulses from the demand side to the production side of the economy. The same holds for price (cost) impulses in the opposite direction, from the production side to the demand side.

For the Implementation Model, we have chosen a version that we think is best adapted to the National Accounts data situation, given the needs of the Ministry to have a model that both displays the allocation of GDP by industry and by final demand category, and the distribution of primary income components on wages, (net) indirect taxes and (gross) operating surplus. The I-O part of the model gives a simplified and «reduced form» description of the product flows in the economy. Especially when it comes to value concepts, we have had to close our eyes and make some short-cuts. Practical use of the model will show how successful these shortcuts are.

B.1.1. The input/output framework

Assume at the outset a «closed economy», i.e. an economy without imports and exports. In this case, all products (goods and services) are delivered from domestic sectors of production, either as intermediate consumption to other sectors of production, or to final domestic demand. Later we shall expand the model to include imports and exports of products as well.

Let the number of production sectors be n and the number of final demand categories r. If we denote total production of product i ($i = 1,...,n$) by x_i, intermediate consumption of product i in sector j ($j = 1,..,n$) by h_{ij}, and input of product i to final demand category k ($k = 1,...,r$) by g_{ik}, we may describe the product flows in the economy as in table 1.

Table 1. The input/output flows for a closed economy

Output...	.. allocated to intermediate consumption by sector			... and to final demand by category		
x_1	h_{11}	..	h_{1n}	g_{11}	..	g_{1r}
$\vdots$	$\vdots$			$\vdots$		
x_n	h_{n1}	..	h_{nn}	g_{n1}	..	g_{nr}
y	y_1	..	y_n	0	..	0
	x_1	..	x_n	d_1	..	d_r

Each of the n first lines of the table shows how total production (x_i) of each product is allocated to intermediate consumption (h_{ij}, $j = 1,... ,n$) or to final demand (g_{ik}, $k = 1...r$). Written as a system of equations:

$$x_1 = h_{11} + h_{12} + \ldots + h_{1n} + g_{11} + g_{12} + \ldots + g_{1r}$$
$$x_2 = h_{21} + h_{22} + \ldots + h_{2n} + g_{21} + g_{22} + \ldots + g_{2r}$$
$$\ldots$$
$$x_n = h_{n1} + h_{n2} + \ldots + h_{nn} + g_{n1} + g_{n2} + \ldots + g_{nr}$$

or

$$x_i = \sum_{j=1}^{n} h_{ij} + \sum_{k=1}^{r} g_{ik}\,, \qquad (i=1 \ldots n).$$

In matrix notation this may be expressed as (matrices are denoted by capital and vectors by small **bold** letters, respectively)

(B1.1) $\mathbf{x} = \mathbf{H} \cdot \mathbf{e_n} + \mathbf{G} \cdot \mathbf{e}_r$

where **x** is the n-vector for supply by sector, **H** is the (n,n) matrix of intermediate inputs, and **G** is the (n,r) matrix showing the input of products to every r categories of final demand

$$\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ \ldots \\ x_n \end{bmatrix}, \qquad \mathbf{H} = \begin{bmatrix} h_{11} & h_{12} & \cdots & h_{1n} \\ h_{21} & h_{22} & & h_{2n} \\ \vdots & & \ddots & \vdots \\ h_{n1} & h_{n2} & \cdots & h_{nn} \end{bmatrix}, \qquad \mathbf{G} = \begin{bmatrix} g_{11} & g_{12} & \cdots & g_{1r} \\ g_{21} & g_{22} & & g_{2r} \\ \vdots & & \ddots & \vdots \\ g_{n1} & g_{n2} & \cdots & g_{nr} \end{bmatrix},$$

while $\mathbf{e_n}$ and $\mathbf{e}_r$, respectively, are the $(n,1)$ and $(r,1)$ "summation" vectors of length n and r, respectively, containing the number 1 in every element.

In table 1 we have also included two other concepts, value added by sector denoted by y_i $(i = 1,\ldots,n)$, and total final demand by category denoted by d_k $(k = 1, \ldots,r)$. By summarizing the matrices **H** and **G** by columns instead of by rows, $\mathbf{e_n'} \cdot \mathbf{H}$ and $\mathbf{e_n'} \cdot \mathbf{G}$ respectively ($\mathbf{e_n'}$ means that the vector $\mathbf{e_n}$ has been transposed from a column vector to a row vector), we arrive at total intermediate consumption by receiving sector and total final demand by category. Hence, the value added by sector, **y**, may be written as

$$\mathbf{y}' = \mathbf{x}' - \mathbf{e_n'} \cdot \mathbf{H}$$

or

(B.1.2) $\mathbf{y} = \mathbf{x} - \mathbf{H}' \cdot \mathbf{e_n}$

and total final demand by demand category **D** (dimension $(r,1)$) as

$$\mathbf{d}' = \mathbf{e_n'} \cdot \mathbf{G}$$

or

(B.1.3) $\mathbf{d} = \mathbf{G}' \cdot \mathbf{e_n}$.

B.1.2. The Input/Output quantity model

The idea of Input/Output modeling is to combine the concepts introduced above, describing the flows of products in the economy, with assumptions about fixed shares (coefficients) of input of intermediate consumption in production, and fixed composition of products in each category of final demand.

In order to implement the first assumption, fixed composition of intermediate consumption in production, we have to define the *(n,n)* coefficient matrix of intermediate input in production,

$$(\text{B.1.4})\quad A_{\mathbf{x}} = \begin{bmatrix} ax_{11} & ax_{12} & \dots & ax_{1n} \\ ax_{21} & ax_{22} & \dots & ax_{2n} \\ \dots & & & \\ ax_{n1} & ax_{n2} & \dots & ax_{nn} \end{bmatrix} \equiv \begin{bmatrix} h_{11}/x_1 & h_{12}/x_2 & \dots & h_{1n}/x_n \\ h_{21}/x_1 & h_{22}/x_2 & \dots & h_{2n}/x_n \\ \dots & & & \\ h_{n1}/x_1 & h_{n2}/x_2 & \dots & h_{nn}/x_n \end{bmatrix} = \mathbf{H}\cdot\hat{\mathbf{x}}^{-1}$$

where each column in the matrix **H**, representing the input in each sector, is divided by total production in the corresponding sector, or - equivalent to that- multiplied by the inverse of total production in that sector, $\hat{\mathbf{x}}^{-1}$. The symbol ^ means that we have «diagonalized» the **x** vector, placing its elements on the main diagonal and zeros elsewhere, and the symbol $^{-1}$ denote that the matrix has been inverted,

$$\hat{\mathbf{x}}^{-1} = \begin{bmatrix} x_1 & & 0 \\ & \ddots & \\ 0 & & x_n \end{bmatrix}^{-1} = \begin{bmatrix} 1/x_1 & & 0 \\ & \ddots & \\ 0 & & 1/x_n \end{bmatrix}$$

In the same way, we define the *(n,r)* coefficient matrix $\mathbf{A_d}$ assuming fixed composition of products in each category of final demand

$$(\text{B.1.5})\quad \mathbf{A_d} = \begin{bmatrix} ad_{11} & ad_{12} & \dots & ad_{1r} \\ ad_{21} & ad_{22} & \dots & ad_{2r} \\ \dots & & & \\ ad_{n1} & ad_{n2} & \dots & ad_{nr} \end{bmatrix} \equiv \begin{bmatrix} g_{11}/d_1 & g_{12}/d_2 & \dots & g_{1r}/d_r \\ g_{21}/d_1 & g_{22}/d_2 & \dots & g_{2r}/d_r \\ \dots & & & \\ g_{n1}/d_1 & g_{n2}/d_2 & \dots & g_{nr}/d_r \end{bmatrix} = \mathbf{G}\cdot\hat{\mathbf{d}}^{-1}$$

By multiplying (B.1.4) and (B.1.5) with **x** and **d**, respectively

$$\mathbf{A_x}\cdot\mathbf{x} = \mathbf{H}\cdot\hat{\mathbf{x}}^{-1}\cdot\mathbf{x} = \mathbf{H}\cdot\mathbf{e_n}$$
$$\mathbf{A_d}\cdot\mathbf{d} = \mathbf{G}\cdot\hat{\mathbf{d}}^{-1}\cdot\mathbf{d} = \mathbf{G}\cdot\mathbf{e_r}$$

and inserting this into (B.1.1), we arrive at

$$(\text{B.1.6})\quad \mathbf{x} = \mathbf{H}\cdot\mathbf{e_n} + \mathbf{G}\cdot\mathbf{e_r} = \mathbf{A_x}\cdot\mathbf{x} + \mathbf{A_d}\cdot\mathbf{d}$$

Further manipulation of (B.1.6) gives

$$(\mathbf{I}-\mathbf{A_x})\cdot\mathbf{x} = \mathbf{A_d}\cdot\mathbf{d}$$

and hence

(B.1.7) $\mathbf{x} = (\mathbf{I} - \mathbf{A}_x)^{-1} \cdot \mathbf{A}_d \cdot \mathbf{d}$

This set of equations describes how - assuming fixed input coefficients in production and final demand - final demand impulses are spread to sectors of production, including cross effects through intermediate inputs from one sector of production to another.

Since (B.1.4) implies that intermediate input in each sector is in a fixed proportion to total production, this also holds for the value added in each sector. By denoting this (n,1) vector of fixed coefficients by $\mathbf{a}_y$

(B.1.8) $\mathbf{a}_y = \hat{\mathbf{x}}^{-1} \cdot \mathbf{y}$

and then using (B.1.2) and (B.1.4), and utilizing that transposing a diagonal matrix does not change the matrix, gives

(B.1.9)
$$\begin{aligned} \mathbf{a}_y &= \hat{\mathbf{x}}^{-1} \cdot \mathbf{y} = \hat{\mathbf{x}}^{-1} \cdot (\mathbf{x} - \mathbf{H}' \cdot \mathbf{e}_n) = \hat{\mathbf{x}}^{-1} \cdot \mathbf{x} - \hat{\mathbf{x}}^{-1} \cdot \mathbf{H}' \cdot \mathbf{e}_n \\ &= \mathbf{e}_n - (\mathbf{H} \cdot \hat{\mathbf{x}}^{-1})' \cdot \mathbf{e}_n = (\mathbf{I} - \mathbf{A}_x)' \cdot \mathbf{e}_n \end{aligned}$$

i.e. fixed coefficients of value added to total production follows from the assumption of fixed coefficient for intermediate inputs.

By reformulating (B.1.8), we have

(B.1.10) $\mathbf{y} = \hat{\mathbf{x}} \cdot \mathbf{a}_y = \hat{\mathbf{a}}_y \cdot \mathbf{x}$

and by inserting (B.1.7)

(B.1.11) $\mathbf{y} = \hat{\mathbf{a}}_y \cdot \mathbf{x} = \hat{\mathbf{a}}_y \cdot (\mathbf{I} - \mathbf{A}_x)^{-1} \cdot \mathbf{A}_d \cdot \mathbf{d} = \mathbf{A} \cdot \mathbf{d}$

where we have introduced the compounded - or reduced form - matrix **A**

(B.1.12) $\mathbf{A} = \hat{\mathbf{a}}_y \cdot (\mathbf{I} - \mathbf{A}_x)^{-1} \cdot \mathbf{A}_d$

The *ik*-th element in the $\mathbf{A}_d$ matrix shows the input of product *i* demanded by one unit (i.e. 1 millions of SR, the base unit in the Implementation Model) of the final demand category *k*. The *ij*-th element in the $(\mathbf{I} - \mathbf{A}_x)^{-1}$ matrix shows needed total output from sector *i* per unit delivered to final demand by sector *j*. Hence, the *ik*-th element in the matrix $(\mathbf{I} - \mathbf{A}_x)^{-1} \cdot \mathbf{A}_d$ is the total output of sector *i* demanded by one unit of final demand category *k*. By pre-multiplying with the diagonal matrix $\hat{\mathbf{a}}_d$, value added per unit of total output, the *ij*-th element in the matrix **A** obviously expresses the value added generated in sector *i* by one unit demanded by final demand category *j*.

The equations (B.1.7) and (B.1.11) (alternatively the equations (B.1.6) and (B.1.10)) are the main two quantity relationships in the Input/Output model. Because the Saudi Arabian national accounts only includes the values of **y** and **d** (the last vector deflated to constant prices by the Ministry of Planning itself) we have to base our model on the equation (B.1.11) alone.

B.1.3. Introducing imports and exports

Introducing exports do not add anything new to the model, it is just an expansion of the number of categories of final demand.

The way to introduce imports is less obvious. Alternative approaches may be considered. Our proposal has been influenced by the fact that the National Accounts only specify *total* import as a time series. Specifically, we have no time series information regarding the share of imported products in different product groups. The way we have dealt with the problem is to treat total imports in the same way as the value added component in the production sectors. We simply add one new «sector of production» to the **H**, **x** and **y** matrices, as shown in table 2:

Table 2. The input/output flows including an import sector

Output...	...allocated. to intermediate consumption				... and to final demand category		
x_1	h_{11}	..	h_{1n}	0	g_{11}	..	g_{1r}
:	:		:	:	:		:
x_n	h_{n1}	..	h_{nn}	0	g_{n1}	..	g_{nr}
m	m_1	..	m_n	0	0	..	0
y	y_1	..	y_n	m	0	..	0
	x_1	..	x_n	m	d_1	..	d_r

On the input side of the «import sector», total imports enter the table just like the value added component enters the ordinary production sectors. Because other inputs are zero, total output (= total input) is equal to total imports as well. Hence, on the output side total imports are allocated to receiving sectors. As may be seen from the table, there are no direct deliveries from imports to final demand. This means that all imports are allocated to the domestic sector that produces the same group of products (but not necessary the same products) as the one imported.

This specification is well adapted to the data situation. We only need time series for total imports (in line with value added by sectors). The allocation of imports to receiving sectors is taken care of by the input/output coefficients in the $\mathbf{A_x}$ matrix and the $\mathbf{a_y}$ vector, which are both expanded to include imports.

The consequence of treating imports this way, is that imports of a specific product is put in a fixed proportion to domestic production (just like intermediate consumption), implying constant market shares between imported and domestically produced products. In the model, however, we will relax this assumption somewhat, by allowing all import shares to be adjusted in the same proportion (there will also be a possibility of ad hoc adjusting production in each sector against imports). As a consequence of the data situation, we only have time series for prices on total imports, hence we are only able to estimate and implement an import market share function for total imports.

B.1.4. The Input/Output price model

The Input/Output price model is dual to the quantity model. While the quantity model shows the impacts from final demand to gross production and value added by sector, the price model shows the price impulses from value added and gross production to the prices on final demand.

The two price equations, corresponding to the two quantity equations (B.1.6) and (B.1.10), are

(B.1.13) $$\mathbf{p}'_\mathbf{x} = \mathbf{p}'_\mathbf{x} \cdot \mathbf{A}_\mathbf{x} + \mathbf{p}'_\mathbf{y} \cdot \hat{\mathbf{a}}_\mathbf{y}$$

(B.1.14) $$\mathbf{p}'_\mathbf{d} = \mathbf{p}'_\mathbf{x} \cdot \mathbf{A}_\mathbf{d}$$

Equation (B.1.14) shows how prices on final demand categories - under the assumption of fixed input coefficients in constant prices - is a weighted average of the prices of the products delivered. Correspondingly, (B.1.13) shows how the price on output (gross production) may be calculated by taking a weighted average of the prices on intermediate consumption and primary inputs. This equation may be motivated by showing that it follows from the definition of the value added deflator, as the value of output minus the value of intermediate consumption, both in current prices, divided by the value added in constant prices:

$$\mathbf{p}_y' = (\mathbf{p}_x' \cdot \hat{\mathbf{x}} - \mathbf{p}_x' \cdot \mathbf{H}) \cdot \hat{\mathbf{y}}^{-1}$$

By inserting (B.1.4) and (B.1.8), i.e. assuming fixed input coefficients in constant prices, we get

$$\mathbf{p}_x' = (\mathbf{p}_x' \cdot \hat{\mathbf{x}} - \mathbf{p}_x' \cdot \mathbf{A}_x \cdot \hat{\mathbf{x}}) \cdot \hat{\mathbf{y}}^{-1} = \mathbf{p}_x' \cdot (\mathbf{I} - \mathbf{A}_x) \cdot \hat{\mathbf{x}} \cdot \hat{\mathbf{y}}^{-1} = \mathbf{p}_x' \cdot (\mathbf{I} - \mathbf{A}_x) \cdot \hat{\mathbf{x}} \cdot (\hat{\mathbf{a}}_y \cdot \hat{\mathbf{x}})^{-1} =$$
$$\mathbf{p}_x' \cdot (\mathbf{I} - \mathbf{A}_x) \cdot \hat{\mathbf{x}} \cdot \hat{\mathbf{x}}^{-1} \cdot \hat{\mathbf{a}}_y{}^{-1} = \mathbf{p}_x' \cdot (\mathbf{I} - \mathbf{A}_x) \cdot \hat{\mathbf{a}}_y{}^{-1}$$

which, by reorganizing the terms, leads to (B.1.13).

One comment should be made regarding the consequences for price concepts of the way we treat imports in the model. Prices on total imports enters the model as the last element of the $\mathbf{p}_y$ vector. By equation (B.1.13), it is set equal to the output price for total imports (the last element of $\mathbf{p}_x$), since the $\mathbf{a}_y$ coefficient for imports is equal to one and the $\mathbf{A}_x$ coefficients for inputs to the import sector are all zero, cf. table 2. However, when calculating prices on output from the other sectors according to equation (B.1.13) as a weighted average of input prices to the sectors, the price on total imports will be included, since the coefficients for imported inputs in these sectors in general are non-zero. This means that the $\mathbf{p}_x$ prices we calculate from (B.1.13) are weighted averages of imported and domestic produced products, and not prices on domestic produced products alone. However, since we do not have access to time series for the output prices, they have to be excluded from the model anyhow, so it does not matter how they are defined.

The price equations corresponding to the quantity equations (B.1.7) and (B.1.11) may be found by solving (B.1.13) for $\mathbf{p}_x$ and inserting the result into (B.1.14):

(B.1.15) $$\mathbf{p}_x' = \mathbf{p}_y' \cdot \hat{\mathbf{a}}_y (\mathbf{I} - \mathbf{A}_x)^{-1}$$

(B.1.16) $$\mathbf{p}_d' = \mathbf{p}_y' \cdot \hat{\mathbf{a}}_y \cdot (\mathbf{I} - \mathbf{A}_x)^{-1} \cdot \mathbf{A}_d = \mathbf{p}_y' \cdot \mathbf{A}$$

where we again have introduced the matrix **A** defined in (B.1.12). As for the quantity model, and as already mentioned, we have to base our model on equation (B.1.16) alone, because we do not have access to time series for output prices ($\mathbf{p}_x$). We do however have time series for the variables $\mathbf{p}_d$ and $\mathbf{p}_y$ (the last vector including prices on total imports), which in the model will be connected through the reduced form I/O-matrix **A**. We now turn over to the problem of how to estimate this very central matrix.

B.2. Estimating an I/O-matrix consistent with NA-data for 1989

The Saudi National Accounts do not include information about the flows of products in the economy, only about GDP by sector and final demand categories. Hence, we have to look elsewhere for data to establish the **A** matrix to be used in the model, of course by also taking into account the information incorporated in the NA figures. Regarding input/output information about the Saudi economy, we have two sources, both carried out on behalf of the Ministry of Planning : A very comprehensive study by Coopers&Lybrand for the year 1976, and a more exercise type of work by Wartenberg for 1989. After discussion with MOP representatives, it was agreed to base the matrix on an adjusted and updated Coopers&Lybrand matrix.

B.2.1. Establishing the A matrix based on Coopers&Lybrand 1976

The work of Coopers&Lybrand resulted in a full Social Accounting Matrix (SAM-matrix) for the Saudi economy, showing both the flows of products and income between sectors. In the I/O-core of the model, however, we only utilize information about the flows of products, i.e. the elements included in the matrices **H** and **G** above.

The **H** matrix and part of the **G** matrix (all final demand except for private consumption) was taken from the full SAM table published as an annex to Volume I of the C&L report. The other part of the **G** matrix were taken from a table inside the same volume, giving almost the same levels of sectors of production, but a far more detailed specification of private consumption categories (31 categories instead of only 9 (not corresponding to the 10 NA categories) in the full C&L table).

The full C&L table displays 34 sectors of production (for some sectors the input table is further split into two parts, depending on the nature of competition between imported and domestically produced products). The Implementation Model has got only 16 sectors (corresponding to the sectors in the National Accounts). The aggregation from C&L sectors (identified by their row/column numbers in the full SAM-table) to NA sectors is shown in table 3.

In the C&L table, exports of crude and refined oil were calculated at domestic prices. The difference between word market and domestic prices was treated as an «export tax», earned by the government. There are good theoretical reasons for such a method since, with different price levels in the domestic and export market, changes in the allocation of oil between domestic use and export will cause changes in value added in constant prices in the oil sector, even if total production measured in physical units is unchanged. The C&L method solves this problem. Even so, we have reversed this adjustments in the Input/Output table, finding it too complicated to introduce in the current version of the model. As long as focus in the use of the model is on the GDP (value added) in the private, non-oil sector, and not on total GDP, this will not be a problem. The treatment of the oil sector, completely exogenously in this version of the model, should anyhow be reformulated in a later version of the model, and a different solution may be implemented then.

Table 3. Aggregation of sectors of production, intermediate consumption and imports

No.	*NA sector*	*Rows/columns in the full C&L table*
1	Agriculture, forestry and fishing	3
2	Other mining and quarrying	16, 17
3	Petrochemicals	-
4	Other manufacturing	7, 8, 9, 10, 11, 12, 14, 15, 18, 19, 20 ,21
5	Electricity, gas and water	22, 24
6	Construction	26, 27, 28, 29
7	Wholesale/retail trade, restaur. and hotels	30, 31, 32
8	Transport and communication	33, 34, 35
9	Real estate	37, 38
10	Finance, insurance	36, 39
11	Community services	40, 41, 42
12	Government services	45, 46, 47, 48, 49
13	Imputed bank charges	51
14	Crude oil and natural gas	Δ13
15	Petroleum refining	Δ13
16	Import duties	52

In the C&L table, crude oil and refined petroleum were treated like one sector, and consequently we had to try to split it into two sectors. The deliveries to exports are distributed on the two sectors by using MOP information (facsimile noted «Exports by SABIC») for 1976. All other final demand deliveries are allocated to the refining sector. The intra-sector delivery of intermediate consumption (i.e. of own products) is allocated as a delivery from the crude oil sector to the refinery sector. All other intermediate consumption deliveries are assumed to be refined products. The sum of deliveries for each of the two sectors are used to split the inputs to the sector proportionally (giving crude oil a 93.5 per cent share, and refined products a 6.5 per cent share). However, the inputs of own products (as mentioned above) and all imports were allocated to the refining sector alone (assuming that all imported oil in 1976 was refined).

Petrochemicals was not specified in the C&L table for the obvious reason that there was no such production in Saudi Arabia in 1976. For the petrochemical sector we have inserted 1/100,000 of the corresponding values (lines and columns) in the I/O tables presented by Wartenberg (1993). The idea is to introduce a presumably right input/output structure for the sector, without changing the actual figures for production, intermediate consumption and value added for the other sectors or final demand categories. If this is the best way to introduce the sector into the I/O-table should be discussed in more detail.

The dummy sector for imputed bank charges had to be given special attention. The idea behind this sector is to allow financial services financed by net capital income instead of bank charges to be included in the value added in the financial sector, without influencing the primary income accruing to fixed capital (i.e. operating surplus) according to the production accounts. (Instead it will enter as net financial income in the income/outlay accounts.) This is achieved by imputing a service delivered as intermediate consumption from the financial sector to the dummy sector. This sector have no production on its own, only the input from the financial sector. The value added (and operating surplus) in the dummy sector thus become negative by the same amount, implying that total GDP is unaffected by the manipulations. The zero production in this sector creates problems, however, because we have to divide both inputs of intermediate consumption and value added by total production (output) to get the $\mathbf{A}_x$ and $\mathbf{a}_y$ matrix/vector, and dividing by zero is not allowed. We solved this problem by inserting a very small number (0.001 millions of SR) as a delivery from the dummy sector to intermediate consumption in the financial sector, ensuring that total output was no longer exactly zero.

(With this solution, the level of imputed bank charges is determined by the activity level in the financial sector. Another way to model this variable, is to estimate net financial income to the financial sector directly. At the moment, we think the data situation for financial data is so unclear, that the proposed solution will probably be better.)

There are all together 22 categories of final demand in the I/O-core in the version 2.0 of the Implementation model.The aggregation from 31 to 9 private consumption categories is shown in table 4, while table 5 shows the aggregation for the remaining 13 components of final demand.

Table 4. Aggregation of categories of private final consumption

No.	*NA categories*	*C&L detailed consumption categories*
1	Food, beverage, tobacco	1, 2, 3, 4, 5, 6, 7
2	Clothing and footwear	8
3	Rent, fuel and power	9, 10, 11, 12, 13
4	Furniture and household equipment	14, 15, 16, 24, 25
5	Medical health care	Δ18
6	Transport and communication	17, 19, 20, 21, 22
7	Entertainment and education	Δ18, 26
8	Other goods and services	27, 28, 29, 30, 31
10	Resident direct purchase abroad	23

Table 5. Aggregation of categories of public consumption, capital formation and exports

No.	NA categories	Columns in the full C&L table
	Government final consumption	65
	Private non oil sector's residential GFCF	Δ108 - Δ113, Δ115 - Δ138
	Private non oil sector's non-residential GFCF	Δ108 - Δ113, Δ115 - Δ138
	Private non oil sector's GFCF in transp.equipm. and machinery	Δ108 - Δ113, Δ115 - Δ138
	Government GFCF in buildings	Δ141 - Δ145
	Governement GFCF in transport equipment and machinery	Δ141 - Δ145
	Oil sector GFCF in buildings	Δ114
	Oil sector GFCF in transport equipment and macinery	Δ114
	Increase in inventories	108
	Exports of crude oil and natural gas	Δ157
	Exports of refined products	Δ157
	Exports of petrochemical products	Δ157
	Exports of other goods and serivices, excl. non-residents' dir. purchase	Δ157

[1] Gross fixed capital formation

The aggregation of public consumption into one category is due to the aggregation level in the National Accounts. If government consumption, alternatively value added for government services, could be specified in more detail, the C&L table gives information about the specific input structure in five government service sectors (public administration, health, education, defense, and ports) that could be used to improve the I/O structure of the model.

The National Accounts only specify gross fixed formation for three institutional categories, while C&L specifies for 28 functional sectors. On the other hand, C&L gives only information about total GFCF in each sector, while NA specifies four different categories of capital: Residential building, non-residential buildings, machinery, and transport equipment. In the model the two last mentioned categories are aggregated to one: Transport equipment and machinery.

After aggregation of the sectors of production, the C&L matrix showed supplies of investment goods and services from 8 sectors of production. The deliveries to the 28 receiving sectors were aggregated to three receiving sectors according to table 5 above, giving (in principle) a matrix of deliveres from 8 supply sectors to 3 receiving sectors. Each of these deliveries were allocated to the (in principle) three categories in the following way: For each receiving sector, the deliveries from the agricultural sector, the mining sector and the construction sector were allocated to investment in buildings. For the private non-oil sector the deliveries were distributed on residential and non-residential buildings in proportion to the NA figures for investment by category. Hence, since residential investments' share of total investment in buildings for the private non-oil sector was approximately ¾ according to NA for 1976, ¾ of deliveries from agriculture, etc. were allocated to residential and ¼ to non-residential investment. The deliveries from wholesale/retail trade, transport/communications, finance/insurance, and import duties were distributed on (in principle) all three categories in a corresponding way. Finally, deliveries from the manufacturing sector were distributed to the three categories in such a way that total investment by category for each receiving sector became proportional to the NA figures.

Since the Implementation model should focus on private non-oil sector behaviour, it is important to separate exports between oil and non-oil products. Both the C&L table and the NA accounts display only one category of exports (total exports). Since the deliveries to exports in the C&L table are specified by sector of supply, it was simple to make a specification on export categories from the supply side. In order to make time series for exports categories as a break down of total exports in

NA, i.e. time series for these components in the $\mathbf{d}_{NA}$ vector, we had to use material from the trade statistics.

The non-residents' direct purchase in Saudi Arabia is as usual in the NA system included in (the input/output flows for) the other consumption categories, and is therefore excluded from (the input/output flows for) the exports. The specification of this consumption is treated as a sector-to-sector adjustment outside the I/O model, contributing negatively to total private consumption and positively to total exports.

After adjusting and aggregating the **H** and **G** matrices we recalculated the vectors **x** by using equation (B.1.1), **y** by using equation (B.1.2), and **d** by using equation (B.1.3). The reason for recalculating these vectors (instead of using the same adjusting and aggregating procedures as for the matrices) is that the C&L table does not always «sum up». We must here bear in mind that the full table were probably calculated in not very user friendly (i.e. not matrix oriented) software (certainly constructed before the era of the spread sheets!) and later written down by hand. Of course, there may also be errors in entering the data into our spreadsheet, even if we double checked the result. However, the differences between the original and the recalculated vectors are minor, probably mostly reflecting rounding errors, etc.

With all these matrices and vectors established, we were able to derive the coefficient matrices/vectors $\mathbf{A}_x$, $\mathbf{A}_d$, and $\mathbf{a}_y$, according to equations (B.1.4), (B.1.5) and (B.1.8) above, and hence to calculate the **A** matrix according to (B.1.12).

Table 6a and b shows the aggregated **H** and **G** matrices before and after the pre-adjustments, while table 6c shows the resulting coefficient matrices/vector $\mathbf{A}_x$, $\mathbf{a}_y$, and $\mathbf{A}_d$.

Table 6a. Aggregated Coopers&Lybrand matrices for 1976

Delivering sectors — *Receiving sectors*

Matrix H

Interm. consumption

Interm. consumption		Aggriculture	Other mining	Petrochemic	Other manu	Electricity, g	Construction	Wholesale a	Transport ar	Real estate	Finance, ins	Community	Goverment	Imputed ban	Crude oil	Petroleum r	Import dutie	Import
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Aggriculture, forestry and fishing	1	280	0	0	4	0	1	37	112	0	0	0	13	0	0	0	0	0
Other mining and quarrying	2	0	690	0	96	5	2617	4	1	2	1	1	16	0	108	0	0	0
Petrochemicals	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other manufacturing	4	140	173	0	2453	114	5321	567	563	9	77	564	3644	0	998	0	0	0
Electricity, gas and water	5	0	35	0	28	5	89	37	19	5	7	19	79	0	25	0	0	0
Construction	6	0	1	0	118	11	1636	26	763	38	14	14	1463	0	35	0	0	0
Wholesale and retail trade	7	70	97	0	435	61	967	2461	286	5	30	101	710	0	11	0	0	0
Transport and communication	8	0	93	0	149	109	676	1008	685	24	83	60	1298	0	452	0	0	0
Real estate	9	0	29	0	100	21	175	690	270	42	48	117	364	0	69	0	0	0
Finance, insurance	10	30	7	0	203	49	2980	89	145	5	102	19	747	1750	484	0	0	0
Community services	11	0	8	0	24	4	70	32	20	1	2	7	396	0	150	0	0	0
Goverment services	12	13	83	0	225	0	0	0	0	0	0	0	0	0	0	0	0	0
Imputed bank charges	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crude oil and natural gas	14	60	10	0	35	45	150	43	223	5	11	64	273	0	209	0	0	0
Petroleum refining	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import duties	16	-10	-22	0	-52	-17	-75	-98	-149	-10	-23	-21	-465	0	-147	0	0	0
Import	17	2790	3006	0	60647	0	2005	0	1406	0	4894	143	0	0	325	0	0	0

Delivering sectors — *Receiving categories*

Matrix G

Final demand

Final demand		Private consumption (including non-resident direct purchase)									Gross fix cap. formation			Public	Increase	Export
		Food, beverage, tobacco	Clothing, footwear	Rent, fuel, power	Furniture, household equipment	Medical health service	Transport communi-cation	Entertain-ment, education	Other goods and services	Resident dir purch abroad	Private non-oil sector	Govern-ment sector	Oil sector	consump-tion	in stocks	(excl non res. purch)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Aggriculture, forestry and fishing	1	11060	0	123	0	0	0	0	115	0	114	0	0	0	47	0
Other mining and quarrying	2	0	0	49	188	0	0	0	0	0	726	0	906	0	517	0
Petrochemicals	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other manufacturing	4	7750	4298	317	2127	149	2885	326	1092	6	8558	15848	7136	0	3110	112
Electricity, gas and water	5	0	0	514	0	0	0	0	0	0	0	0	0	0	0	0
Construction	6	0	0	341	0	0	0	0	5	0	10413	19939	2452	0	0	0
Wholesale and retail trade	7	9496	1681	298	1294	106	2650	204	1442	0	1088	269	283	0	0	0
Transport and communication	8	0	0	160	0	0	2197	0	31	1465	0	0	641	0	0	0
Real estate	9	0	0	7607	0	0	0	0	0	0	0	0	0	0	0	0
Finance, insurance	10	0	0	0	0	0	11	0	11	0	348	2916	1387	0	0	422
Community services	11	0	99	0	0	161	1121	161	517	0	0	0	0	0	0	1
Goverment services	12	0	0	0	0	0	0	0	0	0	0	0	0	18555	0	0
Imputed bank charges	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crude oil and natural gas	14	0	0	41	5	256	693	0	0	0	0	0	0	0	75	21147
Petroleum refining	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import duties	16	-1237	0	-307	0	0	-429	0	-8	-185	-4	0	0	0	-2	125101
Import	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6b. Aggregated and pre-adjusted Coopers&Lybrand matrices for 1976

Delivering sectors — *Receiving sectors*

Matrix H — Interm. consumption

Interm. consumption		Agriculture	Other mining	Petrochemic	Other manuf	Electricity, g	Construction	Wholesale a	Transport ar	Real estate	Finance, ins	Community	Goverment s	Imputed ban	Crude oil	Petroleum re	Import duties	Import
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Aggriculture, forestry and fishing	1	280	0	0	4	0	1	37	112	0	0	0	13	0	0	0	0	0
Other mining and quarrying	2	0	690	0	96	5	2617	4	1	2	1	1	16	0	100	7	0	0
Petrochemicals	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other manufacturing	4	140	173	0	2453	114	5321	567	563	9	77	564	3644	0	930	68	0	0
Electricity, gas and water	5	0	35	0	28	5	89	37	19	5	7	19	79	0	23	2	0	0
Construction	6	0	1	0	118	11	1636	26	763	38	14	14	1463	0	33	2	0	0
Wholesale and retail trade	7	70	97	0	435	61	967	2461	286	5	30	101	710	0	11	1	0	0
Transport and communication	8	0	93	0	149	109	676	1008	685	24	83	60	1298	0	421	31	0	0
Real estate	9	0	29	0	100	21	175	690	270	42	48	117	364	0	64	5	0	0
Finance, insurance	10	30	7	0	203	49	2980	89	145	5	102	19	747	1750	451	33	0	0
Community services	11	0	8	0	24	4	70	32	20	1	2	7	396	0	140	10	0	0
Goverment services	12	13	83	0	225	0	0	0	0	0	0	0	0	0	0	0	0	0
Imputed bank charges	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crude oil and natural gas	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	209	0	0
Petroleum refining	15	60	10	0	35	45	150	43	223	5	11	64	273	0	0	0	0	0
Import duties	16	-10	-22	0	-52	-17	-75	-98	-149	-10	-23	-21	-465	0	-137	-10	0	0
Import	17	2790	3006	0	60647	0	2005	0	1406	0	4894	143	0	0	0	325	0	0

Delivering sectors — *Receiving categories*

Matrix G — Final demand

Final demand		Private consumption (including non-resident direct purchase)									Gross fix cap. formation			Public consump-tion	Increase in stocks	Export (excl non res. purch)
		Food, beverage, tobacco	Clothing, footwear	Rent, fuel. power	Furniture, household equipment	Medical health service	Transport communi-cation	Entertain-ment, education	Other goods and services	Resident dir purch abroad	Private non-oil sector	Govern-ment sector	Oil sector			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Aggriculture, forestry and fishing	1	11060	0	123	0	0	0	0	115	0	114	0	0	0	47	0
Other mining and quarrying	2	0	0	49	188	0	0	0	0	0	726	0	906	0	517	0
Petrochemicals	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other manufacturing	4	7750	4298	317	2127	149	2885	326	1092	6	8558	15848	7136	0	3110	112
Electricity, gas and water	5	0	0	514	0	0	0	0	0	0	0	0	0	0	0	0
Construction	6	0	0	341	0	0	0	0	5	0	10413	19939	2452	0	0	0
Wholesale and retail trade	7	9496	1681	298	1294	106	2650	204	1442	0	1088	269	283	0	0	0
Transport and communication	8	0	0	160	0	0	2197	0	31	1465	0	0	641	0	0	0
Real estate	9	0	0	7607	0	0	0	0	0	0	0	0	0	0	0	0
Finance, insurance	10	0	0	0	0	0	11	0	11	0	348	2916	1387	0	0	422
Community services	11	0	99	0	0	161	1121	161	517	0	0	0	0	0	0	1
Goverment services	12	0	0	0	0	0	0	0	0	0	0	0	0	18555	0	0
Imputed bank charges	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crude oil and natural gas	14	0	0	0	0	0	0	0	0	0	0	0	0	0	75	138415
Petroleum refining	15	0	0	41	5	256	693	0	0	0	0	0	0	0	0	7833
Import duties	16	-1237	0	-307	0	0	-429	0	-8	-185	-4	0	0	0	-2	0
Import	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

B.2.2. Adjusting the A matrix to NA figures for 1989

Let us look at what sort of information we have got. From the Coopers&Lybrand study, we have the matrices/vectors **H**, **G**, **x**, **y**, **d**, $\mathbf{A_x}$, $\mathbf{a_y}$,$\mathbf{A_d}$ and **A** for 1976. From the National Accounts we have only the vectors **y** and **d** (the level of GDP by sector and final demand category), and we want to use those vectors to update the information in the **A** matrix.

We want to confront the structure in the C&L A-matrix with the (unknown) structure underlying the **y** and **d** vectors from the National Accounts. Since **A** is a matrix of *coefficients*, while the National Accounts figures for 1989 are on *level* form, we first have to bring the matrix on level form as well. This is done by post-multiplying the matrix with a diagonalized **d** vector from the National Accounts:

(B.2.1) $\boldsymbol{\Theta} = \mathbf{A} \cdot \hat{\mathbf{d}}_{\mathbf{NA1989}}$

By taking the sum of each column of Θ, we of course arrive at GDP by final demand components, according to the National Accounts:

(B.2.2) $\mathbf{e}_{\mathbf{n}}' \cdot \boldsymbol{\Theta} = \mathbf{e}_{\mathbf{n}}' \cdot \mathbf{A} \cdot \hat{\mathbf{d}}_{\mathbf{NA1989}} = \mathbf{e}_{\mathbf{n}}' \cdot \hat{\mathbf{d}}_{\mathbf{NA1989}} = \mathbf{d}_{\mathbf{NA1989}}'$

since, taking the columnwise sum of the **A** matrix gives a row vector with elements equal to 1.

By taking the sum of each row (inserting for **A**), we get:

(B.2.3) $\boldsymbol{\Theta} \cdot \mathbf{e}_{\mathbf{r}} = \hat{\mathbf{a}}_{\mathbf{y}} \cdot (\mathbf{I} - \mathbf{A}_{\mathbf{x}})^{-1} \cdot \mathbf{A}_{\mathbf{d}} \cdot \hat{\mathbf{d}} \cdot \mathbf{e}_{\mathbf{r}} = \hat{\mathbf{a}}_{\mathbf{y}} \cdot (\mathbf{I} - \mathbf{A}_{\mathbf{x}})^{-1} \cdot \mathbf{A}_{\mathbf{d}} \cdot \mathbf{d} = \hat{\mathbf{a}}_{\mathbf{y}} \cdot \mathbf{x} = \mathbf{y}$

i.e. the GDP by sector together with total imports. If **A** had the true structure behind the NA figures, this **y** should be equal to GDP by industry according to the National Accounts for 1989. Since **A** is taken from another data-set and for another year, it is not surprising that it is'nt. The question is, could we adjust the elements of Θ so that the sum by rows and column, respectively, give the GDP by industry and final demand components according to NA 1989?

The task of adjusting the Θ matrix so that both columns and rows add up to the National Accounts vectors, is solved through the so called RAS or biproportional method, that has been used as a standard method for adjusting matrices both in I/O analyses as well as in other fields of economics (population studies, etc.) . The method means iterative allocation of row and column discrepancies (i.e. the differences between each element in the NA vectors and the corresponding row or column sum) pro-rata with the elements obtained at previous iteration. For example, first every row in Θ is pro-rata adjusted to add up to the National Accounts **y** vector. This generally means that each column no longer ad up to the corresponding element in the National Accounts **d** vector. Hence, in the next step every column in the *previously adjusted* Θ matrix is pro-rata adjusted to add up to the National Accounts **d** vector. However, this generally means that the row elements no longer ad up to the National Accounts **y** vector, so each row has to be pro-rata adjusted again.

The iterations goes on until the solution converges (what it eventually will do). The solution is not dependent of the direction (either rows or columns) of the first adjustment. We also tested for adjusting the matrix in two steps, first adjusting the C&L matrix to 1976 National Accounts data, and thereafter adjusting this new matrix to the NA 1989 data. However, this procedure gave the same result.

According to Lecomber (1975) the RAS method is the solution of the minimizing problem:

$$\text{(B.2.4)} \quad \min. \sum_{i,j} \left(\Theta^*_{ij} \log \frac{\Theta^*_{ij}}{\Theta_{ij}} \right)$$

given the row and column summation constraints (B.2.3) and (B.2.4), where Θ_{ij} is an element in the original Θ matrix, while the asterix marks the corresponding element in the finally adjusted matrix Θ^*. Lecomber also argues that the method preserves the signs of the original Θ.

Once we have adjusted the Θ matrix to the 1989 NA figures, we calculate the adjusted **A** matrix by dividing each column by the corresponding element of the NA 1989 version of **d**:

$$\text{(B.2.5)} \quad \mathbf{A}^* = \Theta^* \cdot \hat{\mathbf{d}}_{\mathbf{NA1989}}^{-1}$$

The **A** matrix from the C&L study (based on the matrices in table 6c) is shown in table 7a, while table 7b shows the final Θ^* matrix, and table 7c the final $\mathbf{A}^*$ matrix.

Table 6c. Aggregated and pre-adjusted Coopers&Lybrand coefficient matrices for 1976

Matrix Ax — Interm. cons. coeff.

Interm. cons. coeff.		Aggriculture	Other mining	Petrochemic	Other manuf	Electricity, g	Construction	Wholesale a	Transport ar	Real estate	Finance, ins	Community	Goverment	Imputed ban	Crude oil	Petroleum r	Import dutie	Import
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Aggriculture, forestry and fishing	1	0,023526	0,000000	0,000000	0,000061	0,000000	0,000035	0,001526	0,012281	0,000000	0,000000	0,000000	0,000689	0,000000	0,000000	0,000000	0,000000	0,000000
Other mining and quarrying	2	0,000000	0,116441	0,000000	0,001399	0,006162	0,070211	0,000150	0,000110	0,000252	0,000120	0,000289	0,000837	0,000000	0,000724	0,000752	0,000000	0,000000
Petrochemicals	3	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000006	0,000001	0,000000	0,000000	0,000000	0,000000	0,000000
Other manufacturing	4	0,011767	0,029157	0,000000	0,035890	0,132775	0,142783	0,023594	0,061690	0,000913	0,006613	0,203289	0,193060	0,000000	0,006704	0,006961	0,000000	0,000000
Electricity, gas and water	5	0,000000	0,005889	0,003045	0,000410	0,005697	0,002377	0,001522	0,002114	0,000504	0,000581	0,006852	0,004196	0,000000	0,000165	0,000171	0,000000	0,000000
Construction	6	0,000000	0,000202	0,004350	0,001731	0,012905	0,043909	0,001069	0,083546	0,003955	0,001222	0,005121	0,077487	0,000000	0,000236	0,000245	0,000000	0,000000
Wholesale and retail trade	7	0,005862	0,016316	0,000000	0,006364	0,071387	0,025955	0,102355	0,031332	0,000567	0,002589	0,036424	0,037588	0,000000	0,000076	0,000079	0,000000	0,000000
Transport and communication	8	0,000000	0,015608	0,031050	0,002177	0,126264	0,018128	0,041903	0,075012	0,002560	0,007082	0,021494	0,068750	0,000000	0,003036	0,003152	0,000000	0,000000
Real estate	9	0,000000	0,004944	0,000000	0,001457	0,024881	0,004706	0,028708	0,029547	0,004417	0,004067	0,042158	0,019268	0,000000	0,000461	0,000479	0,000000	0,000000
Finance, insurance	10	0,002520	0,001249	0,000000	0,002965	0,057319	0,079954	0,003706	0,015885	0,000472	0,008714	0,006924	0,039559	175,0E+6	0,003255	0,003379	0,000000	0,000000
Community services	11	0,000000	0,001316	0,012023	0,000348	0,004186	0,001889	0,001335	0,002136	0,000084	0,000205	0,002380	0,021001	0,000000	0,001007	0,001045	0,000000	0,000000
Goverment services	12	0,001109	0,013920	0,000000	0,003290	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000002	0,000002	0,000000	0,000000
Imputed bank charges	13	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000
Crude oil and natural gas	14	0,000000	0,000000	0,458454	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,021422	0,000000	0,000000
Petroleum refining	15	0,005056	0,001755	0,000000	0,000512	0,051971	0,004028	0,001801	0,024376	0,000556	0,000923	0,023117	0,014442	0,000000	0,000000	0,000000	0,000000	0,000000
Import duties	16	-0,000848	-0,003763	0,000000	-0,000765	-0,020230	-0,002010	-0,004055	-0,016313	-0,001070	-0,001999	-0,007681	-0,024614	0,000000	-0,000984	-0,001022	0,000000	0,000000
Import	17	0,234323	0,507171	0,056333	0,887481	0,000000	0,053792	0,000000	0,154011	0,000000	0,418112	0,051534	0,000000	0,000000	0,000000	0,033293	0,000000	0,000000

Matrix Ay' — Value added coeff.

Value added coeff.		Aggriculture	Other mining	Petrochemic	Other manuf	Electricity, g	Construction	Wholesale a	Transport ar	Real estate	Finance, ins	Community	Goverment	Imputed ban	Crude oil	Petroleum r	Import dutie	Import
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		0,716685	0,289795	0,434746	0,056678	0,526683	0,554241	0,796388	0,524272	0,986791	0,551773	0,608094	0,547736	-175,0E+6	0,985319	0,930042	1,000000	1,000000

Matrix Ad — Final demand coeff.

Matrix Ad		Private consumption (including non-resident direct purchase)									Gross fix cap. formation			Public consump-tion	Increase in stocks	Export (excl non res. purch)
		Food, beverage, tobacco	Clothing, footwear	Rent, fuel. power	Furniture, household equipment	Medical health service	Transport communi-cation	Entertain-ment, education	Other goods and services	Resident dir purch abroad	Private non-oil sector	Govern-ment sector	Oil sector			
Final demand coeff.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Aggriculture, forestry and fishing	1	0,408596	0,000000	0,013411	0,000000	0,000000	0,000000	0,000000	0,035929	0,000000	0,005367	0,000000	0,000000	0,000000	0,012515	0,000000
Other mining and quarrying	2	0,000000	0,000000	0,005371	0,052128	0,000000	0,000000	0,000000	0,000000	0,000000	0,034159	0,000000	0,070760	0,000000	0,137985	0,000000
Petrochemicals	3	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000001	0,000000
Other manufacturing	4	0,286289	0,707140	0,034719	0,588457	0,221577	0,315975	0,472359	0,340877	0,004590	0,402890	0,406659	0,557303	0,000000	0,829993	0,000766
Electricity, gas and water	5	0,000000	0,000000	0,056170	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000
Construction	6	0,000000	0,000000	0,037268	0,000000	0,000000	0,000000	0,000000	0,001498	0,000000	0,490203	0,511620	0,191467	0,000000	0,000000	0,000000
Wholesale and retail trade	7	0,350825	0,276587	0,032575	0,358032	0,157205	0,290331	0,294501	0,449977	0,000000	0,051206	0,006892	0,022095	0,000000	0,000000	0,000000
Transport and communication	8	0,000000	0,000000	0,017502	0,000000	0,000000	0,240686	0,000000	0,009521	1,139645	0,000000	0,000000	0,050079	0,000000	0,000000	0,000000
Real estate	9	0,000000	0,000000	0,832081	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000
Finance, insurance	10	0,000000	0,000000	0,000000	0,000000	0,000000	0,001249	0,000000	0,003527	0,000000	0,016369	0,074829	0,108296	0,000000	0,000000	0,002874
Community services	11	0,000000	0,016274	0,000000	0,000000	0,240054	0,122841	0,233140	0,161230	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000005
Goverment services	12	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	1,000000	0,000000	0,000000
Imputed bank charges	13	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000
Crude oil and natural gas	14	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,019960	0,942990
Petroleum refining	15	0,000000	0,000000	0,004529	0,001383	0,381165	0,075869	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,053364
Import duties	16	-0,045709	0,000000	-0,033625	0,000000	0,000000	-0,046950	0,000000	-0,002560	-0,144235	-0,000193	0,000000	0,000000	0,000000	-0,000454	0,000000
Import	17	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000

Table 7a. Aggregated and pre-adjusted C&L A matrix for 1976 (multiplied by 100)

		Private consumption (including non-resident direct purchase)									Gross fix cap. formation							Public consumption	Increase in stocks	Exports (excl. non-residents' purchases)			
											Private non-oil sector			Government sector		Oil sector							
		Food, beverage, tobacco	Clothing, footwear	Rent, fuel. power	Furniture, household equipment	Medical health service	Transport communi-cation	Entertain-ment, education	Other goods and services	Resident dir purch abroad	Housing	Other buildings	Machin. & transp. eq.	(Other) buildings	Mach. & transp. eq.	(Other) buildings	Mach. & trsp. eq.			Crude oil & natural gas	Refined petroleum products	Petro-chemical products	Other (excl. non r. purch.)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Aggriculture, forestry and fishing	1	30,1	0,1	1,0	0,1	0,0	0,3	0,1	2,7	1,1	0,7	0,7	0,0	0,0	0,0	0,1	0,1	0,1	0,9	0,0	0,0	0,0	0,0
Other mining and quarrying	2	0,0	0,0	0,3	1,7	0,0	0,1	0,0	0,0	0,3	3,9	3,9	0,1	1,4	0,1	3,8	0,1	0,2	4,6	0,0	0,0	0,0	0,0
Petrochemicals	3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	43,5	0,0
Other manufacturing	4	1,8	4,2	0,3	3,5	1,6	2,2	3,1	2,3	0,6	1,0	1,0	5,5	2,5	5,4	3,0	4,9	1,3	4,9	0,0	0,0	0,1	1,3
Electricity, gas and water	5	0,0	0,1	3,0	0,1	0,1	0,1	0,1	0,1	0,2	0,2	0,2	0,0	0,1	0,0	0,1	0,0	0,3	0,1	0,0	0,0	0,2	0,0
Construction	6	0,2	0,2	2,6	0,2	0,2	1,5	0,3	0,4	6,0	48,0	48,1	0,1	34,3	0,1	15,4	0,4	4,9	0,1	0,0	0,0	0,4	0,1
Wholesale and retail trade	7	31,6	25,1	3,6	32,3	15,0	27,3	27,3	40,8	3,8	7,0	7,0	5,1	2,5	1,2	3,3	2,7	4,0	0,8	0,0	0,0	0,2	0,4
Transport and communication	8	1,0	0,9	1,7	1,1	0,9	14,7	1,2	2,0	64,9	1,3	1,3	0,3	0,9	0,2	3,5	3,1	4,2	0,3	0,2	0,2	1,9	0,4
Real estate	9	1,2	1,1	82,9	1,4	1,7	2,4	2,1	2,3	3,9	0,9	0,9	0,4	0,6	0,2	0,7	0,5	2,5	0,3	0,1	0,1	0,2	0,5
Finance, insurance	10	0,3	0,3	0,5	0,3	0,3	0,8	0,4	0,6	1,9	5,7	5,7	1,3	8,3	5,1	8,8	7,4	3,2	0,2	0,2	0,2	0,2	51,8
Community services	11	0,0	1,0	0,0	0,1	14,7	7,6	14,3	9,9	0,2	0,1	0,1	0,0	0,1	0,0	0,1	0,0	1,3	0,0	0,1	0,1	0,8	0,1
Goverment services	12	0,1	0,1	0,0	0,2	0,1	0,1	0,1	0,1	0,0	0,1	0,1	0,2	0,1	0,2	0,2	0,2	54,8	0,3	0,0	0,0	0,0	0,0
Imputed bank charges	13	-0,1	-0,1	-0,1	-0,1	-0,1	-0,2	-0,1	-0,2	-0,5	-1,6	-1,6	-0,4	-2,2	-1,4	-2,4	-2,0	-0,9	-0,1	-0,1	-0,1	-0,1	-14,0
Crude oil and natural gas	14	0,0	0,0	0,0	0,0	0,8	0,2	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	98,5	2,1	45,2	0,0
Petroleum refining	15	0,3	0,2	0,9	0,3	36,1	8,1	0,7	0,6	2,9	0,5	0,5	0,1	0,3	0,1	0,3	0,2	1,7	0,1	0,0	93,0	0,1	0,1
Import duties	16	-4,8	-0,2	-3,7	-0,3	-0,4	-5,4	-0,4	-0,7	-16,5	-0,4	-0,4	-0,1	-0,3	-0,1	-0,3	-0,2	-2,7	-0,2	-0,1	-0,1	-0,1	-0,2
Import	17	38,3	67,0	7,0	59,1	28,9	40,5	50,9	38,9	31,2	32,5	32,4	87,3	51,3	88,8	63,4	82,8	24,9	85,7	0,9	4,3	7,4	59,5
Total		100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Table 7b. Aggregated and pre-adjusted C&L TETA matrix, RAS-adjusted against NA figures for 1989

		Private consumption (including non-resident direct purchase)									Gross fix cap. formation							Public consumption	Increase in stocks	Exports (excl. non-residents' purchases)				Total (sum of rows)	Total according to NA 1989
											Private non-oil sector			Government sector		Oil sector									
		Food, beverage, tobacco	Clothing, footwear	Rent, fuel. power	Furniture, household equipment	Medical health service	Transport communi-cation	Entertain-ment, education	Other goods and services	Resident dir purch abroad	Housing	Other buildings	Machin. & transp. eq.	(Other) buildings	Mach. & transp. eq.	(Other) buildings	Mach. & trsp. eq.			Crude oil & natural gas	Refined petroleum products	Petro-chemical products	Other (excl. non r. purch.)		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
Aggriculture, forestry and fishing	1	20491	10	896	15	1	92	3	467	191	69	110	3	6	1	1	0	203	82	2	6	2	1	22650	22650
Other mining and quarrying	2	10	5	159	229	1	16	1	4	26	230	363	5	219	2	35	0	228	241	9	27	1	1	1812	1812
Petrochemicals	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4001	0	4001	4001
Other manufacturing	4	1560	1049	356	1001	55	878	169	504	128	131	205	1044	813	442	61	23	2568	561	33	96	5	140	11821	11821
Electricity, gas and water	5	7	2	596	3	1	8	1	4	6	4	6	1	6	0	0	0	93	1	1	4	3	1	750	750
Construction	6	107	37	2209	45	5	451	11	69	1004	4668	7375	21	8561	9	236	1	7538	12	19	55	30	11	32475	32475
Wholesale and retail trade	7	8773	1968	1271	2891	158	3468	467	2842	284	282	444	309	256	31	21	4	2555	28	7	20	5	13	26078	26078
Transport and communication	8	594	149	1301	215	20	4005	44	304	9601	114	180	39	198	12	48	10	5751	24	94	273	114	32	23121	23121
Real estate	9	64	16	5478	22	3	56	7	30	49	7	10	4	11	1	1	0	293	2	3	9	1	3	6071	6071
Finance, insurance	10	199	58	518	67	10	257	16	112	352	614	970	209	2278	351	149	30	5454	22	145	421	15	4750	16998	16998
Community services	11	45	298	46	19	566	3523	892	2515	47	19	30	7	36	3	2	0	3052	5	56	162	79	13	11414	11414
Goverment services	12	38	18	11	24	1	15	3	9	3	9	14	18	20	7	2	0	57626	17	1	3	0	2	57841	57840
Imputed bank charges	13	-49	-14	-128	-17	-2	-64	-4	-28	-87	-152	-240	-52	-563	-87	-37	-7	-1348	-5	-36	-104	-4	-1174	-4200	-4200
Crude oil and natural gas	14	7	1	22	2	27	73	1	3	14	1	2	0	2	0	0	0	75	221	75032	4415	3945	0	83844	83847
Petroleum refining	15	13	2	44	4	54	147	2	6	29	3	4	1	5	0	0	0	151	1	0	8939	1	1	9405	9405
Import duties	16	1390	19	1358	26	4	718	7	51	1185	16	25	9	28	3	2	0	1774	8	27	79	4	8	6740	6740
Import	17	19024	9408	4479	9477	546	9217	1558	4844	3870	2352	3702	9404	9524	4109	725	224	28285	5536	415	5210	372	3681	135962	135961
Total (sum of columns=NA1989)		52272	13027	18614	14024	1448	22861	3177	11735	16683	8366	13202	11022	21401	4884	1248	286	114299	6756	75809	19614	8573	7483	446784	446784

Table 7c. The final A matrix for 1989, after RAS-adjusting against NA figures (multiplied by 100)

		Private consumption (including non-resident direct purchase)									Gross fix cap. formation							Public consumption	Increase in stocks	Exports (excl. non-residents' purchases)			
											Private non-oil sector			Government sector		Oil sector							
		Food, beverage, tobacco	Clothing, footwear	Rent, fuel. power	Furniture, household equipment	Medical health service	Transport communi-cation	Entertain-ment, education	Other goods and services	Resident dir purch abroad	Housing	Other buildings	Machin. & transp. eq.	(Other) buildings	Mach. & transp. eq.	(Other) buildings	Mach. & trsp. eq.			Crude oil & natural gas	Refined petroleum products	Petro-chemical products	Other (excl. non r. purch.)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Aggriculture, forestry and fishing	1	39,2	0,1	4,8	0,1	0,1	0,4	0,1	4,0	1,1	0,8	0,8	0,0	0,0	0,0	0,1	0,1	0,2	1,2	0,0	0,0	0,0	0,0
Other mining and quarrying	2	0,0	0,0	0,9	1,6	0,0	0,1	0,0	0,0	0,2	2,7	2,7	0,0	1,0	0,0	2,8	0,0	0,2	3,6	0,0	0,1	0,0	0,0
Petrochemicals	3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	46,7	0,0
Other manufacturing	4	3,0	8,0	1,9	7,1	3,8	3,8	5,3	4,3	0,8	1,6	1,6	9,5	3,8	9,0	4,9	8,1	2,2	8,3	0,0	0,5	0,1	1,9
Electricity, gas and water	5	0,0	0,0	3,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0
Construction	6	0,2	0,3	11,9	0,3	0,4	2,0	0,4	0,6	6,0	55,8	55,9	0,2	40,0	0,2	18,9	0,5	6,6	0,2	0,0	0,3	0,3	0,1
Wholesale and retail trade	7	16,8	15,1	6,8	20,6	10,9	15,2	14,7	24,2	1,6	3,4	3,4	2,8	1,2	0,6	1,7	1,4	2,2	0,4	0,0	0,1	0,1	0,2
Transport and communication	8	1,1	1,1	7,0	1,5	1,4	17,5	1,4	2,6	57,6	1,4	1,4	0,4	0,9	0,2	3,8	3,5	5,0	0,4	0,1	1,4	1,3	0,4
Real estate	9	0,1	0,1	29,4	0,2	0,2	0,2	0,2	0,3	0,3	0,1	0,1	0,0	0,1	0,0	0,1	0,0	0,3	0,0	0,0	0,0	0,0	0,0
Finance, insurance	10	0,4	0,4	2,8	0,5	0,7	1,1	0,5	1,0	2,1	7,3	7,4	1,9	10,6	7,2	11,9	10,3	4,8	0,3	0,2	2,1	0,2	63,5
Community services	11	0,1	2,3	0,2	0,1	39,1	15,4	28,1	21,4	0,3	0,2	0,2	0,1	0,2	0,1	0,1	0,1	2,7	0,1	0,1	0,8	0,9	0,2
Goverment services	12	0,1	0,1	0,1	0,2	0,1	0,1	0,1	0,1	0,0	0,1	0,1	0,2	0,1	0,2	0,2	0,1	50,4	0,2	0,0	0,0	0,0	0,0
Imputed bank charges	13	-0,1	-0,1	-0,7	-0,1	-0,2	-0,3	-0,1	-0,2	-0,5	-1,8	-1,8	-0,5	-2,6	-1,8	-2,9	-2,6	-1,2	-0,1	0,0	-0,5	0,0	-15,7
Crude oil and natural gas	14	0,0	0,0	0,1	0,0	1,9	0,3	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	3,3	99,0	22,5	46,0	0,0
Petroleum refining	15	0,0	0,0	0,2	0,0	3,8	0,6	0,1	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	45,6	0,0	0,0
Import duties	16	2,7	0,1	7,3	0,2	0,3	3,1	0,2	0,4	7,1	0,2	0,2	0,1	0,1	0,1	0,2	0,1	1,6	0,1	0,0	0,4	0,0	0,1
Import	17	36,4	72,2	24,1	67,6	37,7	40,3	49,0	41,3	23,2	28,1	28,0	85,3	44,5	84,1	58,1	78,2	24,7	81,9	0,5	26,6	4,3	49,2
Total		100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

B.2.3. Concluding remarks

The updated **A** matrix was established by a procedure that in some way *minimized* the adjustments of rows and columns in a matrix based on the structure in the (pre-adjusted) Coopers&Lybrand matrix from 1976. Of course, the true input/output structure of the Saudi economy in 1989 may have changed in a far more dramatic way, implying that the coefficients in the updated **A** matrix is far from correct. On the other hand, an examination of the elements in the matrix does not unveil any evidently wrong coefficients.

The results may also be seen in context with alternative methods for determing the variables, e.g. the way value added by sector is determined in the current macroeconomic module, c.f. the description in Bjerkholt (1993), pp. 25-26. In general this may be written as (the vector **y** now containing only the value added by sector elements):

$$\mathbf{y} = \mathbf{B}_\mathbf{y} \cdot \mathbf{y} + \mathbf{B}_\mathbf{d} \cdot \mathbf{d}$$

where the two matrices $\mathbf{B}_\mathbf{y}$ and $\mathbf{B}_\mathbf{d}$ mostly contain zeros, and where the non-zero coefficients are estimated by time series regressions. This may be transformed to:

$$\mathbf{y} - \mathbf{B}_\mathbf{y} \cdot \mathbf{y} = \mathbf{B}_\mathbf{d} \cdot \mathbf{d}$$

and hence

$$\text{(B.2.6)} \quad \mathbf{y} = (\mathbf{I} - \mathbf{B}_\mathbf{y})^{-1} \cdot \mathbf{B}_\mathbf{d} \cdot \mathbf{d} = \mathbf{B} \cdot \mathbf{d}$$

Due to all the zeros in the $\mathbf{B}_\mathbf{y}$ and $\mathbf{B}_\mathbf{d}$ matrices, this is obviously a less «rich» description of the interdependence between final demand components and value added by sector, compared to the information incorporated in the matrix **A**. The reason for all the zeros is obvious, even on the reduced form (B.2.6) there are in principle r=15 coefficients to be estimated for each sector. This cannot be done precisely with time series of only some twenty observations.

Annex C: Estimation of behavioural equations

C.1. Introduction

The choice of variables to be estimated is made partly in order to cover main parts of private sector economic behaviour and also by availability of data and level of aggregation fitting into the input-output part of the model. One obvious candidate is private consumption, which is important in terms of its contribution to GDP. An aggregate consumption function has been estimated, while parameters used in the linear expenditure system, which divides total consumption into nine groups of consumer goods, have been determined by using external information on consumption patterns. Private non-oil investment by category (residential and non-residential buildings, machinery and transport equipment) is also endogenized in the model. Together with private consumption, investment contributed to around 50 percent of GDP in 1992. Aggregate capital formation comprises different investment activities for several sectors of the economy. It may therefore seem inappropriate to ignore the sectoral dimension. However, sectoral data on investment are available only for the year 1989, making estimation on a sectoral level impossible. An equation for private sector wage rates is also estimated, showing that wage formation is connected to labour productivity and that there are spill-over effects from government to private wages. Furthermore, an employment equation, based on a production function approach, is estimated for private sector. Finally, equations for value added prices are estimated for 8 sectors of production.

The estimation method utilised is Ordinary Least Squares (OLS), relying on our experience that the gains by e.g. using 2SLS are not very significant. More important is the dynamic specification as presented below. Compared to the static equations in the former MOP macroeconomic module, there are considerable gains to be made by introducing dynamic specification of the econometric relationships. A good description of the dynamic process is needed in a model where short to medium term effects of policy shocks are to be evaluated. On the other hand, the dynamic specification requires more effort by the model user to obtain a sound knowledge of the working of the model than in the case of static equations.

The general econometric approach is often named "general to specific", implying that one starts with a fairly general model including all relevant variables according to economic theory, and with a flexible econometric specification. During the estimation process insignificant variables are removed and restrictions are tested and imposed in order to obtain the most parsimonious specification in terms of the number of estimated coefficients. In all equations presented in this annex, the log-linear form is used. An advantage with the log-form is that elasticities can be calculated easily from the estimation results. However, one could argue that the choice of functional form should be subject to empirical testing, see e.g. Doroodian et al. (1994) who use a Box-Cox test to differentiate between a linear and a log-linear model for Saudi-Arabian imports. Our procedure has been to start with the log-linear form. As long as the functional form test is not significant, we do not test whether other specifications improve the results. Results reveal that the log-form is preferred to the standard linear specification.

The dynamic specification is the so-called error-correction model (ECM) in which both long run properties and short run dynamics can be specified explicitly. When simulating these equations, the error-correction mechanism will force the endogenous variable towards the long run solution, while disturbances (or shocks) can temporarily impact the path towards the equilibrium level. One particular advantage with this specification is that it is easy to impose and test theoretical assumptions. The outcome for the general models usually gives indications for possible restrictions for the respective equation which then can be tested empirically.

For a simple two variable model, the (log-linear) specification can be written as follows;

(C.1.1) $\log(y)-\log(y_{-1}) = a + \mathbf{b*\log(y_{-1})} + \mathbf{c*\log(x_{-1})} + \underline{d*(\log(x)-\log(x_{-1})) + e*(\log(y_{-1})-\log(y_{-2}))}$+u

where y is the endogenous variable, x is the exogenous (explanatory) variable, u is the error term and a, b, c, d and e coefficients.

The **highlighted** part of the equation is the long run solution, while the underlined is (an example of) short run dynamics. The estimate of b should always be negative and the long-run elasticity is given by -c/b. If the estimate of c is negative, the elasticity is accordingly positive and vice versa. If estimates of c and d are equal, the (long-run) elasticity is equal to 1 and this restriction (b = c) can be imposed explicitly in the equation and tested as in the following regression (where difference terms are omitted for simplicity);

(C.1.1') $\log(y)-\log(y_{-1}) = a + b*(\log(y_{-1}) + \log(x_{-1})) + f*\log(y_{-1}) + u$

If f is insignificant, the restriction b=c is accepted.

For a three variable model, the restriction will be imposed somewhat differently. For ease of exposition, we omit difference terms and error terms. The model without restrictions is;

(C.1.2) $\log(y)-\log(y_{-1}) = a + b*\log(y_{-1}) + c*\log(x_{-1}) + d*\log(z_{-1})$

The following specification imposes the restriction that the sum of the long run elasticities are unity, the elasticity of y w.r.t. x being c/c+d, while the elasticity w.r.t. z is equal to d/c+d;

(C.1.2') $\log(y)-\log(y_{-1}) = a + c*(\log(y_{-1}) - \log(x_{-1})) + d*(\log(y_{-1}) - \log(z_{-1}))$

Tests of restrictions and the procedure leading from the general to the preferred equations are not reported here, but explanations of the chosen specification are attached to each equation. The final version of each equation is presented, based on estimation of the implemented equations in TROLL and the appropriate TROLL commands are shown. The most important output from TROLL estimations is as follows;

NOB = no. of observations	NOVAR = no. of variables
NOCOEF = no. of coefficients	RANGE = estimation period
RSQ = R^2	SER = standard error of regression
DW = Durbin Watson statistic	ESTIMATE = estimated values
STER = standard deviation	TSTAT = T-statistic

C.2. Private consumption

Private consumption by residents is determined in an aggregate macro consumption function, presented in section C.2.1, while the calibration of parameters to the linear expenditure system is described in section C.2.2.

C.2.1. The macro consumption function

Estimation results;

DO Command: bounds 1974a to 1991a;
DO Command: usemod im95;
TROLL Command: olsmod 1;

ORDINARY LEAST SQUARES

1 : LOG(CPR)-LOG(CPR(-1)) = CPR.1+CPR.2*(LOG(HR*(1-THR)/PCPR)-LOG(HR(-1)*(1-THR(-1))/PCPR(-1)))+CPR.3*(LOG(CPR(-1))-LOG(HR(-1)*(1-THR(-1))/PCPR(-1)))+CPR.4*(LOG(CPR(-1))-LOG(HW(-2)/PCPR(-2)))+CPR.5*POIL/PCPR+CPR.6*D9091

NOB = 18	NOVAR = 6	NCOEF = 6	
RANGE: 1974A to 1991A			
RSQ =	0.9638	CRSQ =	0.948717
F(5/12) =	63.898959	PROB>F =	0
SER =	0.032411	SSR =	0.012606
DW(0) =	2.4616	COND =	27.454133
MAX:HAT =	0.884155	RSTUDENT =	-2.202805
DFFITS =	2.52946		

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
CPR.1	-0.082221	0.082594	-0.995491	0.339148
CPR.2	0.974522	0.097661	9.978587	0
CPR.3	-0.741828	0.155935	-4.7573	0.000466
CPR.4	-0.126573	0.026377	-4.798681	0.000435
CPR.5	0.007362	0.001689	4.358303	0.000931
CPR.6	-0.159388	0.031489	-5.061624	0.000279

OLSMOD Command:

Definition of variables included in the regression;
CPR = private consumption by residents, in 1989-prices
PCPR = price index for CPR
HR = disposable income
THR = income tax rate, equal to 0
HW = net financial wealth
POIL = crude oil price (Arabian light)
D9091 = dummy variable which is equal to 1 in 1990, 0.5 in 1991
CPR.i = estimated coefficients, i=1,...,6

Description of the chosen equation;
Disposable income for households consists of three parts; compensation of employees (wage income) which is the main component of household income, households' share of operating surplus and social security services. A tax rate (equal to 0) is added to the equation in the model in order to allow studies of effects of implementing an income tax. The consumer expenditure deflator is used for deflating nominal disposable income.

Net financial wealth is equal to money supply (M2) less currency and notes and bank claims on private sector, all data taken from SAMA publications. The choice between three money supply definitions (M0, M1 and M2) was decided by the estimation results which favoured M2-M0, i.e. the sum of time and demand deposits less currency outside banks. Bank claims on private sector is used as a proxy for household gross liabilities, even if the company sector is included in the figures. The consumer expenditure deflator is used for deflating net financial assets.

Results favoured inclusion of a dummy variable for the Gulf war period and the variable is equal to the one used in the wage equation. The chosen equation contains the change in disposable income, while lagged changes in consumption and wealth are not found to be significant. The sum of the long run elasticities of income and wealth sum to 1 (by restriction). The income elasticity is equal to -0.742/ (-0.742-0.127) = 0.85, while the wealth elasticity is equal to -0.127/(-0.742-0.127) = 0.15. Note that the wealth variables are lagged two periods. Since the stock of wealth is measured at the end of the period, this means that it is the wealth stock 1.5 years ago that affects consumption.

C.2.2. The linear expenditure system (LES)

The LES has not been estimated, but the parameters are determined by using consumption data for 1989 (the base year) and price-elasticities taken for Theil et al. (1989) for countries where budget shares are similar to those in Saudi Arabia. Income elasticities are then chosen so as to minimize the discrepancy between actual consumption and estimated consumption by the LES in 1989. This means there will be deviations (residuals) in all other periods.

The LES determines resident consumption for nine groups of consumption. Resident consumption by item is calculated based on figures in Coopers and Lybrand (1982), showing that 7 per cent of foreigners' consumption is Food etc, 6 per cent is Clothing etc., 22 per cent is Furniture etc., 1 per cent is Transport etc. and the remaining 64 per cent is Other goods and services. Corrections of total consumption of these groups are implemented as follows;

CPRFOO = CPFOO - 0.07*CPN
CPRCLO = CPCLO - 0.06*CPN
CPRFUR = CPFUR - 0.22*CPN
CPRTRA = CPTRA - 0.01*CPN
CPROTH = CPOTH - 0.64*CPN

The table below presents figures for consumption by residents (in mill. Riyals), price and income elasticities and the calibrated parameters (contained in the file LES-COEF.INP).

Table 1 Elasticities and parameters of the linear expenditure system

	Cons. by residents	Income elasticity	Price elasticity	CPRiii.1	CPRiii.2
1. Food etc.	51655.44	0.64	-0.60	0.23	26762.55
2. Clothing etc.	12498.52	0.90	-0.70	0.08	4064.82
3. Rent etc.	18614.00	1.10	-0.85	0.14	3251.08
4. Furniture etc.	12086.24	1.17	-0.90	0.10	1339.00
5. Medicals etc.	1448.00	1.30	-1.00	0.01	0.00
6. Transport etc.	22772.92	1.33	-1.00	0.21	0.00
7. Entertainm. etc.	3177.00	1.17	-0,90	0.03	326.06
8. Other goods etc.	6097.88	1.32	-1.00	0.06	0.00
9. Purchase abroad	16683.00	1.33	-1.00	0.15	0.00
Total	145033.00				

Definition of variables;

CPRiii = consumption by residents, group iii, iii = FOO, CLO, REN, FUR, MED, TRA, ENT, OTH, ABR
CPR = total consumption by residents
Eiii = Income (Engel) elasticity, group iii
eiii = Direct price elasticity, group iii

The parameters are calculated by using the following definitions;

CPRiii.1 = (Eiii*CPRiii)/CPR
CPRiii.2 = CPRiii*[(1 + eiii)/(1 - CPRiii.1)]

C.3. Private non-oil gross fixed capital formation (GFCF)

Private sector capital formation is, together with private consumption, an important part of domestic demand and should if possible be determined endogenously by the model. In the national account data, four categories of capital formation are available; residential buildings, non-residential buildings, machinery and transport equipment. The two latter categories are aggregated, and equations for the three groups are estimated.

A common approach in investment analyses is to derive the demand for investment goods by looking at what determines the need for gross fixed capital, see e.g. Looney (1990) ch. 8 for a discussion of a theoretical model of this kind and empirical results for Saudi Arabia. In the accelerator model the desired capital stock level is assumed to depend upon output. As Looney shows, this model can be extended to include variables which affect the speed of adjustment of the capital stock, notably financial variables. In our analysis operating surplus and credit disbursement is the main determinants of capital formation by firms, while household capital formation in residential buildings is determined by real disposable income (same as in consumption function) and credit.

C.3.1. Residential buildings

Estimation results;

TROLL Command: bounds 1980a to 1991a;
TROLL Command: olsmod 25;

ORDINARY LEAST SQUARES

```
25 : LOG(JPH)-LOG(JPH(-1)) = JPH.1+JPH.2*(LOG(ICH/PJPH)-LOG(ICH(-1)/PJPH(-1)
))+JPH.3*LOG(ICH(-1)/PJPH(-1))+JPH.4*LOG(HR(-1)/PJPH(-1))+JPH.5*LOG(JPH(-1))
```

NOB = 12 NOVAR = 5 NCOEF = 5
RANGE: 1980A to 1991A

RSQ =	0.949286	CRSQ =	0.920307
F(4/7) =	32.757339	PROB>F =	0.000127
SER =	0.042773	SSR =	0.012807
DW(0) =	2.512911	COND =	391.194995
MAX:HAT =	0.71003	RSTUDENT =	1.972777
DFFITS =	1.499663		

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
JPH.1	0.255011	0.83348	0.305959	0.768535
JPH.2	0.612648	0.074863	8.183623	7.88194888e-005
JPH.3	0.454895	0.066624	6.827822	0.000247
JPH.4	0.918443	0.122501	7.49741	0.000138
JPH.5	-1.67044	0.193138	-8.648959	5.52025095e-005

OLSMOD Command:

Definition of variables included in the regression;

JPH = gross fixed capital formation, residential buildings
PJPH = price index for JPH
ICH = investment credit, housing
HR = disposable income for households
JPH.i = estimated coefficients, i = 1, ..., 5

Description of the chosen equation;
Both disposable income and investment credit are deflated with the price index for investment in residential buildings. The income elasticity is equal to -(0.92/1.67) = 0.55 while the credit elasticity is estimated to -(0.45/1.67) = 0.27. The credit variable is also included as a difference (or short run) variable.

C.3.2. Non-residential buildings

Estimation results;

ORDINARY LEAST SQUARES

26 : LOG(JPB)-LOG(JPB(-1)) = JPB.1+JPB.2*(LOG(ICB/PJPB)-LOG(ICB(-1)/PJPB(-1)))
+JPB.3*LOG(VYSC(-1)/PJPB(-1))+JPB.4*LOG(JPB(-1))

NOB = 12 NOVAR = 4 NCOEF = 4
RANGE: 1980A to 1991A

RSQ =	0.866804	CRSQ =	0.816855
F(3/8) =	17.353939	PROB>F =	0.000732
SER =	0.062129	SSR =	0.030881
DW(0) =	2.803747	COND =	360.611415
MAX:HAT =	0.600026	RSTUDENT =	-2.071572
DFFITS =	-1.465781		

COEF	ESTIMATE	STER	TSTAT	PROB>ITI
JPB.1	0.437883	1.826521	0.239736	0.816563
JPB.2	0.294549	0.142724	2.063769	0.072932
JPB.3	0.562338	0.255227	2.20328	0.058693
JPB.4	-0.680086	0.160905	-4.226636	0.00289

Definition of variables included in the regression;
JPB = gross fixed capital formation, non-residential buildings
PJPB = price index for JPB
ICB = investment credit, buildings
VYSC = operating surplus, private sector, excl. households
JPB.i = estimated coefficients, i = 1, ..., 4

Description of the chosen equation;
Investment credit is deflated with the price index for investment in non-residential buildings. The operating surplus elasticity is equal to -(0.56/0.68) = 0.83. The credit variable is only included as a difference (or short run) variable.

C.3.3. Machinery and transport equipment

Estimation results;

ORDINARY LEAST SQUARES

27 : LOG(JPTM)-LOG(JPTM(-1)) = JPTM.1+JPTM.2*(LOG(JPTM(-1))-LOG(JPTM(-2)))+J
PTM.3*(LOG(ICTM/PJPTM)-LOG(ICTM(-1)/PJPTM(-1)))+JPTM.4*LOG(ICTM(-1)/PJPTM(-1)
)+JPTM.5*LOG(VYSC(-1)/PJPTM(-1))+JPTM.6*LOG(JPTM(-1))

NOB = 19 NOVAR = 6 NCOEF = 6
RANGE: 1973A to 1991A

RSQ =	0.951892	CRSQ =	0.93339
F(5/13) =	51.44562	PROB>F =	0
SER =	0.068235	SSR =	0.060528
DW(0) =	2.084359	COND =	271.148846
MAX:HAT =	0.758378	RSTUDENT =	-2.181854
DFFITS =	-2.838012		

COEF	ESTIMATE	STER	TSTAT	PROB>ITI
JPTM.1	0.059105	0.494059	0.119632	0.906604
JPTM.2	0.255641	0.101087	2.528919	0.025176
JPTM.3	0.190642	0.038019	5.014355	0.000237
JPTM.4	0.106292	0.032595	3.260956	0.006196
JPTM.5	0.774644	0.143292	5.406044	0.00012
JPTM.6	-0.992768	0.154809	-6.412837	2.29535156e-005

Definition of variables included in the regression;
JPTM = gross fixed capital formation, machinery and transport equipment
PJPTM = price index for JPTM
ICTM = investment credit, transport and machinery
VYSP = operating surplus, private sector excl. households
JPTM.i = estimated coefficients, i = 1, ..., 6

Description of the chosen equation;
Both operating surplus and investment credit are deflated with the price index for investment in machinery and transport equipment. The operating surplus elasticity is equal to -(0.77/0.99) = 0.78 while the credit elasticity is estimated to -(0.11/0.99) = 0.11. The credit variable and the lagged change in investment are also included as difference (or short run) variables.

C.4. The aggregate import share

In order to explain the development of the import share, the relative price between imported and domestically produced goods was tried as the key explanatory variable. The notion that relative price movements affect the import share relies, however, on the assumption of competitive imports, i.e. of substitutability of imports and domestically produced goods and services. However, with the present definition of the import share there was not possible to obtain sensible results for this equation. A reason could be that the degree of competitive imports is in fact very low in Saudi Arabia, making it hard to find effects from relative prices to imports. Another reason could be poor data quality, e.g. for the import price index.

Using a somewhat different approach, Doorodian et. al. (1994) estimate the level of imports as a function of relative prices and domestic demand. They focus on both income and price effects while we restricted our analysis to price effects. While their estimation period starts in 1963 and the analysis is based on international (IMF) data, we used National Account data for the period 1969-91. Doorodian et al. (op.cit) find relative price effects to be significant, thereby supporting the notion of competitive imports. However, it is rejected that import and domestic prices both have the same long-run impact (in absolute terms) on imports.

C.5. Private sector wages

Estimation results;

ORDINARY LEAST SQUARES

88 : LOG(WP/PCP)-LOG(WP(-1)/PCP(-1)) = WP.1+WP.2*(LOG(QP)-LOG(QP(-1)))+WP.3*(LOG(WP(-1)/PCP(-1))-LOG(QP(-1)))+WP.4*LOG(WG(-1))+WP.5*D9091

NOB = 22 NOVAR = 5 NCOEF = 5
RANGE: 1970A to 1991A

RSQ =	0.939758	CRSQ =	0.925583
F(4/17) =	66.298408	PROB>F =	0
SER =	0.029488	SSR =	0.014782
DW(0) =	1.756814	COND =	94.228371
MAX:HAT =	0.846058	RSTUDENT =	2.936623
DFFITS =	1.417484		

COEF	ESTIMATE	STER	TSTAT	PROB>ITI
WP.1	-2.350182	0.271986	-8.640827	0
WP.2	0.473295	0.157897	2.997496	0.008098
WP.3	-1.051037	0.112229	-9.365098	0
WP.4	0.333668	0.041423	8.055034	0
WP.5	0.245605	0.039644	6.195201	9.77370700e-006

Definition of variables;
WP = wage rate private sector
WG = wage rate public sector
QP = productivity
D9091 = a "Gulf-war" dummy taking the value 1 in 1990 and 0.5 in 1991
WP.i = estimated coefficients, i = 1,...,5

Description of the chosen equation;
The dependent variable is the wage rate (compensation of employees divided by total employment) and the explanatory variables are productivity, measured as the non-oil GDP/employment ratio and government wages. A dummy variable was needed for the wage development in 1990/91 which can probably be related to the Gulf-war. In the long run, the elasticity of wages with respect to productivity is equal to 1 (by restriction) and the change is productivity is also included in the estimated equation. Government wages affect private wages positively, so that wage increases can exceed productivity growth in the long run.

C.6. Employment, private sector

Estimation results;

OLSMOD Command: bounds 1971A to 1991A;
OLSMOD Command: olsmod 66;

ORDINARY LEAST SQUARES

66 : LOG(EP)-LOG(EP(-1)) = EP.1+EP.2*(LOG(EP(-1))-LOG(EP(-2)))+EP.3*(LOG(EP(-1))-LOG(YP(-1)))+EP.4*LOG(KP(-2))

NOB = 21 NOVAR = 4 NCOEF = 4
RANGE: 1971A to 1991A

RSQ = 0.736658 CRSQ = 0.690186
F(3/17) = 15.851621 PROB>F = 0
SER = 0.038497 SSR = 0.025194
DW(0) = 1.958089 COND = 81.758146
MAX:HAT = 0.445068 RSTUDENT = -2.276439
DFFITS = -1.38018

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
EP.1	-0.371437	0.289926	-1.281145	0.217344
EP.2	0.274304	0.192042	1.428351	0.171306
EP.3	-0.221421	0.066373	-3.336	0.003914
EP.4	-0.030712	0.014724	-2.08579	0.052379

Definition of variables;
EP = employment in the private non-oil sector
YP = production in the private non-oil sector
KP = capital stock in the private non-oil sector
EP.i = estimated coefficients, i = 1,....,4

Description of the chosen equation;
A restriction of the long run elasticity of employment with respect to production is imposed, and the (negative) long run elasticity with respect to the capital stock is -(-0.03/-0.22) = -0.14.
The lagged change in employment is included in the equation despite the low degree of significance.

C.7. Value added prices

Value added prices are estimated for 8 production groups; agriculture, mining, manufacturing, construction, community services, government services, trade and transport. Estimation results for the 6 former are presented in the following. For trade and transport, it was not possible to obtain homogeneity in the appropriate cost variables. These sectors were aggregated and in the aggregate equation, homogeneity was achieved. Results from this equation are utilized for both sectors. Accordingly, these results cannot be obtained by estimating the implemented equations in TROLL. The coefficients are loaded to TROLL in the file called PYF-COEF.INP and the contents of this file is attached to this chapter (in part C.7.7).

C.7.1. Agriculture

Estimation results;

OLSMOD Command: bounds 1970A to 1991A;
OLSMOD Command: olsmod 82;

ORDINARY LEAST SQUARES

82 : LOG(PYFAG)-LOG(PYFAG(-1)) = PYFAG.1+PYFAG.2*(LOG(WP)
-LOG(WP(-1)))+PYFAG.3*(LOG(PYFAG(-1))-LOG(WP(-1)))

NOB = 22 NOVAR = 3 NCOEF = 3
RANGE: 1970A to 1991A

RSQ = 0.721533 CRSQ = 0.69222
F(2/19) = 24.615323 PROB>F = 0
SER = 0.080036 SSR = 0.12171
DW(0) = 1.497642 COND = 23.321941
MAX:HAT = 0.325958 RSTUDENT = 2.473469
DFFITS = 1.270176

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
PYFAG.1	-0.415173	0.180323	-2.302388	0.032792
PYFAG.2	0.577437	0.106277	5.433297	3.04745431e-005
PYFAG.3	-0.162862	0.060861	-2.675963	0.014943

Definition of variables;
PYFAG = value added price, agriculture
WP = wage rate, private sector
PYFAG.i = estimated coefficients, i = 1, 2, 3

Description of the chosen equation;
The long run elasticity with respect to the wage rate is equal to 1 (by restriction), and the wage rate also enters as a short run variable.

C.7.2. Mining and quarrying

Estimation results;

OLSMOD Command: olsmod 83;

ORDINARY LEAST SQUARES

83 : LOG(PYFMI)-LOG(PYFMI(-1)) = PYFMI.1+PYFMI.2*(LOG(WP)
-LOG(WP(-1)))+PYFMI.3*(LOG(PYFMI(-1))-LOG(WP(-1)))

NOB = 22 NOVAR = 3 NCOEF = 3
RANGE: 1970A to 1991A

RSQ = 0.74789 CRSQ = 0.721352
F(2/19) = 28.181939 PROB>F = 0
SER = 0.09032 SSR = 0.154998
DW(0) = 1.473612 COND = 42.091664
MAX:HAT = 0.395405 RSTUDENT = 2.39945
DFFITS = 1.418803

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
PYFMI.1	-1.264426	0.366602	-3.449044	0.002689
PYFMI.2	0.552789	0.129361	4.273215	0.000411
PYFMI.3	-0.472565	0.13472	-3.507744	0.002354

Definition of variables;
PYFMI = value added price, mining
WP = wage rate, private sector
PYFMI.i = estimated coefficients, i = 1, 2, 3

Description of the chosen equation;

The long run elasticity with respect to the wage rate is equal to 1 (by restriction), and the wage rate also enters as a short run variable.

C.7.3. Other manufacturing

Estimation results;

OLSMOD Command: olsmod 84;

ORDINARY LEAST SQUARES

84 : LOG(PYFMA)-LOG(PYFMA(-1)) = PYFMA.1+PYFMA.2*(LOG(WP) -LOG(WP(-1)))+PYFMA.3*(LOG(PM)-LOG(PM(-1)))+PYFMA.4*(LOG(PYFMA(-1))-LOG(WP(-1)))+PYFMA.5*(LOG(PYFMA(-1))-LOG(PM(-1)))

NOB = 22 NOVAR = 5 NCOEF = 5
RANGE: 1970A to 1991A

RSQ = 0.791907 CRSQ = 0.742943
F(4/17) = 16.173519 PROB>F = 0
SER = 0.071262 SSR = 0.08633
DW(0) = 1.935099 COND = 57.396657
MAX:HAT = 0.410477 RSTUDENT = 2.288786
DFFITS = 1.382472

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
PYFMA.1	-0.66194	0.35531	-1.86299	0.079835
PYFMA.2	0.532373	0.109935	4.842614	0.000152
PYFMA.3	0.866329	0.243475	3.558182	0.002419
PYFMA.4	-0.23492	0.12532	-1.874568	0.078141
PYFMA.5	-0.094904	0.045356	-2.092437	0.051711

Definition of variables;
PYFMA = value added price, manufacturing
WP = wage rate, private sector
PM = import price index
PYFMA.i = estimated coefficients, i = 1,...,5

Description of the chosen equation;
The sum of the long run elasticities with respect to the wage rate and import prices is equal to 1 (by restriction), and both the wage rate and import prices also enter as short run variables.

C.7.4. Construction

Estimation results;

OLSMOD Command: olsmod 85;

ORDINARY LEAST SQUARES

85 : LOG(PYFCN)-LOG(PYFCN(-1)) = PYFCN.1+PYFCN.2*(LOG(WP)-LOG(WP(-1)))+PYFCN.3*(LOG(PM)-LOG(PM(-1)))+PYFCN.4*(LOG(PYFCN(-1))-LOG(WP(-1)))+PYFCN.5*(LOG(PYFCN(-1))-LOG(PM(-1)))

NOB = 22 NOVAR = 5 NCOEF = 5
RANGE: 1970A to 1991A

RSQ = 0.90004 CRSQ = 0.87652
F(4/17) = 38.266837 PROB>F = 0
SER = 0.036024 SSR = 0.022061
DW(0) = 1.986054 COND = 48.922263
MAX:HAT = 0.49419 RSTUDENT = -2.731063
DFFITS = -1.405763

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
PYFCN.1	-0.55048	0.152009	-3.621355	0.002109
PYFCN.2	0.368586	0.058918	6.255878	8.68683902e-006
PYFCN.3	0.25604	0.122879	2.083674	0.052594
PYFCN.4	-0.212777	0.055069	-3.863831	0.001246
PYFCN.5	-0.155253	0.034848	-4.455181	0.000348

Definition of variables;
PYFCN = value added price, construction
WP = wage rate, private sector
PM = import price index
PYFCN.i = estimated coefficients, i = 1,...,5

Description of the chosen equation;
The sum of the long run elasticities with respect to the wage rate and import prices is equal to 1 (by restriction), and both the wage rate and import prices also enter as short run variables. The impact of wages and import prices in the short run is smaller than for manufacturing.

C.7.5. Community services

Estimation results;

OLSMOD Command: olsmod 88;

ORDINARY LEAST SQUARES

88 : LOG(PYFCS)-LOG(PYFCS(-1)) = PYFCS.1+PYFCS.2*(LOG(WP)-LOG(WP(-1)))+PYFCS.3*(LOG(PM)-LOG(PM(-1)))+PYFCS.4*(LOG(PYFCS(-1))-LOG(WP(-1)))

NOB = 22 NOVAR = 4 NCOEF = 4
RANGE: 1970A to 1991A
RSQ = 0.730952 CRSQ = 0.686111
F(3/18) = 16.300858 PROB>F = 0
SER = 0.078939 SSR = 0.112164
DW(0) = 1.429157 COND = 29.40001
MAX:HAT = 0.41706 RSTUDENT = 2.185937
DFFITS = 1.024125

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
PYFCS.1	-0.407363	0.204395	-1.993015	0.061643
PYFCS.2	0.491389	0.108779	4.517316	0.000267
PYFCS.3	0.71429	0.266395	2.681319	0.015244
PYFCS.4	-0.145749	0.067811	-2.149333	0.045457

Definition of variables;
PYFCS = value added price, community services
WP = wage rate, private sector
PM = import price index
PYFCS.i = estimated coefficients, i = 1,...,5

Description of the chosen equation;
The long run elasticities with respect to the wage rate is equal to 1 (by restriction), and both the wage rate and import prices enter as short run variables.

C.7.6. Government services

Estimation results;

OLSMOD Command: olsmod 89;

ORDINARY LEAST SQUARES

89 : LOG(PYFGS)-LOG(PYFGS(-1)) = PYFGS.1+PYFGS.2*(LOG(WG)-LOG(WG(-1)))+PYFGS.3*(LOG(PYFGS(-1))-LOG(WG(-1)))

NOB = 22 NOVAR = 3 NCOEF = 3
RANGE: 1970A to 1991A

RSQ = 0.885206 CRSQ = 0.873122
F(2/19) = 73.256858 PROB>F = 0
SER = 0.039193 SSR = 0.029185
DW(0) = 2.414829 COND = 66.795305
MAX:HAT = 0.368264 RSTUDENT = -5.654095
DFFITS = -3.548893

COEF	ESTIMATE	STER	TSTAT	PROB>|T|
PYFGS.1	-0.724471	0.247357	-2.928847	0.008614
PYFGS.2	0.773051	0.072665	10.638545	0
PYFGS.3	-0.165608	0.053568	-3.091564	0.006007

Definition of variables;
PYFGS = value added price, government services
WG = wage rate, government sector
PYFGS.i = estimated coefficients, i = 1, 2 , 3

Description of the chosen equation;
The sum of the long run elasticities with respect to the wage rate is equal to 1 (by restriction), and the wage rate also enters as a short run variable.

C.7.7. Coefficients for Wholesale and retail trade, and Transport and communication

/* COEFFICIENTS ESTIMATED BY USING AGGREGATED EQUATION

DO PYFTD.1=-0.60483;
DO PYFTD.2=0.77;
DO PYFTD.3=0.74858;
DO PYFTD.4=-0.21719;

DO PYFTC.1=-0.60483;
DO PYFTC.2=0.77;
DO PYFTC.3=0.74858;
DO PYFTC.4=-0.21719;

<u>Definitions of coefficients;</u>

PYFjj.1 = the constant term, jj= TD, TC
PYFjj.2 = the coefficient for change in the wage rate (WP), jj= TD, TC
PYFjj.3 = the coefficient for the change in import prices (PM), jj= TD, TC
PYFjj.4 = the long run coefficient, jj= TD, TC

<u>Description of the chosen equation;</u>
The long run elasticities with respect to the wage rate is equal to 1 (by restriction), and both the wage rate and import prices enter as short run variables.

Annex D: A complete list of the equations in the model

This annex gives the equations in the Implementation Model, with the attached equation numbers and a short description of each equation. At the end there is a list of all endogenous variables and coefficients.

D.1. Private consumption

D.1.1. Total consumption by residents

(1) The macro consumption function

LOG(CPR) - LOG(CPR(- 1)) = CPR.1 + CPR.2 * (LOG((HR * (1 - THR)) / PCPR) - LOG((HR(- 1) * (1 - THR(- 1))) / PCPR(- 1))) + CPR.3 * (LOG(CPR(- 1)) - LOG((HR(- 1) * (1 - THR(- 1)) / PCPR(- 1)))) + CPR.4 * (LOG(CPR(- 1)) - LOG(HW(- 2) / PCPR(- 2))) + CPR.5 * (POIL / PCPR) + CPR.6 * D9091 + RCPR

(2) Consumption by residents, value

VCPR = PCPFOO * CPRFOO + PCPCLO * CPRCLO + PCPREN * CPRREN + PCPFUR * CPRFUR + PCPMED * CPRMED + PCPTRA * CPRTRA + PCPENT * CPRENT + PCPOTH * CPROTH + PCPABR * CPRABR + RVCPR

D.1.2. The linear expenditure system (LES)

(3) Food, beverages and tobacco

CPRFOO = CPRFOO.1 + (CPRFOO.2 / PCPFOO) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPRFOO

(4) Clothing and footwear

CPRCLO = CPRCLO.1 + (CPRCLO.2 / PCPCLO) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPRCLO

(5) Rent fuel and power

CPRREN = CPRREN.1 + (CPRREN.2 / PCPREN) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPRREN

(6) Furniture and household equipment

CPRFUR = CPRFUR.1 + (CPRFUR.2 / PCPFUR) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPRFUR

(7) Medical health care

CPRMED = CPRMED.1 + (CPRMED.2 / PCPMED) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPRMED

(8) Transport and communication
CPRTRA = CPRTRA.1 + (CPRTRA.2 / PCPTRA) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPRTRA

(9) Entertainment and education
CPRENT = CPRENT.1 + (CPRENT.2 / PCPENT) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPRENT

(10) Other goods and services
CPROTH = CPROTH.1 + (CPROTH.2 / PCPOTH) * (VCPR - (CPRFOO.1 * PCPFOO + CPRCLO.1 * PCPCLO + CPRREN.1 * PCPREN + CPRFUR.1 * PCPFUR + CPRMED.1 * PCPMED + CPRTRA.1 * PCPTRA + CPRENT.1 * PCPENT + CPROTH.1 * PCPOTH + CPRABR.1 * PCPABR)) + RCPROTH

(11) Resident direct purchase abroad
CPRABR = CPR - (CPRFOO + CPRCLO + CPRREN + CPRFUR + CPRMED + CPRTRA + CPRENT + CPROTH)

D.1.3. Total private consumption by object of expenditure

(12) Food, beverages and tobacco
CPFOO = CPRFOO + 0.07 * CPN

(13) Clothing and footwear
CPCLO = CPRCLO + 0.06 * CPN

(14) Rent fuel and power
CPREN = CPRREN

(15) Furniture and household equipment
CPFUR = CPRFUR + 0.22 * CPN

(16) Medical health care
CPMED = CPRMED

(17) Transport and communication
CPTRA = CPRTRA + 0.01 * CPN

(18) Entertainment and education
CPENT = CPRENT

(19) Other goods and services
CPOTH = CPROTH + 0.64 * CPN

(20) Resident direct purchase abroad
CPABR = CPRABR

D.1.4. Total private consumption

(21) Value
VCP = VCPR + VCPN

(22) Volume
CP = CPR + CPN

(23) Price deflator
PCP = VCP / CP

D.2. Government consumption

(24) Value
VCG = CG * PCG

D.3. Gross fixed capital formation

(25) Non-oil private residential buildings
LOG(JPH) - LOG(JPH(- 1)) = JPH.1 + JPH.2 * (LOG(ICH / PJPH) - LOG(ICH(- 1) / PJPH(- 1))) + JPH.3 * LOG(ICH(- 1) / (PJPH(- 1))) + JPH.4 * LOG(HR(- 1) / PJPH(- 1)) + JPH.5 * LOG(JPH(- 1)) + RJPH

(26) Non-oil private non-residential buildings
LOG(JPB) - LOG(JPB(- 1)) = JPB.1 + JPB.2 * (LOG(ICB / PJPB) - LOG(ICB(- 1) / PJPB(- 1))) + JPB.3 * LOG(VYSC(- 1) / PJPB(- 1)) + JPB.4 * LOG(JPB(- 1)) + RJPB

(27) Non-oil private, transport and machinery equipment
LOG(JPTM) - LOG(JPTM(- 1)) = JPTM.1 + JPTM.2 * (LOG(JPTM(- 1)) - LOG(JPTM(- 2))) + JPTM.3 * (LOG(ICTM / PJPTM) - LOG(ICTM(- 1) / PJPTM(- 1))) + JPTM.4 * LOG(ICTM(- 1) / PJPTM(- 1)) + JPTM.5 * LOG(VYSC(- 1) / PJPTM(- 1)) + JPTM.6 * LOG(JPTM(- 1)) + RJPTM

(28) Private non-oil sector
JP = JPH + JPB + JPTM

(29) Government sector
JG = JGB + JGTM

(30) Oil sector
JO = JOB + JOTM

(31) Total
J = JP + JG + JO

(32) Private non-oil sector, value
VJP = PJPH * JPH + PJPB * JPB + PJPTM * JPTM

(33) Government sector, value
VJG = PJGB * JGB + PJGTM * JGTM

(34) Oil sector, value
VJO = PJOB * JOB + PJOTM * JOTM

(35) Total, value
VJ = VJP + VJG + VJO

D.4. Capital stock and depreciation, private non- oil sector

(36) Capital stock
KP - KP(- 1) = JP - DKP

(37) Depreciation
DKP = DKPRATE * KP(- 1)

D.5. Domestic absorption

(38) Domestic absorption
DA = CP + CG + J + DS

D.6. Exports

(39) Total
X = XOG + XPR + XPS + XX + CPN

(40) Total, value
VX = VXOG + VXPR + VXPS + VXX + VCPN

(41) Oil and gas, value
VXOG = PXOG * XOG

(42) Petroleum refining, value
VXPR = PXPR * XPR

(43) Petrochemicals, value
VXPS = PXPS * XPS

(46) Other exports
VXX = PXX * XX

(45) Consumption by non-residents, value
VCPN = PCPN * CPN

D.7. Imports

(46) Total
M = MS *(A.M.CPFOO * CPFOO + A.M.CPCLO * CPCLO + A.M.CPREN * CPREN + A.M.CPFUR * CPFUR + A.M.CPMED * CPMED + A.M.CPTRA * CPTRA + A.M.CPENT * CPENT + A.M.CPOTH * CPOTH + A.M.CPABR * CPABR + A.M.JPH * JPH + A.M.JPB * JPB + A.M.JPTM * JPTM + A.M.JGB * JGB + A.M.JGTM * JGTM + A.M.JOB * JOB + A.M.JOTM * JOTM + A.M.CG * CG + A.M.DS * DS + A.M.XOG * XOG + A.M.XPR * XPR + A.M.XPS * XPS + A.M.XX * XX) + (1 - (RYAG + RYPS + RYMA + RYEW + RYCN + RYTD + RYTC + RYRE + RYFI + RYCS + RYGS + RYBC + RYOG + RYPR + RYID))

(47) Total, value
VM = PM * M

D.8. Value added by sector

(48) Agriculture, forestry and fishing
YAG =
A.AG.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.AG.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.AG.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.AG.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.AG.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.AG.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.AG.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.AG.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.AG.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.AG.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.AG.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.AG.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.AG.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.AG.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.AG.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.AG.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.AG.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.AG.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.AG.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.AG.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.AG.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.AG.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYAG

(49) Other mining, quarrying
YMI =
A.MI.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.MI.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.MI.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.MI.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.MI.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.MI.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.MI.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.MI.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.MI.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.MI.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.MI.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.MI.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.MI.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.MI.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.MI.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.MI.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.MI.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.MI.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.MI.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.MI.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +

A.MI.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.MI.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYMI

(50) Petrochemicals
YPS =
A.PS.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.PS.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.PS.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.PS.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.PS.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.PS.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.PS.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.PS.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.PS.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.PS.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.PS.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.PS.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.PS.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.PS.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.PS.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.PS.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.PS.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.PS.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.PS.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.PS.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.PS.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.PS.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYPS

(51) Other manufacturing
YMA =
A.MA.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.MA.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.MA.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.MA.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.MA.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.MA.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.MA.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.MA.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.MA.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.MA.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.MA.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.MA.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.MA.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.MA.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.MA.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.MA.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.MA.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.MA.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.MA.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.MA.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.MA.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.MA.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYMA

(52) Electricity, gas and water
YEW =
A.EW.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.EW.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.EW.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.EW.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.EW.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.EW.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.EW.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.EW.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.EW.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.EW.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.EW.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.EW.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.EW.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.EW.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.EW.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.EW.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.EW.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.EW.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.EW.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.EW.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.EW.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.EW.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYEW

(53) Construction
YCN =
A.CN.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.CN.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.CN.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.CN.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.CN.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.CN.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.CN.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.CN.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.CN.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.CN.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.CN.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.CN.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.CN.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.CN.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.CN.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.CN.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.CN.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.CN.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.CN.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.CN.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.CN.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.CN.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYCN

(54) Wholesale and retail trade
YTD =

A.TD.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.TD.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.TD.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.TD.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.TD.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.TD.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.TD.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.TD.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.TD.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.TD.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.TD.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.TD.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.TD.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.TD.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.TD.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.TD.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.TD.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.TD.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.TD.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.TD.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.TD.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.TD.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYTD

(55) Transport and communication
YTC =
A.TC.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.TC.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.TC.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.TC.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.TC.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.TC.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.TC.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.TC.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.TC.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.TC.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.TC.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.TC.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.TC.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.TC.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.TC.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.TC.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.TC.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.TC.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.TC.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.TC.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.TC.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.TC.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYTC

(56) Real estate
YRE =
A.RE.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.RE.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +

A.RE.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.RE.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.RE.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.RE.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.RE.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.RE.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.RE.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.RE.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.RE.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.RE.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.RE.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.RE.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.RE.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.RE.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.RE.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.RE.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.RE.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.RE.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.RE.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.RE.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYRE

(57) Finance and insurance
YFI =
A.FI.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.FI.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.FI.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.FI.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.FI.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.FI.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.FI.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.FI.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.FI.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.FI.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.FI.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.FI.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.FI.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.FI.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.FI.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.FI.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.FI.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.FI.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.FI.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.FI.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.FI.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.FI.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYFI

(58) Community services
YCS =
A.CS.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.CS.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.CS.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.CS.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +

A.CS.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.CS.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.CS.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.CS.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.CS.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.CS.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.CS.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.CS.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.CS.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.CS.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.CS.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.CS.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.CS.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.CS.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.CS.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.CS.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.CS.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.CS.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYCS

(59) Government services
YGS =
A.GS.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.GS.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.GS.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.GS.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.GS.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.GS.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.GS.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.GS.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.GS.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.GS.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.GS.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.GS.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.GS.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.GS.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.GS.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.GS.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.GS.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.GS.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.GS.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.GS.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.GS.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.GS.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYGS

(60) Imputed bank charges
YBC =
A.BC.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.BC.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.BC.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.BC.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.BC.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.BC.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +

A.BC.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.BC.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.BC.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.BC.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.BC.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.BC.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.BC.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.BC.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.BC.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.BC.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.BC.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.BC.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.BC.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.BC.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.BC.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.BC.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYBC

(61) Crude oil and natural gas
YOG =
A.OG.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.OG.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.OG.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.OG.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.OG.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.OG.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.OG.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.OG.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.OG.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.OG.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.OG.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.OG.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.OG.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.OG.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.OG.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.OG.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.OG.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.OG.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.OG.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.OG.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.OG.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.OG.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYOG

(62) Petroleum refining
YPR =
A.PR.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.PR.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.PR.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.PR.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.PR.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.PR.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.PR.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.PR.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +

A.PR.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.PR.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.PR.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.PR.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.PR.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.PR.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.PR.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.PR.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.PR.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.PR.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.PR.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.PR.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.PR.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.PR.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYPR

(63) Import duties
YID =
A.ID.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * CPFOO +
A.ID.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * CPCLO +
A.ID.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * CPREN +
A.ID.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * CPFUR +
A.ID.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * CPMED +
A.ID.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * CPTRA +
A.ID.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * CPENT +
A.ID.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * CPOTH +
A.ID.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * CPABR +
A.ID.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * JPH +
A.ID.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * JPB +
A.ID.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * JPTM +
A.ID.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * JGB +
A.ID.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * JGTM +
A.ID.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * JOB +
A.ID.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * JOTM +
A.ID.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * CG +
A.ID.DS * (1 - MS * A.M.DS) / (1 - A.M.DS) * DS +
A.ID.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * XOG +
A.ID.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * XPR +
A.ID.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * XPS +
A.ID.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * XX + RYID

(64) Non-oil private sector
YP = YAG + YMI + YPS + YMA + YEW + YCN + YTD + YTC + YRE + YFI + YCS + YBC

(65) Non-oil private sector, value
VYP =
PYAG * YAG + PYMI * YMI + PYPS * YPS + PYMA * YMA + PYEW * YEW + PYCN * YCN +
PYTD * YTD + PYTC * YTC + PYRE * YRE + PYFI * YFI + PYCS * YCS + PYBC * YBC

(66) Oil sector
YO = YOG + YPR

(67) Government sector
YG = YGS

(68) GDP
Y = YP + YO + YG + YID

(69) Government sector, value
VYG = PYG * YG

(70) Import duties, value
VYID = PYID * YID

(71) GDP, value
VY = VYP + VYOG + VYPR + VYG + VYID

D.9. Employment and labour supply

(72) Private sector
LOG(EP) - LOG(EP(- 1)) = EP.1 + EP.2 * (LOG(EP(- 1)) - LOG(EP(- 2))) + EP.3 * (LOG(EP(- 1)) - LOG(YP(- 1))) + EP.4 * LOG(KP(- 2)) + REP

(73) Saudis, private sector
ESP = EP - ENP

(74) Saudis, government sector
ESG = EG - ENG

(75) Government sector
EG = YG / QG

(76) Total
E = EP + EG

(77) Saudis
ES = ESP + ESG

(78) Non-Saudis
EN = ENP + ENG

(79) Labour supply, Saudis
LS = LSW + LSM

(80) Unemployment, Saudis
US = LS - ES

D.10. Productivity

(81) Private non-oil sector
QP = YP / EP

D.11. Wage rate

(82) Private non-oil sector
LOG(WP / PCP) - LOG(WP(- 1) / PCP(- 1)) = WP.1 + WP.2 * (LOG(QP) - LOG(QP(- 1))) + WP.3 * (LOG(WP(- 1) / PCP(- 1)) - LOG(QP(- 1))) + WP.4 * LOG(WG(- 1)) + WP.5 * D9091 + RWP

D.12. Compensation of employees

(83) Private sector
VYWP = WP * EP

(84) Government sector
VYWG = WG * EG

(85) Total
VYW = VYWP + VYWG + VYWO

D.13. Household disposable income and wealth

(86) Disposable income
HR = VYW + VYSH + GESS

(87) Wealth
HW = M2 - M0 - LIABP

D.14. Factor prices by sector

(88) Agriculture, forestry and fishing
LOG(PYFAG) - LOG(PYFAG(- 1)) = PYFAG.1 + PYFAG.2 * (LOG(WP) - LOG(WP(- 1))) + PYFAG.3 * (LOG(PYFAG(- 1)) - LOG(WP(- 1))) + RPYFAG

(89) Other mining, quarrying
LOG(PYFMI) - LOG(PYFMI(- 1)) = PYFMI.1 + PYFMI.2 * (LOG(WP) - LOG(WP(- 1))) + PYFMI.3 * (LOG(PYFMI(- 1)) - LOG(WP(- 1))) + RPYFMI

(90) Other manufacturing
LOG(PYFMA) - LOG(PYFMA(- 1)) = PYFMA.1 + PYFMA.2 * (LOG(WP) - LOG(WP(- 1))) + PYFMA.3 * (LOG(PM) - LOG(PM(- 1))) + PYFMA.4 * (LOG(PYFMA(- 1)) - LOG(WP(- 1))) + PYFMA.5 * (LOG(PYFMA(- 1)) - LOG(PM(- 1))) + RPYFMA

(91) Construction
LOG(PYFCN) - LOG(PYFCN(- 1)) = PYFCN.1 + PYFCN.2 * (LOG(WP) - LOG(WP(- 1))) + PYFCN.3 * (LOG(PM) - LOG(PM(- 1))) + PYFCN.4 * (LOG(PYFCN(- 1)) - LOG(WP(- 1))) + PYFCN.5 * (LOG(PYFCN(- 1)) - LOG(PM(- 1))) + RPYFCN

(92) Wholesale and retail trade
LOG(PYFTD) - LOG(PYFTD(- 1)) = PYFTD.1 + PYFTD.2 * (LOG(WP) - LOG(WP(- 1))) + PYFTD.3 * (LOG(PM) - LOG(PM(- 1))) + PYFTD.4 * (LOG(PYFTD(- 1)) - LOG(WP(- 1))) + RPYFTD

(93) Transport and communication

LOG(PYFTC) - LOG(PYFTC(- 1)) = PYFTC.1 + PYFTC.2 * (LOG(WP) - LOG(WP(- 1))) + PYFTC.3 * (LOG(PM) - LOG(PM(- 1))) + PYFTC.4 * (LOG(PYFTC(- 1)) - LOG(WP(- 1))) + RPYFTC

(94) Community services
LOG(PYFCS) - LOG(PYFCS(- 1)) =
PYFCS.1 + PYFCS.2 * (LOG(WP) - LOG(WP(- 1))) + PYFCS.3 * (LOG(PM) - LOG(PM(- 1))) + PYFCS.4 * (LOG(PYFCS(- 1)) - LOG(WP(- 1))) + RPYFCS

(95) Government services
LOG(PYFGS) - LOG(PYFGS(- 1)) =
PYFGS.1 + PYFGS.2 * (LOG(WG) - LOG(WG(- 1))) + PYFGS.3 * (LOG(PYFGS(- 1)) - LOG(WG(- 1))) + RPYFGS

D.15. Factor prices including net indirect taxes

(96) Agriculture, forestry and fishing
PYAG = ((1 - TAG.0) / (1 - TAG)) * PYFAG

(97) Other mining, quarrying
PYMI = ((1 - TMI.0) / (1 - TMI)) * PYFMI

(98) Other manufacturing
PYMA = ((1 - TMA.0) / (1 - TMA)) * PYFMA

(99) Construction
PYCN = ((1 - TCN.0) / (1 - TCN)) * PYFCN

(100) Wholesale and retail trade
PYTD = ((1 - TTD.0) / (1 - TTD)) * PYFTD

(101) Transport and communication
PYTC = ((1 - TTC.0) / (1 - TTC)) * PYFTC

(102) Community services
PYCS = ((1 - TCS.0) / (1 - TCS)) * PYFCS

(103) Government services
PYGS = ((1 - TGS.0) / (1 - TGS)) * PYFGS

(104) Petrochemicals
PYPS = ((1 - TPS.0) / (1 - TPS)) * PYFPS

(105) Electricity and water
PYEW = ((1 - TEW.0) / (1 - TEW)) * PYFEW

(106) Real estate
PYRE = ((1 - TRE.0) / (1 - TRE)) * PYFRE

(107) Finance and insurance
PYFI = ((1 - TFI.0) / (1 - TFI)) * PYFFI

(108) Impued bank charges
PYBC = ((1 - TBC.0) / (1 - TBC)) * PYFBC

(109) Petroleum refining
PYPR = ((1 - TPR.0) / (1 - TPR)) * PYFPR

(110) Crude oil and natural gas
PYOG = ((1 - TOG.0) / (1 - TOG)) * PYFOG

(111) Private sector
PYP = VYP / YP

D.16. Final demand prices

(112) Food,beverages and tobacco
PCPFOO =
(MS * A.M.CPFOO * PM +
A.AG.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYAG +
A.MI.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYMI +
A.PS.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYPS +
A.MA.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYMA +
A.EW.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYEW +
A.CN.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYCN +
A.TD.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYTD +
A.TC.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYTC +
A.RE.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYRE +
A.FI.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYFI +
A.CS.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYCS +
A.GS.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYGS +
A.BC.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYBC +
A.OG.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYOG +
A.PR.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYPR +
A.ID.CPFOO * (1 - MS * A.M.CPFOO) / (1 - A.M.CPFOO) * PYID) * RPCPFOO

(113) Clothing and footware
PCPCLO =
(MS * A.M.CPCLO * PM +
A.AG.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYAG +
A.MI.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYMI +
A.PS.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYPS +
A.MA.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYMA +
A.EW.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYEW +
A.CN.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYCN +
A.TD.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYTD +
A.TC.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYTC +
A.RE.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYRE +
A.FI.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYFI +
A.CS.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYCS +
A.GS.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYGS +
A.BC.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYBC +
A.OG.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYOG +
A.PR.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYPR +

A.ID.CPCLO * (1 - MS * A.M.CPCLO) / (1 - A.M.CPCLO) * PYID) * RPCPCLO

(114) Rent, fuel and power
PCPREN =
(MS * A.M.CPREN * PM +
A.AG.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYAG +
A.MI.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYMI +
A.PS.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYPS +
A.MA.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYMA +
A.EW.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYEW +
A.CN.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYCN +
A.TD.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYTD +
A.TC.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYTC +
A.RE.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYRE +
A.FI.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYFI +
A.CS.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYCS +
A.GS.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYGS +
A.BC.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYBC +
A.OG.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYOG +
A.PR.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYPR +
A.ID.CPREN * (1 - MS * A.M.CPREN) / (1 - A.M.CPREN) * PYID) * RPCPREN

(115) Furniture and household equipment
PCPFUR =
(MS * A.M.CPFUR * PM +
A.AG.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYAG +
A.MI.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYMI +
A.PS.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYPS +
A.MA.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYMA +
A.EW.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYEW +
A.CN.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYCN +
A.TD.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYTD +
A.TC.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYTC +
A.RE.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYRE +
A.FI.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYFI +
A.CS.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYCS +
A.GS.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYGS +
A.BC.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYBC +
A.OG.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYOG +
A.PR.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYPR +
A.ID.CPFUR * (1 - MS * A.M.CPFUR) / (1 - A.M.CPFUR) * PYID) * RPCPFUR

(116) Medical health care
PCPMED =
(MS * A.M.CPMED * PM +
A.AG.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYAG +
A.MI.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYMI +
A.PS.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYPS +
A.MA.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYMA +
A.EW.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYEW +
A.CN.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYCN +
A.TD.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYTD +

A.TC.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYTC +
A.RE.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYRE +
A.FI.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYFI +
A.CS.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYCS +
A.GS.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYGS +
A.BC.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYBC +
A.OG.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYOG +
A.PR.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYPR +
A.ID.CPMED * (1 - MS * A.M.CPMED) / (1 - A.M.CPMED) * PYID) * RPCPMED

(117) Transport and communication
PCPTRA =
(MS * A.M.CPTRA * PM +
A.AG.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYAG +
A.MI.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYMI +
A.PS.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYPS +
A.MA.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYMA +
A.EW.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYEW +
A.CN.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYCN +
A.TD.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYTD +
A.TC.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYTC +
A.RE.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYRE +
A.FI.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYFI +
A.CS.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYCS +
A.GS.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYGS +
A.BC.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYBC +
A.OG.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYOG +
A.PR.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYPR +
A.ID.CPTRA * (1 - MS * A.M.CPTRA) / (1 - A.M.CPTRA) * PYID) * RPCPTRA

(118) Entertainment and education
PCPENT =
(MS * A.M.CPENT * PM +
A.AG.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYAG +
A.MI.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYMI +
A.PS.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYPS +
A.MA.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYMA +
A.EW.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYEW +
A.CN.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYCN +
A.TD.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYTD +
A.TC.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYTC +
A.RE.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYRE +
A.FI.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYFI +
A.CS.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYCS +
A.GS.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYGS +
A.BC.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYBC +
A.OG.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYOG +
A.PR.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYPR +
A.ID.CPENT * (1 - MS * A.M.CPENT) / (1 - A.M.CPENT) * PYID) * RPCPENT

(119) Other goods and services
PCPOTH =
(MS * A.M.CPOTH * PM +
A.AG.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYAG +
A.MI.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYMI +
A.PS.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYPS +
A.MA.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYMA +
A.EW.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYEW +
A.CN.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYCN +
A.TD.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYTD +
A.TC.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYTC +
A.RE.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYRE +
A.FI.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYFI +
A.CS.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYCS +
A.GS.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYGS +
A.BC.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYBC +
A.OG.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYOG +
A.PR.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYPR +
A.ID.CPOTH * (1 - MS * A.M.CPOTH) / (1 - A.M.CPOTH) * PYID) * RPCPOTH

(120) Resident direct purchase abroad
PCPABR =
(MS * A.M.CPABR * PM +
A.AG.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYAG +
A.MI.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYMI +
A.PS.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYPS +
A.MA.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYMA +
A.EW.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYEW +
A.CN.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYCN +
A.TD.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYTD +
A.TC.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYTC +
A.RE.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYRE +
A.FI.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYFI +
A.CS.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYCS +
A.GS.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYGS +
A.BC.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYBC +
A.OG.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYOG +
A.PR.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYPR +
A.ID.CPABR * (1 - MS * A.M.CPABR) / (1 - A.M.CPABR) * PYID) * RPCPABR

(121) Total resident
PCPR = VCPR / CPR

(122) Private non-oil, residential buildings
PJPH =
(MS * A.M.JPH * PM +
A.AG.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYAG +
A.MI.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYMI +
A.PS.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYPS +
A.MA.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYMA +
A.EW.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYEW +
A.CN.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYCN +

A.TD.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYTD +
A.TC.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYTC +
A.RE.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYRE +
A.FI.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYFI +
A.CS.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYCS +
A.GS.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYGS +
A.BC.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYBC +
A.OG.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYOG +
A.PR.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYPR +
A.ID.JPH * (1 - MS * A.M.JPH) / (1 - A.M.JPH) * PYID) * RPJPH

(123) Private non-oil, non-residential buildings
PJPB =
(MS * A.M.JPB * PM +
A.AG.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYAG +
A.MI.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYMI +
A.PS.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYPS +
A.MA.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYMA +
A.EW.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYEW +
A.CN.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYCN +
A.TD.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYTD +
A.TC.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYTC +
A.RE.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYRE +
A.FI.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYFI +
A.CS.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYCS +
A.GS.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYGS +
A.BC.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYBC +
A.OG.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYOG +
A.PR.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYPR +
A.ID.JPB * (1 - MS * A.M.JPB) / (1 - A.M.JPB) * PYID) * RPJPB

(124) Private non-oil, transport and machinery equipment
PJPTM =
(MS * A.M.JPTM * PM +
A.AG.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYAG +
A.MI.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYMI +
A.PS.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYPS +
A.MA.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYMA +
A.EW.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYEW +
A.CN.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYCN +
A.TD.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYTD +
A.TC.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYTC +
A.RE.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYRE +
A.FI.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYFI +
A.CS.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYCS +
A.GS.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYGS +
A.BC.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYBC +
A.OG.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYOG +
A.PR.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYPR +
A.ID.JPTM * (1 - MS * A.M.JPTM) / (1 - A.M.JPTM) * PYID) * RPJPTM

(125) Government investment, non-residential building
PJGB =
(MS * A.M.JGB * PM +
A.AG.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYAG +
A.MI.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYMI +
A.PS.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYPS +
A.MA.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYMA +
A.EW.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYEW +
A.CN.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYCN +
A.TD.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYTD +
A.TC.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYTC +
A.RE.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYRE +
A.FI.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYFI +
A.CS.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYCS +
A.GS.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYGS +
A.BC.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYBC +
A.OG.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYOG +
A.PR.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYPR +
A.ID.JGB * (1 - MS * A.M.JGB) / (1 - A.M.JGB) * PYID) * RPJGB

(126) Government investment, transport and machinery equipment
PJGTM =
(MS * A.M.JGTM * PM +
A.AG.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYAG +
A.MI.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYMI +
A.PS.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYPS +
A.MA.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYMA +
A.EW.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYEW +
A.CN.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYCN +
A.TD.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYTD +
A.TC.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYTC +
A.RE.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYRE +
A.FI.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYFI +
A.CS.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYCS +
A.GS.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYGS +
A.BC.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYBC +
A.OG.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYOG +
A.PR.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYPR +
A.ID.JGTM * (1 - MS * A.M.JGTM) / (1 - A.M.JGTM) * PYID) * RPJGTM

(127) Oil-sector investment, non-residential buildings
PJOB =
(MS * A.M.JOB * PM +
A.AG.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYAG +
A.MI.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYMI +
A.PS.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYPS +
A.MA.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYMA +
A.EW.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYEW +
A.CN.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYCN +
A.TD.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYTD +
A.TC.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYTC +
A.RE.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYRE +

A.FI.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYFI +
A.CS.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYCS +
A.GS.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYGS +
A.BC.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYBC +
A.OG.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYOG +
A.PR.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYPR +
A.ID.JOB * (1 - MS * A.M.JOB) / (1 - A.M.JOB) * PYID) * RPJOB

(128) Oil-sector investment, transport and machinery equipment
PJOTM =
(MS * A.M.JOTM * PM +
A.AG.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYAG +
A.MI.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYMI +
A.PS.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYPS +
A.MA.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYMA +
A.EW.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYEW +
A.CN.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYCN +
A.TD.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYTD +
A.TC.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYTC +
A.RE.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYRE +
A.FI.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYFI +
A.CS.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYCS +
A.GS.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYGS +
A.BC.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYBC +
A.OG.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYOG +
A.PR.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYPR +
A.ID.JOTM * (1 - MS * A.M.JOTM) / (1 - A.M.JOTM) * PYID) * RPJOTM

(129) Government final consumption
PCG =
(MS * A.M.CG * PM +
A.AG.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYAG +
A.MI.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYMI +
A.PS.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYPS +
A.MA.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYMA +
A.EW.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYEW +
A.CN.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYCN +
A.TD.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYTD +
A.TC.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYTC +
A.RE.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYRE +
A.FI.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYFI +
A.CS.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYCS +
A.GS.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYGS +
A.BC.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYBC +
A.OG.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYOG +
A.PR.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYPR +
A.ID.CG * (1 - MS * A.M.CG) / (1 - A.M.CG) * PYID) * RPCG

(130) Increase in stocks
PDS = (VY + VM - VCP - VCG - VJ - VX) / DS

(131) Exports of oil and gas
PXOG =
(MS * A.M.XOG * PM +
A.AG.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYAG +
A.MI.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYMI +
A.PS.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYPS +
A.MA.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYMA +
A.EW.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYEW +
A.CN.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYCN +
A.TD.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYTD +
A.TC.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYTC +
A.RE.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYRE +
A.FI.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYFI +
A.CS.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYCS +
A.GS.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYGS +
A.BC.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYBC +
A.OG.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYOG +
A.PR.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYPR +
A.ID.XOG * (1 - MS * A.M.XOG) / (1 - A.M.XOG) * PYID) * RPXOG

(132) Exports of refined products
PXPR =
(MS * A.M.XPR * PM +
A.AG.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYAG +
A.MI.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYMI +
A.PS.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYPS +
A.MA.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYMA +
A.EW.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYEW +
A.CN.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYCN +
A.TD.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYTD +
A.TC.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYTC +
A.RE.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYRE +
A.FI.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYFI +
A.CS.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYCS +
A.GS.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYGS +
A.BC.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYBC +
A.OG.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYOG +
A.PR.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYPR +
A.ID.XPR * (1 - MS * A.M.XPR) / (1 - A.M.XPR) * PYID) * RPXPR

(133) Exports of petrochemicals
PXPS =
(MS * A.M.XPS * PM +
A.AG.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYAG +
A.MI.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYMI +
A.PS.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYPS +
A.MA.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYMA +
A.EW.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYEW +
A.CN.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYCN +
A.TD.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYTD +
A.TC.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYTC +
A.RE.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYRE +

A.FI.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYFI +
A.CS.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYCS +
A.GS.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYGS +
A.BC.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYBC +
A.OG.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYOG +
A.PR.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYPR +
A.ID.XPS * (1 - MS * A.M.XPS) / (1 - A.M.XPS) * PYID) * RPXPS

(134) Exports of goods and services, less export of oil, gas, petrochemicals, refined products and non-resident direct purchase
PXX =
(MS * A.M.XX * PM +
A.AG.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYAG +
A.MI.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYMI +
A.PS.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYPS +
A.MA.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYMA +
A.EW.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYEW +
A.CN.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYCN +
A.TD.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYTD +
A.TC.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYTC +
A.RE.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYRE +
A.FI.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYFI +
A.CS.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYCS +
A.GS.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYGS +
A.BC.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYBC +
A.OG.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYOG +
A.PR.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYPR +
A.ID.XX * (1 - MS * A.M.XX) / (1 - A.M.XX) * PYID) * RPXX

(135) Non-resident direct purchase
PCPN = 0.07 * PCPFOO + 0.06 * PCPCLO + 0.22 * PCPFUR + 0.01 * PCPTRA + 0.64 * PCPOTH + RPCPN

D.17. Value of sectoral production

(136) Agriculture, forestry and fishing
VYAG = PYAG * YAG

(137) Other mining, quarrying
VYMI = PYMI * YMI

(138) Petrochemicals
VYPS = PYPS * YPS

(139) Other manufacturing
VYMA = PYMA * YMA

(140) Electricity, gas and water
VYEW = PYEW * YEW

(141) Construction
VYCN = PYCN * YCN

(142) Wholesale and retail trade
VYTD = PYTD * YTD

(143) Transport and communication
VYTC = PYTC * YTC

(144) Real estate
VYRE = PYRE * YRE

(145) Finance, insurance
VYFI = PYFI * YFI

(146) Community services
VYCS = PYCS * YCS

(147) Imputed bank charges
VYBC = PYBC * YBC

(148) Petroleum refining
VYPR = PYPR * YPR

(149) Crude oil and natural gas
VYOG = PYOG * YOG

D.18. Net indirect taxes

(150) Agriculture, forestry and fishing
VYTAG = VYAG - PYFAG * (1 - TAG.0) * YAG

(151) Other mining, quarrying
VYTMI = VYMI - PYFMI * (1 - TMI.0) * YMI

(152) Petrochemicals
VYTPS = VYPS - PYFPS * (1 - TPS.0) * YPS

(153) Other manufacturing
VYTMA = VYMA - PYFMA * (1 - TMA.0) * YMA

(154) Electricity, gas and water
VYTEW = VYEW - PYFEW * (1 - TEW.0) * YEW

(155) Construction
VYTCN = VYCN - PYFCN * (1 - TCN.0) * YCN

(156) Wholesale and retail trade
VYTTD = VYTD - PYFTD * (1 - TTD.0) * YTD

(157) Transport and communication
VYTTC = VYTC - PYFTC * (1 - TTC.0) * YTC

(158) Real estate
VYTRE = VYRE - PYFRE * (1 - TRE.0) * YRE

(159) Finance, insurance
VYTFI = VYFI - PYFFI * (1 - TFI.0) * YFI

(160) Community services
VYTCS = VYCS - PYFCS * (1 - TCS.0) * YCS

(161) Imputed bank charges
VYTBC = VYBC - PYFBC * (1 - TBC.0) * YBC

(162) Petroleum refining
VYTPR = VYPR - PYFPR * (1 - TPR.0) * YPR

(163) Crude oil and natural gas
VYTOG = VYOG - PYFOG * (1 - TOG.0) * YOG

(164) Private sector
VYTP = VYTAG + VYTMI + VYTPS + VYTMA + VYTEW + VYTCN + VYTTD + VYTTC + VYTRE + VYTFI + VYTCS + VYTBC

(165) Total
VYT = VYTP + VYTOG + VYTPR

D.19. Gross operating surplus

(166) Private, total
VYSP = VYP - VYTP - WP * EP

(167) Household share
VYSH = VYSSHARE * VYSP

(168) Company share
VYSC = (1 - VYSSHARE) * VYSP

(169) Total
VYSO = VYOG + VYPR - VYTOG - VYTPR - VYWO

D.20. Current account balance

(170) Total
Z = VX - VM + ZR

D.21. Government budget

(171) Chapter 1 and 2
GECH12 = VYWG + RGECH12

(172) Chapter 3
GECH3 = GESS - VYT + RGECH3

(173) Chapter 4
GECH4 = VJG + RGECH4

(174) Other revenues
GROTH = VYID + RGROTH

(175) Oil revenues
GROIL = GROSHARE * VYSO

(176) Budget balance
ZG = GROIL + GROTH + THR * HR - GECH12 - GECH3 - GECH4

D.22. Private sector net financial investment

(177) Total
ZP = Z - ZG

Endogenous variables

GECH12 GECH3 GECH4 GROIL GROTH YAG YMI YPS YMA YEW YCN YTD YTC YRE YFI YCS YGS YBC XOG XPR YID PCPFOO PCPCLO PCPREN PCPFUR PCPMED PCPTRA PCPENT PCPOTH PCPABR PCPN PJPH PJPB PJPTM PJGB PJGTM PJOB PJOTM PCG PXOG PXPR PXPS PXX PDS PCPR PYP CPR CP VCP CPFOO CPCLO CPREN CPFUR CPMED CPTRA CPENT CPOTH CPABR VCPR CPRABR CPRFOO CPRCLO CPRREN CPRFUR CPRMED CPRTRA CPRENT CPROTH JP JG JO JPH JPB JPTM J DA M VM YP YO YG Y KP DKP ES EN EP ESP EG ESG E LS US QP VYSO VYT VYTP VYTAG VYTMI VYTPS VYTMA VYTEW VYTCN VYTTD VYTTC VYTRE VYTFI VYTCS VYTBC VYTPR VYTOG VYSC VYSH VYAG VYMI VYPS VYMA VYEW VYCN VYTD VYTC VYRE VYFI VYCS VYBC VYPR VYOG VYID VYG VCG VY VJ VJP VJG VJO VYP VYWP VYWG VYW HR HW VYSP VX VCPN VXOG VXPR VXPS VXX WP X Z ZG ZP PYAG PYMI PYGS PYCS PYTD PYTC PYMA PYCN PYPS PYEW PYRE PYFI PYBC PYPR PYOG PYFAG PYFMI PYFGS PYFCS PYFTD PYFTC PYFMA PYFCN PCP;

Coefficients

CPR.1 CPR.2 CPR.3 CPR.4 CPR.5 CPR.6 CPRFOO.1 CPRFOO.2 CPRCLO.1 CPRCLO.2 CPRREN.1 CPRREN.2 CPRFUR.1 CPRFUR.2 CPRMED.1 CPRMED.2 CPRTRA.1 CPRTRA.2 CPRENT.1 CPRENT.2 CPROTH.1 CPROTH.2 CPRABR.1 JPH.1 JPH.2 JPH.3 JPH.4 JPH.5 JPB.1 JPB.2 JPB.3 JPB.4 JPTM.1 JPTM.2 JPTM.3 JPTM.4 JPTM.5 JPTM.6 EP.1 EP.2 EP.3 EP.4 WP.1 WP.2 WP.3 WP.4 WP.5 PYFAG.1 PYFAG.2 PYFAG.3 PYFMI.1 PYFMI.2 PYFMI.3 PYFGS.1 PYFGS.2 PYFGS.3 PYFCS.1 PYFCS.1 PYFCS.2 PYFCS.3 PYFCS.4 PYFTD.1 PYFTD.2 PYFTD.3 PYFTD.4 PYFTC.1 PYFTC.2 PYFTC.3 PYFTC.4 PYFMA.1 PYFMA.2 PYFMA.3 PYFMA.4 PYFMA.5 PYFCN.1 PYFCN.2 PYFCN.3 PYFCN.4 PYFCN.5 TAG.0 TMI.0 TMA.0 TCN.0 TTD.0 TTC.0 TCS.0 TGS.0 TBC.0 TEW.0 TFI.0 TOG.0 TPR.0 TPS.0 TRE.0 A.AG.CG A.AG.CPCLO A.AG.CPENT A.AG.CPFOO A.AG.CPFUR A.AG.CPMED A.AG.CPOTH A.AG.CPREN A.AG.CPABR A.AG.CPTRA A.AG.DS A.AG.JGB A.AG.JGTM A.AG.JOB A.AG.JOTM A.AG.JPH A.AG.JPB A.AG.JPTM A.AG.XOG A.AG.XPR A.AG.XPS A.AG.XX A.BC.CG A.BC.CPCLO A.BC.CPENT A.BC.CPFOO A.BC.CPFUR A.BC.CPMED A.BC.CPOTH A.BC.CPREN A.BC.CPABR A.BC.CPTRA A.BC.DS A.BC.JGB A.BC.JGTM A.BC.JOB A.BC.JOTM A.BC.JPH A.BC.JPB A.BC.JPTM A.BC.XOG A.BC.XPR A.BC.XPS A.BC.XX A.CN.CG A.CN.CPCLO A.CN.CPENT A.CN.CPFOO A.CN.CPFUR A.CN.CPMED A.CN.CPOTH A.CN.CPREN A.CN.CPABR A.CN.CPTRA A.CN.DS A.CN.JGB A.CN.JGTM A.CN.JOB A.CN.JOTM A.CN.JPH A.CN.JPB A.CN.JPTM A.CN.XOG A.CN.XPR A.CN.XPS A.CN.XX A.CS.CG A.CS.CPCLO A.CS.CPENT A.CS.CPFOO A.CS.CPFUR A.CS.CPMED A.CS.CPOTH A.CS.CPREN A.CS.CPABR A.CS.CPTRA A.CS.DS A.CS.JGB A.CS.JGTM A.CS.JOB A.CS.JOTM A.CS.JPH A.CS.JPB A.CS.JPTM A.CS.XOG A.CS.XPR A.CS.XPS A.CS.XX A.EW.CG

A.EW.CPCLO A.EW.CPENT A.EW.CPFOO A.EW.CPFUR A.EW.CPMED A.EW.CPOTH A.EW.CPREN A.EW.CPABR A.EW.CPTRA A.EW.DS A.EW.JGB A.EW.JGTM A.EW.JOB A.EW.JOTM A.EW.JPH A.EW.JPB A.EW.JPTM A.EW.XOG A.EW.XPR A.EW.XPS A.EW.XX A.FI.CG A.FI.CPCLO A.FI.CPENT A.FI.CPFOO A.FI.CPFUR A.FI.CPMED A.FI.CPOTH A.FI.CPREN A.FI.CPABR A.FI.CPTRA A.FI.DS A.FI.JGB A.FI.JGTM A.FI.JOB A.FI.JOTM A.FI.JPH A.FI.JPB A.FI.JPTM A.FI.XOG A.FI.XPR A.FI.XPS A.FI.XX A.GS.CG A.GS.CPCLO A.GS.CPENT A.GS.CPFOO A.GS.CPFUR A.GS.CPMED A.GS.CPOTH A.GS.CPREN A.GS.CPABR A.GS.CPTRA A.GS.DS A.GS.JGB A.GS.JGTM A.GS.JOB A.GS.JOTM A.GS.JPH A.GS.JPB A.GS.JPTM A.GS.XOG A.GS.XPR A.GS.XPS A.GS.XX A.ID.CG A.ID.CPCLO A.ID.CPENT A.ID.CPFOO A.ID.CPFUR A.ID.CPMED A.ID.CPOTH A.ID.CPREN A.ID.CPABR A.ID.CPTRA A.ID.DS A.ID.JGB A.ID.JGTM A.ID.JOB A.ID.JOTM A.ID.JPH A.ID.JPB A.ID.JPTM A.ID.XOG A.ID.XPR A.ID.XPS A.ID.XX A.M.CG A.M.CPCLO A.M.CPENT A.M.CPFOO A.M.CPFUR A.M.CPMED A.M.CPOTH A.M.CPREN A.M.CPABR A.M.CPTRA A.M.DS A.M.JGB A.M.JGTM A.M.JOB A.M.JOTM A.M.JPH A.M.JPB A.M.JPTM A.M.XOG A.M.XPR A.M.XPS A.M.XX A.MA.CG A.MA.CPCLO A.MA.CPENT A.MA.CPFOO A.MA.CPFUR A.MA.CPMED A.MA.CPOTH A.MA.CPREN A.MA.CPABR A.MA.CPTRA A.MA.DS A.MA.JGB A.MA.JGTM A.MA.JOB A.MA.JOTM A.MA.JPH A.MA.JPB A.MA.JPTM A.MA.XOG A.MA.XPR A.MA.XPS A.MA.XX A.MI.CG A.MI.CPCLO A.MI.CPENT A.MI.CPFOO A.MI.CPFUR A.MI.CPMED A.MI.CPOTH A.MI.CPREN A.MI.CPABR A.MI.CPTRA A.MI.DS A.MI.JGB A.MI.JGTM A.MI.JOB A.MI.JOTM A.MI.JPH A.MI.JPB A.MI.JPTM A.MI.XOG A.MI.XPR A.MI.XPS A.MI.XX A.OG.CG A.OG.CPCLO A.OG.CPENT A.OG.CPFOO A.OG.CPFUR A.OG.CPMED A.OG.CPOTH A.OG.CPREN A.OG.CPABR A.OG.CPTRA A.OG.DS A.OG.JGB A.OG.JGTM A.OG.JOB A.OG.JOTM A.OG.JPH A.OG.JPB A.OG.JPTM A.OG.XOG A.OG.XPR A.OG.XPS A.OG.XX A.PR.CG A.PR.CPCLO A.PR.CPENT A.PR.CPFOO A.PR.CPFUR A.PR.CPMED A.PR.CPOTH A.PR.CPREN A.PR.CPABR A.PR.CPTRA A.PR.DS A.PR.JGB A.PR.JGTM A.PR.JOB A.PR.JOTM A.PR.JPH A.PR.JPB A.PR.JPTM A.PR.XOG A.PR.XPR A.PR.XPS A.PR.XX A.PS.CG A.PS.CPCLO A.PS.CPENT A.PS.CPFOO A.PS.CPFUR A.PS.CPMED A.PS.CPOTH A.PS.CPREN A.PS.CPABR A.PS.CPTRA A.PS.DS A.PS.JGB A.PS.JGTM A.PS.JOB A.PS.JOTM A.PS.JPH A.PS.JPB A.PS.JPTM A.PS.XOG A.PS.XPR A.PS.XPS A.PS.XX A.RE.CG A.RE.CPCLO A.RE.CPENT A.RE.CPFOO A.RE.CPFUR A.RE.CPMED A.RE.CPOTH A.RE.CPREN A.RE.CPABR A.RE.CPTRA A.RE.DS A.RE.JGB A.RE.JGTM A.RE.JOB A.RE.JOTM A.RE.JPH A.RE.JPB A.RE.JPTM A.RE.XOG A.RE.XPR A.RE.XPS A.RE.XX A.TC.CG A.TC.CPCLO A.TC.CPENT A.TC.CPFOO A.TC.CPFUR A.TC.CPMED A.TC.CPOTH A.TC.CPREN A.TC.CPABR A.TC.CPTRA A.TC.DS A.TC.JGB A.TC.JGTM A.TC.JOB A.TC.JOTM A.TC.JPH A.TC.JPB A.TC.JPTM A.TC.XOG A.TC.XPR A.TC.XPS A.TC.XX A.TD.CG A.TD.CPCLO A.TD.CPENT A.TD.CPFOO A.TD.CPFUR A.TD.CPMED A.TD.CPOTH A.TD.CPREN A.TD.CPABR A.TD.CPTRA A.TD.DS A.TD.JGB A.TD.JGTM A.TD.JOB A.TD.JOTM A.TD.JPH A.TD.JPB A.TD.JPTM A.TD.XOG A.TD.XPR A.TD.XPS A.TD.XX

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