CESAM

The CCSO annual model of the Dutch economy

S.K. Kuipers, B.W.A. Jongbloed, G.H. Kuper and E. Sterken

This paper presents CESAM, a macroeconomic model of the Dutch economy based on annual data. CESAM can be characterized as a Keynesian expenditure model including a neoclassical production model and a post-Keynesian financial model. This characterization holds for most of the Dutch macroeconomic models including, for instance, FREIA-KOMPAS of the Dutch Central Planning Bureau. There are, however, some interesting features that distinguish CESAM from other Dutch models: the production structure is based on a putty-clay vintage approach; the financial model is based on a system of financial accounts and is modelled using the portfolio approach; and the institutional structure of Dutch public finance is described in detail. The main objectives in using the model are to generate medium-term forecasts of the Dutch economy and to analyse economic policy.

Keywords: Macroeconomic model; Vintage approach; Portfolio behaviour

This paper presents CESAM,¹ an annual model of the Dutch economy. CESAM can be labelled a macroeconomic model based on a standard Keynesian expenditure model (multiplier and accelerator effects) with a neoclassical description of productive capacity and a post-Keynesian financial submodel. The model describes the real and financial behaviour of both the private sector and the government sector and is estimated for the period up to 1985.

CESAM is a large-scale macroeconomic model of the Dutch economy. Like other models, CESAM is constructed to evaluate economic policy and to generate medium-term macroeconomic forecasts. The model can also be used to evaluate recent economic developments. CESAM resembles other Dutch macroeconomic models in some respects but differs from them in others. Throughout the paper attention is drawn to these differences in order to highlight the characteristic features of CESAM.

Before presenting CESAM in more detail we will give a short overview of Dutch economic model building and describe the main features of CESAM. Tinbergen's work was the starting point for the Dutch tradition of econometric model building. After World War 2 the Central Planning Bureau, which was founded and directed by Tinbergen, developed its first Keynesian demand models (see Central Planning Bureau [16, 17] and Verdoorn and Post [77]). The first model containing supply elements was the CS model (see van den Beld [4]), which was succeeded by the VINTAF model (see den Hartog *et al* [38]). VINTAF combined conventional Keynesian demand equations with a clay-clay vintage production structure. Later versions of the VINTAF model (CPB [18]) contained a description of the social security sector as well. The models mentioned so far were all based on annual data. The first quarterly model was published by the Central Planning Bureau in 1972 (see Driehuis [26]).

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¹ CESAM is the medium-term macroeconomic model of the Centre for Cyclical and Structural Research, or in Dutch, Centrum voor Conjunctuur – en Structuur Onderzoek (CCSO). Three Dutch universities participate in the underlying CCSO research project: the University of Groningen, the University of Twente and the University of Limburg.

According to den Butter [11] and van den Berg *et al* [5] the models developed by the Central Planning Bureau up to the late 1970s did not pay detailed attention to the monetary sphere. Because rising interest rates and increasing interest payments by the government sector were a feature of the 1970s, the need to describe the monetary sphere became obvious at that time. This led the Central Planning Bureau to develop the FREIA model, a yearly model with a well developed monetary sector. Before that time other attempts, mostly rather partial in nature, had already been made. In 1971 Korteweg [48] introduced a theoretical monetary model, which was implemented empirically by van Loo and Korteweg (see van Loo [58], Korteweg and van Loo [49] and van Loo [59]). The Central Planning Bureau presented studies of the monetary sector as well (see Bakhoven [2], de Ridder [67] and den Haan *et al* [36]). Research staff members of De Nederlandsche Bank (the Dutch central bank) investigated different aspects of monetary transactions (see Fase [29] for a survey).

Models describing the behaviour of the Dutch government sector are scarce: in 1981 van Winden [82] presented a model based on the public choice theory.

Serious treatment of expectations in Dutch macroeconomic models is absent. A model like the Liverpool model (see Minford *et al* [64]), which is a rational expectations model, is missing from Dutch model building.

In the 1980s a number of macroeconomic models were constructed, not only by the Central Planning Bureau but also by other institutions such as universities. These models are listed in Table 1. Throughout this paper CESAM is compared with the models listed in Table 1, of which FREIA-KOMPAS (FK for short) and MORKMON are based on quarterly data. The other models are annual models.

CESAM describes the behaviour of economic subjects in the markets for goods and services, in the labour market and in financial markets. Total supply of goods and services is the sum of domestic production and imports of goods and services. Domestic production is described by means of a putty-clay vintage model. The vintage approach implies that the stock of capital is built up from capital of different vintages. The production model makes it possible to calculate total capacity output and total capacity demand for labour. Actual production is determined by effective demand. The demand for goods and services is modelled according to the System of National Accounts. Expenditure categories such as private consumption, gross fixed capital formation, inventory formation and exports of goods and services are modelled by means of behavioural equations. Price formation is modelled

Table 1. Dutch macroeconomic models.

Model	Institution	Reference
FREIA-KOMPAS	Central Planning Bureau	van den Berg <i>et al</i> [5]
MORKMON	Dutch Central Bank	De Nederlandsche Bank [23]
RASMUS	Erasmus University Rotterdam	De Groene <i>et al</i> [35]
KNOESTER	Ministry of Economic Affairs	Knoester [47]
CESAM	University of Groningen	

in the traditional way: prices are set as a mark up over the costs of production. The demand model and the supply model together determine the utilization rate of capital.

The labour market is modelled by relating employment (labour demand) to capacity demand for labour, and labour supply to rates of labour force participation. Labour supply is modelled for men and women separately, whereas labour demand is modelled as an aggregate. The nominal wage rate equation, describing nominal wage rates in enterprises, incorporates the wage-unemployment trade off (known as the Phillips curve effect).

The financial model is based on a statistical framework of financial accounts in which five sectors and twelve assets are distinguished. The behaviour of private banks and the private non-monetary sector is modelled in detail. The interest rates are determined either outside the market process (quantity adjustment) or by equilibrating supply and demand (price adjustment). Some interest rates are exogenous.

The submodel of the government sector describes spending and tax receipts of central and local government. Premiums received and benefits paid by social security funds are also modelled. The government submodel consists of about 150 equations and describes in detail the institutional structure of the Dutch public sector. Although the government submodel is relatively large in terms of number of equations, little attention will be paid to this part of the model in the paper. The reason is that the public sector as described in CESAM incorporates to a large extent institutional features which are specifically Dutch.

The structure of the complete model is given in Figure 1. The core of the model is the expenditure part together with wage and price formation. The supply side (capacity) has an impact on expenditure through capacity output and demand for labour. The utilization rate of productive capacity is used as an indicator for tension on the market for goods and services, influencing all markets. A second indicator is the unemployment

Figure 1. The main structure of CESAM.

— endogenous variables
 --- exogenous variables

rate, measuring tension on the labour market. This indicator also affects other market processes. The level of economic activity has an impact on financial transactions (real transmission). Monetary transmission, as opposed to real transmission, takes place through interest rates and wealth components. The government sector influences private income, the labour market and financial markets, while the development of the real and financial sphere affects public finance.

In the next sections CESAM is presented in more detail. The real part of the model (the market for goods and services and the labour market) is discussed in the second and third sections. The fourth section contains the financial model and discusses the interaction between the real and the financial part of the model. The fifth section discusses briefly the government submodel and the next section presents *ex post* simulation results for the period 1977–85. In the final section a summary is given and some conclusions are drawn.

The market for goods and services

The next two sections present the equations² of CESAM describing the real behaviour of the private sector of the Dutch economy. The financial behaviour of the private sector is discussed in the fourth section. In this section supply of goods and services, demand for goods and services and price formation are discussed; the labour market is discussed in the next section.

Capacity output and capacity demand for labour

In order to describe the development of capacity output and of capacity demand for labour a vintage approach is used (see den Hartog [37] for a survey on empirical vintage models for the Netherlands). The

² The equations are all listed in Appendix 1. The symbols used are listed in Appendix 2.

Figure 2. Putty-clay: *ex ante* and *ex post* isoquants.

vintage approach adopted in FK and in CESAM is very attractive from a theoretical point of view since it assumes that capital is heterogeneous and allows for embodied technical progress. The supply side in MORKMON, RASMUS and KNOESTER consists of factor demand functions derived from the concept of cost minimization. The production functions in these models are aggregate production functions, with homogeneous capital and with disembodied technical progress.

The vintage approach used in FK and in CESAM implies that the stock of capital is built up from capital of different vintages. The assumption of homogeneous capital is therefore relaxed. Within one vintage, however, capital is assumed to be homogeneous. Each year new equipment is installed and old equipment is scrapped if it becomes obsolete, in the sense of showing a negative quasirent. Furthermore, the vintage approach allows for embodied technical progress (see Allen [1]). The various vintages differ because of technical progress on the one hand and differences in labour intensity on the other.

Following Kuipers and van Zon [54] we assume substitutability *ex ante* between factors of production (labour and capital). *Ex post* labour and capital are complementary. This means that our vintage model is of the putty-clay variety. Diagrammatically, this means that the *ex ante* and *ex post* isoquants are no longer identical (see Figure 2).

Putty-clay implies that *ex ante* the firm can choose the optimal capital-labour ratio, say point A in Figure 2. Over the remainder of the economic lifetime of the machine (ie *ex post*) the factor proportion is fixed. Clay-clay vintage models like FK assume both *ex ante* and *ex post* complementarity between factors of production ie FK adopts a fixed coefficients technology (*ex post* and *ex ante* isoquants have the right-angled shape shown in Figure 3), whereas putty-putty models allow for continuous factor substitution as is shown in Figure 4 (smoothly curved isoquants).

Figure 3. Clay-clay: right-angled isoquants.

Figure 4. Putty-putty: smoothly curved isoquants.

As indicated above, the major difference between FK and CESAM concerns the substitution possibilities between different factors of production. The putty-clay specification in CESAM is more general. In his doctoral thesis Hausman [41] concludes that putty-clay is superior to clay-clay, both in terms of goodness of fit and predictive power. This means that putty-clay not only dominates clay-clay on theoretical grounds but outperforms clay-clay empirically as well.

There are, however, other differences between the vintage approach in CESAM and FK. These differences are listed in Table 2.

The characteristics of our putty-clay vintage model³ can be summarized as follows:

- (i) *ex ante* constant returns to scale CES technology;
- (ii) complementarity *ex post*;
- (iii) embodied labour and capital augmenting technical progress;

³ See Kuper et al [56].

Table 2. Differences in vintage models.

	FK	CESAM
Type of vintage model	Clay-clay	Putty-Clay
Production function	Complementary	CES
factors of production	Labour, capital, energy	Labour, capital
technical progress:		
embodied	Labour augmenting	Labour and capital augmenting
disembodied	Partly endogenous	Hicks neutral

- (iv) disembodied technical progress;
- (v) variable lifetime of the oldest equipment;
- (vi) the capital intensity of the newest equipment is determined by maximization of the net present value of investments over a fixed and exogenously determined expected lifetime.

Production structure

The *ex ante* production structure can be described by a constant returns to scale CES production function:

$$x_{\tau t} = [A \{(1 + \mu_n)^{\tau} N_{\tau t} h_{\tau}^{\delta_1}\}^{-\rho} + B \{(1 + \mu_i)^{\tau} i_{\tau t} h_{\tau}^{\delta_2}\}^{-\rho}]^{-1/\rho} \quad (1)$$

where

$x_{\tau t}$ = capacity output of vintage τ (first index) in period τ (second index)

$N_{\tau t}$ = capacity demand for labour of vintage τ in period τ

$i_{\tau t}$ = gross investment in equipment of vintage τ

h_{τ} = index of working hours in period τ

μ_n = rate of embodied labour augmenting technical progress

μ_i = rate of embodied capital augmenting technical progress

ρ = substitution parameter; the elasticity of substitution (σ) equals $1/(1 + \rho)$

A, B, δ_1, δ_2 are parameters

Ex ante, entrepreneurs can choose the most profitable production technique ie the optimal capital-labour ratio. *Ex post*, when the investment decision has been taken, the technical coefficients are fixed. They can change only as a consequence of a change in working hours and hours of operation for equipment on the one hand and disembodied technical progress on the other. The fixed coefficients production structure *ex post* can be described by the following equations:

$$x_{\tau t}/i_{\tau t} = (h_t/h_{\tau})^{\delta_2} (1 + \gamma)^{t-\tau} x_{\tau t}/i_{\tau t} \quad t \geq \tau \in V_t \quad (2)$$

$$x_{\tau t}/N_{\tau t} = (h_t/h_{\tau})^{\delta_1} (1 + \gamma)^{t-\tau} x_{\tau t}/N_{\tau t} \quad t \geq \tau \in V_t \quad (3)$$

After installation equipment deteriorates. In year t the value of vintage τ is:⁴

$$i_{\tau t} = \Omega_{t-\tau} i_{\tau t} \quad t \geq \tau \in V_t \quad (4)$$

where

$x_{\tau t}$ = capacity output of vintage τ in period t

$N_{\tau t}$ = capacity labour demand of vintage τ in period t

$i_{\tau t}$ = equipment of vintage τ in period t

γ = rate of Hicks neutral disembodied technical progress

V_t = set of vintages yielding a positive quasirent in in period t

$\Omega_{t-\tau}$ = technical survival fraction of equipment of vintage τ in period t

Equations (2) and (3) together with Equation (4) yield expressions for capacity output and capacity labour demand of the old vintages:

$$x_{\tau t} = \Omega_{t-\tau} (h_t/h_{\tau})^{\delta_2} (1 + \gamma)^{t-\tau} x_{\tau t} \quad t \geq \tau \in V_t \quad (5)$$

$$N_{\tau t} = \Omega_{t-\tau} (h_t/h_{\tau})^{\delta_2 - \delta_1} N_{\tau t} \quad t \geq \tau \in V_t \quad (6)$$

Equations (1), (5) and (6) provide a description of the production structure *ex ante* as well as *ex post*. In the next subsection attention is drawn to the choice of the optimal production technique.

Choice of production technique

We assume that entrepreneurs choose the production technique which maximizes the net present value (NPV) of investments over their expected lifetime (θ_1). Net present value is defined as:

$$NPV_{\tau} = \sum_{t=\tau}^{\tau + \theta_1 - 1} \{(x_{\tau t} - w_{\tau t}^e N_{\tau t})(1 + r)^{-(t-\tau)}\} - i_{\tau t} \quad (7)$$

where

θ_1 = expected lifetime of equipment

$w_{\tau t}^e$ = real wage rate expected in period τ for period t ($t \geq \tau$)

r = discount rate (assumed to be constant)

⁴ The survival function from which the survival reactions $\Omega_{t-\tau}$ are calculated can be written as a cumulative normal distribution.

Substitution of Equations (5) and (6) into Equation (7) yields:

$$NPV_t = x_{tt}\Sigma_1 - N_{tt}\Sigma_2 - i_{tt} \quad (8)$$

in which

$$\Sigma_1 = \sum_{t=\tau}^{\tau+\theta_1-1} \Omega_{t-\tau} (h_{tt}^e/h_t)^{\delta_2} (1+\gamma)^t (1+r)^{-(t-\tau)} \quad (9)$$

and

$$\Sigma_2 = \sum_{t=\tau}^{\tau+\theta_1-1} \Omega_{t-\tau} (h_{tt}^e/h_t)^{\delta_2 - \delta_1} w_{tt}^e (1+r)^{-(t-\tau)} \quad (10)$$

where h_{tt}^e is the expectation in period τ for the index of working hours for period t . The way expectations are formed is discussed in the next subsection.

Maximizing the net present value of investments, as defined by Equation (8), given the production function (1), yields the optimal production technique ie the optimal labour intensity:

$$(N_{tt}/i_{tt})^+ = [(B/A)[(1+\mu_i)/(1+\mu_n)]^{-\rho} h_t^{-p(\delta_2-\delta_1)\Sigma_2}^{-1/(1+\rho)} \quad (11)$$

Combining Equations (11) and (1), the optimal capital productivity of the newest vintage can be calculated as:

$$(x_{tt}/i_{tt})^+ = [A\{(1+\mu_n)^{\tau}(N_{tt}/i_{tt})^+ h_t^{\delta_1}\}^{-\rho} + B\{(1+\mu_i)^{\tau} h_t^{\delta_2}\}^{-\rho}]^{-1/\rho} \quad (12)$$

Equation (11) shows that the optimal labour intensity not only depends on the technological parameters A , B , μ_i , μ_n , r , δ_1 and δ_2 , but also on Σ_2 and hence on expected real wages, on the expected index of working hours, on technical depreciation and on the discount rate.

Formation of expectations

The above showed that the optimal labour intensity is dependent on expected real wages and on the expected index of working hours. In our model expectations are formed in a very simple way: entrepreneurs are assumed to expect constant relative changes in real wages and in the index of working hours ie:

$$w_{tt}^e = w_t (1 + gw_t^e)^{t-\tau} \quad t \geq \tau \quad (13)$$

$$h_{tt}^e = h_t (1 + gh_t^e)^{t-\tau} \quad t \geq \tau \quad (14)$$

It is further assumed that expected growth rates (gw_t^e , gh_t^e) are calculated as the averages of the growth rates over the last θ_2 years:

$$gw_t^e = (1/\theta_2) \sum_{j=\tau-\theta_2+1}^{\tau} (w_j - w_{j-1})/w_{j-1} \quad (15)$$

and

$$gh_t^e = (1/\theta_2) \sum_{j=\tau-\theta_2+1}^{\tau} (h_j - h_{j-1})/h_{j-1} \quad (16)$$

So, in our model expectations are based on the past and the present ie the expectations are backward looking.

Scrapping condition

In order to calculate total capacity output and total capacity demand for labour for a certain year we have to determine which vintages are still in production ie we have to determine which vintages have become obsolete and should therefore be scrapped. In Kuipers and van Zon [54] scrapping of vintages depends on real wage rates and labour productivity only, according to

$$w_T > x_{tT}/N_{tT} \quad (17)$$

However, due to a sustained situation of underutilization of productive capacity in the period after 1979, it seems reasonable to assume that underutilization of productive capacity leads to additional scrapping of equipment (see Kuipers and Kuper [53]). Both FK and CESAM take account of the level of utilization in the scrapping of vintages. The scrapping condition in CESAM is reformulated as follows: vintage τ is scrapped in year T if⁵

$$\left. \begin{aligned} w_T &> \bar{q}_{x\tau} x_{tT}/N_{tT} & \text{if } \bar{q}_{x\tau} < 0.95 \\ \text{and} \\ w_T &> x_{tT}/N_{tT} & \text{if } \bar{q}_{x\tau} \geq 0.95 \end{aligned} \right\} \quad (18)$$

The average utilization rate $\bar{q}_{x\tau}$ is defined as:

$$\bar{q}_{x\tau} = \frac{1}{3} \sum_{j=1}^3 q_{x\tau-j} \quad (19)$$

⁵ The boundary value for the utilization rate is set, *ad hoc*, to 0.95.

where

$x_{\tau T}/N_{\tau T}$ = labour productivity of vintage τ in period T

$q_{x\tau}$ = utilization rate of productive capacity in period T , defined as the ratio of current output and total capacity output

w_T = real wage rate, defined as a three-year uniformly distributed lag

The economic lifetime is $T - \tau$. It is decisive if it is smaller than the maximum technical lifetime S . If $S < T - \tau$, equipment is scrapped on technical grounds.

Aggregation

Finally, total capacity output (x_t), total capacity demand for labour (N_t) and the total stock of capital (k_t) can be calculated. These aggregates depend on: (i) the lifetime of equipment; (ii) the initial amount of equipment in use; (iii) the rate of technical progress; and (iv) the choice of the production technique. In formulas:

$$x_t = \sum_{\tau \in V_t} x_{\tau t} \quad (20)$$

$$N_t = \sum_{\tau \in V_t} N_{\tau t} \quad (21)$$

and

$$k_t = \sum_{\tau \in V_t} i_{\tau t} \quad (22)$$

The variables $x_{\tau t}$, $N_{\tau t}$ and $i_{\tau t}$ are defined by Equations (5), (6) and (4) respectively. The set of vintages that yield a non-negative quasirent (V_t) is calculated in the manner described above.

Estimation results

In estimating the vintage model we excluded the energy sector. The behaviour in the energy sector deviates from that in other industrial sectors. To avoid disturbances from the energy sector on the estimation results, gross investment and employment in the energy sector are exogenous.

The parameters are estimated using the non-linear estimation method (NLEM) developed by Berndt *et al* [6]. A number of parameters have been fixed *a priori* in order to reduce the number of parameters to be estimated:

- (i) The elasticities of capacity output and capacity demand for labour with respect to working hours (δ_1 and δ_2) are fixed at den Hartog's and Tjan's [40] *a priori* estimates ie $\delta_1 = \delta_2 = 0.75$.

Table 3. Estimation results.

Fixed *a priori*

$$\begin{aligned} \delta_1 &= 0.75 & r &= 0.02 \\ \delta_2 &= 0.75 & \theta_2 &= 4 \end{aligned}$$

Estimated using NLEM

$$\begin{aligned} \sigma &= -0.25 & \theta_1 &= 13 \\ \mu_n &= 0.048 & A &= 0.009 \\ \mu_i &= 0.002 & B &= 0.483 \\ \gamma &= -0.012 \text{ (during the 1950s)} \end{aligned}$$

The minimum value of the objective function

$$F = 0.133$$

- (ii) For the discount rate (r), the average real rate of interest of consols is used: $r = 0.02$.
- (iii) The number of preceding periods over which the expected values of the real wage rate and the number of working hours (θ_2) are calculated is set equal to the number derived in Kuipers and van Zon [54]: $\theta_2 = 4$.

Ignoring time indices, we can define the objective function to be minimized as:

$$F = \sum ((q_x - 1)/q_x)^2 + \sum ((q_N - 1)/q_N)^2 \quad (23)$$

where

F = the value of the objective function

q_x = the utilization rate of productive capacity

q_N = the utilization rate of capacity demand for labour

The utilization rates of productive capacity (q_x) and of capacity demand for labour (q_N) are defined as: v_{oa}/x and a_{bx}/N respectively where v_{oa} is current output and a_{bx} is current employment. x and N are defined above as total capacity output and total capacity demand for labour.

The results which minimize the objective function F are listed in Table 3. For more details we refer to Kuper *et al* [56].

Finally, the results improve by setting the rate of Hicks neutral disembodied technical progress to -1.5% for the 1980s to account for the factor productivity slowdown. By doing so we compensate for the overestimation of capacity output in the 1980s.

Expenditure

Regarding national expenditure we base our model on the System of National Accounts (SNA) published by the Central Bureau of Statistics (CBS). Table 4 lists the primary economic aggregates in CESAM. The

Table 4. Macroeconomic aggregates (1985).

		Billion hfl
+ Consumption		
by households	C_p	244.790
by general government	C_o	67.460
+ Gross fixed capital formation		
of enterprises	I_b	66.450
of general government	I_o	10.920
+ Increase in stocks	ΔVR	5.110
+ Exports of goods and services (fob)	EX	266.290
– Imports of goods and services (cif)	IM	245.950
= Gross domestic product	BPR	415.070

Source: National Accounts 1986.

variables listed in Table 4 are all endogenous. Gross investment in equipment and means of transport, as part of gross fixed capital formation by enterprises, is estimated by means of the results of the putty-clay model described in the previous subsection. Energy is excluded from the enterprise sector in the equations for exports of goods and services, employment and investment in equipment and means of transport.

Most equations are specified in relative first differences, defined as $\hat{x} = 100 \cdot (x - x_{-1}) / x_{-1}$. This subsection focuses on describing the development of economic variables at constant prices which are indicated by lower case characters; the next subsection will describe the determination of prices. The equations are estimated using ordinary least squares (OLS) unless otherwise stated.⁶

Consumption

In CESAM total consumption consists of consumption of households and consumption of general government. Before discussing consumption of households we will briefly focus attention on consumption of the public sector.

As will be pointed out later, the public sector is divided into three subsectors: central government, local government and the social security sector. Consumption of the public sector consists of total wages (including social security contributions) and net material consumption. Net material consumption of central government in constant prices acts as a macro-economic policy instrument and is therefore exogenous. Net material consumption of local government is negatively influenced by the unemployment rate indicating that local government expenditure is falling when unemployment and hence income transfers to households are increasing.

⁶ All equations are estimated by means of ESP (The Econometric Software Package [28]).

Consumption by households (c_p) depends on:

- real disposable income of households, which is divided up into wages, salaries and social security benefits (l_b) and other income (nl_b);
- the real interest rate (r_r), defined as the average of the nominal interest rates on long-term government debt (r_{ss}) and on short-term government debt (r_{sk}) minus lagged inflation;
- real wealth of the private sector (W^{ps}/p_c). The wealth of the private sector is defined as the sum of financial assets of all non-monetary institutions and households. It does not include the capital stock of corporations.

Estimation yields the following results:⁷

$$\hat{c}_p = 0.728 \hat{l}_b + 0.10 \hat{nl}_b - 0.251 r_{r,-1} + 0.135 (W^{ps}/p_c)_{-1} \quad (24)$$

(18.13) (–) (2.28) (3.22)

Estimation period: 1959–85 $\bar{R}^2 = 0.83$ DW = 2.46

The marginal propensity to consume (MPC) of the various income categories, l_b and nl_b , can now be calculated as the product of the elasticity of consumption and the ratio of consumption and the income variable under consideration. For the year 1980 this results in $MPC(l_b) = 0.79$ and $MPC(nl_b) = 0.48$. The coefficient for the other income variable is fixed *a priori* and is indicated by (–).⁸

Comparing the consumption equation in the various models of the Dutch economy we can conclude that, by and large, the same specification is adopted:

$$C = c \text{ (disposable income, interest rate, wealth)}$$

⁷ Terms within parenthesis are *t*-statistics. $\bar{R}^2$ is the adjusted coefficient of determination. DW is the Durbin–Watson statistic and *h* is Durbin's *h* statistic. The latter test is added because the Durbin–Watson statistic is asymptotically biased toward the acceptance of the null hypothesis and the power of DW is low in the presence of lagged dependent variables. The *h* statistic is calculated as:

$$h = r_1 \sqrt{T/(1 - T\hat{V})} \quad \text{if } T\hat{V} < 1$$

r_1 is the first order autocorrelation coefficient calculated from the OLS residuals; it can be replaced by $1 - DW/2$, see for instance Judge *et al* [44]. *T* is the sample size and $\hat{V}$ is the estimated variance of the OLS estimator of the lagged dependent variable. The *h* statistic is asymptotically distributed as a $N(0, 1)$ random variable under the null hypothesis $H_0: r_1 = 0$.

⁸ The parameter for other income becomes insignificant when estimating the complete equation. The fixed parameter value is based on regressions with a slightly different equation.

As far as the differences are concerned a few remarks are in order:

- (i) MORKMON and RASMUS use nominal interest rates, which is unsatisfactory from a theoretical point of view, but might have empirical relevance.
- (ii) FK, MORKMON and CESAM use a wealth variable, containing wealth of corporations, households and institutional investors. Objections can be raised to this total wealth variable. Time series of household wealth are not available so total wealth is used as a proxy variable.
- (iii) KNOESTER specifies a buffer stock variable, which represents monetary disequilibrium. Accounting for monetary disequilibrium seems to be advantageous. However, KNOESTER does not allow for disequilibrium in the real sphere: if disequilibrium is assumed in the monetary sphere, the real sphere is likely to be in disequilibrium too.
- (iv) A similar argument can be made with respect to the RASMUS specification, where the unemployment rate is used as a proxy for uncertainty.

The FK specification of consumption of households is perhaps slightly preferable to the CESAM specification: three income categories are distinguished. Household wealth, although not endogenous in FK, and revaluation of wealth in housing are included. None of the models accounts for revaluation of wealth due to changes in prices of shares.

Gross fixed capital formation

Before treating investment of the private sector in full detail we first discuss investment of the public sector. Investment by the central government in constant prices is modelled as a policy instrument and is therefore exogenous. Investment by local government, on the other hand, is assumed to depend on the real interest rate and on the labour market situation. The latter indicates the effect of decreasing government expenditure as a consequence of increasing unrequited income transfers to households due to increasing unemployment.

The investment equations for the private sector in economic models of the Dutch economy do not show large differences. Most models include output and interest rates. Furthermore, all models distinguish between investment in equipment and investment in non-residential buildings.

Looking at the differences between the various models, we see that:

- (i) MORKMON does not specify an inventory equation, because total production by enterprises

Table 5. Gross fixed capital formation of enterprises (1985).

		Billion hfl
Type of capital good		
Equipment and means of transport	I_{ou}	34.333
Non-residential buildings	I_{qb}	10.948
Dwellings	I_{wo}	19.655
Other investment	I_{or}	1.514
Gross fixed capital formation	I_b	66.450

Source: National Accounts 1986.

- is modelled by means of a behavioural equation. Therefore inventory formation is a residual.
- (ii) MORKMON does not include a capital stock variable in the investment equations; the accelerator mechanism has not been incorporated.
- (iii) MORKMON emphasizes the credit facilities needed for investment. However, the financial variables refer to the transactions of corporations, households and institutional investors.
- (iv) MORKMON, RASMUS and CESAM include nominal interest rates as explanatory variables, which is unsatisfactory from a theoretical point of view.
- (v) FK and CESAM implicitly account for the influence of working hours via the index of working hours in the vintage model.
- (vi) KNOESTER uses the monetary buffer as an explanatory variable; CESAM specifies tension indicators for the labour market and the market for goods and services which influence other market processes.
- (vii) FK is the only model including a scrapping variable in the investment equation.

The above indicates the differences between the models concerning the specification of the investment equations. We now discuss the investment equations incorporated in CESAM.

Gross fixed capital formation of enterprises (i_b) is subdivided according to the type of capital good, as listed in Table 5. Other investment as well as investment in dwellings is assumed to be exogenous in our model.

Gross investment in equipment and means of transport
The behavioural equation which describes gross investment in equipment and means of transport of the private non-monetary sector, excluding energy, (i_{ou}), is specified on the basis of the putty-clay vintage model. Gross investment in equipment and means of transport for the energy sector is exogenous.

Gross investment in equipment and means of transport (i_{ou}) is a geometrically distributed lag function

of the desired increase in total capacity output (Δx^*):

$$i_{oa}\chi - i_{oa-1}\chi_{-1} = \theta(\Delta x^* - i_{oa-1}\chi_{-1}) + d_{oa} - (1 - \theta)d_{oa-1} \quad (25)$$

with $0 < \theta < 1$, where

i_{oa} = gross investment in equipment and means of transport of enterprises, excluding energy
 d_{oa} = depreciation in terms of productive capacity
 χ = the capital coefficient of the newest vintage, or $(x_{tt}/i_{tt})^+$, according to Equation (12)
 x = total productive capacity

Depreciation (d_{oa}) in period t is calculated as the difference between capacity output of the newest vintage (x_{tt}) and the desired increase in capacity output (Δx_t^*). The desired increase in capacity output is dependent on the increase in current output of enterprises with the exclusion of energy (v_{oa}), real disposable income of enterprises, again excluding energy (zd_{oa}), the absolute change in the long-term interest rate (Δr_{ss}), the relative change in the utilization rate (q_x) and the acceleration of inflation (Δp_v). The last variable shows that a rapid increase in inflation evokes uncertainty, which tempers investment. Real disposable income of enterprises is calculated as current output corrected for wage costs, depreciation, direct taxes on non-labour income and subsidies.

Estimation yields:

$$\begin{aligned} i_{oa}\chi = & 0.693 i_{oa-1}\chi_{-1} + 0.178 \Delta v_{oa} + 0.061 zd_{oa-1} \\ & (12.90) \quad (7.14) \quad (5.37) \\ & - 230.294 \Delta r_{ss} + 135.272 \hat{q}_{x-1} \\ & (1.71) \quad (3.47) \\ & - 234.210 \Delta \hat{p}_{v-1} \quad (26) \\ & (3.76) \end{aligned}$$

Estimation period: 1956–85 $\bar{R}^2 = 0.97$
 $h = -0.07$ DW = 2.45

The real interest rate turned out to be insignificant; on statistical grounds we included the change in the nominal interest rate. The depreciation term in Equation (25) drops out since $d_{oa} - (1 - \theta)d_{oa-1}$ is approximately a white noise process.

Gross investment in non-residential buildings Net investment in non-residential buildings (i_{gb}^n) is dependent on gross output of enterprises (v), the price index of investment in non-residential buildings (p_{igb}), the unemployment rate (u) and an indicator *CONJ* measuring tension on the market for goods and services. *CONJ* is defined as the sum of increases in

stocks and work in progress and the current account on the balance of payments, as a percentage of net national income (at market prices).

Estimation of the equation, as described above, yields:

$$\begin{aligned} i_{gb}^n = & 1.415 \hat{v} - 3.443 \Delta CONJ - 0.548 \hat{p}_{igb} \\ & (2.20) \quad (3.32) \quad (1.43) \\ & - 2.127 \Delta u \quad (27) \\ & (1.51) \end{aligned}$$

Estimation period: 1965–85 $R^2 = 0.56$
DW = 1.94

Increase in stocks and work in progress

We distinguish three motives for keeping stocks:

- (i) a transaction motive: stocks depend on expected output ($\hat{v}_{-1}$);
- (ii) the precautionary motive: stocks cover events of a more uncertain nature ($\Delta \hat{v}$);
- (iii) the speculative motive: price changes in the imports of goods and services ($\Delta \hat{p}_m$) affect the stocks of raw materials and intermediate products.

Estimation of the equation incorporating these motives leads to:

$$i_r = 0.322 \hat{v}_{-1} + 0.194 \Delta \hat{v} + 0.032 \Delta \hat{p}_m \quad (28)$$

(14.50) (5.50) (2.48)

Estimation period: 1956–85 $\bar{R}^2 = 0.71$
DW = 1.61

Exports of goods and services

Models of the Dutch economy show a remarkable resemblance in their explanations of exports of goods and services. All models, except MORKMON, include supply side factors like the investment–income ratio. Most models exclude energy. RASMUS and KNOESTER do not exclude energy, which, in the Dutch case, certainly disturbs the results. MORKMON excludes ships and aircraft and energy. Exports of services do not seem to behave differently from exports of goods.

In CESAM exports of goods and services of enterprises, from which energy is excluded, (ex_{xa}), depend on:

- (i) double weighted (that is for product category and country of destination) world trade (ex_c);
- (ii) foreign competition, measured as the ratio between the domestic export price of goods and services (p_{exa}) and export price on foreign markets (p_{exa}), both excluding energy;

- (iii) gross fixed capital formation as a percentage of gross domestic product (IQ) compared with the same ratio for total OECD (IQ_{OECD}). This ratio is a proxy for the access of domestic enterprises to foreign markets.

The estimated equation is:

$$\begin{aligned} \dot{x}_{xa} = & 0.388 \Delta \dot{x}_c - 1.7 (\dot{p}_{exa} - \dot{p}_{exc})_{-1/2} \\ & (4.66) \quad (-) \\ & + 1.334 (IQ - IQ_{OECD})_{-1} + 6.909 \quad (29) \\ & (5.50) \quad (15.03) \end{aligned}$$

Estimation period: 1971–85 $\bar{R}^2 = 0.79$
DW = 1.73

The coefficient for the price ratio is fixed *a priori* on results presented by Brakman *et al* [8]. The change in the growth rate of world trade is preferred to the level of the growth rate of world trade on statistical grounds. The simulation model includes an export equation in which the level of the growth rate of world trade is included:

$$\begin{aligned} \dot{x}_{xa} = & \dot{x}_c - 1.7(\dot{p}_{exa} - \dot{p}_{exc})_{-1/2} \\ & + 1.334(IQ - IQ_{OECD})_{-1} + \dot{x}_{xa}^{aut} \quad (30) \end{aligned}$$

Imports of goods and services

In specifying the import equation, CESAM, RASMUS and KNOESTER do not exclude energy. MORKMON excludes energy and ships and aircraft. FK presents the most detailed description of import categories. In some models inventory formation and capacity utilization are included.

The structure of the equations is almost the same in each of the models: imports are related to domestic demand and the price ratio of imports and output:

$$\begin{aligned} \dot{m} = & 1.502 \dot{v} - 0.329(\dot{p}_m - \dot{p}_v)_{-1/2} \quad (31) \\ & (13.42) \quad (2.87) \end{aligned}$$

Estimation period: 1955–85 $\bar{R}^2 = 0.80$
DW = 2.38

Prices

In all models, prices are set via a mark up over production costs. Some remarks with respect to the price formation should be made:

- (i) MORKMON and CESAM do not assume linear homogeneous price functions in other prices.
- (ii) The models show a wide variety with respect to price categories distinguished.
- (iii) Import prices, production costs, taxes and utilization rates are often used as explanatory variables.

In CESAM, and in the other models, prices are set as a mark up over production costs. Labour costs are measured by unit wage costs, and import costs by the price index of imports of goods and services. Costs of capital are measured by interest rates. Furthermore, prices may depend on market factors, indicated by the indicator *CONJ* and by the utilization rate of productive capacity (q_x).

The price index of consumption

The price index of consumption (p_c) depends on the price index of imports of goods and services (p_m), on the nominal wage costs per unit of output ($W.a/v$) and on the change in indirect taxes minus subsidies as a percentage of gross output (T_k):

$$\begin{aligned} \dot{p}_c = & 0.208 \dot{p}_{m-1} + 0.517 (\dot{W} + \dot{a} - \dot{v})_{-1/2} \\ & (4.79) \quad (7.67) \\ & + 2.305 T_{k-1} \quad (32) \\ & (4.00) \end{aligned}$$

Estimation period: 1956–85 $\bar{R}^2 = 0.76$
DW = 1.97⁹

The price index of net material consumption of the public sector (p_{nmc}) is a weighted average of the price index of private consumption and the price index of imports of goods and services. The former price variable is described in Equation (32) above, while the latter price variable is exogenous.

The price index of gross fixed capital formation

Just like gross fixed capital formation itself, the price index of gross fixed capital formation is subdivided according to the type of capital goods: (i) equipment and means of transport; (ii) non-residential buildings; and (iii) dwellings (exogenous).

The price index of investment in equipment and means of transport The price index of investment in equipment and means of transport (p_{iou}) depends on the nominal wage costs per unit of output ($W.a/v$) and on the price index of imports of goods and services (p_m):

$$\begin{aligned} \dot{p}_{iou} = & 0.471 \dot{p}_{m-1} + 0.298 (\dot{W} + \dot{a} - \dot{v})_{-1/2} \quad (33) \\ & (6.45) \quad (4.12) \end{aligned}$$

Estimation period: 1957–85 $\bar{R}^2 = 0.62$
DW = 1.42

⁹ The equations for the price index of consumption (p_c) and the nominal wage rate (W) are estimated simultaneously, using 3SLS. The values of $\bar{R}^2$ and DW relate to OLS estimates.

The price index of investment in non-residential buildings
Besides the lagged dependent variable, the price index of investment in non-residential buildings (p_{igb}) is dependent on the wage costs (nominal) per unit of output ($W \cdot a/v$) and on the capital market interest rate (r_{ss}):

$$\begin{aligned} \hat{p}_{igb} = & 0.413 \hat{p}_{igb-1} + 0.536 (\hat{W} + \hat{a} - \hat{v}) + 1.005 \Delta r_{ss} \\ & (3.67) \quad (4.36) \quad (2.33) \end{aligned} \quad (34)$$

Estimation period: 1957–85 $\bar{R}^2 = 0.75$
 $h = 1.46$ $DW = 1.57$

The price index of public sector investment (p_{io}) is related to the price index of private sector investment in non-residential buildings and to the price index of private sector investment in equipment and means of transport.

The price index of exports of goods and services

The price index of exports of goods and services, excluding energy, (p_{exa}), primarily depends on the price index of imports of goods and services (p_m). Nominal wage costs per unit of output ($W \cdot a/v$) are also included:

$$\begin{aligned} \hat{p}_{exa} = & 0.803 \hat{p}_m + 0.073 (\hat{W} + \hat{a} - \hat{v})_{-1} \\ & (27.82) \quad (1.72) \end{aligned} \quad (35)$$

Estimation period: 1970–85 $\bar{R}^2 = 0.98$
 $DW = 1.29$

The labour market

All models of the Dutch economy specify labour demand and labour supply equations. In general, as mentioned earlier, government labour demand is exogenous in all models. Labour demand by the private sector depends on capacity demand for labour. Labour supply is related to: exogenous structural labour supply (the labour force depends on demographic factors and participation rates); the (real) wage rate; and the discouraged worker effect. FK assumes the labour market to be in disequilibrium, in such a way that employment does not exceed the minimum of demand and supply.

The discussion of the specification of the labour market in CESAM is divided into three parts. First, the demand for labour (in man years) is determined mainly by capacity demand for labour. Second, labour supply (in persons) depends on labour force participation rates. Labour supply is divided into male and female labour supply. Third, the wage rate equation is presented.

Demand for labour

Actual labour demand, or employment, is related to capacity demand for labour as calculated in the vintage model. Employment in the enterprise sector, excluding exogenous employment in the energy sector, (a_{bx}), is dependent on the desired level of employment, (a_{bx}^*), according to a stock adjustment equation:

$$a_{bx} - a_{bx-1} = \theta(a_{bx}^* - a_{bx-1}) \quad 0 < \theta < 1 \quad (36)$$

where

a_{bx} = total employment in the enterprise sector, excluding energy

a_{bx}^* = desired employment in enterprises, excluding energy

Desired employment follows from the assumption that:

$$q_N^* = q_{N-1} + \beta \Delta q_x \quad \beta > 0 \quad (37)$$

where

q_N^* = desired utilization rate of capacity demand for labour, defined as a_{bx}^*/N

q_x = utilization rate of productive capacity

N = total capacity demand for labour as defined by Equation (21)

Equation (37) implies that the change in desired utilization with respect to capacity demand for labour changes proportionally to the change in the utilization rate of productive capacity. Substituting (37) into (36) yields:

$$a_{bx} = \theta\beta(\Delta q_x)N + \theta(\Delta N)q_{N-1} + a_{bx-1} \quad (38)$$

Estimation of this equation yields:

$$\begin{aligned} a_{bx} = & 0.203 \Delta q_x \cdot N + 0.396 \Delta N \cdot q_{N-1} + 0.999 a_{bx-1} \\ & (2.13) \quad (4.51) \quad (490.69) \end{aligned} \quad (39)$$

Estimation period: 1966–85 $\bar{R}^2 = 0.89$ $h = 0.79$
 $DW = 1.65$

Total employment ie employment in the private sector and in the public sector, is defined as:

$$av = a_{bx} + a_{ba} + a_v \quad (40)$$

where

a_{ba} = employment in the energy sector (exogenous)
 a_o = employment in the public sector
 av = total employment in man years (demand for labour)

Labour supply

Male and female labour supply (aa_m and aa_v) is related to participation rates (P_m and P_v) and to the size of the male and female population (TB_m and TB_v), according to:

$$aa_v = P_v \cdot TB_v / 100 \quad (41)$$

and

$$aa_m = P_m \cdot TB_m / 100 \quad (42)$$

where

TB_v = size of the female population (exogenous)
 TB_m = size of the male population (exogenous)
 P_m = male participation rate
 P_v = female participation rate
 aa_v = female labour supply (in persons)
 aa_m = male labour supply (in persons)

Changes in participation rates are described by means of behavioural equations relating labour force participation rates to labour market conditions:

$$\Delta P_m = -0.007 \text{ } wkl_{m-1} + 0.015 \text{ } wkl_{v-1} - 0.540 \quad (43)$$

(3.82) (4.21) (4.44)

Estimation period: 1974–85 $\bar{R}^2 = 0.62$
 DW = 2.53

and

$$\Delta P_v = -0.011 \text{ } wkl_{v-1} - 0.060 \text{ } \hat{w}^{net} + 0.260 \text{ } trend \quad (44)$$

(4.66) (3.03) (6.19)

Estimation period: 1974–85 $\bar{R}^2 = 0.75$
 DW = 2.35

where

wkl_m = number of unemployed men
 wkl_v = number of unemployed women
 $\hat{w}^{net}$ = net average real wage rate
 trend = time trend

The equations above include the so-called encouraged worker effect: female unemployment affects male participation in a positive way. The negative response of male unemployment or male participation is known as the discouraged worker effect. *Mutatis mutandis* the same holds for female participation. Furthermore, female participation is dependent on the net average real wage rate. The net real wage rate ($\hat{w}^{net}$) is defined as the nominal net wage rate (W^{net}) deflated with the price index of consumption (p_c).

Unemployment in persons and divided by sex (wkl_m and wkl_v) can now be calculated as

$$wkl_m = aa_m - \lambda \cdot bb_m / (bb_m + bb_v) av \quad (45)$$

and

$$wkl_v = aa_v - \lambda \cdot bb_v / (bb_m + bb_v) av \quad (46)$$

for men and women respectively, where

bb_m = male labour force
 bb_v = female labour force
 λ = recalculation factor,¹⁰ used to calculate the number of persons from the number of man years

Defining a as total employment in enterprises (excluding self employed), the rate of unemployment (u) follows from:

$$u = 100 \cdot wkl / (a + a_o + wkl) \quad (47)$$

where wkl is the total number of unemployed persons.

The nominal wage rate

With respect to the wage rate, all models of the Dutch economy include the Phillips curve effect, labour productivity and a tax shift variable.

The models differ with respect to the presence or absence of money illusion. In FK, CESAM, RASMUS and KNOESTER there is no money illusion; the shift factor with respect to prices is assumed to be equal to one. MORKMON assumes money illusion.

In CESAM the nominal wage rate (W) depends on the consumer price index (p_c) and on the unemployment rate (u), reflecting the wage–unemployment trade off suggested by Phillips. Furthermore, labour productivity (v/a) and tax shift variables $\Delta pr_{b_{wm}}$ and Δpr_{w_g} are introduced. The tax shift variables indicate a shift of direct taxes on wage income and social security

¹⁰ The parameter λ is assumed to be equal for men and women and is calculated as: $\lambda = [aa_m + aa_v - (wkl_m + wkl_v)] / av$.

contributions of employees (Δprb_{wn}) and a shift of social security contributions of employers (Δpr_{wg}), both as a percentage of wages and salaries. The coefficients for the price variable and the labour productivity variable are fixed *a priori*.

$$\begin{aligned} \dot{W} = & -2.232 + 1.0 \dot{p}_c + 1.0(\dot{v} - \dot{a})_{-1} + 6.635 \, 1/u \\ & (3.32) \quad (-) \quad (-) \quad (6.30) \\ & + 0.862 \Delta pr_{wg} + 0.428 \Delta prb_{wn} \quad (48) \\ & (2.32) \quad (1.70) \end{aligned}$$

Estimation period: 1956–85 3SLS $\bar{R}^2 = 0.93$
DW = 2.06

The results show that employees shift about 43% of increases in taxes and social security contributions to employers. Employers do not fully adjust wage rates to increases in social security contributions.

The equation above describes the formation of the wage rate in the private sector. The wage rate in the public sector ($\dot{W}_o$) is linked to the contractual wage rate in the private sector ($\dot{I}^{RL}$). The latter obviously depends on the gross nominal wage rate in the private sector ($\dot{W}$). The wage rate in the public sector may deviate from the private sector contractual wage rate due to specific policy measures of the government. If $\dot{W}_o^{aut}$ indicates the autonomous public sector wage rate and β_{wo} indicates the degree to which the public sector wage increase does not follow that in the private sector, then the public sector wage equation can be written as:

$$\dot{W}_o = \dot{I}^{RL}(1 - \beta_{wo}) + \dot{W}_o^{aut} \quad (49)$$

The financial submodel

All models of the Dutch economy discussed in this paper are based on a closed system of financial accounts. Furthermore, they all contain five sectors. However, there are differences in the asset categories distinguished in the models. These differences relate to the distinction between short-term and long-term assets and to government debt and private sector credit.

The financial block forms a substantial part of CESAM. It contains 30 equations of which 19 are behavioural. In this section a brief description of the financial submodel is given. Detailed information is provided by Sterken [68]. The general outline of the model is discussed first. Next, the specification of the model is presented in detail and monetary as well as fiscal instruments are listed. Estimation results are then given. The final subsection deals with the transmission between the real and the financial side of the model.

General outline

The basic philosophy underlying the financial submodel can be described in the following way:

- (i) The statistical starting point is the financial framework in which rows represent asset markets and columns represent the market participants. Each row and each column adds up to zero, which implies that market equilibrium conditions and balance sheet restrictions are satisfied.
- (ii) The specification of financial behaviour of market participants is modelled in accordance with portfolio theory as developed by Brainard and Tobin [7].
- (iii) On four markets the interest rates are determined by demand and supply: on the market for short-term and long-term bank credit and on the market for short-term and long-term government debt.
- (iv) Government debt is distinguished as short-term and long-term debt. This is done in order to evaluate different methods of debt management. Monetary policy instruments are the discount rate, a credit restriction variable and a liquidity constraining variable.
- (v) Real transmission takes place through a number of variables. Besides equilibrium variables, tension indicators in the goods and labour market are included. These variables take care of disequilibrium transmission from the real part of the model to the financial sphere.

Five sectors are distinguished in the financial model: central bank (CB), private banks (PB), private non-monetary sector (PS), government (G) and foreign sector (F). The behaviour of central bank and other government sectors is exogenous. The foreign sector demands long-term government debt (SS_d^f) only. The behaviour of private banks and of the private non-monetary sector is modelled by means of portfolio models, in which the following assets are distinguished: currency (L_c), demand deposits (L_g), short-term and long-term time and savings deposits (TDK and TDL), short-term and long-term bank credit (BCR and CR), short-term and long-term government debt (SK and SS), international reserves (IR), cash and balances with the central bank (R), discounts and advances (H) and net foreign assets (NFA). The corresponding financial framework is listed in Table 6. The last row in Table 6 represents the wealth position (W) of the foreign sector, the private non-monetary sector and the government sector. Other net liabilities (ONL) of the central bank are exogenous. Total government wealth depends on debt creation by the government. The financial liabilities of private banks are demand

Table 6. Monetary framework at the end of 1985 (billion hfl).

Assets	Financial sectors				
	Central bank	Private banks	Private sector	Government	Foreign
IR	24.7				-24.7
NFA		18.0	72.4		-90.4
H	5.6	-5.6			
R	-1.9	1.9			
KT ^{cb}	-3.3			3.3	
L _c	-27.4		28.9	-1.5	
L _G		-59.7	59.7		
TDK		-66.4	66.4		
TDL		-150.2	150.2		
SK	1.9	16.4	3.0	-21.3	
SS	1.1	44.0	210.6	-278.4	22.7
BCR		91.3	-91.3		
CR		143.8	-143.8		
W/ONL	-0.7	-33.5	-356.1	297.9	92.4

Source: De Nederlandsche Bank, Jaarverslag, Kluwer, Deventer, various issues; De Nederlandsche Bank, *Monetaire Statistische Jaaren Kwartaalreeksen 1957-1983*, Kluwer, Deventer, 1985.

deposits and short-term and long-term time and savings deposits. The item in the last row of private banks represents other net liabilities. Other net liabilities are determined by portfolio considerations. Foreign financial wealth is accumulated by the surplus on the current account of the balance of payments (apart from some minor statistical differences). Financial wealth of the private non-monetary sector is now determined as a residual. This means that wealth of the private non-monetary sector is positively related to the government budget deficit and to the surplus on the current account of the balance of payments, and negatively related to the wealth of the central bank and to other net liabilities of private banks.

Specification

The theoretical background for our model is provided by Brainard and Tobin [7]. They introduce the portfolio approach within a complete financial model, which finds its statistical base in a financial framework as presented in Table 6. One of the properties of this specification is that market equilibrium conditions and balance sheet restrictions have to be met. This implies that portfolio models have to be estimated under these restrictions.

For both private banks and the private non-monetary sector we formulate a portfolio model of the following type (compare Friedman [31]):

$$\Delta A_t / W_{t-1} = E[r_t, W_t / W_{t-1}, Z_t] + C A_{t-1} / W_{t-1} + u_t \quad (50)$$

where

A_t = vector of asset holdings

W_t = total wealth

r_t = vector of interest rates

Z_t = vector of miscellaneous regressors

E, C = matrices of parameters

u_t = vector of disturbances

Relation (50) implies that actual asset holdings adjust to desired holdings, which depend on the levels of interest rates and total wealth. The portfolio of private banks consists of eight assets and liabilities, which are endogenous in the portfolio model: demand for net foreign assets (NFA^{pb}), supply of short-term and long-term bank credit (BCR and CR), demand for discounts and advances (H), demand for cash balances (R) and demand for short-term and long-term government debt (SK_d^{pb} and SS_d^{pb}) and a balancing item (ONL^{pb}). Liabilities of private banks consist of supply of time and savings deposits (TDK and TDL) and demand deposits (L_G) to the private non-monetary sector. Wealth of private banks forms a restriction on portfolio investments. This additive constraint requires that increases in predetermined items be fully absorbed into the portfolio model and that reallocations within the portfolio model add up to zero. In order to account for cross equation effects, portfolio models are estimated with Zellner's seemingly unrelated regressions (SUR) technique (Zellner [83]). Because SUR estimation requires a variance-covariance matrix of full rank, one equation has to be deleted in the estimation. For the portfolio of private banks, the equation for other net liabilities is deleted. The main regressors in the model are corresponding interest rates of foreign assets (r_f), short-term and long-term bank credit (r_{bcr} and r_{cr}), short-term and long-term government debt (r_{sk} and r_{ss}) and the discount rate (r_{cb}). Other determinants in the portfolio model are a liquidity requirement variable (kr_1), a credit restriction dummy (kr_2) and the utilization rate of productive capacity (q_x).

The portfolio of the private non-monetary sector consists of eight equations. Demand for net foreign assets (NFA^{ps}), short-term and long-term bank credit (BCR and CR), currency (L_c), demand deposits (L_G), long-term government debt (SS_d^{ps}) and short-term and long-term time and savings deposits (TDK and TDL) are modelled. The amount of short-term government debt held by the private non-monetary sector is relatively small and is exogenous. Demand for currency is the residual item in the portfolio model. The main regressors are the corresponding interest rates, the utilization rate of productive capacity (q_x), private gross investment in equipment and means of transport (I_{oa}), the unemployment rate (u) and a dummy variable representing rapid substitution of short-term savings

deposits for long-term deposits in the years of the reverse interest rate structure, 1974 and 1976 (dum_{tdk}).

Besides the two portfolio models, five additional equations have been estimated. The first one relates foreign demand for long-term government debt (SS_d^f), to total supply of long-term government debt (SS_s), to world trade (WT) as a proxy of world financial wealth, and to the difference between the Dutch capital market interest rate and the foreign capital market interest rate, ($r_{ss} - r_f$). Interest rates on short-term (r_{tdk}) and long-term time and savings deposits (r_{tdt}) are modelled by two interest rate setting equations. The interest rate on long-term deposits depends on the foreign interest rate (r_f), the discount rate (r_{cb}) and the interest rate on demand deposits (r_{rc}). The other interest rate setting equation relates the interest rate on short-term deposits to the interest rate on long-term deposits (r_{tdt}), the discount rate (r_{cb}) and the interest rate on demand deposits (r_{rc}).

Interest rate determination is an important aspect in financial models. FK uses an interest rate adjustment mechanism for the markets for long-term credit, short-term government debt and net foreign assets. CESAM uses the equilibrium mechanism on the markets for short-term and long-term bank credit and long-term and short-term government debt. On the market for domestic liquidity KNOESTER assumes equilibrium interest rate setting. MORKMON and RASMUS are complete demand orientated models, with only quantity adjustment.

The 90-days' forward exchange rate (π^*) depends on the spot rate in the current (π) and last period, while the current guilder-dollar rate (π) depends on the, deutschmark-dollar rate (π_{SDM}) (in first differences).

The choice of exogenous variables is an important model characteristic. We differentiate between three types of exogenous variables in the financial block:

- (i) instruments: discount rate, credit restricting, liquidity constraining variables and the composition of government debt financing;
- (ii) foreign variables: world trade, deutschmark-dollar exchange rate, foreign interest rate (long-term);
- (iii) real (transmission) variables: net national income, surplus on the current account of the balance of payments, government budget deficit, gross private investment in equipment and means of transport, utilization rate of productive capacity and the unemployment rate. These variables are, however, endogenous in the complete model.

Estimation results

The model is estimated using annual data for the period 1958–85. The exchange rate equations are

estimated for the period 1973–85, because exchange rates were fixed during the Bretton Woods period. The equation for foreign demand for government debt has been estimated for the period 1965–85 because of the negligible quantity of debt held by foreigners before 1965. The demand equation of cash and balances held by private banks has been estimated with OLS for the period 1963–85 because no satisfactory results could be obtained for the period 1958–85. These parameters are fixed in the SUR estimation of the portfolio of private banks. The equations for interest rate setting are estimated with 3SLS.

The estimation of the portfolio model has been performed stepwise. First, the models are estimated inducing all the relevant variables in the equations. The obtained estimation results give a first impression of the values of the parameters. Next, parameters having signs conflicting with economic theory are set equal to zero. If the estimated parameters cause unsatisfactory simulation results, adjustments are made. In general, interest elasticity parameters are underestimated (see Middeldorp [63]) so that these parameters are set to higher values. The portfolio models are estimated independently from each other, which might result in underestimation of interest rate elasticities.

Tables 7 and 8 present the final estimation results. Some interest elasticities are set in advance, for reasons mentioned above. In the portfolio of private banks, homogeneity is assumed with respect to the elasticities of net foreign assets, of long-term bank credit and of short-term government debt. The discounting facilities depend on the official price set by the central bank. Some interest elasticities of the portfolio of the private non-monetary sector are set in advance as well. Demand for net foreign assets, demand for long-term government debt and demand for long-term time and savings deposits are assumed to be homogeneous in interest rates.

Foreign demand for long-term government debt is modelled as follows:

$$SS_d^f = 1.690 SS_s + 0.292 WT + 0.178 (r_{ss} - r_f) \quad (51)$$

(9.34) (2.74) (1.02)

Estimation period: 1966–85 $\bar{R}^2 = 0.00$

DW = 1.38

Interest rate setting equations of short-term and long-term time and savings deposits (r_{tdk} and r_{tdt}) are estimated with 3SLS:

$$\hat{r}_{tdk} = 0.815 \hat{r}_{tdt} - 0.112 \hat{r}_{cb} + 0.188 \hat{r}_{rc} \quad (52)$$

(4.76) (1.80) (6.50)

Estimation period: 1958–85 $\bar{R}^2 = 0.92$

DW = 2.31

Table 7. Estimation results for the portfolio of private banks.^c

	NFA^{pb}	BCR	CR	$-H$	R	SK_d^{pb}	SS_d^{pb}
NFA_{-1}^{pb}	-0.308						
BCR_{-1}		-1.027					
CR_{-1}			-0.158	-0.035		-0.200	
$-H_{-1}$				-0.700			
R_{-1}					-0.420		
SK_d^{pb}			-0.430			-0.234 ^a	
SS_d^{pb}							-0.182
W^{pb}	0.022	0.270	0.152		0.004	0.149	0.091
r_f	1.00 ^b	-0.12					-0.68
r_{bcr}		2.00 ^b	-1.00 ^b				
r_{cr}		-1.00 ^b	1.00 ^b				
r_{cb}				-0.20			
r_{sk}						2.00 ^b	-0.48
r_{ss}	-1.00 ^b					-2.00 ^b	0.44
OB	0.320						
q_x				0.0153			
kr_1			0.003				-0.003
kr_2		-0.023	0.044				-0.023
$\bar{R}^2$	0.43	0.43	0.53	0.39	0.45	0.13	0.73
DW	2.15	1.88	1.99	1.93	1.72	1.81	2.69

^a Indicates a parameter insignificant at a 95 % confidence level.^b Indicates a parameter set in advance.^c Note that all quantity variables are scaled by lagged wealth of private banks.Table 8. Estimation results for the portfolio of the private non-monetary sector.^c

	NFA^{ps}	$-BCR$	$-CR$	L_G	SS_d^{ps}	TDK	TDL
NFA_{-1}^{ps}	-0.108 ^a	-0.328					
$-BCR_{-1}$		-0.267				-0.182	
$-CR_{-1}$	-0.129		-0.037				-0.836
$L_{G,-1}$		-0.942	-0.515	-0.300 ^b			
SS_d^{ps}					-0.100 ^b		
TDK_{-1}			-0.255			-0.462	
TDL_{-1}							-0.775
r_f	1.00 ^b				-2.00		
r_{bcr}		0.50	-0.46				
r_{cr}			2.00				
r_{ss}	-1.00 ^b		-1.25		2.00 ^b		
r_{tdk}						0.85	-2.00 ^b
r_{tdl}							2.00 ^b
q_x		0.147	0.133	0.025 ^a		0.071	
I_{oa}	-0.141	-0.408	-0.321	0.431	-0.545	-0.400	0.494
OB	0.409						
u							-0.004
W^{ps}					0.165		
dum_{tdk}						0.093	
$\bar{R}^2$	0.66	0.72	0.96	0.24	0.65	0.91	0.65
DW	1.06	1.77	1.63	1.07	1.77	2.31	1.63

^a Indicates a parameter insignificant at a 95 % confidence level.^b Indicates a parameter set in advance.^c Note that all quantity variables are scaled by lagged wealth of the private non-monetary sector.

and

Exchange rate equations are given by:

$$\hat{r}_{idl} = 0.521 \hat{r}_f + 0.179 \hat{r}_{cb} + 0.080 \hat{r}_{rc} \quad (53)$$

(3.38) (2.18) (1.83)

$$\hat{\pi} = 0.996 \hat{\pi}_{\$DM} \quad (54)$$

(20.97)

Estimation period: 1958–85 $\bar{R}^2 = 0.64$
 DW = 1.88

Estimation period: 1973–85 $\bar{R}^2 = 0.97$
 DW = 1.92

and

$$\hat{\pi}^*_t = 0.756 \hat{\pi}_t + 0.262 \hat{\pi}_{t-1} \quad (55)$$

(39.31) (12.39)

Estimation period: 1973–85 $\bar{R}^2 = 0.99$
DW = 1.96

Real and financial transmission

Transmission from the real part of the model to the financial submodel and the other way round takes place through a number of variables. In the first subsection we discuss transmission from the real to the financial model (real transmission). After that we deal with monetary transmission. From a theoretical point of view possible transmission channels are discussed in general terms; actual transmission in CESAM is discussed in more detail.

In general, transmission takes place through price and quantity variables. Both real and financial prices influence real and financial decisions: real prices influence financial investments, and interest rates and exchange rates influence costs of expenditure. Real decisions yield income surpluses and shortages of the sectors distinguished (savings for the private sector, budget deficit for the public sector, surplus on the current account of the balance of payments). In the financial model these surpluses need to be divided over assets and liabilities. Alongside this direct relation a number of other transmission possibilities are available. Demand for money depends on the level of economic activity as imposed by the transactions motive. Monetary quantities influence real expenditure through two possible channels:

- (i) the real balance effect: the consumption decision of households depends on the real wealth of the private sector;
- (ii) the liquidity effect: a shortage of liquidity may have a negative impact on expenditure. The liquidity variable acts as a buffer: part of the increase in money supply may be kept in stock for later use, thus creating a difference between the moment of availability of means of spending and the moment of spending.

This liquidity transmission is a weak form of disequilibrium transmission. A stronger form of disequilibrium transmission results from the difference between effective demand and supply on financial markets. This imbalance will influence real expenditure.

Actual transmission as modelled in CESAM is dependent on the statistical significance of the variables in the behavioural equations. First, we deal with real transmission, then actual financial transmission is discussed.

Real transmission

Real transmission takes place through the following channels in CESAM:

- (i) Income deficits of the foreign sector, the government sector and the private sector influence total portfolio holdings. This means that the surplus on the current account of the balance of payments directly influences the international reserve position and therefore supply of currency. The government budget deficit determines supply of short-term and long-term government debt. The growth of private wealth influences asset holdings of the private non-monetary sector.
- (ii) The surplus on the current account of the balance of payments directly influences net foreign asset positions of both private banks and the private non-monetary sector: capital will flow in a direction opposite to exports and imports of goods and services.
- (iii) The utilization rate of productive capacity indicates the tension on the goods market. It is assumed that investors assume lower financial risk when utilization of productive capacity is high.
- (iv) Gross investment in equipment and means of transport is used as a proxy for the level of economic activity.
- (v) The unemployment rate indicates the tension on the labour market and influences portfolio decisions of the private non-monetary sector.

Monetary transmission

Monetary transmission is modelled in the following way:

- (i) The real interest rate, calculated as the arithmetic mean of interest rates on the money market and the capital market minus inflation, influences real consumption by households.
- (ii) The real wealth of the private sector (W^{ps}/p_c) is a determinant of consumption by households. Because in the financial submodel the private non-monetary sector has been modelled in total, a separation between wealth of the household sector and the corporate sector has not yet been made.
- (iii) The capital market interest rate influences gross investment and the price index of investment in dwellings and non-residential buildings.

Other financial transmission channels did not affect the real side of the model in a significant way. The influence of the liquidity ratio on consumption and investment decisions especially has been investigated. No significant parameter values have been found, however.

The public sector

Before giving a brief description of the public sector in CESAM, we first discuss the main features of the government submodels in FK, MORKMON and RASMUS.

FK includes a detailed government submodel. Central and local government are aggregated; social security funds are included. Premiums paid by households and firms are distinguished. FK includes an equation which explains interest payments on government debt.

MORKMON presents a relatively small and largely exogenous government submodel. Four institutional equations describe tax revenues. The government wage rate, unemployment benefits and interest payments are endogenized. Interest payments on government debt are modelled using a vintage approach.

RASMUS contains a highly aggregated government submodel, in which direct and indirect taxes, the government wage rate, interest payments, social security premiums and benefits are endogenized. KNOESTER does not include a detailed government submodel.

CESAM consists of about 260 equations, 150 of which give a detailed description of the workings of the Dutch public sector. In CESAM the public sector consists of three subsectors: the central government; local government (municipalities, provinces and authorities for water control); and the social security system.

Modelling the public sector

The submodel for the public sector is constructed in order to describe the financial flows between subsectors of the public sector and the private sector, thereby generating the variables that link the public sector part to the real as well as the financial part of CESAM. Examples of variables that establish these links can be found at the end of the next subsection.

The public sector part of CESAM shows a high degree of detail. The first reason for this arises from one of the main objectives of CESAM: to be able to shed light on the consequences of the use of (several combinations of) different public policy instruments. The public sector submodel therefore has to account for the large number of today's existing public policy instruments. The number of these instruments has increased rapidly in the Netherlands in recent decades, along with the size and role of the public sector.

The expansion of the public sector is the second reason for the high degree of detail in our description of the Dutch public sector. Modelling the government sector is necessary because a large part of economic activity is due to government behaviour. The sharp rise in unemployment in the last decade led to a strong increase in social security benefits and hence to a sharp

rise in the government budget deficit and the public burden. The large government budget deficit resulted in borrowing on the capital market and a sharp increase in interest payments on existing debt.

The third reason for the attention paid to the modelling of the public sector stems from our wish to expose, wherever possible, the endogenous nature of government expenditure and revenue categories by showing the reaction of the government sector to the behaviour of the private sector. Obvious examples of endogenous government revenues are taxes and social security premiums. Unemployment benefits are another example of an endogenous government expenditure component. Neglecting the endogenous nature of (at least a great part of) government activity would lead to serious specification errors in modelling the economic process (see for example Johansen [43]). In the traditional approach to economic modelling public sector activities are incorporated into the model mostly in an exogenous way, with the exception of the usual, above mentioned, examples. Our approach, however, does not follow public choice theorists (like Frey and Schneider [30]) in assuming explicit objective functions for the government or for politicians. Nor do we propose, in line with van Winden [82], so called interest functions for specific groups of individuals in a society. This is because we feel that the incorporation of public choice concepts into large macroeconomic models has not yet yielded empirically useful results. The principal reason for our reserve in endogenizing public sector activities, however, is the sharp reduction in usefulness of a policy model like CESAM when all income and expenditure categories of the public sector are endogenized. This would leave us with little room for studying policy alternatives and hamper the analysis of the use of various combinations of policy instruments. Our public sector model nevertheless shows more endogeneity than that of our colleagues at the Central Planning Bureau (see van den Berg *et al* [6]), thanks to our more detailed description of the constituent parts of the public sector (especially of the local government sector and of the social security funds).

A part of government behaviour is exogenous and independent of the state and development of the private sector. Variables representing this part of government behaviour are exogenous instruments in a model. So our strategy with regard to government behaviour is to specify equations for those government actions that largely depend on the behaviour of the private sector and therefore can be considered endogenous. Other government activities remain exogenous and can be altered if policy projections are undertaken.

Incorporating endogenous as well as exogenous government behaviour into a public sector submodel

results in a description of the system of rules and institutional regulations responsible for reactions of the public sector to trends and fluctuations in the private sector. This institutional structure is described by institutional equations, which at times resemble behavioural equations because of the fact that parameters have been estimated or because of the fact that their specifications are found by approximating the mechanism at work in reality. We have to note that if there are reasons to believe that only the recent past has any relevance for the near future, the estimation period is adjusted (shortened) accordingly. Examples of institutional equations are tax equations and equations for the various types of social security premiums and social benefits. A number of these equations have been augmented by the inclusion of autonomous variables, representing *ad hoc* government policy changes or interventions.

Although for some public sector variables there is no direct constitutional link with other economic variables, a stable relationship between public sector variables and private sector variables can be detected. We model this relationship by means of so called reaction equations. Examples of reaction equations are the equations which show a relationship between local government consumption or investment expenditures and variables such as interest rates and the unemployment level (the latter affecting the budgetary capacity of local authorities). We note that local government, which has to work under stricter budgetary controls than the central government and in some ways behaves more or less like private sector enterprises, has been endogenized to a further degree than the central government.

General outline of the submodel

In this subsection we will not describe Dutch public finance in detail, but we will focus on the general structure of the model. Detailed information on the government submodel can be found in Kuipers *et al* [52]. Estimation results are not listed here, but a full description of the equations and the symbols can be found in Appendices 1 and 2. The reason for discussing the government submodel briefly is that the specific Dutch institutional structure may be not so relevant for outsiders. Besides, the institutional sphere changes rapidly, as was shown by the recent 1987 change in the social security system. These changes force model builders to adjust their models continuously.

CESAM distinguishes 24 central government spending categories and a variety of 17 central government tax and non-tax receipts, all according to the System of National Accounts. Wages and salaries, paid by the central government, depend on the number of civil

servants (a policy instrument) and the central government nominal wage rate. This wage rate follows the private sector nominal wage rate although it also depends on political considerations. Interest payments on government debt are modelled using a vintage model in which each vintage of central government debt has its special characteristics with regard to years of creation and redemption and the rate of interest. Most transfers and subsidies paid by the central government to households, local government, social security funds and foreigners are endogenized. Government expenditures on consumption and investment, as well as the remaining expenditure categories, are exogenous in real terms, the exception being the investment subsidies to firms. Total central government spending in 1985 was about 160 billion guilders.

Central government taxes are modelled by relating taxes to their corresponding tax bases, that is the income or spending flow that is subject to direct or indirect tax. Government revenues from natural gas exploitation are dealt with exogenously, just like most other (non-tax) income categories. The central government budget deficit is determined as the difference between outlays and revenues.

Total spending of the local government in 1985 was about 90 billion guilders. Important endogenous spending categories are wages and salaries, with the number of local government employees being endogenized, material consumption and investment expenditures and income transfers to households. Taxes levied by the local government, although of less importance than central government taxes, are endogenous.

Social security funds use premiums paid by employers and employees and financial support by the central government to finance their expenditures in the current period. In contrast with the large Dutch institutional pension funds, which invest their premiums in capital market assets, social security funds only plan one year ahead. Actual premiums are determined by the current benefits to be covered, as well as by administration expenses and the need for building a (small standard) financial reserve. Social security benefits have an endogenous price component that is linked to the private sector (minimum) wage rate or some price index. This indexation scheme can be switched off or adjusted in policy experiments by means of binary dummy variables and variables representing autonomous changes. The quantity (or volume) components of benefits, with the exception of those for unemployment, sickness and worker disability, are exogenous in our model. In our submodel for the social security system we distinguish 13 different insurance funds.

The transmission between the private sector and the government sector is modelled in detail. Private

expenditures, price and wage formation, unemployment, income variables and interest rates determine government behaviour. On the other hand the government influences the disposable income of households and firms, price and wage formation via tax shifting and employment. The government budget deficit is an important variable in the financial submodel.

Simulation

The model as specified above was tested in some endogenous simulation experiments.¹¹ In our opinion the performance of the whole model is important when the model is used as an instrument of policy evaluation. Statistical properties of the various behavioural equation. These statistics do not show the dynamic properties of the model as a whole. Dynamic simulation of the model should be used as a method to analyse the properties of large-scale non-linear models. The model was first tested by means of a static (one-step ahead) simulation. Provided that the simulation period coincides with the estimation period, the residuals generated by a static simulation are white noise. In this case the Durbin–Watson statistic can be used to test whether the residuals are autocorrelated or not. Furthermore, standard tests can be used to test the homoscedasticity assumption.

The interpretation of dynamic simulation errors is very difficult, since these errors are typically autocorrelated and heteroscedastic. Nevertheless, a dynamic simulation was performed for the years 1977 to 1985 to check the dynamic tracking of the model ie the performance of the model as a whole over the medium term. The results of dynamic *ex post* simulation of the complete model are presented in Table 9. This table presents goodness of fit statistics according to Theil (U) as well as the mean relative absolute error ($MRAE$). The goodness of fit statistic, U , and the mean relative absolute error, $MRAE$, are defined as:

$$U = \sqrt{\frac{\sum_{j=1}^n [\Delta y_{t+j}^f - \Delta y_{t+j}^r]^2}{\left[\sum_{j=1}^n [\Delta y_{t+j}^f]^2 + \sum_{j=1}^n [\Delta y_{t+j}^r]^2 \right]}} \quad (56)$$

¹¹ The model compiler used to solve the non-linear model has been developed by A.H. van Zon [84] and turned into a user program by N.S. Kroonenberg [50]. The solution method is a Newton type method. This involves the construction of a small subset of the variables from which the remainder of the model can be computed recursively. Iteration is still required, but is vastly more efficient and more likely to succeed.

Table 9. Theil's inequality coefficient (U) and the mean relative absolute error ($MRAE$) for some major variables over the period 1977–85.

Variable	U	$MRAE$	Variable	U	$MRAE$
c_p	0.32	3.87	i_b	0.17	4.32
i_{oa}	0.35	9.30	i_{ab}^*	0.38	10.41
ex	0.21	4.58	im	0.13	5.86
v	0.27	2.32	u	0.43	16.13
a_r	0.48	1.47	a_u	0.15	0.61
bpr	0.24	2.46	BPR	0.06	0.96
C_p	0.12	1.42	I_b	0.15	4.43
p_c	0.20	3.51	p_{iou}	0.31	2.72
p_{igb}	0.30	8.46	p_{exa}	0.08	1.63
p_v	0.19	2.40	W	0.12	0.98
OB	0.31	108.25	Y_n	0.07	1.04
NFA^{pb}	0.42	365.06	NFA^{ps}	0.20	48.63
BCR	0.24	7.12	CR	0.21	12.13
SS_d^{pb}	0.11	4.82	SS_d^{ps}	0.27	8.74
SS_d^f	0.22	16.89	LIQ	0.52	7.58
L_c	0.75	25.48	L_G	0.34	11.74
TDK	0.31	7.02	DDL	0.16	9.12
W^{pb}	0.12	6.54	W^{ps}	0.21	6.17
r_{bcr}	0.65	13.61	r_{cr}	0.32	8.62
r_{ss}	0.51	16.98	r_{sk}	0.55	24.89
r_{dk}	0.32	18.59	r_{dl}	0.31	25.27
r_r	0.52	74.75	π	0.11	4.74
W_o	0.16	0.81	a_o	0.06	0.40
T_L	0.39	3.40	T_{ZIB}	0.40	4.31
T_k	0.27	2.46	Y_{ob}	0.56	11.14
AIQ	0.42	1.49	L_o	0.07	0.38
VB	0.54	9.13	FTR	0.41	24.91
FTL	0.13	21.54	FTK	0.39	22.57
PSV	0.20	3.04	USV	0.06	2.24
C_o	0.07	0.83	I_o	0.68	5.67

and

$$MRAE = (1/n) \sum_{j=1}^n [|y_{t+j}^f - y_{t+j}^r| / y_{t+j}^r] \quad (57)$$

In the formulae above y^f and y^r are forecasts (generated values) and realizations respectively; n is the total number of simulated periods.

U indicates whether the shape of the generated series fits the shape of the realizations. U takes on values between 0 and 1 and U assumes the value 0 if prediction is perfect. Systematic prediction errors are not accounted for; for this reason we have listed both U and $MRAE$.

Table 9 shows that, on the basis of goodness of fit measures U and $MRAE$, the past is predicted fairly satisfactorily. Only 15% of the variables listed show large errors ($U > 0.50$). About 50% show small errors ($U \leq 0.25$).

It is our experience that the goodness of fit is revealed more clearly graphically than it is by statistical measures. For this reason the dynamic simulation results are presented graphically in Appendix 3. From the results presented in Appendix 3 we may also conclude that the simulation results *ex post* are fairly satisfactory.

Summary and conclusions

In this paper we present CESAM, an annual model of the Dutch economy. This model roughly consists of six submodels: the production model, the expenditure model, the labour market, price formation, the financial model and the government model.

In the production model a vintage approach is used for the determination of capacity output and capacity demand for labour. With respect to the production structure we assume substitutability *ex ante*, using a constant returns to scale CES production function. *Ex post* labour and capital are supposed to be complementary (putty-clay). Although substitutability *ex ante* is rather low ($\sigma = -0.25$) our assumption seems valid. The estimation of the vintage model leads to the conclusion that embodied technical progress is mainly labour augmenting in character.

The expenditure model is traditionally based on the System of National Accounts in which consumption, gross investment, increase in stocks and work in progress, and exports minus imports add up to gross domestic product. Consumption by households depends, among other things, on real disposable income of households (subdivided into wage and transfer income and other income) and on the price index of consumption. Gross investment by enterprises is subdivided according to the type of capital good. Gross investment in equipment (machinery) and means of transport is explained within the vintage approach presented above.

The equation representing the development of the nominal wage rate is based on the Phillips curve, which shows the relationship between the rate of change of wages and the level of unemployment. The real wage rate affects capital and labour intensities of new vintages and therefore total capacity of both output and labour demand. Prices are set as a mark up over production costs; labour costs are measured by unit wage costs and import costs are measured by the price index of imports of goods and services. With respect to price formation of investment, gross investment is subdivided according to types of capital good.

Total employment in the enterprise sector is estimated with the use of a stock adjustment equation, in which the desired utilization rate of capacity demand for labour is proportional to the utilization rate of productive capacity. In our vintage model capacity demand for labour is derived simultaneously with capacity output. Labour supply is modelled by explaining labour force participation rates for both men and women.

The financial sector shows five subsectors which invest in twelve assets. Behaviour of private banks and the private non-monetary sector is modelled by means

of portfolio theory. Private banks supply bank credit, demand government debt, hold foreign assets and borrow from the central bank. Private banks set interest rates on these assets. The private non-monetary sector demands bank credit, net foreign assets, demand deposits, time and savings deposits and long-term government debt. Foreign demand for long-term government debt is also modelled. The behaviour of the central bank and the government is exogenous. Both the spot market and the forward market exchange rate are modelled. Although economic theory suggests many possible transmission channels between the real and the financial sphere, only a few were found to be significant. The main transmission variables are the long-term interest rate and the wealth of the private non-monetary sector in the transmission from the monetary to the real sphere; the budget deficit of the government, the surplus on the current account of the balance of payments and gross investment in equipment and means of transport in the transmission from the real to the monetary sphere.

The model of the public sector contains about 150 equations for the central government, local government and the social security system. It presents a detailed description of the Dutch institutional sphere.

The paper concludes with some endogenous simulation results that proved fairly satisfactory. These experiments, together with some policy experiments which are not discussed in this paper, showed that our model can be used for policy evaluations.

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Appendix 1

Equations

The symbols are listed in alphabetical order in Appendix B. Variables in capital letters refer to variables at current prices, lower case variables refer to variables at constant prices of 1980.

The private sector – the real submodel

Behavioural equations

Capacity (including definitional equations)

$$x_{tt} = \Omega_{t-\tau} (h_t/h_\tau)^{0.75} (1+\gamma)^{\tau} x_{\tau\tau} \quad t \geq \tau \in V_t$$

$$\text{where } \gamma = \begin{cases} \neq 0 & \text{in the 1950s and the 1980s} \\ = 0 & \text{otherwise} \end{cases}$$

$$N_{tt} = \Omega_{t-\tau} N_{\tau\tau} \quad t \geq \tau \in V_t$$

$$\Sigma_2 = \sum_{t=\tau}^{\tau-12} \Omega_{t-\tau} w_{tt}^e (1.02)^{-(t-\tau)}$$

$$\eta = [(0.48/0.01)[(1.00)/(1.05)]^5 \Sigma_2]^{0.25}$$

$$\chi = [0.01 \{ (1.05)^5 (N_{tt}/i_{tt}) + h_t^{0.75} \}^5 + 0.48 \{ (1.00)^5 h_t^{0.75} \}^5]^{0.2}$$

$$x_{tt} = \chi i_{tt}$$

$$N_{tt} = \eta i_{tt}$$

$$w_{tt}^e = w_\tau (1 + g w_\tau^e)^{t-\tau} \quad t \geq \tau$$

$$g w_\tau^e = \left(\frac{1}{4}\right) \sum_{j=\tau-3}^{\tau} (w_j - w_{j-1})/w_{j-1}$$

$$h_{tt}^e = h_\tau (1 + g h_\tau^e)^{t-\tau} \quad t \geq \tau$$

$$g h_\tau^e = \frac{1}{4} \sum_{j=\tau-3}^{\tau} (h_j - h_{j-1})/h_{j-1}$$

$$x_t = \sum_{\substack{\tau \in V_t \\ \tau \neq t}} x_{tt} + x_{tt}$$

$$N_t = \sum_{\substack{\tau \in V_t \\ \tau \neq t}} N_{tt} + N_{tt}$$

$$d_{oa_t} = x_{tt} - x_t + x_{t-1}$$

$$q_x = v_{oa}/x_t$$

$$q_N = a_{bx}/N_t$$

V_t according to:

$$w_T > \bar{q}_{x_t} x_{tT}/N_{tT} \quad \text{if } \bar{q}_{x_t} < 0.95$$

and

$$w_T > x_{tT}/N_{tT} \quad \text{if } \bar{q}_{x_T} \geq 0.95$$

$$\text{where } \bar{q}_{x_T} = \frac{1}{3} \sum_{j=1}^3 q_{x_{T-j}}$$

Expenditure

$$\dot{\epsilon}_p = 0.728\dot{l}_b + 0.10\dot{n}_{ib} - 0.251r_{r-1} + 0.135(W^{ps}/p_c)_{-1}$$

$$i_{oa} = (0.693i_{oa-1}\chi_{-1} + 0.178\Delta v_{oa} + 0.061zd_{oa-1} - 230.294\Delta r_{ss} + 135.272\dot{q}_{x-1} - 234.210\Delta\dot{p}_{t-1})/\chi$$

$$\dot{i}_{gb} = 1.415\dot{v} - 3.443\Delta CONJ - 0.548\dot{p}_{igb} - 2.127\Delta u$$

$$i_t = 0.322\dot{t}_{-1} + 0.194\Delta\dot{v} + 0.032\Delta\dot{p}_m$$

$$\dot{\epsilon}_{x_{xa}} = \dot{\epsilon}_{x_c} - 1.7(\dot{p}_{exa} - \dot{p}_{exc})_{-\frac{1}{2}} + 1.334(IQ - IQ_{OECD})_{-1} + \dot{\epsilon}_{x_{xa}}^{aut}$$

$$\dot{i}_m = 1.502\dot{v} - 0.329(\dot{p}_m - \dot{p}_v)_{-\frac{1}{2}}$$

Price formation

$$\dot{p}_c = 0.208\dot{p}_{m-1} + 0.517(\dot{W} + \dot{a} - \dot{v})_{-\frac{1}{2}} + 2.305T_{k-1}$$

$$\dot{p}_{iou} = 0.471\dot{p}_{m-1} + 0.298(\dot{W} + \dot{a} - \dot{v})_{-1}$$

$$\dot{p}_{igb} = 0.413\dot{p}_{igb-1} + 0.536(\dot{W} + \dot{a} - \dot{v}) + 1.005\Delta r_{ss}$$

$$\dot{p}_{exa} = 0.803\dot{p}_m + 0.073(\dot{W} + \dot{a} - \dot{v})_{-\frac{1}{2}}$$

Labour market

$$a_{bx} = 0.203\Delta q_x N + 0.396\Delta N q_{N-1} + 0.999a_{bx-1}$$

$$P_m = P_{m-1} - 0.007wkl_{m-1} + 0.015wkl_{t-1} - 0.540$$

$$P_t = P_{t-1} - 0.011wkl_{t-1} + 0.260trend - 0.060\dot{w}^{net}$$

$$\dot{W} = -2.232 + 1.0\dot{p}_c + 1.0(\dot{v} - \dot{a})_{-\frac{1}{2}} + 6.6351/u + 0.862\Delta pr_{wg} + 0.428\Delta pr_{bwn}$$

Definitional equations

$$\dot{q}_x = 100(q_x/q_{x-1} - 1)$$

$$\Delta q_x = q_x - q_{x-1}$$

$$\Delta N = N - N_{-1}$$

$$zd_{oa} = v_{oa} - d_{oa} - (1 - tzz)Wa/p_v 100 - tzza + vba + wir$$

$$av = a_{bx} + a_{ba} + a_o$$

$$aa_t = P_t TB_v / 100$$

$$aa_m = P_m TB_m / 100$$

$$\Delta P_t = P_t - P_{t-1}$$

$$\Delta P_m = P_m - P_{m-1}$$

$$wkl_m = aa_m - \lambda bb_m / (bb_m + bb_v) av$$

$$wkl_v = aa_v - \lambda bb_v / (bb_m + bb_v) av$$

$$wkl = wkl_m + wkl_v$$

$$bb_m = P_m TB_m / 100 + bb_m^{65+}$$

$$bb_v = P_v TB_v / 100 + bb_v^{65+}$$

$$a = a_{bx} + a_{ba} - a_z$$

$$u = 100wkl / (a + a_o + wkl)$$

$$\dot{u} = 100(u/u_{-1} - 1)$$

$$\dot{u}_{-1} = 0.5(\dot{u} + \dot{u}_{-1})$$

$$\Delta u = u - u_{-1}$$

$$\dot{a} = 100(a/a_{-1} - 1)$$

$$W = (1 + 0.01\dot{W})W_{-1}$$

$$L_b = Wa + L_b^{rest}$$

$$l_b = 100L_b/p_c$$

$$\dot{l}_b = 100(l_b/l_{b-1} - 1)$$

$$NL_b = Y_{gb} - L_b$$

$$nl_b = 100NL_b/p_c$$

$$\dot{nl}_b = 100(nl_b/nl_{b-1} - 1)$$

$$c_p = (1 + 0.01\dot{c}_p)c_{p-1}$$

$$C_p = c_p p_c / 100$$

$$i_{gb}^n = (1 + 0.01\dot{i}_{gb}^n)i_{gb-1}^n$$

$$I_{gb} = 0.01p_{igb}i_{gb}^n + AF_{gb}$$

$$I_{oa} = 0.01p_{iou}i_{oa}$$

$$p_{igb} = (1 + 0.01\dot{p}_{igb})p_{igb-1}$$

$$p_{iou} = (1 + 0.01\dot{p}_{iou})p_{iou-1}$$

$$I_p = I_{oa} + I_{ag} + I_{gb} + I_{ov}$$

$$I_b = I_{oa} + I_{ag} + I_{wo} + I_{gb} + I_{ov}$$

$$i_b = 100[(I_{oa} + I_{ag})/p_{iou} + I_{wo}/p_{iwo} + I_{gb}/p_{igb} + I_{ov}/p_{ib}]$$

$$IQ = 100(I_b + I_o)/BPR$$

$$ex_{xa} = (1 + 0.01\dot{ex}_{xa})ex_{xa-1}$$

$$ex = ex_{xa} + ex_{ag}$$

$$\Delta\dot{ex}_c = \dot{ex}_c - \dot{ex}_{c-1}$$

$$EX = ex_{xa}p_{exa}/100 + EX_{ag}$$

$$im = (1 + 0.01\dot{im})im_{-1}$$

$$IM = im p_m/100$$

$$OB = EX - 0.01p_m im + S_{pib} + S_{ion}$$

$$p_c = (1 + 0.01\dot{p}_c)p_{c-1}$$

$$\dot{p}_{c-1} = 0.5(\dot{p}_c + \dot{p}_{c-1})$$

$$p_{exa} = (1 + 0.01\dot{p}_{exa})p_{exa-1}$$

$$(\dot{p}_{exa} - \dot{p}_{exc})_{-1/4} = 0.5(\dot{p}_{exa} - \dot{p}_{exc} + \dot{p}_{exa-1} - \dot{p}_{exc-1})$$

$$p_m = (1 + 0.01\dot{p}_m)p_{m-1}$$

$$\Delta\dot{p}_m = \dot{p}_m - \dot{p}_{m-1}$$

$$\dot{p}_{m-1} = 0.5(\dot{p}_m + \dot{p}_{m-1})$$

$$\Delta vr = vr - vr_{-1}$$

$$\Delta VR = \Delta vr p_{\Delta vr}/100$$

$$bpr = c_p + c_o + i_b + i_o + \Delta vr + ex - im$$

$$p_{bpr} = (p_c c_p + 100C_o + 100I_b + 100I_o + 100\Delta VR + 100EX - p_m im)/bpr$$

$$BPR = p_{bpr} bpr/100$$

$$v = bpr - v_o$$

$$\dot{v} = 100(v/v_{-1} - 1)$$

$$\Delta\dot{v} = \dot{v} - \dot{v}_{-1}$$

$$(\dot{v} - \dot{a})_{-1/4} = 0.5(\dot{v} - \dot{a} + \dot{v}_{-1} - \dot{a}_{-1})$$

$$(\dot{W} + \dot{a} - \dot{v})_{-1/4} = 0.5(\dot{W} + \dot{a} - \dot{v} + \dot{W}_{-1} + \dot{a}_{-1} - \dot{v}_{-1})$$

$$v_{oa} = v - T/p_v 100 - v_{ag}$$

$$\Delta v_{oa} = v_{oa} - v_{oa-1}$$

$$V = vp_v/100$$

$$V_{nf} = V - AF_b - T$$

$$V_{ag,n} = v_{ag}p_v/100 - a_{ba}W - 0.017AF_b$$

$$p_v = (bpr p_{bpr} - 100V_o)/v$$

$$\hat{p}_t = 100(p_t/p_{t-1} - 1)$$

$$\Delta \hat{p}_t = \hat{p}_t - \hat{p}_{t-1}$$

$$(\hat{p}_m - \hat{p}_t)_{-1} = 0.5(\hat{p}_m - \hat{p}_t + \hat{p}_{m-1} - p_{t-1})$$

$$AF = AF_b + AF_o$$

$$Y_n = 0.01 p_{bpr} bpr - AF + S_{pib}$$

$$Y_{bb} = V - AF_b - Wa - Y_{bel} - T - VB$$

$$Y_{gb} = Y_n - Y_{bb} - Y_{ob} + S_{ion}$$

$$Y_{nf} = Y_n - T - T_o$$

$$AIQ = W(a + a_z)/V_{nf}$$

$$\Delta \hat{I}Q = 100(AIQ/AIQ_{-1} - 1)$$

$$CONJ = 100(\Delta VR + OB)/Y_n$$

$$\Delta CONJ = CONJ - CONJ_{-1}$$

The private sector – the financial submodel

Behavioural equations

Private banks

$$\Delta NFA^{pb} = -0.308NFA_{-1}^{pb} + 0.022W^{pb} + 0.01r_f W_{-1}^{pb} - 0.01r_{ss} W_{-1}^{pb} + 0.320OB$$

$$\Delta BCR = -1.027BCR_{-1} + 0.270W^{pb} - 0.001r_f W_{-1}^{pb} + 0.02r_{bcr} W_{-1}^{pb} - 0.01r_{cr} W_{-1}^{pb} - 0.023kr_2 W_{-1}^{pb}$$

$$\Delta CR = -0.158CR_{-1} - 0.430SK_d^{pb} + 0.152W^{pb} - 0.01r_{bcr} W_{-1}^{pb} + 0.01r_{cr} W_{-1}^{pb} + 0.003kr_1 W_{-1}^{pb} + 0.044kr_2 W_{-1}^{pb}$$

$$-\Delta H = -0.035CR_{-1} + 0.700H_{-1} - 0.002r_{cb} W_{-1}^{pb} + 0.015q_x W_{-1}^{pb}$$

$$\Delta R = -0.420R_{-1} + 0.004W^{pb}$$

$$\Delta SK_d^{pb} = -0.200CR_{-1} - 0.234SK_d^{pb} + 0.149W^{pb} + 0.02r_{sk} W_{-1}^{pb} - 0.02r_{ss} W_{-1}^{pb}$$

$$\Delta SS_d^{pb} = -0.182SS_d^{pb} + 0.091W^{pb} - 0.068r_f W_{-1}^{pb} - 0.0048r_{sk} W_{-1}^{pb} \\ + 0.0044r_{ss} W_{-1}^{pb} - 0.0034kr_1 W_{-1}^{pb} - 0.0027kr_2 W_{-1}^{pb}$$

Private sector

$$\Delta NFA^{ps} = -0.108NFA_{-1}^{ps} + 0.129CR_{-1} + 0.01r_f W_{-1}^{ps} - 0.01r_{ss} W_{-1}^{ps} - 0.141I_{oa} + 0.409OB$$

$$-\Delta BCR = -0.328NFA_{-1}^{ps} + 0.267BCR_{-1} - 0.942L_{G-1} + 0.005r_{bcr} W_{-1}^{ps} + 0.147q_x W_{-1}^{ps} - 0.408I_{oa}$$

$$-\Delta CR = 0.037CR_{-1} - 0.515L_{G-1} - 0.255TDK_{-1} - 0.0046r_{bcr} W_{-1}^{ps} + 0.02r_{cr} W_{-1}^{ps} - 0.0125r_{ss} W_{-1}^{ps} + 0.133q_x W_{-1}^{ps} - 0.321I_{oa}$$

$$\Delta L_G = -0.300L_{G-1} + 0.025q_x W_{-1}^{ps} + 0.431I_{oa}$$

$$\Delta SS_d^{ps} = -0.100SS_d^{ps} - 0.02r_f W_{-1}^{ps} + 0.02r_{ss} W_{-1}^{ps} - 0.545I_{oa} + 0.165W^{ps}$$

$$\Delta TDK = 0.182BCR_{-1} - 0.462TDK_{-1} + 0.0085r_{tdk} W_{-1}^{ps} + 0.071q_x W_{-1}^{ps} - 0.400I_{oa} + 0.093dum_{tdk}$$

$$\Delta TDL = 0.835CR_{-1} - 0.764TDL_{-1} - 0.02r_{tdk}W_{-1}^{ps} + 0.02r_{tdl}W_{-1}^{ps} + 0.494I_{oa} - 0.004uW_{-1}^{ps}$$

Foreign demand for long-term government debt

$$SS_d^f = 1.690SS_s^s + 0.292W\hat{T} + 0.178(\hat{r}_{ss} - \hat{r}_f)$$

Interest rates on deposits and saving accounts

$$\hat{r}_{tdk} = 0.815\hat{r}_{tdl} - 0.112\hat{r}_{cb} + 0.188\hat{r}_{rc}$$

$$\hat{r}_{tdl} = 0.521\hat{r}_f + 0.179\hat{r}_{cb} + 0.080\hat{r}_{rc}$$

Exchange rate

$$\hat{\pi} = 0.996\hat{\pi}_{SDM}$$

$$\hat{\pi}_{-1}^* = 0.756\hat{\pi} + 0.262\hat{\pi}_{-1}$$

Definitional equations

Balance sheet restrictions

$$ONL^{pb} = NFA^{pb} + BCR + CR - H + R + SK_d^{pb} + SS_d^{pb} - W^{pb}$$

$$L_c = BCR + CR + W^{ps} - L_g - SK_d^{ps} - SS_d^{ps} - TDK - TDL - NFA^{ps}$$

$$M_c^{cb} = IR + SK_d^{cb} + SS_d^{cb} + H - R - KT^{cb} - ONL^{cb}$$

$$\Delta IR = OB - \Delta NFA^{pb} - \Delta NFA^{ps} + \Delta SS_d^f + STATT$$

Liquidity ratio

$$LIQ = (L_c + L_g + TDK + M_2^{cb} + KOS)/Y_n$$

Government budget deficit financing

$$\Delta SS_s = (1 - \phi)FTK + (1 - \kappa)LA$$

$$\Delta SK_s = \phi FTK + \kappa LA$$

Other definitional equations

$$W^{pb} = L_g + TDK + TDL$$

$$\Delta W^{ps} = OB + STATT + \Delta KT^{cb} - \Delta M_c^{ro} - FTK - \Delta ONL^{cb} - \Delta ONL^{pb}$$

$$(W^{ps}/p_c) = \hat{W}^{ps} - \hat{p}_c$$

$$\hat{W}^{ps} = 100(W^{ps}/W_{-1}^{ps} - 1)$$

$$SK_d^{pb} = SK_s - SK_d^{ps} - SK_d^{cb}$$

$$SS_d^{pb} = SS_s - SS_d^{ps} - SS_d^{cb} - SS_d^f$$

$$r_r = (r_{sk} + r_{ss})/2 - (0.4\hat{p}_c + 0.3\hat{p}_{c-1} + 0.2\hat{p}_{c-2} + 0.1\hat{p}_{c-3})$$

$$\Delta r_{ss} = r_{ss} - r_{ss-1}$$

The public sector

Central government expenditure

Wage formation

$$L_o^R = (1 + 0.01\dot{W}_o)(1 + 0.01\dot{a}_R)L_{o-1}^R$$

$$\dot{W}_o = \dot{I}^{RL}(1 - \beta_{wo}) + \dot{W}_o^{aut}$$

Central government consumption and investment

$$NMC^R = nmc^R p_{nmc}/100$$

$$\dot{p}_{nmc} = 0.816\dot{p}_c + 0.248\dot{p}_m$$

$$I_o^R = i_o^R p_{io}/100$$

$$\dot{p}_{io} = 0.927\dot{p}_{igb} + (1 - 0.927)\dot{p}_{iou}$$

Unemployment benefits and subsidies

$$URWW = [1 + 0.01[\dot{I}_{min}^L(1 - \beta_{WAM}) + \dot{I}_{RWV}^{aut}]](1 + 0.01\dot{v}_{RWV})URWW_{-1}$$

$$v_{RWV} = v_{RWV_{-1}}(1 - \delta_{sh}) + 0.181(wkl - wkl_{-1})(1 - \delta_{sh}) + 0.424(wkl_{-2} - wkl_{-3})(1 - \delta_{sh}) + 0.60wkl \delta_{sh} + v_{RWV}^{aut}$$

$$UWV = [1 + 0.01[\dot{I}_{\frac{1}{2}}^{RL}(1 - \beta_{WAM}) + \dot{I}_{WV}^{aut}]](1 + 0.01\dot{v}_{WV})UWV_{-1}$$

$$v_{WV} = v_{WV_{-1}}(1 - \delta_{sh}) + (wkl - wkl_{-1} - \Delta v_{RWV} - \Delta v_{WV} - \epsilon_{wkl})(1 - \delta_{sh}) + v_{WV}^{aut}$$

$$BYS95 = (1 + 0.01(0.232\dot{u} + 0.864\dot{I}_{min}^L))BYS95_{-1}$$

$$IHS = (1 + 0.01(0.561\dot{u}_{-1} + 1.132\dot{p}_h + IHS^{aut}))IHS_{-1}$$

Interest payments ($t > 1985$)

$$\begin{aligned} ROS_R = & \sum_{\tau=1950}^{1985} r_{\tau} S_{\tau} \phi_{\tau,t-1} + \sum_{i=1986}^t r_{ss_{i-1}} FTR_{i-1} \phi_{i-1,t-1} \\ & + \sum_{\tau=1950}^{1985} r_{ss_{\tau-1}} S_{\tau} (\phi_{\tau,t-2} - \phi_{\tau,t-1}) \phi_{i-1,t-1} \\ & + 20000(r_{sk} + r_{sk-1} + r_{sk-2} + r_{sk-3} + r_{sk-4})/5 \end{aligned}$$

Income transfers to social security, local government, EC and foreigners

$$\begin{aligned} RSF = & RSFAOW + RSFAWW + RSFAWBZ + RSFAAW + RSFAKW + RSFKWL \\ & + RSFZFW + RSFOVGZK + RSFWAO + RSFVUT + RSFWW \end{aligned}$$

$$A_{GFPF} = c_{GFPF} TAX$$

$$\begin{aligned} U_{GFPF} = & U_{GFPF_{-1}}(1 + 0.01\dot{v}_{GFPF})[1 + 0.01\{0.93[0.78(1 + 0.01\dot{W}_o) \\ & + 0.22(1 + 0.01\dot{p}_{nmc})]\} + 0.01\{0.07(1 + 0.01\dot{p}_{bpr})\}] + U_{GFPF}^{aut} \end{aligned}$$

$$AEG = (0.01 + 0.004\delta_{BTW})G_{BTW} + 0.9(INR + LHEF) + AEG_{oi} + AEG_{ok}$$

$$I_o^{bui} = 0.513(0.015Y_{nf}) - K_o^{bui}$$

Investment premiums

$$WIR^k = 0.121I_p + KASTR_{WIR} + WIR^{aut}$$

Central government tax receipts*Wage tax*

$$T_L = [1 + 0.01(1.624\hat{G}_{TL} - 0.624\delta_{inc}\hat{p}_{c-1} + \hat{T}_L^{aut})]T_{L-1}$$

Direct taxes on other income, excluding VB

$$T_{ZIB} = [1 + 0.01(0.322\hat{G}_{TZIB_{4321}} - 1.813\Delta u_{-1} + \hat{T}_{ZIB}^{aut})]T_{ZIB-1}$$

Corporate taxes (transaction basis (excluding natural gas))

$$VBX^{tr} = 5944.55 + 0.030G_{VB-1} + VBX^{tr,aut}$$

Corporate taxes (including natural gas)

$$VB = VBX_{-1}^{tr} + (0.80 + 0.05\delta_{vb})(VBX_{-1}^{tr} - VBX_{-2}^{tr}) + VBA$$

Indirect taxes

$$BTW = 0.070(C_p - C_p^{ag}) + 0.153(C_p^{ag} + I_o + I_{wo}) + 0.028I_p + 0.123NMC_o + 0.003EX + 0.006V_{nf} + BTW^{aut}$$

$$INB = 0.041(C_p + NMC_o + I_p + I_{wo} + I_o) + INB^{aut}$$

$$INR = 0.008IM + INR^{aut}$$

Income transfers from households

$$EMR = -464.103 + 0.005Y_{nf}$$

Central government budget deficit

$$\begin{aligned} FTR = & L_o^R + NMC^R + I_o^R + ROS_R + 0.90URWW + UWWV + BYS95 + IHS + A_{GFPF} \\ & + SPE_R^l + SPE_R^k + SUB_R + RSF + I_R^{pf} + AEG + I_o^{bui} + K_o^{bui} + WIR^k + K_R^b \\ & + K_R^{gsvpf} + K_R^{onww} + K_R^{onww} + KRD_R^{bg} + KRD_R^{bui} - T_L - T_{ZIB} - VB - BTW \\ & - INB - INR - EMR - NBM_R - NAM - ROS_{ww} - AFL_{ww} - VAW - I_{bui}^o \\ & - K_{bui}^o - LHEF - AFL_{nww} - KASTR_R \end{aligned}$$

Local government expenditure*Wage formation and number of civil servants*

$$L_o^{OPL} = L_{o-1}^{OPL} \cdot x(1 + 0.01\hat{a}_{OPL}^x)(1 + 0.01\hat{W}_o) + L_o^{ond} + a_{OPL}^{gp}W_o$$

$$\hat{a}_{OPL}^x = 0.769\hat{a}_{OPL-1}^x + 0.992[(U_{GFPF} + SPE_R^l)/W_o]61.289/1000$$

Local government expenditure

$$nmc^{OPL} = -2687.21 + 18.913a_{OPL} - 56.704\Delta u_{-1}$$

$$i_o^{OPL} = 5999.15 - 366.40\Delta u_{-2} - 198.44(r_{sk} - \hat{p}_{io}) + SPE_R^k/p_{io}100$$

Income transfers to households

$$BYS^{OPL} = 0.522BYS95$$

Local government tax receipts

$$OGB_{zlf} = -928.166 + 0.007Y_{nf}$$

$$OGB_{wzl} = -1\,232.06 + 0.014Y_{nf}$$

$$EMO = -731.489 + 0.007Y_{nf-1}$$

Local government budget deficit

$$\begin{aligned} FTL = & L_o^{OPL} - LOI + NMC^{OPL} + I_o^{OPL} + ROS_L + ROS_{ww} + 0.10URWW + UGG \\ & + BYS05 + SUB_{OPL} + K_L^{bgp} + KRD_L^{bg} + AFL_{ww} + 0.5VAW + AFL_{nww} \\ & - A_{GFPF} - SPE_R^l - SPE_R^k - OGB_{zlf} - OGB_{wzl} - EMO - NBM_L - K_R^{onww} - K_R^{onww} - O_{bui}^o - KASTR_L \end{aligned}$$

Total government budget deficit

$$FTK = FTR + FTL$$

Social security system

Premiums paid to social security funds

$$PAOW = 1.010(UAOW + OBLAOW) - RSFAOW$$

$$PAWW = 1.029(UAWW + OBLAWW) - RSFAWW$$

$$PAWBZ = 1.015UAWBZ - RSFAWBZ - OBBAWBZ$$

$$PAAW = 1.043(UAAW + OBLAAW) - RSFAAW - OBBAAW$$

$$PAKW = 1.022(UAKW + OBLAKW) - RSFAKW$$

$$PKWL = 1.027UKWL - RSFKWL - OBBKWL$$

$$PZFW = 1.048(UZFW + OBLZFW) - RSFZFW - OBBZFW$$

$$POVGZK = 1.034UOVGZK - RSFOVGZK - OBBOVGZK$$

$$PWAOW = 1.031(UWAO + OBLWAO) - RSFWAO - OBBWAO$$

$$PZW = 1.066(UZW + OBLZW) - OBBZW$$

$$PVUT = 1.161(UVUT + OBLVUT) - RSFVUT - OBBVUT$$

$$\begin{aligned} PWW = & 1.133[3(UWW + OBLWW) + 2(UWW_{-1} + OBLWW_{-1}) \\ & + (UWW_{-2} + OBLWW_{-2})]/6 - RSFWW - OBBWW \end{aligned}$$

$$PVV = 244.400 + 10.890trend$$

Sum of the premiums paid

$$\begin{aligned} PSV = & PAOW + PAWW + PAWBZ + PAAW + PAKW + PKWL + PZFW + POVGZK \\ & + PWAOW + PZW + PVUT + PWW + PVV \end{aligned}$$

$$PSV_{gez} = psv_{gez}PSV$$

$$SLWG = psv_{wg,b}PSV + ppf_{wg,b}PPF + slr_{wg,b}(Wa)$$

$$SLWN = T_L + PSV_{gez} + PPF_{gez}$$

$$PZS = pzsPSV$$

Social security benefits

$$UAOW = [1 + 0.01[\hat{l}_{min}(1 - \beta_{WAM}) + \hat{l}_{AOW}^{aut}]] [1 + 0.01(\hat{v}_{AOW} + \hat{v}_{AOW}^{aut})] UAOW_{-1}$$

$$UAWW = [1 + 0.01[\hat{l}_{min}(1 - \beta_{WAM}) + \hat{l}_{AWW}^{aut}]] (1 + 0.01\hat{v}_{AWW}) UAWW_{-1}$$

$$UAWBZ = (1 + 0.01\hat{l}_{AWBZ})(1 + 0.01\hat{v}_{AWBZ}) UAWBZ_{-1}$$

$$\hat{l}_{AWBZ} = 0.835\hat{p}_c + 0.756\hat{W}_o + \hat{l}_{AWBZ}^{aut}$$

$$UAAW = [1 + 0.01[\hat{l}_{min}(1 - \beta_{WAM}) + \hat{l}_{AAW}^{aut}]] (1 + 0.01\hat{v}_{AAW}) UAAW_{-1}$$

$$UAKW = [1 + 0.01[\hat{p}_{c-1}(1 - \beta_{KB}) + \hat{l}_{AKW}^{aut}]] (1 + 0.01\hat{v}_{AKW}) UAKW_{-1} + UAKW80$$

$$UWAO = [1 + 0.01[\hat{l}_{-1}^R(1 - \beta_{WAM}) + \hat{l}_{WAO}^{aut}]] (1 + 0.01\hat{v}_{WAO}) UWAO_{-1}$$

$$\hat{v}_{WAO} = 5.512 + 0.983A\hat{I}Q + \hat{v}_{WAO}^{aut}$$

$$UZW = [1 + 0.01(\hat{l}_{bruto} + \hat{l}_{ZW}^{aut})] [1 + 0.01(\hat{d} + \hat{v}_{ZW}^{aut})] UZW_{-1}$$

$$UVUT = (1 + 0.01\hat{l}_{VUT})(1 + 0.01\hat{v}_{VUT}) UVUT_{-1}$$

$$UWW = [1 + 0.01[\hat{l}_{bruto}(1 - \beta_{WAM}) + \hat{l}_{WW}^{aut}]] (1 + 0.01\hat{v}_{WW}) UWW_{-1}$$

$$v_{WW} = v_{WW_{-1}}(1 - \delta_{sh}) + 0.322(wkl - wkl_{-1})(1 - \delta_{sh}) - 0.256(wkl_{-1} - wkl_{-2})(1 - \delta_{sh}) + 0.26wkl\delta_{sh} + \hat{v}_{WW}^{aut}$$

$$UVV = Wv_{VV}$$

$$v_{VV} = 0.251ijs + 0.102L_b^{bouw}/1000$$

Sum of the social security benefits paid

$$USV = UAOW + UAWW + UAWBZ + UAAW + UAKW + UKWL + UZFW + UOVGZK \\ + UWAO + UZW + UVUT + UWW + UVV + USVOV$$

$$USV_{bui} = 0.008USV$$

$$NMC^{SV} = 0.368[0.007(UAOW + OBLAOW) + 0.029(UAWW + OBLAWW) \\ + 0.015UAWBZ + 0.043(UAAW + OBLAAW) + 0.022UAKW + 0.027UKWL \\ + 0.048(UZFW + OBLZFW) + 0.034UOVGZK + 0.031(UWAO + OBLWAO) \\ + 0.066(UZW + OBLZW) + 0.023(UVUT + OBLVUT) \\ + 0.042(UWW + OBLWW) + 0.016(UVV + OBLVV)]$$

$$L_o^{SV} = 0.632[0.007(UAOW + OBLAOW) + 0.029(UAWW + OBLAWW) \\ + 0.015UAWBZ + 0.043(UAAW + OBLAAW) + 0.022UAKW + 0.027UKWL \\ + 0.048(UZFW + OBLZFW) + 0.034UOVGZK + 0.031(UWAO + OBLWAO) \\ + 0.066(UZW + OBLZW) + 0.023(UVUT + OBLVUT) + 0.042(UWW + OBLWW) \\ + 0.016(UVV + OBLVV)]$$

Disposable income of the government and the social security system

$$\begin{aligned}
 Y_{ob}^R &= T_L + T_{ZIB} + VB + BTW + INB + INR + EMR + NBM_R + NAM + ROS_{ww} \\
 &\quad + LHEF + I_{bui}^o - 0.90URWW - UWWV - BYS95 - IHS - A_{GFPPF} \\
 &\quad - SPE_R^L - SUB_R - ROS_R - (AEG - AEG_{ok}) - RSF - I_R^{pf} - I_o^{bui} \\
 Y_{ob}^{OPL} &= A_{GFPPF} + SPE_R^L + OGB_{zlf} + OGB_{wzl} + EMO + NBM_L - 0.10URWW \\
 &\quad - BYS05 - UGG - SUB_{OPL} - ROS_L - ROS_{ww} \\
 Y_{ob}^{SV} &= PSV + RSF + NBM_{SV} - USV \\
 Y_{ob} &= Y_{ob}^R + Y_{ob}^{OPL} + Y_{ob}^{SV}
 \end{aligned}$$

Other behavioural equations

$$\begin{aligned}
 tzza &= 0.967 (T_{ZIB} + VB)/p_v 100 \\
 vba &= VBA/p_v 100 \\
 T_o &= 0.009(BTW + INB + INR + OGB_{wzl}) \\
 L_b^{bouw} &= 2580.82 + 0.679I_{wo} \\
 LOI &= 0.011L_o^{OPL} \\
 PLVMPF &= 0.860(PLVM + PPF) \\
 PPF_{gez} &= ppf_{gez} PPF
 \end{aligned}$$

Definitional equations

$$\begin{aligned}
 l_{bruto} &= W - SLWG/a \\
 \dot{l}_{bruto} &= 100(l_{bruto}/l_{bruto-1} - 1) \\
 \dot{l}_{min} &= \dot{l}^{RL}(1 - \beta_{WAM}) + \dot{l}_{min}^{aut} \\
 \dot{l}^{RL} &= \dot{l}_{bruto} - \dot{l}_{inc} \\
 \dot{l}_{-1}^{RL} &= 0.5(\dot{l}^{RL} + \dot{l}_{-1}^{RL}) \\
 W^{net} &= W - [0.72PSV_{gez} + T_L + PPF_{gez} + SLWG]/a \\
 w^{net} &= 100(W^{net}/p_c) \\
 \dot{w}^{net} &= 100(w^{net}/w_{-1}^{net} - 1) \\
 TAX &= T_L + T_{ZIB} + VB + BTW + INB - TAX^{cor} \\
 prb_{wn} &= 100[SLWN/(Wa + L_o)] \\
 \Delta prb_{wn} &= prb_{wn} - prb_{wn-1} \\
 pr_{wg} &= 100[SLWG/(Wa)] \\
 \Delta pr_{wg} &= pr_{wg} - pr_{wg-1} \\
 T &= BTW + INB + INR + OGB_{wzl} + LHEF - SUB_R - SUB_{OPL} - T_o
 \end{aligned}$$

$$T_k = (T - T_{-1})/v_{-1} 100$$

$$G_{TL} = (Wa) + L_o + USV + ULVMPF + URWW + UWWV - PSV - PLVMPF - UAKW \\ - UKWL + PZFW + POVZK + PZS - USV_{bui}$$

$$\dot{G}_{TL} = 100(G_{TL}/G_{TL-1} - 1)$$

$$G_{TZIB} = V_{nf} - V_{ag,n} - (Wa) + (1 - SS_{d-1}^f/SS_{s-1}^f)ROS_R + ROS_L - NBM_R - NBM_L - NBM_{SV} - RPF - PZS$$

$$G_{TZIB_{4321}} = 0.4G_{TZIB} + 0.3G_{TZIB-1} + 0.2G_{TZIB-2} + 0.1G_{TZIB-3}$$

$$\dot{G}_{TZIB_{4321}} = 100(G_{TZIB_{4321}}/G_{TZIB_{4321-1}} - 1)$$

$$G_{VB} = V_{nf} - V_{ag,n} - (Wa) - RPF - NBM_R - NBM_L - NBM_{SV}$$

$$G_{BTW} = 0.70(1 - 0.070)(C_p - C_p^{ag}) + (1 - 0.153)(C_p^{ag} + I_{wo} + I_o) + (1 - 0.123)NMC_o$$

$$p_{nmc} = (1 + 0.01\dot{p}_{nmc})p_{nmc-1}$$

$$p_{io} = (1 + 0.01\dot{p}_{io})p_{io-1}$$

$$\dot{p}_{co} = [(L_o + LOI)/C_o]\dot{W}_o + [(C_o - L_o - LOI)/C_o]\dot{p}_{nmc}$$

$$p_{co} = (1 + 0.01\dot{p}_{co})p_{co-1}$$

$$\Delta v_{RWW} = v_{RWW} - v_{RWW-1}$$

$$\Delta v_{WW} = v_{WW} - v_{WW-1}$$

$$\dot{v}_{RWW} = 100(v_{RWW}/v_{RWW-1} - 1)$$

$$\dot{v}_{WWV} = 100(v_{WWV}/v_{WWV-1} - 1)$$

$$\dot{v}_{WW} = 100(v_{WW}/v_{WW-1} - 1)$$

$$AF_o = AF_o^R + AF_o^{OPL}$$

$$C_o = L_o + NMC_o + AF_o$$

$$c_o = C_o/p_{co} 100$$

$$NMC^{OPL} = nmc^{OPL}p_{nmc}/100$$

$$NMC_o = NMC^R + NMC^{OPL} + NMC^{SV}$$

$$V_o = L_o^R + L_o^{OPL} + L_o^{SV} + T_o + AF_o$$

$$v_o = (a_o/a_{o-1})v_{o-1}$$

$$I_o^{OPL} = i_o^{OPL}p_{io}/100$$

$$I_o = I_o^R + I_o^{OPL}$$

$$L_b^{rest} = L_o + LOI + URWW + UWWV + BYS95 + BYS05 + IHS + UGG + USV \\ - USV_{bui} + TOES_p - T_L - PSV - EMR - EMO$$

$$L_o = L_o^R + L_o^{OPL} + L_o^{SV}$$

$$L_o^o = L_o + LOI$$

$$W_o = (1 + 0.01 \dot{W}_o) W_{o-1}$$

$$\dot{a}_{OPL}^x = 100(a_{OPL}^x/a_{OPL-1}^x - 1)$$

$$a_{OPL} = a_{OPL}^x + a_{OPL}^{ond} + a_{OPL}^{gp}$$

$$a_{SV} = a_{SV-1} + L_o^{SV}/W_o - L_{o-1}^{SV}/W_{o-1}$$

$$a_o = a_R + a_{OPL} + a_{SV}$$

$$WIR = WIR^k - KASTR_{WIR}$$

$$wir = WIR/p_t 100$$

Appendix 2

Symbols

Sources and definitions of the variables presented in this appendix, as well as the data, are listed in Brunia *et al* [10].

a	= labour volume of employees in enterprises (1 000 man years)
a_{ba}	= total employment in the gas sector (1 000 man years)
a_{bx}	= total employment in enterprises, excluding the exploitation of natural gas (1 000 man years)
a_o	= employees in the government sector (1 000 man years)
a_z	= labour volume self employed (1 000 man years)
a_{OPL}	= total employment in the local government sector (1 000 man years)
a_{OPL}^{gp}	= total employment in the local police force (1 000 man years)
a_{OPL}^{ond}	= total employment in the education sectors (1 000 man years)
a_{OPL}^x	= total employment in the local government sector, excluding employment in the local police force and the education sectors (1 000 man years)
a_R	= total employment in the public sector (1 000 man years)
a_{SV}	= total employment in the social security sector (1 000 many years)
aa	= total labour supply (1 000 persons)
aa_m	= labour supply of men (1 000 persons)
aa_c	= labour supply of women (1 000 persons)
av	= total labour demand, including self employed (1 000 man years)
A_{GFPF}	= tax transfers from central government to local government (million hfl, current prices)
AE_G	= unrequited income and capital transfers from central government to the EC (million hfl, current prices)
$AE_{G_{oi}}$	= unrequited current transfers not classified elsewhere from central government to the EC (million hfl, current prices)
$AE_{G_{ok}}$	= contribution of central government to EOGFL, CERN, and to the fast breeder (million hfl, current prices)
AF	= depreciation of fixed capital of enterprises and general government (million hfl, current prices)
AF_b	= depreciation of fixed capital of enterprises (million hfl, current prices)
AF_{gb}	= depreciation of non-residential buildings (million hfl, current prices)
AF_o	= depreciation of fixed capital of general government (million hfl, current prices)
AF_o^{OPL}	= depreciation of fixed capital of local government (million hfl, current prices)
AF_o^R	= depreciation of fixed capital of central government (million hfl, current prices)
AFL_{nw}	= local government redemptions (million hfl, current prices)
AFL_{ww}	= redemptions on social housing loans paid by the local government to central government, excluding advance redemptions (million hfl, current prices)
AIQ	= share of private sector labour income in total value-added of the private sector
bb_m	= male labour force (1 000 persons)
bb_c	= female labour force (1 000 persons)
bb_m^{65+}	= labour force of men older than 65 years (1 000 persons)
bb_c^{65+}	= labour force of women older than 65 years (1 000 persons)
bpr	= gross domestic product at market prices (million hfl, constant prices, 1980 = 100)
BCR	= short-term bank credit (million hfl, current prices)

<i>BPR</i>	= gross domestic product at market prices (million hfl, current prices)
<i>BTW</i>	= value-added tax (actual receipts, current prices)
<i>BYS^{OPL}</i>	= unrequited income transfers from local government to households, for account of central government, excluding unemployment benefits (million hfl, current prices)
<i>BYS05</i>	= income transfers not classified elsewhere connected with <i>BYS^{OPL}</i> from local government to households, for account of local government itself (million hfl, current prices)
<i>BYS95</i>	= unrequited income transfers from central government to households, excluding unemployment benefits and individual house rent subsidies (million hfl, current prices)
<i>c_o</i>	= consumption by general government (million hfl, constant prices, 1980 = 100)
<i>c_p</i>	= consumption by households (million hfl, constant prices, 1980 = 100)
<i>c_{GFPF}</i>	= share of central government tax revenues available for the municipalities and provinces funds
<i>C_o</i>	= consumption by general government (million hfl, current prices)
<i>C_p</i>	= consumption by households (million hfl, current prices)
<i>C_p^{ag}</i>	= consumption of natural gas (million hfl, current prices)
<i>CONJ</i>	= economic indicator (according to Zijlstra)
<i>CR</i>	= long-term bank credit (million hfl, current prices)
<i>d_{oa}</i>	= depreciation in terms of productive capacity of the enterprise sector, excluding the exploitation of natural gas (million hfl, constant prices, 1980 = 100)
<i>dum_{tdk}</i>	= dummy variable representing the rapid substitution of saving deposits in long-term deposits in 1974 and 1976
<i>ex</i>	= exports of goods (fob) and services (million hfl, constant prices, 1980 = 100)
<i>ex_{ag}</i>	= exports of goods (fob) and services of the natural gas sector (million hfl, constant prices, 1980 = 100)
<i>ex_c</i>	= double-weighted world trade (million hfl, constant prices, 1980 = 100)
<i>ex_{xa}</i>	= exports of goods (fob) and services excluding the exploitation of natural gas (million hfl, constant prices, 1980 = 100)
<i>EMO</i>	= income transfers from households to local government (million hfl, current prices)
<i>EMR</i>	= income transfers from households to central government (million hfl, current prices)
<i>EX</i>	= exports of goods (fob) and services (million hfl, current prices)
<i>EX_{ag}</i>	= exports of goods (fob) and services of the natural gas sector (million hfl, current prices)
<i>FTK</i>	= government budget deficit (million hfl, current prices)
<i>FTL</i>	= budget deficit of local government (million hfl, current prices)
<i>FTR</i>	= budget deficit of central government (million hfl, current prices)
<i>G_{BTW}</i>	= tax base of value-added taxes (million hfl, current prices)
<i>G_{TL}</i>	= tax base of direct taxes on wage and transfer income (million hfl, current prices)
<i>G_{TZIB}</i>	= tax base of direct taxes levied by central government, excluding taxes on wage and transfer income and corporate taxes (million hfl, current prices)
<i>h_t</i>	= index of working hours in period <i>t</i> (1950 = 1)
<i>H</i>	= discounts and advances including special loans (million hfl, current prices)
<i>i_{ag}</i>	= gross investment in equipment and means of transport in the gas sector (million hfl, constant prices, 1980 = 100)
<i>i_b</i>	= gross fixed capital formation of enterprises (million hfl, constant prices, 1980 = 100)
<i>i_{gb}</i>	= gross investment in non-residential buildings of enterprises (million hfl, constant prices, 1980 = 100)
<i>i_{gb}ⁿ</i>	= net investment in non-residential buildings of enterprises (million hfl, constant prices, 1980 = 100)
<i>i_o</i>	= gross fixed capital formation of general government (million hfl, constant prices, 1980 = 100)
<i>i_o^{OPL}</i>	= gross fixed capital formation of local government (million hfl, constant prices, 1980 = 100)
<i>i_o^R</i>	= gross fixed capital formation of central government (million hfl, constant prices, 1980 = 100)
<i>i_{oa}</i>	= gross investment in equipment and means of transport of enterprises excluding the exploitation of natural gas (million hfl, constant prices, 1980 = 100)
<i>i_{oa}ⁿ</i>	= net investment in equipment and means of transport of enterprises excluding the exploitation of natural gas (million hfl, constant prices, 1980 = 100)
<i>i_{ou}</i>	= gross investment in equipment and means of transport of enterprises (million hfl, constant prices, 1980 = 100)
<i>i_v</i>	= increase in stocks and work in progress as a percentage of gross output of enterprises in the previous period (million hfl, constant prices, 1980 = 100)
<i>im</i>	= imports of goods (cif) and services (million hfl, constant prices, 1980 = 100)
<i>I_{ag}</i>	= gross investment in equipment and means of transport in the gas sector (million hfl, current prices)
<i>I_b</i>	= gross fixed capital formation of enterprises (million hfl, current prices)
<i>I_{bui}^c</i>	= income transfers from foreign countries to general government (million hfl, current prices)
<i>I_{gb}</i>	= gross investment in non-residential buildings of enterprises (million hfl, current prices)
<i>I_o</i>	= gross fixed capital formation of general government (million hfl, current prices)
<i>I_{bui}^c</i>	= income transfers from the government sector to the rest of the world (million hfl, current prices)
<i>I_o^{OPL}</i>	= gross fixed capital formation of local government (million hfl, current prices)

I_o^R	= gross fixed capital formation of central government (million hfl, current prices)
I_{oa}	= gross investment in equipment and means of transport of enterprises, excluding the exploitation of natural gas (million hfl, current prices)
I_{ot}	= other investment by enterprises (million hfl, current prices)
I_p	= gross investment by private sector, excluding gross investment in dwellings (million hfl, current prices)
I_{wo}	= gross investment in dwellings of enterprises (million hfl, current prices)
I_R^{pf}	= unrequited income transfers from central government to pension funds (million hfl, current prices)
IHS	= individual house rent subsidies from central government to households (million hfl, current prices)
IM	= imports of goods (cif) and services (million hfl, current prices)
INB	= indirect central government taxes (actual receipts), excluding VAT and import duties (million hfl, current prices)
INR	= import duties (million hfl, current prices)
IQ	= gross fixed capital formation as percentage of gross domestic product
IQ_{OECD}	= gross fixed capital formation of the OECD countries as percentage of OECD product
IR	= international reserves held by the central bank (thousand hfl, current prices)
kr_1	= required cash and liquidity ratio in percentages
kr_2	= credit restriction dummy variable
K_o^{bui}	= unrequited capital transfers from central government to the rest of the world, excluding the EC (million hfl, current prices)
K_L^{bap}	= net capital transfers from local government to private sector and pension funds (million hfl, current prices)
K_R^b	= net capital transfers from central government to enterprises, excluding WIR investment premiums (million hfl, current prices)
K_R^{qsup}	= net capital transfers from central government to households, social security sector and pension funds (million hfl, current prices)
K_R^{oww}	= social housing loans supplied by central government via local government (million hfl, current prices)
K_R^{onww}	= credit loans, excluding social housing loans from central government to local government (million hfl, current prices)
$KASTR_L$	= cash account transaction account discrepancies and other definitional differences with respect to local government expenditures (million hfl, current prices)
$KASTR_R$	= cash account transaction account discrepancies and other definitional differences with respect to differences for central government spendings (million hfl, current prices)
$KASTR_{WIR}$	= cash account transaction account discrepancies with respect to WIR investment grants (million hfl, current prices)
KOS	= short-term government debt as part of domestic liquidity (million hfl, current prices)
KRD_L^{bg}	= net loans from local government to enterprises and households (million hfl, current prices)
KRD_R^{bg}	= net loans from central government to enterprises and households (million hfl, current prices)
KRD_R^{bui}	= net loans from central government to the rest of the world (million hfl, current prices)
KT^{cb}	= cash balances of the government (thousand hfl, current prices)
l^{RL}	= index of contractual wage rate in the private sector (1980 = 100)
l_b	= wages, salaries and social charges (million hfl, constant prices, 1980 = 100)
l_{bruto}	= gross wage rate in enterprises (million hfl, constant prices, 1980 = 100)
l_{inc}	= non-contractual change of wages, wage drift (%)
l_{min}	= statutory minimum wage rate (thousand hfl, current prices)
l_{aut}^{AAW}	= autonomous price change of general disability benefits (%)
l_{aut}^{AKW}	= autonomous price change of general family allowance benefits (%)
l_{aut}^{AOW}	= autonomous price change of old age pensions (%)
l_{AWBZ}	= average cost of a patient per day, based on General Special Medical Expenses Act
l_{aut}^{AWW}	= autonomous price change of widows' and orphans' benefits (%)
l_{aut}^{RWW}	= autonomous price change of general unemployment benefits (%)
l_{aut}	= price component of early retirement benefits
l_{aut}^{WAO}	= autonomous price change of disability insurance benefits (%)
l_{aut}^{WW}	= autonomous price change of unemployment insurance benefits (%)
l_{aut}^{ZW}	= autonomous price change of health benefits (%)
L_b	= wages, salaries and social charges (million hfl, current prices)
L_b^{bouw}	= wage bill of the residential construction sector (million hfl, current prices)
L_b^{test}	= wages, salaries and social charges of the general government and current transfers of the general government with regard to wage earners minus taxes on wages at current prices (million hfl, current prices)
L_o^o	= wages and salaries, including social security premiums of employees in the public sector (million hfl, current prices)

L_o^{ond}	= wages, salaries and social charges paid by government and public and private education sector (million hfl, current prices)
L_o^{OPL}	= wages, salaries and social charges of local government (million hfl, current prices)
L_o^R	= wages, salaries and social charges of central government (million hfl, current prices)
L_o^{SV}	= wages, salaries and social charges of the social security sector (million hfl, current prices)
L_C	= currency (million hfl, current prices)
L_G	= demand deposits (million hfl, current prices)
L_o	= wage sum of general government (million hfl, current prices)
LA	= liquidity destruction by the government (million hfl, current prices)
$LHEF$	= transfers from central government to the EC (Agriculture Equalization Fund) (million hfl, current prices)
LIQ	= liquidity ratio
LOI	= wages, salaries and social charges paid by local government due to own investment (million hfl, current prices)
M_C^{cb}	= banknotes (million hfl, current prices)
M_C^{co}	= coins (million hfl, current prices)
M_2^{cb}	= demand deposits and short-term time and saving deposits with the central bank (million hfl, current prices)
nl_b	= other disposable income of households (million hfl, constant prices, 1980 = 100)
nmC^{OPL}	= net material consumption of local government (million hfl, constant prices, 1980 = 100)
nmC^R	= net material consumption of central government (million hfl, constant prices, 1980 = 100)
N_t	= total capacity demand for labour (1 000 man years)
N_{tt}	= capacity demand for labour of vintage t in period t (in 1 000 man years)
NAM	= non-tax revenues of central government from exploitation of natural gas (million hfl, cash account, current prices)
NBM_L	= non-tax revenues of local government, excluding natural gas profits (million hfl, current prices)
NBM_R	= non-tax revenues of central government, excluding natural gas profits (million hfl, current prices)
NBM_{SV}	= non-tax revenues of the social security sector (million hfl, current prices)
NFA^{pb}	= net foreign assets of private banks (million hfl, current prices)
NFA^{ps}	= net foreign assets of the private non-monetary sector (million hfl, current prices)
NL_b	= other disposable income of households (million hfl, current prices)
NMC_o	= net material consumption of government, excluding depreciation (million hfl, current prices)
NMC^{OPL}	= net material consumption of local government, excluding depreciation (million hfl, current prices)
NMC^{SV}	= net material consumption of the social security sector, excluding depreciation (million hfl, current prices)
O_{bui}^o	= capital transfers from the rest of the world to local government (million hfl, current prices)
OB	= surplus on the current account of the balance of payments (million hfl, current prices)
$OBBAAW$	= mutual payments of other social security funds to the general disability insurance fund (million hfl, current prices)
$OBBAKW$	= mutual payments of other social security funds to the family allowance children's fund (million hfl, current prices)
$OBBAWBZ$	= mutual payments of other social security funds to the General Special Medical Expenses Act health insurance fund (million hfl, current prices)
$OB BKWL$	= mutual payments of other social security funds to the Workers' Family Allowances Act children's fund (million hfl, current prices)
$OBBOVGZK$	= mutual payments of other social security funds to the other compulsory health insurance fund (million hfl, current prices)
$OB BVUT$	= mutual payments of other social security funds to the early retirement fund (million hfl, current prices)
$OB BVV$	= mutual payments of other social security funds to the frost insurance fund (million hfl, current prices)
$OB BWAO$	= mutual payments of other social security funds to the disability insurance fund (million hfl, current prices)
$OB BW$	= mutual payments of other social security funds to the unemployment insurance fund (million hfl, current prices)
$OB BZFW$	= mutual payments of other social security funds to the compulsory medical insurance fund (million hfl, current prices)
$OB BZW$	= mutual payments of other social security funds to the Health Law sickness insurance fund (million hfl, current prices)
$OB LAAW$	= mutual payments of the general disability health insurance fund to other social security funds (million hfl, current prices)
$OB LAOW$	= mutual payments of the old age pensions' insurance fund to other social security funds (million hfl, current prices)
$OB LAW$	= mutual payments of the general widows' and orphans' fund to other social security funds (million hfl, current prices)

<i>OBLVUT</i>	= mutual payments of the early retirement fund to other social security funds (million hfl, current prices)
<i>OBLVV</i>	= mutual payments of the other compulsory medical insurance fund to other social security funds (million hfl, current prices)
<i>OBLWAO</i>	= mutual payments of the disability insurance fund to other social security funds (million hfl, current prices)
<i>OBLWW</i>	= mutual payments of the unemployment insurance fund to other social security funds (million hfl, current prices)
<i>OBLZFW</i>	= mutual payments of the compulsory medical insurance fund to other social security funds (million hfl, current prices)
<i>OBLZW</i>	= mutual payments of the Health Law sickness insurance fund to other social security funds (million hfl, current prices)
<i>OGB_{wzl}</i>	= indirect local government taxes (actual receipts) (million hfl, current prices)
<i>OGB_{zlf}</i>	= direct local government taxes (actual receipts) (million hfl, current prices)
<i>ONL^{cb}</i>	= other net liabilities of the central bank (million hfl, current prices)
<i>ONL^{pb}</i>	= other net liabilities of private banks (million hfl, current prices)
<i>p_{bpr}</i>	= price index of gross domestic product (1980 = 100)
<i>p_c</i>	= price index of consumption of households (1980 = 100)
<i>p_{co}</i>	= price index of consumption of government (1980 = 100)
<i>p_{exa}</i>	= price index of exports of goods and services excluding natural gas (1980 = 100)
<i>p_{exc}</i>	= price index of foreign goods and services excluding natural gas (1980 = 100)
<i>p_{exg}</i>	= price index of exports of goods and services of the natural gas sector (1980 = 100)
<i>p_h</i>	= statutory increase of house rents (%)
<i>p_{ib}</i>	= price index of gross fixed capital formation (1980 = 100)
<i>p_{igb}</i>	= price index of investment in non-residential buildings (1980 = 100)
<i>p_{io}</i>	= price index of investment by government (1980 = 100)
<i>p_{iou}</i>	= price index of investment in equipment and means of transport (1980 = 100)
<i>p_{iwo}</i>	= price index of investment in dwellings (1980 = 100)
<i>p_m</i>	= price index of imports of goods and services (1980 = 100)
<i>p_{nmc}</i>	= price index of net material consumption of government (1980 = 100)
<i>p_v</i>	= price index of gross output of enterprises (1980 = 100)
<i>p_{Δvr}</i>	= price index of the increase in stocks and work in progress (1980 = 100)
<i>ppf_{gez}</i>	= households' contribution to pension funds as fraction of total pension premiums
<i>ppf_{wg,b}</i>	= employers' contribution to pension funds as fraction of total pension premiums
<i>pr_{wg}</i>	= social security contributions and pension premiums of employers as a percentage of the private sector wage bill
<i>prb_{wn}</i>	= social security contributions, pension premiums and taxes on wages and transfers of households, as a percentage of wage income of households
<i>psv_{gez}</i>	= social security contributions of households as a fraction of total social security contributions
<i>psv_{wg,b}</i>	= social security contributions of employers as a fraction of total social security contributions
<i>pzs</i>	= social security contributions of self employed as a fraction of total social security contributions
<i>P_m</i>	= labour force participation rate, men
<i>P_v</i>	= labour force participation rate, women
<i>PAAW</i>	= social security contributions to the general disability fund (million hfl, current prices)
<i>PAKW</i>	= social security contributions to the children's general family allowance fund (million hfl, current prices)
<i>PAOW</i>	= social security contributions to the old age pensions fund (million hfl, current prices)
<i>PAWBZ</i>	= social security contributions to the General Special Medical Expenses Act health care fund (million hfl, current prices)
<i>PAWW</i>	= social security contributions to the widows' and orphans' fund (million hfl, current prices)
<i>PKWL</i>	= social security contributions to the Workers' Family Allowances Act children's fund (million hfl, current prices)
<i>PLVM</i>	= life insurance premiums (million hfl, current prices)
<i>PLVMPF</i>	= premiums paid to life insurance companies and pension funds, deductible for tax on wage and transfer income (million hfl, current prices)
<i>POVGZK</i>	= social security contributions to the other compulsory health insurance fund, excluding compulsory health insurance and General Special Medical Expenses Act funds (million hfl, current prices)
<i>PPF</i>	= total premiums paid to pension funds (million hfl, current prices)
<i>PPF_{gez}</i>	= households' contribution to pension funds (million hfl, current prices)
<i>PSV</i>	= total contribution to social security funds (million hfl, current prices)
<i>PSV_{gez}</i>	= households' contribution (including self employed) to social security funds (million hfl, current prices)
<i>PVUT</i>	= social security contributions to the early retirement fund (million hfl, current prices)
<i>PVV</i>	= social security contributions to the VV insurance fund in (million hfl, current prices)

<i>PWAO</i>	= social security contributions to the disability insurance fund (million hfl, current prices)
<i>PWW</i>	= social security contributions to the unemployment insurance fund (million hfl, current prices)
<i>PZFW</i>	= social security contributions to the compulsory health insurance fund (million hfl, current prices)
<i>PZS</i>	= social security contributions paid by self employed (million hfl, current prices)
<i>PZW</i>	= social security contributions to the Health Law sickness insurance fund (million hfl, current prices)
q_x	= utilization rate of productive capacity
q_N	= utilization rate of capacity demand for labour
r_{bcr}	= interest rate on short-term bank credit
r_{cb}	= discount rate
r_{cr}	= interest rate on long-term bank credit
r_f	= foreign long-term interest rate
r_r	= real interest rate
r_{rc}	= interest rate on demand deposits
r_{sk}	= interest rate on short-term government debt
r_{ss}	= interest rate on long-term government bonds (capital market interest rate)
r_{tdk}	= interest rate on short-term time and saving deposits
r_{tdl}	= interest rate on long-term time and saving deposits
r_τ	= average interest rate connected to the vintage of long-term debt of central government created in year τ
<i>R</i>	= cash balances of private banks (million hfl, current prices)
<i>ROS_{ww}</i>	= interest payments paid by local government on loans for social housing programmes (million hfl, current prices)
<i>ROS_L</i>	= interest payments paid by local government, excluding interest on social housing loans (million hfl, current prices)
<i>ROS_R</i>	= interest payments paid by central government, excluding interest on social housing loans (million hfl, current prices)
<i>RPF</i>	= interest payments received by pension funds and life insurance companies (= imputed interest) (million hfl, current prices)
<i>RSF</i>	= contributions of central government (income transfers) to social security funds (million hfl, current prices)
<i>RSFAAW</i>	= income transfers from the central government to the general disability fund (million hfl, current prices)
<i>RSFAKW</i>	= income transfers from the central government to the general family allowances children's fund (million hfl, current prices)
<i>RSFAOW</i>	= income transfers from the central government to the old age pensions' fund (million hfl, current prices)
<i>RSFAWBZ</i>	= income transfers from the central government to the General Special Medical Expenses Act health insurance fund (million hfl, current prices)
<i>RSFAWW</i>	= income transfers from the central government to the general widows' and orphans' fund (million hfl, current prices)
<i>RSFKWL</i>	= income transfers from the central government to the Workers' Family Allowances Act children's fund (million hfl, current prices)
<i>RSFOVGZK</i>	= income transfers from the central government to the other health insurance fund (million hfl, current prices)
<i>RSFVUT</i>	= income transfers from the central government to the compulsory early retirement fund (million hfl, current prices)
<i>RSFWW</i>	= income transfers from the central government to the unemployment insurance fund (million hfl, current prices)
<i>RSFWAO</i>	= income transfers from the central government to the disability insurance fund (million hfl, current prices).
<i>RSFZFW</i>	= income transfers from the central government to the compulsory health insurance fund (million hfl, current prices)
$slr_{wg,b}$	= imputed social security contributions of employers as a fraction of the private sector wage bill
S_{ion}	= current transfers received from the rest of the world (million hfl, current prices)
S_{pib}	= net primary income received from the rest of the world (million hfl, current prices)
S_τ	= central government debt of vintage τ (million hfl, current prices)
SK_d^{cb}	= demand for short-term government debt by the central bank (million hfl, current prices)
SK_d^{pb}	= demand for short-term government debt by private banks (million hfl, current prices)
SK_d^{ps}	= demand for short-term government debt by the private non-monetary sector (million hfl, current prices)
SK_s	= supply of short-term government debt (million hfl, current prices)
<i>SLWG</i>	= actual and imputed social premiums and pension funds premiums paid by employers (million hfl, current prices)
<i>SLWN</i>	= social security premiums, pension funds premiums and taxes on wages and transfers paid by households (million hfl, current prices)
SPE_R^l	= unrequited current transfers not classified elsewhere from central to local government, excluding

	compensations for social benefits (million hfl, current prices)
SPE_R^k	= unrequited capital transfers and investment grants from central to local government (million hfl, current prices)
SS_d^{cb}	= demand for long-term government debt by the central bank (million hfl, current prices)
SS_d^f	= foreign demand for long-term government debt (million hfl, current prices)
SS_d^{pb}	= demand for long-term government debt by private banks (million hfl, current prices)
SS_d^{ps}	= demand for long-term government debt by the private non-monetary sector (million hfl, current prices)
SS_s	= supply of long-term government debt (million hfl, current prices)
$STATT$	= statistical differences in the IR equation
SUB_{OPL}	= local government (price) subsidies (million hfl, current prices)
SUB_R	= central government (price) subsidies, excluding EC agricultural subsidies (million hfl, current prices)
$trend$	= trend variable
$tzz \cdot W \cdot a/p_v$	= share of self employed in the total wage sum of enterprises (million hfl, constant prices, 1980 = 100)
$tzza$	= direct taxes of the enterprise sector, excluding the exploitation of natural gas, before adjusting for self employed and company taxes with respect to profits on the exploitation of natural gas (million hfl, constant prices, 1980 = 100)
T	= indirect taxes minus subsidies (million hfl, current prices)
T_k	= change in indirect taxes minus subsidies as a percentage of gross output of enterprises (million hfl, current prices)
T_o	= indirect taxes paid by the government (million hfl, current prices)
T_L	= direct taxes on wage and transfer income (cash account) (million hfl, current prices)
T_{ZIB}	= direct central government taxes on non-wage income, excluding corporate taxes (million hfl, cash account current prices)
TAX	= direct and indirect central government taxes, excluding motor vehicle taxes of enterprises and import duties (million hfl, current prices)
TAX^{cor}	= correction of central government taxes, in the calculation of the relevant tax base of the municipalities and provinces funds (million hfl, current prices)
TB_m	= total male population (1 000 persons)
TB_v	= total female population (1 000 persons)
TDK	= short-term time and saving deposits (million hfl, current prices)
TDL	= long-term time and saving deposits (million hfl, current prices)
$TOES_p$	= social benefits as supplements to pensions (million hfl, current prices)
u	= unemployment as a percentage of the labour volume of employees
U_{GFPF}	= transfers from the municipalities and provinces funds to local government (million hfl, current prices)
$UAAW$	= social security benefits paid by the general disability fund (million hfl, current prices)
$UAKW$	= children's allowances paid by the general family allowances fund (million hfl, current prices)
$UAKW80$	= autonomous change in children's allowances due to revision of laws on children's allowances in 1980
$UAOW$	= social security benefits paid by the old age pensions' fund (million hfl, current prices)
$UAWBZ$	= social security benefits paid by the General Special Medical Expenses Act insurance fund (million hfl, current prices)
$UAWW$	= social security benefits paid by the general widows' and orphans' insurance fund (million hfl, current prices)
UGG	= current transfers (excluding unemployment benefits) to households by local government for its own account (million hfl, current prices)
$UKWL$	= social security benefits paid by the Workers' Family Allowances Act children's fund (million hfl, current prices)
$ULVMPF$	= pension and life insurance benefits (million hfl, current prices)
$UOVGZK$	= social security benefits paid by the other compulsory health insurance fund (million hfl, current prices)
$URWW$	= compulsory unemployment benefits paid to households (million hfl, current prices)
USV	= total social security benefits paid to households (million hfl, current prices)
USV_{bui}	= social security benefits paid to foreign residents (million hfl, current prices)
$USVOV$	= benefits paid by other social security funds (million hfl, current prices)
$UVUT$	= social security benefits paid by the early retirement fund (million hfl, current prices)
UVV	= social security benefits paid by the frost insurance fund (million hfl, current prices)
$UWAO$	= social security benefits paid by the disability insurance fund (million hfl, current prices)
UWW	= social security benefits paid by the unemployment insurance fund (million hfl, current prices)
$UWWV$	= unemployment insurance benefits paid by the government to households (million hfl, current prices)
$UZFW$	= social security benefits paid by the compulsory health insurance fund (million hfl, current prices)
UZW	= social security benefits paid by the Health Law sickness insurance fund (million hfl, current prices)
v	= gross value-added of enterprises at market prices (or gross output of enterprises) (million hfl, constant prices, 1980 = 100)

v_{ag}	= gross value-added of the exploitation of natural gas at factor costs (million hfl, constant prices, 1980 = 100)
v_o	= gross value-added of general government at market prices (million hfl, constant prices, 1980 = 100)
v_{oa}	= current output of enterprises, excluding the exploitation of natural gas, at factor cost (constant prices, 1980 = 100)
v_{AKW}	= volume of the general family allowances children's benefits (thousands)
v_{AOW}	= volume of the old age pension benefits (thousands)
v_{AWBZ}	= volume of the General Special Medical Expenses Act insurance benefits (in number of nursing days)
v_{AWW}	= volume of the general widows' and orphans' fund (thousands of benefit years)
$\hat{v}_{GFPF}$	= volume change of transfers from the municipalities and provinces funds
v_{RWW}	= volume of the unemployment benefits (thousands of benefit years)
v_{VUT}	= volume of the early retirement benefits (thousands of benefit years)
v_{VV}	= volume of the frost insurance benefits (thousands of benefit years)
v_{WAO}	= volume of the disability insurance fund (thousands of benefit years)
v_{WW}	= volume of the unemployment insurance benefits (thousands of benefit years)
v_{WWV}	= volume of unemployment insurance benefits (thousands of benefit years)
$\hat{v}_{ZW}^{sauf}$	= autonomous volume change of the Health Law sickness insurance benefits, due to revision of the social security system in 1987
vba	= company taxes with regard to profits on the exploitation of natural gas (million hfl, cash account, constant prices, 1980 = 100)
Δv_r	= increase in stocks and work in progress (million hfl, constant prices, 1980 = 100)
$V_{ag,n}$	= net value-added of the energy sector (transaction account) (million hfl, current prices)
V_{nf}	= net value-added of enterprises (transaction account) (million hfl, current prices)
V_o	= gross value-added of general government at market prices (million hfl, current prices)
V_t	= set of vintages that yield a non-negative quasirent in period t
VAW	= advanced redemptions on social housing loans as received by central government (million hfl, current prices)
VB	= corporate taxes (million hfl, cash account, current prices)
VBA	= corporate taxes in (million hfl, cash account, current prices)
VBX^{tr}	= corporate taxes (transaction account), excluding taxes on natural gas profits (million hfl, current prices)
ΔV_R	= increase in stocks and work in progress (million hfl, current prices)
w^{net}	= net real wage rate (million hfl, constant prices, 1980 = 100)
wir	= investment premiums WIR (million hfl, transaction account, constant prices, 1980 = 100)
wkl	= total unemployment (1 000 persons)
wkl_m	= unemployed men (1 000 persons)
wkl_v	= unemployed women (1 000 persons)
W	= nominal wage rate in enterprises (million hfl, current prices)
W^{net}	= net real wage rate (million hfl, current prices)
W^o	= total wealth of general government (million hfl, current prices)
W^{pb}	= total wealth of private banks (million hfl, current prices)
W^{ps}	= total wealth of the private non-monetary sector (million hfl, current prices)
W_o	= average gross wage rate for employees in the government sector (million hfl, current prices)
WIR	= investment grants supplied by the WIR investment account fund to enterprises (transaction account) (million hfl, current prices)
WIR^k	= investment grants supplied by the WIR investment account fund to enterprises (million hfl, cash account, current prices)
WT	= world trade (billion US\$ current prices)
x_t	= total capacity output (million hfl, constant prices, 1980 = 100)
x_{it}	= capacity output of vintage t in period t (million hfl, constant prices, 1980 = 100)
ijs	= number of days with an average temperature below zero degrees centigrade
Y_{bb}	= disposable income of enterprises (million hfl, current prices)
Y_{bel}	= other income of enterprises (million hfl, current prices)
Y_{gb}	= disposable income of households (million hfl, current prices)
Y_n	= net national income at market prices (million hfl, current prices)
Y_{nf}	= net national income at factor costs (million hfl, current prices)
Y_{ob}	= disposable income of the public sector (million hfl, current prices)
Y_{ob}^{OPL}	= disposable income of local government (million hfl, current prices)
Y_{ob}^R	= disposable income of central government (million hfl, current prices)
Y_{ob}^{SV}	= disposable income of social security funds (million hfl, current prices)
zd_{oa}	= real disposable income of enterprises, excluding natural gas (million hfl, constant prices, 1980 = 100)
β_{wo}	= binary dummy, indicating (non-) adjustment of government wages to changes in the contractual average wage rate in the private sector

β_{KB}	= binary dummy, indicating (non-) adjustment of children's allowances to changes in the general price level
β_{WAM}	= binary dummy, indicating (non-) adjustment of social security benefits (excluding health care and children's allowances) and of the statutory minimum wage rate to changes in the contractual average wage rate in the private sector
δ_{inc}	= dummy for inflation adjustment of tariffs for wage and income taxes (between zero and unity)
δ_{sh}	= binary dummy, indicating the revision of the social security system in 1987
δ_{BTW}	= binary dummy, indicating the increase in (VAT) contributions to the EC since 1986
δ_{VB}	= binary dummy, indicating a change in the assessment scheme of corporate tax since 1979
e_{wkl}	= variable indicating the discrepancies between the number of unemployed and the total volume of unemployment benefits
η	= labour intensity of the newest vintage
κ	= percentage of liquidity destruction by the government
λ	= recalculation factor, man years to persons
π	= exchange rate of the US\$ vis-à-vis the guilder
π^*	= expected exchange rate
π_{SDM}	= exchange rate of the US\$ vis-à-vis the deutschmark
ϕ	= percentage of the government budget deficit financed with short-term debt
$\phi_{i,j}$	= fraction (percentage) of a vintage of government debt created in year i and existing at the end of year j
χ	= the capital coefficient of the newest vintage

Appendix 3

Ex post simulation results

Goodness of fit is revealed most clearly in figures showing realizations together with the simulations. For a number of variables the results are presented graphically in the Figures 5-40.

Figure 5. Consumption of households.

Figure 7. Gross investment in equipment and means of transport, excluding energy.

Figure 6. Gross fixed capital formation of enterprises.

Figure 8. Exports of goods and services.

Figure 9. Imports of goods and services.

Figure 13. Price index of consumption of households.

Figure 10. Gross domestic product at market prices.

Figure 14. Nominal wage rate in enterprises.

Figure 11. Gross output of enterprises.

Figure 15. Total employment.

Figure 12. Surplus on the current account of the balance of payments.

Figure 16. Total labour supply.

Figure 17. Unemployed men.

Figure 21. Total wealth of the private non-monetary sector.

Figure 18. Unemployed women.

Figure 22. Interest rate on short-term bank credit.

Figure 19. Demand for long-term government debt by the private non-monetary sector.

Figure 23. Interest rate on long-term bank credit.

Figure 20. Foreign demand for long-term government debt.

Figure 24. Interest rate on short-term government debt.

Figure 25. Interest rate on long-term government bonds.

Figure 29. Direct taxes on wage and transfer income.

Figure 26. Real interest rate.

Figure 30. Direct central government taxes on non-wage income, excluding corporate taxes.

Figure 27. Liquidity ratio.

Figure 31. Corporate taxes.

Figure 28. Exchange rate of the US\$ vis-à-vis the guilder.

Figure 32. Change of indirect taxes minus subsidies.

Figure 33. Budget deficit of central government.

Figure 37. Social security benefits.

Figure 34. Budget deficit of local government.

Figure 38. Share of private sector labour income in total value-added of the private sector.

Figure 35. Budget deficit of central and local government.

Figure 39. Employment in the government sector.

Figure 36. Total contributions to social security funds.

Figure 40. Total wage bill of government.