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JADE

A model for the Joint Analysis of Dynamics and Equilibrium

CPB Netherlands Bureau for Economic Policy Analysis
Van Stolkweg 14
P.O. Box 80510
2508 GM The Hague, the Netherlands

Telephone	+31 70 338 33 80
Telefax	+31 70 338 33 50
Internet	www.cpb.nl

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Preface

This document presents a revised edition of the macro econometric model JADE that is developed and maintained at the CPB Netherlands Bureau for Economic Policy Analysis. The acronym JADE stands for Joint Analysis of Dynamics and Equilibrium. As the name indicates, the main feature of JADE is that it combines dynamics and equilibrium into one model. This is accomplished by incorporating error correction mechanisms into the model, which have been estimated with cointegration techniques. JADE has been used in projects like the analysis of election platforms and coalition agreements. The most important change in JADE is the adoption of new behavioural equations for wages, labour and capital demand, consumption and exports. Furthermore JADE has been simplified by combining the exposed and sheltered sector into the market sector, by combining low- and high-skilled labour and by simplifying the cumulated production structure.

Compared to the 1997 working paper about JADE, the current document has been revised in several respects. First, it provides more information about the balance between estimation results and final model specification. Second, a detailed description of the public sector and its links with the private sector has been included. Third, it provides a more intuitive description of the mechanisms behind the equilibrium rate of unemployment, compared to the 1997 working paper. Fourth, it offers an extended description of the reduced-form input-output production structure (the Cumulated Production Structure). Finally, the set of simulations has been substantially extended to include fifteen new simulations, e.g. changes in corporate taxes and social security contributions of employees.

The annual model JADE has a long history and builds upon predecessors like FKSEC, FREIA and KOMPAS. It is therefore almost impossible to mention exactly which (ex)-CPB staff contributed directly or indirectly to realization of JADE in its current shape. Peter Broer, Nick Draper, Albert van der Horst, Aad Houweling, Free Huizinga, Henk Kranendonk, Arnold Kusters, Marco Ligthart and Johan Verbruggen have made contributions to the current version of JADE with respect to the estimation of various behavioural equations. The implementation of various modifications and the handling of new data has been ably executed by Paul de Jongh, Albert van der Horst and Alex Lammertsma. The current document was written by Peter Broer, Albert van der Horst and Alex Lammertsma, freely using comments of other CPB staff.

Henk Don,
Director

Contents

1 Introduction

This document presents a revised edition of the macro econometric model JADE developed at the CPB Netherlands Bureau for Economic Policy Analysis. It is a model that is suitable to analyse the medium and long term effects of various policy proposals and exogenous shocks as wells as building macroeconomic scenarios. Many of these policy proposals are aimed at improving the structure of the economy and thus to change the equilibrium of the economy. However, this new equilibrium is not reached overnight, and a policy may in effect have very different effects in the medium term compared to the long term. Indeed, the medium and long term effects of these policies may be of opposite sign, following the saying of 'no pain, no gain', and it is this trade-off between 'current pain' and 'future gain' that often makes it unclear whether a policy should be adopted, or at least makes the proposal controversial. A proper economic analysis of such a policy, or of a certain exogenous shock of a similar nature, requires a discussion of both the equilibrium or long-run effects and the process of transition towards the new equilibrium. To make the model suitable for medium and long-run analyses the long run must be defined as well as the dynamics towards this long run. Furthermore, these two elements must be consistent. Therefore, JADE has been formulated in levels and estimated in error correction form.

Seen from an international perspective, JADE fits in a general trend towards greater theoretical and econometric consistency in econometric model building that occurred in response to both theoretical and empirical challenges. These were posed to model builders by structural shifts in the economy and by the emergence of the new classical macroeconomics. Lucas (1976) argued that econometric models were not suited for policy analysis, as the model parameters are not invariant across policy regimes. Sims (1980) identified three main points on which the then current models were at fault: the theoretical foundation of the individual equations of the model, the econometric identification of the parameters and the treatment of the expectations of forward-looking agents.

A response to this and similar criticism came forth along several lines, both theoretical and econometric (see Hall, 1995). On the theory side, one part of Sims's critique was that the long run of macroeconometric models was essentially unrestricted, as the models used to be constructed on an equation-by-equation basis, generally neglecting cross-equation restrictions. Since then, more effort has been put into a consistent modelling of individual blocks of the model. A notable example of this approach is the production sector, in which both factor demands and cost equations are usually derived from an underlying common production function or dual cost function. For example both the FREIA model (CPB, 1983) and the NIESR model (National Institute, 1994) use a vintage production structure to derive demand equations for capital and labour that are consistent in the long term. The LBS model (Allen, 1997) uses a

translog dual cost function to derive long-term demands for capital, labour, energy, and materials. The FRB/MPS model (Brayton and Mauskopf, 1985) uses a Cobb-Douglas production function in capital, labour, and energy to specify long-term factor demands. JADE employs a CES cost function to specify long-term demand equations for labour and capital.

The trend towards better theoretical foundations of the model equations also helps to answer the second problem raised by Sims, the structural identification of the parameters of the model in the absence of a priori restrictions on the lag structure of the model. Current econometric practice entails estimation of the model's equations by estimation of a restricted VAR for the equations of separate blocks of the model, using theory to identify cointegrating relationships among the variables. Short-run dynamics are largely data-determined, but the use of an ECM guarantees long-term behaviour that is consistent with economic theory. This approach is now standard in the newer versions of for example the NIESR model, the LBS model, the FRB/MPS model. It is also used in JADE.[1]

The rational expectations revolution started by Lucas and Sargent has had a large impact on macroeconometric model building, particularly in the UK, see for example Hall (1995). However, the general picture arising from these efforts is that the empirical issue is far from resolved. Rational expectations models typically predict a more rapid adjustment of agent's behaviour than is generally observed. As a result, rational expectations models do not always perform well in practice. There exists a fair amount of research that focuses on learning behaviour as a possible solution (see for example Sargent, 1993), but it seems fair to say that the choice of learning rule is still arbitrary. Furthermore it is less clear that empirical models with explicit modelling of expectations outperform those without expectations. To adjust expectations economic agents need a lot of information. The costs of gathering information, however, is not zero as the early rational expectations literature assumed. If these costs are rather high and if the costs of making inaccurate predictions is rather low, it may be rational for economic agents not to adjust their expectations. For these reasons the specification of expectations is rather simple in JADE.[2] Expectations are either exogenous (expected prices of investment goods) or are modelled as a distributed lag of the actual development (expected wage- and price inflation).

[1] An alternative to this modelling strategy is provided by Real Business Cycle models, that are typically designed so that the dynamics follow from the optimal adjustments of agents to a changing economic environment. The empirical basis of these models, however, is generally weak, see Stadler (1994).

[2] This low key approach to the specification of expectations is also related to the fact that, because of the fixed exchange rate regime that exists within most of the European Union, the model does not contain a financial sector, the exchange rate is exogenous and the long term interest rate is tied directly to the German one. For models of the Dutch economy that do contain an elaborate financial sector, see for example the FREIA model (CPB, 1983), MORKMON II model (Fase et. al., 1990) and the EUROMON model (De Nederlandsche Bank, 2000).

A key element of the JADE model is the description of the labour market. Our modelling approach builds on the recent theoretical and empirical literature that attempts to explain the increasing unemployment in Western Europe by some form of wage bargaining (see for example Layard, Nickell, and Jackman, 1991, and Bean, 1994). This work has also been incorporated into macroeconometric models, for example in the NIESR model and the LBS model. Our specification of the wage bargaining model differs from this literature with respect to the fact that an independent effect of the replacement rate on labour costs is specified next to the wedge. This is achieved by including an informal sector.

The wage bargaining model implies that the equilibrium rate of unemployment is endogenous in JADE. The analysis of this equilibrium rate has become an important ingredient in many CPB analyses.[3] It was used to estimate potential growth for the period 2003-2006, see Don(2001). The estimated potential growth and equilibrium rate of unemployment have been used to build medium term scenarios (CPB, 2001). Of these scenarios the cautious medium term scenario has been used as a reference scenario for the analysis of the election platforms 2002 (CPB, 2002b) and the coalition agreement 2002 (CPB, 2002c).

Related to the equilibrium rate of unemployment is the concept of the equilibrium labour income share (ELIS). This variable is a useful benchmark for wage negotiations, which also takes into account changes in the cost of capital. If the labour income share is below the ELIS, firms will expand and unemployment falls over time, see Draper and Huizinga (2000).

The extensive public sector in JADE increases its fitness for policy analyses. As a result, JADE has been used to analyse the election platforms in 1998 (CPB, 1998a) and 2002 (CPB, 2002b) and the coalition agreement in 1998 (CPB, 1998b) and 2002 (CPB, 2002c). In these projects, Jade is part of a broader process. For example, in the analysis of coalition agreements the first step is the translation of the budgetary proposals into impulses for Jade. Besides the budgetary implications also the non-budgetary implications on for example labour supply, replacement rate and housing prices are taken into account. Given these impulses Jade provides the macroeconomic implications of the proposals.

1.1 Background and modifications

JADE first became operational in the summer of 1997 and replaced FKSEC, the previous macroeconometric model of the CPB (CPB, 1992). In terms of the macro models in use at the Bureau, JADE bridges the gap between SAFE (CPB, 2002a) and MIMIC (Graafland et al., 2001).

[3] The concept of equilibrium rate of unemployment has also been used to analyse the growth of employment in the 1990s in the Netherlands (see Huizinga, 2001). It implies an equilibrium labour income share (see Draper and Huizinga, 2000).

SAFE is a quarterly econometric model for short and medium term analyses: the horizon for reasonable forecasts or simulations with SAFE is limited to three years. JADE on the other hand is a yearly model in which in general the equilibrium is reached in about 10 to 12 years. The properties of JADE such as the specification and the simulation outcomes have been matched with those of SAFE. MIMIC is an applied general equilibrium model meant for long term analyses. It is calibrated to have reasonable long run properties, but contains virtually no dynamics. JADE is used to judge the plausibility of the long run properties of MIMIC.
Since the 1997 version of JADE (CPB, 1997a) the model has been substantially revised. First, new research and the availability of new data has led to the re-specification of a number of elements of the model:

- the wage equation has been re-estimated given new data for the wedge and the replacement rate.[4] Furthermore in these estimates the consumer price index is used instead of the price of private consumption. This is done because in actual wage negotiations the consumer price index is used as a reference variable for inflation, not the price of private consumption (section 2.2.3);
- the production function has been re-estimated for the market sector (section 2.1.2);
- the consumption function has been re-estimated to account for the increased importance of wealth-effects (section 2.5.2). Until recently no reliable wealth statistics were available that could be used to estimate the effect of components of net wealth of households;
- the exports of goods (excluding energy) has been split into exports of domestic origin and re-exports. The argument for this split is that the price sensitivity of re-exports is significantly lower than that of exports of domestic origin. Furthermore the share of re-exports has risen from about 20 percent of the total exports of goods in 1990 to more than 40 percent in 2000.[5] For both components new equations have been estimated (section 2.6.1). The intermediate imports of raw materials and semi manufactured products excluding energy has been split along the same lines into imports intended for re-export and other intermediate imports. These imports for re-export are interpreted as final imports (section 2.8);
- the specification of the price of capital has been adjusted to include the effect of corporate tax rates on the decision to invest in the Netherlands. As such this effect was absent in the 1997 version of JADE. Besides the user cost of capital this provides an additional channel through which the corporate tax rate affects the cost of capital. Both channels have about the same impact on the cost of capital (see Draper and Huizinga, 2001);
- subsidies have been split into cost-price decreasing subsidies and wage costs subsidies. The first category affects the market prices of the various demand categories, whereas the second reduces the production costs in the various production sectors (section 2.7.1).

[4] See Stegeman (2002) for the new definitions of the wedge and the replacement rate.

[5] See Kusters and Verbruggen (2001).

Second, in order to have a reliable long run reduced form, volume-elasticities should be homogeneous of the degree one in exogenous volumes and price-elasticities homogeneous of the degree zero in exogenous prices. To improve the homogeneity of JADE the following adjustments have been made:

- the JADE 1997 version contained import penetration. This phenomenon is primarily related to technological progress (decreasing transport costs, increasing product variety) and not to the growth of domestic expenditures. Therefore the final import equations for consumption and investments have been re-estimated under the condition that there is no long-run import penetration (section 2.6.2). The equation for the imports of travelling services, however, has not been re-estimated under this restriction. From an economic point of view such a restriction is hardly realistic moreover empirical estimates with no long run import penetration were statistically rejected;
- in the 1997 version of JADE the exports of services were linked to the exports of goods with an elasticity of 0.6. The empirical basis for this coefficient was weak and therefore, the equation has been replaced by an error correction specification that links the exports of services to the growth of world trade (section 2.6.1);
- the income elasticity of the investment in dwellings has been adjusted from 1.3 to 1.0 to make the model more homogeneous (section 2.1.4).

Third, JADE has been simplified to make the model easier to handle:

- the distinctions between low and high skilled labour and between the exposed and sheltered sector have been removed because they contributed little to the properties of the model. Furthermore recent data on low and high skilled labour are lacking. The exposed and sheltered sector have been joined together and are labelled as the market sector. The labour and capital demand equations have therefore been re-estimated for the market sector (section 2.1.2);
- in the 1997 version of JADE the specification of the cumulative production structure (CPS) was rather complex. In the current version the CPS has been simplified by reordering various equations and making some minor simplifying assumptions. The main difference is that in the current version only the margins, i.e. column and row totals, of the CPS are specified instead of all cells as in the 1997 version (section 2.8);
- the matching function has been removed. The feedback of the matching function to the long run labour cost equation had already been cut in 1997 version of JADE.

Finally, some adjustments have been made to take into account the revision of the National Accounts in accordance with the new worldwide System of National Accounts (SNA) 1993, and its European equivalent, the European System of National and Regional Accounts (ESA) 1995. For example, due to the revision, consumption in kind has been separated from private consumption and is considered as government consumption. From an economic point of view such a split makes sense as price changes of consumption in kind are the result of government

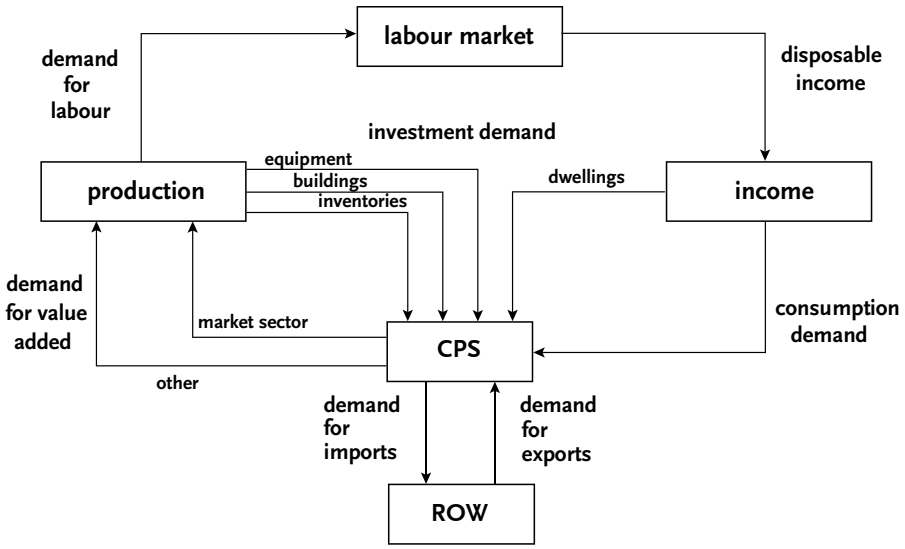
policy whereas consumption prices are mainly determined by the market sector. Furthermore the revision allows for the split between exports of domestic origin and re-exports.

Of course, a macroeconometric model is always an unfinished product. The present document reflects the state of JADE as of the end of 2002. Currently, research is undertaken to provide better empirical foundations for the dynamics of labour market adjustment. In the near future, we plan to update the estimates for the wage equation and the CPS structure that links final demand categories with industry structure. Next on the programme will be the specification of government price and expenditures adjustments.

1.2 A bird's eye view

Figure 1.1 gives an overview of the model excluding the public sector. We outline the structure of the model starting at the box labelled production and then follow the arrows.

Figure 1.1 Overview of the model



The supply side is divided into five sectors, namely the market sector, mining and quarrying, residential, healthcare and the government sector. The market sector is the main sector of interest. Value added for this sector is modelled by a CES cost function with equipment, buildings and labour as inputs. The other sectors do not contain production functions, and employment in these sectors is exogenous in the model. Employment in the mining and quarrying sectors contributes only little to total employment, while their production structures

are very different from those of the others. Employment in the healthcare and government sectors is exogenous because they are strongly influenced by government policy.

The production of value added is the primary determinant of the demand for production factors. We assume that the markets for factor inputs operate at the macro level, so that there is a free flow of variable inputs (labour, materials) between sectors. The demand for labour enters the labour market block, and the demand for investment enters the cumulated production structure (CPS, Section 2.8). The labour market confronts labour supply and demand. The most important determinant of labour supply is the structural supply of labour, which is exogenous in JADE. Furthermore there are two endogenous determinants: the unemployment rate (proxying the discouraged worker effect), and the net real wage rate.

Besides the public sector there are three sources for the demand of goods and services. First, disposable labour and non-labour income, transfers, wealth and the interest rate determine consumption demand. Disposable labour income, together with the interest rate and exogenous government policy, determine investment in residential dwellings by households. Second, the investment demand for equipment, buildings and inventories is generated by firms in the different production sectors. Third, the demand for exports comes from the rest of the world (ROW).

To close the circle of the demand for goods and services, we need to translate the components of final demand into demand for the different sectors of production. This is done by the CPS. This is the reduced form of an input-output matrix in which the matrix of intermediary deliveries has been substituted out. It provides therefore a direct link between the components of final demand on the one side and imports and sectoral value added on the other. Import demand goes to the rest of the world, and demand for value added to the different sectors of production.

The arrows in figure 1.1 indicate the demands for goods and services. Prices are linked in a similar way, although in reverse order. The price of value added is determined by unit costs of labour and capital and by demand components, such as the price of foreign competitors and the capacity utilization rate. The CPS links value added prices and the price of intermediary and final imports with final demand prices. The price of investment goods, together with the interest rate, determines the cost of capital. The value added and consumer prices influence wages.

In addition to the private sector, the model contains a detailed model of the public sector. The receipts and expenditures of the public sector include many potential instruments for economic policy. Most of the equations in the public sector block reflect policy rules rather than behavioural relationships. Indeed, while it may be argued that some aspects of policy are

endogenous, we purposely made no attempt to model government policy, so as to be able to analyse the effects of government policy as is and as proposed. That is, all simulations are made conditional on a specific policy stand.

2 JADE, a more detailed description

2.1 Labour and capital demand

2.1.1 Model specification

We distinguish two production factors: labour *l* and capital *k*. Capital is made up of equipment and buildings. The shares of equipment and buildings are fairly constant over time, so that we did not model these components separately. Technology can be represented by a CES production function:

$$y = \frac{1}{\beta}\left[\eta^{\frac{1}{\sigma}} l_e^{\frac{\sigma-1}{\sigma}} + (1-\eta)^{\frac{1}{\sigma}} k_e^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

where y stands for production of gross value added, l_e for labour input in efficiency-units, k_e for capital input in efficiency-units, β is a scaling parameter, η a constant and σ the elasticity of substitution between labour and capital. The labour and capital input in efficiency units l_e and k_e are equal to:

$$l_e = l\, d_l\, e^{v_l} p_{lo}, \quad (2)$$

$$k_e = k\, p_{ko}, \quad (3)$$

where l and k represent the input of labour (in fte) and capital, d_l working time of labour (hours per fte), v_l the degree of technical progress of labour, and p_{lo} and p_{ko} the labour- and capital-costs in the base year respectively. Note that it is assumed that the working time of capital is constant and that the degree of technical progress of capital is zero.[6] Given the above production function, the minimal cost function is specified as follows:

$$C_y = \beta\, y\, c_y, \quad (4)$$

$$c_y = \left[\eta\, p_{le}^{1-\sigma} + (1-\eta)\, p_{ke}^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \quad (5)$$

$$p_{le} = \frac{p_l}{d_l\, e^{v_l} p_{lo}}, \qquad p_{ke} = \frac{p_k}{p_{ko}}, \quad (6)$$

$$p_k = \frac{p_{ie}}{p_{ko}}\left(1 - \frac{(1-\delta)(1+\dot{p}_i^e)}{1+(1-t_g) r_l}\right), \qquad p_{ie} = p_i \frac{1 - t_b\,(s_i + d_i)}{1 - t_b}. \quad (7)$$

[6] This hypothesis has been tested in the empirical application and could not be rejected, see Draper, Huizinga and Kranendonk (2001).

Capital costs p_k are based on the concept of the user cost of capital. They are defined as a function of the effective investment price p_{ie}, the rate of depreciation δ and the real after tax rate of interest. The latter depends on the nominal long run rate of interest r_l, the income tax rate t_g and the expected rate of price change of investment goods $\dot{p}_i^e$. The effective investment price is the investment price that is corrected for tax facilities. The correction factor is determined by the corporate tax rate t_b, investment subsidies s_i and the discounted value of the depreciation rights per invested euro d_i. Labour costs per fte p_l are defined as the gross wage rate w including the social security contributions paid by employers s_e:

$$p_l = w\,(1 + s_e)\,. \tag{8}$$

Assuming cost minimization, the optimal factor demand relations can easily be derived from the cost function using Shepard's lemma:

$$l^* = \frac{\partial C_y}{\partial p_l} = \beta\,\eta\,y\left[\frac{p_{le}}{c_y}\right]^{-\sigma}(d_l\,p_{lo})^{-1}e^{-v_l}\,, \tag{9}$$

$$k^* = \frac{\partial C_y}{\partial p_k} = \beta\,(1-\eta)\,y\left[\frac{p_{ke}}{c_y}\right]^{-\sigma}p_{ko}^{-1}\,. \tag{10}$$

Given the long run labour and capital demand equations (9) an (10), the capacity utilization rate q_y is specified as a weighted average of the deviations of the optimal demand:

$$q_y = 1 - q_c^*\,(\log l - \log l^*) - (1 - q_c^*)\,(\log k - \log k^*)\,, \tag{11}$$

where the weight q_c^* is equal to the long run cost share of labour:

$$q_c^* = \frac{l^*\,p_l}{l^*\,p_l + k^*\,p_k}\,. \tag{12}$$

2.1.2 Estimation results [7]

The short run is modelled as an error correction model in which the deviations from optimal demand enter. Moreover, excess profitability influences factor demand in the short run. This term is meant to capture X-inefficiencies in the production process, when the economy is not operating at its production frontier. For instance, firms may be less likely to fire workers who

[7] The estimation results for labour and capital demand in the market sector can be found in Draper (2001) and Draper, Huizinga and Kranendonk (2001).

are no longer needed if productivity is high, or engage more in labour hoarding when faced with cyclical fluctuations. In addition, on the macro level relatively inefficient firms may perish less quickly if overall profitability is high. The labour demand equation has been estimated for the market sector (*mz*) for the period 1971-1999 (standard errors between brackets) as:[8]

$$\begin{aligned}\Delta \ln l^{mz} = {} & \underset{(0.08)}{0.59}\ \Delta \ln y^{mz} - \underset{(0.06)}{0.28}\ \Delta^2 \ln y^{mz} - \underset{(0.06)}{0.37}\ (\Delta \ln p_{le}^{mz} - \Delta \ln c_y^{mz}) \\ & + \underset{(0.05)}{0.33}\ (\ln p_y^{mz} - \ln c_y^{mz})_{-1} + \underset{(0.07)}{0.51}\ (\Delta \ln p_y^{mz} - \Delta \ln c_y^{mz})_{-1} \\ & - \underset{(0.05)}{0.23}\ (\ln l^{mz} - \ln l^{*mz})_{-1} - \underset{(0.003)}{0.01}\ ,\end{aligned} \tag{13}$$

se = 0.0087 DW = 1.6

$$\ln l^{*mz} = \ln \beta + \ln \eta + \ln y^{mz} - \underset{(0.05)}{0.32}\ \ln\left(\frac{p_{le}^{mz}}{c_y^{mz}}\right) - \ln d_1 p_{lo}^{mz} - v_l^{*mz}\ , \tag{14}$$

se = 0.020 DW = 0.79

with $\beta = 0.978$ (0.003), $\eta = 0.724$ (0.0044).[9] Furthermore the labour cost in the base year 1990, p_{lo}^{mz}, is equal to 26.256. The long-run labour demand relation (14) determines the elasticity of substitution at $\sigma = 0.32$. Note that the estimated substitution elasticity is significantly higher than in the 1997 version of JADE.[10] This implies that labour supply is absorbed more quickly. Note that the term $\ln p_y^{mz} - \ln c_y^{mz}$ is not added in the long run labour demand equation (14). In the long run profits become zero and therefore this term drops out.[11]

Starting from the estimation result for the labour demand equation some adjustments have been made. First, the estimated labour demand equation shows that the short run effect of unit labour costs relative to production costs (−0.37) is higher than the long run effect (−0.32). This

[8] The labour demand in the market sector includes self-employment. Note that the change in employment in the mining and quarrying (*de*), residential (*wo*), healthcare (*kw*) and the government (*pl*) sectors is exogenous.

[9] The inverse of the markup, β, has been estimated in a system consisting of a long run wage equation, a long run labour demand equation, a price level-equation and an output gap equation, see Draper, Huizinga and Kranendonk (2001). The structural degree of technical progress of labour, v_l^{*mz}, is determined using a Hodrick-Prescott filter on the actual series of the degree of technical progress of labour, see also Draper, Huizinga and Kranendonk (2001).

[10] In the 1997 version the substitution elasticity between labour and capital was 0.15 for the exposed sector and 0.00 for the sheltered sector.

[11] Given the two-step procedure used adding the profit level in the long run equation is furthermore not possible due to multicollinearity. The only way to take it into account is by estimating an additional cointegration relation using the Johansen procedure. However, such a relation is already implied by the various price equations for the various demand categories, see equation (A.1) in appendix 3. Therefore, we decided not to proceed this way.

results in overshooting, which is avoided by fixing the short run effect at −0.30. Furthermore it shows that the short run real profit elasticity (0.51) turned out to be higher than the long run elasticity (0.33). This has been corrected by setting the short run real profit elasticity equal to its long run value of 0.33. Finally, the delay of output on labour demand is increased in order to achieve a more uniform pattern of labour productivity. Therefore the coefficient for output growth has been adjusted from 0.59 to 0.50 and for the acceleration of output growth from −0.28 to −0.15.

The capital demand equation has been estimated for the market sector (*mz*) for the period 1971-1999 as:[12]

$$\begin{aligned}\Delta \ln k^{mz} = {} & \underset{(0.05)}{0.50}\ \Delta \ln k^{mz}_{-1} + \underset{(0.03)}{0.18}\ \Delta \ln y^{mz} \\ & - \underset{(0.01)}{0.01}\ (\Delta \ln p^{mz}_{ke} - \Delta \ln c^{mz}_{y}) - \underset{(0.01)}{0.02}\ (\Delta^2 \ln p^{mz}_{ke} - \Delta^2 \ln c^{mz}_{y}) \\ & + \underset{(0.02)}{0.11}\ (\Delta \ln p^{mz}_{y} - \Delta \ln c^{mz}_{y})_{-1} - \underset{(0.01)}{0.03}\ (\ln k^{mz} - \ln k^{*mz})_{-1} + \underset{(0.002)}{0.01}\ ,\end{aligned} \tag{15}$$

se = 0.002 DW = 2.03

$$\ln k^{*mz} = \ln \beta + \ln (1 - \eta) + \ln y^{mz} - \underset{(\ -\ )}{0.32}\ \ln\left(\frac{p^{mz}_{ke}}{c^{mz}_{y}}\right) - \ln p^{mz}_{ko}\ , \tag{16}$$

where the coefficients in the long run capital demand equation have been set equal to the estimated coefficients in the long run labour demand equation (14).[13] Given the data, the capital cost in the base-year 1990, p^{mz}_{ko}, is equal to 0.136. Compared to the 1997 estimate of −0.17, the error correction coefficient of −0.03 is remarkably low. It implies that the adjustment towards the long run takes a lot of time, whereas it is implicitly assumed in the theoretical model that capital is a variable production factor.

[12] Note that the capital demand equation is estimated using the user cost of capital. However, in JADE the price of capital is adjusted to include the effect of corporate tax rate on the decision whether or not to invest in the Netherlands (see section 1.1). Estimating the capital demand equation using this modified definition of capital costs is impossible because of lack of data. Therefore the risk premium on equity has been calibrated such that the price of capital is roughly the same.

[13] The long run capital demand equation is not estimated jointly with the long run labour demand equation because the capital stock as well as the user cost of capital are measured rather inaccurately. Joint estimation would bias the substitution elasticity downwards. Therefore the long run labour demand equation is estimated separately and its coefficients are imposed on the long run capital demand equation. This estimated capital demand turns out to be roughly consistent with observed capital demand.

The estimated coefficients in equation (15) have been adjusted for various reasons. First, it is found that the change in the increase in real capital costs has a higher elasticity (−0.02) than the increase in real capital costs (−0.01). This implies that an initial impulse in for example the interest rate is reinforced in later years, whereas it is expected to fade out. Therefore the coefficient for the change in the increase of real capital costs is fixed at 0.00 instead of −0.02. Second, the estimate of elasticity of the change in the profit margin is considered too high, as it would imply an impact elasticity with respect to *investment* substantially above unity. Hence the coefficient has been scaled down to 0.06.

The rest of the model uses aggregate investment of firms in equipment (*ibo*) and buildings (*ibb*). These variables are determined from investment in the market sector by adding various exogenous components:

$$ibo = e_c^{mz} + e_c^{de} + e_c^{re} + ivo \ , \tag{17}$$

with

ibo	investments of firms in equipment
e_c^{mz}	investments of firms in the market sector in equipment
e_c^{de}	investments of firms in the mining and quarrying sector in equipment (exogenous)
e_c^{re}	investments of firms in other sectors in equipment (exogenous)
ivo	investments in cattle, trade margins and costs of transferring second hand investments (exogenous)

$$ibb = e_b^{mz} + e_b^{re} \ , \tag{18}$$

with

ibb	investments of firms in buildings
e_b^{mz}	investments of firms in the market sector in buildings
e_b^{re}	investments of firms in other sectors in equipment (exogenous)

The investments of firms in the market sector in equipment and buildings, e_c^{mz} and e_b^{mz}, are determined by distributing total capital demand in the market sector(Δk^{mz}) over equipment and buildings given fixed weights.

2.1.3 Inventory formation by firms

Besides the investments in equipment and buildings firms also invest in inventory formation of produced goods excluding energy (*nf*) and energy (*no*). The volume of inventory formation of produced goods is modelled as:[14]

$$\underset{(\ -\ )}{nf} = \underset{(\ -\ )}{0.15\ \Delta\ vc}\ , \tag{19}$$

where *vc* represents the volume of gross domestic production at factor costs excluding exports of energy (*bag* and *bo*), government wages (*gl*) and inventory formation (*nf* and *no*).[15] Inventory formation of energy (*no*) is exogenous.

2.1.4 Private investments in residential dwellings by households

Private investments in residential dwellings by households[16] consists of two parts. The first and most important part concerns the building of new houses and reconstruction of existing dwellings. The second part consists of transfer costs (transfer taxes, costs of real estate agencies, costs of architects, costs of estimating the value of properties and legal dues with respect to transferring property). Given their disposable labour income and the long run interest rate, households determine their total investments in residential dwellings as follows:

$$\underset{(\ -\ )}{\dot{iwo}} = \underset{(\ -\ )}{1.00\ \dot{Y}_L}\ \underset{(\ -\ )}{-\ 0.05\ \Delta\ r_l}\ , \tag{20}$$

where Y_L denotes disposable labour income excluding the privately financed consumption of health care (*ckg*) and r_l the nominal long run interest rate.[17] Government policy such as changes in transfer taxes of houses and fiscal regime changes with respect to owning houses are exogenous. In the 1997 version the coefficient on disposable labour income was fixed at 1.30. In order to make JADE more homogenous in the long run, it is fixed at 1.00 instead of 1.30. Note that both parts of investments in residential dwellings are not modelled separately. Furthermore, JADE disregards depreciation of the existing stock of residential dwellings.

[14] The equation for inventory formation of produced goods is a simplified version of that in FKSEC (CPB, 1992).

[15] See appendix 2 for the complete list of demand categories and Table 2.3 in section 2.8 for the definition of gross domestic production at factor costs.

[16] Heineken (1986) gives various estimation results for private investment in dwellings by households.

[17] The privately financed consumption of health care (*ckg*) is excluded as it is assumed that its consumption share is unity (see section 2.5.2).

2.2 Wage determination

2.2.1 Wedge and replacement rate in a wage bargaining model

Policy makers often point to the wedge as a cause of unemployment because the wedge is an important component of total labour costs. The underlying idea is that employees are able to pass on all increases in direct taxes and social security contributions to employers such that their real wage remains equal. Employers on the other hand are assumed not to be able to pass on higher social security contributions to customers by increasing output prices. However, it is not clear why the incidence of the wedge might not be borne partly by workers in the form of lower net real wages. Indeed, many bargaining models of wage formation suggest that the incidence of the wedge falls *completely* on workers. In their influential books, Layard, Nickell and Jackman (1991, 1994) argue more broadly that the tax wedge should have no long term influence on labour costs and is, therefore, fully borne by workers so that it is not relevant whether employers or employees are taxed.[18] If so, the wedge should not have any effect on unemployment, at least in the long run. However, most of the empirical literature indicates that in the Netherlands the wedge does have a long run effect on wage costs (see for example Knoester and van der Windt (1987), Graafland and Verbruggen (1993), Broer et al. (2000)).

In a bargaining framework, the condition for the wedge to affect labour costs is that it affects the ratio of the utilities of unemployed and employed workers (i.e. the relative fall-back position of workers). To explain the empirical significance of the wedge, both types of workers should somehow be affected differently by the same taxes, so that their *relative* utility levels change if the wedge changes. One way for such an independent effect of the wedge to arise is from the presence of an informal sector or household production. Suppose that negotiations break down, the worker becomes unemployed and tries to find work again. If she succeeds she gets a real wage which we assume to be equal to the real wage she would have got if the first negotiations had resulted in an agreement. If she cannot find another job, she receives unemployment benefits equal to the replacement rate times that wage. While unemployed, she may also engage in activities in the informal sector. We assume that these activities are not taxed. This may be because these activities simply are not subject to taxation, such as household production, or because taxes are evaded (black market activities). In either case we think of the worker selling her labour directly to either herself or to another consumer. The (implicit) wage is a fraction of the going total cost of her labour, including all direct and indirect taxes and premium costs. Thus the replacement rate affects the fallback position of a worker.

[18] Whether this is the case also depends on institutional settings. See further section 2.7.4.

2.2.2 Model specification

Given the ideas in section 2.2.1 the wage negotiation process is specified as follows. First, the union and the firm bargain about the total wage bill, and then the individual members bargain about the division of this wage bill. The solution to the second stage would set wages by maximizing the product of the individual gain functions subject to the constraint that the total wage bill is distributed. The replacement rate enters through the introduction of the fallback in the union gain function. We specify this function as the product of the individual gain functions and state the overall bargaining problem as follows:[19]

$$argmax(w): \quad \left(\frac{p_y y - l w (1 + s_e)}{p_c} \right) \left(\frac{w (1 - s_l)(1 - t_d)}{p_c} - F \right)^{\alpha} , \tag{21}$$

where p_y denotes the value added price deflator, p_c the price of private consumption, y real output, w the gross wage rate, l employment, s_e the rate of employers' social security contributions and other labour costs (such as pension costs), s_l the contribution rate for the social security contributions paid by labour, t_d the rate of direct taxes paid by labour, F the fallback position of a worker, and α a measure of the relative bargaining power of the union. The fallback position in equation (21) is determined as: [20]

$$F = pr_e \; w_{rc} + (1 - pr_e) \; [rp \; w_{rc} + \varsigma \; w_{ry}] , \tag{22}$$

where pr_e denotes the probability of finding another job, w_{rc} the real consumption wage he would have got if the first negotiations had resulted in an agreement, rp the official replacement rate, ς the (implicit) wage as a fraction of the going total cost of his labour, including all direct and indirect taxes and social security contributions, and w_{ry} represents the real product wage. The real consumption wage w_{rc} and the real product wage w_{ry} are defined as:

$$w_{rc} = \frac{w (1 - s_l)(1 - t_d)}{p_c} , \tag{23}$$

$$w_{ry} = \frac{w (1 + s_e)}{p_y} , \tag{24}$$

and the wedge is the ratio of these two real wage rates:

[19] The firm's gain function consists of real operating profits. Total profits are given by operating profits minus some unspecified sunk of fixed costs. These could, for example, be hiring costs or capital costs. In equilibrium, these costs correspond to quasi rents that make the bargaining necessary. They also generate unemployment as a necessary force to reduce the union wage claims to a level compatible with general equilibrium, that is a level such that the firms' operating profits are high enough to cover the fixed costs.

[20] One may also interpret the fallback position F as the expected income to the worker during a strike. However, this does not affect the analysis.

$$\Lambda = \frac{w_{ry}}{w_{rc}} = \frac{1 + s_e}{(1 - s_l)(1 - t_d)} \frac{p_c}{p_y} . \tag{25}$$

Then the first order condition to the bargaining problem may be stated as:

$$w_{ry} = \frac{w(1 + s_e)}{p_y} = \frac{\alpha}{1 - rp' + \alpha} h , \tag{26}$$

where h denotes labour productivity ($h = y/l$). The ratio of the utilities of unemployed and employed workers is defined as $rp' = F/w_{rc}$ and can be thought of as a replacement rate. This equation indicates that if productivity h and the coefficient α are exogenous, the real product wage only depends on rp'. So, if the wedge affects labour costs, it does so only indirectly, by altering rp', the ratio of the utilities of the unemployed and employed workers. Even if this is the case, the wedge does not enter the equation for w_{ry} once we include rp'. Therefore, if we find an independent effect of the wedge next to a measure of the replacement rate, this must be because that measure of the replacement rate is not equal to rp'.

It makes sense that the probability to find another job, depends negatively on the unemployment rate, u. If we assume that $pr_e = 1 - u^{\epsilon}$, with $\epsilon > 0$, we get after some arithmetic:

$$rp' = 1 - u^{\epsilon} (1 - rp - \varsigma\Lambda) . \tag{27}$$

Substituting this expression into (26) we get the equation for the wage level:[21]

$$\frac{w(1 + s_e)}{p_y} = \frac{\alpha}{u^{\epsilon} (1 - rp - \varsigma\Lambda) + \alpha} h . \tag{28}$$

Linearizing equation (28) gives the following long run labour cost equation:

$$\ln (w(1 + s_e))^* = \ln p_y + \ln h + \alpha_1 \ln \Lambda + \alpha_2 \ln rp + \alpha_3 u + \alpha_4 . \tag{29}$$

Note that in the long run labour cost equation (29) the wedge enters as a single variable, that is, all components of the wedge have the same coefficient. An important condition for this result is that gross wages are not sticky, which is a reasonable assumption for the long run.

In the short run, however, we may expect gross wages to be relatively fixed since most wage contracts specify gross wages. An unexpected shock to employer social security payments then has to be absorbed by the employers, while unexpected shocks to employee taxes and social security payments must be borne by workers. Many empirical studies have found that employer

[21] Note that if we disregard the informal sector, that is, set $\varsigma = 0$, the wedge again drops out of the analysis.

social security payments have a stronger effect on labour costs in the short run than do employee taxes and social security payments.[22]

An important property of the long run labour cost equation (29) is that it is stated as a wage curve, that is, the wage level is related to the unemployment level. This implies a change in comparison with the wage equation in FKSEC, where wage changes are linked to the level of unemployment. As a result, the equilibrium unemployment rate is endogenous in JADE whereas it was constant in FKSEC.[23] Section 2.3 provides some background for such an endogenous equilibrium rate of unemployment as well as the intuition behind this feature of JADE.

2.2.3 Estimation results

In estimating the wage block the change in the gross wage rate w is decomposed into a rise in the contractual wage w_c and an incidental wage w_i. The first component is the rise in wages due to an overall increase in collective bargaining agreements. This is the average wage increase in the unionized sector if workers do not receive any promotion or bonuses. The second component consists of the rise in wages due to changes in the composition of the workforce and the wage drift. The most important factors behind the change in the composition of the workforce are the rise in the average age and education level of the workforce and the increase in the participation rate of women. The distinction between these two components is important because the minimum wage and many social security schemes rise only with the contractual wage increase (see section 2.7.4). An overall one-time bonus payment does not affect welfare benefits and raises the gap between wages and these benefits, that is it lowers the replacement ratio. The estimated equation for contractual wages in the market sector (*mz*) for the period 1970-1997 is:[24,25]

[22] For instance, Knoester and van der Windt (1987), testing a macro wage equation for ten OECD countries, find that the effect of employer and worker taxes and social security contributions is stronger than the effect of indirect taxes for Australia, Canada, Germany, Italy, Japan, the Netherlands, Sweden and the United States. For the United Kingdom, Layard and Nickell (1986) find that only the taxes and social security contributions paid by employers affect wages. For the Netherlands, most studies find that the effect of the social security contributions paid by employers is larger than that of the other components of the wedge (see, for instance, Fase, et al., 1990; CPB, 1992; Graafland, 1991, 1992; Graafland and Verbruggen, 1993).

[23] For a discussion of the relation between the wage curve, the NAIRU, and the conventional Phillips curve, see Layard et al. (1991), chapter 8.

[24] The wages in the exogenous sectors mining and quarrying (*de*), residential (*wo*), health care (*kw*) and the government (*pl*) are assumed to change at the same rate as in the market sector (*mz*).

[25] Note that the consumer price index is used in estimating the wage block instead of the price of private consumption. The intuition is that the consumer price index is the reference point for wage negotiations and not the price of private consumption. The main difference between these two is the weighting scheme that is used. Furthermore, government services are included in the consumer price index and not in the price of private consumption whereas health care is included in the price of private consumption but not in the consumer price index.

$$\Delta \ln w_c^{mz} = \Delta \ln p_y^{mz}$$

$$+ \underset{(0.11)}{0.45} (\Delta \ln p_{ci} - \Delta \ln p_y^{mz}) - \underset{(0.11)}{0.38}\, d_{8089} (\Delta \ln p_{ci} - \Delta \ln p_y^{mz})$$

$$+ \underset{(\ -\ )}{0.20}\, \Delta \ln \left(\frac{1}{(1 - s_l)(1 - t_d)} \right) - \underset{(\ -\ )}{0.20}\, \Delta \ln (1 + s_e) \qquad (30)$$

$$+ \underset{(\ -\ )}{0.20}\, \Delta \ln rp - \underset{(0.16)}{0.18}\, \Delta u_{-1}$$

$$- \underset{(0.09)}{0.85} \left[\ln (w^{mz}(1 + s_e)) - \ln (w^{mz}(1 + s_e))^* \right]_{-1},$$

se = 0.005 DW = 2.3

where $d_{8089} = 1$ for 1980-1989 and 0 elsewhere and p_{ci} represents the consumption price index.[26] Equation (30) shows that from 1990 onwards about half of the change in the real consumption price is passed on without delay to contractual wages. The short run impact of social security contributions and employers and employees is fixed at 0.20.[27] Given the error correction coefficient of 0.85 wages approach their long run level rather quickly. The coefficient of the price of value added has been restricted to unity to preserve the long-run restrictions in the short-run equation. This way we can be sure that the long-run solution of the wage equation has the theoretically correct properties.[28] Note that the error correction term does not contain the contractual wage, but rather the market wage, w^{mz}.[29] As a result, any shocks that affect the market wage will automatically lead to an adjustment of the contractual wage in the next period.

Next to the contractual wage, the market wage also reflects *wage drift* that results from incidental factors like ageing, job reallocation, etc. The estimated equation for incidental wage increases in the market sector for the period 1970-1997 is:

[26] The dummy d_{8089} captures an apparent structural break in the impact effect of consumer prices on wages. In the period 1980-89 the contractual wage rate increase followed the production price rather accurately. From 1989 on the development of the change in the contractual wage rate is more similar to the consumer price index than to the production price. Note that the dummy does not affect the properties of the model after 1989.

[27] Freely estimating the coefficient for the impact of social security contributions of employers and employees resulted in an estimated coefficient of about 0.1 for both variables. This free estimate was implausibly low compared to the JADE(1997) estimates that were more than twice as high.

[28] Restrictions have to be imposed in the short-run equation on coefficients of variables with non-zero drift. See e.g. Hall and Henry (1988), pp. 78 ff. For a more general application in a similar setting see Broer et al. (2000).

[29] The market wage consists of the contractual wage, plus wage drift resulting from incidental factors.

$$\Delta \ln w_i^{mz} = \underset{(0.09)}{0.40}\ \Delta \ln h^{mz} - \underset{(0.21)}{0.69}\ \Delta u_{-1} - \underset{(0.002)}{0.0008}\ . \qquad (31)$$

se = 0.008 DW = 1.6

The incidental wage equation shows that total wage growth exceeds contractual wage growth if productivity growth is positive or if the unemployment rate is falling. Finally, the long run labour cost equation is estimated for the period 1970-1997 as:

$$\ln (w^{mz}(1 + s_e))^* = \ln p_y^{mz} + \ln h^{mz} + \underset{(0.03)}{0.34}\ \ln \Lambda + \underset{(0.02)}{0.47}\ \ln rp - \underset{(0.12)}{1.71}\ u_{-1} - \underset{(0.01)}{0.24}\ . \qquad (32)$$

This long run labour cost equation shows that the wedge and replacement rate have a significant impact in the long run. The deviations from the level equation for labour costs affect only contractual wages, not incidental wages. Productivity affects wages in the short run only through incidental wages, but in the long run productivity affects total wage costs with a coefficient of one because of the error correction term in the contractual wage equation. According to the contractual wage equation (30) in the short run 20% of an increase in the employers' social security contributions results in higher labour cost, 20% of an increase in direct taxes and social security contributions paid by employees and 45% of the rise in the real consumption price. In the long run all elements of the wedge have the same effect on labour costs: 34% of an increase in any element of the wedge is passed on.

The wage equation in JADE deviates from equations (30)-(32) in several respects. First, the virtually complete absence of effects of consumption price inflation on short-run contractual wages over the period 1980-1989 was considered implausible. To remedy this, the coefficient of the real consumption price has been fixed at 0.50 instead of the estimated 0.45. Second, in order to agree with the MIMIC-model, the coefficients for long run wage equation have been adjusted. More specifically, the coefficient of unemployment in the long run labour cost equation is set at −2.00 instead of −1.71 and the coefficient of the replacement rate is set at 0.15 instead of 0.47.[30] The parameters in the short run contractual wage equation have been adjusted proportionally to −0.21 for the change in unemployment and 0.064 for the replacement rate. Furthermore, it is expected that the terms of trade have no effect in the long run. Therefore the indirect tax rate is used in specifying the wedge in JADE instead of the ratio of the price of private consumption to the price of production (see section 2.7.4).

[30] The higher elasticity of the lagged unemployment rate in the long run labour costs equation implies a higher speed of absorption of labour supply.

2.3 The equilibrium rate of unemployment

Unemployment, especially when it is high, is of major concern to economists and policy makers. Yet, despite all this attention, it has proven difficult to develop a satisfactory theory that explains the development of unemployment over time. After the Keynesian-monetarist debate about the possibility of a trade-off between inflation and unemployment a consensus arose that equilibrium unemployment was a relatively fixed number, called the NAIRU (for Non-Accelerating Inflation Rate of Unemployment). It was called that because whenever unemployment was below that particular level, inflation would increase. As a result, any attempt to permanently reduce unemployment below this equilibrium level would be futile, and would ultimately lead only to ever increasing inflation. This mechanism also ensures that unemployment always has a tendency to return to this NAIRU.

However, the dramatic and long-lasting upward shift in the unemployment rate in the 1980s in Europe is hard to reconcile with the notion of a fixed equilibrium rate of unemployment. As a result, the theory of unemployment is, again, being reconsidered. There are currently two main approaches to accommodate the apparent non-constancy of equilibrium unemployment. The first approach assumes that the equilibrium rate of unemployment follows a smooth process without specifying the underlying economic mechanisms, see for example Douven (1999). The second approach - which is used in JADE - tries to provide microeconomic foundations for the equilibrium rate of unemployment, and thus also for any changes in it.[31] In a sense, this approach is a continuation of the argument of Friedman (1968) that led to the NAIRU. Friedman did not claim that the equilibrium rate of unemployment was constant, but rather that it was equal to the level ground out by the real side of the economy and thus independent of monetary policy. He mentioned an economy's institutional arrangements in particular as a determinant of equilibrium unemployment. Indeed many economists link the prolonged rise in European unemployment in the 1980s to the concurrent rise in tax and benefits levels. So we can think of this approach, exemplified in particular by Layard, Nickell and Jackman (1991), as endogenising Friedman's NAIRU.

More specifically, in JADE the equilibrium rate of unemployment is based upon union bargaining because union bargaining and union presence in general is an important factor in the Dutch labour market. Given the specification of the production function and the wage bargaining model in section 2.1 and 2.2 respectively the equilibrium rate of unemployment u^* can be derived in essence by combining the long run labour cost equation (29) and the cost equation (5):[32]

[31] See Katz (1988), Broer, Draper and Huizinga (1999), Broer, Draper and Huizinga (2000).

[32] See section 9 in CPB(1997a).

$$u^* = \frac{1}{\chi_3}\left[\chi_1 \ln \Lambda + \chi_2 rp + \omega_o - \ln\left(1 - (1-\eta)\left(\frac{p_{ke}}{c}\right)^{1-\sigma}\right)\right]. \qquad (33)$$

What is the interpretation of equation (33)? First, remember that the long run labour cost equation (32) is a wage curve, which defines a negative relation between unemployment and wages because higher unemployment results in reduced union bargaining power. The wage curve shifts upward if labour productivity, the wedge, or the replacement rate rises. On the other hand the real wage that firms are able to pay at the required profit rate is independent of the unemployment rate. Unemployment as such does not have a direct influence on the firm's profitability. This 'ability-to-pay' curve shifts downward if the relative cost of capital rises or if the markup (the required profitability) rises. It shifts upward in case of technological progress. The intersection of both curves determines the equilibrium rate of unemployment.

Now suppose that the unemployment is at its equilibrium level, that is at the level where the wage curve and the ability-to-pay curve intersect. Then an increase in the wedge Λ causes an upward shift in the wage curve without a concurrent rise in the firm's ability to pay. As a result, wages rise and the economy is not in equilibrium anymore. How will equilibrium be restored? Profitability has fallen below its required level and layoffs will occur. The increased unemployment erodes the union's bargaining power, and the wage demands move back along the new wage curve until they are in line with the firms ability to pay. In the end, the real wage cost to the firm has not changed, and the tax increase is fully borne by the workers in the form of lower purchasing power. To make unions accept this, unemployment has to rise to diminish their bargaining power.

A rise in the replacement rate rp results in a similar story. Again the wage curve shifts up, without a concurrent shift in the ability-to-pay curve. Again we move to the point with higher unemployment. A fall in the required profit rate (the markup ω_o) leads to the opposite story. Now the ability-to-pay curve shifts up, without a change in the wage curve. We may stay at the old unemployment rate, but that is no longer an equilibrium. Now firm expansion will reduce unemployment, which will lead to higher wage demands. At the new equilibrium, real wages will be higher and unemployment lower than at the original equilibrium.

Finally, we consider a rise in the real cost of capital $\frac{p_k}{c}$, due for example to an increase in the interest rate or an increase in the corporate tax rate. Its effect depends on the elasticity of substitution between labour and capital σ. First take the case in which this elasticity is zero. Then the ability to pay curve shifts down without any change in the wage curve. The new equilibrium is at a point with higher unemployment. The higher unemployment rate induces unions to accept the lower real wage that is necessary to maintain profitability in the face of higher real capital costs. If the substitution elasticity is above zero, the story gets an additional component. Now firms can reduce their use of expensive capital and produce in a less capital-intensive way. Investment will be reduced and the capital-labour ratio will fall. Over time, this

causes a fall in labour productivity, and hence a downward shift in the wage curve results. The reduction in wage demands implies that unemployment rises less. If the elasticity of substitution is one - the Cobb-Douglas case - labour productivity and the wage curve fall as much as the real wage. In that case we end up with no increase in unemployment at all. So then real capital costs do not have an effect on the equilibrium rate of unemployment. Given the estimated substitution elasticity of 0.32 (see section 2.1.2) this additional transmission channel is fairly effective.

Given the estimated equations in section 2.1.2 and 2.2.3 the equilibrium rate of unemployment rate provides a good explanation of the long run development of the unemployment rate (see Broer, Draper and Huizinga, 1999). Actual unemployment moves towards its equilibrium. In fact, the estimated dynamic adjustment implies that it takes about eight years for a shock to be almost fully (90%) absorbed. There is evidence that the concept of the equilibrium rate of unemployment that is used here also provides a reasonable explanation of the long run developments of unemployment in other OECD countries, see van der Horst (2002a).

2.4 Labour supply

The most important determinant of labour supply, the structural supply of labour, is exogenous in JADE.[33] Besides structural labour supply there are two endogenous determinants. First, labour supply is determined by the real after tax wage rate. The higher the real after tax wage rate, the more labour is supplied. This implies that the substitution effect in the labour-leisure choice is more important than the income effect. Second, the change in the labour supply depends on the tension in the labour market, the so-called 'discouraged worker effect'. If there is less scarcity on the labour market, that is if unemployment is higher, the supply of labour is reduced because the probability to find a job decreases and search costs increase. The equation for labour supply is specified as follows:[34]

$$\frac{\Delta l_s}{l_s^*} = \frac{\Delta l_s^*}{l_s^*} + \underset{(-)}{0.1}\left(\Delta \ln \frac{w^f(1 - s_l - t_d)}{p_c}\right) + \underset{(-)}{0.2}\,\frac{\Delta l - \Delta l_s^*}{l_s^*}, \qquad (34)$$

where l_s denotes labour supply, l_s^* structural labour supply and $w^f(1 - s_l - t_d)/p_c$ the real average net wage rate for employees in firms. The coefficient for the real net wage rate is fixed at 0.1, which is in line with the most of the empirical estimates in the literature, see for example Bover (1989). Besides this substitution effect a discouraged worker effect is included in terms of the

[33] The most important factors behind structural labour supply are demographics and trends in participation rates. These factors, however, are not modelled explicitly in JADE.

[34] See CPB(1992) and the references cited therein.

difference between the change in employment and structural labour supply relative to the level of structural labour supply. With a coefficient of 0.2 this effect is assumed to be rather small.

2.5 Consumption

2.5.1 Model specification

The consumption equation of JADE is based on a mixture of the behaviour of two types of households. Households of type I have free access to the capital market and behave according to the life-cycle theory of consumption.[35] They consume a fraction ε of their total wealth, which consists of non-human wealth A and the discounted value of their expected income H. Households of type II are liquidity-constrained, and consume their current income Y in full. The fraction of type II households is denoted by ϕ. In order to specify human and non-human wealth, three types of disposable income are distinguished: labour income Y_L, transfer income Y_O and profit income Y_Z. Labour and transfer income are both assumed to grow with the expected net wage rate Ψ and are discounted with rate κ to take into account the death hazard rate, the expected real wage increase and a risk premium. [36] Profit income on the other hand is assumed to grow with the expected consumer price inflation π and is discounted with the death hazard rate λ. Thus the long run consumption function can be stated as:

$$c^* = \varepsilon\left(A + (1 - \phi_L) H_L + (1 - \phi_O) H_O\right) + \phi_L Y_L + \phi_O Y_O \,, \tag{35}$$

where ε, H_L and H_o are given by:

$$\varepsilon = \gamma(\lambda + \mu) + (1 - \gamma)(r_{l,n} - (\pi - \lambda)) \,, \tag{36}$$

$$H_L = \frac{Y_L}{r_{l,n} - (\Psi - \kappa)} \,, \tag{37}$$

$$H_O = \frac{Y_O}{r_{l,n} - (\Psi - \kappa)} \,, \tag{38}$$

and where γ represents the elasticity of intertemporal substitution, λ the death hazard rate, μ the rate of time preference, $r_{l,n}$ the relevant long run nominal interest rate (see section 2.7.4 for the definition), π the expected rate of inflation, H_L the discounted value of labour income and H_o the discounted value of transfer income, and ϕ_L and ϕ_O the fractions of wage earners and transfer income recipients that are liquidity-constrained. Note that it is assumed that $r_{l,n} > \psi - \kappa$.

[35] The consumption model is based on the overlapping generation models of Yaari(1965) and Blanchard(1985).

[36] Benefits grow with the same rate as labour income as benefits are linked to changes in wage rate (see section 2.7.4).

Furthermore it may be expected that $0 \leq \phi_L \leq \phi_O \leq 1$. In the steady state $A = Y_Z / (r_{l,n} - (\pi - \lambda))$. Finally note that it is implicitly assumed that labour supply and portfolio decisions are determined prior to the consumption decision, so that life-time wealth is exogenous in the consumption decision.

The fraction ε consists of two components. The first component reflects the desire of households to consume a fraction of their human and non-human wealth that depends on their impatience (μ) and life expectancy (λ). The second component reflects the incentive to substitute future consumption for current consumption through saving. The higher the real interest rate the more consumers will save. If the elasticity of intertemporal substitution γ equals unity, a constant fraction $\lambda + \mu$ of lifetime wealth is consumed in each period. In that case, the effect of the interest rate on consumption is unambiguously negative, as higher interest rates imply a lower present value of lifetime income. If $\gamma = 0$, intertemporal substitution does not take place, and the interest rate may affect consumption positively if the effect of a change in interest rate on the present value of life time income dominates the interest rate effect on wealth.

2.5.2 Estimation results [37]

The parameters of the steady-state consumption equation are estimated directly on the basis of the cointegration relation that exists between the variables of this equation. The short run consumption equation used is obtained from the steady state equation by adding ad-hoc dynamics, in the form of an error-correction mechanism. The final estimation result for the period 1972-1999 is:

$$\begin{aligned}\frac{c - c_{-1}}{c_{-1}} = {} & \underset{(-)}{0.55}\frac{\Delta Y_L / p_c}{c_{-1}} + \underset{(0.20)}{0.69}\frac{\Delta Y_O / p_c}{c_{-1}} + \underset{(0.25)}{0.37}\frac{\Delta Y_Z / p_c}{c_{-1}} \\ & + \underset{(0.010)}{0.046}\frac{\Delta A_{h_{-1}}}{c_{-1}} + \underset{(0.028)}{0.033}\frac{\Delta A_{s_{-1}}}{c_{-1}} + \underset{(0.033)}{0.054}\frac{\Delta A_{r_{-1}}}{c_{-1}} + \underset{(0.013)}{0.035}\frac{\Delta hw}{c_{-1}} \\ & - \underset{(0.41)}{0.60}\,\Delta r_{l,n} - \underset{(0.10)}{0.15}\,(\ln c - \ln c^*)_{-1}\,,\end{aligned} \tag{39}$$

se = 0.011 DW = 1.49

where c denotes the volume of private consumption excluding the privately financed consumption of health care (*ckg*), imputed rents on owner occupied houses (*cwe*) and administration costs of pension funds and life insurance companies (*c_a*), Y_L the disposable labour income excluding the privately financed consumption of health care (*ckg*), Y_O disposable

[37] See Kranendonk and Verbruggen (2002).

transfer income, Y_Z profit income excluding imputed rents on owner occupied houses (*cwe*) and administration costs of pension funds and life insurance companies (*c_a*).[38] Furthermore A_h denotes the stock of residential dwellings owned by households, A_s the stock of share owned by households, A_r the other assets of households and *hw* the revaluation of the stock of residential dwellings.

Compared with the 1997 estimates the elasticities of wage income and transfer income are substantially lower; in the 1997 version of JADE they were estimated as 0.88 and 0.87 respectively whereas they are now 0.55 and 0.69. The elasticity of profit income, however, is higher; it is estimated as 0.37 whereas it was only 0.23. The wealth-elasticities are lower than in the 1997 version of JADE. More precisely, the wealth elasticity in the 1997 version of JADE was 0.07. This rather high elasticity was partly due to the construction of the wealth-series used. The current estimates are lower and are thereby in line with the estimates in the literature.[39] In spite of the lower the wealth elasticities, the wealth effect on consumption is nowadays much larger than say ten years ago because the wealth of households increased considerably. The size of the error correction coefficient is significantly lower. Compared to the 1997 estimate of 0.46 the current estimate of the error correction coefficient is rather low. Therefore it has been adjusted from 0.15 to 0.30.

For the long run the following parameter estimates have been obtained:

Φ_L = 0.63(0.18) λ = 0.009(--) μ = 0.03(0.02)

Φ_o = 0.81(0.19) κ = 0.23(0.11) γ = 0.85(0.07)

se = 0.14 DW = 1.00,

where the forecasting rule for net wage growth, ψ , is specified as a distributed lag of the actual net wage development:

$$\Psi = \Psi_{-1} + \Delta\pi + \underset{(-)}{0.6}\,[(\dot{w} - \dot{p}_c) - (\Psi_{-1} - \pi)] , \qquad (40)$$

and where π, the expected change in the price of private consumption, is approximated by:

$$\pi = \pi_{-1} + \underset{(-)}{0.4}\,(\dot{p}_c - \pi_{-1}) . \qquad (41)$$

[38] The reason for this split in consumption and income components is that the consumption share of privately financed healthcare (*ckg*), imputed rents on owner occupied houses (*cwe*) and administration costs of pension funds and life insurance companies (*c_a*) is assumed to be equal to unity. This split is especially relevant if these three consumption categories have a different development than the other consumption categories. See section 2.7.4 for the construction of the three income series Y_L , Y_O and Y_Z .

[39] See Poterba (2000).

The estimates of the long-run equation agree well with prior beliefs. Campbell and Mankiw (1991) also obtain large estimates for several western European countries for the fraction of consumers that is liquidity-constrained, a finding that they relate to the existence of substantial capital-market imperfections in those countries. Heijdra and van Dalen (1996) also find that the majority of Dutch consumers is liquidity-constrained. From our results it appears that it is important to distinguish between the different types of income: the fraction of transfer income recipients has increased substantially in the Netherlands, which, in this interpretation, has also raised the fraction of consumers that is liquidity-constrained. The estimate for κ points to a much shorter effective horizon for labour income than for profit income. The effective horizon for labour income earners implied by these estimates is about four years. This value is comparable with that obtained by Draper (1994) and Heijdra and van Dalen (1996). The estimates for the rate of time preference μ and the elasticity of substitution γ accord well with the results found in the literature. Note that the labour-leisure choice that is implicit in the estimate of the elasticity of substitution γ is not consistent with the labour supply block (section 2.4). There the *intra*-temporal substitution elasticity is fixed at 0.1. Even if an interest rate effect would be taken into account in the labour supply equation not such a high inter-temporal substitution elasticity would result.

2.6 Exports and final imports

2.6.1 Exports

Exports [40] are divided in JADE into exports of domestic origin (*bfb*), re-exports (*bfm*), exports of services (*bd*) and exports of energy (*b3*). Exports of goods of domestic origin *bfb* (excluding energy and re-exports) vary due to changes in exports of competitors b_c, relative prices and changes in supply conditions. Two variables measure supply conditions. First, the relative investment ratio indicates the capacity to produce modern products and to enter new foreign markets. More precisely, the difference between the investment-ratio in the Dutch market sector, $(i/y)^{mz}$, and the investment-ratio of competitors, $(i/y)^{c}$, is used.[41] Second, the utilization rate q_y^{mz} measures the home pressure of demand. Firms prefer supply to the home country above supply to foreign countries because costs of home deliveries are lower. The estimation result for the period 1972-1999 reads as:

[40] Estimation results for exports and re-exports of goods can be found in Kusters, Ligthart and Verbruggen (2001).

[41] The investments i^{mz} are equal to the sum of the investments of firms in the market sector in equipment and buildings, e_c^{mz} and e_b^{mz}, see section 2.1.2.

$$\Delta \ln bfb = \underset{(0.14)}{1.05}\ \Delta \ln b_c - \underset{(0.14)}{0.76}\ (\Delta \ln p_{bfb} - \Delta \ln p_{bc})$$

$$+ \underset{(0.23)}{0.54}\left[\left(\frac{i}{y}\right)^{mz} - \left(\frac{i}{y}\right)^{c}\right]_{-1} - \underset{(0.22)}{0.41}\ \Delta q_y^{mz} \qquad (40)$$

$$- \underset{(0.08)}{0.18}\left((\ln bfb - \ln b_c)_{-1} + \underset{(1.04)}{2.58}\ (\ln p_{bfb} - \ln p_{bc})_{-1} + \underset{(0.06)}{0.31} \right) .$$

se = 0.021 DW = 2.23

The estimated error correction coefficient in equation (40) of 0.18 is considered too low, compared to the estimate in the 1997 version of JADE of 0.55. Therefore it has been fixed in JADE at 0.35. The relative investment ratio is not included in the long run equation for statistical reasons. Since the investment ratio in the market sector is a stationary time series, including the relative investment ratio in the long run equation would bias coefficients due to multicollinearity.

Besides exports of domestic origin (*bfb*), a major part of exports of goods consists of re-exports (*bfm*). These re-exports consist of goods that are transported from a foreign country to the Netherlands and then to another country without being processed. They are distinguished from the exports of domestic origin in JADE because they behave quite differently. Re-exports of goods have been estimated for the period 1970-1999 as follows:

$$\Delta \ln bfm = \Delta \ln b_c - \underset{(0.21)}{0.49}\ (\Delta \ln p_{bfm} - \Delta \ln p_{bc})$$

$$- \underset{(0.21)}{0.59}\left((\ln bfm - \ln b_c)_{-1} + \underset{(0.32)}{0.44}\ (\ln p_{bfm} - \ln p_{bc})_{-1} + \underset{(0.05)}{0.58} \right) . \qquad (41)$$

se = 0.029 DW = 1.90

Note that the price elasticities of re-exports are significantly lower than those for the exports of domestic origin. Whereas the long-run price elasticity of exports of domestic origin is –2.58, it is only –0.44 for re-exports. Also the short-run price elasticity is lower for re-exports. For exports of domestic origin the short-run price elasticity is –0.76, but it is only –0.49 for re-exports.

Instead of linking the exports of services to the exports of goods with a coefficient of 0.6 as in the 1997 version of JADE, an error-correction specification is estimated for the period 1970-1999 that links the export of services to the growth of world trade:

$$\Delta \ln bd = \Delta \ln b_c - \underset{(0.10)}{0.33} \left((\ln bd - \ln b_c)_{-1} + \underset{(0.26)}{1.65} (\ln p_{bd} - \ln p_{bc})_{-1} \right) . \quad (42)$$

se = 0.036 DW = 2.28

The long-run price elasticity of the exports of services of −1.65 is substantially lower than that for the exports of goods of domestic origin (−2.58).

Finally, the export of energy (*b3*), consists of the export of gas (*bag*) and other energy product excluding gas (*bo*). The volume changes in both components are exogenous in JADE.

2.6.2 Final imports

Final imports in JADE consist of four components: imports of consumer goods, imports of investment goods, imports intended for re-export and the imports of travelling services. For imports of consumer goods (*mc*), we did not succeed in finding a satisfactory equation in error-correction form, that is in levels. Assuming no long run import penetration the equation has been re-estimated as

$$\Delta \ln mc = \Delta \ln cre - \underset{(0.19)}{0.69} (\Delta \ln p_{mc} - \Delta \ln p_{cre}^{bh}) + \underset{(0.31)}{0.78} \Delta q_y^{mz} + \underset{(0.0049)}{0.011} , \quad (43)$$

se = .023 DW = 1.89

where *cre* denotes the volume of private consumption excluding rents (*cwo*) and privately financed consumption of health care (*ckg*), p_{cre}^{bh} the price index of private consumption of *cre* excluding indirect taxes, subsidies and final imports of consumption goods *mc*, p_{mc} the price index of imported consumer goods and q_y^{mz} the utilization rate of production capacity in the market sector (*mz*).

The equation for the imports of investment goods (*mi*) has also been re-estimated under the assumption of no long run import penetration as

$$\begin{aligned} \Delta \ln mi = {} & \underset{(0.36)}{1.88} \Delta q_y^{mz} + \underset{(0.07)}{0.88} \Delta \ln ibo - \exp(\underset{(0.0029)}{-0.0037} t) \\ & - \underset{(0.11)}{0.21} \left(\ln mi_{-1} - \ln ibo_{-1} + \underset{(0.39)}{0.17} (\ln p_{mi} - p_{ibo}^{bh})_{-1} + \underset{(0.36)}{6.36} q_{y,-1}^{mz} - \underset{(1.48)}{2.25} \right) , \end{aligned} \quad (44)$$

se = 0.019 DW = 2.15

where *ibo* denotes the investments in equipment by firms, *t* a time trend and p_{ibo}^{bh} the price of investment in equipment of domestic origin, that is indirect taxes, subsidies and final imports of investments goods (mi) are excluded. In comparison with the 1997 version of JADE, the long-run price elasticity is more than twice as high. The long-run effect of the utilization rate is 6.36, which is somewhat larger than in the 1997 estimate, and larger than the short-run elasticity. This implies a strong and increasing negative effect of utilization rate on imports of investment goods. The time trend reflects the increasing share of foreign suppliers in total investment. In the long run, the share reaches a maximum.

The volume of imports for re-export, *mbf*, is assumed to behave in the same way as re-exports:

$$\Delta \ln mbf = \Delta \ln bfm \ . \tag{45}$$

The equation for the imports of travelling services (*mdc*) is estimated over the period 1972-1999 as

$$\begin{aligned} \Delta \ln mdc = {} & \underset{(0.45)}{0.89}\ \Delta \ln cre - \underset{(0.49)}{0.77}\ \Delta \ln p_{mdc} \\ & - \underset{(0.19)}{0.27}\left(\ln mdc_{-1} - \underset{(0.70)}{1.81}\ \ln cre_{-1} + \underset{(1.49)}{1.56}\ (\ln p_{mdc} - \ln p_{c})_{-1} + \underset{(3.66)}{6.96} \right) . \end{aligned} \tag{46}$$

se = 0.039 DW = 2.11

The long-run price elasticity is −1.56 and the long-run expenditure elasticity out of private consumption (*cre*) is 1.81, indicating an increasing share of travelling expenses in total consumption. The short-run elasticity of total consumption is somewhat below unity, however. The term $\Delta \ln p_{mdc}$ intends to capture the short-run effect of unexpected price changes of travelling services. Note that this equation is not re-estimated under the assumption of no long run import penetration. Given the estimated equation (46) such an assumption is hard to make and furthermore it is hardly realistic from an economic point of view. An alternative would be to estimate an equation for the imports of travelling services that depends upon the consumption of Dutch citizens abroad. The latter should then also be specified.

2.7 The public sector

The public sector block is more or less the same as in the JADE 1997 model.[42] The expenditures and receipts of the government, the social security system and the EMU-balance are described in section 2.7.1-2.7.3. The major focus of this section is, however, to describe the important links between the public and the private sector without regard to all institutional details (section 2.7.4).

2.7.1 Receipts and expenditures of the government

Table 2.1 provides an overview of the various receipts and expenditures of the government. Government expenditures consist of government consumption, investments, subsidies, transfers and other expenditures. Wage costs are by far the largest expenditure category. Note that subsidies are split into cost-price decreasing subsidies (*suk*) and wage costs subsidies (*sul*). The first category affects the market prices of the various demand categories, whereas the second reduces the production costs in the various production sectors.

Most of the volumes of the different expenditure categories are exogenous. Exceptions are government wages (*gl*), unemployment benefits paid by public funds (*oyw*), transfers to the European Union (*mpe*) and income- and capital transfers abroad (*oyu*). The volume of government wages (*gl*) depends on the number of government employees and their productivity. The unemployment benefits paid by public funds (*oyw*) are part of the income transfers (*oyg*) and its volume is assumed to change with 40 per cent of the change in the number of unemployed persons. The transfers to the European Union (*mpe*) are equal to a fixed percentage of indirect taxes. The income- and capital transfers abroad (*oyu*) are linked to the growth in net national income.

The development of most prices of expenditures are linked to other prices. The change in the government wage rate is decomposed in a contractual and an incidental wage component. The change in contractual government wages follows the change of the contractual wage rate in the market sector. The change in the incidental wage rate in the government sector, however, is exogenous. The price change of intermediary deliveries (*gi*) and that for the sales by the government (*gv*) depends upon costs, see section 2.8. The price change of the consumption in kind (g_n^{ro}) follows the change in the price of total private consumption. The price change of the various income transfers depend on the change of the minimum wage, the price of private consumption and government wages. It is important to note that some of the latter price

[42] One notable difference is that due to the revision in national accounts consumption in kind is included in government consumption. Another difference is that the equation for the volume of unemployment insurance *uww* benefits (equation (3.69) in CPB, 1992) is replaced by an equation that links these benefits to the number of unemployed persons (see further section 2.7.2). A more detailed description of the public sector can be found in CPB (1992) and CPB (2002a).

changes are not passed on fully and thus, some non-homogeneities result. Finally, the interest payments are not indexed.

Governments receipts can be decomposed into direct taxes on wage, transfer and profit income, indirect taxes, capital income and sales of land. Of these receipts components indirect taxes (*tk*) are by far the largest income source of the government. Apart from indirect taxes levied on final sales on the domestic market, indirect taxes consist of taxes imputed to the enterprise sector, like for example import duties, excise duties and vehicle taxes.

2.7.2 Receipts and expenditures of the social security system

The social security system consists of two sub-sectors, social insurance funds and pension funds and life insurance companies. Contributions to social insurance funds are based on a pay-as-you-go system.[43] This implies that contribution rates are set in a such a way that they cover net costs. Their net costs consists of their expenditures (benefits paid, benefits in kind and administration costs), less income other than contributions (*viz*. net income and capital transfers from the government and investment returns), see Table 2.2. Contributions are levied on four different income categories, namely gross wages paid by firms, gross wages paid by the government, imputed wage income of self-employed, and transfer income. The contribution rates are determined exogenously in JADE. This endogenizes the balance of revenues and expenditures of the social security funds.

Households receive income due to three types of social insurance benefits: disability benefits (*uzw*), unemployment benefits (*uww*) and elderly and widow's pensions (*uow*).
The volume of these benefits is exogenous in JADE, except the volume of unemployment benefits. It is assumed that the change in the number of unemployment benefits paid by social security funds is 60 per cent of the change in number of unemployed persons. Furthermore households enjoy sickness benefits (*uzf*) and health insurance benefits (*ubz*). However, they receive these benefits in kind. Thus, these benefits in kind (g_n^{sv}) do not enter disposable transfer income Y_o (see section 2.7.5).

Whereas the social security funds are based on a pay-as-you-go system, the pension funds and life insurance companies are fully funded. As such this characteristic is not modelled in JADE: the volume of benefits paid by pension funds and life insurances companies is exogenous. The benefits paid (*ulp*) are indexed to the growth rate of private and government sector contract wages, and their premium income is determined by multiplying the relevant income categories

[43] An overview of the social security system in the Netherlands can be found in Missoc (2001).

with exogenous contribution rates. The premiums for pension funds and life insurances are paid for employees in firms (pb^{lp}), for civil servants (pp^{lp}) and for self-employed (pz^{lp}).

Table 2.1 Receipts and expenditures of the government in 2000 in billions of euro

Government expenditures			Government receipts		
Government consumption			**Direct taxes**		
gl	Government wages	38.0	*tl*	Taxes on wage income	21.1
gi	Intermediary deliveries	25.3	*tlu*	Taxes on transfer income	4.6
gv	Sales by the government	– 12.3	*tz*	Taxes on profit income	22.9
go	Profit income of the government + investments under own control	– 1.0			
g_n^{ro}	Consumption in kind	3.8			
Government investments			**Indirect taxes**		
ipo	Investments in equipment	3.0	*tk*	Indirect taxes	52.4
ipb	Investments in buildings	8.0			
igf	Investments of government firms	1.8			
Subsidies			**Non tax receipts**		
suk	Cost-price decreasing subsidies	4.7	*zr*	Capital income	7.6
sul	Wage cost subsidies	2.5	*igl*	Sales of land	3.9
Domestic transfers					
oyg	Income transfers	13.5			
okg	Capital transfers	0.4			
Foreign transfers					
mpe	Transfers to European Union	2.3			
oyu	Income and capital transfers abroad	5.0			
Other expenditures					
r__	Interest payments	15.9			
xvc	Miscellaneous	– 0.4			
*xv_*	Total government expenditures	111.0	*t_t*	Total government receipts	112.5

Source: *CPB Report* 2002/3, *Macro Economische Verkenning* 2003

Table 2.2 Receipts and expenditures of the social insurance funds in 2000 in billions of euro

Social security expenditures			Social security receipts		
Benefits			**Social security contributions**		
uzw	Disability benefits	9.2	pb^{sv}	Social security contributions on gross wages paid by firms	46.2
uww	Unemployment benefits	3.3	pp^{sv}	Social security contributions on gross wages paid by the government	6.7
uow	Elderly and widow's pensions	21.0	pz^{sv}	Social security contributions on imputed wage income of self-employed	2.7
			pu	Social security contributions paid on transfer income	7.8
Benefits in kind (g_n^{sv})			**Transfers**		
uzf	Sickness benefits	12.0	oyg^{sv}	Income transfers by the government	2.4
ubz	Health insurance benefits	13.0	okg^{sv}	Capital transfers by the government	0.0
Administration costs			**Other receipts**		
g_a		2.2	zr^{sv}	Investment returns	0.5
			psd^{sv}	Statistical difference	0.8
$xv\_^{sv}$	Total expenditures of social security funds	60.0	$p\_\_^{sv}$	Total receipts of social security funds	67.1

Source: *CPB Report* 2002/3, *Macro Economische Verkenning* 2003

2.7.3 EMU-balance

The EMU-balance consists of the sum of the difference between receipts and expenditures of the government and social security funds. To determine this balance direct taxes are used on a cash basis and indirect taxes on transactions basis. The reason behind this practice is that the government is obliged to report its EMU balance to the European Central Bank (ECB) rather timely. According to the Growth and Stability Pact a government is not allowed to have a budget deficit higher than 3 percent of Gross Domestic Product. It turns out that it takes about five years before the final data for the receipts of direct taxes are available on transaction basis. However, this lag is too long. The lag between indirect taxes on a transaction basis and cash basis on the other hand is about zero, so indirect taxes enter on transactions basis. Note that deficits or surpluses of pension funds and life insurance companies are not included in the EMU-balance definition.

2.7.4 Links between public and the private sector

From sections 2.7.1 - 2.7.3 it is clear that the public sector affects the private sector in various ways. First, the government is a source of demand for goods and services by way of its consumption and investment demand. Second, the government affects the market prices by cost price decreasing subsidies and indirect taxes and the production prices through wage cost subsidies. Third, the government sector affects the income distribution by means of direct taxes

and income transfers. The social security system affects the income distribution through social insurance benefits and contributions levied to pay for these benefits. These income redistributions affect disposable income. Disposable labour income, Y_L, is determined as:[44]

$$Y_L = p_l l + lz - tll - tzl - pb^{sv} - pp^{sv} - pz^{sv} - pb^{lp} - pp^{lp} - pz^{lp} - ckg \,, \qquad (47)$$

with

p_l	labour costs per fte (including employers' social security contributions)
l	number of employees in full time equivalents
lz	imputed gross wage sum of self-employed
tll	direct taxes paid over wage income
tzl	taxes on the imputed wage income of self-employed
pb^{sv}	social security contributions paid by firms
pp^{sv}	social security contributions paid by the government
pz^{sv}	social security contributions paid by self employed
pb^{lp}	premiums for pension funds and life insurances paid by firms
pp^{sv}	premiums for pension funds and life insurances paid by the government
pz^{sv}	premiums for pension funds and life insurances paid by self employed
ckg	privately financed consumption of health care

Disposable transfer income, Y_O, is determined as:

$$Y_O = uzw + uww + uow + ulp + oyg + oyu - tlu - pu \,, \qquad (48)$$

with

uzw	disability benefits
uww	unemployment benefits paid by social security funds
uow	elderly and widow's pensions
ulp	benefits paid by pension funds and life insurance companies
oyg	income transfers of the government to households
oyu	balance of income- and capital transfers abroad
pu	social security contributions paid over transfer income
tlu	income taxes over transfer income

Disposable profit income, Y_Z, is determined as:[45]

[44] Note that disposable labour income is adjusted for the privately financed consumption of health care (*ckg*) in order to take into account that it is assumed that its consumption share is unity (see section 2.5.2).

[45] Note that disposable profit income is adjusted for the imputed rents on owner occupied houses (*cwe*) and the administration costs of pension funds and life insurance companies (*c_a*) in order to take into account that it is assumed that their consumption share is unity (see section 2.5.2).

$$Y_Z = zhu - lz - tzr - cwe - c\_a \,, \tag{49}$$

with

zhu profit income of households

lz imputed gross wage sum of self-employed

tzr corporate taxes paid by households

cwe imputed rents on owner occupied houses

c_a administration costs of pension funds and life insurance companies

To determine income taxes the growth of the nominal tax base (wage- and transfer income minus social security contributions) is divided in a volume component and a price component. The volume growth of the income tax base equals the development of the number of wage-earners and the volume component of transfer income equals the growth of the number of benefits and income transfers. It is taken into account that the progression factor is higher in the case of wage income than in the case of transfer income. The system of inflation correction ensures that the progression in the tax system is applied to real income increases only. The length of the tax brackets is indexed to the change in consumer price inflation.

Besides the effect on disposable income, taxes and social security contributions also affect the net long run rate of interest $r_{l,n}$ that is used in the consumption function (see section 2.5) as follows:[46]

$$r_{l,n} = r_l(1 - s_l - t_d) \,, \tag{50}$$

where r_l is the nominal long run interest rate, s_l the social security contribution rate for employees and t_d the rate of direct taxes paid by labour. Furthermore they affect the wedge. More specifically, the wedge is defined in JADE as follows:[47]

$$\Lambda = \frac{1 + s_e}{(1 - s_l)(1 - t_d)} (1 + t_i), \tag{51}$$

where s_l is the social security contribution rate for employees, t_d the rate of direct taxes paid by labour, s_e the social security contribution rate for employers, and t_i the rate of indirect taxes. The institutional basis for the determination of the contribution rates and direct taxes is the gross wage rate. Given the non-linearity of the wedge, the same increase in contribution rates for employers and employees results in a different change in the wedge and thus a different effect on the economy. Even if the contribution rates are calculated so, that the wedge-effect is

[46] Note that the relevant net long run interest rate is not adjusted to take into account the new tax system that has been introduced in 2001.

[47] This is the wedge definition that is used in JADE. It differs from the wedge definition (25) with regards to the terms of trade effect. In equation (51) a terms of trade effect is excluded whereas it is included in equation (25).

the same, the effect on the economy remains different (see van der Horst, 2002b). The reason is that several benefits are linked to the gross wage rate which responds differently to changes in contribution rates for employers and employees.

In the case of the unemployment benefits (*uww*) paid by social security funds even the composition of the group who receives such benefits is relevant. The nominal development of the benefits to persons who are unemployed for a longer time are institutionally linked to the development of the minimum wage, whereas those of persons who recently entered the unemployment pool are linked to the wage rate in the market sector.[48]

2.8 The Cumulative Production Structure

The final model block to be discussed is the Cumulative Production Structure (CPS). In essence it consists of three elements: the CPS-matrix (section 2.8.1), the specification of price behaviour of the various demand categories (section 2.8.2) and the quantity equations in the various sectors (section 2.8.3).

2.8.1 The CPS matrix

As such the CPS-matrix is a reduced form of an input-output matrix in which the matrix of intermediary deliveries has been substituted out, see CPB (1992). Due to various changes in the model (see section 1.1) adjustments have been made in the number of demand categories (columns) as well as changes with respect to the number of sectors, final imports and subsidies (rows). First, some demand categories have been split.[49] Second, some changes have been made with respect to the rows in the CPS. As noted in section 1.1 the exposed and the sheltered sector (including the gross value added interest margin) have been combined to the market sector. Furthermore, the intermediate import of raw material and semi manufactured products excluding energy (*mgr*) has been split into imports of raw material and semi manufactured products excluding energy intended for domestic use (*mg*) and imports intended for re-export (*mbf*).[50] Finally, subsidies are split into cost price decreasing subsidies and wage cost subsidies.

[48] The number of unemployment benefits (in full time equivalents) consists of two components: the fraction of claimants who received benefits in the previous year and who also receives a benefit this year (the "stayers") and the fraction of persons who were employed in the previous year, but lost their job and currently receive unemployment benefits (the "new entrants"). Both fractions are specified as non-linear functions of the unemployment rate and the growth of employment in firms (excluding self-employment). The specification implies that the fraction of unemployed persons who remain unemployed increases with higher unemployment rates. New entrants also increase with higher unemployment rates, but decrease with the growth rate of employment.

[49] See Appendix 1 for a comparison of the current split in demand categories and the split in the 1997 version of JADE.

[50] *mg* is considered as an intermediate import and *mbf* as a final import. As a result final imports are introduced in the export column of the CPS, whereas they were absent in the 1997 version, see Table 6, CPB(1997a).

Table 2.3 gives an overview of the CPS matrix. It shows how much of valued added, intermediate imports, final imports, and indirect taxes and subsidies are ultimately used for production in the various demand categories. For convenience various demand categories have been clustered (see Appendix 2). For the whole economy about 70 per cent of the gross value added at factor costs comes from the market sector. For private consumption, private investments and exports this is 71 percent, 96 percent and 92 percent respectively. In the government sector only 28 percent is related to the market sector; the government is the main contributor with 46 percent. Of the gross value added at factor costs for the whole economy about 33 percent comes from private consumption and 31 percent from exports. This indicates that the Netherlands is a rather open economy. In the market sector private consumption and exports also take up most of value added. In the mining and quarrying sector export uses most (62 percent) whereas private consumption uses up most of the gross value added in the residential sector. In the healthcare and the government sector government spending takes up most: 74 and 96 percent respectively.

The CPS is intended to take into account the heterogeneous character of the various sectors. In the model this is achieved by using the CPS-weights in the specifications of the behavioural equations for price and costs in the various demand categories and the specification of quantities in the various sectors (see section 2.8.2 and 2.8.3 respectively). Given the CPS matrix column weights (*cw*) as well as row weights (*rw*) are calculated. Column weights are defined relative to the level of gross domestic production at factor costs (*bh*) and row weights are defined relative to the total gross value added or total intermediate imports in each sector. In JADE these weights are exogenous.

Table 2.3 Aggregated Cumulative Production Structure in 2000 in billions of euro

	Private consumption	Private investments	Government spending	Exports	Total
Gross value added at factor costs in various sectors					
Gross value added market sector (*mz*)	84.4	39.8	24.8	101.0	250.0
Gross value added mining and quarrying (*de*)	2.7	0.5	0.6	6.0	9.7
Gross value added residential sector (*wo*)	24.5	0.7	1.5	1.7	28.4
Gross value added health care (*kw*)	5.9	0.2	20.3	1.1	27.5
Gross value added government (*pl*)	0.9	0.3	40.1	0.5	41.8
Gross value added at factor costs	118.4	41.5	87.3	110.3	357.5
Intermediate imports					
Intermediate imports of goods (*mg*)	12.2	5.1	7.0	47.8	72.1
Intermediate imports of services (*md*)	8.0	3.3	2.2	16.4	29.9
Intermediate imports of energy (*m3*)	2.6	0.7	1.0	16.6	20.9
Gross domestic production at factor costs (*bh*)	141.2	50.6	97.5	191.2	480.4
Final imports					
Final imports of consumer goods (*mc*)	24.5	-	-	-	24.5
Final imports of investments goods (*mi*)	-	17.6	-	-	17.6
Final imports for re-export (*mbf*)	-	-	-	77.4	77.4
Final imports of travelling services (*mdc*)	8.5	-	-	-	8.5
Indirect taxes and subsidies					
Indirect taxes (*tk*)	29.6	10.7	6.3	5.8	52.4
Cost-price decreasing subsidies (*suk*)	– 1.4	0.0	– 1.3	– 2.0	– 4.7
Wage cost subsidies (*sul*)	– 1.2	0.0	– 0.3	– 1.0	– 2.5
Gross domestic production at market prices	201.1	78.9	102.2	271.4	653.6

Source: *CPB Report 2002/3*, *Macro Economische Verkenning* 2003

2.8.2 Specification of price changes in the CPS

The second part of the CPS is the specification of the price changes [51] in the various demand categories. In the 1997 version of JADE for each sector up to the level of factor costs (*bh*) and for each demand category the price change was modelled. This made the block rather complex while it did not contribute much to the properties of the model. In the current version of JADE prices are only modelled at the level of factor costs. Furthermore, the specification is simplified by omitting a number of specific variables in the GPS price equations. In order to specify the price equations, first the changes in the production costs $\dot{c}_y^j$ in sector *j* are specified as follows:

$$\dot{c}_y^{mz} = (c_y^{mz} - c_{y,-1}^{mz}) / c_{y,-1}^{mz} , \qquad (52)$$

[51] See Houweling (1997) for the estimation results of the GPS price equations.

$$\dot{c}_y^{wo} = \tau^{wo}\,\dot{p}_{l,u}^{wo} + (1 - \tau^{wo})\,\dot{p}_k^{wo} \,, \tag{53}$$

$$\dot{c}_y^{kw} = \tau^{kw}\,\dot{p}_{l,u}^{kw} + (1 - \tau^{kw})\,\dot{p}_k^{kw} \,, \tag{54}$$

$$\dot{c}_y^{de} = \underset{(-)}{0.14}\,[\tau^{de}\,\dot{p}_{l,u}^{de} + (1 - \tau^{de})\,\dot{p}_k^{de}] + \underset{(-)}{0.86}\,\dot{p}_{mro} \,, \tag{55}$$

$$\dot{c}_y^{m} = \dot{p}^{m} \qquad m = mg,\ md,\ ,m3,\ pl \,, \tag{56}$$

where $p_{l,u}^{j}$ is the unit labour cost in sector j, p_k^j the capital cost in sector j and p_{mro} the import price of crude oil. The production costs in the market sector are determined by equation (5). For the other non-government sectors costs are determined by weighting unit labour costs and capital costs with the wage share τ^j in value added. In the mining and quarrying industry (*de*) production costs depend for a large part on the import price of crude oil. The labour costs per unit of product consists of the wage costs per unit minus the wage cost subsidies. For the intermediate imports of goods (*mg*), services (*md*) and energy (*m3*) costs are assumed to be equal to their price level. In the government sector (*pl*) costs are by definition equal to their price level.

Given these costs in the various sectors, the change of production costs at the level of factor costs (*bh*) for each demand category i $\dot{c}_{y,i}^{bh}$ is determined by weighting the costs changes in the sectors with the CPS column weights of demand category i:

$$\dot{c}_{y,i}^{bh} = \sum_j cw_i^j\,\dot{c}_y^j \,, \qquad j = mz,\ wo,\ kw,\ de,\ pl,\ mg,\ md,\ m3 \,. \tag{57}$$

Like costs, also price changes are determined at the factor cost level. For all demand categories with the exception of *bfb*, *bfm*, *ckg*, *cwo*, *nf*, *gl*, and *dg* the price change at the level of domestically produced final demand is modelled as follows:[52]

$$\dot{p}_{y,i}^{bh} = \rho_i\,\dot{c}_{y,i}^{bh} + \varphi_i(\ln p_{y,i}^{bh} - \ln c_{y,i}^{bh} + \nu_i y_i^{bh} + \Omega_i \ln q_y^{sh})_{-1} + \zeta_i\,\dot{y}_i^{bh} + \theta_i\,\dot{y}_n^{c} + \xi_i \,, \tag{58}$$

where $c_{y,i}^{bh}$ represents the production cost level of demand category i, q^{sh} the rate of capacity utilization in the sheltered sector (*sh*), y_n^c the nominal world income and i the list of all demand categories (see Appendix 2) excluding *bfb*, *bfm*, *ckg*, *nf*, *gl* and *dg*.

[52] See Houweling and Huizinga (1997a) for the specification of price equation.

Table 2.4 Estimated coefficients in the price equations of the CPS according to equation (58)[a]

	ρ	φ	υ	Ω	ζ	θ	ξ	se	DW
Private consumption									
cr5	0.34	– 0.24					0.014	0.008	2.07
	– 0.04	– 0.04					0.000		
cag	0.34	– 0.24					0.014	0.008	2.07
	– 0.04	– 0.04					0.000		
Private investments									
ibo	0.2	– 0.26		– 1.62			0.030	0.010	2.32
	– 0.06	– 0.08		– 0.48			– 0.010		
ibb	0.73	– 0.54		– 0.82			0.024	0.013	1.11
	– 0.09	– 0.17		– 0.30			–0.010		
no	1.03	– 0.58	0.34				– 0.010	0.039	2.00
	– 0.05	– 0.21	-0.16				– 0.015		
iwo	0.73	– 0.54		– 0.82			0.024	0.013	1.11
	– 0.09	-0.17		– 0.30			– 0.010		
Government spending									
gi	0.59	– 0.26					0.009	0.008	1.89
	– 0.04	– 0.06					0.000		
gv	0.59	– 0.26					0.009	0.008	1.89
	– 0.04	– 0.06					0.000		
go	0.59	– 0.26					0.009	0.008	1.89
	– 0.04	– 0.06					0.000		
g_n	0.29	– 0.24					0.026	0.012	1.50
	– 0.07	– 0.06					0.000		
ipo	0.2	– 0.26		– 1.62			0.030	0.010	2.32
	– 0.06	– 0.08		– 0.48			– 0.010		
ipb	0.73	– 0.54		– 0.82			0.024	0.013	1.11
	– 0.09	– 0.17		– 0.30			– 0.010		
Exports									
bd	0.5	– 0.39			– 0.27	0.26	0.014	0.012	2.25
	– 0.1	– 0.11			– 0.09	– 0.06	– 0.010		
bag	0.47	– 0.80					0.038	0.063	1.55
	– 0.08	– 0.08					– 0.016		
bo	1.03	– 0.58	0.34				– 0.010	0.039	2.00
	– 0.05	– 0.21	-0.16				– 0.015		

[a] The CPS price equations have been jointly estimated as one equation for *cr5* and *cag*, for *ibb*, *iwo* and *ipb*, for *ibo* and *ipo*, for *no* and *bo*, for *gi*, *go* and *gv* and for *bfb* and *bfm*. For *g_n* the estimated equation for *ckt* is used.

The estimated coefficients are listed in Table 2.4. Note that for a number of demand categories the coefficients are assumed to be equal as these price equations have not been re-estimated for the current decomposition of demand categories (see appendix 1). Some of the estimates in Table 2.4 have been adjusted before inclusion in JADE. First, the coefficient on production cost in the equation for inventory formation of energy (*no*) and exports of energy excluding gas (*bo*) have been fixed at 1.00 instead of 1.03 to prevent overshooting.[53] In the current version some additional simplifications have been made. As Table 2.4 shows, for various price equations an additional set of variables is used besides cost changes and the difference between the price level and the cost level. This set consists of variables such as the volume of demand, the degree of capacity utilization, the change in demand and nominal world income. The contribution of these variables in simulation analyses turned out to be negligible and therefore they have been omitted in the current specification of JADE.

For the sum of exports of goods of domestic origin (*bfb*), re-exports (*bfm*), and the inventory formation of produced goods (*nf*) a somewhat different equation has been estimated:[54]

$$\begin{aligned}\Delta \ln p^{bh}_{y,bnf} = {} & \underset{(0.12)}{0.33}\ \Delta \ln c^{bh}_{y,bnf} + \underset{(0.10)}{0.44}\ \Delta \ln p_{bc} - \underset{(0.0054)}{0.01} \\ & - \underset{(0.14)}{0.40}\left(\ln p^{bh}_{y,bnf} - \underset{(\ -\ )}{0.30}\ln c^{bh}_{y,bnf} - \underset{(0.21)}{0.70}\ln p_{bc} + \underset{(0.04)}{0.09}\ln y^{bh}_{bnf}\right)_{-1} .\end{aligned} \tag{59}$$

se = 0.012 DW = 2.02

Also with respect to equation (59) some adjustments have been made. First, it is assumed that in the long run prices will follow production costs. Second, the effect of the volume of demand in the long run demand equation is neglected like in the other price equations. Third, it is assumed that export prices fall if the degree of capacity utilization drops. The reason for this is that if the degree of capacity utilization decreases, firms are willing to offer price concessions, which lower the profit margin. In order to take this effect into account a capacity utilization elasticity of 0.50 is assumed. Given these assumptions the following price equation results for the exports of domestic origin (*bfb*):

$$\begin{aligned}\Delta \ln p^{bh}_{y,bfb} = {} & 0.77\,\Delta \ln c^{bh}_{y,bfb} + 0.44\,(\Delta \ln p_{bc} - \Delta \ln c^{bh}_{y,bfb}) + 0.01 \\ & - 0.40\,(\ln p^{bh}_{y,bfb} - \ln c^{bh}_{y,bfb})_{-1} + 0.50 \ln q^{mz}_{y} .\end{aligned} \tag{60}$$

[53] This was already the case in the 1997 version of JADE.

[54] See Houweling (1997).

For re-exports the effects of the short run relative price term as well as the utilization production capacity are assumed to be absent, thus:

$$\Delta \ln p^{bh}_{y,bfm} = 0.77\,\Delta \ln c^{bh}_{y,bfm} - 0.40\,(\ln p^{bh}_{y,bfm} - \ln c^{bh}_{y,bfm})_{-1} + 0.01\ . \tag{61}$$

For the other four demand categories the change in the price level against factor costs is modelled as follows:

$$\dot{p}^{bh}_{y,ckg} = \dot{p}_{uzf}\ , \tag{62}$$

$$\dot{p}^{bh}_{y,nf} = \underset{(-)}{0.5\ \dot{p}^{bh}_{vc}} + \underset{(-)}{0.5\ \dot{p}_{mg}}\ , \tag{63}$$

$$\dot{p}^{bh}_{y,gl} = \frac{1 + \dot{w}^{ro}}{1 + \dot{h}^{ro}} - 1\ , \tag{64}$$

$$\dot{p}^{bh}_{y,dg} = \underset{(-)}{0.27\ \dot{p}^{bh}_{ipo}} + \underset{(-)}{0.73\ \dot{p}^{bh}_{ipb}}\ , \tag{65}$$

where p_{uzf} is the price of sickness benefits, p^{bh}_{vc} is the price of gross domestic production at factor costs excluding exports of energy (*bag* and *bo*), government wages (*gl*) and inventory formation (*nf* and *no*), w^{ro} the wage rate in the government sector including government firms and h^{ro} the productivity in this sector. According to equation (62) the price of privately financed consumption of health care, $p^{bh}_{y,ckg}$, behaves the same as the price of sickness benefits. The price of inventory formation of produced goods depends on the price of gross domestic production at factor costs and the price of imports of goods. The weights of both components are assumed to be equal to 0.5. The price change of government wages is by definition equal to the growth of the wage rate relative to productivity. The price change of depreciation of the government depends on the price of government investments in equipment and buildings. Finally, the price of rents, $p^{bh}_{y,cwo}$, is exogenous. Given these price equations for the various demand categories, the prices in the various sectors are determined by weighting the various price equations (see appendix 3).

2.8.3 Specification of volume changes in the CPS

Like the price block of the CPS (see section 2.8.2), the volume block[55] was also modelled in each cell in the 1997 version of JADE. Compared to the price block, the specification of the quantity block in the CPS was, however, relatively simple. Therefore it was rather easy to abstract from specifying all cells in the volume block.[56] The growth of the volume of value added in the sectors mining and quarrying (*de*), residential (*wo*) and healthcare (*kw*) is now modelled by weighting the growth rates of all demand categories *i* with the CPS row-weights:

$$\dot{y}^{de} = \underset{(0.10)}{(1 + 0.38)} \sum_i rw_i^{de}\, \dot{y}_i^{bh} \quad , \tag{66}$$

$$\dot{y}^{wo} = \underset{(\ -\ )}{(1 + 0.00)} \sum_i rw_i^{wo}\, \dot{y}_i^{bh} - \underset{(0.11)}{0.41}\ (\dot{p}^{wo} - \dot{p}^{v}) \quad , \tag{67}$$

$$\dot{y}^{kw} = \underset{(0.06)}{(1 - 0.14)} \sum_i rw_i^{wo}\, \dot{y}_i^{bh} \quad , \tag{68}$$

where rw_i^s is the row-weight from demand category *i* in sector *s* and p^v is the average price of total gross value added including intermediate imports. In JADE the relative price elasticity of value added in the residential sector has been fixed at zero instead of -0.41 in line with the proportionality hypothesis.[57] The value added of the government sector (*pl*) is by definition equal to the sum of gross government wages plus depreciation. The growth of the volume of intermediate imports of goods (*mg*), services (*md*), and energy (*m3*), is estimated as follows:

$$\dot{mg} = \underset{(0.05)}{(1 + 0.31)} \sum_i rw_i^{mg}\, \dot{y}_i^{bh} - \underset{(0.07)}{0.24}\ (\dot{p}^{mg} - \dot{p}^{v}) \quad , \tag{69}$$

$$\dot{md} = \underset{(0.26)}{(1 - 0.93)} \sum_i rw_i^{md}\, \dot{y}_i^{bh} + \underset{(0.008)}{0.035} \quad , \tag{70}$$

[55] See Houweling (1997) for the estimation results of the GPS quantity equations and Houweling and Huizinga (1997b) for their specification.

[56] In the 1997 version of JADE a binomial logit model was used to take into account the substitution between raw materials and value added in the exposed sector. This was necessary to account for the fact that imports of raw material grew faster than demand and that this was almost exclusively at the cost of the exposed sector. As the inner cells of the CPS are not modelled anymore this logit model has been removed.

[57] According to the proportionality hypothesis value added changes proportionately with the weighted sum of value added changes in the various demand categories. Furthermore the price elasticities should be zero and there should be no constant in the estimated equation (see Houweling and Huizinga, 1997a).

$$\dot{m3} = \underset{(0.09)}{(1 - 0.23)} \sum_i rw_i^{m3}\, \dot{y}_i^{bh} - \underset{(0.09)}{0.42}\ (\dot{p}^{m3} - \dot{p}^{v}) \ , \qquad (71)$$

where pe^{m3} is the expected price of energy. In JADE the following adjustments have been made with respect to equation (69) - (71). First, all three coefficients for the reweighted total demand and the constant in the equation for import of services have been set equal to 0.0 in line with the proportionality hypothesis (see Houweling and Huizinga, 1997b). Second, the price elasticity for the imports of energy has been reduced to -0.21.

Finally the volume of gross value added in the market sector is determined as a residual. First, gross domestic value added at factor costs, y^{bh} is determined by subtracting the volume of intermediate imports from the sum of gross value added in all demand categories:

$$y^{bh} = \sum_i y_i^{bh} - mg - md - m3 \ . \qquad (72)$$

Then the volume of the value added in the market sector (mz) is the residual:

$$y^{mz} = y^{bh} - \sum_s y^s \qquad , \qquad s = de,wo,kw,pl \ . \qquad (73)$$

3 Simulation analysis

To show the properties of JADE this section presents a number of simulations. In each simulation a once-off impulse is given to the rate of or absolute change of a certain exogenous variable. So, in levels the impulses are permanent. The impulses in the various simulations are ex ante impulses, that is, it is the effect of the impulse in an exogenous variable that is reported, not the effect of the impulse in the relevant endogenous variable.[58] The simulations are carried out under the assumption that social security and pension contribution rates as well as tax rates are fixed. This is done to isolate the effect of the various impulses as much as possible. It implies that foreign countries form the balancing entry.

The results of the simulations depend upon the underlying base path. This base path is a dynamic simulation over the period 2003-2018. Until 2003 it is equal to the projection published in the CPB Report 2002/3 (Macro Economische Verkenning 2003). From 2004 on this path is extended under the assumption of zero increase in labour supply, 2% growth in the volume of all goods and services and 2% inflation. The response of the model is tracked by calculating the differences between the values (levels) of the model variables in the simulation path and in the base path. In all simulations the impulse is given in 2003 and the simulation results are presented for the first, the second, the fourth, the eighth and the sixteenth year. Since the effects generally appear to stabilize in about ten years, this time horizon is sufficient in most cases.

In most of the simulations the budgets of the government and the social funds are not balanced. Deficits and surpluses are reflected in the EMU balance. For short-run results this setup is the more relevant one, as taxes and contribution rates generally are not adjusted on an annual basis to close the budget. In the long run however, budget deficits must lead to tax increases or cut-backs in public consumption. To show the properties of the model if the closure rules on the government and social security funds are imposed, we present the long-term balanced-budget multipliers for the case where the EMU balance is kept constant as a percentage of GDP by adjusting wage and income taxes and social security contribution rates.[59] These balanced budget (BB) simulations are presented for the sixteenth year in an additional column for each simulation.

To illustrate the main properties of JADE we present a world trade simulation, an interest rate simulation, a wage simulation and a labour supply simulation. These simulations are reported

[58] This distinction is relevant if the impulse is conceptually in an endogenous variable, e.g. in case of a wage rate increase (Section 3.3 below). In such cases, the impulse is in the "autonomous part" (i.e. the error term) of the equation of the relevant variable.

[59] We close the budget for each social security fund separately by means of the relevant contribution rate and the government budget by adjusting wage and income taxes. For wage and income taxes no balanced budget simulation is presented because wage and income taxes are used to construct the balanced budget simulations.

in section 3.1-3.4 respectively. Besides these four more or less exogenous shocks there is also a set of variables that the government can control. This set can be subdivided in three groups: those affecting public expenditures, public receipts and institutions. With respect to public expenditures four simulations are provided in sections 3.5-3.8. In section 3.5 the effect of a negative wage rate impulse in the public sector is analysed. Section 3.6 provides a simulation in which government employment is reduced. Besides wage-expenditures, the government can change material government consumption and investment.

It should be noted that JADE takes into account only the spending and finance aspect of material government expenditures. It abstracts from capacity-creating effects of government investment. Therefore there is little difference between the effect of government investment and government consumption. Section 3.7 provides a simulation with respect to material government consumption. Finally, the government can affect disposable income by altering income transfers to households (section 3.8).

With respect to public receipts there are a number of possibilities that affect the economy. Changes may occur in direct taxes like the income tax rates on labour and transfer income (section 3.9), taxes on profit income and corporate taxes (section 3.10) or indirect taxes (section 3.11). Given the structure of the social security system the volume and prices of the various benefits can be altered, as well as contribution rates for employers (section 3.12) and for employees (section 3.13).

Finally, the government can change the institutional settings like the progression factor, the inflation correction and the table correction factor in the tax system, and the link between benefits and contractual wages. We present two examples. Section 3.14 investigates the effects of an increase in the replacement rate, and Section 3.15 shows the results of an increase in market sector wage rates if the link between private sector wages and public sector wages and benefits is absent.

3.1 A 1% increase in world trade

In the short run, the increase in foreign demand boosts sales and production. The initial impulse is amplified through positive effects on domestic expenditures. The production increase raises employment and wages, which boosts disposable income. Because both employment and wages respond with a lag to production, the initial increase in consumption is modest. On impact, investment rises considerably more, as a result of the high short-run elasticity of production in capital demand (Section 2.1.2). The increase in private expenditure results in further increases in domestic production. The effect is strongly dampened, however, as a result of the open character of the Dutch economy. Hence, a large part of the increase in private expenditure is satisfied through additional imports.

The expansion creates tensions on the labour market and product markets in the form of lower unemployment rates and higher utilization rates. In the first year, the inflationary effects of the demand increase are limited, as the labour productivity increase is only partly passed on into higher wages. In later years, tighter labour markets and higher utilization rates boost input prices and production costs. Higher production costs in turn generate higher production prices, that result in additional wage claims. The end result is a substantial rise of the domestic price level and a loss of competitiveness on foreign markets. Eventually less than half of the increase in world trade is reflected in higher exports. The increase in capacity utilization is gradually met by an expansion of production capacity. This takes several years, because of the continuing expansion of the domestic economy. In addition, the increase in real wages and production costs leads to a sectoral shift from the production of export goods towards home goods.

The new equilibrium is characterised by a permanent expansion of the Dutch economy, with higher real wages and higher employment. The equilibrium level of unemployment is hardly changed, so that the expansion comes mainly from an increase in labour supply, as a result of higher real wages. Intuitively, the increase in the real wage is caused by the willingness of foreigners to pay more for Dutch products, an assumption that is implicit in the impulse in world trade. This terms-of-trade effect also shows from the relatively strong increase in national income and consumption, that rise substantially more than domestic production. The government benefits from the increase in foreign demand through an improvement in the EMU balance as a result of higher tax revenues and a decrease in unemployment benefits.

In the balanced budget simulation the permanent expansion of the economy is somewhat larger as the EMU surplus is returned to the private sector through lower wage and income taxes. This stimulates employment and improve GDP growth. Price responses are about the same as the long run effect of a change in wage and income taxes is rather small.

Tabel 3.1 Increase in world trade volume of 1%

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	0.13	0.40	0.63	0.77	0.74	0.75	0.79
Contractual wage rate, market sector	0.04	0.25	0.45	0.63	0.69	0.71	0.76
Private consumption	0.01	0.05	0.09	0.14	0.25	0.33	0.34
GDP deflator	0.06	0.16	0.25	0.35	0.47	0.55	0.57
Exports excluding energy	0.08	0.13	0.16	0.20	0.22	0.21	0.22
Production, market sector	0.08	0.10	0.20	0.33	0.54	0.62	0.66
Real labour costs, market sector	0.05	0.30	0.43	0.45	0.19	0.12	0.12
User costs of capital	0.01	0.04	0.08	0.13	0.24	0.32	0.31
Volumes							
Private consumption	0.08	0.18	0.31	0.40	0.37	0.31	0.61
Investments excluding dwellings	0.54	1.04	0.73	0.42	0.07	0.19	0.24
Investments in dwellings	0.01	0.08	0.21	0.37	0.60	0.44	0.92
Exports excluding energy	0.87	0.79	0.71	0.64	0.42	0.38	0.35
Imports of goods	0.71	0.72	0.71	0.69	0.58	0.54	0.61
Production, market sector	0.43	0.45	0.41	0.36	0.19	0.14	0.26
Real net national income	0.42	0.48	0.49	0.50	0.40	0.36	0.46
Gross domestic product	0.30	0.33	0.31	0.28	0.17	0.12	0.23
Labour productivity, market sector	0.22	0.16	0.16	0.17	0.08	0.04	0.04
Employment, market sector(fte)	0.21	0.30	0.25	0.19	0.11	0.09	0.22
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.16	0.23	0.19	0.15	0.08	0.07	0.17
	absolute change						
Total employment (1000 persons)	12	17	14	11	6	5	12
Total labour supply (1000 persons)	1	3	4	4	4	3	7
Unemployment rate (%)	– 0.14	– 0.18	– 0.13	– 0.08	– 0.03	– 0.02	– 0.07
Ratios							
Labour income share, market sector (%)	– 0.22	0.05	0.16	0.16	0.03	0.01	0.02
Capacity utilization rate, market sector (%)	0.25	0.18	0.15	0.14	0.04	0.00	– 0.01
Current account (% GDP)	0.17	0.15	0.14	0.13	0.08	0.07	– 0.02
Wedge (%)	0.01	0.05	0.09	0.11	0.08	0.07	– 0.23
Government balance (% GDP)	0.06	0.10	0.12	0.13	0.11	0.12	0.00
Social security balance (% GDP)	0.04	0.06	0.06	0.05	0.04	0.04	0.00
EMU balance (% GDP)	0.10	0.17	0.19	0.18	0.14	0.16	0.00

3.2 A 1% increase in foreign interest rates

In JADE it is assumed that capital markets are fully integrated in the world market. This implies that Dutch interest rates follow foreign rate one-to-one. Higher interest rates boost saving, and lower expenditures on investment goods and consumption. In later years, investment in particular suffers from this increase in the interest rates. The fall in investment lowers production capacity.

Capital costs increase as a result of the higher interest rate, and raise production costs and production prices from the start. The increase in production costs leads to a deterioration of cost competitiveness of Dutch firms.[60] The loss of competitiveness is exacerbated by a fall in investment relative to foreign competitors, which leads to a lower quality of export goods (see Section 2.6.1). As a result exports fall, which lowers effective demand even further.

Labour productivity falls, as the high required return on new investment projects leads to a lower capital intensity per worker. Initially, the rise in domestic prices drives up nominal wages. As the terms of trade improve, consumption price inflation is moderate, and real consumption wages increase. Unemployment goes up, however, which increasingly exerts a downward pressure on wages. Intuitively, the low substitution elasticity implies a fall in labour productivity, that must show up in wages, even though product prices rise to accommodate the rising capital costs. That is, equilibrium unemployment rises to induce unions to accept a higher income share of capital in production (see Section 2.3). The general slump that is caused by the interest rate hike is not beneficial for the EMU balance either. The interest burden increases continually, while tax receipts fall.

In the balanced budget simulation the negative impact of the increase in foreign interest rates on the economy is reinforced by the adverse effects of the interest rate hike on the government budget.[61] The fall in tax revenues and the boost of the government debt service combined lead to a relatively large increase in wage and income taxes. The resulting decrease in disposable income significantly lowers private consumption and investment. On the supply side of the economy, employment declines dramatically and the unemployment rate increases by nearly 2%-point. The negative impact on GDP more than triples. The effect on prices is on the other hand relatively small because of the low long run effect on prices of a change in wage and income taxes.

[60] The impact of an increase in foreign interest rates on *foreign* production costs and investment is neglected.

[61] The government balance differs slightly from zero in the balanced budget simulation because interest payments are not fully covered by the closure rule for the government budget.

Tabel 3.2 Increase in long run interest rate of 1%

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	0.09	0.23	0.37	0.31	– 0.50	– 0.49	0.04
Contractual wage rate, market sector	0.18	0.39	0.64	0.68	0.07	0.00	0.47
Private consumption	0.12	0.28	0.46	0.58	0.63	0.57	1.09
GDP deflator	0.21	0.49	0.80	0.97	0.85	0.78	1.52
Exports excluding energy	0.05	0.16	0.29	0.38	0.35	0.39	0.50
Production, market sector	0.24	0.64	1.04	1.25	1.19	1.02	1.80
Real labour costs, market sector	– 0.15	– 0.41	– 0.67	– 0.95	– 1.72	– 1.54	– 1.84
User costs of capital	2.83	4.50	5.61	5.65	5.63	5.55	6.53
Volumes							
Private consumption	– 0.39	– 0.27	– 0.18	– 0.19	– 0.56	– 0.48	– 6.04
Investments excluding dwellings	– 0.75	– 2.11	– 3.06	– 3.53	– 3.17	– 2.45	– 5.65
Investments in dwellings	– 1.02	– 3.48	– 4.94	– 5.10	– 6.04	– 6.34	– 13.86
Exports excluding energy	– 0.01	– 0.12	– 0.32	– 0.58	– 1.15	– 1.12	– 1.60
Imports of goods	– 0.17	– 0.29	– 0.40	– 0.51	– 0.82	– 0.69	– 2.54
Production, market sector	– 0.35	– 0.68	– 0.97	– 1.19	– 1.62	– 1.44	– 4.69
Real net national income	– 0.26	– 0.44	– 0.56	– 0.65	– 1.03	– 0.84	– 3.51
Gross domestic product	– 0.28	– 0.53	– 0.74	– 0.90	– 1.25	– 1.16	– 3.82
Labour productivity, market sector	– 0.23	– 0.27	– 0.29	– 0.29	– 0.53	– 0.53	– 0.65
Employment, market sector(fte)	– 0.12	– 0.40	– 0.69	– 0.91	– 1.10	– 0.92	– 4.09
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	– 0.09	– 0.31	– 0.53	– 0.70	– 0.84	– 0.71	– 3.14
	absolute change						
Total employment (1000 persons)	– 6	– 22	– 38	– 50	– 61	– 51	– 227
Total labour supply (1000 persons)	– 1	– 3	– 5	– 8	– 15	– 15	– 91
Unemployment rate (%)	0.07	0.26	0.43	0.55	0.60	0.48	1.83
Ratios							
Labour income share, market sector (%)	0.12	– 0.05	– 0.26	– 0.49	– 0.92	– 0.87	– 0.71
Capacity utilization rate, market sector (%)	– 0.12	– 0.13	– 0.12	– 0.10	– 0.14	0.07	– 0.29
Current account (% GDP)	0.17	0.26	0.31	0.29	0.12	0.09	1.45
Wedge (%)	0.02	0.04	0.06	0.03	– 0.15	– 0.15	7.44
Government balance (% GDP)	– 0.10	– 0.27	– 0.46	– 0.65	– 1.24	– 2.07	– 0.03
Social security balance (% GDP)	– 0.03	– 0.09	– 0.15	– 0.21	– 0.33	– 0.44	0.00
EMU balance (% GDP)	– 0.13	– 0.36	– 0.62	– 0.86	– 1.56	– 2.51	– 0.04

3.3 A permanent increase in wage rates of 1%

The wage rate impulse is executed as a 1% upward permanent shift in the level of the equation for contractual wages (see eq. (32)). Intuitively, the impulse represents an increase in the relative bargaining strength of labour unions. Table 3.3 shows that the actual wage outcome is considerably higher than can be explained by the ex ante increase in wage demands. Several mechanisms contribute to this outcome.

First, the increase in wages drives up production costs and output prices. This sets off a wage-price feedback loop. Second, the increase in real wages induces firms to substitute capital for labour. The increase in capital intensity boosts labour productivity, which reduces production costs but leads to additional wages increases. Third, the wage increase lowers labour demand and raises unemployment. Higher unemployment weakens the fall-back position of workers and puts pressure on wages. This negative feedback effect acts as a stabilizing force on wage inflation.

The adverse effects of lower employment on final demand are initially compensated by the extra disposable income for wage earners. Disposable income of other households also increases, as a result of the link between social security benefits and net wages. The increase in disposable income boosts consumption and provides an initial stimulus to effective demand and production.

The demand stimulus is short-lived, however. Employment continues to fall which erodes the increase in the disposable income of households and curbs consumption growth. The increase in labour costs weakens the cost competitiveness of Dutch exporters. After two years, the decline in exports dominates the effect of consumption on final demand. Investment starts falling even sooner, as a result of the decrease in profitability. The fall in investment harms the competitive position of Dutch exporters even more.

Households succeed in increasing their consumption even though employment falls. However, this consumption is not sustainable, as it is effectively financed from abroad, as shown by the negative EMU balance. This budgetary imbalance originates with the government, who does not adjust tax rates in the face of an increase in wage-related government expenditures, including transfers. Income transfers increase substantially as a result of the increase in unemployment. This enables unemployed households to maintain their consumption level.

In the balanced budget simulation the negative impact of the wage boom on the EMU balance causes an increase in wage and income taxes. This tax increase erodes the favourable effects of the wage increase on disposable income and real consumption expenditures. In addition, the increase in the wedge boosts the equilibrium unemployment rate. Consequently, real GDP falls more than twice as much as without closure. The price responses are in the same order as without the compensation of the EMU deficit.

Tabel 3.3 A permanent wage increase of 1%

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	1.50	1.99	2.03	1.87	1.38	1.52	1.53
Contractual wage rate, market sector	1.41	1.96	2.09	2.03	1.66	1.77	1.65
Private consumption	0.25	0.42	0.51	0.56	0.60	0.69	0.75
GDP deflator	0.61	0.97	1.12	1.15	1.05	1.16	1.23
Exports excluding energy	0.20	0.37	0.46	0.48	0.38	0.41	0.41
Production, market sector	0.52	0.84	1.01	1.11	1.18	1.24	1.32
Real labour costs, market sector	0.97	1.13	0.99	0.73	0.16	0.24	0.16
User costs of capital	0.21	0.40	0.50	0.55	0.59	0.66	0.78
Volumes							
Private consumption	0.43	0.81	0.91	0.88	0.45	0.50	– 0.49
Investments excluding dwellings	0.23	– 0.06	– 0.52	– 0.87	– 0.67	– 0.39	– 0.88
Investments in dwellings	0.06	0.24	0.51	0.75	0.40	0.28	– 1.17
Exports excluding energy	– 0.18	– 0.41	– 0.64	– 0.82	– 1.04	– 1.02	– 1.06
Imports of goods	0.14	0.17	0.09	0.00	– 0.21	– 0.17	– 0.49
Production, market sector	0.06	– 0.01	– 0.18	– 0.33	– 0.60	– 0.57	– 1.11
Real net national income	0.29	0.41	0.35	0.23	– 0.11	– 0.09	– 0.56
Gross domestic product	0.08	0.07	– 0.04	– 0.14	– 0.36	– 0.34	– 0.79
Labour productivity, market sector	0.29	0.38	0.35	0.29	0.08	0.09	0.06
Employment, market sector(fte)	– 0.23	– 0.39	– 0.53	– 0.63	– 0.69	– 0.66	– 1.18
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	– 0.18	– 0.30	– 0.41	– 0.48	– 0.53	– 0.51	– 0.91
	absolute change						
Total employment (1000 persons)	– 13	– 22	– 30	– 35	– 38	– 37	– 66
Total labour supply (1000 persons)	0	1	3	3	– 1	– 1	– 14
Unemployment rate (%)	0.16	0.29	0.41	0.49	0.48	0.46	0.67
Ratios							
Labour income share, market sector (%)	0.54	0.59	0.50	0.34	0.07	0.12	0.13
Capacity utilization rate, market sector (%)	0.17	0.21	0.17	0.11	– 0.03	– 0.01	– 0.05
Current account (% GDP)	– 0.04	– 0.10	– 0.15	– 0.20	– 0.29	– 0.33	– 0.10
Wedge (%)	0.22	0.30	0.29	0.24	0.13	0.13	1.30
Government balance (% GDP)	0.02	0.05	0.02	– 0.02	– 0.10	– 0.14	0.00
Social security balance (% GDP)	– 0.02	– 0.06	– 0.10	– 0.13	– 0.19	– 0.26	0.00
EMU balance (% GDP)	0.00	– 0.01	– 0.08	– 0.15	– 0.29	– 0.40	0.00

3.4 An increase in labour supply of 20,000 persons

The impulse is executed as an increase of 20,000 persons in structural labour supply. In full-time equivalent units, this corresponds to an increase in labour supply of about 0.25%. The extra job seekers initially enter the unemployment pool. This shock has a number of effects. First, the actual increase in labour supply is smaller than the impulse since part of the ex ante supply withdraws from the labour market (the "discouraged worker" effect). A second mechanism is through social security. The new job seekers are entitled to unemployment benefits,[62] which increases disposable income of households and boosts private consumption at the expense of the government budget. The main adjustment mechanism is through wages. Since wages respond with a one-year lag to unemployment, the model generates a slow initial absorption of labour supply. In the first year the net increase in employment is only 10% of the size of new entrants. In later years the downward pressure on wages results in an increase in labour demand.

The mechanisms that restore labour market equilibrium are the same as those discussed above. Lower wages bring about lower prices, higher profit margins and a more competitive position on foreign markets. Exports rise and imports fall. The increased demand for domestically produced goods and services boosts investment, which raises exports further.

Consumption is slightly lower on the transition path, as the fall in wages dominates the increase in employment. Intuitively, households suffer from the deterioration in the terms of trade. The extra production that results from the expansion of labour supply cannot be sold on foreign markets without accepting a lower export price. As import prices do not fall, households do not profit proportionally from the reduction in production costs. The terms-of-trade loss therefore reduces the purchasing power of households.

For the EMU balance an increase in labour supply hardly matters. Although the fall in wages lowers taxes receipts, it lowers public expenditure to the same degree. Initially the government budget is negatively affected by the increase in unemployment related social security. In time, however, the increase in the labour tax base as well as the increase in corporate taxes improve the government budget.

As the effect of the labour supply increase on the EMU balance is limited, the balanced budget simulation gives broadly the same results as the non-compensated simulations. Only private consumption and investments are somewhat higher due to higher disposable income.

[62] This entitlement is counterfactual if the increase in labour supply originates from households without sufficient recent contributions to the social security system (typically, the equivalent of three years of full payment in the last five years).

Tabel 3.4 Increase in labour supply of 20,000 persons

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	0.01	– 0.24	– 0.60	– 0.70	– 0.49	– 0.51	– 0.52
Contractual wage rate, market sector	0.00	– 0.10	– 0.47	– 0.60	– 0.48	– 0.49	– 0.49
Private consumption	0.00	– 0.04	– 0.12	– 0.17	– 0.21	– 0.23	– 0.26
GDP deflator	0.00	– 0.08	– 0.26	– 0.35	– 0.36	– 0.38	– 0.41
Exports excluding energy	0.00	– 0.03	– 0.09	– 0.15	– 0.14	– 0.14	– 0.14
Production, market sector	0.00	– 0.09	– 0.25	– 0.34	– 0.42	– 0.43	– 0.46
Real labour costs, market sector	0.00	– 0.16	– 0.37	– 0.38	– 0.08	– 0.09	– 0.06
User costs of capital	0.00	– 0.04	– 0.11	– 0.17	– 0.21	– 0.23	– 0.27
Volumes							
Private consumption	0.05	0.02	– 0.11	– 0.20	– 0.07	– 0.04	0.18
Investments excluding dwellings	0.03	0.03	0.05	0.18	0.38	0.19	0.32
Investments in dwellings	0.00	0.00	– 0.04	– 0.10	– 0.17	– 0.02	0.30
Exports excluding energy	– 0.01	0.02	0.09	0.18	0.36	0.35	0.38
Imports of goods	0.02	0.00	– 0.02	– 0.02	0.10	0.10	0.17
Production, market sector	0.02	0.03	0.03	0.08	0.26	0.25	0.39
Real net national income	0.03	– 0.01	– 0.08	– 0.09	0.07	0.08	0.19
Gross domestic product	0.02	0.02	0.01	0.03	0.16	0.17	0.28
Labour productivity, market sector	0.01	– 0.04	– 0.11	– 0.13	– 0.04	– 0.03	– 0.02
Employment, market sector(fte)	0.01	0.07	0.15	0.21	0.30	0.29	0.41
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.01	0.05	0.11	0.16	0.23	0.22	0.32
	absolute change						
Total employment (1000 persons)	1	4	8	12	17	16	23
Total labour supply (1000 persons)	18	17	17	17	18	18	21
Unemployment rate (%)	0.21	0.16	0.10	0.05	0.00	0.02	– 0.04
Ratios							
Labour income share, market sector (%)	– 0.01	– 0.11	– 0.21	– 0.21	– 0.04	– 0.05	– 0.05
Capacity utilization rate, market sector (%)	0.01	– 0.01	– 0.06	– 0.06	0.01	0.00	0.02
Current account (% GDP)	– 0.01	– 0.02	0.00	0.02	0.07	0.08	0.03
Wedge (%)	0.00	– 0.04	– 0.10	– 0.11	– 0.06	– 0.05	– 0.32
Government balance (% GDP)	– 0.01	– 0.02	– 0.02	– 0.02	0.02	0.03	0.00
Social security balance (% GDP)	– 0.02	– 0.03	– 0.01	0.00	0.03	0.04	0.00
EMU balance (% GDP)	– 0.03	– 0.05	– 0.04	– 0.03	0.05	0.07	0.00

3.5 A permanent wage rate decrease in the public sector of 1%

It is assumed that wages in the public sector can be decreased without adverse consequences to either public sector employment or the quality of public goods. A permanent decrease in public sector wage rates also implies a reduction of the expenditures on income transfers. In addition, because the wage rates in the medical sector are linked to the wages in the public sector, the wage rates in the medical sector are lower too. This results in a decline in health care costs. As health care is a part of social security, social security expenditures decrease as well. The falling costs of health care and public services leads to a decrease in average consumption prices and a (small) reduction in the contractual wages in the market sector. The wage-price feedback loop results in some further decrease in prices and wages.

The decrease in prices boosts the competitiveness of Dutch firms, as shows from the increase in exports and the decrease in imports. Nevertheless, production falls as a result of the fall in domestic demand. The decrease in public sector wages lowers disposable income and results in a decrease in private consumption that dominates the increase in net exports. In comparison with the general wage impulse in Section 3.3, domestic demand falls relatively more compared to wage costs. Employment is stable as the fall in real labour costs compensates for the decrease in production.

On balance the public sector profits from the reduction in public sector wages, in terms of an improvement in the fiscal stance, while the private sector loses, as consumption falls and employment remains stable. The main reason why the private sector does not expand in response to lower public consumption is that the reduction in government wages does not lead to a fall of tax rates. In addition, the terms-of-trade loss also lowers consumption.

In the balanced budget simulation the positive effect of the reduction in public sector wages on the EMU balance enables a decrease in wage and income taxes. This in turn results in higher disposable income and thus an increase in real expenditures. Compared to the non-compensated simulation the GDP-effect becomes positive. This positive GDP-effect is mainly due to lower wages and the decrease in wage and income taxes.

Tabel 3.5 A permanent wage decrease in the public sector of 1%

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 0.16	– 0.20	– 0.24	– 0.26	– 0.28	– 0.28	– 0.29
Contractual wage rate, market sector	– 0.03	– 0.06	– 0.10	– 0.12	– 0.15	– 0.16	– 0.14
Private consumption	– 0.04	– 0.05	– 0.06	– 0.06	– 0.09	– 0.11	– 0.13
GDP deflator	– 0.18	– 0.20	– 0.22	– 0.24	– 0.27	– 0.29	– 0.31
Exports excluding energy	– 0.01	– 0.03	– 0.03	– 0.04	– 0.05	– 0.05	– 0.05
Production, market sector	– 0.01	– 0.02	– 0.04	– 0.06	– 0.11	– 0.14	– 0.16
Real labour costs, market sector	– 0.03	– 0.06	– 0.08	– 0.09	– 0.05	– 0.02	– 0.01
User costs of capital	– 0.01	– 0.02	– 0.02	– 0.03	– 0.05	– 0.07	– 0.11
Volumes							
Private consumption	– 0.13	– 0.21	– 0.24	– 0.26	– 0.27	– 0.27	0.05
Investments excluding dwellings	– 0.06	– 0.13	– 0.13	– 0.08	– 0.01	– 0.03	0.14
Investments in dwellings	– 0.01	– 0.06	– 0.13	– 0.20	– 0.29	– 0.26	0.20
Exports excluding energy	0.02	0.03	0.05	0.06	0.11	0.12	0.13
Imports of goods	– 0.05	– 0.07	– 0.07	– 0.07	– 0.06	– 0.04	0.05
Production, market sector	– 0.04	– 0.07	– 0.07	– 0.06	– 0.03	– 0.01	0.16
Real net national income	– 0.06	– 0.10	– 0.11	– 0.11	– 0.09	– 0.06	0.08
Gross domestic product	– 0.04	– 0.07	– 0.07	– 0.07	– 0.05	– 0.04	0.11
Labour productivity, market sector	– 0.03	– 0.04	– 0.04	– 0.04	– 0.02	– 0.01	0.00
Employment, market sector(fte)	– 0.01	– 0.03	– 0.03	– 0.03	– 0.01	– 0.01	0.16
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	– 0.01	– 0.02	– 0.03	– 0.02	– 0.01	0.00	0.13
	absolute change						
Total employment (1000 persons)	– 1	– 2	– 2	– 2	– 1	0	9
Total labour supply (1000 persons)	0	– 1	– 1	– 1	– 1	– 1	3
Unemployment rate (%)	0.01	0.02	0.01	0.01	0.00	– 0.01	– 0.08
Ratios							
Labour income share, market sector (%)	0.00	– 0.01	– 0.03	– 0.03	– 0.01	– 0.01	– 0.01
Capacity utilization rate, market sector (%)	– 0.03	– 0.04	– 0.04	– 0.03	– 0.01	0.00	0.01
Current account (% GDP)	0.04	0.06	0.07	0.07	0.09	0.11	0.03
Wedge (%)	– 0.04	– 0.05	– 0.05	– 0.05	– 0.05	– 0.05	– 0.43
Government balance (% GDP)	0.06	0.05	0.04	0.04	0.06	0.09	0.00
Social security balance (% GDP)	0.03	0.03	0.03	0.03	0.04	0.06	0.00
EMU balance (% GDP)	0.09	0.07	0.07	0.07	0.10	0.15	0.00

3.6 A decrease in government employment of 10,000 fte

The reduction in government employment initially results in a net decrease in labour supply. In comparison to the simulation results of Section 3.4, the main difference is that the size of the public sector also decreases. This considerably improves the government budget, as the decrease in the government wage bill outweighs the increase in unemployment benefits. In the absence of any tax cuts, the effects of this policy measure on the private sector are very similar to a general increase in labour supply. The increase in labour supply exerts a downward pressure on wages. This boosts employment in the market sector, so that aggregate employment hardly falls. GDP falls as a result of the lower volume of public production. By assumption, this production does not have any spill-overs to the private sector.

In the long run, a small decrease in total employment results. The reason is the same as in the case of a general labour supply impulse, a deterioration of the terms of trade. This causes a long-term fall in real consumption wages of about 0.2%.

In the balanced budget simulation the EMU surplus is returned to the private sector by a decrease in wage and income taxes. This in turn results in higher disposable income and as a consequence real expenditures rise. The fall in the wedge leads to a small drop in equilibrium unemployment, so that total employment *rises* in the long run. The price responses are about the same as without the compensation of the EMU deficit.

Tabel 3.6 A decrease in government employment of 10,000 fte

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	0.00	– 0.16	– 0.40	– 0.48	– 0.37	– 0.38	– 0.39
Contractual wage rate, market sector	0.00	– 0.07	– 0.31	– 0.41	– 0.36	– 0.37	– 0.39
Private consumption	0.00	– 0.03	– 0.08	– 0.11	– 0.15	– 0.17	– 0.20
GDP deflator	0.00	– 0.06	– 0.17	– 0.24	– 0.26	– 0.28	– 0.32
Exports excluding energy	0.00	– 0.02	– 0.07	– 0.10	– 0.11	– 0.11	– 0.11
Production, market sector	0.00	– 0.06	– 0.16	– 0.23	– 0.30	– 0.32	– 0.35
Real labour costs, market sector	0.00	– 0.11	– 0.25	– 0.27	– 0.07	– 0.06	– 0.04
User costs of capital	0.00	– 0.03	– 0.07	– 0.11	– 0.15	– 0.17	– 0.22
Volumes							
Private consumption	– 0.02	– 0.09	– 0.18	– 0.25	– 0.19	– 0.17	0.20
Investments excluding dwellings	0.01	– 0.03	– 0.04	0.05	0.22	0.09	0.29
Investments in dwellings	– 0.01	– 0.05	– 0.13	– 0.23	– 0.34	– 0.24	0.30
Exports excluding energy	0.00	0.02	0.07	0.13	0.26	0.27	0.29
Imports of goods	0.00	– 0.03	– 0.05	– 0.04	0.03	0.03	0.15
Production, market sector	0.01	– 0.01	– 0.01	0.01	0.13	0.14	0.35
Real net national income	– 0.13	– 0.17	– 0.22	– 0.24	– 0.14	– 0.12	0.05
Gross domestic product	– 0.11	– 0.13	– 0.14	– 0.13	– 0.04	– 0.04	0.14
Labour productivity, market sector	0.00	– 0.04	– 0.08	– 0.09	– 0.03	– 0.03	– 0.02
Employment, market sector(fte)	0.00	0.03	0.07	0.11	0.17	0.16	0.36
Employment, public sector (fte)	– 0.66	– 0.66	– 0.66	– 0.66	– 0.66	– 0.66	– 0.66
Total employment (fte)	– 0.15	– 0.13	– 0.10	– 0.07	– 0.02	– 0.03	0.13
	absolute change						
Total employment (1000 persons)	– 11	– 10	– 7	– 5	– 2	– 2	9
Total labour supply (1000 persons)	– 1	– 2	– 2	– 2	– 2	– 1	3
Unemployment rate (%)	0.13	0.11	0.07	0.04	0.00	0.01	– 0.07
Ratios							
Labour income share, market sector (%)	0.00	– 0.06	– 0.13	– 0.14	– 0.03	– 0.03	– 0.04
Capacity utilization rate, market sector (%)	0.00	– 0.02	– 0.05	– 0.05	0.00	0.00	0.02
Current account (% GDP)	0.01	0.02	0.03	0.04	0.08	0.10	0.01
Wedge (%)	– 0.01	– 0.03	– 0.07	– 0.08	– 0.05	– 0.05	– 0.49
Government balance (% GDP)	0.08	0.07	0.07	0.07	0.12	0.17	0.00
Social security balance (% GDP)	– 0.03	– 0.04	– 0.04	– 0.03	– 0.01	– 0.02	0.00
EMU balance (% GDP)	0.05	0.03	0.04	0.04	0.10	0.15	0.00

3.7 A reduction in material government consumption by 1% of GDP

A decrease in government consumption reduces the demand for goods and thereby lowers the production of domestic firms. Employment falls, which exerts a downward pressure on wages. This causes a decrease in private consumption and investments in residential dwellings. Exports increase due to a reduction in production costs. The increase in the EMU balance is initially smaller than 1 percent of GDP. The main factors behind this result are the lower indirect taxes due to the reduction in material government consumption and higher expenditures on unemployment benefits.

In the long run, the private sector does not fully succeed in finding new markets to compensate for the loss of sales to the government. First, the reduction in government spending does not lead to an increase in disposable private income, as the government used the extra revenues to reduce its debt. Second, the expansion of foreign markets result in a deterioration in the terms-of-trade, that lowers consumption and raises equilibrium unemployment.

In the balanced budget simulation the positive effect of the reduction in material government consumption on the EMU balance of about 1.5 % GDP ex post is compensated by a relatively large decrease in wage and income taxes. The resulting increase in disposable income significantly raises the volume of all expenditures in the long run and consequently raises GDP. Furthermore, the decrease in wage and income taxes lowers the wedge, and provides a substantial boost to employment. The lower wedge is also passed on to wages and prices.

Tabel 3.7 A reduction in material government consumption by 1% GDP

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 0.35	– 1.07	– 1.72	– 2.14	– 2.12	– 2.12	– 2.18
Contractual wage rate, market sector	– 0.11	– 0.67	– 1.24	– 1.73	– 1.95	– 2.01	– 2.26
Private consumption	– 0.03	– 0.13	– 0.26	– 0.40	– 0.70	– 0.93	– 1.12
GDP deflator	– 0.19	– 0.45	– 0.73	– 1.00	– 1.36	– 1.58	– 1.82
Exports excluding energy	– 0.21	– 0.33	– 0.44	– 0.54	– 0.61	– 0.59	– 0.61
Production, market sector	– 0.21	– 0.29	– 0.55	– 0.91	– 1.54	– 1.77	– 1.99
Real labour costs, market sector	– 0.13	– 0.80	– 1.19	– 1.26	– 0.57	– 0.33	– 0.14
User costs of capital	– 0.01	– 0.11	– 0.23	– 0.37	– 0.68	– 0.91	– 1.32
Volumes							
Private consumption	– 0.23	– 0.52	– 0.85	– 1.11	– 1.09	– 0.89	2.52
Investments excluding dwellings	– 1.47	– 2.88	– 2.11	– 1.27	– 0.21	– 0.55	1.19
Investments in dwellings	– 0.04	– 0.22	– 0.56	– 1.02	– 1.71	– 1.25	3.86
Exports excluding energy	0.31	0.44	0.62	0.81	1.40	1.54	1.66
Imports of goods	– 0.51	– 0.62	– 0.61	– 0.58	– 0.29	– 0.16	0.88
Production, market sector	– 1.16	– 1.27	– 1.17	– 1.05	– 0.56	– 0.39	1.49
Real net national income	– 1.26	– 1.46	– 1.49	– 1.50	– 1.16	– 0.90	0.66
Gross domestic product	– 0.96	– 1.05	– 1.01	– 0.96	– 0.63	– 0.49	1.08
Labour productivity, market sector	– 0.59	– 0.44	– 0.45	– 0.48	– 0.23	– 0.12	– 0.06
Employment, market sector(fte)	– 0.57	– 0.83	– 0.72	– 0.57	– 0.33	– 0.26	1.57
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	– 0.44	– 0.64	– 0.55	– 0.44	– 0.25	– 0.20	1.20
	absolute change						
Total employment (1000 persons)	– 32	– 46	– 40	– 32	– 18	– 14	87
Total labour supply (1000 persons)	– 3	– 8	– 11	– 13	– 12	– 9	35
Unemployment rate (%)	0.37	0.50	0.38	0.25	0.08	0.07	– 0.68
Ratios							
Labour income share, market sector (%)	0.60	– 0.10	– 0.43	– 0.46	– 0.11	– 0.04	– 0.10
Capacity utilization rate, market sector (%)	– 0.69	– 0.51	– 0.44	– 0.40	– 0.12	– 0.01	0.09
Current account (% GDP)	0.41	0.48	0.52	0.57	0.75	0.90	0.02
Wedge (%)	– 0.03	– 0.14	– 0.25	– 0.31	– 0.25	– 0.19	– 4.21
Government balance (% GDP)	0.87	0.80	0.79	0.83	1.12	1.61	0.00
Social security balance (% GDP)	– 0.12	– 0.18	– 0.18	– 0.16	– 0.11	– 0.13	0.00
EMU balance (% GDP)	0.75	0.62	0.61	0.68	1.01	1.49	0.00

3.8 A reduction of income transfers to households by 1% of GDP

A reduction in income transfers from the government to households initially causes an almost equal decrease in private consumption. The decrease in consumption demand causes a fall in production, which results in a decrease in employment and a downward pressure on wage rates.

The positive effect of the budgetary cut on the EMU-balance is somewhat smaller than that of a decrease in government consumption of the same size (section 3.7). The effect on private production is somewhat smaller, as the import content of private consumption is larger than that of public material consumption.

In the balanced budget simulation the positive effect of the reduction in income transfers to households on the EMU balance is neutralised by a relatively large decrease in wage and income taxes. The increase in disposable income that results significantly raises the volume of all expenditures in the long run. Furthermore, the decrease in wage and income taxes lowers the wedge. This decrease in the wedge lowers wages and prices.

Given the smaller impact on the EMU balance compared to the material government consumption simulation (section 3.7), the reduction in wage and income taxes that is needed to close the budget is lower and thus the decrease in the wedge is lower. As a result the impact on GDP and employment is somewhat smaller in the current balanced budget simulation.

Tabel 3.8 A reduction of income transfers to households by 1% GDP

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 0.16	– 0.53	– 0.91	– 1.19	– 1.32	– 1.35	– 1.41
Contractual wage rate, market sector	– 0.05	– 0.33	– 0.65	– 0.95	– 1.21	– 1.28	– 1.54
Private consumption	– 0.02	– 0.07	– 0.14	– 0.22	– 0.42	– 0.59	– 0.74
GDP deflator	– 0.08	– 0.22	– 0.38	– 0.54	– 0.82	– 0.99	– 1.19
Exports excluding energy	– 0.09	– 0.17	– 0.24	– 0.30	– 0.38	– 0.38	– 0.40
Production, market sector	– 0.10	– 0.15	– 0.29	– 0.49	– 0.92	– 1.12	– 1.29
Real labour costs, market sector	– 0.06	– 0.38	– 0.64	– 0.72	– 0.40	– 0.22	– 0.08
User costs of capital	– 0.01	– 0.05	– 0.12	– 0.20	– 0.41	– 0.57	– 0.92
Volumes							
Private consumption	– 1.24	– 1.69	– 1.95	– 2.16	– 2.32	– 2.26	0.62
Investments excluding dwellings	– 0.67	– 1.46	– 1.29	– 0.88	– 0.18	– 0.34	1.09
Investments in dwellings	– 0.02	– 0.10	– 0.28	– 0.53	– 1.03	– 0.80	3.54
Exports excluding energy	0.14	0.23	0.34	0.45	0.83	0.98	1.07
Imports of goods	– 0.36	– 0.50	– 0.52	– 0.53	– 0.39	– 0.30	0.58
Production, market sector	– 0.53	– 0.70	– 0.69	– 0.64	– 0.38	– 0.25	1.32
Real net national income	– 0.59	– 0.81	– 0.87	– 0.90	– 0.74	– 0.55	0.74
Gross domestic product	– 0.45	– 0.59	– 0.61	– 0.59	– 0.43	– 0.33	0.98
Labour productivity, market sector	– 0.27	– 0.26	– 0.27	– 0.29	– 0.17	– 0.09	– 0.04
Employment, market sector(fte)	– 0.26	– 0.43	– 0.42	– 0.35	– 0.21	– 0.16	1.37
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	– 0.20	– 0.33	– 0.32	– 0.27	– 0.16	– 0.12	1.05
	absolute change						
Total employment (1000 persons)	– 14	– 24	– 23	– 20	– 12	– 9	76
Total labour supply (1000 persons)	– 2	– 4	– 6	– 7	– 8	– 6	32
Unemployment rate (%)	0.17	0.26	0.23	0.17	0.06	0.04	– 0.59
Ratios							
Labour income share, market sector (%)	0.27	0.01	– 0.20	– 0.25	– 0.08	– 0.03	– 0.08
Capacity utilization rate, market sector (%)	– 0.31	– 0.30	– 0.27	– 0.25	– 0.09	– 0.01	0.06
Current account (% GDP)	0.28	0.39	0.44	0.48	0.64	0.78	0.03
Wedge (%)	– 0.03	– 0.09	– 0.15	– 0.19	– 0.18	– 0.15	– 3.55
Government balance (% GDP)	0.85	0.81	0.81	0.84	1.06	1.50	0.00
Social security balance (% GDP)	– 0.11	– 0.16	– 0.17	– 0.16	– 0.15	– 0.20	0.02
EMU balance (% GDP)	0.74	0.65	0.64	0.68	0.91	1.30	0.02

3.9 A reduction in wage and income taxes by 1% of GDP

A reduction in wage taxes and income taxes affects spending, labour supply, wage formation and the EMU balance. First, a reduction in income taxes increases disposable income, which stimulates higher private consumption. An important part of the additional consumption demand is directed to imports of goods and services. Thus, domestic production and employment benefit only partly from the increase in demand. Still, the positive feedback effects of the production increase provide a further boost to investment and consumption. Second, the higher net wage that results from the reduction in income taxes increases labour supply. Higher labour supply facilitates the increase in employment by moderating wage growth.

Wage growth is also moderated directly through the outcome of wage bargaining. Lower taxes make non-participation relatively less attractive and indirectly improve the bargaining position of employers. Lower wages result in higher profitability of firms which further boosts investment. Higher investment and lower production costs result in more exports. The increase in exports, however, is not large enough to cover the extra imports. Therefore the balance of payments shows a deterioration.

In the long run, the size of the expansion is determined by the increase in effective labour supply. The decrease in taxes lowers equilibrium unemployment. Terms-of-trade losses are minor, as the initial reduction in production costs is gradually eliminated as a result of the fall in unemployment. Thus before-tax wages return to their original level, while after-tax wages increase.

The costs of the expansion are borne by the government. The increase in the tax base and the decrease in income transfers combined do not offset the loss in tax receipts due to the decrease in tax rates. The interest burden gradually accelerates the negative effect of the tax cut on the EMU balance.

Tabel 3.9 A reduction in wage and income tax by 1% GDP

Year	1	2	3	4	8	16
	percentage change					
Prices						
Wage rate enterprises	– 0.66	– 1.08	– 1.00	– 0.77	– 0.08	– 0.08
Contractual wage rate, market sector	– 0.68	– 1.19	– 1.23	– 1.07	– 0.45	– 0.37
Private consumption	– 0.12	– 0.25	– 0.32	– 0.33	– 0.23	– 0.09
GDP deflator	– 0.27	– 0.52	– 0.62	– 0.60	– 0.30	– 0.15
Exports excluding energy	– 0.05	– 0.11	– 0.15	– 0.15	– 0.02	– 0.02
Production, market sector	– 0.22	– 0.48	– 0.62	– 0.63	– 0.34	– 0.10
Real labour costs, market sector	– 0.44	– 0.60	– 0.38	– 0.12	0.29	0.05
User costs of capital	– 0.26	– 0.39	– 0.47	– 0.49	– 0.38	– 0.24
Volumes						
Private consumption	0.53	1.06	1.27	1.44	2.04	2.03
Investments excluding dwellings	0.32	1.27	1.96	2.08	1.40	1.01
Investments in dwellings	0.09	0.43	0.96	1.59	2.95	3.07
Exports excluding energy	0.01	0.06	0.16	0.25	0.27	0.05
Imports of goods	0.15	0.36	0.49	0.59	0.74	0.60
Production, market sector	0.30	0.70	0.95	1.11	1.29	1.09
Real net national income	0.22	0.51	0.69	0.83	1.10	0.87
Gross domestic product	0.24	0.55	0.73	0.86	1.05	0.91
Labour productivity, market sector	0.03	0.02	0.00	0.02	0.10	0.02
Employment, market sector(fte)	0.28	0.69	0.96	1.10	1.19	1.08
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.21	0.53	0.74	0.84	0.91	0.83
	absolute change					
Total employment (1000 persons)	15	38	53	61	66	60
Total labour supply (1000 persons)	3	11	18	22	28	27
Unemployment rate (%)	– 0.16	– 0.36	– 0.46	– 0.52	– 0.51	– 0.45
Ratios						
Labour income share, market sector (%)	– 0.43	– 0.61	– 0.42	– 0.23	0.02	– 0.06
Capacity utilization rate, market sector (%)	0.10	0.18	0.18	0.18	0.17	0.02
Current account (% GDP)	– 0.15	– 0.31	– 0.37	– 0.39	– 0.43	– 0.54
Wedge (%)	– 2.57	– 2.63	– 2.61	– 2.56	– 2.46	– 2.48
Government balance (% GDP)	– 0.78	– 0.88	– 0.84	– 0.82	– 0.91	– 1.32
Social security balance (% GDP)	0.04	0.11	0.17	0.20	0.27	0.36
EMU balance (% GDP)	– 0.74	– 0.77	– 0.67	– 0.61	– 0.64	– 0.96

3.10 A reduction in corporate taxes by 1% of GDP

A reduction in the corporate tax rate lowers capital costs of domestic firms. This has a number of effects. First, lower capital costs diminish production costs and production prices, which boosts production. Second, lower capital costs stimulate investment and raise the capital intensity of production. Third, the reduction in corporate tax rates affects the location decision of firms and makes its more profitable to supply both domestic and foreign markets.[63]

Lower production prices cause a decrease in nominal wages via the wage-price link. The net outcome of this process is a substantial cost advantage for domestic firms on foreign markets and an increase in exports. The increase in production also boosts employment and increases real production wages. Initially, the net stimulus to domestic consumption is small, since the favourable effects of the expansion are nullified by the deterioration in the terms of trade. After a few years the increase in labour demand raises wages sufficiently to compensate for the loss in terms of trade, however.

As explained in Section 2.3, the equilibrium rate of unemployment drops as a result of the fall in capital costs. This effect is reinforced by the increased attractiveness of the Netherlands as a production location. This encourages new firms to enter, which lowers the mark-up of incumbent and new firms alike, and decreases the equilibrium rate of unemployment even further. The net effect is a considerable boost of employment in the long run, together with a substantial increase in real wages.

Compared to other simulations, the long-run effects take a long time to materialize. The simulation results show that there is still a substantial difference between the effects of the shock after eight years and after sixteen years. The main cause of this sluggish adjustment is the low adjustment speed of the capital stock in the market sector. As equation (15) indicates, the mean adjustment period of capital is more than thirty years. The reduction in corporate taxes results in a decrease of the EMU balance of substantially less than 1 percent of GDP. The initial decrease of government revenue is mitigated, mainly through the reduction in unemployment benefits.

In the balanced budget simulation the fall in corporate taxes is compensated by an increase in wage and income taxes. This reduces the beneficial effects on unemployment of lower capital costs. Still, equilibrium unemployment falls, because lower capital costs stimulate the entry of new firms and boost competition. This lowers the markup of price over cost and thereby reduces the wedge between the afer-tax wage and marginal labour productivity. In addition, the investment stimulus of lower capital costs continues to provide a competitive edge to exporting firms. The net result of these effects is a substantial long-run efficiency gain.

[63] The modelling of this effect in JADE has been described in D. Draper and F. Huizinga (2001), "The effect of corporate taxes on investment and the capital stock," CPB Memorandum 1/2001/07. For the present analysis, the relevant markup effect is assumed to apply only to nontradeables.

Tabel 3.10 A reduction in corporate taxes by 1 % GDP

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 0.27	– 0.51	– 0.71	– 0.82	– 0.77	– 0.02	– 0.58
Contractual wage rate, market sector	– 0.33	– 0.60	– 0.86	– 1.03	– 1.18	– 0.50	– 0.73
Private consumption	– 0.33	– 0.60	– 0.85	– 1.06	– 1.55	– 1.51	– 1.71
GDP deflator	– 0.39	– 0.72	– 1.03	– 1.27	– 1.77	– 1.51	– 1.82
Exports excluding energy	– 0.05	– 0.12	– 0.19	– 0.25	– 0.35	– 0.29	– 0.37
Production, market sector	– 0.34	– 0.71	– 1.06	– 1.33	– 1.90	– 1.52	– 1.95
Real labour costs, market sector	0.06	0.21	0.36	0.53	1.18	1.56	1.43
User costs of capital	– 1.18	– 1.61	– 2.02	– 2.35	– 2.99	– 2.94	– 3.06
Volumes							
Private consumption	0.24	0.27	0.33	0.40	0.85	1.41	– 0.18
Investments excluding dwellings	0.35	0.88	1.15	1.36	1.97	1.94	1.53
Investments in dwellings	0.01	0.04	0.11	0.21	0.79	1.93	– 0.80
Exports excluding energy	0.01	0.09	0.20	0.32	0.77	0.81	0.95
Imports of goods	0.05	0.09	0.13	0.20	0.50	0.61	0.25
Production, market sector	0.19	0.35	0.50	0.66	1.24	1.45	0.79
Real net national income	0.10	0.14	0.19	0.27	0.67	1.02	0.38
Gross domestic product	0.15	0.25	0.36	0.48	0.95	1.22	0.61
Labour productivity, market sector	0.13	0.16	0.21	0.27	0.42	0.32	0.43
Employment, market sector(fte)	0.07	0.19	0.29	0.39	0.83	1.14	0.36
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.05	0.14	0.22	0.30	0.63	0.88	0.28
	absolute change						
Total employment (1000 persons)	4	10	16	22	46	63	20
Total labour supply (1000 persons)	0	1	2	3	10	19	– 3
Unemployment rate (%)	– 0.04	– 0.12	– 0.18	– 0.24	– 0.47	– 0.59	– 0.29
Ratios							
Labour income share, market sector (%)	– 0.10	– 0.01	0.06	0.14	0.50	0.90	0.74
Capacity utilization rate, market sector (%)	0.09	0.13	0.17	0.22	0.32	0.09	0.27
Current account (% GDP)	– 0.08	– 0.12	– 0.13	– 0.13	– 0.10	– 0.11	0.32
Wedge (%)	– 0.04	– 0.06	– 0.06	– 0.04	0.09	0.25	1.70
Government balance (% GDP)	– 0.27	– 0.71	– 0.85	– 0.84	– 0.86	– 1.04	0.00
Social security balance (% GDP)	0.02	0.05	0.07	0.10	0.23	0.42	0.00
EMU balance (% GDP)	– 0.25	– 0.67	– 0.78	– 0.74	– 0.63	– 0.62	0.00

3.11 A reduction in indirect tax rates by 1% of GDP [64]

A cut in the rate of indirect taxes lowers the price of consumption goods relative to leisure. The ex ante effect of the cut is to reduce the price of private consumption with a little over 1 per cent. The change in consumer prices affects the bargaining position of workers.[65] In JADE 50% of the price change is passed on to wages within the same period. Thus a lower consumption price initially results partly in wage moderation, and partly in an increase in the net real wage rate. This boosts both the consumption of goods and services and labour supply. As a result, production increases as well.

Employment increases both as a result of the increase in production and because real labour costs fall. Unemployment however does not fall to the same degree because the higher real wage rate and the increase in employment both induce additional labour supply.

In terms of the ex post effects on the government budget, the size of the impulse is smaller than in ex ante terms, because the government itself also profits from the tax cut in terms of lower outlays on goods and services. In addition, the economic expansion that results from the tax cut has a favourable effect on the government budget, that partly compensates for the loss of indirect tax revenues. This initially puts a floor under the decrease in the EMU balance, that is gradually swamped by the accumulating debt service.

In the long run, the effects are very similar to those of a cut in income taxes (Section 3.9), once the two measures are scaled to the same level in terms of their implications for the EMU balance. A balanced-budget switch between income taxes and consumption taxes therefore has little real effect.

In the balanced budget simulation the EMU deficit is compensated by an increase in wage and income taxes. The shift from indirect taxes towards wage taxation increases the wedge because a larger part of wage and income taxes affects the wedge and part of the indirect taxes are paid by the government itself. This higher wedge increases labour costs in the long run. As a result the equilibrium rate of unemployment is higher and the GDP effect is negative. Prices are in general of the same order.

[64] The impulse is executed as a decrease in the upper tariff bracket.

[65] Section 2.2.1 describes how the existence of an informal sector induces an effect of the tax wedge, independent of the replacement rate.

Tabel 3.11 A reduction in indirect tax rates by 1% GDP

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 0.79	– 0.69	– 0.37	– 0.03	0.38	0.40	0.48
Contractual wage rate, market sector	– 0.80	– 0.83	– 0.62	– 0.34	0.11	0.18	0.50
Private consumption	– 1.33	– 1.39	– 1.39	– 1.37	– 1.25	– 1.13	– 1.04
GDP deflator	– 1.42	– 1.50	– 1.46	– 1.37	– 1.11	– 0.98	– 0.84
Exports excluding energy	– 0.13	– 0.15	– 0.14	– 0.10	0.01	0.00	0.03
Production, market sector	– 0.31	– 0.42	– 0.45	– 0.39	– 0.07	0.13	0.24
Real labour costs, market sector	– 0.48	– 0.27	0.11	0.40	0.48	0.30	0.24
User costs of capital	– 0.85	– 0.93	– 0.94	– 0.92	– 0.79	– 0.67	– 0.45
Volumes							
Private consumption	0.23	0.78	0.92	1.06	1.45	1.41	– 0.21
Investments excluding dwellings	0.27	1.36	2.00	1.88	1.05	0.93	0.11
Investments in dwellings	0.05	0.23	0.55	0.97	2.05	2.01	– 0.45
Exports excluding energy	0.09	0.13	0.19	0.21	0.08	– 0.09	– 0.16
Imports of goods	0.08	0.33	0.44	0.49	0.53	0.42	– 0.07
Production, market sector	0.22	0.67	0.85	0.91	0.93	0.79	– 0.10
Real net national income	0.01	0.40	0.57	0.66	0.78	0.62	– 0.08
Gross domestic product	0.16	0.51	0.65	0.71	0.76	0.67	– 0.07
Labour productivity, market sector	– 0.02	0.10	0.11	0.14	0.17	0.11	0.09
Employment, market sector(fte)	0.24	0.56	0.74	0.77	0.76	0.69	– 0.20
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.18	0.43	0.57	0.59	0.58	0.53	– 0.15
	absolute change						
Total employment (1000 persons)	13	31	41	43	42	38	– 11
Total labour supply (1000 persons)	1	5	9	12	17	16	– 6
Unemployment rate (%)	– 0.15	– 0.34	– 0.43	– 0.40	– 0.33	– 0.29	0.07
Ratios							
Labour income share, market sector (%)	– 0.56	– 0.55	– 0.24	– 0.04	– 0.01	– 0.08	– 0.04
Capacity utilization rate, market sector (%)	0.03	0.19	0.18	0.18	0.12	0.01	– 0.01
Current account (% GDP)	– 0.10	– 0.23	– 0.24	– 0.23	– 0.27	– 0.35	0.08
Wedge (%)	– 1.32	– 1.30	– 1.24	– 1.17	– 1.11	– 1.13	0.89
Government balance (% GDP)	– 0.81	– 0.73	– 0.67	– 0.66	– 0.76	– 1.08	0.00
Social security balance (% GDP)	0.06	0.14	0.18	0.20	0.24	0.31	0.00
EMU balance (% GDP)	– 0.74	– 0.59	– 0.49	– 0.45	– 0.52	– 0.76	0.00

3.12 A reduction of employers' social security contributions by 1% of GDP

A reduction in employers' social security contributions initially reduces the wage bill of firms by about 1¾ per cent. Since this event does not affect the relative bargaining strength of firms and unions, part of this cost reduction is claimed by workers in the form of a higher contractual wage rate.

The decrease in labour costs lowers producer's prices and boosts consumption demand and exports. Production increases, which stimulates investment and employment growth. The fall in real wage costs also contributes to employment growth. As prices of foreign competitors remain constant, producers do not pass on all cost advantages to customers. As a result, profit margins rise, which adds to the increase in investment.

In time, the favourable effect on wage costs of the reduction of social security contributions vanishes as a result of increasing labour market tightness. Equilibrium unemployment falls as the reduction of social security contributions lowers the wedge. Lower unemployment rates and higher real wages both boost labour supply, so that a substantial increase in employment results.

Given the reduction in employers' social security contribution the EMU balance decreases. The higher receipts on indirect taxes, income taxes and corporate taxes and the lower expenditures on benefits do not outweigh the costs of the reduction in employers' social security contributions.

In the balanced budget simulation both wage and income taxes and employee social security premiums are raised to close the government budget and the budget of the social funds. This implies that the favourable effect of the policy measure on the wedge disappears. Furthermore, a negative side effect of the social security system becomes apparent. Benefits are linked to the *contractual* wage rather than the gross wage, so that the shift in social security contributions from employers to employees implies that benefits are raised. These additional expenditures have to be compensated by an increase in wage and income taxes. *Ex post*, the wedge increases in a balanced-budget implementation of this measure so that in the long run employment and GDP-growth fall.

Tabel 3.12 A reduction of employers' social security contributions by 1% GDP

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 2.49	– 1.70	– 0.90	– 0.41	– 0.15	– 0.24	– 0.05
Contractual wage rate, market sector	– 0.13	0.38	1.07	1.53	1.90	1.85	0.87
Private consumption	– 0.38	– 0.41	– 0.34	– 0.28	– 0.15	– 0.08	0.06
GDP deflator	– 0.71	– 0.67	– 0.43	– 0.22	0.04	0.09	0.03
Exports excluding energy	– 0.28	– 0.33	– 0.25	– 0.15	– 0.01	– 0.05	0.00
Production, market sector	– 0.87	– 0.87	– 0.74	– 0.62	– 0.28	– 0.17	0.00
Real labour costs, market sector	– 1.64	– 0.81	– 0.13	0.26	0.17	– 0.03	– 0.04
User costs of capital	– 0.34	– 0.43	– 0.38	– 0.31	– 0.17	– 0.10	0.08
Volumes							
Private consumption	0.06	0.41	0.80	1.13	1.55	1.43	– 0.28
Investments excluding dwellings	0.01	1.43	2.07	1.93	0.67	0.68	– 0.18
Investments in dwellings	0.01	0.11	0.39	0.85	2.26	2.04	– 0.43
Exports excluding energy	0.22	0.37	0.45	0.46	0.23	0.10	0.00
Imports of goods	0.02	0.28	0.48	0.59	0.56	0.45	– 0.08
Production, market sector	0.23	0.67	0.93	1.04	0.92	0.78	– 0.17
Real net national income	– 0.11	0.24	0.56	0.76	0.80	0.60	– 0.14
Gross domestic product	0.14	0.47	0.69	0.79	0.76	0.66	– 0.13
Labour productivity, market sector	– 0.33	– 0.15	– 0.01	0.08	0.07	– 0.01	– 0.01
Employment, market sector(fte)	0.57	0.83	0.95	0.96	0.86	0.80	– 0.15
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.44	0.63	0.73	0.74	0.66	0.61	– 0.12
	absolute change						
Total employment (1000 persons)	32	46	53	53	47	44	– 9
Total labour supply (1000 persons)	3	8	12	16	22	20	– 4
Unemployment rate (%)	– 0.37	– 0.50	– 0.53	– 0.49	– 0.35	– 0.33	0.06
Ratios							
Labour income share, market sector (%)	– 1.09	– 0.61	– 0.18	0.05	– 0.01	– 0.07	– 0.01
Capacity utilization rate, market sector (%)	– 0.10	0.07	0.17	0.21	0.11	0.02	– 0.01
Current account (% GDP)	– 0.13	– 0.22	– 0.24	– 0.24	– 0.31	– 0.39	0.06
Wedge (%)	– 2.36	– 2.20	– 2.05	– 1.95	– 1.93	– 1.95	0.29
Government balance (% GDP)	– 1.00	– 0.92	– 0.84	– 0.82	– 0.99	– 1.42	0.00
Social security balance (% GDP)	0.18	0.26	0.30	0.32	0.35	0.47	0.00
EMU balance (% GDP)	– 0.82	– 0.66	– 0.54	– 0.50	– 0.65	– 0.95	0.00

3.13 A reduction of employee social security contributions by 1% of GDP

Conceptually, a reduction of employee social security contributions has similar effects to a reduction in social security contributions of employers. Both measures affect the wedge between real labour costs and the real consumption wage, without affecting the relative bargaining positions of unions and firms. Since the division of the surplus of a match between firm and worker depends only on the relative bargaining position, the exact division of social security contributions between employers and workers should not affect either net real labour costs, or the net real consumption wage.

While the effects of a given amount of social security contributions do not depend on whether they are raised from employers or employees, this equivalence result does not hold for a levy that keeps contribution rates constant, even if ex ante the changes in contribution rates imply the same amount of contributions. The reason is that the contribution base is the gross wage, which is a hypothetical accounting wage, without direct interpretation as an actual market price. A reduction in social security contributions of workers lowers the gross wage, while a reduction in employer contributions will raise it. As a result, the ex post revenue of a fall in social security contributions of workers is smaller than the ex ante revenue, while the opposite holds for employers. The wedge therefore falls more if the same ex ante amount is levied from workers as when the initial burden falls on firms.[66]

This difference between ex ante and ex post is evident from a comparison between Table 3.13 below with the results from an ex ante increase in employer contribution in Table 3.12 above. The wedge falls more in case of the reduction in employee contributions, so that the reduction in labour market distortions is also larger. As a result employment rises substantially more in the present case. The associated fall in the gross wage implies that social security funds receive lower contributions, despite a larger contribution base due to the larger increase in employment.

In the balanced budget simulation the EMU deficit is compensated by an increase in wage and income taxes as well as an increase in employers' social security contributions. As in the preceding case of a reduction in employer contributions, the effects of the measure on the wedge are therefore largely undone by the requirement to balance the budget. However, in this case the side effects of the measure on social security benefits are efficiency-increasing. Social security benefits fall as a result of the linkage to the contractual wage. This allows for a reduction in premiums and contribution rates for employees which results in a reduction of the wedge. This provides a boost to employment and GDP, so that the unemployment rate falls.

[66] CPB Memorandum 2002/4 shows that this difference between employee and employer social security contributions does indeed vanish if the government strives for an equal ex-post reduction of contributions.

Tabel 3.13 A reduction of employee social security contributions by 1% GDP

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 0.91	– 1.59	– 1.65	– 1.51	– 0.77	– 0.80	– 0.63
Contractual wage rate, market sector	– 0.91	– 1.67	– 1.85	– 1.78	– 1.19	– 1.14	– 2.03
Private consumption	– 0.13	– 0.32	– 0.44	– 0.49	– 0.46	– 0.39	– 0.33
GDP deflator	– 0.11	– 0.50	– 0.69	– 0.74	– 0.52	– 0.44	– 0.42
Exports excluding energy	– 0.08	– 0.20	– 0.29	– 0.33	– 0.22	– 0.23	– 0.18
Production, market sector	– 0.33	– 0.70	– 0.94	– 1.03	– 0.88	– 0.71	– 0.62
Real labour costs, market sector	– 0.58	– 0.89	– 0.72	– 0.47	0.15	– 0.06	0.00
User costs of capital	– 0.34	– 0.53	– 0.66	– 0.73	– 0.69	– 0.60	– 0.51
Volumes							
Private consumption	0.41	0.84	0.85	0.96	1.58	1.59	0.38
Investments excluding dwellings	0.25	1.18	1.96	2.17	1.68	1.12	0.55
Investments in dwellings	0.13	0.54	1.13	1.74	2.96	3.18	1.41
Exports excluding energy	0.04	0.16	0.34	0.51	0.75	0.56	0.51
Imports of goods	0.13	0.32	0.43	0.54	0.79	0.65	0.30
Production, market sector	0.26	0.67	0.92	1.12	1.46	1.27	0.63
Real net national income	0.14	0.39	0.51	0.65	1.04	0.84	0.37
Gross domestic product	0.20	0.51	0.69	0.84	1.13	1.02	0.47
Labour productivity, market sector	– 0.03	– 0.08	– 0.14	– 0.12	0.04	– 0.03	– 0.01
Employment, market sector(fte)	0.29	0.75	1.06	1.24	1.43	1.31	0.64
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.23	0.58	0.82	0.96	1.10	1.01	0.49
	absolute change						
Total employment (1000 persons)	16	42	59	69	79	73	35
Total labour supply (1000 persons)	4	13	21	25	32	31	14
Unemployment rate (%)	– 0.16	– 0.38	– 0.50	– 0.58	– 0.63	– 0.56	– 0.28
Ratios							
Labour income share, market sector (%)	– 0.49	– 0.76	– 0.57	– 0.39	– 0.02	– 0.09	– 0.02
Capacity utilization rate, market sector (%)	0.06	0.12	0.09	0.11	0.15	0.02	0.03
Current account (% GDP)	– 0.15	– 0.30	– 0.32	– 0.32	– 0.28	– 0.36	– 0.01
Wedge (%)	– 3.36	– 3.47	– 3.47	– 3.43	– 3.27	– 3.29	– 1.63
Government balance (% GDP)	– 0.93	– 0.83	– 0.79	– 0.76	– 0.79	– 1.14	0.00
Social security balance (% GDP)	0.02	0.09	0.14	0.19	0.27	0.35	0.00
EMU balance (% GDP)	– 0.92	– 0.75	– 0.65	– 0.57	– 0.52	– 0.79	0.00

3.14 A reduction of the minimum wages and related benefits by 1%

A reduction of the minimum wage has several effects in JADE. First, given the current system of linking wages and benefits in the Netherlands, a reduction in the minimum wage implies a reduction in benefits. Second, it affects the relation between social security benefits (that are linked to the minimum wage) and the average wage rate. That is, it changes the replacement rate. A change in the replacement rate influences wage negotiations through the fallback position of employees, that is the income that is received upon dismissal. A reduction in the minimum wage therefore lowers contractual wages in the market sector. The resulting wage moderation has a downward effect on private consumption, but production hardly decreases. The decrease in consumption is offset by a larger foreign demand and by a reduction in import demand. Both are caused by a deterioration in the terms of trade.

The fall in wages causes a shift towards more labour-intensive production which lowers labour productivity and is beneficial for employment. The beneficial effect on unemployment is small, however, as the increase in exports is for the larger part swamped by the fall in domestic consumption. The reduction in unemployment benefits and social security assistance generates only a small improvement of the EMU balance because tax receipts also decrease due to the fall in private income and consumption.

Because the reduction of the minimum wage and related benefits has only a small effect on the EMU balance, compensating this balance by adjusting wage and income taxes only slightly changes the results. Real expenditures are somewhat higher, prices are about the same.

Tabel 3.14 A reduction of the minimum wages and related benefits by 1%

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	– 0.07	– 0.11	– 0.13	– 0.13	– 0.12	– 0.13	– 0.13
Contractual wage rate, market sector	– 0.06	– 0.10	– 0.12	– 0.13	– 0.12	– 0.14	– 0.13
Private consumption	– 0.01	– 0.02	– 0.03	– 0.03	– 0.04	– 0.06	– 0.07
GDP deflator	– 0.03	– 0.05	– 0.06	– 0.07	– 0.08	– 0.10	– 0.11
Exports excluding energy	– 0.01	– 0.02	– 0.03	– 0.03	– 0.03	– 0.04	– 0.04
Production, market sector	– 0.03	– 0.04	– 0.06	– 0.07	– 0.09	– 0.11	– 0.12
Real labour costs, market sector	– 0.05	– 0.07	– 0.07	– 0.06	– 0.02	– 0.02	– 0.01
User costs of capital	– 0.01	– 0.02	– 0.03	– 0.03	– 0.04	– 0.05	– 0.08
Volumes							
Private consumption	– 0.08	– 0.11	– 0.13	– 0.14	– 0.12	– 0.13	0.09
Investments excluding dwellings	– 0.04	– 0.07	– 0.04	0.00	0.02	0.00	0.11
Investments in dwellings	0.00	– 0.02	– 0.04	– 0.06	– 0.06	– 0.05	0.28
Exports excluding energy	0.01	0.03	0.04	0.06	0.08	0.09	0.10
Imports of goods	– 0.02	– 0.03	– 0.03	– 0.02	– 0.01	– 0.01	0.06
Production, market sector	– 0.03	– 0.03	– 0.02	– 0.01	0.01	0.01	0.13
Real net national income	– 0.04	– 0.06	– 0.05	– 0.05	– 0.03	– 0.03	0.08
Gross domestic product	– 0.03	– 0.03	– 0.03	– 0.02	0.00	0.00	0.10
Labour productivity, market sector	– 0.03	– 0.03	– 0.03	– 0.02	– 0.01	– 0.01	0.00
Employment, market sector(fte)	0.00	0.00	0.00	0.01	0.02	0.02	0.14
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	0.00	0.00	0.00	0.01	0.01	0.01	0.11
	absolute change						
Total employment (1000 persons)	0	0	0	1	1	1	8
Total labour supply (1000 persons)	0	0	0	0	0	0	3
Unemployment rate (%)	0.00	0.00	– 0.01	– 0.01	– 0.02	– 0.02	– 0.07
Ratios							
Labour income share, market sector (%)	– 0.01	– 0.02	– 0.03	– 0.03	– 0.01	– 0.01	– 0.01
Capacity utilization rate, market sector (%)	– 0.02	– 0.02	– 0.02	– 0.02	0.00	0.00	0.00
Current account (% GDP)	0.02	0.02	0.03	0.03	0.04	0.05	0.00
Wedge (%)	– 0.01	– 0.02	– 0.02	– 0.02	– 0.01	– 0.01	– 0.28
Government balance (% GDP)	0.00	– 0.01	– 0.01	– 0.01	– 0.01	– 0.01	0.00
Social security balance (% GDP)	0.05	0.05	0.05	0.06	0.07	0.10	0.00
EMU balance (% GDP)	0.05	0.04	0.04	0.05	0.07	0.10	0.00

3.15 A permanent wage rate increase of 1% without linking

In the absence of a link between public sector wages and benefits with contractual wages in the market sector, the effects of a permanent increase of wage rates in the market sector are smaller than with the general wage rise discussed in Section 3.3. First, social security benefits do not increase in line with market wages. As a result, the replacement rate falls, which weakens the bargaining position of workers. This leads to a smaller ex post increase in wages. Second, disposable income of government employees and persons on relief rises less than with a general wage hike. The ensuing demand impulse is therefore lower as well.

Initially, the smaller increase in wages leads to a smaller decrease in employment. In the long run, the increase in unemployment is also slightly lower than with a general wage hike, as a result of a lower replacement rate.

The EMU balance improves compared to the wage simulation in which benefits and public sector wages are linked because government wages do not increase and transfers remain at a lower level.

In the balanced budget simulation the permanent expansion of the economy is somewhat larger as the EMU surplus is returned to the private sector through lower taxes and premiums. Price response are about the same as the additional reduction of wage and income taxes is relatively small.

Tabel 3.15 A permanent wage rate increase of 1% without linking

Year	1	2	3	4	8	16	16 (BB)
	percentage change						
Prices							
Wage rate enterprises	1.40	1.80	1.79	1.62	1.20	1.31	1.33
Contractual wage rate, market sector	1.32	1.79	1.87	1.79	1.46	1.55	1.46
Private consumption	0.23	0.39	0.46	0.50	0.53	0.60	0.64
GDP deflator	0.57	0.88	1.00	1.01	0.92	1.01	1.06
Exports excluding energy	0.18	0.33	0.41	0.42	0.33	0.35	0.36
Production, market sector	0.49	0.77	0.91	0.99	1.03	1.07	1.13
Real labour costs, market sector	0.91	1.01	0.86	0.60	0.14	0.20	0.15
User costs of capital	0.20	0.36	0.46	0.50	0.51	0.57	0.66
Volumes							
Private consumption	0.32	0.61	0.67	0.63	0.26	0.28	– 0.34
Investments excluding dwellings	0.17	– 0.17	– 0.60	– 0.89	– 0.62	– 0.40	– 0.73
Investments in dwellings	0.05	0.22	0.45	0.65	0.29	0.19	– 0.72
Exports excluding energy	– 0.16	– 0.37	– 0.57	– 0.72	– 0.91	– 0.88	– 0.91
Imports of goods	0.10	0.11	0.04	– 0.05	– 0.22	– 0.19	– 0.39
Production, market sector	0.02	– 0.07	– 0.23	– 0.37	– 0.58	– 0.55	– 0.91
Real net national income	0.23	0.31	0.24	0.14	– 0.15	– 0.13	– 0.43
Gross domestic product	0.05	0.01	– 0.09	– 0.18	– 0.36	– 0.35	– 0.64
Labour productivity, market sector	0.25	0.33	0.30	0.24	0.07	0.07	0.06
Employment, market sector(fte)	– 0.24	– 0.40	– 0.53	– 0.61	– 0.66	– 0.63	– 0.97
Employment, public sector (fte)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment (fte)	– 0.18	– 0.31	– 0.41	– 0.47	– 0.51	– 0.49	– 0.75
	absolute change						
Total employment (1000 persons)	– 13	– 22	– 29	– 34	– 36	– 35	– 54
Total labour supply (1000 persons)	0	1	2	2	– 2	– 2	– 10
Unemployment rate (%)	0.17	0.29	0.40	0.46	0.45	0.43	0.57
Ratios							
Labour income share, market sector (%)	0.52	0.55	0.45	0.29	0.07	0.11	0.12
Capacity utilization rate, market sector (%)	0.14	0.17	0.13	0.08	– 0.03	– 0.01	– 0.04
Current account (% GDP)	– 0.02	– 0.06	– 0.10	– 0.15	– 0.22	– 0.25	– 0.10
Wedge (%)	0.21	0.27	0.25	0.20	0.11	0.11	0.87
Government balance (% GDP)	0.02	0.03	0.00	– 0.04	– 0.11	– 0.15	0.00
Social security balance (% GDP)	0.04	0.04	0.01	– 0.03	– 0.07	– 0.09	0.00
EMU balance (% GDP)	0.06	0.07	0.00	– 0.07	– 0.18	– 0.24	0.00

4 Summary and conclusion

This paper presents the current version of JADE, a macroeconometric model of the Netherlands. The model is suitable for both medium and long run analyses. To achieve consistent outcomes for the long run, the model contains relations for production, factor demand, and wage formation that are formulated in levels and estimated using an error correction framework.

The paper investigates the response patterns to changes in exogenous variables and policy variables. It appears that, while the length of the adjustment path depends on the particular simulation, in most cases the effects appear to stabilize after around ten years. Overall, it appears that the model provides a consistent infrastructure to analyse issues with both short and long run dimensions. This offers a promising avenue to continue this type of research.

A macroeconometric model used for policy analysis is always an unfinished product, in a constant state of flux. This also holds for JADE. There are several aspects of the model that still under scrutiny, and that we plan to improve upon. In the near future further research will be carried out on several issues. First, given new data for contractual wages the wage equation will be re-estimated. Second, after the results of an exploratory vector auto-regression (VAR) study become available, an effort will be made to respecify the dynamics of the labour market. Third, an error correction equation for the investments in residential dwellings will be estimated. Fourth, adjustments have to be made to take into account the new tax system that was introduced in January 2001. This new tax system has implications for consumption, tax bases, capital costs and profit income. A revision of the government and social security block is also envisaged. Another issue that will be changed is the valuation against factor prices. In case of valuation against factor prices the balance of subsidies and indirect taxes that are not product-related are included. The major difficulty with these non product-related subsidies and indirect taxes is that hard to make a split between their prices and volumes. Therefore, in the near future base-prices will be used instead of factor prices. The difference between base-prices and factor prices is that base-prices exclude these non product-related subsidies and indirect taxes. Finally, the theoretical basis for the cumulative production structure should be revised. From a theoretical perspective a somewhat different setup is required, see Broer (2002).

Appendix 1 Demand categories in JADE (1997) and JADE (2002)

The split in demand categories in the 1997 version is the same as in FKSEC, see chapter 2 in CPB (1992). In Table A1.1 it is shown which demand categories in JADE (1997) correspond to the current demand categories. Categories that have not been adjusted are omitted.

Table A1.1 Demand categories in JADE (1997) and JADE (2002)

Demand categories in JADE (1997)		Demand categories in JADE (2002)	
bnf	Exports and stock-building of non-energy goods	*bfb*	Exports of goods of domestic origin
		bfm	Re-exports
		nf	Inventory formation of produced goods excluding energy
bno	Exports and stock-building of energy excluding natural gas	*bo*	Exports of energy excluding gas
		no	Inventory formation of energy
cre	Private consumption excluding the consumption of medical services and rents	*cag*	Consumption of gas
		cr5	Total private consumption excluding consumption of health care (*ckg*), rents (*cwo*) and gas (*cwo*).
ckt	Consumption of medical services	*ckg*	Privately financed consumption of health care
		g_n	Consumption in kind
cg	Net non-wage government consumption	*gi*	Intermediary deliveries to the government
		gv	Sales by the government
		go	Profit income of the government + investments under own control
		dg	Depreciation
ib	Gross investments in buildings (including dwellings) by the private sector and the government	*ibb*	Investments in buildings by firms
		ipb	Investments in buildings by the government
		iwo	Investments in residential dwellings by households
ir	Gross investments in equipment by firms and the government	*ibo*	Investments in equipment by firms
		ipo	Investments in equipment by the government

Appendix 2 Demand categories in the Cumulated Production Structure (CPS)

Table A2.1 Overview of volume and price equations of the various demand categories

		Volumes	Volumes described in section	Prices	Prices described in section
Private consumption					
cr5	Total private consumption excluding *ckg, cwo* and *cag*	endogenous	2.5.2[a]	endogenous	2.8.1
cag	Consumption of gas	exogenous	-	endogenous	
ckg	Privately financed consumption of healthcare	exogenous	-	endogenous	2.8.1
cwo	Rents	exogenous	-	exogenous	-
Private investments					
ibo	Investments of firms in equipment	endogenous	2.1.3	endogenous	2.8.1
ibb	Investments of firms in buildings	endogenous	2.1.3	endogenous	2.8.1
nf	Inventory formation of produced goods	endogenous	2.1.3	endogenous	2.8.1
no	Inventory formation of energy	exogenous	2.1.3	endogenous	2.8.1
iwo	Investments of households in residential dwellings	endogenous	2.1.4	endogenous	2.8.1
Government spending[b]					
gl	Wages paid by the government	exogenous	-	endogenous	2.8.1
gi	Intermediary deliveries to the government	exogenous	-	endogenous	2.8.1
gv	Sales by the government	exogenous	-	endogenous	2.8.1
go	Profit income of the government + investments under own control	exogenous	-	endogenous	2.8.1
dg	Depreciation	exogenous	-	endogenous	2.8.1
g_n	Consumption in kind	exogenous[c]	-	endogenous	2.8.1
ipo	Investments of government in equipment	exogenous	-	endogenous	2.8.1
ipb	Investments of government in buildings	exogenous	-	endogenous	2.8.1
Exports					
bfb	Exports of goods of domestic origin	endogenous	2.6.1	endogenous	2.8.1
bfm	Re-exports	endogenous	2.6.1	endogenous	2.8.1
bd	Exports of services	endogenous	2.6.1	endogenous	2.8.1
bag	Exports of gas	exogenous	2.6.1	endogenous	2.8.1
bo	Exports of energy excluding gas	exogenous	2.6.1	endogenous	2.8.1

[a] Note that the concept that is used in estimation consumption demand in section 2.5.2 is not equal to *cr5*. The imputed rents on owner occupied houses (*cwe*), privately financed consumption of health care(*ckg*), and the administration costs of pension funds and life insurance companies(*c_a*) are excluded from private consumption (see section 2.5.2).

[b] Government spending consists of government consumption and investments. The other five expenditure categories (see section 2.7.1) are not primary inputs.

[c] Note that *g_n* is the sum of consumption in kind by the government, g_n^{ro}, and by social security funds, g_n^{sv}. The volumes of the underlying components are exogenous.

Appendix 3 Implicit price equations for value added

Assuming that costs are equal across demand categories, the price changes for the market sector (*mz*), the residential sector (*wo*) and the health care sector (*kw*) are determined by weighting the price equations (58)-(65) over the various demand categories with row weights in the CPS matrix. This gives the following set of equations:

$$\begin{aligned}
&\dot{p}_y^{mz} = \rho^{mz}\dot{c}_y^{mz} + \varphi^{mz}(\ln p_y^{mz} - \ln c_y^{mz})_{-1} + \varrho^{mz}(\dot{p}_{bc} - \dot{c}_{y,bfb}) + \Upsilon^{mz}\ln q^{mz} + \xi^{mz}\,,\\
&\rho^{mz} = \sum_i rw_i^{mz}\rho_i\,,\quad \varphi^{mz} = \sum_i rw_i^{mz}\varphi_i\,,\quad \varrho^{mz} = \frac{rw_{bfb}^{mz}}{cw_{bfb}^{mz}}\varrho_{bfb}\,,\quad \Upsilon^{mz} = \frac{rw_{bfb}^{mz}}{cw_{bfb}^{mz}}\Upsilon_{bfb}\,,
\end{aligned} \tag{A3.1}$$

$$\begin{aligned}
&\dot{p}_y^{wo} = \rho^{wo}\dot{c}_y^{wo} + \varphi^{wo}(\ln p_y^{wo} - \ln c_y^{wo})_{-1} + \xi^{wo}\,,\\
&\rho^{wo} = \sum_i rw_i^{wo}\rho_i\,,\quad \varphi^{wo} = \sum_i rw_i^{wo}\varphi_i\,,
\end{aligned} \tag{A3.2}$$

$$\begin{aligned}
&\dot{p}_y^{kw} = \rho^{kw}\dot{c}_y^{kw} + \varphi^{kw}(\ln p_y^{kw} - \ln c_y^{kw})_{-1} + \xi^{kw}\,,\\
&\rho^{kw} = \sum_i rw_i^{kw}\rho_i\,,\quad \varphi^{kw} = \sum_i rw_i^{kw}\varphi_i\,,
\end{aligned} \tag{A3.3}$$

where the terms for the increase in foreign prices relative to the production costs of exports of goods of domestic origin and the degree of capacity utilization in equation (A3.1) are normalized as they refer to one demand category.

Given the volume and price changes in the various demand categories the price change for total gross domestic production at factor costs can be determined (see Table 2.2). Then subtracting intermediate imports, gross value added at factor costs results. The price changes for the intermediate imports (*mg*, *md*, *m3*) are exogenous; the volume changes are specified in section 2.8.2. Then subtracting the gross value added for the government from gross value added at factor costs, the gross value added for firms results. For the government sector the price change of value added is determined by the price change of wages and depreciation. The underlying volume components of gross value added in the government sector are exogenous. As the price change of gross value added in the market sector (*mz*), the residential sector (*wo*), health care (*kw*) and the government sector (*pl*) are already modelled, the price changes of mining and quarrying (*de*) is calculated as a residual, to guarantee that the sum of valued added over the sectors equals the sum over the demand categories.

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Abstract

We present a revised edition of the macro econometric model JADE developed at the CPB Netherlands Bureau for Economic Policy Analysis. Dynamics and equilibrium are linked together through error correction mechanisms estimated with cointegration techniques. With some simulation exercises we indicate how these features operate within the larger model.