WORKING PAPER

6-03

MODTRIM II: A quarterly model for the Belgian economy

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Abstract:

In this working paper we describe the new quarterly model of the Federal Planning Bureau. More precisely, we present the specification and estimation results of the main behavioural equations of the model, and give an overview of its overall accounting structure. The dynamic model properties are examined through different technical simulations and scenario analyses.

JEL classification: C5, E1

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I Introduction

Since 1994, the Federal Planning Bureau has been using the annual version of the econometric model MODTRIM[1] as central tool to produce its short-term macroeconomic forecasts[2]. At the origin of the project, and as its name indicates, this annual version was meant to be short-lived and quickly replaced by a quarterly version. Unfortunately, the lack of quarterly national accounts prevented from doing so for several years. In 1998, the Institute for National Accounts published official quarterly accounts for the first time[3] and the construction of the quarterly version of the model started in Spring 2000. On that occasion, the opportunity was seized to reassess all behavioural equations of the model. The more limited availability of quarterly data, in comparison with annual data, implied that a more aggregated version of the accounting framework of the yearly model had to be constructed.

The choice to develop a quarterly model was of course not only motivated by its original name, but seemed highly suitable for business cycle analysis and short-term forecasting. In this context, three elements are worth mentioning:

(i) Working with a quarterly instead of a yearly model allows to integrate explicitly all the quarterly information available when preparing the forecasts. Of course this 'advantage' of relying entirely on recent information may be a drawback if data are subject to major revisions over time.

(ii) Working with quarterly data means that carry-over effects are taken much more precisely into account as compared with yearly data. In fact, the average yearly growth rate of a variable is influenced by the quarterly pattern of that variable during the course of the previous year. Working exclusively with annual data means ignoring this phenomenon completely.

(iii) Business cycles are simply better described with quarterly data: the specific within one year dynamics and the lag structure in economic relationships can be captured more precisely.

The aim of this working paper is not to provide a complete model user's guide, but to present the specification and estimation results of the behavioural equations, and to give an insight into the overall accounting structure of the model. The simultaneous response of the complete model to exogenous shocks is examined through different technical simulations and scenario analyses.

1. See Jamar and Verlinden (1994).
2. Twice a year, the Federal Planning Bureau prepares the so-called 'Economic Budget'. These forecasts serve as background for the preparation of the Federal Government's Revenue and Expenditure Budget.
3. This does by no means imply that no additional work had to be done on the data base (see Appendix I for further details).

II Model specification and estimation results

A. The main characteristics of the model

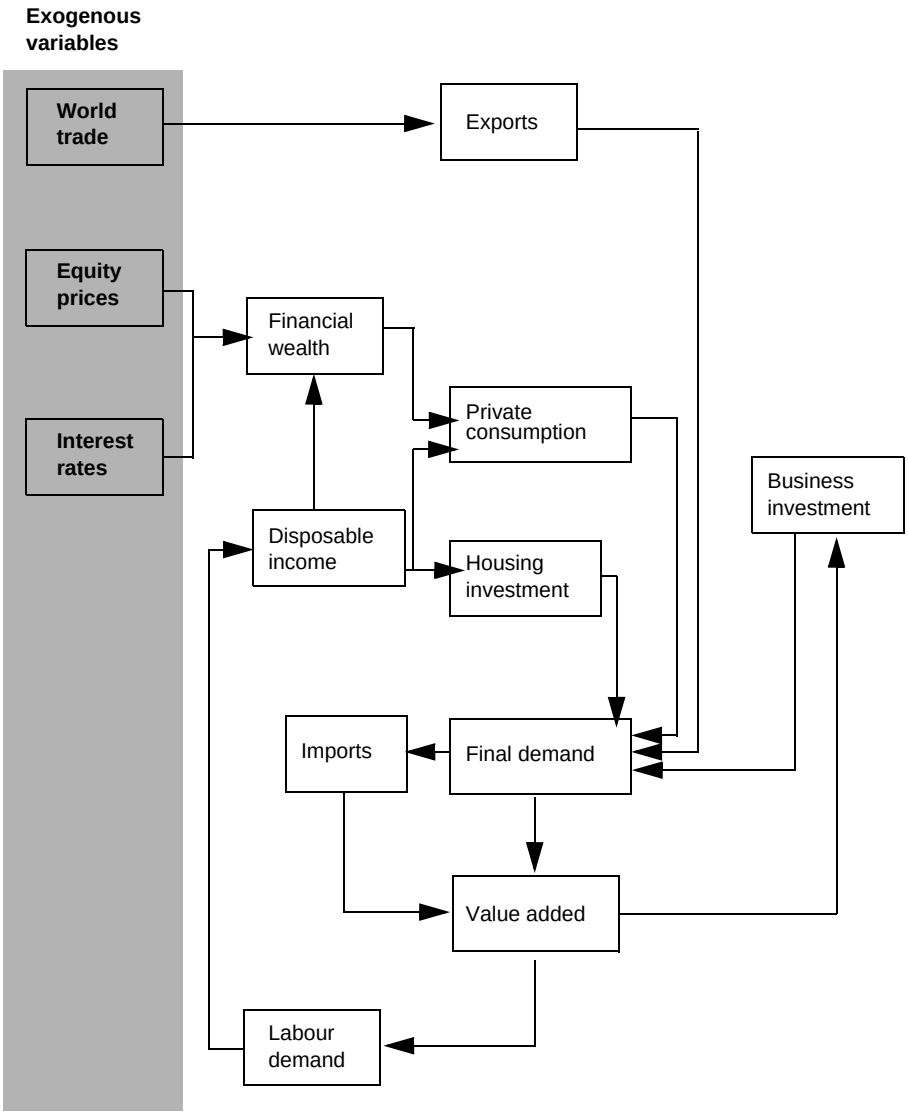
Structural macroeconometric models came under heavy fire during the last two decades[1]. Despite this criticism, a number of factors convinced us to stick to traditional structural modelling[2]. First of all, non-structural models (as vector autoregression models) can only produce forecasts for a limited number of endogenous variables. Secondly, a structural model does not only deliver forecasts, but also plays a pedagogical role because causal relationships between different economic aggregates can be explained. Finally, such a model allows to test the effects of alternative hypotheses for the exogenous variables on the economic system.

The size and the aggregation level of the model were mainly determined by two factors. On the one hand, the model had to be able to forecast all variables needed by the Government and Federal Agencies in order to allow them to prepare their budgets. On the other hand, we were constrained by the more limited availability of quarterly data in comparison to annual data. The structure of identities, which makes it possible to reconstruct the accounts of the institutional sectors, can therefore be considered as an aggregate version of the accounting framework of the yearly model. In all, the model contains about 20 true behavioural equations, around 180 *ad hoc* equations and about the same number of identities.

The solution of the quarterly model is, like its annual predecessor, 'demand-driven' in the sense that output is essentially determined by the level of aggregate demand. World trade, international prices (including oil prices), interest rates and exchange rates remain the principal exogenous variables, but equity prices also play a role now. In the illustration below, we give an overview of the main channels between core variables, but to keep it readable, the influence of prices (including wages) and national policy variables (taxation rates, public expenditure...) has been omitted here.

1. See Diebold and Rudebusch (1999) for a recent review.
2. See Donders and Lunsing (1999).

FIGURE 1 - An illustration of the demand-driven character of the model



The main long-run characteristics of the model can be summarized as follows. Factor demands (demand for labour and capital) and the price of value added in the private sector are derived from a profit maximization problem, constrained by a Cobb-Douglas production function with constant returns to scale. Households' expenditure is determined by disposable income and financial wealth. Export and import volumes are related to a re-weighted indicator of world demand, respectively final demand, and to relative prices.

The deflator of private value added deduced from the Cobb-Douglas production function plays a central role in the price formation mechanisms of the model. Import and export prices are modelled as a weighted average of international trade prices and domestic prices, the latter reflecting some 'pricing to the market strategy' of importing firms and a certain degree of price-makership of exporting firms. To calculate the deflator of private consumption, the underlying inflation is first modelled and then specific profiles of the excluded products and indirect taxes are added. The model also contains an integrated wage indexation module, which reproduces specific Belgian legislation.

As the primary use of the model is forecasting four to six quarters ahead, we decided not to define steady state properties, which are only essential for medium and long-term analysis[1]. Nevertheless, in order to ensure a certain degree of theoretical consistency as well as a good statistical fit, the modelling strategy relies to a large extent on error correction mechanisms. Economic agents' expectations, being of interest mainly for policy evaluation, are not treated explicitly[2].

To allow estimation with ordinary least squares and to easily interpret the coefficients as elasticities, most equations were log-linearized. To estimate the error correction mechanisms, the Two-Step Engle-Granger method was used. The long-term specifications were derived from explicit optimization problems or validated by means of cointegration tests. The short-run dynamics are described with quarter-on-quarter growth rates of data that are seasonally adjusted and corrected for calendar effects. In addition to the usual regression statistics, an indicator of the speed of absorption of a disequilibrium, called hereafter MRL (Median Response Lag to a long-term shock), will be reported. More about the regression statistics and the construction and interpretation of the MRL indicator can be found in Appendix IV.

A short description of the construction and content of the quarterly data base is given in Appendix I. A glossary of the names for the different variables used in the behavioural equations, is provided in Appendix II.

Macroeconometric models are of course always unfinished products. Publications describing such models, give only a snapshot of the state of the model at a certain moment. Planned future developments of MODTRIM II are: a refinement of the equations concerning public finances (direct and indirect taxes, social security contributions...), a separate treatment of energy in the modelling of international trade volumes and prices, integration of a wage equation. Progress in all these fields should be preceded by further research on the data base level, laying the foundations for more complete and coherent quarterly data for the Belgian economy.

1. See for instance Meyermans and Van Brusselen (2001).
2. A good example of this type of model for the Belgian economy can be found in Jeanfils (2000).

B. Households

1. Private consumption

The specification of the consumption function follows the one proposed by INSEE (2001), which states that in the long run[1], private consumption is determined by current disposable income[2] and wealth accumulated up to the previous quarter. For reasons of data availability, only financial wealth could be considered. Households' nominal financial wealth is approximated by the sum of three types of assets:

- assets without income (bank notes, checking accounts);
- fixed income assets (time deposits, bonds, mutual fund shares....);
- direct equity holdings.

As complete financial accounts for the institutional sectors are not available, we could not use a portfolio allocation approach, but had to rely on a more basic modelling procedure. The specifications we retained, imply that accumulation of financial wealth is a function of households' net lending and equity price indices.

To guarantee the stability of the private consumption equation on a steady state growth path, the sum of the two coefficients has been constrained to unity. It is easy to show that in this specification the savings rate is a positive function of the ratio of current income on past wealth. The higher (lower) this ratio, the higher (lower) the savings rate. An unchanged ratio (as in a steady state) implies a constant savings rate.[3]

ln(**CCO_L**) = *cco_l01**(t<1990Q1) + *cco_l02**(t>1989Q4) +
*cco_l1**ln(YDH_I / PCC) + (1-*cco_l1*)*ln(WEA / PCC)[-1]

Estimation period: 1982Q1-2001Q4

Tests:

R^2 adjusted: 0.98; Durbin-Watson: 0.46; Dickey-Fuller: -3.23

Coefficient values:

cco_l01: -0.518

cco_l02: -0.570

cco_l1: 0.859

In order to obtain stationary residuals (i.e. a stable relation between consumption, disposable income and wealth) a structural break in the constant term was introduced in 1990. Our estimate of the elasticity of consumption with respect to wealth (around 0.14) is higher than the one obtained by INSEE for France (0.075 on average) but significantly smaller than for the US (0.23).

1. This concept of long-term or desired level in the absence of rigidities is noted 'variable code'_L further in the text.
2. The composition of disposable income is described in the section on institutional sectors' accounts (section F).
3. One can easily show that this constant savings rate is equal to *1-exp(a)*, with *a = cco_l02 + (1-cco_l1)*ln(b)*, and *b* equal to the constant ratio *WEA[-1]/YDH_I*.

In the short run, the quarter-on-quarter growth rate of private consumption is a function of the evolution of disposable income, lagged wealth, unemployment (to take the phenomenon of precautionary savings into account) and the lagged error from the long-term target:

dln(**CCO**) = *cco0* + *cco1**dln(YDH_I / PCC) + *cco2**dln(WEA / PCC)[-1] + *cco3**d(UY / NATY) + *cco_e**(ln(CCO)-ln(CCO_L))[-1]

Estimation period: 1982Q3-2001Q4

Tests:

F-stat: 8.62; R^2 adjusted: 0.29; Durbin-Watson: 2.19; MRL: 11

Coefficient values *(t-stat)*:

cco0: 0.003 *(4.3)*

cco1: 0.303 *(3.5)*

cco2: 0.043 *(1.7)*

cco3: -0.093 *(-3.1)*

cco_e: -0.065 *(-1.9)*

Short-term elasticities for income and wealth are clearly lower than their long-term values. Adjustment towards the long-term level is rather slow. The development of the unemployment rate is an important explanatory factor of consumption spending in the short run. The relatively low R^2 is to a large extent explained by the high volatility on a quarterly basis of certain components of disposable income.

2. Housing investment

The estimated coefficients of an equation on housing investment are usually unstable because their values incorporate different policy measures, rendering them unsuitable for prospective use (*cf.* Lucas critique). This is especially true in Belgium for the first half of the eighties. The choice of the specification and of the estimation period have consequently been guided by the desire to obtain stationary residuals and robust ('structural') elasticities.

In the long run, household investment is assumed to be a function of disposable income and housing prices (approximated by its deflator and a smoothed long-term real interest rate) relative to consumer prices:

ln(**IRO_L**) = *iro_l0* + *iro_l1**ln(YDH_I / PCC) + *iro_l2**ln((PIR / PCC)*RLBERHP)

Estimation period: 1988Q1-2001Q4

Tests:

R^2 adjusted: 0.79; Durbin-Watson: 0.27; Dickey-Fuller: -3.18

Coefficient values:

iro_l0: -2.150

iro_l1: 0.902

iro_l2: -0.135

The long-run elasticity with respect to real disposable income is, as expected, close to unity. The price-effect is rather limited.

The short-run dynamics are as follows:

dln(**IRO**) = *iro1**dln(IRO)[-1] + *iro2**dln(YDH_I / PCC) + *iro_e**(ln(IRO) -ln(IRO_L))[-1]

Estimation period: 1988Q2-2001Q4

Tests:

F-stat: 137.7; R^2 adjusted: 0.72; Durbin h: 2.43; MRL: 3

Coefficient values *(t-stat)*:

iro1: 0.600 *(--)*

iro2: 0.240 *(1.6)*

iro_e: -0.192 *(-5.2)*

The dynamics are strongly influenced by the autoregressive process, which can be really delicate in forecasting. For that reason, the coefficient of the lagged endogenous variable has been limited to a value of 0.6 and, therefore, the autocorrelation of the residuals has not been completely eliminated (as shown by the value of the Durbin h).

C. Firms

1. Demand for production factors

a. Demand for labour

Firms are supposed to maximize their profits, constrained by a Cobb-Douglas production function with constant returns to scale[1]. Labour demand (expressed in hours)[2] is then given by:

ln(**NFYH_L**) = *nfyh_l0* + ln(QVOFF) - ln((WBF / NFYH) / PQVFZ)

Estimation period: 1981Q1-2001Q4

Coefficient values:

nfyh_l0: -0.387

The choice of a Cobb-Douglas production function in the long run implies output and own price (deflated by the deflator of value added) elasticities equal to one and minus one respectively. The exponent of the estimated constant gives the share of value added attributed to labour, here around 68%, which seems a realistic figure.

In the short run, rigidities are introduced through an autoregressive process and an error correction mechanism:

dln(**NFYH**) = *nfyh1**dln(NFYH)[-1] + *nfyh2**dln(QVOFF) + *nfyh3**dln((WBF / NFYH) / PQVFZ) + *nfyh_e**(ln(NFYH)-ln(NFYH_L))[-1]

Estimation period: 1981Q4-2001Q4

1. A similar hypothesis is made in Jeanfils (2000) or Brayton *et al.* (1997).
2. Labour demand is only endogenous in the model for wage earners of the private sector. The self-employed are considered as exogenous in this version of the model.

Tests:

F-stat: 36.18; R^2 adjusted: 0.57; Durbin h: -0.68; MRL: 9

Coefficient values *(t-stat)*:

nfyh1: 0.230 *(2.5)*

nfyh2: 0.244 *(5.9)*

nfyh3: -0.113 *(-3.7)*

nfyh_e: -0.062 *(-4.5)*

Short-run elasticities with respect to value added and real wages are much smaller than the (imposed) long-run elasticities. The coefficient of the error correction term is also very small, although highly significant. Adjustments towards long-term values are thus made very slowly.

The equation above holds for the volume of labour, expressed in number of hours. To calculate employment in number of heads, the model proceeds as follows. Firstly, labour expressed in hours is divided by the average number of effective working hours per full-time equivalent wage earner, to provide a number for employment expressed in full-time equivalents. This work duration is endogenous in the model and is a positive function of economic activity (this dampens somewhat the effect of economic activity on unemployment). Secondly, employment expressed in full-time equivalents is translated into number of heads, taking into account the share and the relative length of part-time work.

b. Demand for capital

Demand for capital[1] is also derived from the Cobb-Douglas function, allowing however for medium-term fluctuations in the capital share depending on profitability of the private sector value added. Moreover, a partial adjustment mechanism is introduced to take into account that in each period only a fraction of the capital stock is adjusted to the desired level. This leads to the following long-term relation:

ln(**KNF_L**) = *knf_l* * ((*knf_l0*+ln(QVOF)-ln(CKNF_ / PQVFZ)) +
*knf_l1**ln((QVUF-WBF) / QVUF)) + (1-*knf_l*)*ln(KNF)[-1]

Estimation period: 1980Q2-2001Q4

Coefficient values:

knf_l: 0.036

knf_l0: -1.137

knf_l1: 0.115

The cost of capital is defined as a function of the long-term real interest rate, the deflator of corporate investment and the depreciation rate of the capital stock. In the above specification, the constant term has been constrained in accordance with the estimated coefficient in the long-term labour demand function and the hypothesis of constant returns to scale.

1. The private sector capital stock refers to the accumulation of capital by firms and the self-employed.

The desired level of business investment is then calculated by means of the following identity:

IQO_L = KNF_L-(1-VKF)*KNF[-1]

In the short run, the growth rate of investment is only determined by the evolution of value added and the error correction term, as the coefficient associated with the change in the real cost of capital is insignificant:

dln(**IQO**) = *iqo1**dln(IQO)[-1] + *iqo2**dln(QVOF) + *iqo_e**(ln(IQO)-ln(IQO_L))[-1]

Estimation period: 1980Q4-2001Q4

Tests:

F-stat: 13.23; R^2 adjusted: 0.23; Durbin h: -0.16; MRL: 7

Coefficient values *(t-stat)*:

iqo1: -0.232 *(-2.4)*

iqo2: 1.436 *(4.2)*

iqo_e: -0.125 *(-3.2)*

The coefficient of the lagged endogenous variable is negative, reflecting the jagged profile of the series. The short-term elasticity with respect to value added is clearly greater than the long-term elasticity, which reflects the accelerator effect which is usually associated with investment.

2. Changes in inventories

To explain the evolution of inventories on a macro level, two different general models can be distinguished. The first one states that inventories smooth production and thus move in a counter-cyclical way. The second one asserts that stockbuilding acts as an accelerator and has as such a pro-cyclical evolution. Nevertheless, in the Belgian national accounts, changes in inventories are not directly observed, but they merely ensure the equilibrium between production and expenditure accounts. Estimation results should therefore be interpreted with care.

SO = *so1**SO[-1] + *so2**d(QVOF)

Estimation period: 1980Q2-2001Q4

Tests:

F-stat: 6.68; R^2 adjusted: 0.06; Durbin h: -1.02

Coefficient values *(t-stat)*:

so1: 0.220 *(2.1)*

so2: 0.221 *(1.8)*

Given the positive coefficients associated with value added, the accelerator model seems to be the dominant force behind stockbuilding. Because this series is by construction likely to contain a great deal of statistical noise and is accordingly very sensitive to revisions, there is little hope that in the future a stable (in the sense that it would remain valid in consecutively available data sets) equation will be found.

D. Foreign trade

1. Exports of goods and services

The long-term level of Belgian exports is related to a re-weighted indicator of world demand (weights to reflect geographical composition of Belgian exports), domestic export prices relative to competitors' export prices (both expressed in local currency) and a trend since 1997 to take structural market share losses into account that appeared during the last couple of years.

ln(**XO_L**) = *xo_l0* + *xo_l1**ln(QWXSS) + *xo_l2**ln(PX / (PWXSS*EX)) + *xo_l3**T*(t>1996Q4)

Estimation period: 1980Q1-2001Q4

Tests:

R^2 adjusted: 0.99; Durbin-Watson: 0.87; Dickey-Fuller: -4.93

Coefficient values:

xo_l0: 9.04

xo_l1: 0.889

xo_l2: -0.420

xo_l3: -0.001

The elasticity with respect to world trade appears to be somewhat smaller than one. The price competition effect is clearly lower than the volume effect, even in the long run.

In the dynamic equation, the short-run elasticity of exports with respect to relative prices appeared not to be significant anymore during the nineties:

dln(**XO**) = *xo1**dln(QWXSS) + *xo2**dln(QWXSS)[-1] + *xo3**dln(PX / (PWXSS*EX))*(t<1990Q1) + *xo_e**(ln(XO)-ln(XO_L))[-1]

Estimation period: 1980Q3-2001Q4

Tests:

F-stat: 9.73; R^2 adjusted: 0.24; Durbin-Watson: 1.87; MRL: 2

Coefficient values *(t-stat)*:

xo1: 0.461 *(3.3)*

xo2: 0.293 *(2.1)*

xo3: -0.324 *(-2.8)*

xo_e: -0.329 *(-3.9)*

The low R^2 has to be attributed to an unexplained short-run volatility of exports, especially during the first half of the eighties, but the general evolution of the growth rates is correctly described by the equation. As can be seen from the values of the coefficients, exports react very quickly to changes in export markets and converge rapidly to their long-run level. This means that despite a zero value for the short-run price elasticity, exports will still react relatively quickly to changes in relative prices.

2. Imports of goods and services

As imports develop very similarly to re-weighted (weights depending on the import content) final demand, a simple equation in first differences without an error correction mechanism, including relative prices, has been estimated.

dln(**MO**) = *mo1**dln(MO)[-1] + *mo2**dln(PM / PQVFZ)*(t>1989Q4) + *mo3**dln(QMOAB)*(t<1990Q1) + *mo4**dln(QMOAB)*(t>1989Q4)

Estimation period: 1980Q3-2001Q4

Tests:

F-stat: 173.7; R^2 adjusted: 0.86; Durbin h: -2.30

Coefficient values *(t-stat)*:

mo1: -0.127 *(-3.3)*

mo2: -0.110 *(-1.4)*

mo3: 1.438 *(20.4)*

mo4: 1.344 *(13.8)*

As can be seen from the R^2, the equation has a very good fit, but, as in some previous equations, a structural break appears at the beginning of the nineties. First-order serial correlation is still present despite the introduction of a lagged endogenous variable in the right-hand side of the equation. The elasticity with respect to 'theoretical' imports is greater than unity (but somewhat smaller in the second sub-period than in the first) and volume effects clearly dominate price effects, the latter being only (weakly) significant since the beginning of the nineties.

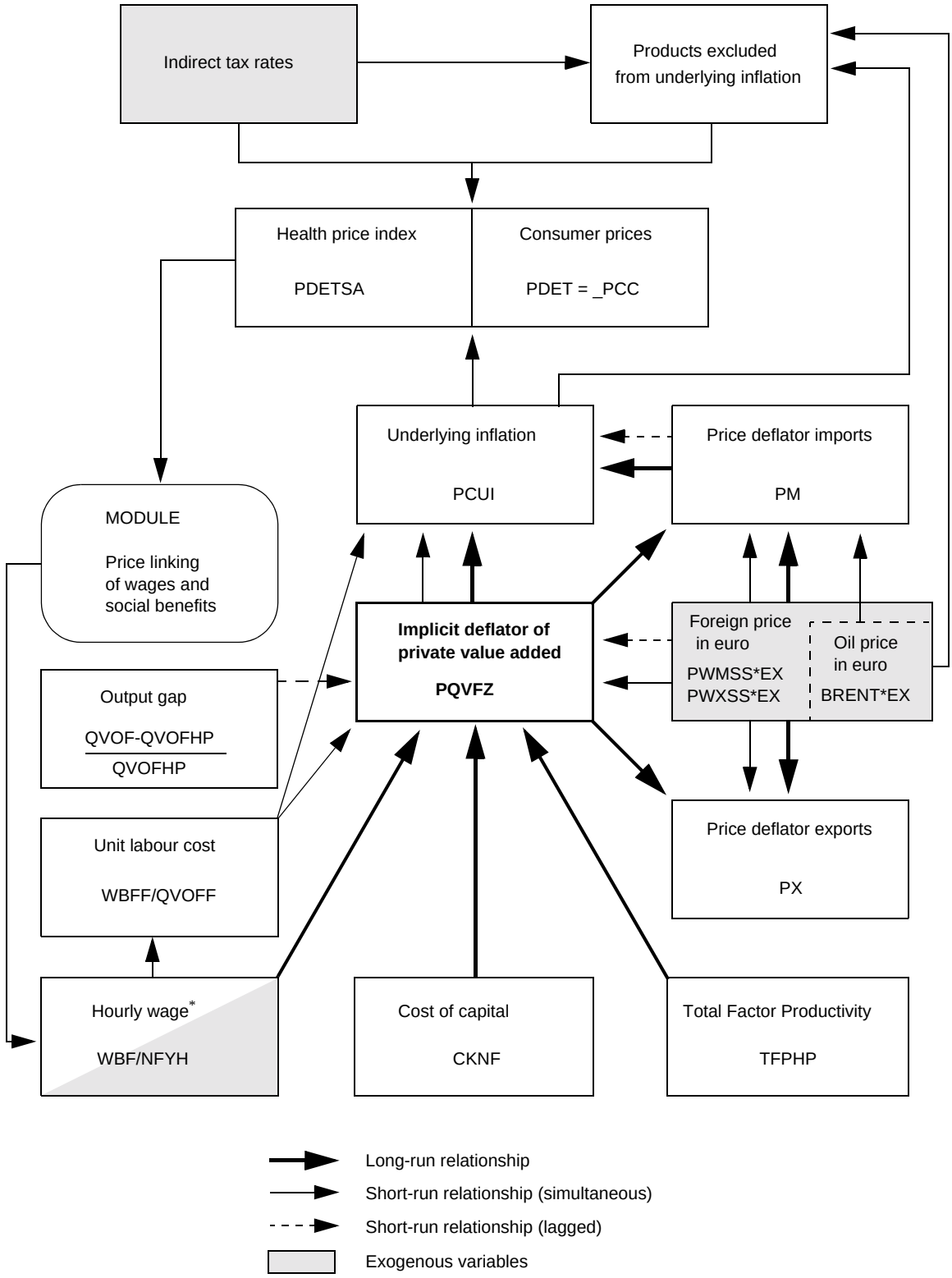
E. Prices and wages

Figure 1 gives a general flow chart of the price formation mechanism. The implicit deflator of private value added deduced from the Cobb-Douglas production function plays a central role in the price formation mechanisms of the model. Export prices are computed as a weighted average of domestic value added prices, reflecting a certain degree of price-makership, and international export prices. Import price formation reflects some 'pricing to the market strategy'. Import prices are therefore not only a function of foreign prices but also of domestic value added prices. To calculate the deflator of private final consumption, the underlying inflation is first modelled and specific profiles for the excluded products and indirect taxes are added afterwards.

The model also contains an integrated indexation module which reproduces specific Belgian legislation. In Belgium, wages and social benefits are automatically price linked, but with a certain time-lag. Public wages and social benefits are adjusted for price changes in a discontinuous way (each time by 2%, respectively two months and one month after the pivotal index is exceeded), while indexation of wages in the private sector can be considered as more continuous, due to the variety (dependent on the sector) of indexation practices.

The flow chart makes clear that inflationary shocks (such as oil price changes or wage increases) only affect domestic inflation with a certain time-lag, due to three types of delays: firstly, the lagged response to changes in long-term values (due to error correction specifications); secondly, some lagged short-run relationships (see dotted lines in the flow chart); and thirdly, the (systemic) delay in the Belgian automatic price linking practice.

FIGURE 2 - Flow chart price formation



* Only hourly gross wages exclusive of indexation are exogenous.

1. Implicit deflator of private value added

The implicit deflator of private value added is the central price in the model. This choice is motivated by the fact that the long-term specification of this price can be directly deduced from the Cobb-Douglas production function. It states that the deflator of private value added (in logarithm) is equal to the weighted sum of wages and the cost of capital, minus total factor productivity, plus a mark-up captured by the constant term:

ln(**PQVFZ_L**) = *pqvfz_l0* + *pqvfz_l1**ln(WBF / NFYH) + (1-*pqvfz_l1*)*ln(CKNF) - ln(TFPHP)

Estimation period: 1981Q4-2001Q4

Coefficient values:

pqvfz_l0: 0.623

pqvfz_l1: 0.679

Total factor productivity, which was calculated as the residual of the production function (the so-called Solow residual) and which is, as such, very volatile, has been filtered with the Hodrick-Prescott filter. The coefficients related to the factor costs represent the share of value added attributed to each production factor and they are constrained to one in accordance with the hypothesis of constant returns to scale (cf. section C.1).

The estimated dynamic equation is as follows:

dln(**PQVFZ**) = *pqvfz0* + *pqvfz01**(t>1993Q4) + *pqvfz1**dln(WBFF / QVOFF) + *pqvfz2**dln(PWMSS*EX) + *pqvfz3**dln(PWMSS*EX)[-3] + *pqvfz4**d((QVOF-QVOFHP) / QVOFHP)[-4] + *pqvfz_e**(ln(PQVFZ)-ln(PQVFZ_L))[-1]

Estimation period: 1982Q1-2001Q4

Tests:

F-stat: 32.45; R^2 adjusted: 0.70; Durbin-Watson: 1.88; MRL: 12

Coefficient values *(t-stat)*:

pqvfz0: 0.008 *(16.7)*

pqvfz01: -0.004 *(-5.6)*

pqvfz1: 0.069 *(2.8)*

pqvfz2: 0.027 *(2.0)*

pqvfz3: 0.035 *(2.6)*

pqvfz4: 0.155 *(3.5)*

pqvfz_e: -0.059 *(-5.5)*

Short-run fluctuations in the deflator of value added can first be explained by unit labour costs (thus taking hourly labour costs and productivity into account), although the estimated coefficient seems to be rather small. In the long run a constant mark-up was imposed. In the short run, one can assume that profit margins react to market tensions (demand pull inflation). This effect was captured by means of an indicator of the output gap, i.e. the percentage deviation of output from its trend. One can also suppose that margins are influenced by the evolution of foreign prices. Indeed, when for example, foreign prices increase, domestic prices can be raised without the risk of losing market shares. These two factors seem to affect profit margins with a certain delay. Finally, we have added a constant term which can be interpreted as a kind of autonomous or 'natural'

inflation rate. This rate is influenced in particular by the credibility of monetary policy and by the degree of competition on goods and services markets. According to our estimates, a structural break occurred at the end of 1993, when 'natural' inflation decreased substantially.

2. Explicit deflator of private value added

As the model is 'demand-driven', value added at current and constant prices is deduced from the expenditure approach. The explicit deflator of value added is then simply computed as the ratio between value added at current prices and value added at constant prices. This implies that the growth rate of this deflator might be slightly different from the growth rate of the implicit deflator generated by the equation mentioned in the previous section[1].

3. Export and import prices

In the long run, exporting firms are supposed to set prices as a weighted average of international export prices (expressed in euro) and (the long-term value of) domestic value added prices, the coefficient of the latter reflecting the degree of price-makership they have.

ln(**PX_L**) = *px_l0* + *px_l1**ln(PWXSS*EX) + (1-*px_l1*)*ln(PQVFZ_L)

Estimation period: 1981Q4-2001Q4

Tests:

R^2 adjusted: 0.94; Durbin-Watson: 0.44; Dickey-Fuller: -3.48

Coefficient values:

px_l0: -1.893

px_l1: 0.559

In the short run, an error correction mechanism is applied:

dln(**PX**) = *px0* + *px1**dln(PX)[-1] + *px2**dln(PWXSS*EX) + *px_e**(ln(PX)-ln(PX_L))[-1]

Estimation period: 1982Q2-2001Q4

Tests:

F-stat: 34.21; R^2 adjusted: 0.56; Durbin h: -0.21; MRL: 3

Coefficient values *(t-stat)*:

px0: 0.003 *(2.2)*

px1: 0.137 *(1.7)*

px2: 0.370 *(7.3)*

px_e: -0.243 *(-3.8)*

As expected, short-run elasticities are smaller than their long-term counterparts and convergence towards the long-term values is rather fast.

Foreign firms are supposed to set prices according to a 'pricing to the market' strategy, which implies that import prices are not only a function of foreign prices (in euro) but also of (the long-term value of) domestic value added prices. The

1. This implicit deflator can be interpreted as a kind of 'shadow price'.

importance of this strategy is given by the value of the elasticity associated with domestic prices.

ln(**PM_L**) = *pm_l0* + *pm_l1**ln(PWMSS*EX) + (1-*pm_l1*)*ln(PQVFZ_L)

Estimation period: 1981Q4-2001Q4

Tests:

R^2 adjusted: 0.92; Durbin-Watson: 0.72; Dickey-Fuller: -4.40

Coefficient values:

pm_l0: -2.889

pm_l1: 0.851

In the dynamic equation, domestic prices appear not to be significant. The oil price is introduced in order to take an additional specific effect of energy prices on import prices into account. Indeed, it seems logical that import prices of energy goods have higher short-run elasticities with respect to international prices than import prices of other goods.

dln(**PM**) = *pm1**dln(PM)[-1] + *pm2**dln(PWMSS*EX) + *pm3**dln(BRENT*EX) + *pm_e**(ln(PM)-ln(PM_L))[-1]

Estimation period: 1982Q2-2001Q4

Tests:

F-stat: 33.56; R^2 adjusted: 0.56; Durbin h: -0.60; MRL: 2

Coefficient values *(t-stat)*:

pm1: 0.207 *(2.5)*

pm2: 0.348 *(4.4)*

pm3: 0.039 *(3.3)*

pm_e: -0.289 *(-3.8)*

4. Consumer prices

Besides its role in the determination of the GDP deflator, the modelling of consumer prices is of particular interest for Belgium because of the prevailing automatic indexation system of wages and social benefits. The latter is linked to the evolution of a special consumer price index, the so-called 'health index'. This implies that three different kinds of consumer price concepts had to be modelled:

(1) the deflator of private consumption;
(2) the national consumer price index;
(3) the health index.

The deflator of private consumption (in raw terms, that is not seasonally adjusted[1]) is strongly correlated with the national consumer price index. This leads to the following equation[2]:

dln **_PCC** = dln PDET

1. Names of variables that are not seasonally adjusted are indicated in the model as _'variable code'.
2. This equation holds in absence of special factors (such as the reduction of the radio and television licence fee, that affects PDET, but not _PCC).

The national consumer price index and the health index are calculated as a weighted sum of underlying inflation, VAT on the product package of underlying inflation and different products excluded from underlying inflation: alcohol, tobacco, fuel for vehicles, other energy products (heating, lighting), fresh vegetables and fruit, circulation tax on vehicles, radio and television licence fee, meat products and water consumption. The first three products are not taken into account for the computation of the health index.

PDET = (*0.75178**(_PCUI*(1 + VATSEL))) + (_EXCLALC + _EXCLTOB + _EXCLOIL + _EXCLEGY + _EXCLFRF + _EXCLTRA + _EXCLKLG + _EXCLWAT + _EXCLMEA)

PDETSA = (PDET - (_EXCLALC+_EXCLTOB+_EXCLOIL)) / *0.91634*

The calculation of both price indices relies consequently on the modelling of underlying inflation and of the different excluded products.

a. Underlying inflation

In the long run, underlying inflation is supposed to be a weighted average of (the long-term value of) domestic value added prices (reflecting domestic factor costs) and import costs.

ln(**PCUI_L**) = *pcui_l0* + *pcui_l1**ln(PQVFZ_L) + (1-*pcui_l1*)*ln(PM)

Estimation period: 1986Q1-2001Q4

Tests:

R^2 adjusted: 0.98; Durbin-Watson: 0.47; Dickey-Fuller: -3.86

Coefficient values:

px_l0: 4.480

px_l1: 0.915

Because underlying (or core) inflation excludes indirect taxes and a number of products which are highly volatile (energy, fresh vegetables and fruit...), it has a greater degree of inertia than global inflation. Its short-run equation, therefore, contains a second order autoregressive process. Nevertheless, it is also influenced by the contemporaneous evolution of the implicit deflator of private value added and of unit labour costs and by the past growth of import prices.

dln(**PCUI**) = *pcui1**dln(PCUI)[-1] + *pcui2**dln(PCUI)[-2] + *pcui3**dln(PQVFZ) + *pcui4**dln(WBFF / QVOFF) + *pcui5**dln(PM)[-2] + *pcui_e**(ln(PCUI)-ln(PCUI_L))[-1]

Estimation period: 1986Q2-2001Q4

Tests:

F-stat: 26.53; R^2 adjusted: 0.67; Durbin h: -1.72

Coefficient values *(t-stat)*:

pcui1: 0.529 *(4.6)*

pcui2: 0.217 *(2.0)*

pcui3: 0.185 *(3.9)*

pcui4: 0.013 *(1.0)*

pcui5: 0.018 *(2.1)*

pcui_e: -0.019 *(-1.3)*

b. Excluded products

Among the nine excluded products, only the modelling of the two energy prices (fuel for vehicles and energy products for heating and lighting) is presented below.

Fuel prices are a positive function of world oil prices, expressed in local currency, and indirect taxes (VAT and excises):

dln(**_EXCLOIL**) = dln((1+VATOIL)*(*excloil1**(BRENT*EX / 159)+ACCOIL))

Estimation period: 1991Q2-2001Q4

Tests:

R^2 adjusted: 0.84; Durbin-Watson: 2.00

Coefficient values *(t-stat)*:

excloil1: 1.047 *(11.0)*

The modelling of energy prices for heating and lighting is done through the use of an error correction mechanism. A number of dummies have been included in order to take several policy measures into account.

ln(**EXCLEGY_L**) = *exclegy_l0* + ln(1+VATEGY) + *exclegy_l1**ln(BRENT*EX) + *exclegy_l2**(t>1992Q4) + *exclegy_l3**(t>1993Q2) + *exclegy_l4**(t>1995Q4)

Estimation period: 1991Q1-2001Q4

Tests:

R^2 adjusted: 0.88; Durbin-Watson: 0.41; Dickey-Fuller: -1.68

Coefficient values:

exclegy_l0: 0.650

exclegy_l1: 0.146

exclegy_l2: 0.013

exclegy_l3: 0.029

exclegy_l4: 0.019

The dynamic equation reflects that energy prices for heating and lighting adjust only with a certain time-lag to changes in the explanatory variables:

dln(**EXCLEGY**) = *exclegy1**dln((1+VATEGY)*(BRENT*EX)) + *exclegy2**dln((1+VATEGY)*(BRENT*EX))[-3] + *exclegy_e**(ln(EXCLEGY)-ln(EXCLEGY_L))[-1] + *exclegy01**(t= 1993Q1) + *exclegy02**(t= 1993Q3) + *exclegy03**(t= 1996Q1)

Estimation period: 1992Q3-2001Q4

Tests:

F-stat: 17.24; R^2 adjusted: 0.69; Durbin-Watson: 2.08; MRL: 3

Coefficient values *(t-stat)*:

exclegy1: 0.065 *(5.3)*

exclegy2: 0.040 *(3.1)*

exclegy_e: -0.215 *(-2.7)*

exclegy01: 0.009 *(1.0)*

exclegy02: 0.014 *(1.5)*

exclegy03: 0.012 *(1.3)*

5. Wages in the private sector

Considering the short-term horizon of this version of the model (six to eight quarters), the hourly gross wage increase exclusive of indexation in the private sector, is considered as exogenous, as it is largely determined by biannual collective agreements between social partners. Nominal hourly wages are then obtained by multiplying this exogenous variable with the indexation coefficient. Hourly wage cost is calculated by adding different categories of employers' social contributions.

F. The institutional sectors' accounts

The model distinguishes four economic agents, called 'institutional sectors': households, firms, general government and the rest of the world.[1]

For each economic agent a sequence of accounts can be made. These accounts provide an insight into the different stages of the economic process: generation of income, distribution of income, redistribution of income, use of income and capital accumulation.[2]

A full set of quarterly data to construct these accounts is currently not available in the officially published quarterly national accounts. As a consequence, part of the data used are unpublished. The remaining part has been constructed by the FPB. In the latter case, maximum consistency with available quarterly and annual accounts has been aimed at (for more general comments on the quarterly database, see Appendix I). For reasons of availability of data and desired simplicity, the institutional sectors' quarterly accounts are more concise than the annual version of these accounts.

In this section, only the sequence of accounts for households will be demonstrated in detail and an overview of the modelling of the key variables of these accounts will be discussed. The summary accounts for all four economic agents will be presented in Appendix III.

The accounting framework provided by the tables below, guarantees a consistent income approach, that is verified both for the historic data base and for the model simulation results.

1. In this paper, households are used in a broad sense, i.e. households *sensu stricto* (S14) and non-profit institutions serving households (S15). Firms include non-financial (S11) and financial (S12) corporations. The other institutional sectors are general government (S13) and the rest of the world (S2). (ESA 1995 codes between brackets).
2. The first stage, namely production, has not been developed in the model, no more than the final stage, namely financial accumulation.

1. Generation and allocation of households' primary income

Households' primary income is composed of four elements: operating surplus, mixed income, compensation of employees and property income.[1]

TABLE 1 - Households: allocation of primary income account

Uses	Resources
	(B.2n) Operating surplus (net) (GOSH_I-DPUH_I)
	(B.3) Mixed income (REMI)
	(D.1) Compensation of employees (WBU+YN)
	(D.4) Property income (net) (IDH_I)
(B.5n) Primary income (net) (GOSH_I-DPUH_I+REMI+WBU+YN+IDH_I)	

Real mixed income per head[2] is determined by two indicators that reflect profitability, namely the output gap and the capital income share (i.e. the inverse of the wage share) of the corporate sector.

The gross wage sum of the private and the public sector and different categories of employers' social contributions sum up to total compensation of employees.

The third component of primary income, namely net property income, has been split into various components. The most important component (received interests and dividends) is written as a function of household financial wealth, long-term and short-term interest rates and the profitability of capital. Interests paid are determined by household investment and the development of interest rates.

The operating surplus is obtained as the residual of the generation of income account, as shown below.

TABLE 2 - Households: generation of income account

Uses		Resources
(D.1)	Compensation of employees (WBFH_I)	(B.1n) Value added (net) (QVUFH_I-DPUH_I)
(D.29)	Other taxes on production minus (D.39) other subsidies on production (ITPDH_I-SUBDGH_I)	
(B.2n) Operating surplus (net) (GOSH_I-DPUH_I) + (B.3) Mixed income (REMI)		

2. The secondary distribution of households' income

The secondary distribution transforms households' primary income into disposable income, taking into account social benefits, social contributions, current taxes and other current transfers.

1. In the tables below, codes between brackets at the beginning of the different items are ESA 1995 references. Codes between brackets at the end of the different items refer to the names of the model variables.
2. More precisely: mixed income per self-employed divided by the deflator of value added at basic prices.

TABLE 3 - Households: secondary distribution of income account

Uses	Resources
(D.5) Current taxes on income and wealth (DTOTH_I)	(B.5n) Primary income (net)
(D.61) Social contributions[a] (YSSH)	(D.62) Social benefits[b] (SBH)
	(D.7) Other current transfers (received minus paid) (OCUH_I)
(B.6n) Disposable income (net) (YDH_I-DPUH_I)	

a. Actual and imputed.
b. Other than social transfers in kind.

Social benefits are split into two categories depending on whether they are influenced or not by the business cycle. Social benefits that do not follow a cyclical pattern are assumed to follow a trend on top of the legal price linking. Unemployment benefits (the main component of the other category) are, in addition to the price linking, determined by the number of unemployed and lagged economic growth.

Social contributions are composed of employers' (actual and imputed) and employees' contributions. Social contributions are split up further (into some 20 categories) on the basis of the receiving institutional sector (social security, federal government, private (insurance) companies) and the agent that pays the contributions (for employers' contributions: public or private sector; for employees' contributions: wage earners, self-employed and people receiving social benefits). Most social contributions are, in absence of social security programmes, kept constant as a share of their respective levying basis (mainly wage sum).

The withholding earned income tax (PAYE revenue), which is the main component of current taxes on income and wealth, takes into account the progressive character of the Belgian personal income tax system and there is a choice to switch the price linking of tax scales on or off.

Most other current transfers are merely price linked or kept constant as a share of GDP.

3. Use of households' disposable income

Households' disposable income is available for consumption expenditure and savings. Changes in net equity of households in pension funds reserves are logically considered as savings.

TABLE 4 - Households: use of disposable income account

Uses	Resources
(P.3) Final consumption expenditure (CCU)	(B.6n) Disposable income (net) (YDH_I-DPUH_I)
	(D.8) Adjustment for the change in net equity of households in pension funds reserves (VAMARE)
(B.8n) Savings (net) (SH_I-DPUH_I)	

The change in net equity of households in pension funds reserves is calculated by identity. It is considered as the difference between social contributions received by private insurance companies, and benefits paid by them.

4. The households' capital account

The capital account shows the transition of savings, which is the final balancing item of the current account, into net lending, respectively net borrowing, which is the amount available for financing other sectors, respectively the amount which the household sector is obliged to borrow from other sectors.

To determine the amount of net lending / net borrowing, other capital resources (mainly capital transfers) are added to savings and capital formation (fixed and changes in inventories, both non-financial assets) is deducted. In the model, capital taxes are isolated from net capital transfers, because they are part of total tax revenues.

TABLE 5 - Households: capital account

Uses	Resources
(P.51)-(K.1) Fixed capital formation (net)[a] (IUH_I-DPUH_I)	(B.8n) Savings (net) (SH_I-DPUH_I)
(P.52) Changes in inventories (SUH)	(D.9) -(D.91)-(P.53)-(K.2) Other capital resources (received minus paid) (ACAHN_I)[b]
(D.91) Capital taxes (IK)	
(B.9) Net lending (+) / net borrowing (-) (FLH_I)	

a. (P.51): gross fixed capital formation; (K.1): consumption of fixed capital.

b. (D.9)-(D.91): receivable capital transfers minus payable capital transfers, other than capital taxes; (P.53): acquisitions less disposals of valuables; (K.2): acquisitions less disposals of non-produced non-financial assets.

As fixed capital formation of households incorporates housing investment (share of 80%) and investment of self-employed and of non-profit institutions serving households, its growth rate is determined as a weighted average of the growth of housing and business investment.

As already mentioned in section B.1, households' net lending contributes to the formation of their financial wealth.

III Model simulations

The purpose of this chapter is to analyse the properties of the complete model through a range of simulation exercises. The simulations presented in the first section, have to be considered as technical, in the sense that they illustrate the endogenous mechanisms of the model in response to the standardized modification of one exogenous variable. In the final section, two simulations that imply a simultaneous change of several exogenous variables will be examined.

The simulation results are expressed relative to a baseline reference, where exogenous variables have been mechanically extrapolated or calculated on the basis of their historical average (in level or growth rate in case of non-stationary variables). This baseline simulation does not represent a forecast in the usual sense, but converges to a stable growth path compatible with past trends. A final remark: econometric equations generate the best forecasts for values of the exogenous variables which are close to their sample mean. This is logic, as for values farther from the mean, one moves out of the range of experience used to estimate the model and generates less reliable forecasts[1]. Therefore, it could be dangerous to use the results presented hereafter to extrapolate, by a simple arithmetic rule, the outcome of larger shocks never experienced in the past.

A. Technical simulations

Five exogenous shocks have been considered, the first two focusing on international variables, the third implying a wage increase and the last two assuming fiscal policy measures:

- an increase in world trade;
- a decrease in equity prices;
- an increase in hourly gross wages;
- a reduction of employers' social security contributions;
- an increase of VAT on consumer goods.

Simulation results reported here cover a period of eight quarters, which corresponds to the horizon over which the model will be used in practice (short-term analysis and forecasting). On this period, the hypothesis of unchanged hourly gross wage increase (exclusive of indexation) seems reasonable, considering the prevailing institutional wage negotiation context. Note also that during this two-year period, an important part of the adjustments towards the long-term values, implied by the level equations, will have taken place[2]. In the

1. For a more formal discussion on the topic, see Pindyck and Rubinfeld (1998), pp. 204-209.
2. The values of the MRL indicators provided in Chapter II give a fairly good idea how fast each variable converges towards its long-term level.

tables below, the four quarters of year T (TQ1...TQ4) and the situation for the last quarter of the simulation period (T+1)Q4 will be presented.

1. An increase in world trade

a. Shock

In this first scenario we assume that potential export markets for Belgium increase by an additional 1% during the first quarter of simulation. Afterwards, the growth rate is identical to that of the baseline.

b. Simulation results

The additional growth in world trade has a direct positive impact on exports. During the first quarter, export demand increases[1] by 0.46%, according to its first quarter short-term elasticity with respect to world trade. Due to the high two quarters cumulative short-term elasticity and the high coefficient of the error correction term, adjustment towards the new long-term level (+0.89%) has already been achieved during the second quarter. This increase in external demand is satisfied by a rise in production, which induces extra business investment (+0.32% at the end of the first year).

This increase in production also boosts labour demand, but due to rigidities, employment in the private sector increases at a slower pace (only +0.11% after four quarters) and temporary productivity gains appear. This rise in employment implies a higher disposable income and a modest rise in consumption spending (0.04% in TQ4). This increase in final demand means of course also an upsurge in imports. Recall that the elasticity of imports with respect to the re-weighted indicator for final demand is larger than one, which signifies that the rise in imports is substantial (+0.74% in the last quarter of the first year) and that the additional growth in GDP (+0.23% in TQ4) is much more modest than the growth in world trade.

As real hourly wages are supposed not to react in the short run to changes in labour market conditions, decreasing unit labour costs have a slight negative impact on prices during the first year. During the second year, a modest acceleration in inflation appears (+0.01% in (T+1)Q4 for the consumer price index) due to market tensions induced by increased economic activity and despite still decreasing unit labour costs. The latter tend to return to their baseline level as employment continues to increase (the hypothesis of constant returns to scale implies that this adjustment process vanishes when employment growth will match value added growth).

During the second year, GDP growth is no longer affected, as the small further increase in domestic demand is compensated by a somewhat lower contribution of net exports. The current account balance stabilizes at some 0.14 percentage point above the baseline.

1. Note that in all following comments concerning simulation results an ‘increase’ or ‘decrease’ has to be understood always as ‘relative to the baseline scenario’.

TABLE 6 - An increase in world trade

% difference from the baseline	TQ1	TQ2	TQ3	TQ4	(T+1)Q4
Exogenous shock					
Potential export markets for Belgium	1.00	1.00	1.00	1.00	1.00
GDP and its components					
Private consumption	0.01	0.02	0.03	0.04	0.06
Government consumption	-0.00	-0.00	-0.00	-0.00	0.00
Gross fixed capital formation, *of which:*	0.08	0.21	0.23	0.23	0.27
- Business investment	0.12	0.29	0.33	0.32	0.36
- Housing investment	0.01	0.02	0.04	0.06	0.10
Total national expenditure	0.04	0.09	0.09	0.07	0.09
Exports of goods and services	0.46	0.89	0.89	0.89	0.89
Imports of goods and services	0.43	0.80	0.75	0.74	0.76
Gross domestic product	0.08	0.20	0.23	0.23	0.23
Prices					
Consumer price index	-0.00	-0.00	-0.01	-0.01	0.01
Health index	-0.00	-0.00	-0.01	-0.01	0.01
Export prices	0.00	0.00	0.00	0.00	0.00
Import prices	0.00	0.00	0.00	0.00	0.00
Terms of trade	0.00	0.00	0.00	0.00	0.00
GDP deflator	-0.00	-0.00	-0.00	-0.00	0.01
Employment and wages (private sector)					
Hourly wage cost	0.00	0.00	0.00	0.00	0.01
Unit labour cost	-0.06	-0.16	-0.18	-0.16	-0.10
Employment (wage earners, in hours)	0.02	0.06	0.09	0.11	0.17
Value added	0.08	0.23	0.28	0.27	0.28
Hourly labour productivity	0.06	0.16	0.18	0.16	0.11
Income					
Real disposable income households	0.02	0.06	0.09	0.09	0.11
Absolute difference from the baseline					
Household savings as % of disposable income	0.01	0.03	0.04	0.04	0.04
Unemployment rate as % of labour force	-0.00	-0.01	-0.02	-0.03	-0.06
Wage share as % of value added of enterprises	-0.04	-0.10	-0.11	-0.10	-0.07
Current account balance as % of GDP	0.04	0.11	0.15	0.15	0.14

2. A decrease in equity prices

a. Shock

In this scenario we consider a general decrease of 10% (in comparison to the baseline) in national and international equity prices (summarized by two indexes: FTSE Eurotop 300 and US Standard&Poors' 500). The impact that this general drop in equity prices in the real world should have on other international variables (interest rates, exchange rates, world demand) is not taken into account in this technical simulation.

b. Simulation results

The impact effect of the equity price shock is a decrease in households' financial wealth of about 2.7%[1]. This in turn induces consumers to start adjusting their savings rate upwards from the second quarter on and consumption spending therefore declines progressively (-0.17% after four quarters). Firms react to this drop in consumer demand by revising investment downwards (-0.09% in TQ4). This decrease in domestic demand also induces lower imports. On the whole, GDP declines by a modest 0.07% at the end of the first year.

During the second year, real disposable income is also affected, as weaker economic activity results in a gradual fall in employment and as dividend payments by firms decrease. This, of course, reinforces the wealth effect described above, so that at the end of the second year private consumption decreases by 0.28%. This erosion of real disposable income also affects housing investment (-0.15%) and business investment declines further (-0.15%). Consequently, GDP continues to diminish (-0.11%). No significant effect on prices arises during the two-year simulation period.

1. Note that we consider here only the purely accounting impact on direct equity holdings and do not take into account portfolio shift effects in favour of other assets. Be also aware that this simulation does not capture the consequences which falling equity prices may have on investment through a change in financing conditions.

TABLE 7 - A decrease in equity prices

% difference from the baseline	TQ1	TQ2	TQ3	TQ4	(T+1)Q4
Exogenous shock					
Equity prices	-10.00	-10.00	-10.00	-10.00	-10.00
GDP and its components					
Private consumption	0.00	-0.12	-0.14	-0.17	-0.28
Government consumption	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation, *of which:*	-0.00	-0.05	-0.06	-0.07	-0.14
- Business investment	0.00	-0.07	-0.08	-0.09	-0.15
- Housing investment	0.00	-0.00	-0.01	-0.03	-0.15
Total national expenditure	0.00	-0.09	-0.10	-0.11	-0.19
Exports of goods and services	0.00	0.00	0.00	0.00	-0.00
Imports of goods and services	-0.00	-0.05	-0.05	-0.05	-0.09
Gross domestic product	0.00	-0.05	-0.06	-0.07	-0.11
Prices					
Consumer price index	-0.00	0.00	0.00	0.00	0.00
Health index	-0.00	0.00	0.00	0.00	0.00
Export prices	0.00	-0.00	-0.00	-0.00	0.00
Import prices	0.00	0.00	-0.00	-0.00	0.00
Terms of trade	0.00	-0.00	-0.00	-0.00	0.00
GDP deflator	0.00	0.00	0.00	0.00	0.00
Employment and wages (private sector)					
Hourly wage cost	-0.00	-0.00	-0.00	-0.00	-0.00
Unit labour cost	-0.00	0.04	0.04	0.05	0.06
Employment (wage earners, in hours)	0.00	-0.01	-0.02	-0.03	-0.06
Value added	0.00	-0.05	-0.07	-0.07	-0.12
Hourly labour productivity	0.00	-0.04	-0.05	-0.05	-0.06
Income					
Real disposable income households	-0.00	-0.01	-0.03	-0.06	-0.20
Absolute difference from the baseline					
Household savings as % of disposable income	0.00	0.09	0.09	0.09	0.07
Unemployment rate as % of labour force	-0.00	0.00	0.00	0.01	0.02
Wage share as % of value added of enterprises	-0.00	0.02	0.03	0.03	0.03
Current account balance as % of GDP	0.00	0.04	0.04	0.05	0.08

3. An increase in hourly gross wages

a. Shock

Hourly gross wages (exclusive of indexation) are exogenous in the present version of the model. In this scenario an additional wage increase of 1% during the first quarter of the simulation period is considered.

b. Simulation results

Higher wages have a direct positive impact on real households' disposable income. This effect will nevertheless be weakened by two factors. On the one hand, other income components, mixed income in particular, will decline. On the other hand, the increase in labour costs initiates factor substitutions in favour of capital, which means that employment decreases. As this phenomenon progresses only gradually, households' disposable income, after a rise of 0.24% during the first quarter, slowly returns to the baseline (it is only 0.14% above the reference simulation in TQ4). This means that private consumption is torn between two opposite forces: the increase in disposable income pushes consumption upwards and the rise in unemployment induces an upsurge in precautionary savings. The result is, that after an initial increase, consumption spending gradually reverts to its baseline level (it is only 0.05% above the baseline at the end of the first year).

The effect on investment is positive thanks to the increase in housing investment, supported by higher disposable income. The impact on business investment is slightly positive during the first quarter, due to the accelerator effect, but is dampened in the following quarters by the loss in profitability. As prices slowly rise, due to higher labour costs, exports start to decrease at the end of the first year as a consequence of a deterioration in price competitiveness. All in all, GDP increases only marginally at the end of the first year (+0.01%).

As substitutions continue to develop, employment in the private sector decreases further during the second year, arriving at -0.50% in the last quarter. As a consequence, labour productivity increases (+0.48%) and profitability is restored progressively. The increase in real disposable income is less than half its initial level at the end of the simulation period, because the acceleration in inflation (CPI ends up 0.33% above the baseline) has a negative impact on real property income and employment destruction weighs on wage income. As a result, consumption continues to revert to the baseline. Exports decrease further as export prices are gradually adapting to higher wage costs and GDP is therefore somewhat below the baseline level after eight quarters (-0.02%).

TABLE 8 - An increase in hourly gross wages

% difference from the baseline	TQ1	TQ2	TQ3	TQ4	(T+1)Q4
Exogenous shock					
Hourly gross wage (before indexation)	1.00	1.00	1.00	1.00	1.00
GDP and its components					
Private consumption	0.07	0.06	0.06	0.05	0.03
Government consumption	0.00	0.00	0.00	0.00	0.03
Gross fixed capital formation, *of which:*	0.03	0.04	0.05	0.05	0.01
- Business investment	0.03	0.02	0.02	0.01	-0.01
- Housing investment	0.06	0.12	0.15	0.17	0.07
Total national expenditure	0.05	0.05	0.04	0.04	0.02
Exports of goods and services	0.00	0.00	-0.01	-0.03	-0.10
Imports of goods and services	0.04	0.03	0.02	0.01	-0.05
Gross domestic product	0.02	0.02	0.02	0.01	-0.02
Prices					
Consumer price index	0.02	0.05	0.08	0.12	0.33
Health index	0.02	0.05	0.09	0.13	0.34
Export prices	0.00	0.08	0.15	0.20	0.33
Import prices	0.00	0.03	0.06	0.08	0.12
Terms of trade	0.00	0.05	0.09	0.12	0.21
GDP deflator	0.02	0.08	0.14	0.21	0.46
Employment and wages (private sector)					
Hourly wage cost	1.05	1.06	1.08	1.11	1.31
Unit labour cost	0.92	0.85	0.81	0.79	0.82
Employment (wage earners, in hours)	-0.11	-0.18	-0.24	-0.30	-0.50
Value added	0.02	0.02	0.02	0.02	-0.02
Hourly labour productivity	0.12	0.20	0.26	0.32	0.48
Income					
Real disposable income households	0.24	0.21	0.17	0.14	0.11
Absolute difference from the baseline					
Household savings as % of disposable income	0.14	0.11	0.09	0.06	0.05
Unemployment rate as % of labour force	0.06	0.10	0.14	0.17	0.28
Wage share as % of value added of enterprises	0.58	0.48	0.41	0.35	0.19
Current account balance as % of GDP	-0.02	0.02	0.05	0.08	0.13

4. A reduction of employers' social security contributions

a. Shock

The reduction in employers' social contributions is calibrated so that *ex ante* the hourly wage cost in the private sector decreases by 1% relative to the baseline. This represents around 251 million euro during the first quarter and 268 million euro at the end of the simulation period.

b. Simulation results

The decrease in wage costs induces two mechanisms. On the one hand, it encourages factor substitution in favour of labour. This employment creation is also strengthened by multiplier effects: more employment boosts households' disposable income which, in turn, stimulates private consumption, economic activity and again employment. Employment in the private sector increases by 0.10% in the first quarter and by 0.29% at the end of the first year. On the other hand, reduced wage costs exert a downward pressure on prices which strengthens competitivity. As prices are rather sticky, the slowdown only appears gradually (-0.11% for the consumer price index and -0.18% for export prices at the end of the first year). This also implies that, in the meantime, firms improve their profit margins as can be seen from the decrease in the wage share.

At the end of the second year, employment in the private sector has improved further (+0.49%), labour productivity has decreased (-0.42%), but GDP has risen (+0.09%). This increase is not only due to higher consumption (+0.15%), but also to higher investment and exports (respectively +0.11% and +0.09%). Consumer prices are almost 0.3% lower than in the baseline. The current account balance deteriorates as net exports in volume decrease and terms of trade losses appear.

TABLE 9 - A reduction of employers' social security contributions

% difference from the baseline	TQ1	TQ2	TQ3	TQ4	(T+1)Q4
GDP and its components					
Private consumption	0.01	0.03	0.04	0.06	0.15
Government consumption	-0.00	-0.00	-0.00	-0.00	-0.00
Gross fixed capital formation, of which:	0.01	0.02	0.04	0.05	0.11
- Business investment	0.02	0.03	0.04	0.05	0.08
- Housing investment	0.01	0.02	0.05	0.08	0.22
Total national expenditure	0.01	0.02	0.03	0.05	0.11
Exports of goods and services	0.00	0.00	0.01	0.02	0.09
Imports of goods and services	0.00	0.01	0.02	0.04	0.11
Gross domestic product	0.01	0.02	0.02	0.04	0.09
Prices					
Consumer price index	-0.02	-0.04	-0.08	-0.11	-0.30
Health index	-0.02	-0.04	-0.08	-0.12	-0.31
Export prices	0.00	-0.07	-0.13	-0.18	-0.30
Import prices	0.00	-0.03	-0.05	-0.07	-0.11
Terms of trade	0.00	-0.04	-0.08	-0.11	-0.19
GDP deflator	-0.02	-0.07	-0.13	-0.19	-0.41
Employment and wages (enterprises)					
Hourly wage cost	-0.94	-0.95	-0.98	-1.01	-1.19
Unit labour cost	-0.85	-0.80	-0.77	-0.75	-0.77
Employment (wage earners, in hours)	0.10	0.18	0.24	0.29	0.49
Value added	0.02	0.02	0.02	0.03	0.07
Hourly labour productivity	-0.09	-0.16	-0.21	-0.26	-0.42
Income					
Real disposable income households	0.03	0.06	0.09	0.13	0.27
Absolute difference from the baseline					
Household savings as % of disposable income	0.01	0.02	0.04	0.05	0.10
Unemployment rate as % of labour force	-0.06	-0.10	-0.13	-0.16	-0.27
Wage share as % of value added of enterprises	-0.53	-0.45	-0.39	-0.33	-0.18
Current account balance as % of GDP	-0.01	-0.05	-0.08	-0.11	-0.18

5. An increase of VAT on private consumption

a. Shock

In this simulation the normal VAT rate of 21% is permanently increased to 23%.[1] This corresponds to an *ex ante* rise of VAT receipts by an amount equivalent to about 0.45% of GDP.

b. Simulation results

The rise of the VAT rate leads to a permanently higher level of consumer prices. The inflationary impact is to a large degree one-off (consumer prices immediately increase by 0.91%). During the following seven quarters the quarter-on-quarter inflation rate is only marginally higher (0.04 percentage point per quarter on average) than in the baseline. Hence, on a yearly average basis, consumer price inflation is 0.98 percentage point higher during the first year and only 0.17 percentage point higher during the second year.[2]

Immediately after the shock, households' real disposable income is hit strongly for two reasons. On the one hand, it takes at least two quarters before higher prices are fully passed on to wages and social benefits[3] and, on the other hand, some income components (for instance property income[4]) are not price linked. As wages and social benefits adjust to the higher prices, households' disposable income somewhat returns to the baseline (-0.59% in (T+1)Q4 against -0.81% in TQ4). The fact that this return is only limited is due to the adverse impact on disposable income of continuously falling employment.

In the first quarter after the shock, the impact on employment is rather limited, as the major part of the fall in value added is initially offset by lower productivity (productivity cycle). Over the whole simulation period, employment deteriorates continuously as compared to the baseline (up to -0.75% in (T+1)Q4), as a consequence of the delayed reaction to the fall in value added and the rise in real[5] hourly wage costs.

During the first two years after the shock, private consumption is less affected than households' real disposable income, as the lower savings rate absorbs part of the shock. In (T+1)Q4 the savings rate has not yet returned to its baseline level (-0.12%). Business investment falls in response to lower output and the deterioration of profitability. Housing investment is depressed by lower disposable income. Exports are not affected during the first year after the shock and only marginally during the second year, as higher domestic labour costs are passed on to export prices, deteriorating cost competitiveness with the rest of the world. The decrease of domestic demand leads to lower imports, which implies, given almost unchanged exports, an amelioration of the current account. On the whole, GDP is mainly affected during the first year after the shock (GDP is -0.18%

1. This simulation takes into account the fact that not all consumer goods and services are subject to the normal rate.
2. We repeat that this simulation has been made in a wage norm context, which means that hourly gross wage increases exclusive of indexation are supposed to remain on their baseline path.
3. Wages and social benefits are automatically price linked in Belgium, but with a certain delay.
4. Note that in this simulation nominal interest rates do not react to higher prices.
5. Deflated by the deflator of value added of the private sector (from a producer's point of view).

below the baseline in TQ4), followed by a very limited additional impact during the second year (-0.21% in (T+1)Q4).

TABLE 10 - An increase of VAT on private consumption

% difference from the baseline	TQ1	TQ2	TQ3	TQ4	(T+1)Q4
GDP and its components					
Private consumption	-0.28	-0.31	-0.35	-0.40	-0.46
Government consumption	0.02	0.00	0.01	0.01	0.06
Gross fixed capital formation, *of which:*	-0.60	-0.34	-0.54	-0.52	-0.63
- Business investment	-0.80	-0.36	-0.60	-0.54	-0.73
- Housing investment	-0.22	-0.41	-0.55	-0.65	-0.58
Total national expenditure	-0.39	-0.24	-0.32	-0.34	-0.39
Exports of goods and services	0.00	0.00	-0.00	-0.01	-0.07
Imports of goods and services	-0.32	-0.10	-0.20	-0.19	-0.28
Gross domestic product	-0.14	-0.15	-0.16	-0.18	-0.21
Prices					
Consumer price index	0.91	0.94	0.99	1.03	1.21
Health index	0.87	0.91	0.95	1.00	1.19
Export prices	0.00	0.00	0.05	0.12	0.27
Import prices	0.00	0.00	0.02	0.05	0.10
Terms of trade	0.00	0.00	0.03	0.07	0.17
GDP deflator	0.51	0.52	0.60	0.66	0.93
Employment and wages (private sector)					
Hourly wage cost	0.04	0.66	0.98	0.97	1.14
Unit labour cost	0.47	0.83	1.12	1.01	0.98
Employment (wage earners, in hours)	-0.14	-0.22	-0.34	-0.42	-0.75
Value added	-0.56	-0.39	-0.47	-0.46	-0.60
Hourly labour productivity	-0.42	-0.17	-0.13	-0.04	0.16
Income					
Real disposable income households	-0.91	-0.76	-0.75	-0.81	-0.59
Absolute difference from the baseline					
Household savings as % of disposable income	-0.53	-0.38	-0.35	-0.35	-0.12
Unemployment rate as % of labour force	0.03	0.07	0.14	0.18	0.36
Wage share as % of value added of enterprises	-0.01	0.19	0.33	0.21	0.03
Current account balance as % of GDP	0.16	0.03	0.12	0.15	0.24

B. Scenarios

In this final section two simulations that imply a simultaneous change of several exogenous variables (in order to construct a coherent alternative scenario)[1] will be examined. A first case presents the impact of a depreciation of the euro against the dollar; in a second scenario, the effects of an oil price increase will be analysed.

1. A depreciation of the euro

a. Shock

In this scenario we impose a depreciation of 10% of the euro against the dollar. Other exogenous variables have to be changed too. Firstly, as only a relative small part of Belgian foreign commerce is traded in dollars, international price indicators for Belgium expressed in local currency will increase by much less than 10%. In this scenario we consider an increase of only 2.5% for the international import and export prices. Secondly, as our main trading partners are within the euro area and as this area will have better growth prospects thanks to an improvement in competitiveness, export markets for Belgium will also progress. In this scenario we assumed a gain of 0.7%. Finally, the hypothesis is put forward that short-term and long-term interest rates remain constant in real terms[2].

b. Simulation results

This scenario favours exports in the first place. As Belgian export firms are only partly price-taker, export prices will increase less than world prices, which means a gain in competitiveness. They will also benefit from additional growth in Europe. On the whole, exports increase by 0.32% in the first quarter and by 1.01% after one year. This extra growth in production boosts corporate investment (+0.52% after one year). Imports are influenced by two factors, operating in opposite directions: the rise in final demand pushes imports upwards, but negative price effects (as import prices have increased faster than domestic prices) restrain them. All in all, volume effects are dominant and imports are 0.66% higher than the baseline in TQ4.

Households' disposable income is affected by several contrary forces. The increase in economic activity diminishes unemployment, which signifies higher labour income. But as consumer price inflation accelerates, indexation is lagging behind, causing purchasing power losses. This phenomenon is reinforced by the fact that wages are linked to the 'health index', which increases much less than the CPI, due to the fact that the health index excludes most of the energy products. Finally, households' real gross operating surplus is negatively affected by the terms of trade losses, causing a decrease of the deflator of value added. The sum of all these effects has a slightly negative impact on real disposable income during the first year (-0.08% after four quarters). This decrease in income is

1. As the purpose of this section still is to test the model properties, we have decided not to introduce gradual changes of exogenous variables, as a more realistic approach would recommend. As a consequence, all time-varying adjustments of endogenous variables merely reflect the internal dynamics of the model.
2. The scenario defined here is comparable with the one described in Bossier and Vanhorebeek (2000), p. 63.

partially compensated by a lower savings rate (thanks to the fall in the unemployment rate), so that private consumption decreases by only 0.04% at the end of the first year. All in all, GDP increases progressively during the first year (from 0.14 in TQ1 to 0.37 in TQ4).

As employment continues to increase and as indexation gradually reduces the loss in purchasing power, real disposable income exceeds somewhat the baseline during the second year. As a consequence, private consumption expenditure is slightly higher than in the reference scenario at the end of the simulation period (0.01%). This explains why GDP continues to rise somewhat, despite higher imports. Domestic prices are increasing steadily during the simulation period, which means that in conjunction with stabilizing terms of trade losses, the GDP deflator is again close to the baseline at the end of the second year. Unit labour costs are above the baseline level, as higher nominal hourly wages are not fully compensated by higher labour productivity. Finally, the impact on the current account balance is still negative at the end of the second year (-0.13%), as higher net exports in volume do not yet completely offset the terms of trade losses.

TABLE 11 - A depreciation of the euro

% difference from the baseline	TQ1	TQ2	TQ3	TQ4	(T+1)Q4
Exogenous shock					
Potential export markets for Belgium	0.70	0.70	0.70	0.70	0.70
Nominal exchange rate euro/dollar	10.00	10.00	10.00	10.00	10.00
World import prices in euro	2.50	2.50	2.50	2.50	2.50
GDP and its components					
Private consumption	-0.03	-0.04	-0.03	-0.04	0.01
Government consumption	0.00	0.00	0.00	0.00	0.03
Gross fixed capital formation, *of which:*	0.16	0.30	0.35	0.33	0.32
- Business investment	0.24	0.45	0.54	0.52	0.47
- Housing investment	-0.03	-0.05	-0.07	-0.08	0.01
Total national expenditure	0.05	0.09	0.09	0.06	0.08
Exports of goods and services	0.32	0.84	0.95	1.01	1.07
Imports of goods and services	0.21	0.62	0.64	0.66	0.71
Gross domestic product	0.14	0.29	0.37	0.37	0.41
Prices					
Consumer price index	0.14	0.15	0.19	0.26	0.44
Health index	0.05	0.07	0.10	0.18	0.36
Export prices	0.92	1.16	1.26	1.31	1.46
Import prices	1.23	1.75	1.96	2.06	2.16
Terms of trade	-0.31	-0.58	-0.69	-0.73	-0.68
GDP deflator	-0.11	-0.27	-0.32	-0.29	-0.07
Employment and wages (private sector)					
Hourly wage cost	0.01	0.04	0.08	0.11	0.34
Unit labour cost	-0.12	-0.20	-0.22	-0.16	0.12
Employment (wage earners, in hours)	0.05	0.11	0.16	0.20	0.27
Value added	0.17	0.36	0.46	0.47	0.49
Hourly labour productivity	0.12	0.25	0.30	0.27	0.21
Income					
Real disposable income households	-0.12	-0.09	-0.07	-0.08	0.13
Absolute difference from the baseline					
Household savings as % of disposable income	-0.07	-0.05	-0.04	-0.04	0.09
Unemployment rate as % of labour force	-0.01	-0.03	-0.04	-0.06	-0.10
Wage share as % of value added of enterprises	0.03	0.11	0.15	0.16	0.19
Current account balance as % of GDP	-0.10	-0.18	-0.19	-0.18	-0.13

2. An oil price increase

a. Shock

In this scenario, we analyse the effects of an increase of the crude oil price, lifting the Brent oil price expressed in dollar 20% above its level in the baseline scenario during the whole simulation period. This negative supply shock leads, at least in the short run, simultaneously to lower output and higher inflation worldwide.[1] Moreover, the generated change in relative prices favours oil producing countries but harms net oil importers, who are also our main trading partners. Consequently, the world trade indicator for Belgium will deteriorate (assumed impact of -0.3%). Higher oil prices increase production costs worldwide, leading to higher world trade prices (obviously for energy, but also for non-energy products) (assumed effect of +1.4% for world import prices)[2]. Finally, the hypothesis is put forward that short-term and long-term interest rates remain constant in real terms and that nominal exchange rates are not affected.[3]

b. Simulation results

For a net oil importing country like Belgium, the oil price shock works its way through the economy as a negative shock on the terms of trade, leading to a loss of real disposable income of the whole economy.

The deterioration of the terms of trade reaches its height in TQ2 (-0.96%). Afterwards, the terms of trade move in the direction of their medium-term path[4], as the shock on oil prices and on other international prices is supposed to be purely one-off. Despite this, the terms of trade deterioration exceeds the rise in the deflator of domestic demand during the whole simulation period, which implies that the GDP deflator has not yet returned to its baseline level after two years. The negative terms of trade shock also deteriorates the profitability of enterprises, as measured[5] by the gross operating surplus as a share of value added.

Households' real disposable income initially drops, because higher prices are only passed on to wages and social benefits with a certain delay. Indexation of wages does not fully compensate higher prices (as measured by the health index), because of this delay and because inflation continues to rise. As wages and social benefits are linked to the development of the health index and the latter does not take the higher fuel prices for vehicles into account, the difference in increase between the consumer price index and the health index (around 0.18%) represents in any case a permanent loss of households' purchasing power. Continuously falling employment has also an adverse impact on households' disposable income during the whole simulation period. After two years, over 3,000 jobs have disappeared.

1. The modifications of the other exogenous variables given below are based on CPB (2002) and Dalsgaard *et al.* (2001).
2. The calculated impact on world export prices is smaller (only 1%). The difference is due to different weights of energy in both indicators.
3. The latter implies that the Brent oil price expressed in euro, also increases by 20%.
4. The medium-term loss in the terms of trade is about 0.5% in this scenario.
5. This measure is roughly identical to the inverse of the wage share, given in the table below.

The loss of purchasing power has a negative impact on private consumption. During the whole simulation period, private consumption is less affected than households' real disposable income, as the lower savings rate absorbs part of the shock. The savings rate returns to its baseline level only in (T+1)Q4.

Housing investment responds mainly to lower disposable income. Business investment reacts to lower output and worsened profitability. Whereas housing investment returns somewhat to its baseline level during the second year after the shock, business investment continues to drop.

Changes in relative prices are supposed not to have an impact on exports and imports, because of the specific character of the shock (oil prices). Import prices rise much more than domestic prices. This should, however, not lead to substitution of imported products by domestic products, as Belgium is not an oil producing country. Although Belgian export prices rise less than world export prices, this should not lead to a gain of market shares, because relative prices of non-energy products are not modified. Accordingly, exports fall in line with lower export markets and imports decrease in line with lower final demand. Net exports are hardly affected.

Four quarters after the oil price shock, GDP at constant prices is 0.13% lower than in the baseline. During the second year after the shock, this difference remains almost unchanged[1] (-0.12% after eight quarters).

1. This is of course partly due to the fact that the assumed shock on all exogenous variables is one-off.

TABLE 12 - An oil price increase

% difference from the baseline	TQ1	TQ2	TQ3	TQ4	(T+1)Q4
Exogenous shock					
Potential export markets for Belgium	-0.30	-0.30	-0.30	-0.30	-0.30
World import prices in euro	1.37	1.37	1.37	1.37	1.37
Oil price	20.00	20.00	20.00	20.00	20.00
GDP and its components					
Private consumption	-0.11	-0.14	-0.15	-0.17	-0.15
Government consumption	0.00	0.00	0.00	0.00	0.04
Gross fixed capital formation, *of which:*	-0.04	-0.12	-0.16	-0.19	-0.28
- Business investment	-0.03	-0.11	-0.15	-0.17	-0.34
- Housing investment	-0.09	-0.19	-0.27	-0.32	-0.20
Total national expenditure	-0.08	-0.12	-0.13	-0.14	-0.15
Exports of goods and services	-0.14	-0.27	-0.27	-0.27	-0.27
Imports of goods and services	-0.16	-0.29	-0.28	-0.29	-0.31
Gross domestic product	-0.06	-0.11	-0.13	-0.13	-0.12
Prices					
Consumer price index	0.27	0.29	0.34	0.43	0.55
Health index	0.09	0.12	0.16	0.26	0.37
Export prices	0.36	0.46	0.50	0.53	0.63
Import prices	1.19	1.43	1.41	1.34	1.23
Terms of trade	-0.82	-0.96	-0.90	-0.80	-0.59
GDP deflator	-0.46	-0.54	-0.45	-0.32	-0.06
Employment and wages (private sector)					
Hourly wage cost	0.00	0.06	0.11	0.16	0.35
Unit labour cost	0.02	0.12	0.17	0.20	0.36
Employment (wage earners, in hours)	-0.00	-0.02	-0.04	-0.05	-0.14
Value added	-0.02	-0.08	-0.10	-0.10	-0.15
Hourly labour productivity	-0.02	-0.06	-0.06	-0.05	-0.01
Income					
Real disposable income households	-0.37	-0.38	-0.36	-0.36	-0.13
Absolute difference from the baseline					
Household savings as % of disposable income	-0.22	-0.20	-0.18	-0.16	0.01
Unemployment rate as % of labour force	-0.00	0.01	0.01	0.02	0.06
Wage share as % of value added of enterprises	0.42	0.55	0.51	0.42	0.33
Current account balance as % of GDP	-0.58	-0.69	-0.65	-0.58	-0.40

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Appendix I: The quarterly data base

Official quarterly national accounts for Belgium were published by the INA (Institute for National Accounts) for the first time in 1998. From the last quarter of 1998 onwards, quarterly accounts have been drawn up following the new ESA 95 methodology. They contain a concise sectoral breakdown (7 branches) of total value added, of wage sum and of employment, a breakdown of GDP into expenditure components (consumption, investment, exports and imports) and some elements from the income accounts. Since October 2002, most of these series are available for the 1980-2001 period, both unadjusted and adjusted for seasonal and calendar effects.

Although Belgium meets, as such, the requirements and the publication calendar imposed by Eurostat, these officially published quarterly data are insufficient to supply the data base of a quarterly model as exhaustive as MODTRIM II. Important fields for which quarterly data are missing are: the international environment, capital stock, household wealth and detailed income accounts of institutional sectors (households, firms, public sector and the rest of the world). These missing data have been constructed by the FPB[1] and are consistent with the available official quarterly and annual series, respecting the accounting identities laid down by the national accounting framework.

By preference, missing series have been constructed using interpolation techniques based on related series. In this case, the annual series ('base' series) is interpolated using the quarterly profile of the related series, based on two principles. Firstly, the annual constraint of the base series is respected. Secondly, the method makes a correction for differences in volatility between the related series and the base series[2]. A fully automated procedure has been written to make these interpolations for both flow and stock variables.

When proper related series were not available, or in the case of series that are not very important in terms of magnitude or do not necessarily have a cyclical pattern, a more mechanical interpolation technique (so-called 'cubic splining') has been used. The series constructed in that way only represent a minority in the data base.

As forecasting exercises are run several times a year, a rapid updating of the quarterly data base is essential. In order to achieve this, a centralized computer procedure has been developed that automatically incorporates the most recent national accounts data and data from other sources (such as financial data) and generates the additional data series on the basis of the methods described above.

1. For the public sector data, some semi-official data were supplied by the INA.
2. This may e.g. be the case when the related series is a more volatile ingredient of a broader base series.

Appendix II: Glossary of variable names

Only variable names appearing in Chapter II, section B to E, are defined here. Other variable names concerning the institutional sectors' accounts are given in the tables in section F of the same chapter and in Appendix III.

ACCOIL	excise duty on fuel for vehicles
BRENT	oil price (Brent, USD per baril)
CCO	private consumption (at constant prices)
CKNF	cost of capital (private sector)
EX	nominal exchange rate euro/dollar
EXCLALC	contribution of alcohol prices to the consumer price index
EXCLEGY	contribution of energy prices for heating and lighting to the consumer price index
EXCLFRF	contribution of fresh vegetables and fruit prices to the consumer price index
EXCLKLG	contribution of radio and TV licence fee to the consumer price index
EXCLMEA	contribution of meat prices to the consumer price index
EXCLOIL	contribution of fuel prices (for vehicles) to the consumer price index
EXCLTOB	contribution of tobacco prices to the consumer price index
EXCLTRA	contribution of circulation tax on vehicles to the consumer price index
EXCLWAT	contribution of water consumption price to the consumer price index
IQO	business investment (gross, at constant prices)
IRO	housing investment (gross, at constant prices)
KNF	capital stock (business sector)
MO	imports of goods and services (at constant prices)
NATY	labour force
NFYH	wage earning employment, private sector (in hours)
PCC	deflator of private consumption
PCUI	underlying inflation index
PDET	national consumer price index
PDETSA	consumer prices, health index
PIR	deflator of housing investment
PM	deflator of imports of goods and services
PQVFZ	implicit deflator of gross value added, private sector (at basic prices)
PWMSS	world import price of goods and services (in USD)
PWXSS	world export price of goods and services (in USD)
PX	deflator of exports of goods and services
QMOAB	re-weighted (depending on import content) final demand (at constant prices)
QVOF	gross value added, private sector (at constant prices)
QVOFF	gross value added, private sector firms (at constant prices)
QVOFHP	trend (H-P filtered) of gross value added, private sector (at constant prices)

QVUF	gross value added, private sector (at current prices)
QWXSS	potential export markets for Belgium (at constant prices)
RLBERHP	trend real long-term interest rate (H-P filtered)
SO	changes in inventories (at constant prices)
TFPHP	trend total factor productivity (H-P filtered)
UY	total unemployment, broad definition (FPB)
VATEGY	VAT rate on energy for heating and lighting
VATOIL	VAT rate on fuel for vehicles
VATSEL	implicit VAT rate for underlying inflation
VKF	depreciation rate of capital stock (private sector)
WBF	wage bill (private sector)
WBFF	wage bill (private sector firms)
WEA	housholds' financial wealth
XO	exports of goods and services (at constant prices)
YDH_I	households' gross disposable income

Appendix III: Summary accounts of the four institutional sectors

The households' summary account

I.	Current transactions	
	a. Resources	
	Operating surplus (net)	GOSH_I-DPUH_I
	Mixed income	REMI
	Compensation of employees	WBU+YN
	Property income (received minus paid)	IDH_I
	Social benefits	SBH
	Other current transfers (received)	OCUHR_I
	Change in net equity of households in pension funds reserves	VAMARE
	b. Uses	
	Current taxes on income and wealth	DTOTH_I
	Social contributions	YSSH
	Other current transfers (paid)	OCUHE_I
	Final consumption expenditure	CCU
	c. Savings (net) (I.a - I.b)	SH_I-DPUH_I
II.	Capital transactions	
	a. Resources	ACAHN_I
	b. Uses	
	Fixed capital formation (net)	IUH_I-DPUH_I
	Changes in inventories	SUH
	Capital taxes	IK
III.	Net lending (+) / net borrowing (-) (I+II)	FLH_I

The corporations' summary account

I.	Current transactions	
a.	Resources	
	Operating surplus (net)	GOSF-DPUF
	Financial intermediation services indirectly measured (FISIM) (-)	QYUIMP
	Social contributions	SSF3L+SSH3L+SSFFICF
	Other current transfers (received)	OCUFR
b.	Uses	
	Property income (paid minus received)	-IDF
	Current taxes on income and wealth	DTOTF
	Social benefits	SBF
	Other current transfers (paid)	OCUFE
	Change in net equity of households in pension funds reserves	VAMARE
c.	Savings (net) (I.a - I.b)	SF-DPUF
II.	Capital transactions	
a.	Capital transfers (received minus paid)	ACAFN
b.	Uses	
	Fixed capital formation (net)	IUF-DPUF
	Changes in inventories	SUF
III.	Net lending (+) / net borrowing (-) (I+II)	FLF

The corporations' primary income is defined as the sum of the operating surplus minus property income (paid minus received), corrected for indirectly measured financial intermediation services.

The disposable income of corporations is equal to the sum of their primary income, the social contributions paid to corporations (mainly to insurance companies) and the other current transfers, less current taxes and social benefits paid by corporations.

By subtracting the change in net equity of households in pension funds reserves from disposable income, corporations' savings are obtained.

To calculate net lending / net borrowing of corporations, capital transfers are added to savings and capital formation (fixed and changes in inventories) is deducted.

The general government summary account

I. Current transactions	
a. Resources	
Operating surplus (net)	GOSG-DPUG
Taxes on production and imports	ITPC0-ITUE+ITPD
Property income	RIDG
Current taxes on income and wealth	DT-DTOL1-DTOC1
of households	DTOTH_I
of corporations	DTOTF
other	DTOTG_W-DTOL1-DTOC1
Social contributions	YSFIC+YSEFT
Other current transfers (received)	OCUGR
b. Uses	
Property income (interest payments)	YIDG
Subsidies	SUBG
Social benefits (other than social transfers in kind)	SBG
Other current transfers (paid)	OCUGE
Final consumption expenditure	CGU
c. Savings (net) (I.a - I.b)	SG
II. Capital transactions	
Capital taxes (+)	IK
Fixed capital formation (net) (-)	IUG-DPUG
Changes in inventories (-)	SUG
Other capital transactions (paid minus received) (-)	-ACAGN
III. Net lending (+) / net borrowing (-) (I+II)	FLG

The general government primary income is defined as the sum of the operating surplus, property income (received minus paid), and taxes on production and imports, net of subsidies.

The disposable income of the general government is equal to the sum of its primary income, current taxes on income and social contributions, less social benefits and other current transfers (paid minus received).

By subtracting final consumption expenditure from disposable income, the general government current savings are obtained.

To calculate net lending / net borrowing of the general government, capital taxes are added to savings and capital formation (fixed and changes in inventories) and other capital transactions (paid minus received) are deducted.

The external transactions account of the nation

I. Current external balance (I.a - I.b)	-SW1
a. Resources	
Exports of goods and services	XU
Compensation of employees	YNX
Subsidies	SUBUE
Property income	YKX
Current taxes on income and wealth	DTOW1
Social contributions	SSB_B
Social benefits (other than social transfers in kind)	SBB_B
b. Uses	
Imports of goods and services	MU
Compensation of employees	YNM
Taxes on production and imports	ITUE
Property income	YKM
Social contributions	SSB_M
Social benefits (other than social transfers in kind)	SBB_M
Other current transfers (paid minus received)	TXM
II. Capital transactions balance	-ACAWN
III. Net lending (+) / net borrowing (-) of the nation (I+II)	-FLW

Appendix IV: Regression statistics

In Chapter II we present for each econometric equation several regression statistics.

The *F-stat* deals with the overall significance of the equation, in other words the F statistic tests the joint hypothesis that all coefficients (except the intercept) are equal to zero. An F-stat not significantly different from zero, signifies that the explanatory variables do little to explain the variation of the dependent variable around its mean.

The R^2 measures the proportion of the variation of the dependent variable which is explained by the explanatory variables (it always lies between 0 and 1 if the intercept is different from zero). As the R^2 increases when new explanatory variables are added, the R^2 can be corrected for the number of degrees of freedom. This *adjusted* R^2 may rise or fall when new variables are included. Note that the relatively low R^2 observed for some dynamic equations, was induced by a few extreme observations, which could have been neutralized with dummies. However, we choose not to do so, as long as there was no specific economic reason or as long as these outliers had no significant effect on the value of the estimated coefficients.

The *Durbin-Watson* verifies if the error term is serially uncorrelated. Values close to 2 point to no first-order serial correlation. When there is a lagged dependent variable in the right-hand side of the equation, the Durbin h should be used instead. An absolute value below 1.7 allows us to accept the hypothesis of no serial correlation.

The *Dickey-Fuller* (test for a unit root) assesses whether the hypothesis of non-stationarity of residuals can be rejected (in our sample an absolute value above 2.9 allows us to do so). In the context of the long-term equations, stationary residuals can be interpreted as a statistical validation that such a long-run relationship exists.

The *t-statistic* tests whether the hypothesis that a regression coefficient is equal to zero can be rejected; an absolute value above 2 enables us to reject this null hypothesis. Note that we have not reported any t-statistic for the long-run equations, as in this case the distributions of the OLS-estimators are non-standard and estimated standard errors cannot be used for significance testing.

The table below presents for different values of the coefficient, associated with the error correction mechanism, the number of quarters required to absorb respectively 50% (this statistic is called *MRL* in the main text) and 90% of an observed imbalance.

TABLE 13 - Number of quarters required to absorb a disequilibrium[1]

% of disequilibrium absorbed	50% (MRL)	90%
Absolute value of coefficient		
0.05	14	45
0.075	9	30
0.1	7	22
0.15	5	15
0.2	4	11
0.25	3	8
0.3	2	7
0.4	2	5
0.5	1	4

If a lagged endogenous variable is present in the right-hand side of the dynamic equation, the speed of absorption mentioned above will be altered (it will be increased if the coefficient of the lagged variable is positive and decreased otherwise). The values of the MRL statistics mentioned in the main text have therefore been determined by simulation. The presence of a constant term in the dynamic equation will imply a drift and will prevent the variable to converge to its equilibrium level. The MRL statistic is not completely relevant in this case. Nevertheless, the error correction mechanism ensures that the variable will not drift away indefinitely from its equilibrium level, and at a certain point there will be convergence in terms of growth rates.

1. Based on the sum of a geometric series (in this case with first term equal to the absolute value of the coefficient (c) and constant increment equal to $1-c$), one can easily prove that the number of quarters required to absorb a proportion (x) of the disequilibrium is equal to $ln(1-x)/ln(1-c)$. The figures in the table are round off upwards to the next integer.