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Ángel Estrada
José Luis Fernández
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Ángel Estrada

José Luis Fernández

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Abstract

This paper presents a new version of the Spanish quarterly macroeconometric model. The previous version [see Willman and Estrada (2002)] evidenced a number of shortcomings, some of which are redressed here. In particular, the model now uses seasonally and working-days-adjusted time series; it considers a breakdown by sector (government and private sectors), by external trade (euro area and rest of the world) and by investment (residential and productive); and finally, it includes wealth evaluated at market prices. While the long-run properties of the old model have not changed substantially, in the short run different simulation exercises show that the new model provides stronger responses in the first two years and a prompter and faster return to the baseline values.

JEL classification: E10, E13, E17.
Keywords: Macro model, Spain.

1 Introduction

This paper presents a new development of the Spanish quarterly macroeconometric model. In the previous version of this model [see Willman and Estrada (2002)] a number of shortcomings were identified. These related both to the quality of the time series used in the estimations and to the specification of some blocks, which made the responses of the model to shocks difficult to rationalise in the short run. Conversely, in the long run the model seemed to be well specified, especially when a fiscal rule was included to prevent the permanent increase (or decline) of public debt. Since the changes in National Accounts statistics to incorporate the ESA 95 requirements made the re-estimation of the model inevitable, an effort was made to re-specify some blocks and to add new features.

The structure of the model is basically the same as the previous one. The supply side of the model determines the long-run equilibrium, while in the short run output is determined by the demand side, which means that there is a sluggish adjustment of prices and quantities towards equilibrium. The model is backward-looking, so expectations are treated implicitly by the inclusion of current and lagged values of the variables. As the policy regime is the Monetary Union, for a small open economy like Spain, short-term interest rates, exchange rates and foreign developments are exogenous. The new features of the model are as follows: 1) the use of seasonally and working-days-adjusted time series instead of the trend-cycle signal; 2) a breakdown by sector (government and private sectors); 3) a breakdown by external trade (euro area and rest of the world); 4) a breakdown by investment (residential and productive); 5) consideration of wealth evaluated at market prices.

The paper is organised as follows. In the second section we present the estimated equations, including some (long-run) theoretical considerations and the (short-term) empirical impulse-response functions. The third section analyses the medium-term responses of the model to different shocks, using different parametrisations, and comparing them with those obtained with the previous version of the model. Section 4 concludes.

2 The Estimated equations: theoretical background and impulse-response functions

In this new version of the model the equations were estimated using the seasonally and working-days-adjusted macroeconomic aggregates provided by the Quarterly National Accounts (QNA). Unfortunately, this database does not include all the required variables (in particular, the income and capital accounts of the institutional sectors are missing), so a previous task involved interpolating these aggregates from the Annual Accounts. This was made by restricting these time series to make them consistent with those of the Spanish National Statistical Office (INE) and using similar procedures.

The econometric methodology used is the cointegration framework, where the error correction mechanisms are estimated in two steps. In the first step, the long-run relations are derived from underlying theory and estimated by blocks, when strong interactions among variables appear or cross-equation restrictions in the parameters need to be imposed. The dynamic equations, however, are estimated equation by equation, considering possible endogeneities and imposing the long-run coefficients obtained in the previous step. All these equations are backward-looking and expectation formation mechanisms are not explicitly modelled.

2.1 The supply side

The supply side of the model includes five core equations defining the demand for the two productive factors by the private sector, the value added deflator, wages and the labour force. Additionally, stochastic equations for the private consumption deflator, the energy and non-energy components of the HICP, and private productive investment are obtained from accounting quasi-identities. Derived equations in this block are employment according to the Labour Force Survey and private wage-earners according to the QNA.

2.1.1 PRODUCTIVE FACTOR DEMAND AND LABOUR MARKET EQUILIBRIUM

In the long run, we assume that firms in the private sector produce goods and services (*PYER*) combining capital (*PKR*)[1] and labour (*PLN*) using a Cobb-Douglas technology with constant returns to scale and exogenous total factor productivity growth (*TFP*, modelled as a trend). Hence, the production function is as follows:

$$PYER = A\exp\big((1-\beta)\gamma TFP\big)PKR^{\beta}\, PLN^{1-\beta} \qquad [1]$$

where A is the scaling constant, β is the elasticity of output with respect to capital and γ is the average growth rate of *TFP*.

Considering that firms have a certain market power, they can fix the price (*PYED*) as a mark-up (η) over their marginal cost. Solving the profit maximisation problem of the representative firm, it is possible to derive, from first-order conditions, the following equations for employment, capital and prices, respectively (lower case letters stand for the log of the corresponding variables):

$$pln = -\frac{1}{1-\beta}a + \frac{1}{1-\beta}pyer - \frac{\beta}{1-\beta}pkr - \gamma TFP \qquad [2]$$

$$pkr = (1-\beta)\ln\left(\frac{\beta}{1-\beta}\right) - a + pyer + (1-\beta)(pwun - puc) - \gamma(1-\beta)TFP \qquad [3]$$

1. The private productive capital stock captures the accumulation of the productive investment of the private sector, therefore, it excludes the capital stock of the public sector and the residential one.

$$pyed = \ln(\eta) - \ln(1-\beta) - \frac{1}{1-\beta}a + \frac{\beta}{1-\beta}(pyer - pkr) - \gamma\, TFP + pwun \qquad [4]$$

where *PWUN* is the nominal wage of the private sector and *PUC* is the user cost of private productive capital[2]. As can be seen from expression [2], employment in the long run is given by the inverse of the production function, while the capital-output ratio (expression [3]) depends on the relative costs of the productive factors. The private value added deflator evolves with the marginal product of labour, the nominal private wage and the mark-up (expression [4]). Since the Spanish economy can be considered as a small open economy, the approach of Layard *et al.* (1991) is used to impose the dependence of the mark-up on competitiveness, as follows[3]:

$$\ln(\eta) = \ln(\eta_0) - \frac{\mu}{1-\mu}(pyed - cxd) \qquad [5]$$

with *CXD* capturing competitor export prices in domestic currency. This implies that increases in external prices allow domestic firms to expand their mark-ups since they face fewer pressures from external competitors. Substituting [5] in [4], domestic prices are seen to be a weighted average of domestic and external factors[4]:

$$pyed = (1-\mu)\left(\ln(\eta_0) - \ln(1-\beta) - \frac{1}{1-\beta}a + \frac{\beta}{1-\beta}(pyer - pkr) - \gamma\, TFP + pwun\right) + \mu\, cxd \qquad [6]$$

The wage equation can be rationalised by a bargaining process where trade unions and firms negotiate the wage workers are to receive, leaving firms the right to decide the level of employment. Assuming that firms try to maximise their profits and trade unions the utility of their members (a weighted average of employees and unemployment), the joint optimisation problem provides the following expression for wages:

$$pwun = w_0 + pyed + (pyer - pln) + \phi\, twed + \varphi(pcd - pyed) + \lambda(pwun - pwun^*) \qquad [7]$$

where *TWED* is the tax wedge (social contributions and labour income taxes), *PCD* the consumption deflator and *PWUN** the alternative wage in the event of being fired. Assuming that the alternative wage is a weighted average of actual wages and unemployment benefits, with the weight depending on the unemployment rate (*URX*), it is possible to write:

$$(pwun - pwun^*) = \rho\, RRU - URX \qquad [8]$$

where *RRU* is the replacement ratio of unemployment. Thus, substituting in the previous expression, the wage equation would adopt the form:

$$pwun = w_0 + pyed + (pyer - pln) + \phi\, twed + \varphi(pcd - pyed) + \lambda(\rho\, RRU - URX) \qquad [9]$$

This is a quite traditional wage equation: real wages depend positively on productivity, the tax wedge, consumer prices relative to domestic prices and the replacement ratio, and negatively on the unemployment rate. The wage equation, jointly with that of price determination [4], allows a NAIRU (the unemployment rate consistent with a constant inflation rate) to be defined as follows:

$$NAIRU = \frac{1}{\lambda}\left[w_0 + \beta + \ln(\eta) + \phi\, twed + \varphi(pcd - pyed)\right] + \rho\, RRU \qquad [10]$$

2. The user cost of capital is defined as follows: $PUC = PID\left(\frac{RCC+LTI}{8} + \delta_{PK} - \ln(\frac{PID}{PID_{-1}})\right)$, where PID is the private productive investment deflator, RCC the bank lending rate to firms, LTI the long-term interest rate and δPK the depreciation rate.

3. López-Salido and Velilla (2002) present a model where mark-ups also depend on the output gap and future profits. These aspects are not considered here.

4. Although external prices are introduced into this equation in a relatively ad-hoc fashion compared to Galí and López-Salido (2001), in the long run both specifications are equivalent.

This expression shows how the NAIRU depends on shocks affecting the labour demand curve (η, the mark-up), and on shocks that move the labour supply curve (tax wedge, the ratio of the consumption to the private value added deflator and the replacement ratio).

Concluding with the labour market, it is assumed –as in Lamo and Dolado (1993)– that the decision of the working age population (*POPWA*) to participate in the labour market depends positively on the gap between the market and the reservation wages. Other cultural and demographic factors affecting this decision are captured through dummy variables:

$$lfn = h_0 + h_1 \, trenlfn + popwa + \kappa\,(\rho\, RRU - URX) \quad [11]$$

where *LFN* is the labour force and *TRENLFN* the dummy variables. Notice that by introducing the unemployment rate into this equation, all the variables influencing the NAIRU will also affect (with the opposite sign) the labour force.

Once all the equations from the supply side have been derived, the potential output of this model is defined as the output that would be reached if all the factors were used at their non-increasing inflation values. Turning to the expression for the production function [1], the convention of making the observed values of the capital stock equivalent to its potential values has been adopted; TFP is captured through a trend so this will be its potential, and, therefore, the only remaining variable is potential labour growth. In order to obtain this, notice that employment can be defined as the product of working age population and the participation rate multiplied by 1 minus the unemployment rate. Thus, replacing the unemployment rate by the NAIRU, private potential employment (*PLNPOT*) can be calculated as follows:

$$PLNPOT = POPWA \exp\left(h_0\, h_1\, trenlfn\, \kappa\,(\rho\, RRU - NAIRU)\right)\left(1 - NAIRU\right) - GLN \quad [12]$$

where *GLN* is public-sector employment, which is considered exogenous. Therefore, the potential output of the private sector (*PYERPOT*) and the implicit output gap (*POUTGAP*) would be:

$$PYERPOT = A \exp\left((1-\beta)\gamma\, TFP\right) PKR^{\beta}\, PLNPOT^{1-\beta} \quad [13]$$

$$POUTGAP = \frac{PYER - PYERPOT}{PYERPOT} \quad [14]$$

Table 1 presents the results obtained for these equations. In the top panel are the long-run estimates, while in the bottom panel the dynamic specifications are presented. Beginning with the top panel, the underlying estimated parameters are as follows. The elasticity of output with respect to employment (*1-β*) is calibrated (using the average of the labour cost share) to 0.64[5]; the estimated annual average growth rate of TFP (γ) is 0.8%; the elasticity of mark-up with respect to competitiveness is 0.11; the sensitivity of real wages to unemployment is -0.42; the impact of the replacement ratio is 0.01; for the tax wedge a unit coefficient is imposed and consumer prices relative to domestic prices are not significant. Finally, in the labour force equation two truncated trends are included implying that from 1993 the incorporation of people into the labour market occurred at a higher pace, and the impact of the difference between the actual and the reservation wage is close to 0.5. As can be seen

5. This number is the average of the ratio between the cost of labour and total costs that are defined as the addition of labour costs and capital costs. Labour costs are obtained multiplying compensation per employee by total employment (that is, we are assuming that wages of self-employment are the same as wages of employees). Capital costs are obtained multiplying the user cost of capital by the capital stock.

from the ADF tests, only the equations for employment and wages seem to pose problems of cointegration, although this is something that will be confirmed looking at the dynamic results.

From these estimates, the NAIRU implicitly estimated has the following expression:

$$NAIRU = \frac{1}{0.41}\left[0.25 + 0.11(pyed - cxd) + twed\right] + 0.03RRU \qquad [15]$$

It is represented along with the observed unemployment rate in figure 1. As can be seen, three periods can be distinguished for the NAIRU. In the first half of the eighties, an upward trend raised the NAIRU from 7% to 17%, and this figure was quite stable until 1993, undergoing a steady fall thereafter that became less steep from the year 2000. The main contributing factors to this reduction were labour taxes and the replacement ratio[6].

Once we have an estimation for the NAIRU, expression [13] can be used to obtain the course of potential output in the private sector. This is shown in figure 2 along with observed output. The growth rate of potential output was very low in the first half of the eighties, increasing to over 2% until the mid-nineties. Thereafter, a fresh impulse pushed potential output growth up to 4%. From 1999 it seems to have stabilised at above 2%.

In the dynamic specifications, the employment equation is estimated using instrumental variable techniques (the instruments used are their own lags), and the autoregressive component is imposed to avoid a strong short-run overreaction. Both the changes in output and in real wages are significant and correctly signed and the error correction mechanism has a t-ratio high enough to accept the stationarity of the long-run solution. The investment equation in the short run depends positively on value added and negatively on the user cost of capital as expected; in addition, after instrumentation of the equation, disposable income of firms (*FDYN*)/capital stock ratio, which captures cash-flow effects, is almost significant. In contrast to the previous equation, the error correction mechanism is not significant, casting some doubt on the stationarity of the long-run relationship for capital stock.

For some idea of how these two variables respond to different shocks, figure 3 depicts the impulse-response functions for 1% permanent shocks to output (panel A), wages (panel B) and user cost of capital (panel C). As can be seen, both employment (dark line) and investment (clear line) overreact with respect to an output shock (this shock should be interpreted as a demand shock as long as the supply conditions are not altered), and then converge to a value of one. With respect to wages, employment declines but investment increases due to substitution effects. This is just the opposite to the responses with respect to the user cost of capital.

Turning to the value added deflator, in the short run a certain persistence is estimated, although contemporaneous changes in wages are the main driving force. Moreover, the lagged changes in the import deflator of goods (*MGD*) have a positive impact and the error correction mechanism is negative and significant. This equation does not satisfy the dynamic homogeneity condition. In the case of wages, some persistence is also estimated, but the most important contributing factor is nominal productivity growth together with the lagged changes in the consumption deflator. Changes in unemployment have a minor role and the error correction mechanism, though negatively signed, is barely significant. To assess the short term responses to shocks on the right-hand-side variables, in figure 4 the impulse-response functions are depicted as if they were independent equations. The demand shock has a positive short-term impact on inflation due to the slow adjustment of capital to the new long-run equilibrium. In the case of wages the effect is initially positive because of the increases in productivity; as in the medium run there is an overreaction by employment,

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6. This characterisation of the NAIRU is basically the same as that previously encountered by Estrada *et al.* (2002). A more in-depth analysis of the Spanish labour market in recent decades can be found in Bentolila and Jimeno (2003).

productivity diminishes and the same occurs to wages. As expected, a positive shock to unemployment reduces wages and a nominal shock increases both prices and wages by the same amount, due to the homogeneity condition.

To conclude this section, changes in the labour force depend only on its own past values and on unemployment, reflecting once more the procyclical behaviour of this variable.

2.1.2 THE PRIVATE CONSUMPTION AND PRODUCTIVE INVESTMENT DEFLATORS, AND THE HICP

The deflators of private consumption and productive investment (net of indirect taxes), and the two HICP components (non-energy, *HICPNE* and energy, *HICPE*) are modelled in the long run as a weighted average of the private value added deflator and the three components of the import deflator (goods from the euro area, goods from the rest of the world and services, *MGED*, *MGND* and *MSD*, respectively), it being imposed that the corresponding parameters add up to one to incorporate the nominal homogeneity condition. This captures the notion that these demand components are a mixture of domestically produced and imported goods. In the top panel of Table 2 the statistical results for these variables are shown. As expected from the input-output tables, in the long-run the relative impact of domestic prices on these deflators is higher in the case of private consumption than in that of productive investment. In any case, the long-run effect of the import deflator on private consumption is well below that derived from input-output tables, and the opposite happens with the productive private investment deflator. Probably, this is a consequence of the dual nature of inflation in the Spanish economy, being higher in services (that are more related to private consumption) and lower in goods (more related to investment), due to the constrains imposed by external prices; this characteristic can not be capture by the model, as long as the value added deflator is not disaggregated. Another difference between these two equations is that the import deflator from the rest of the world excludes the oil price (*PEI*) in the case of the investment deflator, as long as oil is not considered an investment good. With respect to the components of the HICP[7], the equation for the non-energy component is very similar to that of the private consumption deflator, although the import deflator from the rest of the world excludes the oil price, which is included in the energy component. The relatively low elasticity of this latter variable in the energy component is perhaps surprising, but it should be recalled that almost 50% of consumed energy is electricity, and excise duties represent around 80% of the final price of oil derivatives.

The bottom panel of Table 2 shows the dynamic specifications. In the case of the consumption deflator a degree of inertial behaviour is estimated and, apart from the long-run determinants, taxes also have an impact. The inertial behaviour is only repeated in the energy component of the HICP where, moreover, there is an overreaction with respect to the oil prices. In the case of the productive investment deflator, the most salient feature is the small t-value of the error correction mechanism, casting doubts on the stationarity of the long-run relationship.

Figure 5 shows the impulse-response functions of these equations to permanent shocks with respect to domestic and import prices. As can be seen, the impact of domestic prices is higher for consumption prices than for investment, and only in the short run are there differences between the consumption deflator and the HICP.

2.2 The demand side

The demand side of the model is divided into three blocks. First, the block describing private consumption and residential investment determination, including all the identities enables disposable income and wealth to be calculated; second, the equation for inventory

7. They are modelled including indirect taxes, due to the difficulty of disaggregating the indirect consumption taxes. This implies that the indicator of domestic prices is not the same as in the previous cases, it also includes taxes (PYEDT).

investment; and, finally, the trade block, which includes equations of imports, exports and their corresponding deflators, plus all the identities that determine the net borrowing or lending of the nation.

2.2.1 THE BEHAVIOUR OF HOUSEHOLDS

This block includes three behavioural equations (private consumption, residential investment and the residential investment deflator), which are derived from a common framework. According to the life-cycle hypothesis, the first-order conditions of the optimisation problem of a representative household that derives utility from consumption and housing services when the utility function is separable (both inter-temporarily and between goods) and isoelastic, are as follows (lower-case letters represent the log of the corresponding variables):

$$pcr = \mu_{PCR} + (\sigma - 1)\, RR + wper \qquad [16]$$

$$rkr = \mu_{RIR} - \sigma(ruc - pcd) + (\sigma - 1)\, RR + wper \qquad [17]$$

where *PCR* is private consumption, *RR* the real interest rate[8], *WPER* permanent income, *RKR* residential capital stock (assumed to be proportional to housing services), *RUC* the user cost of residential capital[9] and σ the inverse of the intertemporal elasticity of substitution.

As can be seen, the expression for the residential capital stock is basically that of private consumption plus the user cost of capital, so it is possible to substitute one in the other. Further, bearing in mind that the capital stock is simply the accumulation of the corresponding flow –residential investment (*RIR*)–, it can be replaced by this last variable without affecting its long-run properties (if it is integrated of order one). Finally, following the suggestions of Muellbauer and Lattimore (1995), permanent income is proxied by a weighted average of current disposable income and wealth, both in real terms. Thus, the final long-run equations to be estimated are the following:

$$pcr = \mu^{*}_{PCR} + (\sigma - 1)\, RR + \beta\,(hdyn - pcd) + (1 - \beta)\ln\left(\frac{FWN + NFWN}{PCD}\right) \qquad [18]$$

$$rir = \mu^{*}_{RIR} - \sigma^{*}(ruc - pcd) + pcr \qquad [19]$$

where *HDYN* is the nominal disposable income of households, *FWN* financial wealth and *NFWN* residential wealth, both in nominal terms.

Disposable income of households is derived from an accounting identity as follows:

$$HDYN = WUNA + RWWUNA + HGOS + GPRE + HINN + HRES - GCOT - HTDN \qquad [20]$$

where *WUNA* is compensation of employees, *RWWUNA* the rest of the world compensation of employees, *HGOS* the gross operating surplus of households[10], *GPRE* transfers from the government, *HINN* the net interest rates received by households[11], *HRESY* a residual of the income account of households (in the long run it is equal to the disposable income of firms, therefore it is assumed that firms are owned by households), *GCOT* social contributions and *HTDN* the direct taxes paid by households.

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8. The real interest rate is defined as follows:. $RR = LTI - \ln\left(\frac{PCD}{PCD_{-1}}\right)$

9. The user cost of the residential capital is calculated as follows: $RUC = RID\left(\frac{HTI}{4} + \delta_{RK} - \ln\left(\frac{RID}{RID_{-1}}\right)\right)$, where RID is the residential investment deflator, HTI the mortgage interest rate and δRK the depreciation rate.

10. This variable is modelled as a quasi-accounting identity; in particular, it is the sum of the labour income of non-wage earners (assuming they receive the same wage as wage-earners), the imputed income of house-owners (which is a function of the value of the housing stock) and part of the gross operating surplus of the private sector.

11. This variable is obtained as a percentage of the sum of net interest payments of the public sector and the rest of the world.

The financial wealth included in the model is that of the private sector; thus, in nominal terms it includes the private productive capital stock (*PKR*, derived in the supply block) times the Madrid stock exchange index (*PSE*)[12], public debt (*GDN*, to be described in the public sector block) and net foreign assets (NFA, which are derived in the external block):

$$FWN = PSE\ PKR + GDN + NFA \qquad [21]$$

There is a risk that the practice to measure the financial wealth as a product of a stock price index and private productive capital stocks exaggerates the impact of equity prices in the consumption decisions of households. This is so because first, only a subset of companies is quoted in the stock market, and second, only part of the companies is owned directly by households. Thus, the elasticity estimated for this parameter could be biased.

The non-financial component of wealth in nominal terms is the product of the residential capital stock and the residential investment deflator:

$$NFWN = RID\ RKR \qquad [22]$$

Thus the only remaining item in this block is the determination of the residential investment deflator. In order to obtain an empirical expression it is assumed that new residential investment represents a very small fraction of the total housing stock, meaning that the supply of housing services is given by the residential stock of the previous year[13]. In this context, the residential investment deflator would be the price that balances the supply of housing services with the demand for them. Thus, equating expression [19] to the capital stock and solving for the residential investment deflator gives:

$$rid = \mu_{RI} + pcd + \gamma\,(pcr - rkr) - Ln\left(\frac{HTI}{4} + \delta_{RI} - Ln\left(\frac{RID}{RID_{-1}}\right)\right) \qquad [23]$$

This expression is somewhat different from that estimated by Bover (1993) and Martínez and Maza (2003): the price of houses in real terms depends negatively on their financing cost and positively on the gap between the demand for housing services (a proportion of *PCR*) and the supply (*PKR*).

Equations [18], [19] and [23] are estimated by OLS. The results are shown in the top panel of Table 3. As can be seen, the relative weights of disposable income and wealth in private consumption are 0.96 and 0.04[14], respectively, while the elasticity of substitution is 2.3. In the case of residential investment, the user cost of capital enters with a negative sign as expected. Finally, the residential investment deflator is positively influenced by the difference between private consumption and the residential capital stock, and the real interest rate enters with a negative sign. In this last case it is necessary to include a truncated trend until 1997 to achieve a cointegrating vector.

The dynamic specifications appear in the bottom panel of Table 3. Private consumption in the short run depends on the same variables as in the long run (showing certain persistence), although the elasticity estimated for residential wealth is higher than that estimated for non-financial wealth. In the case of residential investment, the short-run financial wealth enters with a negative coefficient, showing a certain degree of substitution between these two wealth components; the unemployment rate enters with a negative sign, capturing

12. For forecasting purposes this variable is considered exogenous, but in simulations the following equation is included: $PSE = \varphi\left(\frac{1+\Delta pyen}{LTI/4 - \Delta pyen}\right)PYEN$, which is consistent with a very simple dividend growth model.

13. This approach is in the spirit of Poterba (1984).

14. The elasticity with respect to wealth is very low compared with the value reported in other studies [see, for example, Estrada and Buisán (1999) or Balmaseda and Tello (2002)]. This is a consequence of the very special definition of wealth used in this paper.

expectations, and credit constraints, among others. The short-run residential investment deflator is affected by the change and the acceleration in the consumption deflator and the change in the real interest rate. It also shows certain persistence.

Figure 6 shows the impulse-responses of these equations to permanent changes in the different explanatory variables. Following a shock to disposable income, both private consumption and residential investment increase. Initially private consumption increases by more, although in the long run the impact is the same. The residential investment deflator increases substantially in the short run, but afterwards there is a reversal in which the residential capital stock begins to increase. In the case of a financial shock, all the variables increase in the long run, but in the short run residential investment declines. With respect to housing wealth there is a clear overreaction in the short run. In these last two cases the impact on prices is, again, transitory. Finally, the effect of an increase in the interest rate is negative and higher for residential investment.

2.2.2 INVENTORY INVESTMENT

The inventory equation is very similar to that estimated in the previous version of the model. In the long run it is assumed that the ratio of the desired level of inventories (*LSR**) to private potential output (*PYERPOT*) is a negative function of the real interest rate (*RRS*)[15], as follows:

$$LSR^{*} = (\eta_0 + \eta_1 \, RRS)\, PYERPOT \qquad [24]$$

In the short run it is assumed that there are quadratic increasing costs associated with deviations of actual production from the potential level and with deviations of actual inventories from the desired level [see Willman *et al.* (2000)]. These hypotheses yield the following equation for inventory investment (*SCR*):

$$\Delta SCR = \sum_{i=0}^{k} \kappa_i \left(\Delta SAL_{-i} - \Delta PYERPOT_{-i} \right) - \varphi \left(SCR - \Delta LSR^{*} \right) \qquad [25]$$

where *SAL* is the proxy for sales of storable goods, defined as the sum of private consumption, private productive investment and goods exports.

The results of the estimation are given in Table 4. As can be seen, inventories represent around 70% of private output on average in the sample period, and this ratio seems to be stationary. In the short run, a buffer effect is estimated contemporaneously, meaning that when sales of storable goods increase by more than the potential output there is an initial reduction of inventories and afterwards they begin to increase. Moreover, as expected the interest rate has a negative effect on inventory investment, and the error correction term is negative and significant.

2.2.3 THE TRADE BLOCK

This block has been substantially disaggregated in the new version of the model. In particular, three sub-blocks are now considered: trade in goods with the euro area, trade in goods with the rest of the world and trade in services. The separation of trade with the euro area from that with the rest of the world is advisable because the exchange rate regime is different. Unfortunately, due to statistical limitations it is not possible to isolate the euro area exports and imports of services, so a third block is considered. This means that, instead of the four behavioural equations estimated in the previous version of the model (imported and exported quantities and prices), twelve equations are now estimated.

a. Export Volumes

15. The real interest rate of inventory investment is defined as: $RRS = LTI - \ln(\frac{PYED}{PYED_{-1}})$

The equations for real exports are quite standard: they depend only on a scale variable capturing the changes in the relevant external markets, and on relative prices to assess the impact of competitiveness. Beginning with the scale variable, we choose to construct a variable that proxies the specific Spanish world markets. This involves weighting the other country indicators of external purchases by their importance in Spanish trade. In the case of goods exports (*XGER* for the euro area and *XGNR* for the rest of the world), the indicator chosen was total imports (MTR_i) from each country (i)[16], while in the case of services exports (*XSR*) the indicator was GDP (YER_i), as a proxy for the real income of households[17], that should be the determinant of tourism demand, the biggest part of Spanish service exports. Thus, three variables are defined:

- World demand for goods exports to the euro area (WDGER)

$$WDGER = 0.32MTRFR + 0.23MTRGE + 0.15MTRIT + 0.14MTRPO + 0.06MTRNE + \\ + 0.05MTRBE + 0.02MTRGR + 0.01MTRAU + 0.01MTRIR + 0.01MTRFI \quad [26]$$

where *FR* stands for France, *GE* Germany, *IT* Italy, *PO* Portugal, *NE* Netherlands, *BE* Belgium, *GR* Greece, *AU* Austria, *IR* Ireland and *FI* Finland.

- World demand for goods exports to the rest of the world (WDGNR)

$$WDGNR = 0.30MTRUK + 0.21MTRAL + 0.15MTRUS + 0.10MTROT + 0.07MTRNI + \\ + 0.04MTRJA + 0.04MTRSU + 0.03MTRSW + 0.02MTRDK + 0.02MTRCA + 0.01MTRAT \quad [27]$$

where *UK* stands for United Kingdom, *AL* Latin America, *US* United States, *OT* other countries, *NI* newly industrialised countries, *JA* Japan, *SU* Switzerland, *SW* Sweden, *DK* Denmark, *CA* Canada and *AT* Australia.

- World demand for services exports (*WDSR*)

$$WDSR = 0.28YERGE + 0.24YERUK + 0.12YERFR + 0.08YERIT + 0.06YERUS + \\ + 0.05YERBE + 0.04YERNE + 0.04YERJA + 0.03YERPO + 0.02YERSU + 0.01YERSW \quad [28]$$

Competitiveness is measured in standard equations by subtracting from domestic export prices an external competitor price constructed as a weighted average of other countries' export prices measured in the same currency (XTD_i). The weights are calculated using a double weighting method. Under this method not only the relevance of Spanish exports to a particular country, but also the importance of that country in total world trade are taken into account in order to allow for the competition coming from that country via third markets. To incorporate this source of competition in the case of the goods exports to the euro area and to the rest of the world, two arrays of weights were compiled for each. The first array relates to the direct effect plus the competition effect of the countries in that area, and the second one to the competition effect coming from the countries in the other area. In the case of services exports, external prices are proxied by the relevant GDP deflators (YED_i) to ensure consistency with the external demand variable, and the weights are the same as those for the demand variable. Thus the five competitor prices are the following:

- Competitor prices of goods exports to the euro area

$$cxgeed = 0.16\,xtdfr + 0.31\,xtdge + 0.16\,xtdit + 0.02\,xtdpo + 0.13\,xtdne + 0.14\,xtdbe + \\ + 0.01\,xtdgr + 0.04\,xtdau + 0.02\,xtdir + 0.02\,xtdfi \quad [29]$$

16. The weights are obtained from the share of total Spanish exports that is sold to the country in question.
17. The weights are the share of total tourists entering Spain from each country.

$$cxgend = 0.27\, xtduk + 0.07\, xtdal + 0.17\, xtdus + 0.15\, xtdni + 0.11\, xtdja + 0.10\, xtdsu + 0.06\, xtdsw + 0.04\, xtddk + 0.02\, xtdca + 0.01\, xtdat \quad [30]$$

- Competitor prices of goods exports to the rest of the world

$$cxgnnd = 0.06\, xtduk + 0.13\, xtdal + 0.25\, xtdus + 0.25\, xtdni + 0.16\, xtdja + 0.03\, xtdsu + 0.04\, xtdsw + 0.02\, xtddk + 0.06\, xtdca + 0.01\, xtdat \quad [31]$$

$$cxgned = 0.20\, xtdfr + 0.36\, xtdge + 0.15\, xtdit + 0.01\, xtdpo + 0.09\, xtdne + 0.08\, xtdbe + 0.01\, xtdgr + 0.02\, xtdau + 0.04\, xtdir + 0.04\, xtdfi \quad [32]$$

- Competitor prices of services exports

$$cxsd = 0.28\, yedge + 0.24\, yeduk + 0.12\, yedfr + 0.08\, yedit + 0.06\, yedus + +0.05\, yedbe + 0.04\, yedne + 0.04\, yedja + 0.03\, yedpo + 0.02\, yedsu + 0.01\, yedsw \quad [33]$$

The upper panel of Table 5 sets forth the results obtained for the breakdown of real exports. As can be seen, unit elasticity of exports with respect to the demand variable prevails in the long run. However, whenever Spanish exports have gained share in the sample period, it is necessary to include a trend dummy. This trend dummy probably captures non-price competitiveness effects[18]. In any case, it is noteworthy that in the case of goods exports the trend is truncated in 1998, so it seems that after that date only gains in competitiveness allow the Spanish economy to gain market share. Also, the equations for goods include a dummy around the mid-1980s capturing Spain's accession to the European Union. The effect of competitiveness is around unity in all cases (*XGED*, *XGND* and *XSD* stand for the respective export deflators), implying very low competition in the world market. The bottom panel of Table 5 lists the dynamic specifications. Most notable in the case of goods are the absence of inertia, the quick adjustment to the long-run solution and the absence of effects from the competitor prices of the other area. In the case of services there is much more inertia and the error correction mechanism has a very low coefficient.

Figure 7 shows the impulse-response functions of these equations for permanent shocks to demand variables and competitiveness. As can be seen, the responses of goods exports are very fast and similar across areas, while services exports show a fluctuating convergence path.

b. Export Prices

The export prices of the three categories of goods and services are modelled as a function of private domestic prices and the previously defined external competitor prices, subject to a nominal homogeneity condition. These equations can be rationalised by regarding the export prices as a mark-up over domestic marginal costs, where the mark-up is variable and depends on the relative competitor export prices. As long as the private value added deflator, rather than the domestic marginal cost, is included, the estimated coefficient for competitor prices will measure the differential impact of competitor prices on mark-ups with respect to that of the private value added deflator.

The upper panel of Table 6 shows the long-run results for the three export deflators (net of indirect taxes). It is important to note that the three equations include a step dummy in 1993 (*D93*) that captures the depreciation of the peseta associated with the EMS crisis. The impact of external prices on the goods export deflator is very similar in both areas and higher than that of domestic prices. This could be the result of including the private sector value added deflator instead of the value added deflator of goods, which, provided the dual

18. Most empirical analyses of exports in Spain do not include such a trend [see for example García and Gordo (1998) or Escribano (1999)]. This is probably due to the unconstrained estimation of demand elasticity.

inflation problem of the Spanish economy, should be a better proxy for domestic costs. In contrast, domestic prices are more important than external prices for the services export deflator. In the short run inertial effects are estimated for the three equations, and interestingly, in the case of goods exports neither domestic prices nor competitor prices from the other area are important. Moreover, the related effective exchange rates are significant, showing that in the short run a smoothing of the exchange rate movements occurs. In the case of the services export deflator, domestic prices are again more important than external prices and convergence is slower and barely significant.

Figure 8 presents the impulse-response functions of the three equations for permanent shocks to external and domestic prices. As can be seen, in the case of the goods export deflator there is an overreaction in the short term to own-area competitor prices. The responses to other-area competitor prices and domestic prices are smoother and it takes around two years to complete the adjustment. In the case of services, the adjustment is completed around six years after the shock occurs.

c. Import Volumes

The real import equations (*MGER*, *MGNR* and *MSR*, respectively) are also quite standard; they depend on a scale variable and on competitiveness, measured by the difference between domestic prices and the corresponding import prices. The scale variable is defined as the weighted sum of the different components of final demand, the weights capturing their import content. Using the Input-Output Tables of the Spanish economy it is possible to disaggregate this import content both geographically and by category[19], the results being closely in line with those reported previously:

- Final demand for goods imports from the euro area

$$FDGER = 0.10\,PCR + 0.03GCR + 0.21PIR + 0.21GIR + 0.03RIR + +0.06SCR + \\ + 0.26\,XGER + 0.14\,XGNR + 0.01XSR \qquad [34]$$

where *GCR* stands for government consumption and *GIR* for government investment.

- Final demand for goods imports from the rest of the world

$$FDGNR = 0.06\,PCR + 0.01GCR + 0.08\,PIR + 0.08GIR + 0.01RIR + +0.11SCR + \\ + 0.10\,XGER + 0.10\,XGNR + 0.01XSR \qquad [35]$$

- Final demand for services imports

$$FDSR = 0.03PCR + 0.00GCR + 0.04\,PIR + 0.04GIR + 0.01RIR + 0.01SCR + 0.02\,XGER + \\ + 0.01XGNR + 0.04\,XSR \qquad [36]$$

With respect to relative prices, competitiveness is proxied by the difference between import prices (*MGED*, *MGND* and *MSD*, respectively) and the private sector value added deflator, although this latter price is probably not the best choice because it is a composite of goods and services.

Table 7 presents the main results of the estimation of these equations. In the long run, unit elasticity with respect to the scale variable prevails. This implies that a trend needs to be included to capture the growing weight of imports in final demand. Interestingly, the latest figures for the Spanish economy show that this trend may have been truncated around the

19. In fact, it is not possible to isolate the euro area from the European Union, so the weights assigned to the former are those of the latter.

year 2000. As in the case of the exports, a step dummy had to be included to capture Spain's accession to the European Union in 1986. Finally, the effect of own-area competitiveness appears with the expected sign and a size similar to that reported in other papers[20]. In the case of goods, it was tested whether the relative import price from the other area was significant in the capture of substitution effects, but the rejection of the hypothesis was the rule. In the short run there is a strong overreaction of goods imports with respect to the scale variable, although the responses of both components are quite similar; there is no inertia, and the effects of competitiveness are fairly different, although in both cases negative. In the case of the services imports, the inertial components are quite important and demand and competitiveness appear with the right sign.

Figure 9 shows the impulse-response functions for permanent shocks of these equations. As can be seen, the responses of both goods components to domestic demand are very similar in the short run, while services overreact one year after the shock. On the contrary, the responses to competitiveness are much more disparate, overreacting in the case of goods imports from the euro area and services. The adjustment to the long run is completed in less than three years for both components of goods.

d. Import Prices

As in the case of export prices, import deflators are modelled as a function of private domestic prices and foreign prices, subject to the nominal homogeneity condition. Domestic prices capture pricing-to-market effects. Foreign prices are defined as a weighted average of the export prices of the respective trade partners, the weights being the share of total imports from the country in question:

- Foreign prices of goods imports from the euro area

$$cmged = 0.32\,xtdfr + 0.27\,xtdge + 0.17\,xtdit + 0.05\,xtdpo + 0.08\,xtdne + 0.04\,xtdbe + \\ + 0.01\,xtdgr + 0.02\,xtdau + 0.02\,xtdir + 0.01\,xtdfi \qquad [37]$$

- Foreign prices of goods imports from the rest of the world

$$cmgnd = 0.30\,xtduk + 0.15\,xtdal + 0.23\,xtdus + 0.07\,xtdni + 0.11\,xtdja + 0.05\,xtdsu + \\ + 0.05\,xtdsw + 0.03\,xtddk + 0.02\,xtdca + 0.01\,xtdat \qquad [38]$$

- Foreign prices of services imports

$$cmsd = 0.62\,cmged + 0.38\,cmgnd \qquad [39]$$

The econometric estimates of these equations appear in Table 8. As can be seen, in the long-run, domestic prices significantly affect only services imports. Also, there is a step dummy after 1993 reflecting the EMS crisis[21]. In the case of imports from the rest of the world, another two determinants –energy prices (*PEI*) and non-energy raw material prices (*PRM*)– are included to capture the prices of those products that are mainly exported by countries not included in our dataset. In the short run, certain inertia is estimated only in the case of services. The adjustments to the long run are relatively fast.

Figure 10 depicts the impulse-response functions for permanent shocks of these equations. As can be seen, the responses are quite smooth. There is a certain overreaction in

20. In the case of the imports from the rest of the world, the oil price was excluded to capture the scarce response of oil demand to prices.
21. This structural change was investigated by Gordo and Sánchez (1997).

the case of the euro area and the services deflators, but convergence to the long-run values is fast.

e. Other equations of the trade block.

Once real exports and imports and their deflators have been determined, it is straightforward to obtain the nominal counterparts and to define the trade balance as:

$$BTN = XTN - MTN \tag{40}$$

Adding to this balance the net compensation of employees from the rest of the world, net indirect taxes (*RWTIN*), net direct taxes (*RWTDN*), net interest payments (*RWINN*) and a residual (*RWRES*) gives the current account (*CAN*):

$$CAN = BTN + RWWUNA + RWTIN + RWTDN + RWINN + RWRES \tag{41}$$

Net interest payments to the rest of the world are modelled using the long-term US interest rate (*LTIUS*) multiplied by net foreign assets as follows:

$$\frac{RWINN}{NFA_{-1}} - LTIUS_{-1} = -0.01 + 0.49\left(\frac{RWINN_{-1}}{NFA_{-2}} - LTIUS_{-2}\right) \tag{42}$$

Finally, net foreign assets are obtained from the identity:

$$NFA = NFA_{-1} + CAN \tag{43}$$

2.3 The government sector

Unlike in the previous version of the model, this block is separated from the private sector. This does not mean they are independent. In fact, some public variables enter in the determination of the long-run equilibrium of the model, but they are exogenous (social contribution rates, replacement ratios and so on). Also, the behaviour of certain private sector variables determines the receipts and expenditures of the public sector. Furthermore, the inclusion of a fiscal rule is crucial for the sustainable trend of government debt and thus of household wealth.

The block only considers four behavioural equations: the public investment deflator, public wages, the public value added deflator and the public consumption deflator. The results appear in Table 9. In the long run the government investment deflator depends on the private sector value added deflator and the different components of the import deflator (excluding energy prices), reflecting the idea that these goods can be domestically produced or imported. As with the other deflators, the nominal homogeneity condition is imposed, although this relationship does not seem to be a stationary one. The second equation implies that real (consumer) wages in the public sector are around half of those of the private sector (the growth rate of productivity in the public sector is about half of that of the private sector). The public value added deflator depends on public wages and the public investment deflator. These two variables have been selected because the value added is the sum of public compensation of employees and gross operating surplus, which in the case of the government equals the depreciation of capital stock. Finally, government consumption is the sum of public value added and net purchases of goods and services; thus, this deflator is modelled as a function of the public sector value added, the private sector value added deflator and the imported goods (excluding energy) and services deflator. This last equation is the only one whose residuals can be considered stationary. In the short run (see bottom panel of Table 9) all the variables apart from the consumption deflator show certain inertia, and they have good forecasting properties except in the case of the investment deflator.

The other equations in this block capture the behaviour of receipts and expenditures in the government accounts. The modelling strategy is the same in all cases: an effective tax rate is calculated and considered exogenous, so the resulting receipt (expenditure) will vary with the tax base, which is an endogenous variable. Receipts (*GREV*) are the sum of the gross operating surplus (*GGOS*), direct taxes (*GTDN*), indirect taxes (*GTIN*), social contributions (*GCOT*) and an exogenous residual (*GRESY*):

$$GREV = GGOS + GTDN + GTIN + GCOT + GRESY \qquad [44]$$

The gross operating surplus of the public sector is obtained by multiplying the depreciation rate of this kind of investment (5% in annual terms) by government capital stock (*GKR*) and by the public investment deflator. Direct taxation is divided into three components, which are the taxes paid by households (*HTDN*), those paid by firms (*FTDN*) and the net taxes from the rest of the world, considered to be exogenous. The tax base for the direct taxes paid by households is their disposable income. Therefore, using *HTDX* to denote the effective tax rate gives:

$$HTDN = \frac{HTDX}{1 - HTDX} HYDN \qquad [45]$$

In the case of firms the tax base is the net operating surplus, so, given the effective tax rate (*FTDX*):

$$FTDN = FTDX\left(FGOS - \delta_{PI}\ PKR\ PID\right) \qquad [46]$$

Turning to indirect tax receipts, information from input-output tables can be used to construct effective indirect taxes (*TIX*) for all the components of final demand (private consumption, government consumption, productive investment, residential investment, government investment, goods exports to the euro area, goods exports to the rest of the world and services exports), so their nominal counterparts are the related tax bases. Only a residual component is exogenous, namely the net indirect taxes paid to (or received from) the rest of the world:

$$GTIN = \sum_{i \in DF} TINi + RWTIN \qquad DF = PC, GC, PI, RI, GI, XGE, XGN, XS \qquad [47]$$

$$TINDF = \frac{TIX_{DF}}{1 + TIX_{DF}} DF \qquad DF = PC, GC, PI, RI, GI, XGE, XGN, XS \qquad [48]$$

Social contributions are disaggregated into five components: contributions paid by wage earners (*COTA*), those paid by firms (*COTE*), those paid by non-wage earners (*COTAU*), those paid by the unemployed (*COTU*) and imputed contributions (*COTIM*). Apart from the latter, which is considered exogenous, the tax bases for the others are: employee compensation for the first two, compensation per employee multiplied by non-wage earners in the third case and transfers to the unemployed (*PREU*) in the fourth:

$$COTA = COTXA\,(PWUNA - COTE) \qquad [49]$$

$$COTE = \frac{COTXE}{1 + COTXE} PWUNA \qquad [50]$$

$$COTAU = COTXAU\ PWUN\,(PLN - PLA) \qquad [51]$$

$$COTU = COTXU\ PREU \qquad [52]$$

Public sector expenditures include nominal government consumption (*GCN*), investment (*GIN*), net interest payments (*GINN*), social transfers (*GPRE*) and a residual (*GRESK*) that is considered exogenous:

$$GEXP = GCN + GIN + GINN + GPRE - GRESK \qquad [53]$$

In this expression real government consumption and investment are considered exogenous, while the deflators have been described above. Net interest payments are modelled similarly to net interest payments to the rest of the world:

$$\frac{GINN}{GDN_{-1}} - 0.72\,LTI_{-1} - 0.28\,STI_{-1} = 0.01 + 0.82\left(\frac{GINN_{-1}}{GDN_{-2}} - 0.72\,LTI_{-2} - 0.28\,STI_{-2}\right) \qquad [54]$$

where *GDN* is government debt, *LTI* the long-term interest rate (10 years) and *STI* the short term interest rate (3 months).

Social transfers are divided into those addressing unemployment (PREU), and others (PREO) that relate mainly to retirement payments:

$$PREU = RRU\ PWUN\,URN \qquad [55]$$

$$PREO = RROWUN\ POP65 \qquad [56]$$

where *RRU* and *RRO* are the replacement ratio of unemployment and retirees, respectively, and *POP65* is the population over 65 (the legal retirement age), which is assumed to be exogenous.

Thus, government net lending (GLN) is obtained by subtracting expenditures from receipts, and the public debt is cumulative net lending:

$$GLN = GREV - GEXP \qquad [57]$$

$$GDN = GDN_{-1} + GLN \qquad [58]$$

In the case of long-run simulations, the model includes a fiscal rule that prevents the continuous accumulation or depletion of public debt following a shock [see Willman and Estrada (2002)]. This rule is specified in the same way as in the previous model: the effective direct tax rate on households is adjusted to maintain the public debt-to-nominal GDP ratio on a predetermined path (B*).

$$\Delta HTDX = 0.0075\left(\frac{GDN_{-1}}{YEN_{-4}} - B^{*}\right) \qquad [59]$$

3 Medium-term simulation properties of the model

In this section we perform several exercises to analyse the simulation properties of the empirical model. Also, they are compared with those of the previous version. These simulations can be considered medium-term, as they only cover five years. We prefer to concentrate on this horizon, because a detailed discussion already exists of the longer-term properties of the previous version of the model and of the role played by the fiscal rule in achieving equilibrium therein. As the general structure of the model has not substantially changed, these long-term properties have stayed the same.

We consider six different shocks, although they are simulated using two different configurations of the model. The first three consist of a contractionary monetary policy shock (demand side), an expansionary fiscal policy shock (demand side) and an expansion of the working age population (supply side). In both cases the configuration of the model used is the same as that presented above, although the fiscal rule is not active. This does not make any difference to the results as the fiscal rule does not begin to have any influence until at least seven years after the shock.

The other three exercises consist of an expansionary extra-euro area demand shock (demand side), an appreciation of the euro exchange rate (demand side) and an increase in the oil price (supply side). In these cases the model is configured as in the forecasting mode. This means that some of the variables that were considered endogenous in the presentation of the model, are considered exogenous, because in the projection exercises they are set well in advance (e.g. public-sector variables) or markets provide a path for them that is considered a better projection than that obtained from the model (e.g. financial prices). We do this in order to mimic the multipliers that we use to update projections when not very important changes occur in these variables during the projection exercises.

3.1 A monetary policy shock

This monetary simulation consists of an increase in the short-term nominal interest rate of 100 basis points during two years. Using an estimated term structure, we consider that long-term interest rates also increase, but by a smaller amount (0.16 pp in the first year and 0.06 pp in the second). Moreover, since this increase in interest rates should be implemented at the area level, the uncovered interest rate parity condition implies that the euro/US dollar exchange rate appreciates temporarily by 1.6 pp the first year and by 0.6 pp the second[22]. This translates into an appreciation of the Spanish effective exchange rate of 0.7 pp and 0.3 pp each year.

Given the structure of the model, this shock feeds into the endogenous variables through five channels. First, the appreciation of the currency damages competitiveness and, therefore, the trade balance (exchange-rate channel). Second, the increase in interest rates raises the user cost of productive and residential capital, inducing a downward adjustment in both components of investment (user-cost-of-capital channel). Third, the increase in interest rates makes saving more attractive for households, who postpone consumption (substitution-effect channel). Fourth, as households and firms have fixed-yield assets and liabilities, their net interest payments are also affected (income/cash-flow channel). Finally, the increase in interest rates reduces the market value of firms and houses, reducing household wealth (wealth effect).

22. Notice that although the interest rate is set at the euro area level we do not consider its impact on the growth and inflation of the other members of the Monetary Union.

As can be seen in Table 10, following the shock there is an immediate drop in domestic demand, mainly arising from the user-cost-of-capital channel (see Table 11), and in exports, associated with the worsening of competitiveness induced by the appreciation of the exchange rate. This downward adjustment of final demand causes firms to reduce output and, thus, the demand for productive factors. In particular, lower employment creation reduces household disposable income, which is also adversely affected by the increase in net interest payments[23]; in addition, the market value of their wealth declines, resulting in a downward adjustment of private consumption, although the saving ratio initially declines. The correction of final demand depresses imports, even though there is a worsening of competitiveness, alleviating somewhat the downward pressures on GDP. These channels, along with the substitution effect, also operate in the second year, when the maximum impact on GDP is reached (-0.4 pp). Afterwards, the impact of the exchange-rate channel substantially moderates, when the exchange rate returns to its baseline values, disappearing thereafter. In fact, exports become positive by the third year because of the recorded competitiveness gains. The wealth and the income/cash-flow channels still show some effect in the third year, even though interest rates have returned to their baseline values. In the first case this is due to the delayed impact of wealth on consumption and, in the second, to the stock nature of debt and assets. The substitution effect, which is very small, has also disappeared by the fourth year. Only the user-cost-of-capital channel shows certain persistence.

On the nominal side, the excess supply makes firms reduce their prices, although this effect begins to be sizable only one year after the shock. More relevant and faster is the reduction in imported inflation (due to the appreciation of the exchange rate) which, first through the private consumption deflator and, then, through wage claims, reduces nominal costs and inflation. The maximum effect on prices is reached three years after the shock (-0.28 pp); and that on inflation one year earlier (-0.1 pp).

The budget balance deteriorates over the five years, although, after reaching a peak two years after the shock (-0.34 pp), it returns to the baseline. Initially the worsening is the result of the increase in net interest payments; when the interest rates return to the baseline values, only the reduction in GDP and the subsequent working of the automatic stabilisers explain the negative deviations.

Figure 11 presents a comparison between the results obtained with the new version of the model and the previous one. As can be seen in the top panels, the impact of monetary policy on prices and quantities is now greater in the first year, similar in the second and lower in the third, when the variables begin to return to their baseline values. The other panels represent the multipliers of the main balances of the economy. In the case of the unemployment rate and the trade balance, both multipliers have the same sign, but they are smaller in the new model. By contrast, the budget-balance multiplier is higher now in absolute terms, while the saving ratio increases in the new model, when it declined in the old one; the difference lies in the wealth channel, which was not present in the old model.

3.2 A fiscal policy shock

This shock consists of an increase in government consumption, amounting to 1% of GDP. Defining public consumption as the sum of net government purchases of goods and services, the compensation of public-sector employees and the gross operating surplus, we have shocked the first two components (the other is endogenous).

This expansionary fiscal policy impacts on domestic demand through two channels. On the one hand, increases in the compensation of public-sector employees stimulates the

23. Notice that the sign of this effect depends on net indebtness. In Spain, households are net creditors, but they are net payers of interest, because of the different retribution of fixed-yield assets and liabilities.

real disposable income of households and, thus, private consumption and residential investment. On the other, net government purchases of goods and services directly increase the demand for firms output. In order to meet this excess demand firms try to expand their production, so they demand more capital and employment, expanding household disposable income once again. The increase in domestic demand partly leaks out to the external markets, so imports deviate positively from their baseline values; also, exports decline due to the competitiveness losses associated with inflationary pressures. As a result, GDP increases by more than one percentage point above the baseline (see Table 12), reaching its maximum effect three years after the shock (1.5 pp).

With respect to inflation, the increase in domestic demand and the decline in the unemployment rate initiate a price-wage spiral, that remains present five years after the shock, because GDP is still well above its baseline values. This increase in prices is especially harmful to our trade balance, as it substantially worsens our competitiveness.

The budget balance also deteriorates, but by much less than the initial impact of the shock, because the strong correction of unemployment reduces transfers from government and the expansion of activity increases tax receipts.

Figure 12 compares the results of the new model with those of the previous one. The main difference lies in the GDP multiplier, which is much higher with the new model. This is due to the smaller reaction of imports, which is also reflected in the reduced trade balance multiplier. The difference in the activity response explains the higher impact on the private consumption deflator and on the unemployment rate. This latter effect is the main explanation for the smaller worsening in the budget balance.

3.3 An increase in working age population

This supply shock consists of a 1% increase in working age population due, for example to an increase in the immigration flows. The simulation is simplified assuming that the participation rate does not change, that is, the new population share with the old one the activity ratio. Although, the observed immigration flows of the Spanish economy have a participation ratio much higher than that of the Spanish population, this simulation can give us a flavour of the expected impact of such process.

The increase in the working age population implies an upward adjustment in active population, that is, in the labour force. This generates an increase in the unemployment rate that provokes downward pressures on nominal wages. This decline of firms' labour costs is transmitted to production prices; thus, all the deflators of the domestic demand components are adjusted downwards. The biggest effect on the consumption deflator is reached five years after the implementation of the shock (-0.45 percentage points); on inflation the strongest effect is founded in the third year (0.16 percentage points). On the real side, the decline of real wages generates an increase in employment that, jointly with the gains of purchasing power by households, implies an increase in real disposable income, stimulating private consumption. This increase in demand is transmitted to domestic firms that strengthen their demand for productive factors. As the real wages decline, while the user cost of capital increases this demand of productive factor is biased against capital. With respect to the external sector, the increase of demand is partially filtered to imports initially, but as prices decline, there is a gain of competitiveness, reducing imports and increasing exports, so the net external demand contribution is positive. All in all, the GDP is 0.21 percentage points higher in the fifth year. In the case of the public sector, there is a worsening in the budget balance as a percentage over GDP. This is basically due to the increase in the transfers to unemployment people.

Figure 13 compares the impact of this shock with this model and the previous version. In first place it is necessary to remind that in the old version the shock was implemented directly on active population, while in the new one it takes some time for the working age population to become active population. As can be seen, the impact on prices in the new model is much lower than in the previous model, implying that the response of GDP is also higher. There are not marked differences in the saving ratio and in the unemployment rate, but the worsening of the trade balance and the budget balance is now smaller than in the previous model.

3.4 An extra-euro area demand shock

In this exercise we have simulated a shock consisting of a one percentage point increase in the imports of the countries outside the euro area. Unlike the two previous exercises, we try to mimic the results obtained when the model is run as in a forecasting exercise. This means that all the asset prices and most of the fiscal variables are left exogenous.

As can be seen in Table 14, this shock implies an increase of 0.4 pp in Spanish export markets, which generates a similar increase in exports (in particular, those directed to the rest of the world). As domestic firms perceive this increase in demand, they adjust output upwards by hiring more labour and buying more machinery. The increase in employment stimulates disposable income, and thus private consumption and residential investment. Although part of this upward adjustment in domestic demand leaks out to the external market through imports, GDP increases, the maximum impact (0.2 pp) being reached three years after the shock.

The effect on prices, associated with demand pressures, is very small but positive. The budget balance improves very moderately due to the working of the automatic stabilisers.

In comparison with the results of the old model (see figure 14), GDP and price multipliers are higher, especially in the first case due to the higher response of domestic demand. Looking at the main disequilibrium multipliers, all of them have the same sign, but they are higher in the case of the unemployment rate and the budget balance, and lower for the saving ratio.

3.5 An appreciation of the euro exchange rate

In this case the exercise consists of a 5% appreciation of the euro exchange rate. The configuration of the model is the same as in the previous case. As can be seen in Table 15, this shock implies an appreciation of our effective exchange rate of around 2%, consistent with an extra-area export share of 40%.

The appreciation of the exchange rate implies a worsening of competitiveness, that is reflected in a marked decline of exports (by around one percentage point in the first two years)[24]. The reduction in external demand leads to a downward adjustment in domestic production, so firms reduce their demand for productive factors. In particular, the downward adjustment of employment squeezes the real disposable income of households, who reduce their spending plans, although there is a temporary contraction of the saving ratio. Initially imports decline following the adjustment in final demand, but afterwards they increase, when competitiveness effects begin to dominate. Thus, the impact on GDP is negative and the maximum deviation is reached three years after the shock (-0.6 pp).

On the nominal side, the decline of external prices in euro induces a downward adjustment in both export and import prices, which is higher in the latter case. Import price reductions feed into the prices of domestic demand, inducing smaller inflationary pressures and reducing wage claims. In addition, the downward correction in activity and the decline of mark-ups also contribute to reducing prices, which still deviate from the baseline five years

24. It is interesting to note that not only the extra-area exports decline, but also those of the euro area, due to third market effects.

after the shock. The balance of the public sector worsens by around 0.3 percentage points of GDP after the second year, due to the working of the automatic stabilisers.

The comparison with the results obtained with the old model (figure 15) shows that the multipliers of prices are very similar, although the response of GDP is much larger (in absolute values) due to the greater adjustment of investment. In the case of the saving ratio, unlike in the old model, there is a progressive correction of the initial impact. The effect on the trade balance is precisely the opposite of that previously encountered.

3.6 An increase in the oil price

The last simulation exercise consists of an increase of 20% in the oil price in US dollars, using the same configuration of the model as in the previous two cases. As be shown below, the model treats this shock as a supply shock, specifically as a cost-push shock.

The immediate effect of the increase in the oil price is a quick and sustained reaction by import prices, which rise 1.7 pp above the baseline values (see Table 16). Insofar, as private consumption includes these imported products, its deflator also increases, reaching a maximum of 0.3 pp two years after the shock. The worsening of workers' inflationary expectations induces higher wage claims, pushing up firms' nominal costs. Although firms temporarily reduce their mark-ups, they increase the prices of domestically produced products, initiating a price-cost spiral. At the same time, the rise in the consumption deflator reduces the real disposable income of households and despite a temporary decline in the saving ratio, this induces a downward revision in private consumption and residential investment. This reduction in domestic demand causes firms to cut production (the maximum impact on GDP, of -0.2 pp, is reached three years after the shock) and thus private investment and employment, thereby increasing the unemployment rate. Obviously, this correction in demand helps to reduce inflationary pressures.

On the external front, exports decline, due to the competitiveness losses (note that the prices of our competitors remain unchanged), and the same happens with imports, because the impact of the losses of competitiveness is counteracted by the downward adjustment in final demand. It is interesting to note that the trade balance improves in real terms, while it worsens in nominal terms due to the increase in the energy bill. With respect to the public sector, the budget balance, as a percentage of GDP, worsens, increasing government debt. This is the result of an increase in expenditure associated with the working of the automatic stabilisers.

Figure 16 presents a comparison between the results obtained with the new version of the model and the old one. With respect to growth and prices, the results are basically the same in the first two years. Afterwards the new model seems to return faster to the baseline values. In the case of the variables capturing the different disequilibria of the economy, the responses of both models have the same sign, although the magnitudes are much lower in the new version. Also, in the case of the saving ratio and the trade balance, the responses increase over time in the old model while diminishing in the new one.

4 Conclusions

This paper has presented a new version of the quarterly macroeconometric model of the Banco de España, which was initially developed in collaboration with the ECB. Although maintaining its basic structure, this new version includes some novelties, whose implications are described below.

In the first place, the database has been changed to seasonally and calendar adjusted time series, as opposed to the trend-cycle signal used before. This change has been quite successful, since, without significantly altering the long-run properties of the model, it has improved the short-run dynamics. Thus, it has made calibration of the equations due to implausible short-run impulse-response functions almost unnecessary. Second, the trade breakdown between euro area and non-euro area goods and services has also provided very interesting results, as it allows us to isolate the effects coming from the rest of the world (that are more directly related to the exchange rate movements), from those coming from the euro area. Besides, a separate analysis of goods and services makes it possible to analyse one of the major industries of the Spanish economy, namely tourism. Third, the disaggregation of private investment has been crucial in enabling one aspect of the Spanish economy that has attracted a lot of attention recently to be included in the model: changes in house prices. Although the model cannot explain the recent surge in these prices, it endogenises their effects in the rest of the economy. Finally, the consideration of financial wealth evaluated at market prices allows us to incorporate a new channel in the propagation of shocks, namely the wealth channel.

The various medium run simulations performed with the new version of the model show responses that are in line with mainstream economic theory. Thus, an increase in interest rates significantly reduces output and, to a lesser extent, inflation; moreover, the maximum effect is reached two years after the shock occurs. Other interesting results are that the fiscal multiplier is greater than one, the increase in the working age population reduces prices but increases output, the exchange rate still has important effects on output and prices and oil price increases reduce output by one-tenth of the shock and increase inflation by slightly more.

Comparing these results with those of the previous version of the model, it seems that the new one has stronger responses in the first two years after the shock occurs and the return to the base-line values begins earlier and takes place faster than previously. Obviously, model building is a continuous process, and some problems identified in the previous version have not been addressed here. This is the case of expectations, which continue to be backward looking. These issues are in our research agenda.

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TABLE 1. EQUATIONS OF THE SUPPLY BLOCK (PRIVATE EMPLOYMENT –PLN–, INVESTMENT –PIR–, VALUE ADDED DEFLATOR –PYED–, WAGES –PWUN– AND LABOUR FORCE –LFN–)

Long-run relationships:

$$pln^{*} = -1.10 - 0.002\,TFP + 1.56\,pyer - 0.56\,pkr$$

$$\sigma(\%) = 1.78;\ DW = 0.40;\ ADF = -2.84$$

$$pkr^{*} = -1.43 - 0.001\,TFP + pyer - 0.64\,(puc - pwun)$$

$$\sigma(\%) = 17.05;\ DW = 1.20;\ ADF = -5.64$$

$$pyed^{*} = -0.60 - 0.08\,D84 - 0.002\,TFP + 0.50\left(pyer - pkr\right) + 0.90\,pwun + 0.10\,cxgeed$$

$$\sigma(\%) = 1.52;\ DW = 1.13;\ ADF = -5.25$$

$$pwun^{*} = -0.80 + 0.08\,D84 + \left(pyed + pyer - pln\right) - 0.42\left(URX - 0.03\,RRU\right) - twed^{\,r}$$

$$\sigma(\%) = 2.56;\ DW = 0.47;\ ADF = -2.74$$

$$lfn^{*} = -0.54 + 0.001\,TRENLFN1 + 0.003\,TRENLFN2 + popwa^{\,r} - 0.46\left(URX - 0.03\,RRU\right)$$

$$\sigma(\%) = 0.70;\ DW = 0.55;\ ADF = -3.58$$

Dynamic specifications:

$$\Delta pln = \underset{(-4.50)}{-0.00} + \underset{(-)}{0.10}\,\Delta pln^{r}_{-1} + \underset{(8.59)}{0.65}\,\Delta pyer + \underset{(3.40)}{0.18}\,\Delta pyer_{-4} - \underset{(-3.27)}{0.13}\,\Delta pwunr - \underset{(-5.70)}{0.13}\,(pln - pln^{*})_{-1}$$

$$ST(8) = 13.24;\ \sigma(\%) = 0.34;\ DW = 1.92;\ LM(5) = 0.55;\ AR(4) = 0.29;\ JB(2) = 0.61;\ FOR_{-}(8) = 4.17;\ FOR_{+}(8) = 4.14$$

$$\Delta pir = \underset{(-2.05)}{-0.24} + \underset{(2.34)}{1.06}\left(\Delta pyer_{-1} + \Delta pyer_{-2}\right) - \underset{(-2.83)}{0.05}\,\Delta pucr + \underset{(1.66)}{2.25}\,\frac{FDYN}{PKN_{-1}} - \underset{(-1.89)}{0.05}(pir - pkr^{*})_{-1}$$

$$ST(12) = 8.27;\ \sigma(\%) = 3.44;\ DW = 2.07;\ LM(5) = 0.35;\ AR(4) = 0.95;\ JB(2) = 1.53;\ FOR_{-}(8) = 5.93;\ FOR_{+}(8) = 5.02$$

$$\Delta pyed = \underset{(2.28)}{0.00} + \underset{(2.06)}{0.17}\,\Delta pyed_{-2} + \underset{(4.84)}{0.43}\,\Delta pwun + \underset{(2.41)}{0.07}\,\Delta mgd_{-4} - \underset{(-4.09)}{0.27}\,(pyed - pyed^{*})_{-1}$$

$$R^{2} = 0.63;\ \sigma(\%) = 0.80;\ DW = 1.93;\ LM(5) = 1.67;\ AR(4) = 1.49;\ JB(2) = 1.10;\ FOR_{-}(8) = 4.41;\ FOR_{+}(8) = 2.00$$

$$\Delta pwun = \underset{(0.76)}{0.00} + \underset{(1.18)}{0.13}\,\Delta pwun_{-1} + \underset{(4.24)}{0.47}\left(0.5\Delta pyed + 0.5\Delta pcd + \Delta pyer - \Delta pln\right) + \underset{(1.97)}{0.28}\,\Delta pcd_{-2} - \underset{(-0.86)}{0.19}\,\Delta URX_{-3} - \underset{(-2.34)}{0.10}\,(pwun - pwun^{*})_{-1}$$

$$R^{2} = 0.50;\ \sigma(\%) = 0.72;\ DW = 1.90;\ LM(5) = 1.85;\ AR(4) = 1.22;\ JB(2) = 0.16;\ FOR_{-}(8) = 4.21;\ FOR_{+}(8) = 3.59$$

$$\Delta lfn = \underset{(2.75)}{0.00} + \underset{(3.73)}{0.34}\,\Delta lfn_{-1} - \underset{(-4.10)}{0.32}\,\Delta URX_{-1} - \underset{(-3.32)}{0.21}(lfn - lfn^{*})_{-1}$$

$$R^{2} = 0.64;\ \sigma(\%) = 0.30;\ DW = 2.30;\ LM(5) = 1.16;\ AR(4) = 0.56;\ JB(2) = 0.01;\ FOR_{-}(8) = 7.24;\ FOR_{+}(8) = 6.38$$

Notes: ^{r}, restricted parameter; σ, residual standard deviation; DW, Durbin-Watson statistic; ADF, augmented Dickey-Fuller statistic; ST(i), Sargan test; LM(i), residual autocorrelation order i statistic; AR(i), heteroscedasticity test for ARCH order i residuals; JB, Bera-Jarque test of normality; FOR-(i), forecasting (in sample) test i periods ahead; FOR_{+}(i), forecasting (out of sample) test i periods ahead. t-ratios in brackets. Estimation period: 1981:1-1998:4.

TABLE 2. DYNAMIC EQUATIONS OF PRIVATE CONSUMPTION –PCD– AND PRIVATE INVESTMENT DEFLATORS –PID– AND NON-ENERGY –HICPNE– AND ENERGY –HICPNE– COMPONENTS OF HICP-

Long-run relationships:

$$Ln\left(\frac{PCD^{*}}{1+TIXPC}\right) = -0.02 - 0.02\ D8691 + 0.94\ pyed + 0.03\ mged + 0.02\ mgnd + 0.01\ msd^{\,r}$$

$$\sigma(\%) = 0.53;\ DW = 0.53;\ ADF = -3.92$$

$$hicpne^{*} = -0.04 + 0.01\ D8691 + 0.95\ pyedt + 0.02\ mged + 0.02\ \frac{mgnd - 0.23\ pei}{0.77} + 0.01\ msd^{\,r} + SEAS$$

$$\sigma(\%) = 0.50;\ DW = 1.05;\ ADF = -6.50$$

$$hicpe^{*} = -0.04 + 0.26\ D8086 + 0.94\ pyedt^{\,r} + 0.06\ pei^{\,r} + SEAS$$

$$\sigma(\%) = 4.73;\ DW = 0.62;\ ADF = -4.49$$

$$Ln\left(\frac{PID^{*}}{1+TIXPI}\right) = 0.01 + 0.02\ D8691 + 0.69\ pyed + 0.21\ mged + 0.07\ \frac{mgnd - 0.23\ pei}{0.77} + 0.03\ msd^{\,r}$$

$$\sigma(\%) = 1.64;\ DW = 0.23;\ ADF = -2.74$$

Dynamic specifications:

$$\Delta Ln\left(\frac{PCD}{1+TIXPC}\right) = \underset{(1.07)}{0.00} + \underset{(3.80)}{0.19}\,\Delta Ln\left(\frac{PCD}{1+TIXPC}\right)_{-2} + \underset{(16.35)}{0.71}\,\Delta pyed + \underset{(2.93)}{0.04}\,\Delta mged + \underset{(7.07)}{0.05}\,\Delta mgnd - \underset{(-8.46)}{0.38}\,\Delta tixpc +$$
$$\underset{(4.69)}{0.25}\,\Delta tixpc_{-2} - \underset{(-3.53)}{0.20}(pcd - pcd^{*})_{-1}$$

$$R^2 = 0.97; \sigma(\%) = 0.22; DW = 1.93; LM(5) = 2.00; AR(4) = 1.05; JB(2) = 0.12; FOR_{-}(8) = 4.79; FOR_{+}(8) = 12.08$$

$$\Delta hicpne = \underset{(7.22)}{0.01} + \underset{(12.33)}{0.71}\,\Delta pyedt + \underset{(4.45)}{0.27}\,\Delta pyedt_{-4} - \underset{(-6.84)}{0.71}(hicpne - hicpne^{*})_{-1} + SEAS$$

$$R^2 = 0.91; \sigma(\%) = 0.38; DW = 2.14; LM(5) = 0.24; AR(4) = 0.45; JB(2) = 2.20; FOR_{-}(8) = 10.98; FOR_{+}(8) = 35.38$$

$$\Delta hicpe = -\underset{(-0.98)}{0.01} + \underset{(2.61)}{0.23}\,\Delta hicpe_{-1} + \underset{(2.46)}{0.55}\,\Delta pyedt + \underset{(5.70)}{0.10}\,\Delta pei + \underset{(2.40)}{0.23}\,\Delta pei_{-2} - \underset{(-4.12)}{0.21}(hicpe - hicpe^{*})_{-1} + SEAS$$

$$R^2 = 0.64; \sigma(\%) = 1.84; DW = 1.97; LM(5) = 1.48; AR(4) = 0.11; JB(2) = 3.91; FOR_{-}(8) = 5.84; FOR_{+}(8) = 15.72$$

$$\Delta Ln\left(\frac{PID}{1+TIXPI}\right) = \underset{(0.22)}{0.00} + \underset{(11.49)}{0.71}\,\Delta pyed + \underset{(2.76)}{0.11}\,\Delta mged + \underset{(2.07)}{0.07}\,\Delta\,\frac{mgnd - 0.23\ pei}{0.77} - \underset{(-2.27)}{0.12}(pid - pid^{*})_{-1}$$

$$R^2 = 0.71; \sigma(\%) = 0.64; DW = 2.06; LM(5) = 3.21; AR(4) = 1.39; JB(2) = 9.76; FOR_{-1}(8) = 3.78; FOR_{-1}(8) = 7.07$$

Notes: See previous table; *SEAS*, seasonal dummies.

TABLE 3. DYNAMIC EQUATIONS OF REAL PRIVATE CONSUMPTION –PCR–, RESIDENTIAL INVESTMENT –RIR– AND RESIDENTIAL INVESTMENT DEFLATOR –RID–

Long-run relationships:

$$pcr^{*} = -0.24 + 0.96\, hdyr + 0.04 \log(FWR_{-1} + NFWR_{-1})^{r} - 0.57\, RR$$

$$\sigma(\%) = 1.57;\; DW = 0.79;\; ADF = -4.23$$

$$rir^{*} = -2.46 + pcr^{r} - 0.03\, ruc$$

$$\sigma(\%) = 5.55;\; DW = 0.41;\; ADF = -2.75$$

$$Ln\left(\frac{RID^{*}}{1+TIXRI}\right) = 2.15 + 0.08\, D84 - 0.00\, TRENRI + Ln\left(\frac{PCD}{1+TIXPC}\right)^{r} + 0.95\,(pcr - rkr_{-1}) -$$

$$0.02\, Ln\left(\frac{HTI}{4} + 0.005 - Ln\left(\frac{RID}{RID_{-1}}\right)\right)$$

$$\sigma(\%) = 1.44;\; DW = 1.23;\; ADF = -5.62$$

Dynamic specifications:

$$\Delta pcr = \underset{(0.78)}{0.00} + \underset{(3.63)}{0.35}\,\Delta pcr_{-2} + \underset{(4.50)}{0.27}\,\Delta hdyr + \underset{(2.24)}{0.11}\,\Delta hdyr_{-1} + \underset{(2.78)}{0.02}\,\Delta fwr_{-2} + \underset{(2.12)}{0.14}\,\Delta nfwr_{-2} - \underset{(-1.21)}{0.14}\left(\Delta RR_{-2} + \Delta RR_{-3}\right)$$

$$- \underset{(-1.98)}{0.11}(pcr - pcr^{*})_{-1}$$

$$R^{2} = 0.54; \sigma(\%) = 0.59; DW = 2.19; LM(5) = 0.73; AR(4) = 0.74; JB(2) = 1.65; FOR_{-}(8) = 2.25; FOR_{+}(8) = 8.53$$

$$\Delta rir = \underset{(1.45)}{0.01} + \underset{(1.17)}{0.23}\left(\Delta hdyr + \Delta hdyr_{-4}\right) - \underset{(-1.82)}{0.07}\,\Delta fwr_{-3} - \underset{(-1.46)}{0.01}\left(\Delta ruc + \Delta ruc_{-2}\right) - \underset{(-3.07)}{2.64}\,\Delta URX_{-3} - \underset{(-2.63)}{0.20}(rir - rir^{*})_{-1}$$

$$R^{2} = 0.37; \sigma(\%) = 2.96; DW = 1.70; LM(5) = 0.72; AR(4) = 0.93; JB(2) = 0.85; FOR_{-}(8) = 9.66; FOR_{+}(8) = 3.91$$

$$\Delta Ln\left(\frac{RID}{1+TIXRI}\right) = \underset{(2.47)}{0.00} + \underset{(5.20)}{0.43}\,\Delta Ln\left(\frac{RID}{1+TIXRI}\right)_{-1} + \underset{(3.22)}{0.36}\,\Delta Ln\left(\frac{PCD}{1+TIXPC}\right) + \underset{(4.02)}{0.38}\,\Delta^{2} Ln\left(\frac{PCD}{1+TIXPC}\right) -$$

$$\underset{(-2.40)}{0.01}\,\Delta\left(\frac{HTI}{4} + 0.005 - Ln\left(\frac{RID}{RID_{-1}}\right)\right)_{-1} - \underset{(-5.72)}{0.35}(rid - rid^{*})_{-1}$$

$$R^{2} = 0.79; \sigma(\%) = 0.72; DW = 1.88; LM(5) = 0.49; AR(4) = 1.82; JB(2) = 0.86; FOR_{-}(8) = 6.12; FOR_{+}(8) = 13.13$$

Notes: See previous table, D84 step dummy, TRENRID, truncated trend.

TABLE 4. DYNAMIC EQUATION OF INVENTORY INVESTMENT –SCR–

Long-run relationships:

$$LSR^{*} = 0.73\,PYERPOT$$

$$\sigma(\%) = -;\ DW = 1.72;\ ADF = -7.12$$

Dynamic specifications:

$$\Delta SCR = \underset{(-2.28)}{-161.0} - \underset{(-2.18)}{0.06}\left(\Delta SAL - 0.97\Delta PYERPOT\right) + \underset{(8.01)}{0.41}\left(\Delta SAL_{-1} - 0.97\Delta PYERPOT_{-1}\right) -$$
$$\underset{(-1.07)}{0.06}\left(\Delta\left(RRS\ PYERPOT\right) + \Delta\left(RRS\ PYERPOT\right)_{-1}\right) - \underset{(-7.23)}{0.49}\left(SCR - \Delta LSR^{*}\right)_{-1}$$

$$R^{2} = 0.57; \sigma(\%) = -; DW = 2.08; LM(5) = 0.51; AR(4) = 1.72; JB(2) = 2.68; FOR_{-}(8) = 22.52; FOR_{+}(8) = 9.90$$

Notes: See previous Table.

TABLE 5. DYNAMIC EQUATIONS OF REAL EXPORTS OF GOODS TO THE EURO AREA –XGER–, TO THE REST OF THE WORLD –XGNR– AND OF SERVICES –XSR–

Long-run relationships:

$$xger^{*} = 8.52 - 0.08\ D84 + 0.01\ TRENXGER + wdger^{r} - 0.86\,(xged - 0.64\,cxgeed^{r} - 0.36\,cxgend^{r})$$

$$\sigma(\%) = 4.83;\ DW = 0.98;\ ADF = -4.87$$

$$xgnr^{*} = 8.57 + 0.32\ D86 + 0.00\ TRENXGNR + wdgnr^{r} - 1.08\,(xgnd - 0.63\,cxgnnd^{r} - 0.37\,cxgned^{r})$$

$$\sigma(\%) = 6.68;\ DW = 0.70;\ ADF = -4.04$$

$$xsr^{*} = 8.62 + 0.01\ TRENXSR1 + 0.03\ TRENXSR2 + wdsr^{r} - 0.91\,(xsd - cxsd)$$

$$\sigma(\%) = 5.39;\ DW = 0.17;\ ADF = -1.86$$

Dynamic specifications:

$$\Delta xger = \underset{(3.22)}{0.02} + \underset{(3.07)}{0.87}\,\Delta wdger - \underset{(-1.73)}{0.24}\Big(\Delta(xged - cxgeed) + \Delta(xged - cxgeed)_{-4}\Big) - \underset{(-4.30)}{0.42}\,(xger - xger^{*})_{-1}$$

$$R^{2} = 0.33; \sigma(\%) = 3.78; DW = 2.41; LM(5) = 1.98; AR(4) = 0.25; JB(2) = 0.33; FOR_{-}(8) = 8.85; FOR_{+}(8) = 2.90$$

$$\Delta xgnr = \underset{(1.40)}{0.01} + \underset{(1.59)}{0.64}\,\Delta wdgnr - \underset{(-3.83)}{0.50}\,\Delta(xgnd - cxgnnd) - \underset{(-4.51)}{0.37}\,(xgnr - xgnr^{*})_{-1}$$

$$R^{2} = 0.67; \sigma(\%) = 4.13; DW = 2.23; LM(5) = 2.43; AR(4) = 0.51; JB(2) = 0.72; FOR_{-}(8) = 5.24; FOR_{+}(8) = 6.77$$

$$\Delta xsr = \underset{(0.78)}{0.00} + \underset{(18.42)}{0.80}\,\Delta xsr_{-1} + \underset{(1.31)}{0.24}\,\Delta wdsr_{-1} - \underset{(-4.22)}{0.09}\Big(\Delta(xsd - cxsd) + \Delta(xsd - cxsd)_{-2}\Big) - \underset{(-4.26)}{0.05}\,(xsr - xsr^{*})_{-1}$$

$$R^{2} = 0.89; \sigma(\%) = 0.51; DW = 1.59; LM(5) = 2.21; AR(4) = 2.46; JB(2) = 1.88; FOR_{-}(8) = 9.92; FOR_{+}(8) = 10.23$$

Notes: See previous tables. TRENX, truncated trend dummy.

TABLE 6. DYNAMIC EQUATIONS OF EXPORT DEFLATORS OF GOODS TO THE EURO AREA –XGED–, TO THE REST OF THE WORLD –XGND– AND OF SERVICES –XSD–

Long-run relationships:

$$\frac{xged^{*}}{1+tixxge} = 0.12 - 0.10\ D93 + 0.73\left(0.64\,cxgeed^{r} + 0.36\,cxgend^{r}\right) + 0.27\ pyed^{r}$$

$$\sigma(\%) = 2.81;\ DW = 0.65;\ ADF = -4.46$$

$$\frac{xgnd^{*}}{1+tixxgn} = 0.20 - 0.16\ D93 + 0.61\left(0.63\,cxgnnd^{r} + 0.37\,cxgned^{r}\right) + 0.39\ pyed^{r}$$

$$\sigma(\%) = 2.92;\ DW = 0.83;\ ADF = -5.28$$

$$\frac{xsd^{*}}{1+tixxs} = 0.06 - 0.02\ D93 + 0.33\,cxsd + 0.67\ pyed^{r}$$

$$\sigma(\%) = 1.69;\ DW = 0.24;\ ADF = -3.59$$

Dynamic specifications:

$$\Delta\frac{xged}{1+tixxge} = \underset{(1.66)}{0.00} + \underset{(-)}{0.28}\,\Delta\left(\frac{xged}{1+tixxge}\right)^{r}_{-2} + \underset{(7.76)}{0.72}\,\Delta cxgeed - \underset{(-4.98)}{0.57}\,\Delta efxge - \underset{(-2.50)}{0.21}\,\Delta efxgee_{-2} - \underset{(-4.70)}{0.34}\,(xged - xged^{*})_{-1}$$

$$R^{2} = 0.60;\ \sigma(\%) = 1.39;\ DW = 1.83;\ LM(5) = 0.82;\ AR(4) = 2.12;\ JB(2) = 0.44;\ FOR_{-}(8) = 2.81;\ FOR_{+}(8) = 4.59$$

$$\Delta\frac{xgnd}{1+tixxgn} = \underset{(0.46)}{0.00} + \underset{(2.32)}{0.23}\,\Delta\frac{xgnd}{1+tixxgn}_{-2} + \underset{(3.51)}{0.44}\,\Delta cxgnnd - \underset{(-2.03)}{0.25}\,\Delta efxgnn - \underset{(-3.25)}{0.27}\,(xgnd - xgnd^{*})_{-1}$$

$$R^{2} = 0.42;\ \sigma(\%) = 1.86;\ DW = 2.01;\ LM(5) = 0.09;\ AR(4) = 0.39;\ JB(2) = 0.52;\ FOR_{-}(8) = 3.75;\ FOR_{+}(8) = 5.56$$

$$\Delta\frac{xsd}{1+tixxs} = \underset{(1.25)}{0.00} + \underset{(7.82)}{0.44}\,\Delta\left(\frac{xsd}{1+tixxs}\right)_{-4} + \underset{(4.25)}{0.10}\,\Delta cxsd + \underset{(6.82)}{0.33}\,\Delta pyed - \underset{(-1.92)}{0.09}\,(xsd - xsd^{*})_{-1}$$

$$R^{2} = 0.79;\ \sigma(\%) = 0.45;\ DW = 1.60;\ LM(5) = 3.00;\ AR(4) = 0.60;\ JB(2) = 11.83;\ FOR_{-}(8) = 2.48;\ FOR_{+}(8) = 5.10$$

Notes: See previous table.

TABLE 7. DYNAMIC EQUATIONS OF REAL IMPORTS OF GOODS FROM THE EURO AREA –MGER–, FROM THE REST OF THE WORLD –MGNR– AND OF SERVICES –MSR–

Long-run relationships:

$$mger^{*} = -0.85 - 0.35\ D86 + 0.01\ TRENMGER + fdger^{r} - 0.52\,(mged - pyed)$$

$$\sigma(\%) = 5.77;\ DW = 0.91;\ ADF = -4.66$$

$$mgnr^{*} = -0.00 + 0.20\ D86 + 0.00\ TRENMGNR + fdgnr^{r} - 0.48\left(\frac{mgnd - 0.23\ pei^{r}}{0.77} - pyed\right)$$

$$\sigma(\%) = 4.23;\ DW = 0.65;\ ADF = -3.58$$

$$msr^{*} = -0.34 + 0.11\ D86 + 0.01\ TRENMSR + fdsr^{r} - 0.65\,(msd - pyed)$$

$$\sigma(\%) = 5.30;\ DW = 0.22;\ ADF = -3.17$$

Dynamic specifications:

$$\Delta mger = -\underset{(-0.01)}{0.00} + \underset{(5.11)}{1.71}\Delta fdger + \underset{(2.10)}{0.68}\Delta fdger_{-1} - \underset{(-5.80)}{0.74}\Delta(mged - pyed) - \underset{(-4.95)}{0.33}(mger - mger^{*})_{-1}$$

$$R^{2} = 0.65; \sigma(\%) = 3.13; DW = 2.37; LM(5) = 1.17; AR(4) = 0.25; JB(2) = 1.45; FOR_{-}(8) = 4.76; FOR_{+}(8) = 1.74$$

$$\Delta mgnr = -\underset{(-0.93)}{0.00} + \underset{(6.41)}{1.60}\Delta fdgnr + \underset{(2.23)}{0.58}\Delta fdgnr_{-1} - \underset{(-1.24)}{0.09}\Delta\left[\left(\frac{mgnd - 0.23\ pei^{r}}{0.77} - pyed\right) + \left(\frac{mgnd - 0.23\ pei^{r}}{0.77} - pyed\right)_{-1}\right] - \underset{(-2.55)}{0.23}(mgnr - mgnr^{*})_{-1}$$

$$R^{2} = 0.48; \sigma(\%) = 2.86; DW = 2.22; LM(5) = 1.50; AR(4) = 1.36; JB(2) = 1.00; FOR_{-}(8) = 12.51; FOR_{+}(8) = 6.84$$

$$\Delta msr = \underset{(1.83)}{0.00} + \underset{(2.48)}{0.23}\Delta msr_{-2} + \underset{(3.78)}{0.32}\Delta msr_{-3} + \underset{(1.34)}{0.33}\Delta fdsr_{-3} - \underset{(-2.49)}{0.24}\Delta(msd - pyed) - \underset{(-3.26)}{0.13}(msr - msr^{*})_{-1}$$

$$R^{2} = 0.58; \sigma(\%) = 1.38; DW = 1.89; LM(5) = 1.82; AR(4) = 5.67; JB(2) = 2.46; FOR_{-}(8) = 11.85; FOR_{+}(8) = 15.79$$

Notes: See previous table; D86, step dummy in 1986, TRENM, deterministic trend.

TABLE 8. DYNAMIC EQUATIONS OF IMPORT DEFLATORS OF GOODS FROM THE EURO AREA –MGED–, FROM THE REST OF THE WORLD –MGND– AND OF SERVICES –MSD–

Long-run relationships:

$$mged^{*} = 0.09 + 0.13\,D8085 - 0.11\,D93 + cmged^{r}$$
$$\sigma(\%) = 4.54;\; DW = 0.46;\; ADF = -4.75$$

$$mgnd^{*} = 0.20 - 0.20\,D93 + 0.52\,cmgnd + 0.23\,pei + 0.25\,prm^{r}$$
$$\sigma(\%) = 3.55;\; DW = 0.89;\; ADF = -4.55$$

$$msd^{*} = -0.04 + 0.10\,D93 + 0.55\,cmsd + 0.45\,pyed^{r}$$
$$\sigma(\%) = 3.54;\; DW = 0.16;\; ADF = -3.11$$

Dynamic specifications:

$$\Delta mged = \underset{(1.11)}{0.00} + \underset{(4.81)}{0.42}\,\Delta cmged + \underset{(4.87)}{0.35}\,\Delta cmged_{-3} - \underset{(-4.37)}{0.25}(mged - mged^{*})_{-1}$$
$$R^{2} = 0.61; \sigma(\%) = 1.64; DW = 1.93; LM(5) = 1.56; AR(4) = 0.42; JB(2) = 3.58; FOR_{-}(8) = 6.04; FOR_{+}(8) = 9.95$$

$$\Delta mgnd = -\underset{(-1.90)}{0.00} + \underset{(7.69)}{0.35}\,\Delta cmgnd + \underset{(3.40)}{0.15}\,\Delta cmgnd_{-2} + \underset{(16.65)}{0.23}\,\Delta pei - \underset{(-2.25)}{0.11}(mgnd - mgnd^{*})_{-1}$$
$$R^{2} = 0.91; \sigma(\%) = 1.33; DW = 2.28; LM(5) = 1.21; AR(4) = 0.54; JB(2) = 0.34; FOR_{-}(8) = 6.53; FOR_{+}(8) = 26.80$$

$$\Delta msd = \underset{(0.87)}{0.00} + \underset{(5.37)}{0.31}\,\Delta msd_{-1} + \underset{(8.04)}{0.31}\,\Delta cmsd + \underset{(2.98)}{0.17}\,\Delta pyed + \underset{(-)}{0.21}\,\Delta pyed_{-4} - \underset{(-3.77)}{0.14}(msd - msd^{*})_{-1}$$
$$R^{2} = 0.86; \sigma(\%) = 0.71; DW = 2.05; LM(5) = 0.73; AR(4) = 0.36; JB(2) = 5.21; FOR_{-}(8) = 1.26; FOR_{+}(8) = 5.73$$

Notes: See previous table; D8085, step dummy 80:1-85:2; D93 step dummy 93:1.

TABLE 9. DYNAMIC EQUATIONS OF GOVERNMENT SECTOR DEFLATORS OF INVESTMENT –GID–, VALUE ADDED –GYED–, CONSUMPTION –GCD– AND WAGES –GWUN–

Long-run relationships:

$$\frac{gid^*}{tixgi} = 0.03 + 0.78\, pyed + 0.14\, mged + 0.05\,\frac{mgnd - 0.23\, pei}{0.77} + 0.02\, msd^{\,r}$$

$$\sigma(\%) = 1.49;\; DW = 0.16;\; ADF = -1.49$$

$$\left(gwun - pcd\right) = 1.10 - 0.03\, D9601 + 0.52\left(pwun - pcd\right)$$

$$\sigma(\%) = 1.91;\; DW = 0.37;\; ADF = -2.42$$

$$gyed^* = -1.36 - 0.02\, D8395 + 0.72\, gwun + 0.28\, gid^{\,r}$$

$$\sigma(\%) = 0.84;\; DW = 0.55;\; ADF = -2.95$$

$$\frac{gcd^*}{tixgc} = -0.01 - 0.01\, D9701 + 0.79\, gyed + 0.20\, pyed + 0.01\, mged + 0.00\,\frac{mgnd - 0.23\, pei}{0.77} + 0.00\, msd^{\,r}$$

$$\sigma(\%) = 0.29;\; DW = 0.48;\; ADF = -4.55$$

Dynamic specifications:

$$\Delta\frac{gid}{tixgi} = \underset{(-1.00)}{-0.00} + \underset{(4.74)}{0.30}\,\Delta\left(\frac{gid}{tixgi}\right)_{-1} + \underset{(13.31)}{0.64}\,\Delta pyed + \underset{(4.78)}{0.13}\,\Delta mged - \underset{(-2.16)}{0.05}\,\Delta mged_{-1} - \underset{(-2.14)}{0.09}\,(gid - gid^*)_{-1}$$

$$R^2 = 0.83; \sigma(\%) = 0.48; DW = 1.67; LM(5) = 4.28; AR(4) = 1.39; JB(2) = 1.28; FOR_{-}(8) = 6.08; FOR_{+}(8) = 19.95$$

$$\Delta\left(gwun - pcd\right) = \underset{(-1.24)}{-0.00} + \underset{(2.77)}{0.32}\,\Delta\left(gwun - pcd\right)_{-1} + \underset{(1.54)}{0.20}\,\Delta\left(pwun - pcd\right)_{-1} - \underset{(-2.62)}{0.18}\,(gwun - gwun^*)_{-1}$$

$$R^2 = 0.22; \sigma(\%) = 0.96; DW = 2.04; LM(5) = 1.09; AR(4) = 1.01; JB(2) = 0.68; FOR_{-}(8) = 9.09; FOR_{+}(8) = 9.77$$

$$\Delta gyed = \underset{(2.84)}{0.00} + \underset{(6.23)}{0.48}\,\Delta gyed_{-1} + \underset{(3.61)}{0.18}\,\Delta gwun + \underset{(3.66)}{0.19}\,\Delta gid - \underset{(-2.17)}{0.12}\,(gyed - gyed^*)_{-1}$$

$$R^2 = 0.84; \sigma(\%) = 0.36; DW = 2.16; LM(5) = 1.26; AR(4) = 0.58; JB(2) = 0.99; FOR_{-}(8) = 20.77; FOR_{+}(8) = 6.56$$

$$\Delta\frac{gcd}{tixgc} = \underset{(-1.19)}{-0.00} + \underset{(46.21)}{0.75}\,\Delta gyed + \underset{(-)}{0.25}\,\Delta pyed^{r} - \underset{(-2.83)}{0.23}\,(gcd - gcd^*)_{-1}$$

$$R^2 = 0.97; \sigma(\%) = 0.16; DW = 2.04; LM(5) = 0.95; AR(4) = 0.26; JB(2) = 1.41; FOR_{-}(8) = 13.32; FOR_{+}(8) = 9.34$$

Notes: See previous table. D?? step dummy

TABLE 10. SIMULATION RESULTS. MONETARY POLICY SHOCK

	Y1	Y2	Y3	Y4	Y5
Prices	*Levels, percentage deviations from baseline*				
HICP	-0.08	-0.23	-0.28	-0.23	-0.15
Consumption deflator	-0.10	-0.21	-0.24	-0.22	-0.14
GDP deflator	-0.06	-0.22	-0.28	-0.24	-0.15
ULCs	-0.02	-0.19	-0.31	-0.30	-0.20
Compensation per employee	-0.10	-0.24	-0.30	-0.27	-0.19
Productivity	-0.08	-0.05	0.01	0.04	0.01
Mark-ups	-0.04	-0.03	0.03	0.06	0.05
Real compensation per employee	-0.04	-0.02	-0.02	-0.03	-0.03
Export deflator	-0.24	-0.33	-0.19	-0.11	-0.08
Import deflator	-0.49	-0.29	-0.08	-0.05	-0.03
GDP and components	*Levels, percentage deviations from baseline*				
GDP	-0.25	-0.38	-0.32	-0.16	-0.06
Consumption	-0.11	-0.36	-0.40	-0.24	-0.09
Investment	-0.78	-1.13	-1.09	-0.73	-0.43
Of which: Productive inv.	-0.84	-1.54	-1.52	-1.08	-0.72
Residential inv.	-1.04	-0.76	-0.71	-0.31	-0.01
Gov. consumption	0.00	0.00	0.00	0.00	0.00
Exports	-0.31	-0.14	0.09	0.13	0.14
Imports	-0.46	-0.58	-0.48	-0.26	-0.07
Contribution to shock	*Percentage of GDP, absolute deviations from baseline*				
Domestic demand	-0.26	-0.49	-0.51	-0.32	-0.15
Inventories	-0.04	-0.04	0.00	0.02	0.03
Net external demand	0.06	0.15	0.19	0.13	0.07
Labour market	*Unemployment: percentage points, absolute deviations from baseline*				
Total employment	-0.16	-0.33	-0.33	-0.20	-0.07
Unemployment rate	0.10	0.21	0.21	0.13	0.05
Household accounts	*Savings rate: percentage points, absolute deviations from baseline*				
Disposable income	-0.17	-0.34	-0.29	-0.16	-0.07
Saving rate	-0.06	0.02	0.10	0.08	0.02
Fiscal ratios	*Percentage of GDP, absolute deviations from baseline*				
Total receipts	0.00	0.00	0.00	0.01	0.01
Total expenditure	0.23	0.34	0.22	0.13	0.07
Budget balance	-0.23	-0.34	-0.22	-0.12	-0.06
Government debt	0.19	0.65	0.95	1.00	0.97
Financial variables	*Percentage points, absolute deviations from baseline*				
Short-term int. rates	1.00	1.00	0.00	0.00	0.00
Long-term int. rates	0.16	0.06	0.00	0.00	0.00
Foreign demand	*Levels, percentage deviations from baseline*				
World demand	0.00	0.00	0.00	0.00	0.00
Foreign prices	*Levels, percentage deviations from baseline*				
Effective exchange rate	-0.65	-0.25	0.00	0.00	0.00
Euro/$ exchange rate	-1.63	-0.62	0.00	0.00	0.00
Foreign prices (euro)	-0.65	-0.25	0.00	0.00	0.00
Oil price (euro)	-1.63	-0.62	0.00	0.00	0.00

TABLE 11. SIMULATION RESULTS. MONETARY POLICY SHOCK. CHANNEL DECOMPOSITION

	Y1	Y2	Y3	Y4	Y5
Prices	*Levels, percentage deviations from baseline*				
Consumption deflator	-0.10	-0.21	-0.24	-0.22	-0.14
Of which:					
Exchange rate channel	*-0.09*	*-0.14*	*-0.12*	*-0.09*	*-0.05*
User cost of capital channel	*-0.02*	*-0.05*	*-0.08*	*-0.08*	*-0.05*
Substitution effect on consumption	*0.00*	*0.00*	*-0.01*	*-0.01*	*-0.01*
Income/Cash-flow effect	*0.00*	*-0.01*	*-0.02*	*-0.03*	*-0.03*
Wealth effect	*0.00*	*-0.01*	*-0.02*	*-0.02*	*-0.01*
GDP	*Levels, percentage deviations from baseline*				
GDP	-0.25	-0.38	-0.32	-0.16	-0.06
Of which:					
Exchange rate channel	*-0.12*	*-0.15*	*-0.07*	*0.00*	*0.04*
User cost of capital channel	*-0.11*	*-0.16*	*-0.18*	*-0.15*	*-0.12*
Substitution effect on consumption	*0.00*	*-0.02*	*-0.01*	*0.00*	*0.00*
Income/Cash-flow effect	*-0.01*	*-0.03*	*-0.03*	*-0.01*	*0.00*
Wealth effect	*-0.01*	*-0.04*	*-0.03*	*0.00*	*0.02*

TABLE 12. SIMULATION RESULTS. A FISCAL POLICY SHOCK.

	Y1	Y2	Y3	Y4	Y5
Prices	*Levels, percentage deviations from baseline*				
HICP	0.15	0.60	1.02	1.31	1.43
Consumption deflator	0.19	0.60	1.01	1.30	1.44
GDP deflator	0.17	0.59	0.99	1.25	1.35
ULCs	-0.07	0.54	1.02	1.35	1.47
Compensation per employee	0.28	0.62	0.96	1.16	1.23
Productivity	0.35	0.08	-0.07	-0.18	-0.24
Mark-ups	0.24	0.05	-0.04	-0.10	-0.11
Real compensation per employee	0.11	0.03	-0.03	-0.09	-0.12
Export deflator	0.04	0.18	0.37	0.54	0.65
Import deflator	0.00	0.04	0.08	0.11	0.13
GDP and components	*Levels, percentage deviations from baseline*				
GDP	1.16	1.44	1.46	1.26	0.98
Consumption	0.43	0.93	1.11	0.95	0.63
Investment	0.95	1.78	1.97	1.75	1.34
Of which: Productive inv.	1.25	2.15	2.43	2.29	1.92
Residential inv.	0.74	1.81	1.92	1.42	0.76
Gov. consumption	5.57	5.40	5.32	5.22	5.12
Exports	-0.01	-0.10	-0.27	-0.46	-0.61
Imports	1.16	1.71	1.79	1.53	1.18
Contribution to shock	*Percentage of GDP, absolute deviations from baseline*				
Domestic demand	1.47	1.95	2.09	1.95	1.64
Inventories	0.07	0.08	0.03	-0.02	-0.05
Net external demand	-0.38	-0.59	-0.66	-0.67	-0.62
Labour market	*Unemployment: percentage points, absolute deviations from baseline*				
Total employment	0.81	1.36	1.53	1.44	1.22
Unemployment rate	-0.50	-0.85	-0.96	-0.91	-0.76
Household accounts	*Savings rate: percentage points, absolute deviations from baseline*				
Disposable income	0.80	0.95	0.90	0.67	0.41
Saving rate	0.33	0.00	-0.21	-0.27	-0.22
Fiscal ratios	*Percentage of GDP, absolute deviations from baseline*				
Total receipts	-0.03	-0.02	0.00	0.00	-0.01
Total expenditure	0.50	0.28	0.19	0.23	0.33
Budget balance	-0.53	-0.30	-0.19	-0.23	-0.34
Government debt	0.02	-0.03	-0.03	0.10	0.43
Financial variables	*Percentage points, absolute deviations from baseline*				
Short-term int. rates	0.00	0.00	0.00	0.00	0.00
Long-term int. rates	0.00	0.00	0.00	0.00	0.00
Foreign demand	*Levels, percentage deviations from baseline*				
World demand	0.00	0.00	0.00	0.00	0.00
Foreign prices	*Levels, percentage deviations from baseline*				
Effective exchange rate	0.00	0.00	0.00	0.00	0.00
Euro/$ exchange rate	0.00	0.00	0.00	0.00	0.00
Foreign prices (euro)	0.00	0.00	0.00	0.00	0.00
Oil price (euro)	0.00	0.00	0.00	0.00	0.00

TABLE 13. SIMULATION RESULTS. WORKING AGE POPULATION SHOCK.

	Y1	Y2	Y3	Y4	Y5
Prices	*Levels, percentage deviations from baseline*				
HICP	0.00	-0.09	-0.27	-0.40	-0.48
Consumption deflator	0.00	-0.09	-0.26	-0.39	-0.46
GDP deflator	0.00	-0.10	-0.26	-0.38	-0.45
ULCs	-0.01	-0.18	-0.41	-0.54	-0.61
Compensation per employee	-0.01	-0.19	-0.42	-0.55	-0.61
Productivity	0.00	0.00	-0.01	0.00	0.00
Mark-ups	0.01	0.09	0.15	0.17	0.16
Real compensation per employee	0.00	-0.09	-0.16	-0.17	-0.16
Export deflator	0.00	-0.02	-0.08	-0.15	-0.20
Import deflator	0.00	0.00	-0.02	-0.03	-0.04
GDP and components	*Levels, percentage deviations from baseline*				
GDP	0.01	0.04	0.09	0.15	0.21
Consumption	0.01	0.05	0.07	0.11	0.17
Investment	0.01	0.03	0.04	0.05	0.07
Of which: Productive inv.	0.01	0.03	0.04	0.04	0.06
Residential inv.	0.01	0.03	0.05	0.07	0.12
Gov. consumption	0.00	0.00	0.00	0.00	0.00
Exports	0.00	0.01	0.05	0.11	0.18
Imports	0.01	-0.01	-0.06	-0.08	-0.07
Contribution to shock	*Percentage of GDP, absolute deviations from baseline*				
Domestic demand	0.01	0.04	0.05	0.08	0.12
Inventories	0.00	0.00	0.00	0.01	0.01
Net external demand	0.00	0.00	0.03	0.06	0.08
Labour market	*Unemployment: percentage points, absolute deviations from baseline*				
Total employment	0.01	0.04	0.10	0.15	0.21
Unemployment rate	0.28	0.75	0.79	0.74	0.68
Household accounts	*Savings rate: percentage points, absolute deviations from baseline*				
Disposable income	0.03	0.07	0.09	0.15	0.20
Saving rate	0.02	0.02	0.02	0.03	0.03
Fiscal ratios	*Percentage of GDP, absolute deviations from baseline*				
Total receipts	0.02	0.05	0.05	0.05	0.04
Total expenditure	0.04	0.10	0.10	0.09	0.08
Budget balance	-0.02	-0.05	-0.05	-0.05	-0.04
Government debt	0.00	0.05	0.15	0.23	0.27
Financial variables	*Percentage points, absolute deviations from baseline*				
Short-term int. rates	0.00	0.00	0.00	0.00	0.00
Long-term int. rates	0.00	0.00	0.00	0.00	0.00
Foreign demand	*Levels, percentage deviations from baseline*				
World demand	0.00	0.00	0.00	0.00	0.00
Foreign prices	*Levels, percentage deviations from baseline*				
Effective exchange rate	0.00	0.00	0.00	0.00	0.00
Euro/$ exchange rate	0.00	0.00	0.00	0.00	0.00
Foreign prices (euro)	0.00	0.00	0.00	0.00	0.00
Oil price (euro)	0.00	0.00	0.00	0.00	0.00

TABLE 14. SIMULATION RESULTS. AN EXTRA-EURO AREA DEMAND SHOCK.

	Y1	Y2	Y3	Y4	Y5
Prices	*Levels, percentage deviations from baseline*				
HICP	0.00	0.03	0.07	0.11	0.12
Consumption deflator	0.01	0.04	0.08	0.11	0.13
GDP deflator	0.00	0.03	0.07	0.10	0.12
ULCs	-0.01	0.02	0.07	0.11	0.13
Compensation per employee	0.01	0.04	0.07	0.10	0.11
Productivity	0.02	0.02	0.00	-0.02	-0.03
Mark-ups	0.01	0.01	0.00	-0.01	-0.02
Real compensation per employee	0.01	0.01	0.00	0.00	-0.01
Export deflator	0.00	0.01	0.03	0.05	0.06
Import deflator	0.00	0.00	0.01	0.01	0.01
GDP and components	*Levels, percentage deviations from baseline*				
GDP	0.06	0.13	0.15	0.13	0.11
Consumption	0.02	0.06	0.08	0.08	0.06
Investment	0.04	0.13	0.18	0.18	0.14
Of which: Productive inv.	0.06	0.17	0.22	0.22	0.19
Residential inv.	0.02	0.12	0.18	0.16	0.10
Gov. consumption	0.00	0.00	0.00	0.00	0.00
Exports	0.27	0.40	0.43	0.39	0.36
Imports	0.17	0.23	0.25	0.24	0.22
Contribution to shock	*Percentage of GDP, absolute deviations from baseline*				
Domestic demand	0.02	0.07	0.09	0.09	0.07
Inventories	0.01	0.01	0.01	0.00	0.00
Net external demand	0.03	0.05	0.05	0.04	0.04
Labour market	*Unemployment: percentage points, absolute deviations from baseline*				
Total employment	0.05	0.11	0.15	0.15	0.14
Unemployment rate	-0.03	-0.07	-0.09	-0.09	-0.09
Household accounts	*Savings rate: percentage points, absolute deviations from baseline*				
Disposable income	0.04	0.09	0.10	0.09	0.07
Saving rate	0.02	0.02	0.01	0.00	0.00
Fiscal ratios	*Percentage of GDP, absolute deviations from baseline*				
Total receipts	0.00	-0.01	-0.01	0.00	0.00
Total expenditure	-0.03	-0.06	-0.08	-0.08	-0.08
Budget balance	0.02	0.05	0.07	0.08	0.08
Government debt	-0.03	-0.11	-0.20	-0.28	-0.36
Financial variables	*Percentage points, absolute deviations from baseline*				
Short-term int. rates	0.00	0.00	0.00	0.00	0.00
Long-term int. rates	0.00	0.00	0.00	0.00	0.00
Foreign demand	*Levels, percentage deviations from baseline*				
World demand	0.40	0.40	0.40	0.40	0.41
Foreign prices	*Levels, percentage deviations from baseline*				
Effective exchange rate	0.00	0.00	0.00	0.00	0.00
Euro/$ exchange rate	0.00	0.00	0.00	0.00	0.00
Foreign prices (euro)	0.00	0.00	0.00	0.00	0.00
Oil price (euro)	0.00	0.00	0.00	0.00	0.00

TABLE 15. SIMULATION RESULTS. AN APPRECIATION IN THE EURO EXCHANGE RATE

	Y1	Y2	Y3	Y4	Y5
Prices	*Levels, percentage deviations from baseline*				
HICP	-0.15	-0.49	-0.74	-0.86	-0.90
Consumption deflator	-0.26	-0.55	-0.77	-0.89	-0.93
GDP deflator	-0.08	-0.38	-0.61	-0.72	-0.76
ULCs	-0.04	-0.33	-0.61	-0.75	-0.78
Compensation per employee	-0.14	-0.39	-0.59	-0.68	-0.70
Productivity	-0.10	-0.07	0.02	0.07	0.08
Mark-ups	-0.03	-0.06	0.00	0.03	0.02
Real compensation per employee	-0.06	-0.01	0.02	0.04	0.05
Export deflator	-0.69	-1.36	-1.57	-1.64	-1.66
Import deflator	-1.49	-1.82	-1.96	-2.01	-2.05
GDP and components	*Levels, percentage deviations from baseline*				
GDP	-0.29	-0.53	-0.55	-0.48	-0.39
Consumption	-0.01	-0.07	-0.10	-0.07	-0.01
Investment	-0.31	-0.70	-0.80	-0.66	-0.47
Of which: Productive inv.	-0.49	-0.99	-1.08	-0.95	-0.74
Residential inv.	-0.05	-0.42	-0.57	-0.37	-0.11
Gov. consumption	0.00	0.00	0.00	0.00	0.00
Exports	-0.93	-1.04	-0.87	-0.72	-0.57
Imports	-0.40	-0.09	0.11	0.16	0.27
Contribution to shock	*Percentage of GDP, absolute deviations from baseline*				
Domestic demand	-0.08	-0.22	-0.26	-0.20	-0.12
Inventories	-0.05	-0.02	0.00	0.01	0.01
Net external demand	-0.16	-0.29	-0.30	-0.28	-0.28
Labour market	*Unemployment: percentage points, absolute deviations from baseline*				
Total employment	-0.19	-0.47	-0.57	-0.54	-0.47
Unemployment rate	0.12	0.29	0.36	0.34	0.29
Household accounts	*Savings rate: percentage points, absolute deviations from baseline*				
Disposable income	-0.04	-0.19	-0.20	-0.12	-0.04
Saving rate	-0.03	-0.10	-0.08	-0.04	-0.02
Fiscal ratios	*Percentage of GDP, absolute deviations from baseline*				
Total receipts	0.01	0.03	0.03	0.02	0.02
Total expenditure	0.12	0.28	0.33	0.34	0.32
Budget balance	-0.11	-0.25	-0.31	-0.32	-0.30
Government debt	0.13	0.55	0.96	1.29	1.55
Financial variables	*Percentage points, absolute deviations from baseline*				
Short-term int. rates	0.00	0.00	0.00	0.00	0.00
Long-term int. rates	0.00	0.00	0.00	0.00	0.00
Foreign demand	*Levels, percentage deviations from baseline*				
World demand	0.00	0.00	0.00	0.00	0.00
Foreign prices	*Levels, percentage deviations from baseline*				
Effective exchange rate	-2.00	-1.99	-2.02	-2.02	-2.03
Euro/$ exchange rate	-5.00	-5.00	-5.00	-5.00	-5.00
Foreign prices (euro)	-2.00	-1.99	-2.02	-2.02	-2.03
Oil price (euro)	-5.00	-5.00	-5.00	-5.00	-5.00

TABLE 16. SIMULATION RESULTS. AN INCREASE IN THE OIL PRICE

	Y1	Y2	Y3	Y4	Y5
Prices	*Levels, percentage deviations from baseline*				
HICP	0.21	0.37	0.31	0.23	0.16
Consumption deflator	0.23	0.32	0.29	0.21	0.14
GDP deflator	0.04	0.19	0.18	0.11	0.06
ULCs	0.09	0.18	0.15	0.07	0.01
Compensation per employee	0.07	0.14	0.13	0.08	0.04
Productivity	-0.02	-0.04	-0.02	0.00	0.02
Mark-ups	-0.05	0.01	0.02	0.04	0.05
Real compensation per employee	0.03	-0.06	-0.04	-0.04	-0.03
Export deflator	0.01	0.05	0.09	0.07	0.04
Import deflator	1.65	1.63	1.67	1.67	1.66
GDP and components	*Levels, percentage deviations from baseline*				
GDP	-0.06	-0.17	-0.22	-0.22	-0.18
Consumption	-0.12	-0.25	-0.31	-0.30	-0.26
Investment	-0.03	-0.12	-0.23	-0.27	-0.25
Of which: Productive inv.	-0.02	-0.09	-0.22	-0.28	-0.27
Residential inv.	-0.06	-0.23	-0.36	-0.40	-0.33
Gov. consumption	0.00	0.00	0.00	0.00	0.00
Exports	0.00	-0.02	-0.07	-0.08	-0.07
Imports	-0.08	-0.11	-0.17	-0.17	-0.14
Contribution to shock	*Percentage of GDP, absolute deviations from baseline*				
Domestic demand	-0.08	-0.18	-0.24	-0.25	-0.21
Inventories	-0.01	-0.02	-0.01	0.00	0.00
Net external demand	0.03	0.03	0.04	0.03	0.03
Labour market	*Unemployment: percentage points, absolute deviations from baseline*				
Total employment	-0.04	-0.12	-0.20	-0.22	-0.21
Unemployment rate	0.03	0.08	0.12	0.14	0.13
Household accounts	*Savings rate: percentage points, absolute deviations from baseline*				
Disposable income	-0.22	-0.26	-0.28	-0.27	-0.22
Saving rate	-0.09	-0.01	0.03	0.03	0.03
Fiscal ratios	*Percentage of GDP, absolute deviations from baseline*				
Total receipts	0.00	0.00	0.00	0.01	0.01
Total expenditure	0.02	0.04	0.07	0.09	0.08
Budget balance	-0.02	-0.04	-0.07	-0.08	-0.07
Government debt	0.01	0.04	0.10	0.20	0.29
Financial variables	*Percentage points, absolute deviations from baseline*				
Short-term int. rates	0.00	0.00	0.00	0.00	0.00
Long-term int. rates	0.00	0.00	0.00	0.00	0.00
Foreign demand	*Levels, percentage deviations from baseline*				
World demand	0.00	0.00	0.00	0.00	0.00
Foreign prices	*Levels, percentage deviations from baseline*				
Effective exchange rate	0.00	0.00	0.00	0.00	0.00
Euro/$ exchange rate	0.00	0.00	0.00	0.00	0.00
Foreign prices (euro)	0.00	0.00	0.00	0.00	0.00
Oil price (euro)	20.00	20.00	20.00	20.00	20.00

FIGURE 1. OBSERVED UNEMPLOYMENT RATE AND NAIRU

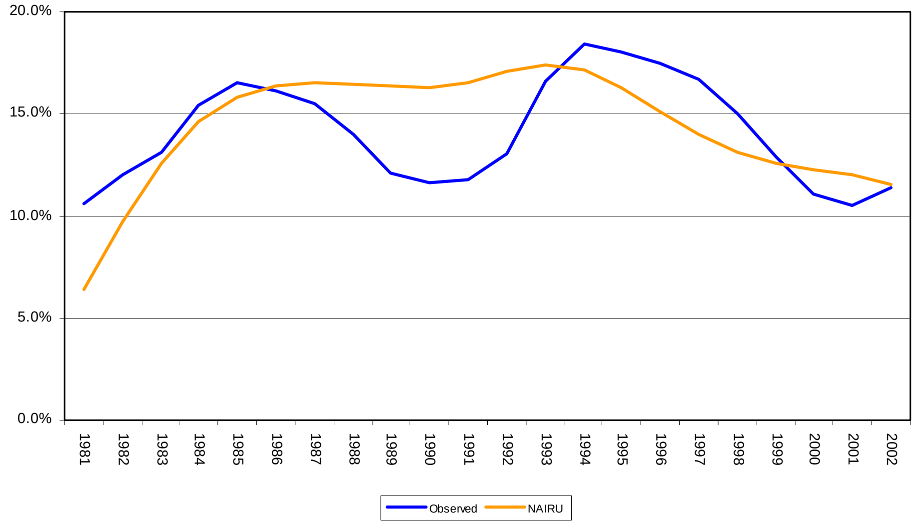


FIGURE 2. OBSERVED AND POTENTIAL OUTPUT GROWTH

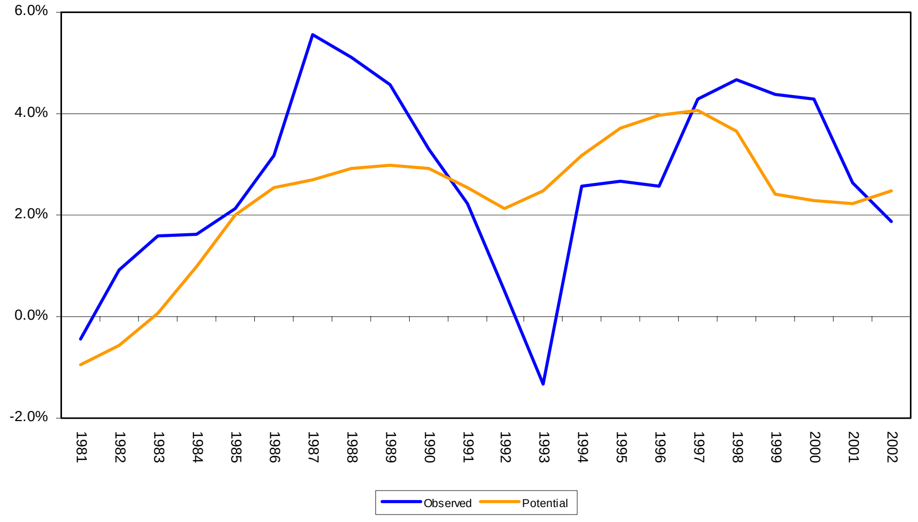


FIGURE 3. PRIVATE EMPLOYMENT AND INVESTMENT EQUATIONS. IMPULSE-RESPONSE FUNCTIONS

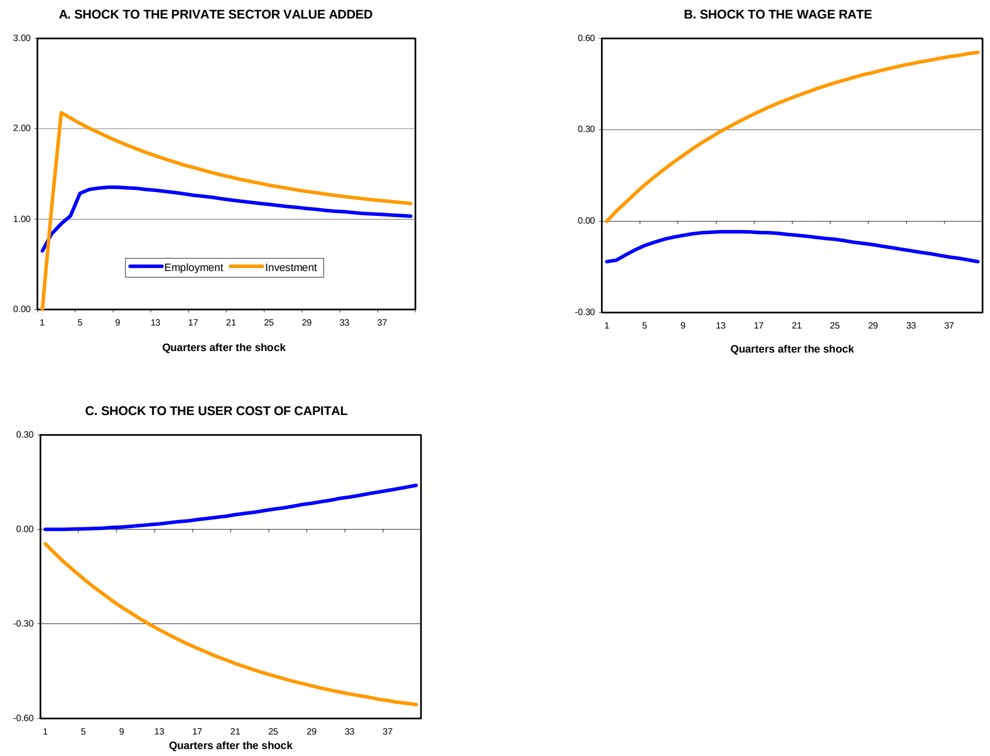


FIGURE 4. PRIVATE VALUE ADDED DEFLATOR AND WAGE RATE EQUATIONS. IMPULSE-RESPONSE FUNCTIONS

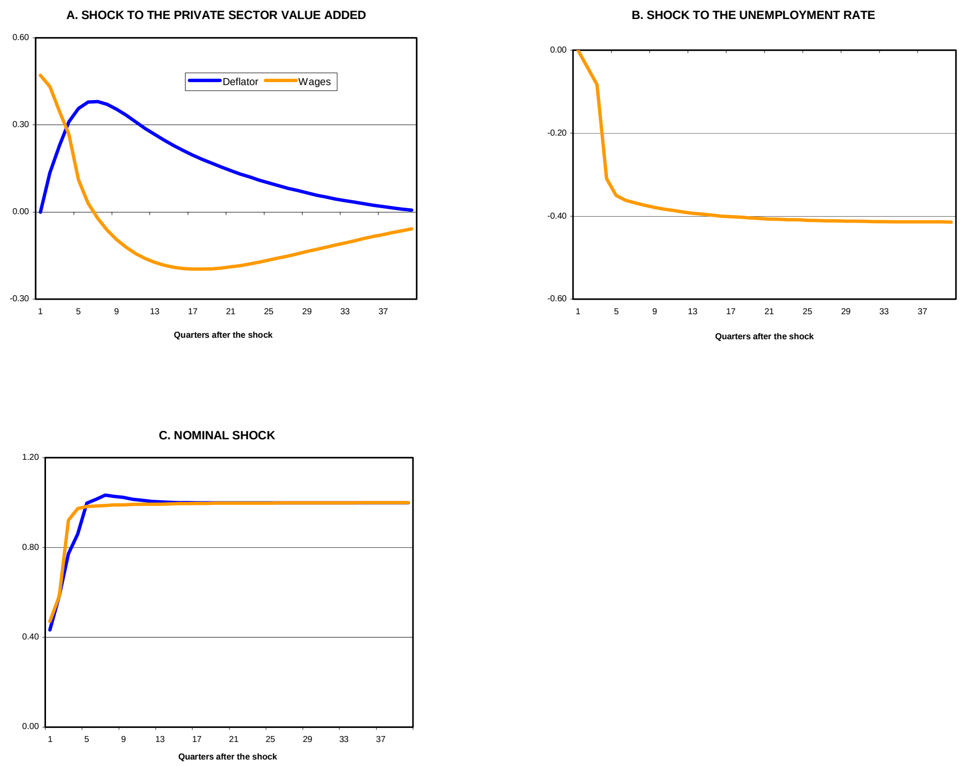
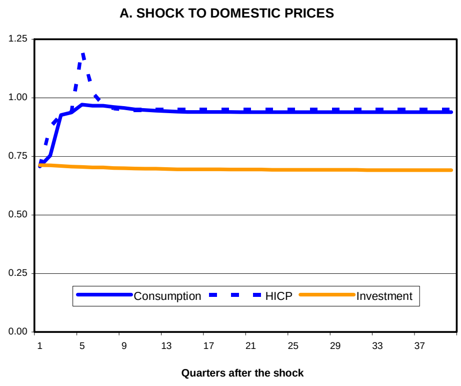


FIGURE 5. PRIV. CONS. AND INVESTMENT DEFLATOR EQUATIONS. IMPULSE-RESPONSE FUNCTIONS



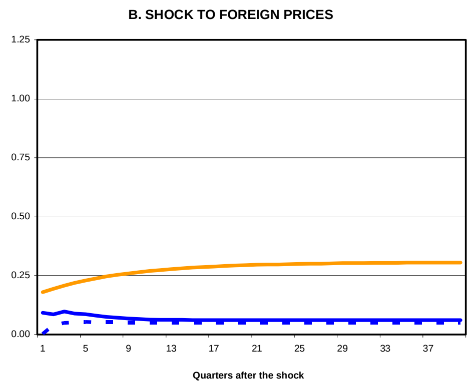


FIGURE 6. HOUSEHOLD BLOCK OF EQUATIONS. IMPULSE-RESPONSE FUNCTIONS

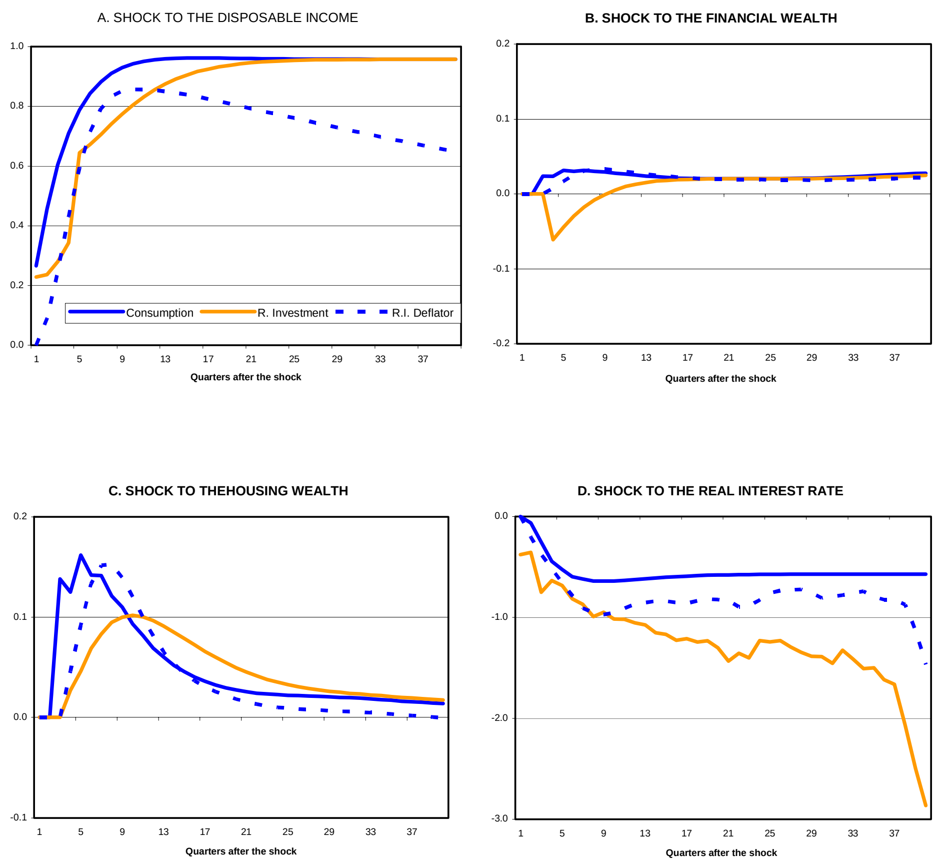


FIGURE 7. REAL EXPORT EQUATIONS. IMPULSE-RESPONSE FUNCTIONS

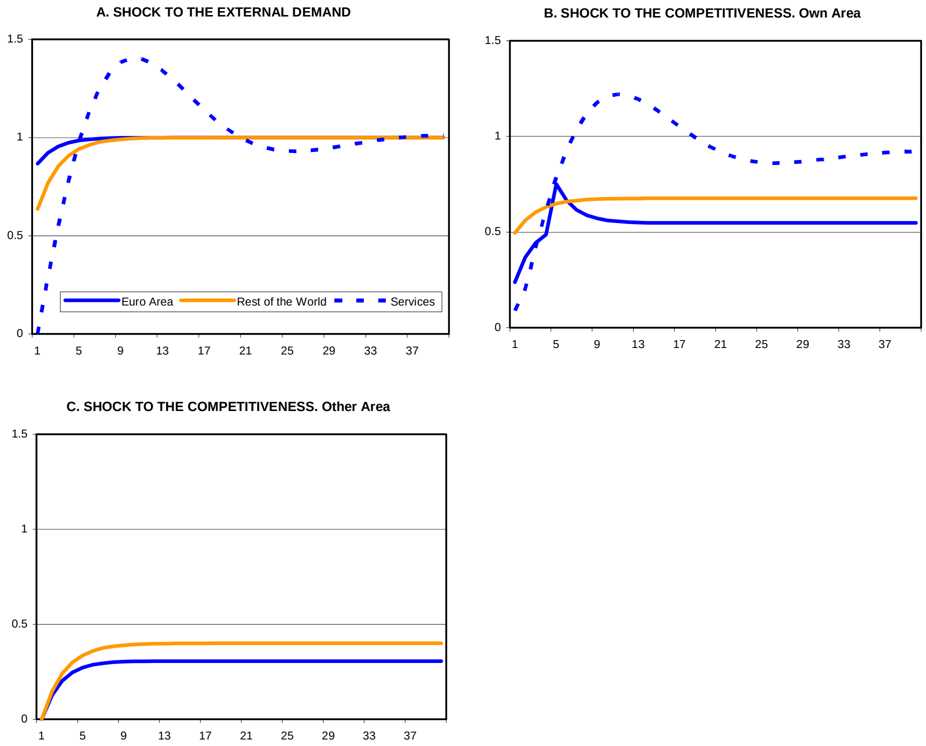


FIGURE 8. EXPORT DEFLATOR EQUATIONS. IMPULSE-RESPONSE FUNCTIONS

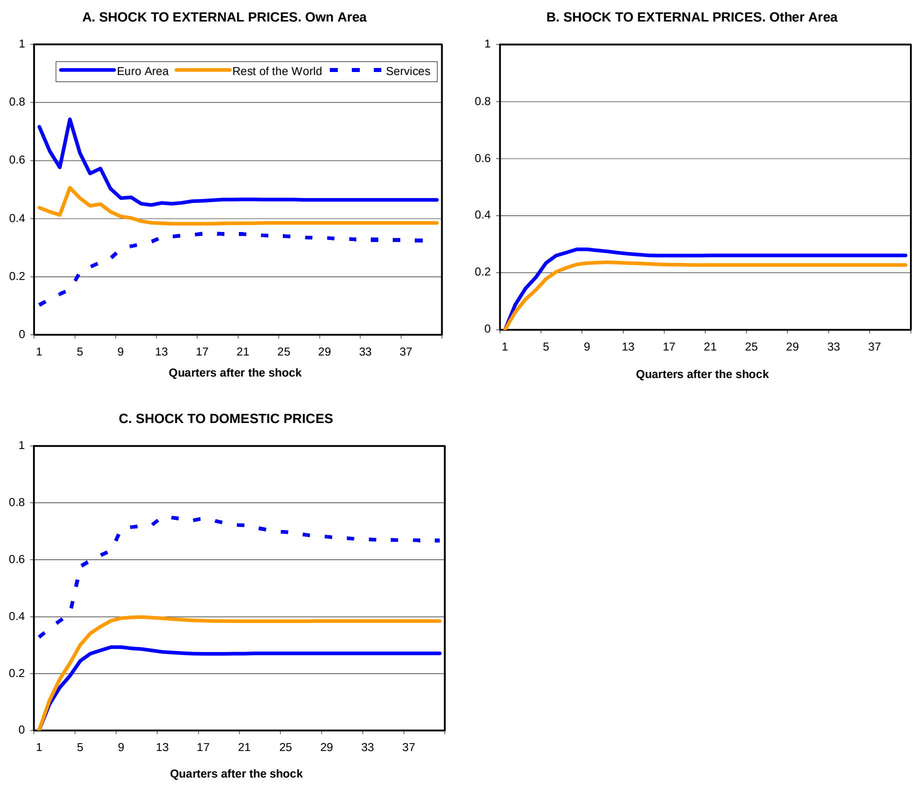


FIGURE 9. REAL IMPORT EQUATIONS. IMPULSE-RESPONSE FUNCTIONS

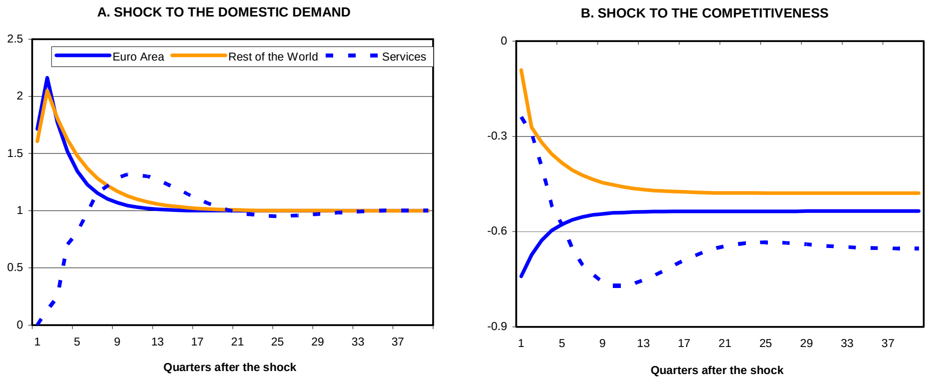


FIGURE 10. IMPORT DEFLATOR EQUATIONS. IMPULSE-RESPONSE FUNCTIONS

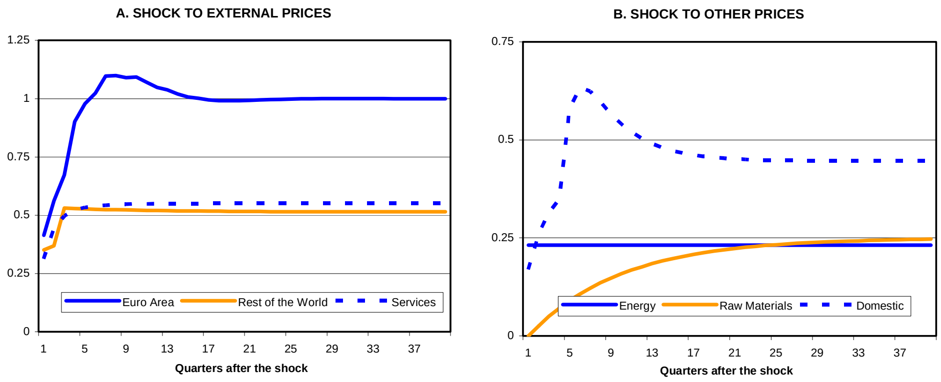


FIGURE 11. SIMULATION RESULTS. MONETARY POLICY SHOCK.

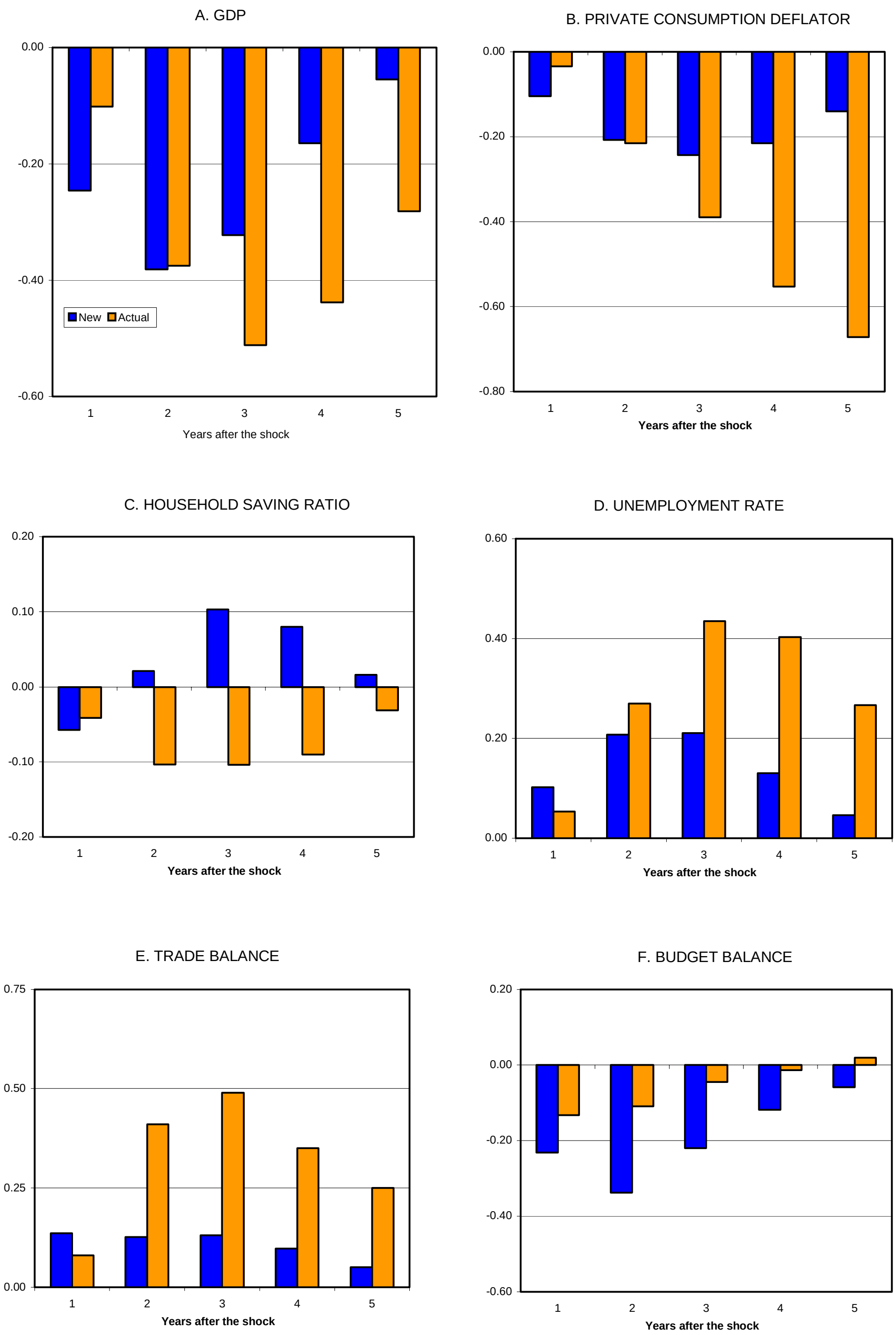


FIGURE 12. SIMULATION RESULTS. A FISCAL POLICY SHOCK.

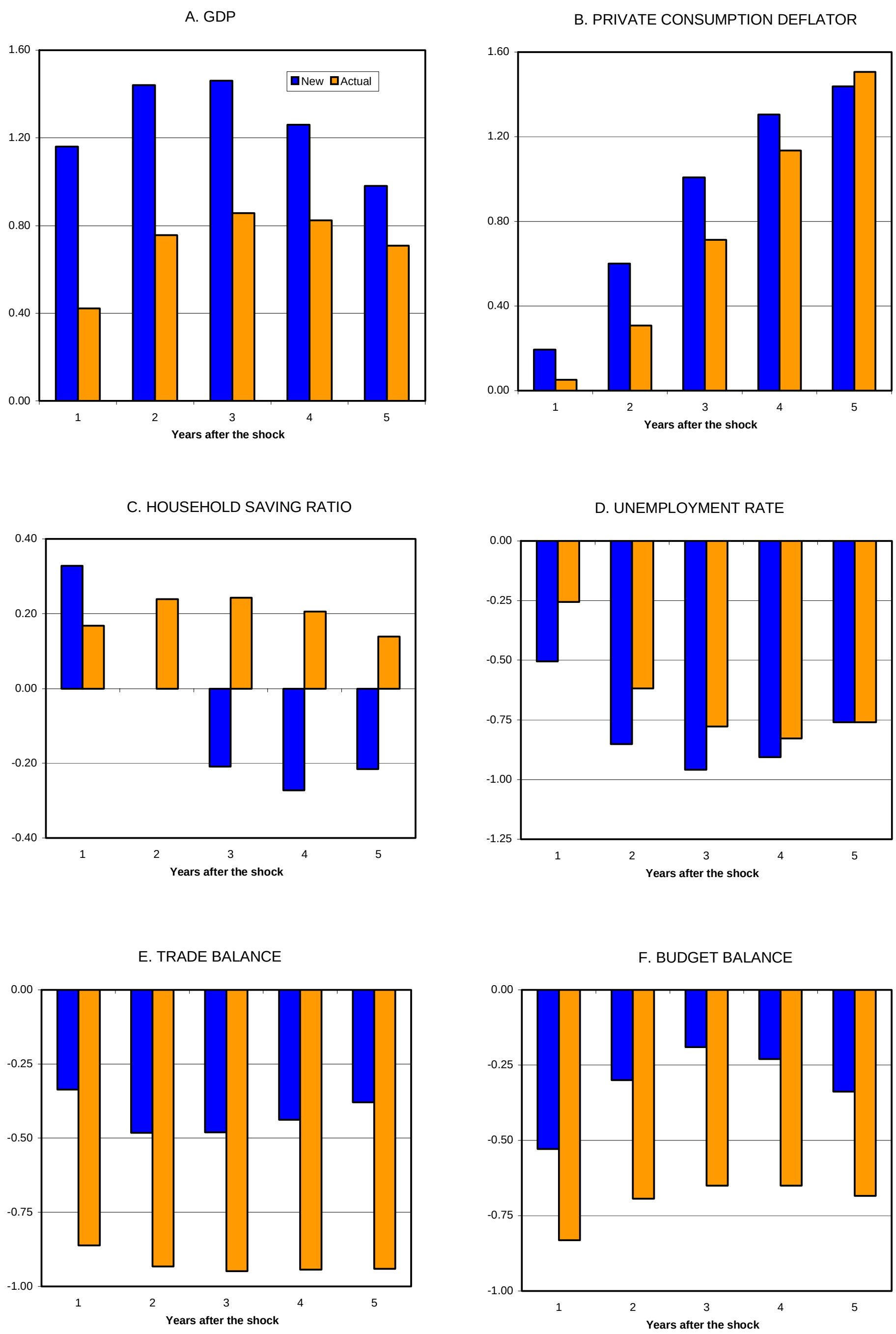


FIGURE 13. SIMULATION RESULTS. WORKING AGE POPULATION SHOCK.

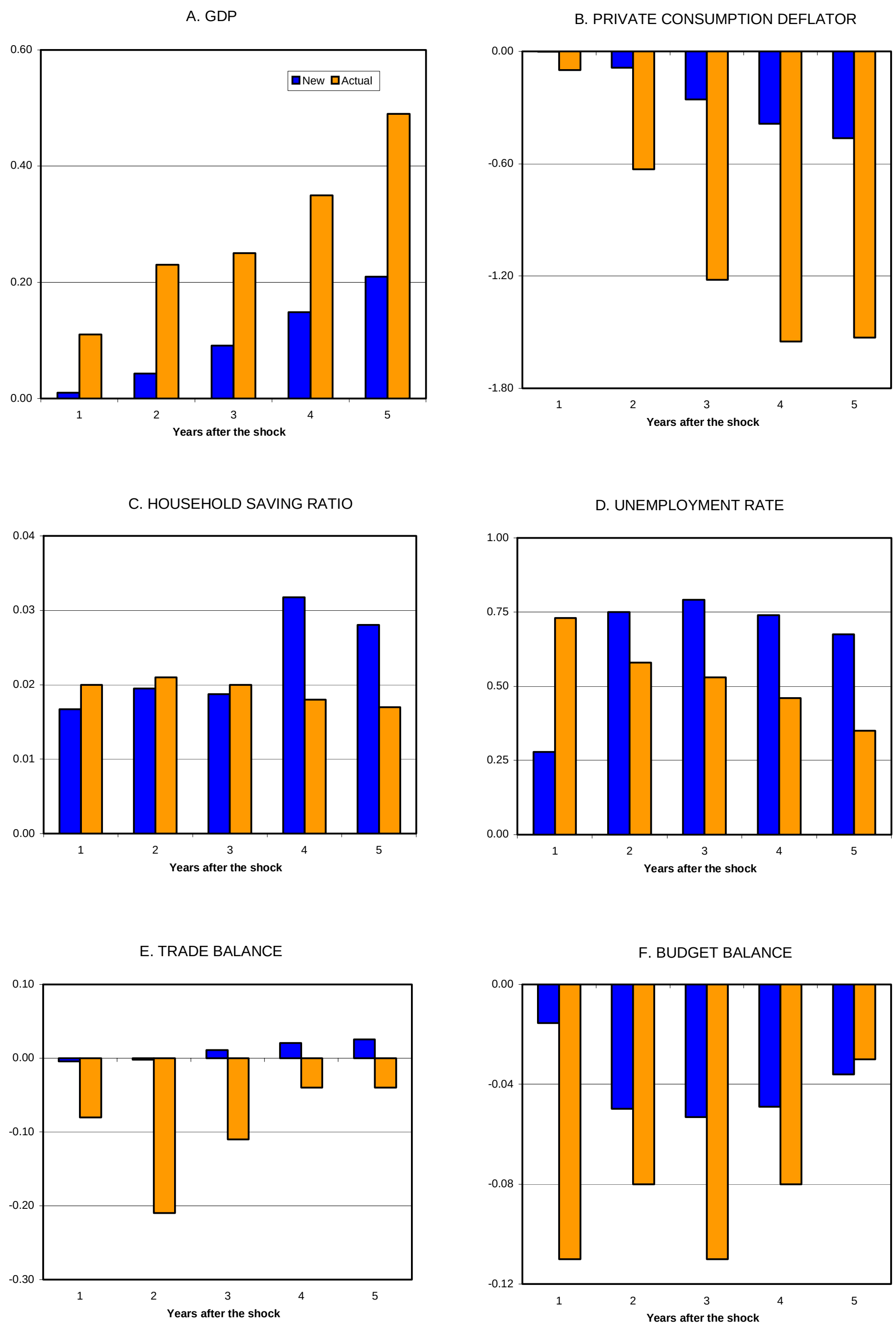


FIGURE 14. SIMULATION RESULTS. AN EXTRA-EURO AREA DEMAND SHOCK.

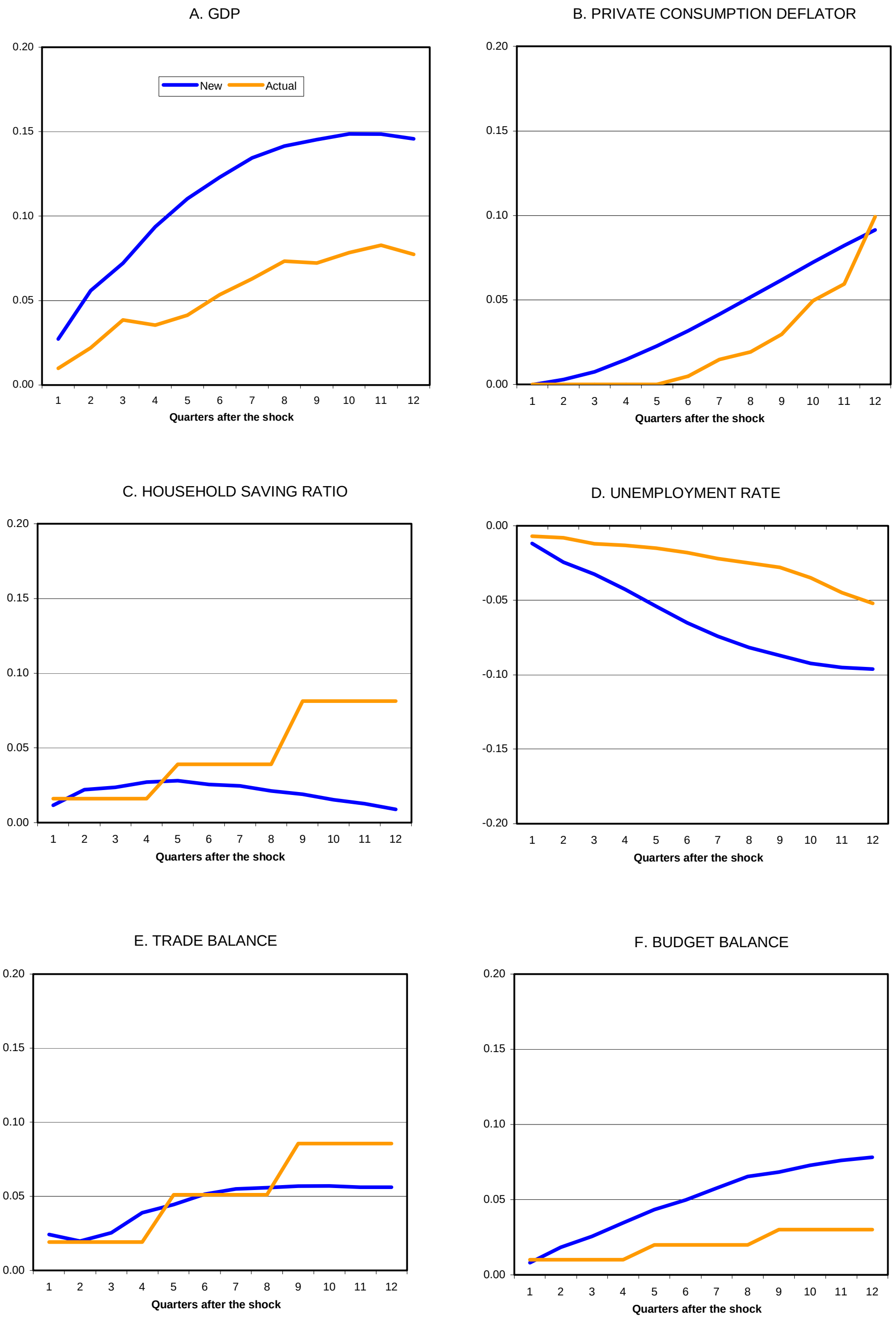


FIGURE 15. SIMULATION RESULTS. AN APPRECIATION IN THE EURO EXCHANGE RATE

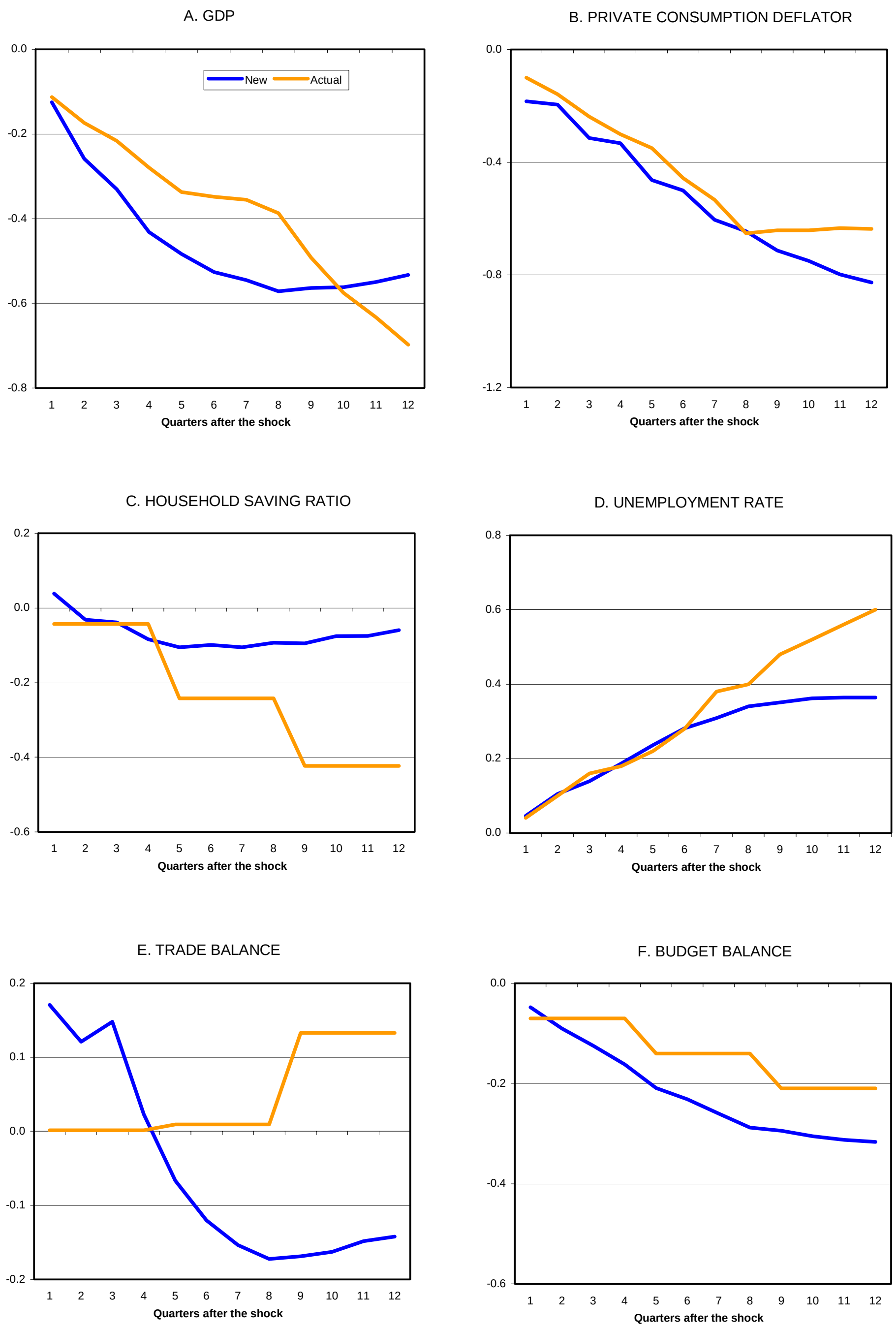


FIGURE 16. SIMULATION RESULTS. AN INCREASE IN THE OIL PRICE