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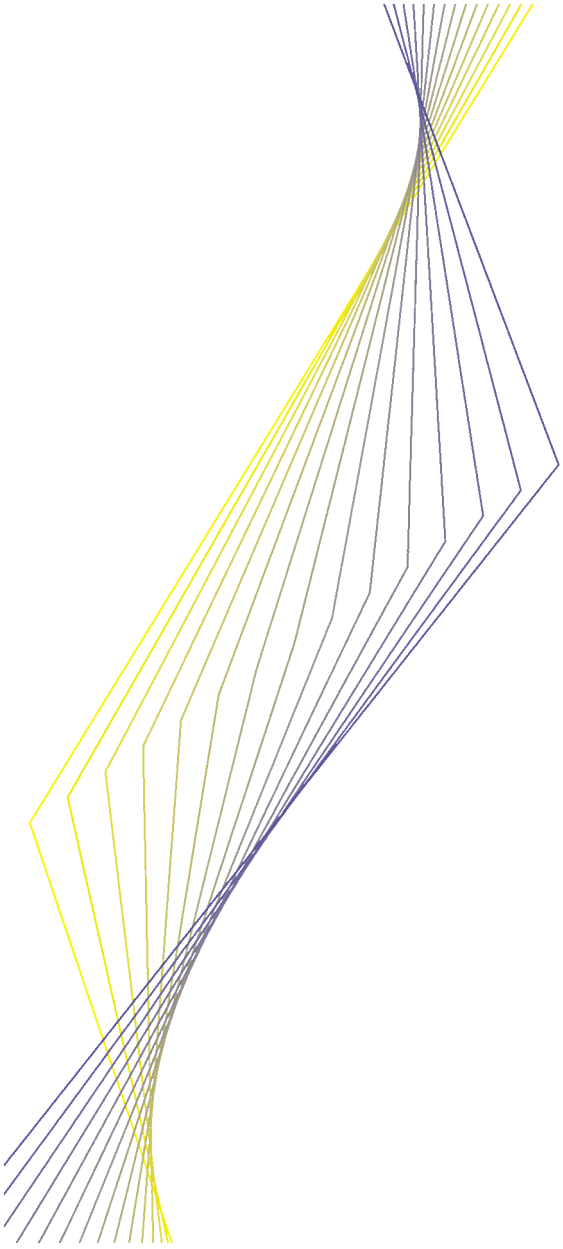

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THE SPANISH BLOCK OF THE ESCB-MULTI-COUNTRY MODEL

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Contents

ABSTRACT

This paper presents the Spanish country block (ES-MCM) of the ESCB Multi-Country Model for the euro area, which has been built in a close co-operation with the ECB and the Banco de España. The theoretical structure of the ES-MCM block is in line with most current mainstream macro models, i.e. the supply factors determine the long-run equilibrium, while in the short run output is demand-determined, resulting from a sluggish adjustment of prices and quantities. The paper is structured as follows. First, a simplified theoretical counterpart of the ES-MCM block is presented and its steady-state comparative statistics and stock-flow equilibrium properties are studied. The theoretical analysis is followed by the review of the estimated equations of the ES-MCM block. Finally the simulation properties of the ES-MCM block are presented in the light of five alternative shock simulations.

JEL classification: E10, E13, E17.

Keywords: Macro model, stock-flow equilibrium, Spain.

NON-TECHNICAL SUMMARY

This paper presents the Spanish country block (ES-MCM) of the ESCB Multi-Country Model (ESCB-MCM) for the euro area, which has been built in a close co-operation with the ECB and the Banco de España. The guiding principle in designing the ESCB-MCM and its country blocks has been that of close compatibility with the ECB Area-Wide model (AWM, see Fagan et al. 2001), in terms both of the theoretical and statistical framework. This is motivated by the fact that, like AWM, the ES-MCM and other country blocks of the ESCB-MCM are used in the ESCB's forecasting work. The common statistical and theoretical structure ensures the comparability of the AWM and the MCM figures and facilitates interpretation of the area-wide results.

The theoretical structure of the ES-MCM block is in line with most current mainstream macro models, i.e. the supply factors determine the long-run equilibrium, while in the short run output is demand-determined, resulting from a sluggish adjustment of prices and quantities. The current version of the ES-MCM block is a traditional backward-looking model, in which expectations are treated implicitly by the inclusion of current and lagged values of the variables. The assumption by default concerning the policy regime is that of the monetary union. Hence, from the standpoint of a single country, the interest rate, exchange rate and foreign developments are exogenously given.

The paper is structured as follows. First, a simplified theoretical counterpart of the ES-MCM block is presented and its steady-state comparative statistics and stock-flow equilibrium properties are studied. The theoretical analysis is followed by the review of the estimated equations of the ES-MCM block. Finally the simulation properties of the ES-MCM block are presented in the light of five alternative shock simulations (fiscal expenditure, world demand, relative foreign price, interest rate and labour supply shock).

One of the main results of theoretical analysis is that the stock-flow equilibrium of the ES-MCM block is regime-dependent. Under EMU, long-run equilibrium is attainable only if the crowding-out responses of net trade to alternative shocks are strong enough. In a regime without a fiscal closure rule, a permanent demand shock has permanent effects on production and the domestic price level. This equilibrium, however, violates the government sector solvency constraint since - although total wealth is in stock equilibrium- government debt is accumulating (diminishing) and net foreign assets are diminishing (accumulating) unlimitedly. A fiscal closure rule is needed to prevent violation of the solvency constraint. With a fiscal closure rule defined in terms of a target debt-to-GDP ratio, a domestic demand shock has no permanent effects on total production and prices. However, this neutrality result does not hold for a permanent foreign demand shock; a positive foreign demand shock requires the appreciation of the real exchange rate and an increase in output. Model simulations show that the dynamic properties of the ES-MCM block are closely in line with those anticipated by theoretical analysis.

1. Introduction

This paper presents the Spanish country block (ES-MCM) of the ESCB Multi-Country Model (ESCB-MCM) for the euro area. The ES-MCM block has been built in close co-operation with the ECB and the Banco de España.[1] When used in isolation, the ES-MCM block is a single-country model, which can be used in a conventional way for forecasting and policy analysis conditional upon exogenously given foreign developments. When used as a country block of the ESCB-MCM, then the repercussion effects from the rest of the euro area are, through trade linkages, also included. The guiding principle in designing the country blocks of the ESCB-MCM has been that of close compatibility with the ECB Area-Wide model (AWM, see Fagan et al. 2001) in terms both of the theoretical and statistical framework. This is motivated by the fact that, in conjunction with the AWM, the country blocks of the ESCB-MCM are used in the ESCB's forecasting work.[2] The common statistical and theoretical structure ensures the comparability of the AWM and the aggregated MCM figures and facilitates the interpretation of the area-wide results.

The ES-MCM block contains a total of 102 equations of which 10 are estimated behavioural long-run and 16 estimated behavioural dynamic equations. The theoretical structure of the ES-MCM is in line with most current mainstream macro models, i.e. the supply factors determine the long-run equilibrium, while in the short run output is demand-determined resulting from sluggish adjustment of prices and quantities. The current version of the ES-MCM block is a traditional aggregate backward-looking aggregate-demand-aggregate-supply model, in which expectations are treated implicitly by the inclusion of current and lagged values of the variables. The assumption by default concerning the policy regime is the monetary union. Thus, for a single country, the interest rate, exchange rate and foreign developments are exogenously given. Coupled with the assumption of perfect capital markets this implies that the financial sector, at a single country level, is completely post-recursive and, hence, can be eliminated from the model.

The remainder of this paper is set out as follows. In section 2 a simplified theoretical counterpart of the ES-MCM block is presented and its steady-state comparative statistic and stock-flow equilibrium properties are studied. Section 3 reviews the estimated equations and their theoretical backgrounds. In Section 4 the dynamic simulation properties of the estimated ES-MCM block are described in the light of selected variant simulation experiments. Section 5 concludes.

[1] For other contributions of National Central Banks to this ESCB project, see Jeanfils (2000) and McGuire and Ryan (2000).

[2] For a presentation of the Eurosystem staff macroeconomic projection exercises, see European Central Bank (2001)

2. A Simplified theoretical version of the ES-MCM block

A frequently encountered problem in studying large-scale macroeconometric models is the difficulty of not being able to "see the wood for the trees": the amount of detail that has to be included in any model, which is intended to be useful in practice, makes it hard to identify the crucial parts and relationships. Although the ES-MCM, with around 100 equations, is a relatively small model, understanding its macro-theoretical characteristics and actual simulation properties merely on the basis of short presentations of key equations and the list of equations may be difficult. Therefore, in this section a simplified fourteen-equation version of the ES-MCM block is presented, which captures well the central macroeconomic features of the model and helps to interpret its long-run simulation properties and their dependency on the policy regime. For presentational reasons we first analyse the stationary version of the model, i.e. no technical progress or growth of the labour force is assumed. This simplifies the analysis of the comparative static and the stock-flow equilibrium properties of the model. Thereafter, the analysis is extended to also include growth.

Our analysis of the simplified theoretical model shows that the stock-flow equilibrium of the ES-MCM block is regime-dependent. We show that, when the ES-MCM block is used in isolation, the stock-flow equilibrium, when defined in terms of financial private wealth, is attainable in the EMU-regime (exogenous nominal interest rate, nominal exchange rate and foreign developments), if the crowding-out responses of net trade to alternative shocks are strong enough.[3] In this case permanent shocks have permanent effects on production and relative prices. This equilibrium, however, violates the solvency constraint, as government debt is accumulating (diminishing) and net foreign assets are diminishing (accumulating) unlimitedly. A fiscal closure rule, in line with the Stability and Growth Pact agreed by the EMU countries, is needed to prevent the violation of the solvency constraint. We show that, if the fiscal closure rule is defined in terms of the target level of the debt-to-GDP ratio, then a domestic demand or a foreign price shock has no permanent effects in the model. However, with exogenous foreign developments, this neutrality result does not hold for a permanent foreign demand shock; a positive foreign demand shock requires the appreciation of the real exchange rate resulting in a rise in output. Later, in Section 4, we show that our diagnostic simulation results with the estimated ES-MCM block are in line with these conclusions.

In this section we proceed as follows. We first show that the capital income component of household disposable income can be expressed in terms of aggregate income, capital stock and net financial assets. This is important from the standpoint of the stock-flow equilibrium of the model, because disposable income (including net interest

[3] In isolated simulations the repercussion effects via responses of euro area variables are not considered.

income), rather than labour income, is used as an argument of private consumption. Thereafter, we present simplified dynamic error-correction equations and their implied steady-state forms. We show that aggregated demand and aggregated supply can be presented in terms of the real exchange rate, real net financial assets and exogenous variables of the model. We first study the comparative statistics of the model by also treating real net financial assets as an exogenous variable, i.e. excluding the feedback effects from the accumulation or depletion of government debt and net foreign assets. Thereafter, the long-run effects of some selected shocks are studied by accounting for the feedback effects of debt/asset accumulation. In the final section we show that the conclusions based on the analysis of the static model version can be generalised for a growing economy, when the stock-flow equilibrium is defined in terms of GDP ratios.

2.1. The determination of household disposable income

In the country blocks of the ESCB-MCM, private consumption is determined through changes in the real private wealth and the real disposable income of households. However, via net interest income, household disposable income is also directly linked to the development of household wealth components. This raises the question as to whether the asset side of the model should be disaggregated into household, corporate, government and foreign sector so as to be able to model properly the effects of net interest income on household disposable income. This is an important issue from the viewpoint of the stock-flow stability conditions of the model. In what follows we show that the disposable income of households can be reduced to total income, the capital stock and the net financial assets of the economy, avoiding the detailed sectoral modelling of the asset side.

Abstracting, for simplicity, the government sector transfers to households from the analysis, we can define the real disposable income of households (Y_d) as the sum of after-tax labour income, net interest income from government debt (B_h) and foreign assets (F_h) held by households and other income of households (*OI*) deflated by the price of domestic demand:

$$Y_d = (1 - TX) \cdot [W \cdot N + r \cdot (B_h + F_h) + OI] / P_f^m P^{1-m} \qquad [2.1]$$

where *TX* stands for the tax rate, *W* the wage rate, *N* the number of employees and *r* the interest rate. The deflator of domestic demand is a weighted average of the competing foreign price P_f and the price of domestic production *P,* with the parameter *m* equalling the share of imports in domestic demand. If we assume that firms in this economy are owned by households, other income will consist of transfers from the corporate sector which, in our simplified accounting framework, is equal to the net operating surplus (*NOS*) and the interest income of firms.

$$OI = NOS + r(B_c + F_c) = P \cdot Y - W \cdot N - P_f^m P^{1-m} \delta K + r(B_c + F_c) \quad [2.2]$$

where B_c and F_c are the government bonds and foreign assets, respectively, held by firms, Y is GDP, δ is the depreciation rate and K is the capital stock. Government bonds (B) are held by households, firms and foreigners (B_f), i.e.

$$B = B_h + B_c + B_f \quad [2.3]$$

Net foreign assets (F) are the sum of net foreign assets held by households and firms minus the government bonds held by foreigners:

$$F = F_h + F_c - B_f \quad [2.4]$$

Inserting [2.2] into [2.1] and utilising [2.3] and [2.4] gives us the following expression:

$$Y_d = (1 - TX)\left[P \cdot Y - P_f^m P^{1-m} \delta K + r(B + F)\right] / P_f^m P^{1-m} = (1 - TX)\left[\frac{P \cdot Y}{P_f^m P^{1-m}} - \delta K + rFA\right] \quad [2.5]$$

where FA are the real net financial assets of the economy. This expression implies that there is a direct link between the disposable income of households and the total income of the economy. In addition, the net interest income of households can be expressed in terms of whole economy financial asset aggregates. There is no need to disaggregate financial holdings across institutional sectors.

2.2. The simplified model

In addition to the simplifications in the accounting framework, which have been introduced in the previous sub-section, the most important simplifying assumptions of the following theoretical model are that inventories, imports of raw materials and intermediate goods, indirect taxes and government sector investment are abstracted from the theoretical framework. Only a single foreign (final) good is produced, which is an imperfect substitute for a single domestically produced good. These assumptions imply that import price is equivalent to competitor export price and that GDP is the relevant activity variable for imports.

On the demand side, equation [A1] below is the national accounting identity determining total demand, i.e. GDP (omitting inventories), for the domestic good as a sum of private consumption (C), government consumption (G), investment (I), exports (X) and minus imports (M):

Total demand for the domestic good:

$$Y = C + G + I + X - M \qquad \text{[A1]}$$

According to equation [A2], private consumption converges through a simple partial adjustment process towards the long-run steady state [B2] determined by real disposable income of households, real private sector wealth (*V*). The real interest rate is included to capture intertemporal substitution effects.

Private consumption:

$$\Delta \log C = \lambda_c \left(w \log\left(\frac{Y_d}{C_{-1}}\right) + (1-w)\log\left(\frac{V}{C_{-1}}\right) - \kappa \cdot r \right) \quad \text{[A2]} \Rightarrow \; C = Y_d^{w} V^{1-w} e^{-\kappa \cdot r} \qquad \text{[B2]}$$

Equation [A3] is the definition of household real disposable income. Using the results of the previous sub-section, real disposable income satisfies the following expression:

Real disposable income:

$$Y_d = (1 - TX) \cdot \left[\frac{P \cdot Y}{P_f^m P^{1-m}} - \delta \cdot K + rFA \right] \qquad \text{[A3]}$$

As households own firms, the relevant wealth concept is total wealth of the private sector. Accordingly, [A4] defines real private sector wealth as the sum of the capital stock and the net financial assets.

***Real private sector wealth*:**

$$V = K + FA = K + \left(\frac{B + F}{P_f^m P^{1-m}} \right) \qquad \text{[A4]}$$

Equation [A5] defines gross investment (*I*) as a sum of net investment and the depreciation of the capital stock. In the steady state, without growth, net investment is equal to zero and, hence, gross investment is equal to capital depreciation as shown by [B5].

Real fixed investment:

$$I = \Delta K + \delta K_{-1} \qquad \text{[A5]} \quad \Rightarrow \quad I = \delta \cdot K \qquad \text{[B5]}$$

The next two equations, i.e. [A6] and [A7] below, are conventional partial adjustment equations for export and import demand. Real exports of goods and services are a function of world demand (*MF*) and the real exchange rate. Real imports depend on GDP and the

real exchange rate.[4] Imports, in turn, depend on domestic GDP and the real exchange rate. Again, equations [B6] and [B7] are the steady-state counterparts of the dynamic equations [A6]-[A7].

Exports:

$$\Delta \log X = \lambda_x \left(\log\left(\frac{MF}{X_{-1}}\right) - \eta_x \log\left(\frac{P}{P_f}\right)\right) \qquad \text{[A6]} \quad \Rightarrow \quad X = MF\left(\frac{P}{P_f}\right)^{-\eta_x} \qquad \text{[B6]}$$

Imports:

$$\Delta \log M = \lambda_m \left(\log\left(\frac{Y}{M_{-1}}\right) + \eta_m \log\left(\frac{P}{P_f}\right)\right) \qquad \text{[A7]} \quad \Rightarrow \quad M = Y\left(\frac{P}{P_f}\right)^{\eta_m} \qquad \text{[B7]}$$

Equations [A1]-[A7] define the simplified dynamic version of the demand side of the model; identities [A1], [A3]-[A4] together with steady-state equations [B2], [B5]-[B7], in turn, determine the long-run course of demand.

The determination of the supply side is based on the following assumptions: profit maximisation by monopolistically competing firms, Cobb-Douglas production technology with constant returns to scale, perfect capital markets and trade unions that maximise the utility of their members. In addition, to account for the fact that domestic production is open to foreign competition, the mark-up is allowed to react to competitive pressures from foreign competitors, which is measured by the ratio of foreign competitors' price to domestic costs.

The first-order conditions of the profit maximisation of the representative firm allow us to jointly obtain the demand of two production factors (equations [B8]-[B9]) and the determination of domestic prices (equation [B10]). In the long run, the capital stock will be proportional to labour costs divided by the user cost of capital (P_k), the proportion being defined by parameter β, i.e. output elasticity with respect to capital in the production function. This reflects the condition that the relative marginal productivities of inputs are equal to their relative factor prices. Due to the existence of adjustment costs, investment will adjust smoothly to close the gap between the steady-state level and the actual level of the capital stock.

[4] It is worth noting that, in the context of our static economy analysis, the income elasticity of exports need not be unity. Without affecting our analysis, the variable MF can also be interpreted as a re-scaled variable $MF = MFOR^{\chi}$, where MFOR is the "true" measure of world demand and χ is the income elasticity of exports.

The demand for capital:

$$\Delta \log I = \lambda_I \left(\frac{\Delta K}{K_{-1}} - \delta\right) + \lambda_K \log\left(\frac{\beta}{1-\beta}\frac{W \cdot N}{P_k \cdot K}\right) \quad \text{[A8]} \quad \Rightarrow \quad K = \left(\frac{\beta}{1-\beta}\right)\frac{W \cdot N}{P_k} \quad \text{[B8]}$$

The long-run demand for labour is solved from the inverted production function, which is implied by the profit maximisation framework with a downward sloping demand curve and the price of output solved from the first-order profit maximisation condition with respect to employment.

The demand for labour:

$$\Delta \log N = \lambda_N \left\{\frac{1}{1-\beta}\left[\log\left(\frac{Y}{A}\right) - \beta \log K\right] - \log N_{-1}\right\} \quad \text{[A9]} \Rightarrow \; N = A^{\frac{1}{1-\beta}} Y^{\frac{1}{1-\beta}} K^{-\frac{\beta}{1-\beta}} \quad \text{[B9]}$$

Equation [A10] is the dynamic price equation, with the long-run steady-state form [B10] corresponding to the first-order profit maximisation condition with respect to labour demand. In the long run, domestic prices are equal to unit labour costs plus a mark-up which, instead of being constant, is assumed to depend on price competitiveness (or, equally, on the real exchange rate).

The price of production:

$$\Delta \log P = \lambda_P \log\left[\left(\frac{P_f}{P_{-1}}\right)^{\frac{s}{1+s}} \left(\frac{W \cdot N}{(1-\beta) Y \cdot P_{-1}}\right)^{\frac{1}{1+s}}\right] \quad \text{[A10]} \Rightarrow P = \frac{1}{(1-\beta)}\left(\frac{P}{P_f}\right)^{-s} \frac{W \cdot N}{Y} \quad \text{[B10]}$$

From this expression it is possible to obtain the labour income share desired by firms, which is equal to the inverse of the mark-up, as a function of the real exchange rate:

$$\frac{W \cdot N}{P \cdot Y} = (1-\beta)\left(\frac{P}{P_f}\right)^{s} \quad \text{[B10']}$$

The wage equation [A11] is a standard bargaining specification whereby the real wage adjusts to its warranted long-run path [B11], where the equilibrium real wage is determined by labour productivity and the equilibrium employment rate (or equally the inverse of the unemployment rate; N_f is the labour force).

Wage rate:

$$\Delta \log W = \Delta \log P_f^m P^{1-m} + \lambda_W \log\left[\frac{(1-\beta) P \cdot Y}{W \cdot N}\right] + \lambda_W \lambda_U \log(N / N_f) \quad \text{[A11]} \quad \Rightarrow$$

$$W = (1-\beta)\frac{P \cdot Y}{N}\left(\frac{N}{N_f}\right)^{\lambda_U} \qquad \text{[B11]}$$

From [B11] is also possible to obtain the labour income share desired by workers, now as a function of the employment rate:

$$\frac{W \cdot N}{P \cdot Y} = (1-\beta)\left(\frac{N}{N_f}\right)^{\lambda_U} \qquad \text{[B11']}$$

Equation [B11'] and [B10'] determine the steady-state employment rate (unemployment rate), which is not constant and depends on competitiveness (the real exchange rate).

The final equation on the supply side of the model is the definition of the nominal user cost of capital [A12]: a weighted average of domestic and foreign prices multiplied by the sum of the real interest rate and the depreciation rate.

The user cost of capital:

$$P_k = P^{1-m} P_f^m \left(r+\delta-\Delta \log P_f^m P^{1-m}\right) \qquad \text{[A12]} \quad \Rightarrow \quad \frac{P_k}{P} = \left(\frac{P_f}{P}\right)^m (r+\delta) \qquad \text{[B12]}$$

To close the model, we have to introduce two additional equations capturing the government budget and foreign debt constraints. Through their feedback effects to wealth accumulation, these two equations play a key role in the determination of the stock-flow equilibrium of the model.

Government debt:

$$\Delta B = (G - TX \cdot Y) \cdot P + rB_{-1} \qquad \text{[A13]} \quad \Rightarrow \quad r\frac{B}{P} = TX \cdot Y - G \qquad \text{[B13]}$$

Net foreign assets:

$$\Delta F = PX - P_f \cdot M + rF_{-1} \qquad \text{[A14]} \quad \Rightarrow \quad r\frac{F}{P} = \left(\frac{P_f}{P}\right)M - X \qquad \text{[B14]}$$

Equation [B13] establishes that, if in a steady state public debt is positive, then a primary surplus on public finances is necessary to finance interest payments. Equation [B14], in turn, requires that, in a steady state, the trade balance must be equal to net foreign interest payments.

2.3. The solution of the steady-state version of the model

In this section we solve the theoretical long-run version of the ES-MCM block presented in the previous section. We first solve all equations of the long-run model in terms of the real exchange rate, real financial assets and exogenous variables of the model. Thereafter, based on the equilibrium condition that total supply equals total demand, output and domestic output price are solved in terms of exogenous variables and real net financial assets, which we treat, at first, as an exogenous variable. This shows the responses of the model to a number of different shocks, when the feedback effects through the wealth channel are cut off. We then endogenise the real net financial assets and examine the effects of the wealth channel on the long-run stock-flow equilibrium. This analysis confirms that the introduction of a fiscal closure rule into the model is needed to prevent the violation of the government sector solvency constraint.

Solving the steady-state demand and supply in terms of the real exchange rate, real financial assets and genuinely exogenous variables of the model is straightforward. By denoting $A_Y = A^{\frac{1}{1-\beta}}$, the reduced-form solutions in per capita form are:

Reduced form consumption:

$$\frac{C}{N_f} = \left\{ (1-TX) \left\{ A_Y \left(\frac{\beta}{r+\delta} \right)^{\frac{\beta}{1-\beta}} \left(\frac{P}{P_f} \right)^{\frac{m+s}{1-\beta}+\frac{s}{\lambda_U}} \left[\left(\frac{P}{P_f} \right)^{-s} - \frac{\delta\beta}{r+\delta} \right] + \frac{rFA}{N_f} \right\} \right\}^{w}$$

$$* \left\{ A_Y \left(\frac{\beta}{r+\gamma} \right)^{\frac{1}{1-\beta}} \left(\frac{P}{P_f} \right)^{\frac{m+s}{1-\beta}+\frac{s}{\lambda_U}} + \frac{FA}{N_f} \right\}^{1-w} \exp(-\kappa \cdot r) = C \left(\underset{+}{A_Y}, \underset{-}{TX}, \underset{(-)}{r}, \underset{-}{N_f}, \underset{+}{FA}, \underset{+}{\frac{P}{P_f}} \right) \qquad [C2]$$

Private consumption per capita depends positively on the level of technology, the real financial assets and the real exchange rate (through the purchasing power of households) and negatively on tax rates (through disposable income) and the labour force. The sign of the interest rate effect is indeterminate, as there are two counteracting forces, i.e. a negative intertemporal substitution effect and a positive income effect (a negative total effect is the more likely, the higher parameter κ and the lower the level of the real financial assets).

***Reduced-form investment*:**

$$\frac{I}{N_f} = \delta A_Y \left(\frac{\beta}{r+\delta}\right)^{\frac{1}{1-\beta}} \left(\frac{P}{P_f}\right)^{\frac{m+s}{1-\beta}+\frac{s}{\lambda_U}} = \delta \cdot K\left(\underset{+}{A_Y}, \underset{-}{r}, \underset{+}{\frac{P}{P_f}}\right) \qquad [C5]$$

Real investment per capita, which in the steady state is proportional to the capital stock and is therefore supply-determined, depends positively on the level of technology and the real exchange rate (through the real user cost of capital) and negatively on the real interest rate (again through the user cost of capital).

Reduced-form exports:

$$\frac{X}{N_f} = \frac{MF}{N_f}\left(\frac{P}{P_f}\right)^{-\eta_x} = X\left(\underset{+}{MF}, \underset{-}{N_f}, \underset{-}{\frac{P}{P_f}}\right) \qquad [C6]$$

Exports show a direct relationship to world demand and an inverse one to the labour force and relative prices.

***Reduced-form imports*:**

$$\frac{M}{N_f} = A_Y \left(\frac{\beta}{r+\delta}\right)^{\frac{\beta}{1-\beta}} \left(\frac{P}{P_f}\right)^{\left(\frac{\beta(m+s)}{1-\beta}+\frac{s}{\lambda_U}\right)+\eta_m} = M\left(\underset{+}{A_Y}, \underset{-}{r}, \underset{+}{\frac{P}{P_f}}\right) \qquad [C7]$$

Imports of goods and services per capita depend positively on the level of technology and the real exchange rate and negatively on the interest rate, reflecting the negative interest rate effect on output (see equation [C15] below).

Reduced-form capital stock:

$$\frac{K}{N_f} = A_Y \left(\frac{\beta}{r+\delta}\right)^{\frac{1}{1-\beta}} \left(\frac{P}{P_f}\right)^{\frac{m+s}{1-\beta}+\frac{s}{\lambda_U}} = K\left(\underset{+}{A_Y}, \underset{-}{r}, \underset{+}{\frac{P}{P_f}}\right) \qquad [C8]$$

The capital stock per capita depends positively on the level of technology and the real exchange rate, and negatively on the real interest rate (in both cases through their effects on the user cost of capital).

Reduced-form employment:

$$\frac{N}{N_f} = \left(\frac{P}{P_f}\right)^{\frac{s}{\lambda_U}} = N\left(\underset{+}{\frac{P}{P_f}}\right) \qquad [C9]$$

As previously seen, the employment (unemployment) rate in the steady state depends positively (negatively) on the real exchange rate or, equally, on the price competitiveness of the economy. This stems from the fact that, through the parameter *s,* the mark-up is not constant but absorbs part of the changes in production costs or in foreign competitors' price.

If we substitute equations [C8]-[C9] into the production function, that gives us:

Reduced-form production:

$$\frac{Y}{N_f} = A_Y\left(\frac{\beta}{r+\delta}\right)^{\frac{\beta}{1-\beta}}\left(\frac{P}{P_f}\right)^{\frac{\beta(m+s)}{1-\beta}+\frac{s}{\lambda_U}} = S\left(\underset{+}{A_Y}, \underset{-}{r}, \underset{+}{\frac{P}{P_f}}\right) \qquad [C15]$$

Production equation [C15] defines total supply. We see that total supply (per capita) depends positively on the real exchange rate (P/P_f), i.e. the supply curve is upward sloping in the real exchange rate (vertical) - output (horizontal) axis (see Figures 2.1 and 2.2 below), the slope depending on the size of the external sector and foreign competition pressures (through parameters *m* and *s,* respectively). A vertical supply schedule is obtained only in the polar cases of a closed economy (i.e *m=s=0*) and a small open economy (i.e. $P = P_f$).

Total per capita demand for domestic goods, in turn, is:

$$\frac{C+G+I+X-M}{N_f} = C\left(\underset{+}{A_Y}, \underset{-}{TX}, \underset{(-)}{r}, \underset{-}{N_f}, \underset{+}{FA}, \underset{+}{\frac{P}{P_f}}\right) + G + \delta \cdot K\left(\underset{+}{A_Y}, \underset{-}{r}, \underset{+}{\frac{P}{P_f}}\right)$$

$$+ X\left(\underset{+}{MF}, \underset{-}{N_f}, \underset{-}{\frac{P}{P_f}}\right) - M\left(\underset{+}{A_Y}, \underset{-}{r}, \underset{+}{\frac{P}{P_f}}\right) = D\left(\underset{+}{A_Y}, \underset{-}{TX}, \underset{+}{G}, \underset{(-)}{r}, \underset{+}{MF}, \underset{-}{N_f}, \underset{+}{FA}, \underset{?}{\frac{P}{P_f}}\right) \qquad [C16]$$

Unlike on the supply side, the sign of the partial derivative of demand with respect to relative prices is indeterminate. This arises from the fact that, besides a negative substitution effect, an increase in the real exchange rate also exerts a positive income effect on demand. The price elasticities of equations [C2]-[C9] imply that, irrespective of the sign

of the partial derivative of demand with respect to prices, the price elasticity of total supply is larger than the price elasticity of total demand. This implies that the comparative static equilibrium solutions implied by the model are also attainable.

However, from the standpoint of comparative static effects the sign (and the size) of the slope of the demand schedule matters. As can be seen in figure 2.1, if the slope of the demand schedule is negative, then the substitution effect in demand dominates and part of the initial output effect of permanent demand shocks is crowded out. In the opposite case, when the slope of the demand curve is positive, like the supply curve (figure 2.2), the income effect prevails over the substitution effect and the price reactions strengthen the initial output effects of demand shocks.

Figure 2.1

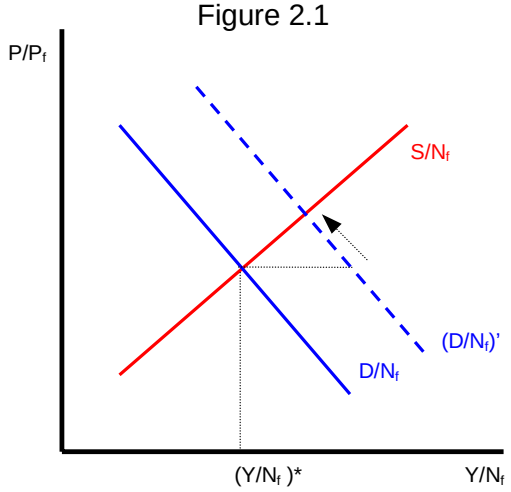
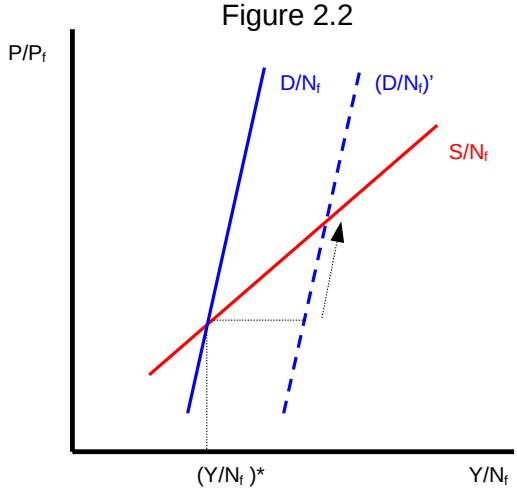


Figure 2.2



Equations [C2]-[C9] show that the greater the shares of exports and imports in GDP and the higher the price elasticities of these trade components, the greater the substitution effect.[5]

2.3.1. Comparative statistics with exogenous real financial wealth (partial equilibrium)

Under the assumptions that the slope of the demand schedule is negative, the interest rate effect on demand is negative and the real financial assets are exogenous, we can illustrate that positive demand shocks increase output (per capita) and the domestic price level (i.e. they appreciate the real exchange rate). Reductions in the tax rate (*TX*), increases in government consumption (*G*), in foreign demand (*MF*) and in the net real financial assets of the private sector (*FA*), which can be classified as positive *demand shocks*, shift only the location of the demand curve on the price (vertical) - output

[5] If the income elasticity of imports is allowed to deviate from unity, it can be shown that the size of (the reduced form) substitution effect depends positively on the size of the income elasticity of imports.

(horizontal) axis. Therefore, it can be readily seen that a positive demand shock increases both output and the domestic price level (figure 2.3).

As can be seen in figure 2.4, a rise in *the interest rate (r)* shifts both the demand and the supply curve to the left, implying a decrease in equilibrium production. However, it cannot be unambiguously stated whether the leftward shift in the demand curve is greater or smaller than the shift in the supply curve and, hence, the sign of the price effect is ambiguous. However, if the stock of real financial assets is positive and the estimated interest elasticity of consumption is zero or close to zero, then it is likely that the supply reaction to the rise in the interest rate is dominant and the price effect is positive. However, the interest rate effect is state-dependent and, with a high negative value of net financial assets, the sign of the interest rate effect on the price level can then turn negative.

Figure 2.3

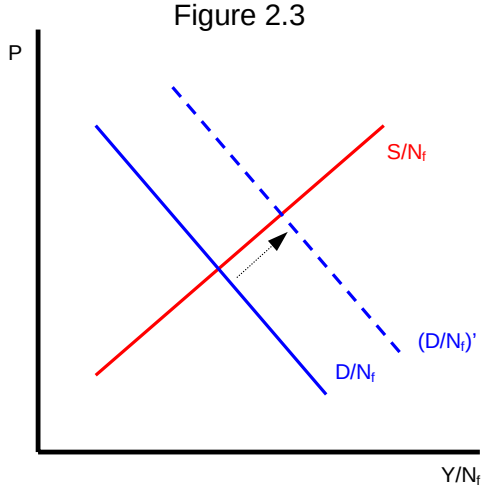
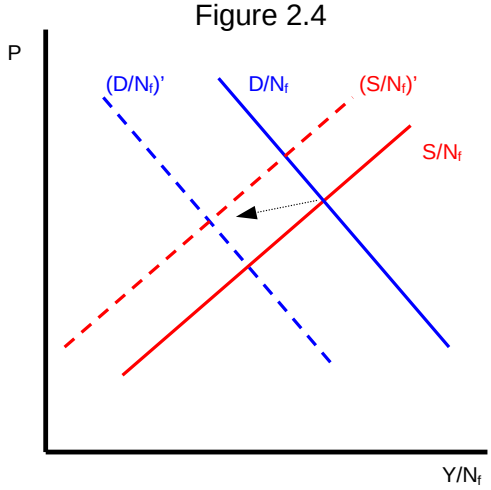


Figure 2.4



A positive *technology shock (A_Y)* shifts both the demand and supply curves outwards, resulting in a rise in output[6] (figure 2.5). It might seem a priori that the impact on prices is ambiguous; however, as the elasticity of supply with respect to the technology shock is greater than the elasticity of demand, the domestic price level must be lower in the new equilibrium.

Due to the linear homogeneity property in the price-wage system, the foreign price shocks (P_f) are passed through in full to the domestic price level, meaning that the shift in the demand curve to the right is exactly equal to the movement in the supply curve to the left (figure 2.6). Therefore, there are no permanent effects on output or on the price level (the real exchange rate).

[6] With high negative values of FA, the sign of the effect of the technology shock on output per capita can turn negative because, via consumption, the shift in the demand curve may exceed the shift in the supply curve

Figure 2.5

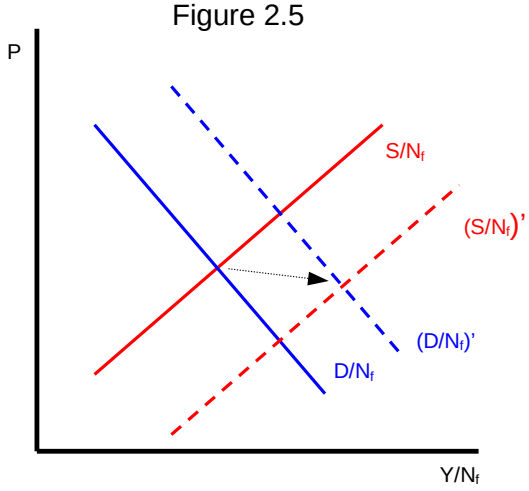
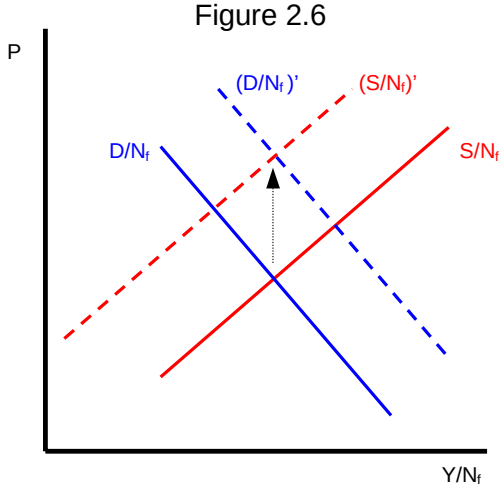
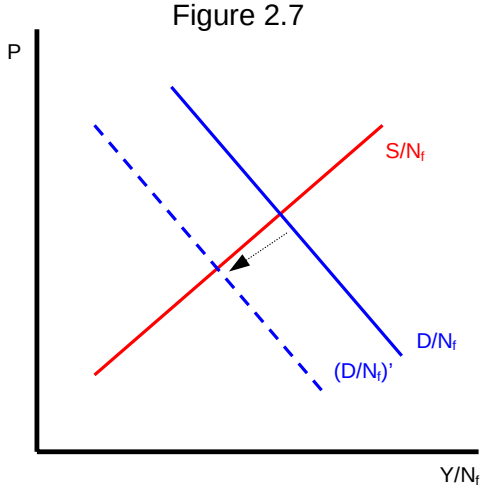


Figure 2.6



Finally, per capita supply is not affected by an increase in *labour supply (N_f).* On the other hand following such a shock, some demand components are affected. Government consumption, exports and real financial wealth, in per capita terms, decrease, thus the demand curve shifts to the left (figure 2.7). Hence, both per capita output and the domestic price level must be lower in the new equilibrium. In terms of aggregate output, this means that the elasticity of output with respect to the labour force is below unity.

Figure 2.7



2.3.2. The stock-flow equilibrium and comparative statistics with endogenous wealth

The analysis above is only a partial equilibrium analysis, as the stock of real net financial assets (*FA*) was assumed to remain constant. However, in the general equilibrium, the stock of real net financial assets is also endogenously determined, through accumulation or depletion of government bonds and net foreign assets, as shown by equations [A13]-[A14], and through responses to changes in the price level. As a result, the necessary condition for the stock equilibrium is as follows:

$$\Delta FA = \Delta B + \Delta F = 0 \qquad \text{[C17]}$$

It is worth noting that the fulfilment of [C17] does not also require that $\Delta B = \Delta F = 0$. What is required is that changes in government debt and net foreign assets offset each other's effects on net financial wealth. As will be discussed later in this section, the requirement that $\Delta B = \Delta F = 0$ presumes an additional reaction function for fiscal policy. However, we examine first the long-run equilibrium without any fiscal policy rule. Steady-state equations [B13] and [B14] together with the previous condition imply that in a steady state the following identity must hold:

$$rFA = TX \cdot Y - G + \frac{P_f}{P} M\left(\underset{+}{Y}, \underset{+}{P/P_f}\right) - X\left(\underset{+}{MF}, \underset{-}{P/P_f}\right) = TX \cdot Y - G - TB\left(\underset{-}{Y}, \underset{-}{P/P_f}, \underset{+}{MF}\right) \qquad \text{[C18]}$$

where TB is the trade balance in real terms. Clearly, the partial derivative of the trade balance with respect to domestic output is negative (i.e. $TB_Y = \frac{\partial TB}{\partial Y} < 0$). The negative sign of the partial derivative with respect to relative prices ($TB_P = \frac{\partial TB}{\partial P}$) , however, requires that the Marshal-Lerner condition holds.

Unless equation [C18] holds, the stock equilibrium of the model is not attained and, through dynamic equations [A13] and [A14], the amount of real net financial asset changes, resulting in continuous shifts in the demand curve [C16]. Hence, the differentiation of [C18] gives the steady-state multiplier effects of permanent shocks required by the stock-flow equilibrium of our model.[7]

For a permanent increase in *government expenditure* we have:

$$\frac{dY}{dG} = \frac{1 + r\frac{dFA}{dG}}{t - TB_Y - TB_P \frac{\partial P}{\partial Y}} > 0$$

As seen in the previous sub-section, the sign of the effects of demand shocks on domestic price and output are the same, i.e. an increase (decrease) in output is associated with an increase (decrease) in the price level. Therefore, the denominator of that expression is unambiguously positive. It can also be deduced that the term dFA/dG in the numerator is positive: dynamic equations [A13]-[A14] imply that, as a response to a permanent increase in government expenditure, there is a government budget deficit. However, the

[7] This equation defines the open economy counterpart of the long-run closed economy multiplier of Blinder and Solow (1973).

budget deficit is negatively related to the induced rise in output and the domestic price level. On the other hand, endogenous output and price reactions result in a current-account deficit, which increases with the rise in output and price level. As long as the government budget deficit is larger than the current-account deficit, the stock of real net financial assets accumulates and, through the wealth channel, is transmitted to domestic demand. This process continues until output has increased enough to ensure that the budget deficit is reduced to a level equal to the current-account deficit or, equivalently, that the current-account deficit is raised to the level of the budget deficit. At this point the net saving of the private sector is zero and the stock equilibrium in terms of private sector wealth is attained. Hence, a permanent increase in government consumption has a permanent positive effect on output, the price level and the stock of real net financial assets, with the latter also shifting the aggregate demand schedule further to the right.

Similarly the long-run multiplier effect of *foreign demand* is:

$$\frac{dY}{dMF} = \frac{TB_{MF} + r\frac{dFA}{dMF}}{t - TB_Y - TB_P\frac{\partial P}{\partial Y}}$$, which is greater than zero, if $TB_{MF} > -r\frac{dFA}{dMF}$

We next argue that $TB_{MF} > -r\frac{dFA}{dMF}$. Firstly, since the partial derivative TB_{MF} equals $\frac{\partial X}{\partial MF}$, it is evident that its sign is positive. However, the term dFA/dMF is not necessarily positive and, hence, unlike in the context of a domestic demand shock, wealth adjustment does not inevitably strengthen the first-round positive output and price effects presented in Figure 2.3. Dynamic equations [A13] and [A14] show that as a response to a permanent increase in foreign demand, there is a government budget surplus (i.e. a decrease in government debt), which may exceed the positive current-account effect on net foreign assets. If that is the case, then net financial wealth *FA* decreases in relation to the baseline and, therefore, crowds out part of the first-round expansionary effects of increased foreign demand on domestic output and prices. This process continues until the current account and government budget effects are equal and, accordingly, they cancel each other out in net financial wealth *FA*. However, the crowding-out effects associated with the dynamic adjustment of net financial assets cannot exceed the first-round positive effects of foreign demand on output and domestic prices. If this were the case then, as a result of lowered output and price, the current-account surplus would be coupled with a government deficit, which would clash with the stock equilibrium of real financial wealth.

In the steady-state model the long-run effect of an increase in *foreign price* should, through price homogeneity, be completely passed through to domestic prices, and the

equilibrium real exchange rate does not change. Therefore, the foreign price shock cannot be associated with permanent real effects either. This conclusion, however, requires that both government debt and net foreign assets adjust to their original (or baseline) levels. In practice, with the non-instantaneous transmission of foreign prices to the domestic price level there will, at least, be transitory current-account, activity and government budget effects. If, in the short run, the positive current-account effect, resulting from a temporary improvement in price competitiveness, exceeds the positive budget balance effect, resulting from increased activity, this will lead to an accumulation of financial assets. Thus, on the basis of the present analysis, we cannot exclude the possibility that a permanent foreign price shock affects the equilibrium level of real net financial assets and, beyond this, the equilibrium real exchange rate and output. However, one would expect these effects to be limited.

Although technically attainable, the long-run equilibrium characterised is open to the critique that it violates the government sector solvency constraint, which, in the current static framework, can be presented on the basis of [A13] as follows:

$$B_t \leq -\sum_{i=1}^{\infty}(1+r)^{-i}\left(G_{t+i} - TX_{t+i}Y_{t+i}\right)P_{t+i}$$

This condition would preclude unbounded accumulation of government debt and depletion of net foreign assets. It states that, sooner or later, the tax rate must be changed to restore balance in the government budget. Therefore, a *fiscal closure rule*, under which taxes are increased to stabilise government debt at some constant level, is needed to prevent an infinite accumulation (or depletion) of government debt. Such a closure rule closely resembles what is embedded in the Stability and Growth Pact. In the case of a permanent increase in *government consumption*, if the target debt level is fixed, then on the basis of equation [B13] it is easy to see that tax income has to rise correspondingly to prevent the widening of government debt. Thus, either output or the tax rate has to increase to cover the budget deficit. However, output cannot permanently increase as the foreign asset equilibrium implied by equation [B14] requires that output and the domestic price level (the real exchange rate) should not change. The current-account equilibrium condition would otherwise be violated and the resulting solution would imply continuous accumulation or depletion of net foreign assets. Consequently, with the fixed government debt target the increased tax rate neutralises the long-run effects of a permanent positive shock in domestic demand.

However, this conclusion does not hold if the shock originates in *foreign demand*. Equilibrium with no changes either to output or the real exchange rate would contradict the requirement that the current account should also hold unchanged, despite permanently higher foreign demand. Hence, to eliminate positive current-account effects, the real

exchange rate has to appreciate with positive impacts on production and the tax base. Therefore, the income tax rate must fall to eliminate the government sector surplus, boosting domestic demand and the price level. The resulting additional appreciation of the real exchange rate and the rise in output eliminates the original current-account surplus. We can conclude that in a new equilibrium the real exchange rate must appreciate (i.e. domestic prices must rise), the income tax rate fall and output increase in relation to the benchmark levels. It can also be argued that the inclusion of the fiscal closure rule has a tendency to strengthen the effects of a permanent foreign demand shock on equilibrium output and on the domestic price level, compared with the absence of the fiscal closure rule.

In the context of a *permanent foreign price* shock the introduction of a fiscal closure rule, with a predetermined target for government debt (or the government debt-to-GDP ratio), implies that additional possible wealth effects are eliminated. Accordingly, there are no permanent real effects.

Our main conclusions are the following. In the EMU regime, with the repercussion effects via area-wide nominal interest rate and trade reactions excluded, the stability of the model requires that the real exchange rate channel be sufficiently strong. This implies that the effective price elasticities of foreign trade, which depend not only on the price elasticity estimates of exports and imports but also positively on the GDP shares of these two trade components, are sufficiently high. In response to a demand shock, in terms of private sector wealth, the model is also able to produce long-run stock-flow equilibrium without a fiscal closure rule. Under these conditions a positive government demand shock results in the appreciation of the real exchange rate, which increases equilibrium output. In this equilibrium the private sector is in balance, i.e. private net wealth (or the wealth-to-GDP ratio) does not accumulate or diminish, but there is a deficit in the government budget which, however, is fully covered by the current-account surplus. Although the perpetual accumulation of government debt and the corresponding depletion of net foreign assets cancel each other out in net private wealth, this situation implies the violation of the sustainability condition of government debt.

The fulfilment of the sustainability condition requires a fiscal closure rule which, through the reactions of the tax rate, sets limits to the indebtedness of the government sector. If the fiscal closure rule is defined in terms of a fixed debt (or the debt-to-GDP ratio) target, then all real effects of the domestic demand and the foreign price shock are eliminated in the stock-flow equilibrium. However, as the target debt (or the debt-to-GDP ratio) is a policy variable, an important implication of the above discussion is that an increase in the target government debt-to-GDP ratio has, through the appreciation of the real exchange rate, a positive effect on equilibrium (potential) output[8]. Similarly, a

[8] An endogenous risk premium could, however, neutralise at least part of that supply effect.

permanent positive foreign demand shock raises equilibrium output which, through the fiscal closure rule and unlike in the context of a domestic demand shock, strengthens via implied tax cuts.

2.4. Extension to the growing economy

In this section the static economy assumption is relaxed allowing for technical progress, population growth and permanent foreign inflation, all of which are assumed to develop exogenously. The technology parameter A of the production function is replaced by the time-dependent term $A_0 e^{(1-\beta)\gamma \cdot T}$, which states that the rate of change of the Harrod-neutral technical progress is γ. The labour force and foreign prices are assumed to grow at constant rates of *n* and π_f, respectively. We show that our main conclusions, presented in previous sections, also hold in the growing economy after defining stock equilibrium conditions in terms of GDP ratios instead of levels. An exception is that the generation of an equilibrium growth path requires the elasticities of both imports and exports to be equal to unity with respect to domestic output.[9]

In the equilibrium growth path, long-run relations [B8]-[B12] hold and imply growth relations (where $\hat{Z} = \frac{\Delta Z}{Z_{-1}}$):

$$\hat{K} = \hat{W} + \hat{N} - \hat{P}_K \qquad \text{[D8]}$$

$$\hat{Y} = (1-\beta)\gamma + \beta\hat{K} + (1-\beta)\hat{N} \qquad \text{[D9]}$$

$$\hat{W} - \hat{P} - (\hat{Y} - \hat{N}) = -s(\hat{P} - \pi_f) \qquad \text{[D10]}$$

$$\hat{W} - \hat{P} - (\hat{Y} - \hat{N}) = \lambda_U (\hat{N} - n) \qquad \text{[D11]}$$

$$\hat{P}_K - \hat{P} = m(\pi_f - \hat{P}) \qquad \text{[D12]}$$

We see that, in the equilibrium growth path, the left-hand sides of [D10] -mark-up price equation- and [D11] -wage equation- are identical and define the change of the labour income share. The underlying Cobb-Douglas production function implies that the labour

[9] This is also an issue of time horizon. Quite plausibly, income elasticities of exports and imports can deviate from unity for several decades, which is the relevant horizon in policy analysis. It is, however, more questionable whether the deviations from unit elasticities can be permanent. The horizon of an equilibrium growth path is, in principle, infinite and in typical empirical applications covers at least several hundred years.

income share is constant, meaning that the left-hand sides of [D10] and [D11] are equal to zero in the equilibrium growth path. Therefore, on the right-hand side of [D11], $\hat{N} = n$ and the equilibrium unemployment rate is constant. The right-hand side of [D10] and, further, equation [D12] impose that domestic inflation and the growth rate of the nominal user cost must be equal to foreign inflation, i.e. $\hat{P} = \hat{P}_K = \pi_f$.

Finally, equations [D8] and [D9] together with [D10] (or [D11]) imply $\hat{K} = \hat{Y} = \gamma + n$, which is in line with the neo-classical growth model. Similarly, in line with this latter model, equilibrium real wage growth is determined by technical progress, i.e. $\hat{W} - \pi_f = \gamma$.

Let us now turn to the demand side. When growth is taken into account, equation [A5] implies the following steady-state relationship for investment

$$I = \left(\hat{K} + \delta\right)K_{-1} = \left(\frac{\gamma + n + \delta}{\gamma + n + 1}\right)K \qquad \text{[D5]}$$

With the capital-output ratio K/Y constant in the equilibrium path, equation [D5] implies that the investment ratio I/Y is also constant. With domestic inflation equal to foreign inflation, equations [B6] and [B7] imply for exports and imports that:

$$\hat{X} = M\hat{F} \qquad \text{[D6]}$$

$$\hat{M} = \hat{Y} = \gamma + n \qquad \text{[D7]}$$

We see that without an additional assumption concerning the growth of export markets, [D6] is not compatible with the constant output share of exports X/Y. It is thus required that $M\hat{F} = \gamma + n$, signifying for instance that, if the growth of the labour force in the rest of the world is higher than in the home country, then the speed of technical progress must be faster in the home country than in the rest of the world.

It is also readily apparent that private consumption grows at the same rate as production, if the net financial wealth-to-GDP ratio remains constant in the equilibrium growth path. In other words, the constancy of the net financial wealth-to-GDP ratio implies a constant GDP share of private consumption. We then examine more closely the determination of the GDP ratios of net financial wealth and its components.

After defining $b_t = B_t / P_t Y_t$, $d_t = G_t / Y_t - TX_t$, $f_t = F_t / P_t Y_t$ and $tb_t = X_t / Y_t - \left(P_{f_t} / P_t\right)\left(M_t / Y_t\right) = tb\left(\underbrace{P_t / P_{f_t}}_{-}\right)$, equations [A13] and [A14] can be written in the form (see e.g. Mitchell et al. (2000)):

$$\Delta b_t = \left(\frac{r-\gamma-n}{1+\gamma+n}\right) b_{t-1} + d_t \qquad \text{[D13]}$$

$$\Delta f_t = \left(\frac{r-\gamma-n}{1+\gamma+n}\right) f_{t-1} + tb\left(\underbrace{P_t / P_{f_t}}_{-}\right) \qquad \text{[D14]}$$

The dynamic "efficiency condition" is that the real interest rate exceeds the equilibrium output growth, i.e. $r > \gamma + n$. (We see that in a static economy with $\gamma = n = 0$ this is always the case). Under this condition the solution of the homogenous parts of difference equations [D13] and [D14] is explosive.

The net financial wealth-to-GDP ratio is obtained as a sum of [D13] and [D14], i.e.:

$$\Delta fa_t = \left(\frac{r-\gamma-n}{1+\gamma+n}\right) fa_{t-1} + d_t + tb\left(\underbrace{P_t / P_{f_t}}_{-}\right) \qquad \text{[D15]}$$

It is worth noting that, although the deficit ratio d_t can be treated as an exogenous control variable of the government, the trade balance-to-GDP ratio tb_t is -via the real exchange rate- a highly endogenous item. Hence, an increase in the GDP share of government consumption (and, accordingly, d_t) leads to an appreciation of the real exchange rate, as was argued in the previous sections. The real exchange rate appreciation continues until $\Delta fa_t = 0$ in [D15], i.e. the change in the trade balance covers the increased government deficit and changes in debt service costs. However, equations [D13] and [D14] imply that the GDP ratios of government debt and net foreign assets may explode unlimitedly and, hence, the sustainability condition of government debt is violated.

On the basis of equation [D13], the sustainability condition of government debt can be defined as:

$$b_t \leq -\sum_{1}^{\infty}\left(\frac{1+r}{1+\gamma+n}\right)^{-i} d_{t+i}$$

which states that future primary surpluses must cover current debt. Thus, a permanent increase in the ratio G/Y implies that, sooner or later, the average tax rate must be raised to cover the accumulated debt. The fulfilment of this condition leads to a reaction function, whereby the average tax rate reacts to deviations by the government debt-to-GDP ratio or the government deficit-to-GDP ratio from the predetermined target ratios.

To sum up, all the results presented in this sub-section are well in line with those based on our analysis of the static economy. Accordingly, the results of the static economy analysis can, with only slight modifications, be generalised to hold also in the growing economy.

3. Estimated equations and theoretical grounds

In this section we present the core equations of the ES-MCM block and the theory underlying the chosen specifications. The econometric methodology used is the co-integration framework and, in most cases, the error correction mechanisms are estimated in two steps. A characteristic feature of this approach is that in the first step long-run relations are derived from underlying theory, whilst in the second step dynamic equations are selected on an empirical basis. The dynamic, however, is constrained in some cases by the need to fulfil long-run steady-state properties implied by first-step equations. All the equations are backward-looking and expectation formation mechanisms are not explicitly modelled. Thus, the dynamic behaviour of the equations stems from genuine rigidities as well as from the expectation formation mechanism.

3.1. The supply side of the model

The supply side of the ES-MCM block includes four core equations defining the demands for production factors, the GDP deflator (net of indirect taxes) and the nominal wage rate. These four equations can be qualified as behavioural and derived from optimisation behaviour. In addition, stochastic equations for the deflators of private and government consumption and private and government investment are derived from accounting quasi-identities with GDP and import deflators as their arguments. Behavioural equations for import and export deflators will be presented in section 3.4 in the context of the trade block.

3.1.1. The demand for the production factors and the value added deflator

In the long run, we assume that firms produce goods and services combining capital (*K*) and labour (*N*) through a Cobb-Douglas production function with constant returns to

scale and exogenous technological progress that we model as a trend (*T*). Hence, the long-run production function is $Y = Ae^{(1-\beta)\gamma T} K^{\beta} N^{1-\beta}$. Moreover, these firms have a certain market power, so they fix their price (*P*) above their marginal cost. Solving the profit maximisation problem of the representative firm, we can derive, from first-order conditions, the following equations for prices, employment and capital:

$$p + \log(1 - TX_I) = \ln(\eta) - \ln(1-\beta) - \frac{\ln(A)}{1-\beta} + \frac{\beta}{1-\beta}(y-k) - \gamma T + w \qquad [3.1]$$

$$n = -\frac{\ln(A)}{1-\beta} + \frac{1}{1-\beta} y - \frac{\beta}{1-\beta} k - \gamma T \qquad [3.2]$$

$$k = (1-\beta)\left\{\ln\left(\frac{\beta}{1-\beta}\right) - \frac{\ln(A)}{1-\beta} + \frac{1}{1-\beta} y + (w - p_K) - \gamma T\right\} \qquad [3.3]$$

where TX_I is the effective indirect tax rate, *W* the nominal wage, P_K the user cost of capital[10] and the lower-case letters stand for the log of the corresponding variable. Parameter η captures the mark-up, β is the elasticity of the capital stock in the production function, A is a scale parameter and γ the growth rate of Harrod-neutral technological progress.

As can be seen from expression [3.3], the long-run capital stock is going to evolve with the relative costs of productive factors and the level of output. Employment will be given by the inverse of the production function as shown by [3.2]. Equation [3.1], in turn, states that the value added deflator after indirect taxes will depend on the mark-up, the marginal product of labour and the nominal wage rate[11]. Since the Spanish economy can be considered as a relatively small open economy, following Layard et al. (1991), we impose that the mark-up is dependent on pressures from competitors' prices on the price-setting of domestic firms, as follows (a similar approach to model the dual inflation problem in Spain can be found in Mauleon y Raymond [1993]):

$$\ln(\eta) = \ln(\eta_0) - \frac{\mu}{1-\mu}(p - e - p_f^*) \qquad [3.4]$$

---

[10] The user cost of capital is defined as follows: $P_K = P_I\left(\frac{r_C + r_L}{2} + \delta - \ln\left(\frac{P_I}{P_{I-1}}\right)\right)$, where P_I is the investment deflator, r_C the bank lending rate to firms, r_L the long-run nominal interest rate and δ the depreciation rate of the total capital stock of the economy.

[11] Notice that in [3.1] the marginal product of labour could be equally well expressed in terms of the output-to-labour ratio instead of the output-to-capital ratio and technical progress. The former form was, for presentational reasons, used in the theoretical model of section 2.

where *E* is the nominal exchange rate and P_f^* the external price in foreign currency. Thus, when external prices in pesetas go up, domestic firms can raise their mark-ups since they face fewer pressures from competitors' prices. Substituting this expression in equation [3.1] gives:

$$p + \log(1 - TX_I) = (1-\mu)\left(\ln(\eta_0) - \ln(1-\beta) - \frac{\log(A)}{1-\beta} + \frac{\beta}{1-\beta}(y-k) - \gamma T + w\right) + \mu(e + p_f^*) \qquad [3.5]$$

Domestic prices are therefore a weighted average of internal and external factors.

After calibrating the parameter β to 0.32 from National Accounts,[12] we estimate the system formed by the equations [3.2], [3.3] and [3.5] in order to set the long run of the value added deflator, and the employment and investment demands.[13] The results are in table 3.1.

As can be seen in the upper panel of Table 3.1, the point estimate for the scale variable in the production function (A) is 0.34. The parameter for technology growth (γ) is 0.0036 (implying annual exogenous growth of 0.97%) and the constant term of the mark-up (η_0) is 0.98, but after accounting for relative prices our estimate for the average mark-up is about 1.3 (very similar to the estimates of Lopez-Salido and Velilla [1997]). The impact of competitiveness (μ) is 0.28 (quite similar to the average weight of imports in value added in the nineties). The adjustment speeds of the equations are quite satisfactory and, apart from employment, the residuals behave as stationary variables.

In the lower panel of Table 3.1 are the results for the dynamic adjustment of these variables to the previous long-run evolution. In the case of the GDP deflator, the chosen specification only includes the changes in nominal wages and in external prices. This equation has been calibrated in order to ensure a smooth convergence path. This was due to the substantially oscillating path obtained when we let the data freely determine the parameters. We think this is not a characteristic of the Spanish economy but a property of the data, as they are the trend-cycle signal.[14] The counterpart of this smooth path of convergence is that the statistics of the residuals can be substantially improved.

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[12] This value is the sample average of the ratio of employment compensation to value added in nominal terms. Employment compensation is calculated imputing employee wages to self-employment.

[13] The estimated long-run price equation also contains a logarithmic trend dummy starting in 1986. To simplify notation it is not presented in Table 3.1.

[14] The trend-cycle signal, as opposed to the seasonally adjusted signal, not only removes the seasonal component of the observed time series but also the more erratic movements. This substantially reduces the variability of the time series, prompting significant econometric difficulties when they are used in regression analysis. For a detailed study of these subjects see, for example, Maravall (1993 and 1994).

TABLE 3.1. VALUE ADDED DEFLATOR, EMPLOYMENT AND INVESTMENT

Long-run relationships:

$$p^* + \log(1 - TX_I) = 0.72\,(0.97 + 0.48\,(y - k) - 0.004\,T + w) + 0.28\,(e + p_f^*)$$

$$\sigma(\%) = 1.83;\ DW = 0.22;\ ADF = -3.27$$

$$n^* = 1.59 + 1.48\,y - 0.48\,k - 0.0041\,T$$

$$\sigma(\%) = 2.86;\ DW = 0.03;\ ADF = -2.04$$

$$ksr^* = 0.68\left[1.09 + 1.48\,yer + (wun - cc0) - 0.004\,T\right]$$

$$\sigma(\%) = 21.89;\ DW = 0.70;\ ADF = -4.63$$

Dynamic Specifications:

$$\Delta\left(p + \log\left(1 - TX_I\right)\right) = \underset{(-)}{-0.00} + \underset{(-)}{0.45}\,\Delta w + \underset{(-)}{0.12}\,\Delta w_{-1} + \underset{(-)}{0.10}\,\Delta w_{-2} + \underset{(-)}{0.03}\,\Delta w_{-3} + \underset{(-)}{0.10}\left[\Delta(e + p_f^*) + \Delta(e + p_f^*)\right]$$

$$\underset{(-)}{-0.07}\,(p - p^*)_{-1}$$

$$R^2 = -;\ \sigma(\%) = 2.47;\ DW = 0.42;\ LM(1) = 66.41;\ LM(4) = 16.16;\ AR(4) = 5.01;\ JB(2) = 2.81;\ HD(1) = -$$

$$\Delta n_P = \underset{(-4.37)}{-0.00} + \underset{(8.22)}{0.87}\,\Delta n_{P-1} - \underset{(-4.57)}{0.39}\,\Delta n_{P-2} + \underset{(6.03)}{0.43}\,\Delta y - \underset{(-1.87)}{0.05}\left[\Delta\left(w - p - \log(1 - TX_I)\right) + \Delta\left(w - p - \log(1 - TX_I)\right)_{-1}\right]$$

$$\underset{(-3.83)}{-0.06}\,(n - n^*)_{-1}$$

$$R^2 = 0.96;\ \sigma(\%) = 0.15;\ DW = 1.68;\ LM(1) = 2.33;\ LM(4) = 1.84;\ AR(4) = 0.32;\ JB(2) = 2.28$$

$$\Delta i_P = \underset{(-2.53)}{-0.07} + \underset{(5.52)}{0.51}\,\Delta i_{P-1} + \underset{(5.55)}{2.87}\,\Delta y - \underset{(-1.62)}{0.96}\,\Delta y_{-1} - \underset{(-2.19)}{0.02}\left[\Delta\left(p_K - p - \log\left(1 - TX_I\right)\right)_{-2} + \Delta\left(p_K - p - \log\left(1 - TX_I\right)\right)_{-4}\right]$$

$$\underset{(-2.31)}{-0.04}\,(i - k^*)_{-1}$$

$$R^2 = 0.89;\ \sigma(\%) = 0.85;\ DW = 1.69;\ LM(1) = 2.00;\ LM(4) = 2.19;\ AR(4) = 0.75;\ JB(2) = 1.34$$

Notes: σ, residual standard deviation; DW, Durbin-Watson statistic; ADF, Augmented Dickey-Fuller statistic; LM(i), autocorrelation order i statistic of the residuals; AR(i); Heteroscedasticity test for the residuals type ARCH order i; JB, Bara-Jarque test of normality; HD, Dynamic homogeneity test. t-ratios between brackets. Estimation period: 1981:1-1996:4.

In the case of employment, we prefer to model only the demand of the private sector (N_P), considering government employment (N_G) as an exogenous variable. The course of both GDP and real wages has an impact on the employment path, and the estimated error-correction parameter is significant. The residual diagnostic tests seem to be satisfied at the standard levels. The long-run solution for capital stock is going to be the error correction mechanism for investment. As the capital stock is the cumulative sum of past investment[15],

[15] In particular, investment is expressed as: $I = K - (1 - \delta)K_{-1}$.

in the long-run equilibrium the ratio of gross investment to capital stock is a constant that captures the depreciation rate and the steady-state growth rate of production. As in the previous case we prefer to model only private investment (I_P=I-I_G) in the short run, leaving government investment (I_G) as an exogenous variable. Empirically, an overshooting effect of GDP is estimated, and the real user cost of capital is negative and significant. While the parameter estimate for the error correction term is not very significant, the residual diagnostic tests do not show major problems.

3.1.2. The nominal wage rate

In the ES-MCM block average compensation per head is used as a measure for the nominal wage rate. In addition to wages and salaries, therefore, it also includes employers' social security contributions. The wage equation can be rationalised by a bargaining process where trade unions and firms negotiate the wage the workers are to receive, leaving firms the right to decide the level of employment they are going to hire. Assuming that firms try to maximise their profit and trade unions the utility of their members (a weighted average of the utility of the workers that are employed and those that are unemployed, where the weight depends on the probability of being employed), the joint optimisation provides the following expression for wages:

$$w = p + \log(1 - TX_I) + y - n - \varphi_1 U + \varphi_2 RR + \varphi_3 \log(1 + TX_F) + \varphi_4 (p_c - p - \log(1 - TX_I)) \quad [3.6]$$

where U is the unemployment rate, RR the replacement ratio (i.e. the ratio of unemployment benefits to wages), TX_F the income tax rate (including CX_F, the social contributions tax rate) and P_C the private consumption deflator.

This expression captures the idea that nominal wages should move in line with nominal labour productivity, but some other variables can generate short-term departures from that rule. For example, a reduction in the unemployment rate induces a fall in the probability of being unemployed, so wages will tend to increase; a more generous policy of transfers to unemployment increases the reservation wage, raising wage pressure once more. The other two variables capture the difference between the labour cost from the firm's perspective and workers' take-home wages. As can be seen, this gap includes direct and indirect taxation and imported inflation (notice that the consumption deflator includes imported goods contrary to the value added deflator). This equation, combined with that which determines the value added deflator [3.5], allows us to define a NAIRU equalising their implicit labour income shares. The NAIRU will be a function of the mark-up (i.e. competitiveness), the replacement ratio and tax rates.

TABLE 3.2. NOMINAL WAGE

Long-run relationship:

$$w^* = -0.73 + p + \log(1 - TX_I) + y - n - 1.04\,U + 0.86\ln(1 + CX_S)$$

$$\sigma(\%) = 2.03;\ DW = 0.16;\ ADF = -3.15$$

Dynamic Specification:

$$\Delta w = \underset{(1.10)}{0.01} + \underset{(7.78)}{0.65}\,\Delta w_{-1} + (1 - 0.65)\Delta p_C - \underset{(-3.52)}{0.12}(w - w^*)_{-1}$$

$$R^2 = 0.58;\ \sigma(\%) = 0.51;\ DW = 1.67;\ LM(1) = 2.53;\ LM(4) =;\ AR(4) = 2.71;\ JB(2) = 56.60;$$

Notes: See previous table.

In Table 3.2 we present the results obtained for this variable. In the long run, the unemployment rate was, in addition to nominal productivity, crucial to setting a co-integrating vector and its sign was negative, as predicted by the theory. Also, the social security contribution rate was found to be significant, appearing in the estimated long-run equation with a positive coefficient below 1. This implies that workers do not totally protect their wages from the increases in these taxes. These results are in line with those obtained in Estrada et al. (2000). As in the case of the GDP deflator, the estimated dynamic wage equation with the best residual properties generated quite a complicated adjustment path to the long-run equilibrium. The current equation, which proved to work better in the full model simulations, is a somewhat simplified version of that equation.

3.1.3. Other demand deflators

In the long run, the deflators (net of indirect taxes) for the demand components other than those included in the trade block are modeled as accounting quasi-identities as a weighted average of the GDP deflator (net of indirect taxes) and the import deflator (P_M). This captures the idea that these goods and services include not only domestic but also imported products. Obviously, the weight of each component will depend on the share accounted for by each product in the corresponding aggregate. As can be seen in the Table 3.3, the bigger impact of the import deflator is estimated in the private investment deflator (P_{PI}), followed by government investment (P_{GI}), private and government consumption (P_C and P_G, respectively). The residuals of the four equations seem to behave as stationary variables (perhaps in the case of the private investment deflator the ADF test is somewhat low). In the short term we impose dynamic homogeneity (i.e. in the medium term the nominal shocks are fully transmitted), and this is not rejected by the data. Besides, the four error correction mechanisms enter with a negative sign that is significant enough (apart from the private investment deflator).

TABLE 3.3. CONSUMPTION AND INVESTMENT DEFLATORS

Long-run relationships:

$$p_C^* + \log(1 - TX_{IC}) = -0.04 - 0.01S8592 + 0.92(p + \log(1 - TX_I)) + 0.08\,p_M$$
$$\sigma(\%) = 3.29;\ DW = 0.88;\ ADF = -4.57$$

$$p_G^* + \log(1 - TX_{IG}) = 0.08 + 0.04I864 + 0.96(p + \log(1 - TX_I)) + 0.04\,p_M$$
$$\sigma(\%) = 1.22;\ DW = 0.42;\ ADF = -4.03$$

$$p_{PI}^* + \log(1 - TX_{IPI}) = 0.10 + 0.03S8691 + 0.76(p + \log(1 - TX_I)) + 0.24\,p_M$$
$$\sigma(\%) = 1.22;\ DW = 0.35;\ ADF = -2.31$$

$$p_{GI}^* + \log(1 - TX_{IGI}) = 0.04 + 0.03S8592 + 0.80(p + \log(1 - TX_I)) + 0.20\,p_M$$
$$\sigma(\%) = 1.12;\ DW = 0.83;\ ADF = -5.86$$

Dynamic Specifications:

$$\Delta(p_C + \log(1 - TX_{IC})) = \underset{(0.28)}{0.00} + \underset{(4.67)}{0.32}\,\Delta(p_C + \log(1 - TX_{IC}))_{-1} - \underset{(-3.25)}{0.24}\,\Delta(p_C + \log(1 - TX_{IC}))_{-2}$$
$$+ \underset{(14.17.)}{0.71}\,\Delta(p + \log(1 - TX_I)) + \underset{(2.42)}{0.14}\,\Delta(p + \log(1 - TX_I))_{-3} + \underset{(-)}{0.08}\,\Delta p_M - \underset{(-4.26)}{0.44}(p_c - p_c^*)_{-1}$$

$$R^2 = 0.99; \sigma(\%) = 0.22; DW = 1.77; LM(1) = 2.74; LM(4) = 1.32; AR(4) = 0.59; JB(2) = 6.31; HD(1) = 0.02$$

$$\Delta(p_{GC} + \log(1 - TX_{IG})) = -\underset{(-0.25)}{0.00} + \underset{(4.35)}{0.32}\,\Delta(p_{GC} + \log(1 - TX_{IG}))_{-1} + \underset{(-.)}{0.68}\,\Delta(p + \log(1 - TX_I))$$
$$- \underset{(-2.30)}{0.14}(p_{GC} - p_{GC}^*)_{-1}$$

$$R^2 = 0.73; \sigma(\%) = 0.59; DW = 1.28; LM(1) = 10.75; LM(4) = 3.55; AR(4) = 4.46; JB(2) = 1.21; HD(1) = 1.22$$

$$\Delta(p_{PI} + \log(1 - TX_{IPI})) = -\underset{(-2.21)}{0.00} + \underset{(7.13)}{0.59}\,\Delta(p_{PI} + \log(1 - TX_{IPI}))_{-1} - \underset{(-3.66)}{0.27}\,\Delta(p_{PI} + \log(1 - TX_{IPI}))_{-2}$$
$$+ \underset{(8.29.)}{0.58}\,\Delta(p + \log(1 - TX_I)) + \underset{(-)}{0.10}\,\Delta p_{M-1} - \underset{(-1.73)}{0.08}(p_{PI} - p_{PI}^*)_{-1}$$

$$R^2 = 0.97; \sigma(\%) = 0.42; DW = 1.72; LM(1) = 1.67; LM(4) = 1.13; AR(4) = 2.19; JB(2) = 4.84; HD(1) = 0.11$$

$$\Delta(p_{GI} + \log(1 - TX_{IGI}))_{-1} = -\underset{(-0.23)}{0.00} + \underset{(5.36)}{0.43}\,\Delta(p_{GI} + \log(1 - TX_{IGI}))_{-1} + \underset{(5.89.)}{0.43}\,\Delta(p + \log(1 - TX_I))$$
$$+ \underset{(-)}{0.14}\,\Delta p_{M-1} - \underset{(-4.18)}{0.37}(p_{GI} - p_{GI}^*)_{-1}$$

$$R^2 = 0.93; \sigma(\%) = 0.63; DW = 2.16; LM(1) = 0.89; LM(4) = 1.47; AR(4) = 0.47; JB(2) = 1.68; HD(1) = 0.03$$

Notes: See previous Table; *S8592*, *S8691*, truncated step dummies; *I864*, impulse dummy; TX_{IC}, TX_{IG}, TX_{IPI}, TX_{IGI}, effective indirect tax rates on private and government consumption and investment, respectively.

3.2. The behaviour of households

The households sector only includes one behavioural equation for private consumption, since we do not consider housing investment separately. The model also considers an equation for labour supply and the definition of disposable income and financial wealth.

According to the life-cycle hypothesis, the first-order conditions of the optimisation problem of the representative consumer imply that the current level of consumption (*C*) is determined by permanent income and the real interest rate. Moreover, permanent income is the sum of wealth (*V*) and the discounted value of future labour income. Assuming backward-looking expectations and following the suggestions of Muellbauer and Lattimore (1995), we specify the following equation for private consumption:

$$c = y_d + \alpha \frac{V}{Y_d} - \sigma r_{Lr} \qquad [3.7]$$

where Y_d is real household disposable income and r_{Lr} the real interest rate (ex-post long-term). Real disposable income is equal to nominal disposable income (Y_{Nd}) deflated by the private consumption deflator. Nominal disposable income is defined as follows:

$$Y_{Nd} = W \cdot N + TR_F + OI_F - T_F \qquad [3.8]$$

where TR_F are transfers from government, OI_F other personal income (that evolves with the net operating surplus of the whole economy, including interest payments plus the income from property)[16] and T_F direct taxes including social contributions. The wealth variable captures the assets of the private sector, so it includes the private capital stock (K-K_G, total capital stock except that of the public sector), public debt and net foreign assets:

$$V = (K - K_G) + \frac{B + F}{P_C} \qquad [3.9]$$

Finally, the equation for changes in the labour force (N_f) establishes that the participation rate is positively correlated with the process of employment creation to capture the degree of tightness of the labour market.

[16] The expression for this variable is very similar to that used in sub-section 2.1. In particular the expression used is the following: $OI_F = -102.25 + 0.38(GOS - \delta P_I K_{-1} + r_{L-1}(B + F)) + 0.02 P_I K$, where GOS is the gross operating surplus, B public debt and F net foreign assets. Unlike in the presentation of 2.1, the estimated equation assumes that firms use part of the net operating surplus for internal financing of investment. In addition, the imputed housing income component of the net operating surplus is linked to the total capital stock, being a proxy for the housing stock.

In the upper panel of Table 3.4 we present the long-run estimation of private consumption in the Spanish economy. As can be seen, we have imposed a coefficient of one with respect to disposable income and the ratio of wealth to disposable income has a positive impact, as expected. The implicit elasticity for wealth is 0.25, well in line with other studies of the Spanish economy (Estrada and Buisan [1999]). In addition, there is a new variable (*DF*). This variable is a truncated step dummy that tries to capture the impact of the deregulation of the financial system. The real interest rate was included in the short term, as it is a stationary variable. The ADF test shows that this can be considered a cointegrating vector.

TABLE 3.4. PRIVATE CONSUMPTION AND LABOUR SUPPLY

Long-run relationship:

$$c^* = -0.34 + 0.03DF + y_d + 0.02\frac{V}{Y_d}$$

$$\sigma(\%) = 1.27;\ DW = 0.46;\ ADF = -4.32$$

Dynamic Specification:

$$\Delta c = \underset{(5.36)}{-0.01} + \underset{(5.43)}{0.01}\Delta_3 DF + \underset{(7.96)}{0.26}\Delta_3 y_d - \underset{(-3.93)}{0.22}(r_{Lr-1} + r_{Lr-4}) - \underset{(-4.81)}{0.33}\Delta p_c - \underset{(-6.89)}{0.30}(c - c^*)_{-3}$$

$$R^2 = 0.65; \sigma(\%) = 0.39; DW = 0.84; LM(1) = 33.40; LM(4) = 9.23; AR(4) = 0.73; JB(2) = 7.60$$

$$n_f = \underset{(2.86)}{1.93} + \underset{(14.34)}{0.73}n_{f-1} + \underset{(2.95)}{0.001}T + \underset{(1.61)}{0.06}n$$

$$R^2 = 0.99; \sigma(\%) = 0.26; DW = 0.84; LM(1) = 192.69; LM(4) = 50.34; AR(4) = 10.87; JB(2) = 10.12$$

Notes: See previous table; *DF*: truncated step dummy.

In the short run, apart from the error correction mechanism (that enters with a negative significant coefficient), the growth rate of real disposable income, the real interest rate (with a negative impact) and inflation (capturing the erosion in wealth) are relevant for explaining private consumption. In any case, the residual tests show that a lot of autocorrelation remains. As in previous cases, the problem lies in the trend-cycle nature of the data, which implies a highly oscillating path to the long run when we try to adjust the remaining correlation in the residuals.

The labour force equation includes a trend, capturing the growth rate in working population (it implies annual growth of 0.2%) and employment, that enters, as expected, with a positive sign in line with the discouraged-worker hypothesis. The residual tests show that some structure remains.

3.3. Inventory investment

Inventory investment (*SR*) is treated as a single aggregate in the ES-MCM block. The derivation of the inventory equation is based on the assumption that quadratic increasing costs are associated with the deviations by actual output from the normal level (Y^N) determined by a production function with normal input intensities, and the deviations by inventories from the desired level (LSR^*). Application of dynamic optimisation to this problem [as shown, for instance, in Willman et al. (2000)] yields the following equation for inventory investment:

$$\Delta SR = \sum_{i=0}^{k} a_i \left(\Delta SAL_{-i} - b\Delta Y_{-i}^{N} \right) - \lambda \left(SR_{-1} - \Delta LSR^{*} \right) \qquad [3.10]$$

The variable (*SAL*) refers to the sales of storable goods and as a proxy for it we use the sum of private consumption and exports (*X*). Since on the production side we are not able to disaggregate production into storable and non-storable goods, we scale total output (and the corresponding normal level), with the help of calibration parameter *b,* to the average level of the *SAL* variable. The buffer-stock role of inventories would imply negative value for a_0, whilst with $i \geq 1$ we would expect non-negative values for a_i reflecting -for example- the adjustments of raw material inventories to changes in sales-induced production. It is, however, the change in desired stocks of inventories which determines the level of inventory investment in the long run. The optimal level of inventories is specified as:

$$LSR^{*} = \left(c + d\ r_{Sr} \right) Y^{N} \qquad [3.11]$$

where r_{Sr} is the real interest rate relevant for inventories. Equation [3.11] relates desired inventories to the normal level of production, with the ratio of desired inventories to normal output depending negatively on the real interest rate. We estimate the parameter *c* from actual data allowing an additional constant to account for the initial value problem in our data. The parameter *d*, in turn, was estimated in the context of dynamic equation [3.10]. Estimation results are presented in Table 3.5. We see that the long-run equation estimated between the stock of inventories and normal output implies co-integration. According to the estimated dynamic equation the buffer-stock effect of current-period sales on inventory investment cannot be observed in the Spanish data. Instead, the lagged change in sales has a positive (although not statistically significant) effect on inventory investment. The estimated equation also confirms the negative link between the real interest rate and the desired level of inventories.

TABLE 3.5. INVENTORY INVESTMENT
Long-run relationship: $LSR^{*} = 585.15 + 1.09\ Y^{N}$ $\sigma = 371.9;\ DW = 0.06;\ ADF = -3.38$
Dynamic Specification: $\Delta SR = \underset{(1.0)}{0.03}\left(\Delta SAL_{-1} - 0.865\Delta Y^{N}_{-1}\right) - \underset{(-2.4)}{0.10}\,\Delta_4\left(r_{Sr-1}\,Y^{N}_{-1}\right) - \underset{(-6.1)}{0.20}\left(SR_{-1} - \Delta LSR^{*}_{-1}\right)$ $R^2 = 0.39; \sigma = 9.1; DW = 0.53; LM(1) = 37.83; LM(4) = 43.71; AR(4) = -; JB(2) = 0.46$
Notes: See previous table

3.4. The Trade block

The estimated trade block in the Spanish MCM is not quite standard and it departs somewhat from that estimated for the other countries. The reason lies in the somewhat surprising properties of those equations when estimated in a traditional way: the demand elasticity of the import volume equation is estimated at close to two and, if the unity constraint is imposed, it significantly worsens the statistical properties of the estimated equation. Standard equations for export volume and export price do not seem very mutually compatible; at the same time, there is a very low effect of domestic prices on export prices (implying highly competitive export markets), and a very low impact of relative export prices on the volume of exports. Therefore, export volume and price equations are estimated as a system containing parameter constraints across equations (for a review of the traditional modelling of Spanish imports and exports, see Escribano [1999] or García and Gordo [1998]).

As a whole, this block includes four behavioural equations (import and export volumes and prices), the definition of the different explanatory factors (the external prices and the demand indicators) and the accounting relations that allow us to obtain net foreign assets.

3.4.1. Import volume and deflator

To model the volume of imports (*M*) it is assumed that, within each category of demand (private and government consumption, investment and exports), imports are substitutes for domestic production but they are not substitutes across demand categories (i.e. you can substitute imported private consumption goods for domestic private consumption goods but not for domestic investment goods). Hence, the AIDS demand system (see Deaton and Muellbauer [1980]) implies the following relation for imports in each demand category*:*

$$\frac{P_M \cdot M_i}{P_{FDi} \cdot FD_i} = \alpha_i + \gamma_i \log\left(\frac{P_{FDi}}{P_M}\right) + \beta_i \log\left(\frac{FD_i}{\bar{FD}_i}\right) \qquad [3.12]$$

where i refers to demand category (i= 1,2..,n), FD_i is the expenditure of domestic and imported goods in demand category i and P_{FDi} is the corresponding deflator of expenditure. $\bar{FD}_i$ is a scaling factor equal to the sample average of FD_i.

Equation [3.12] implies unit price and activity elasticities if $\gamma_i = \beta_i = 0$, greater than unit elasticities if $\gamma_i > 0$ and $\beta_i > 0$, and, in the opposite case, smaller than unit elasticities. Parameter α_i is the import share in expenditure category i in the benchmark year. Denote:

$$E_{MRi} = \alpha_i \frac{P_{FDi}}{P_M} FD_i \qquad [3.13]$$

$$E_{MR} = \sum_1^n E_{MRi} = (\alpha_1 C_N + \alpha_2 G_N + \alpha_3 I_N + \alpha_4 X_N)/P_M \qquad [3.14]$$

$$p_{MD} = \log P_{MD} = \sum_1^n \frac{E_{MRi}}{E_{MR}} \log P_{FDi}$$

$$= \alpha_1 \frac{C_N}{E_{MR}\, P_M} p_C + \alpha_2 \frac{G_N}{E_{MR}\, P_M} p_G + \alpha_3 \frac{I_N}{E_{MR}\, P_M} p_I + \alpha_4 \frac{X_N}{E_{MR}\, P_M} p_X \qquad [3.15]$$

where C_N, G_N, I_N and X_N are the nominal counterparts of the corresponding variables, E_{MR} is the demand indicator for imports (equal to imports in the benchmark year) and P_{MD} is the import content weighted index of domestic demand. Let it be further assumed that price and income elasticities are equal across demand categories, i.e. in equation $\gamma_i/\alpha_i = k$ and $\beta_i/\alpha_i = b$ in all demand categories. After aggregating [3.12] across import categories, the following relation for aggregated import volume can be derived:

$$m - e_{MR} = b\, e_{MR} - k\,(p_{MD} - p_M) \qquad [3.16]$$

These definitions imply that the elasticities with respect to demand and relative prices in the equation [3.16] are (1+b) and -(1+k). As usual, the dynamic specification will include the residuals of the former equation as an additional explanatory factor.

The equation for the import deflator is quite traditional. It depends on the GDP deflator net of indirect taxes (to capture possible pricing to market effects), the competitors' import price (P_{CM}) and the energy price (P_{EI}):

$$p_M = \phi_1 (p + \log(1 - TX_I)) + \phi_2 \, p_{CM} + (1 - \phi_1 - \phi_2) \, p_{EI} \qquad [3.17]$$

where we have imposed a static homogeneity condition. The energy price in foreign currency is an exogenous variable and the competitors' import price is defined as follows:

$$P_{CM} = \exp\left[\sum_j w_j^m \cdot p_{XUj}\right] E_X \qquad [3.18]$$

where P_{XU} are the export deflators of our trade partners in US dollars and E_X the peseta-dollar nominal exchange rate; w_j^m denotes the share of total imports from country *j*.

In the upper panel of Table 3.6 we show the long-run specification of these two variables. In the case of real imports we obtain unitary elasticity with respect to the demand indicator and 0.83 with respect to the relative price. The residuals do not show signs of non-stationarity. In the case of the deflator, the domestic prices were not relevant, so they are mainly determined by import competitor prices and the estimated elasticity for oil prices is quite similar to the share of these kinds of imports in total imports. The nominal homogeneity condition is met but the stationarity test is not very satisfactory.

TABLE 3.6. IMPORT VOLUME AND DEFLATOR

Long-run relationship:

$$m^* = -0.03 + e_{MR} - 0.17\,(p_M - p_{MD})$$
$$\sigma(\%) = 6.02;\ DW = 0.86;\ ADF = -3.52$$

$$p_M^* = -0.04 + 0.82\,p_{CM} + 0.18\,p_{EI}$$
$$\sigma(\%) = 3.75;\ DW = 0.36;\ ADF = -2.47$$

Dynamic Specification:

$$\Delta m = \underset{(-2.01)}{-0.01} + \underset{(5.92)}{0.60}\,\Delta m_{-1} - \underset{(-4.62)}{0.54}\,\Delta m_{-2} + \underset{(7.73)}{1.87}\,\Delta e_{MR} - \underset{(-1.84)}{0.73}\,\Delta e_{MR-1} + \underset{(2.64)}{0.94}\,\Delta e_{MR-2}$$
$$- \underset{(-3.72)}{0.18}\,\Delta((p_M - p_{MD}) + (p_M - p_{MD})_{-3}) - \underset{(-2.78)}{0.05}(m - m^*)_{-1}$$

$$R^2 = 0.92; \sigma(\%) = 0.63; DW = 1.78; LM(1) = 2.38; LM(4) = 9.49; AR(4) = 1.63; JB(2) = 3.34$$

$$\Delta p_M = \underset{(2.14)}{0.01} + \underset{(12.35)}{0.60}\,\Delta p_{M-1} + \underset{(4.35)}{0.20}\,\Delta p_{CM} + \underset{(4.49)}{0.05}\,\Delta p_{EI} - \underset{(-2.29)}{0.06}\,(p_M - p_M^*)_{-1}$$

$$R^2 = 0.92; \sigma(\%) = 0.79; DW = 1.86; LM(1) = 0.38; LM(4) = 0.47; AR(4) = 0.65; JB(2) = 0.75$$

Notes: See previous table.

In the short-term the changes in real imports are explained by the same variables but the equation shows a slightly complex adjustment path to the long run. Although the t-ratio for the error correction mechanism is not very high, the other tests do not reflect problems in the residuals. On the contrary, the dynamic specification of the import deflator is much simpler, as both determinant factors enter contemporaneously. As in the previous case the t-ratio of the error correction mechanism is not very high, but the residual tests are satisfactory.

3.4.2. Export volume and deflator

The volume of exports and its deflator (X and P_X, respectively) are jointly modelled in order to impose cross-equation constrains that avoid the kinds of incompatibilities detected when two isolated equations are considered. The first-order conditions of an optimising firm that produces export goods, through the combination of labour, capital and imported goods, allow us to write export prices as a mark-up over marginal costs. Assuming that the demand for exports takes an AIDS form, the equation for exports will be:

$$\frac{P_X\ X}{P_{CX}\ MF} = a + b\,mf - \phi\,(p_X - p_{CX}) \qquad [3.19]$$

where P_{CX} are the external competitor export prices and MF the world demand for exports. The advantage of this representation is that the elasticity of the demand, that is, the mark-up in the price equation, is no longer constant but depends on the relative competitor export prices. Thus, substituting in the equation for prices gives:

$$p_X = a' + \frac{1 + (a + b\,mf)/\phi}{2 + (a + b\,mf)/\phi}\,mc_S + \frac{1}{2 + (a + b\,mf)/\phi}\,p_{CX} \qquad [3.20]$$

where MC_S are the short-term marginal costs that can be derived from the supply-side estimation presented previously:

$$mc_S = 0.72\,(1.47 - 0.32\,(k - n) - 0.024T + w) + 0.28\,p_M \qquad [3.21]$$

Equation [3.21] assumes that the import content of exported goods is on average 28%, corresponding to the input-output estimate.

Notice that these two expressions ([3.19] and [3.20]) imply, first, that the demand elasticity of exports need not be one; and second, that there is a constraint among the parameters in the two equations. To finalise, it remains only to define the demand indicator, which is a weighted average of the real imports of the other countries expressed in dollars (M_U, the weights are the shares of the exports to each country):

$$MF = \exp\left[\sum_j w_j^x m_{Uj}\right] \qquad [3.22]$$

and the competitor export prices, which are a weighted average of the other countries' export prices in dollars, but the weights take into account third-market effects:

$$P_{CX} = \exp\left[\sum_j w_j^{x*} p_{XUj}\right] E_X \qquad [3.23]$$

In the upper panel of Table 3.7 we show the joint estimation of the volume and price equations. In the case of real exports we obtain an average demand elasticity of 1.2 and –1.5 with respect to the relative price. The residuals do not show signs of non-stationarity. In the case of the deflator, the domestic prices are slightly more relevant than external prices. The nominal homogeneity condition is met but the stationarity test is not very satisfactory.

In the short-term, the course of real exports is explained by their own behaviour and the adjustment to the long run. The tests on the residuals do not reflect problems in the residuals. On the contrary, the long-run determinants of the export deflator also enter in its dynamic specification, apart from the error correction mechanism.

TABLE 3.7. EXPORT VOLUME AND DEFLATOR

Long-run relationship:

$$X^* = \frac{P_{CX} MF}{P_X}(1.08 + 0.24mf - 0.57(p_X - p_{CX}))$$

$$\sigma(\%) = 5.81;\ DW = 0.87;\ ADF = -3.28$$

$$p_X^* = -1.05 + \frac{1 + (1.08 + 0.24mf)/0.57}{2 + (1.08 + 0.24mf)/0.57} mc_S + \frac{1}{2 + (1.08 + 0.24mf)/0.57} p_{CX}$$

$$\sigma(\%) = 2.48;\ DW = 0.46;\ ADF = -2.80$$

Dynamic Specification:

$$\Delta x = \underset{(4.92)}{0.01} + \underset{(9.72)}{1.01}\Delta x_{-1} - \underset{(-4.98)}{0.49}\Delta mf_{-1} - \underset{(-3.12)}{0.06}(x - x^*)_{-1}$$

$$R^2 = 0.70; \sigma(\%) = 0.72; DW = 1.92; LM(1) = 1.24; LM(4) = 2.73; AR(4) = 1.61; JB(2) = 3.32$$

$$\Delta p_X = \underset{(1.21)}{0.01} + \underset{(6.38)}{0.55}\Delta p_{X-1} + \Delta p_X^* - \underset{(-)}{0.55}\Delta p_{X-1}^* - \underset{(-5.02)}{0.43}\Delta^2 p_X^* - \underset{(-2.01)}{0.07}\Delta en - \underset{(-3.12)}{0.10}(p_X - p_X^*)_{-1}$$

$$R^2 = 0.60; \sigma(\%) = 0.17; DW = 1.82; LM(1) = 0.63; LM(4) = 10.45; AR(4) = 0.52; JB(2) = 5.12$$

Notes: See previous table; EN, effective nominal exchange rate.

3.4.3. Identities and definitions in the trade block

Having obtained real exports and imports and their corresponding deflators, the nominal counterparts (X_N and M_N, respectively) can be readily obtained, and we can define the trade balance of goods and services (TB) as follows:

$$TB = X_N - M_N \qquad [3.24]$$

Adding net foreign income from the rest of the world (OI_W) and transfers from the rest of the world (OT_W) to this balance, we obtain the current account (CA):

$$CA = TB + OI_W + OT_W \qquad [3.25]$$

In this expression transfers from the rest of the world are exogenous, but net foreign income is a fixed proportion of the net foreign assets corresponding to the average interest rate estimated for net interest payments abroad.

$$OI_W = 8.6299\, F_{-1} / 400 \qquad [3.26]$$

Accounting identities define net foreign assets as the cumulative sum of past current accounts implying:

$$F = F_{-1} + CA \qquad [3.27]$$

3.5. The public sector

The role played by the public sector in this model is comparatively modest, as most of the variables included are exogenous, or the result of quasi-identities. In any case, as seen in the previous section, the inclusion of a fiscal rule (i.e. a fiscal variable response when the fiscal constraint is not satisfied) is crucial from the standpoint of the sustainable development of government debt.

As in the previous case, public debt (B) is the cumulative sum of past public deficits (D):

$$B = B_{-1} + D \qquad [3.28]$$

The public deficit is the difference between the receipts and the expenditures of the public sector. The receipts are the following: direct taxes of households (T_F, including social contributions), other direct taxes (T_O, taxes on firms), indirect taxes (T_I), and other public income (OI_G, includes the gross operating surplus). On the expenditure side we have the following items: net transfers (TR_F, includes pensions and so on), net interest payments (IN_G), government consumption and government investment (G_N *and* I_{NG}, both in nominal terms):

$$GD = T_F + T_O + T_I + OI_G - TR_F - IN_G - G_N - I_{NG} \quad [3.29]$$

The strategy to model all these variables is quite similar: an implicit tax rate is calculated on the basis of a tax base (which is an endogenous variable) and the tax rate is left, in general, exogenous. In the case of the direct taxes of households, the tax base (TB_F) is quite close to disposable income (including taxes), although labour income is overweighted because social contributions are only levied on wages.

$$T_F = TX_F \; TB_F \quad [3.30]$$

$$TB_F = 1.16 W \; N + TR_F + OI_F \quad [3.31]$$

The implicit tax rate (TX_F) is not exogenous because the fiscal rule is defined on the basis of this tax rate. The fiscal rule implies that the tax rate will react to the deviations by the public debt-to-nominal GDP (Y_N) ratio from the predetermined target path b^*:

$$\Delta TX_F = 0.0075 \left(\frac{B_{-1}}{Y_{N_{-4}}} - b^{\bullet}\right) \quad [3.32]$$

In the case of other direct taxes the tax base is an approximation to firms' profits (the gross operating surplus of firms $-GOS$-OI_O- minus the depreciation allowances); the tax rate (TX_O) is exogenous:

$$T_O = TX_O \; (GOS - 0.01 P_I \; K_{-1} - OI_O) \quad [3.33]$$

Indirect taxes are calculated as an exogenous implicit tax rate (TX_I) multiplied by a tax base that is nominal GDP:

$$T_I = TX_I \; Y_N \quad [3.34]$$

Concluding with receipts, other public income is left exogenous. On the expenditure side, transfers from government are calculated as an implicit rate for transfers (TRX_F) as a proportion of nominal GDP. The main components of these transfers are payments to retirees and unemployment payments. As only the latter are considered in the model, this implicit transfer rate will only depend on the unemployment rate (U):

$$TR_F = TRX_F \; Y_N \quad [3.35]$$

$$TRX_F = 0.11 + 0.22 U \quad [3.36]$$

Net interest payments are a function of public debt and the long-term interest rate (r_L). However, as in the case of net interest payments abroad, the long-term interest rate was reduced to a constant equal to the historical average of net interest payments to

government debt. This was done to retain symmetry between feedback effects from net government and net foreign interest payments, which in section 2 was shown to be important from the standpoint of the convergence of the model with the stock equilibrium.

$$IN_G = 8.6299\, B_{-1} / 400 \qquad [3.37]$$

and, finally, government consumption and investment in real terms are exogenous (both government employment and wages are also exogenous).

4. Simulation properties of the ES-MCM block

In this section some selected simulation experiments with the ES-MCM block are reported to illustrate the main properties of the empirical model. As in the theoretical analysis of section 2, the assumptions concerning the policy regime try to mimic the current EMU-regime, i.e. nominal interest rates and the exchange rate are held fixed. However, the exogenous nominal interest rate implies that the real interest rate is endogenous which, at least in a closed economy framework, results in unstable dynamics. In the open economy this framework need not be the case, if the price elasticity of foreign trade is high enough. The real interest rate channel may still be problematic by generating excessively cyclical adjustment paths. Crucial in this respect is how inflation expectations are specified, especially in the user cost of capital affecting real investment. The interaction between prices, activity and the real interest rate is stronger the larger the weight of actual and past inflation in determining inflation expectations. In the following simulation exercises the expected inflation rate in the user cost of capital is defined as a weighted average of current inflation and the inflation target of the ECB. Tying inflation expectations partly to the ECB inflation target, although exogenous, introduces a forward-looking element into expectations-formation. The weight 0.25 is used for current inflation and 0.75 for the inflation target. The weights are based on the calibration of the estimated investment equation into the post-estimation period data of 1997Q1-2000Q4.

The following simulations are briefly described in the following pages.

1) A permanent increase in government consumption corresponding to one per cent of GDP

2) A permanent increase of one per cent in world demand

3) A ten per cent increase in world prices

4) An increase of one percentage point in interest rates for 3 years

5) A permanent one per cent increase in the labour force

As was shown in section 2, the long-run responses of the model to alternative shocks are dependent on whether a fiscal closure rule is included or not. Therefore, the government consumption and world demand shocks are run in two fiscal policy regimes, i.e. both in the regime without and with the fiscal closure rule. However, as the closure rule can be defined and parameterised in several alternative ways affecting strongly dynamic adjustment paths, the fiscal closure rule is not applied in the context of other shocks.

Our simulation period covers eighteen years. Although this is not long enough for the full convergence of the model solution with the long-run equilibrium, in most cases the simulations indicate quite well where the long-run solution is settling.

4.1. A government consumption shock

The increase in government consumption is equivalent to a rightward shift in the IS-curve with the LM-curve being horizontal. Hence, we would initially expect an increase in output and employment. We would expect this increase in output to be accompanied by increases in wages and prices, resulting in further shifts in the IS curve. In the long run, as shown in section 2, we would expect both output and the price level to settle above the baseline solution as long as the fiscal rule is not active. This is due to the non-vertical supply curve and the expected positive wealth effect. However, the stock equilibrium in terms of government debt and net foreign assets, which cancel out each other's effect on private wealth, is not attainable in the absence of the fiscal closure rule.

Both panels A of figures 4.1 and 4.2 are, along with the numbers of Table 4.1, well in line with the conclusions presented above. The multiplier effect on GDP reaches its maximum of 2 in the second year after the increase in government consumption. Thereafter, output converges quite smoothly towards its long-run level, standing at 0.8% above the baseline solution at the end of the simulation period. As expected, prices do not react to the demand shock as fast as output but, in the medium run, price effects are significant. The price effect reaches its maximum about three and a half years after the implementation of the government demand shock and, thereafter, the price of output converges to about 1% above the baseline. Panel A of figure 4.2 shows that, as anticipated, the government debt-to-GDP ratio widens and the net foreign assets-to-GDP ratio decreases continuously; nonetheless, they compensate each other in net private sector wealth.

To prevent infinitely widening government debt, the increase in government consumption is accompanied by the fiscal closure rule. There are several alternative ways to specify the fiscal closure rule, but only if the fiscal closure rule is specified in terms of the predetermined target debt ratio will there be no permanent output or price effects as was

argued in section 2.[17] Panel B of figure 4.1 presents the output and price effects of a permanent increase in government consumption and panel B of Figure 4.2 shows the corresponding effects on the government debt-to-GDP, net foreign assets-to-GDP and private sector wealth-to-GDP ratios. In Table 4.2 the effects on some selected variables are presented. We see that during the first 6-7 years, the effects of an increase in government consumption remain almost the same as without the closure rule. Thereafter, instead of stabilising above the baseline level, output and domestic price continue to decrease. As expected, output converges very close to the baseline. Price responses follow a longer cycle and after 18 years domestic price, although rising, is around 0.5% below the baseline. The slow convergence of the price level to the baseline level reflects the slow adjustment of the model to the stock equilibrium. Panel B of Figure 4.2 shows that within the simulation period the model has not attained the stock equilibrium. We see that, on converging towards equilibrium, the financial stock variables follow a cyclical pattern. In fact, our experiments with stronger reactions of the tax rate to the deviations by the debt-to-GDP ratio from the target showed that these cycles are not necessarily moderating. In any event, the present experiment indicates that, if the cycles of the stock adjustment ease, they converge to the baseline levels, implying no permanent activity or price effects.

4.2. One per cent increase in world demand

As in the previous case, a permanent increase in world demand shifts the demand curve to the right (through the expansion of exports), without affecting the supply curve. Thus, if the fiscal rule is not active, both output and prices should be increased in relation to the baseline in the long run. Although the private wealth-to-GDP ratio should stabilise, net foreign assets accumulate unlimitedly and public debt diminishes indefinitely, cancelling each other out. Simulation results presented in the upper panels of figures 4.3 and 4.4 are well in line with this line of reasoning. We can see from Figure 4.3 that, 3 years after the implementation of the shock, GDP has risen 0.2% above the baseline, and seems to stabilise around that level also in the longer run. Prices follow a similar pattern and they seem to converge to a level which is about 0.3% above the baseline level. Figure 4.4, in turn, shows that the private wealth-to-GDP ratio stabilises but, as expected, both the net foreign assets-to-GDP ratio and the government debt-to-GDP ratio perpetually diverge from the baseline (see Table 4.3).

In section 2.3.2 we argued that, unlike in the context of domestic demand shocks, the imposition of the fiscal closure rule tends to strengthen the positive long-run output effects of the foreign demand shock compared to the case without a fiscal closure rule. The rationale is that, via the fiscal rule, the average tax rate decreases and strengthens the appreciation of the real exchange rate. This, in turn, increases the size of the positive

[17] For a comparison of fiscal policy rules see Mitchell, Sault and Wallis (2000).

supply effect in output. The response effects presented in the lower panels of Figures 4.3 and 4.4 are supportive of this argument. In the first three years the responses of activity and prices to this shock are quite similar with and without the fiscal rule, but thereafter the fiscal rule strengthens the output and price level effects. However, full convergence to the long-run equilibrium is not achieved by the end of the simulation period, as reflected, especially, in the oscillating response profiles of the GDP ratios of private net wealth and its components (the lower panel of Figure 4.4 and the Table 4.4).

4.3. Ten per cent increase in world market prices

The model is expected to show the presence of homogeneity in that domestic prices rise by the full extent of the import price shock in the long run. In the absence of no permanent relative price effects, no permanent output effects are expected. A caveat to these conclusions is that without a fiscal closure rule, financial stock variables do not necessarily converge to their baseline levels, resulting in permanent effects on output and relative prices. However, at least within our simulation horizon, the latter channel is insignificant as figure 4.5 and Table 4.5 show. We see that within three years the increase in foreign prices is fully transmitted to the domestic price level. In response to the temporary decrease in the real exchange rate and the real interest rate, the demand for domestically produced goods increases, resulting in around a 5% overshooting in the GDP deflator after 5 years. Thereafter, the domestic price response converges in a slightly oscillating way to the level corresponding to a 10% response effect and output converges to the baseline.

4.4. A temporary increase of one percentage point in interest rates

In this simulation short and long interest rates are increased by one percentage point over three years and, thereafter, they return to the baseline level. No fiscal closure rule is imposed. A temporary shock is selected, because a permanent change in nominal interest rates without allowing the exchange rate (or, alternatively, foreign inflation) to move would result in unstable long-run dynamics, at least from the standpoint of stock equilibrium. The effects of the temporary interest rate shock are presented in Figure 4.6 and in Table 4.6. We see that in the ES-MCM interest rates have marked effects on activity, prices and inflation. The rise in interest rates has its maximum effect on output after about two and a half years from the implementation of the shock. At that point of time output is about 0.8% below the baseline. This is mainly due to investment responses but private consumption also reacts to the increased real interest rate. Likewise, the effects on domestic inflation are at their maximum during the third year after the implementation of the interest rate shock, with the decrease in inflation equal to about half a percentage point. The price level effect peaks after four years as from the shock, equal to about a 1.5% decrease in the price level. We see that, although the interest rate shock is temporary, it has small but quite persistent level effects on activity and the price level also in the longer run. Within the present simulation period output settles at slightly below and the price level at slightly above the

baseline. The negative activity effect reflects the response of the capital stock to the shock. By the end of simulation period the capital stock is about 0.9% below the baseline solution. This, in turn, implies lower productivity and higher price pressures compared to the baseline. However, the gradual rise in the real wealth to GDP ratio and the resulting responses of consumption at the end of the simulation period indicate that the adjustment process towards the long-run equilibrium is incomplete.

4.5. A permanent one per cent increase in the labour force

This shock is a pure supply-side shock and illustrates the strength of the labour market equilibrating mechanism. If the model has a strong tendency towards labour market equilibrium, an increase in the labour force should cause a fall in the real wage rate and a quick increase in employment to full employment. On the basis of our analysis of the simplified steady-state version of the ES-MCM block presented in section 2, we expect, however, below-unit long-run elasticity of output with respect to the labour force. This is due to the fact that although total supply is unit-elastic with respect to the labour force, the elasticity of total demand is below unit. Therefore, in the long-run equilibrium, domestic relative to foreign prices and real wages must decrease, implying in per capita terms a decrease in output. In addition, the dependency of the mark-up on foreign competitors' prices in the ES-MCM block implies that, as a response to a decrease in the relative domestic price, the equilibrium unemployment rate increases and absorbs part of the increased labour supply.

Figure 4.7 and Table 4.7 show that actual simulation results are well in line with expected effects. We see that a major part of the adjustment to the long-run equilibrium materialises within about the first seven years. After 18 years, output has increased almost 0.7% above the baseline level; the domestic price level is around 0.4% and the real production wage rate about 0.3 % below its baseline level. The employment effect seems to converge to around 0.8%, with the permanent rise in unemployment absorbing the rest of the increase in the labour force. We see that both capital stock and real private wealth rise in absolute terms but in per capita terms decrease, when compared to the baseline. These results are also in line with the expected effects.

5. Conclusions

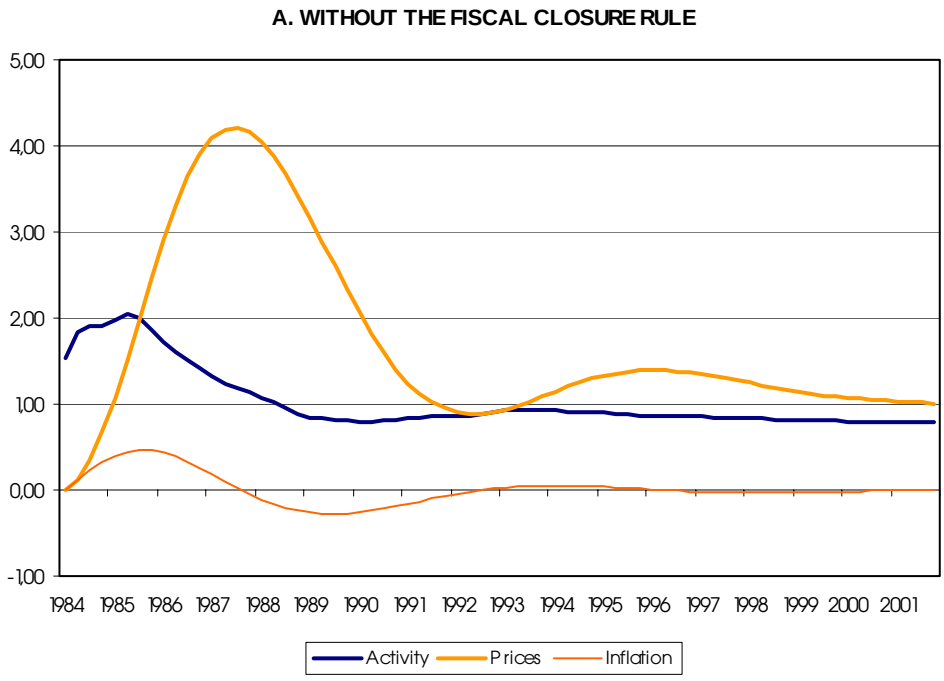
Typically, model development is a continuous process and this is the case also with the ESCB-MCM, including its country block ES-MCM for Spain. This paper could thus be seen as an intermediate report describing the current phase of the work. Hitherto, the main focus has been on building a model, the long-run properties of which are in line with mainstream economic theory, with estimated equations of the model fitting data reasonably well and, in full model simulations, plausible adjustment paths to the long-run equilibrium. In sections 2, 3 and 4 of this report we have shown that the ES-MCM block passes these

criteria satisfactorily. Regarding the estimated equations, the remaining problems relate to the quality of the quarterly data used, which has obliged the inclusion in the model of equations with unsatisfactory autocorrelation properties. Desirably, the new ESA 95 database, which will be used in estimating the next model version, may alleviate somewhat these problems.

Another problem, closely linked to the adjustment dynamics and to policy analysis, concerns the modelling of expectations. The present version of the ES-MCM block is a backward-looking system in which activity, inflation and the real interest rate follow lagged values of each other. Especially in the fixed nominal interest rate regime, this interaction mechanism creates implausibly strong dynamics in the medium run. This is one likely source of the observed quite-high price sensitivity of the ES-MCM block. To tackle this problem the first step would be to separate expectations, especially inflation expectations, from genuine frictional elements in estimated equations. This would allow experiments with alternative expectation formation assumptions, including purely backward-looking expectations e.g. survey-based, learning-based and completely forward-looking model-consistent expectations.

Finally, we think that the inclusion of wealth evaluated at market prices could substantially enrich the model although, at the same time, this would raise many new difficult issues, which would need to be solved satisfactorily. Such issues would, for instance, concern how to endogenise asset prices and how to close the model with households' budget constraint and wealth depending on the 'actual' market value of firms. Additional complications would also arise from the fact that the market value of wealth is denominated partly in domestic currency and partly in foreign currency.

FIGURE 4.1. The effects of a 1% of GDP permanent increase in government consumption on GDP, the GDP deflator and the inflation rate; percentage deviations from the baseline



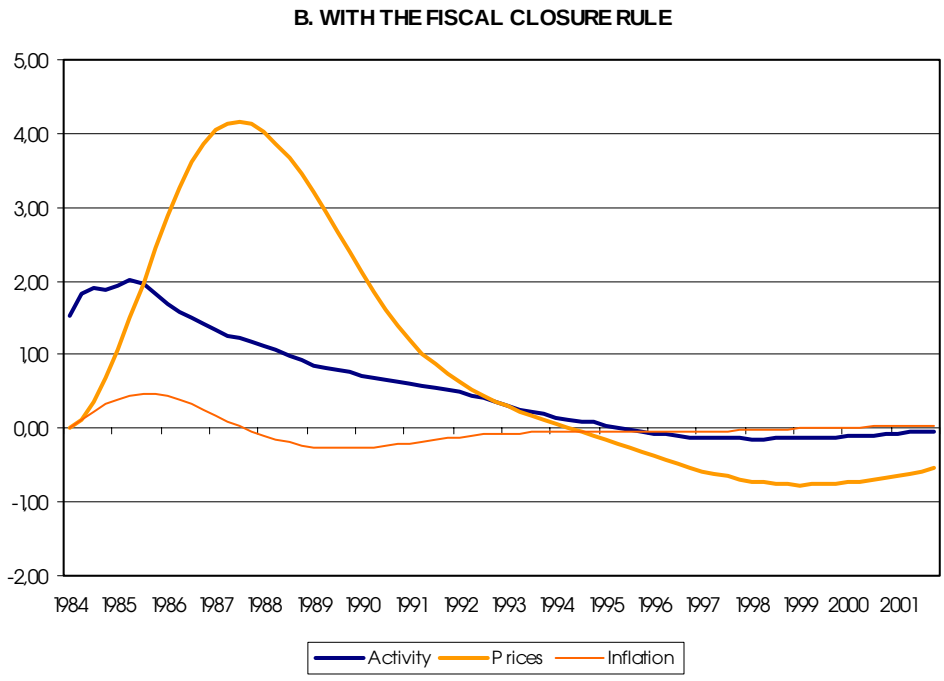
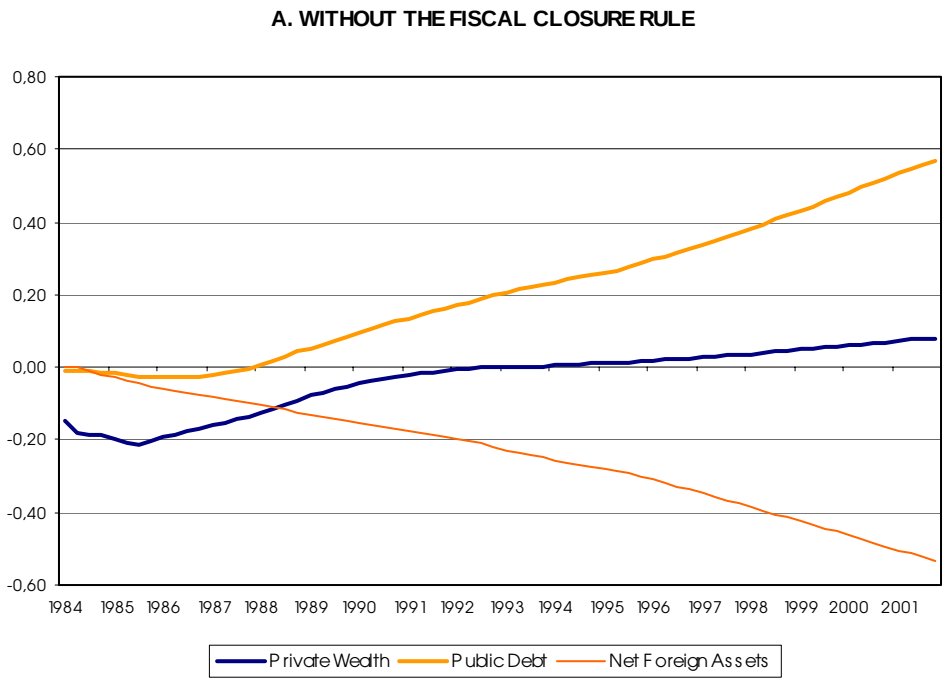


FIGURE 4.2. The effects of a 1% of GDP permanent increase in government consumption on the government debt-to-GDP, net foreign assets-to-GDP and private wealth-to-GDP ratios; absolute deviations from the baseline



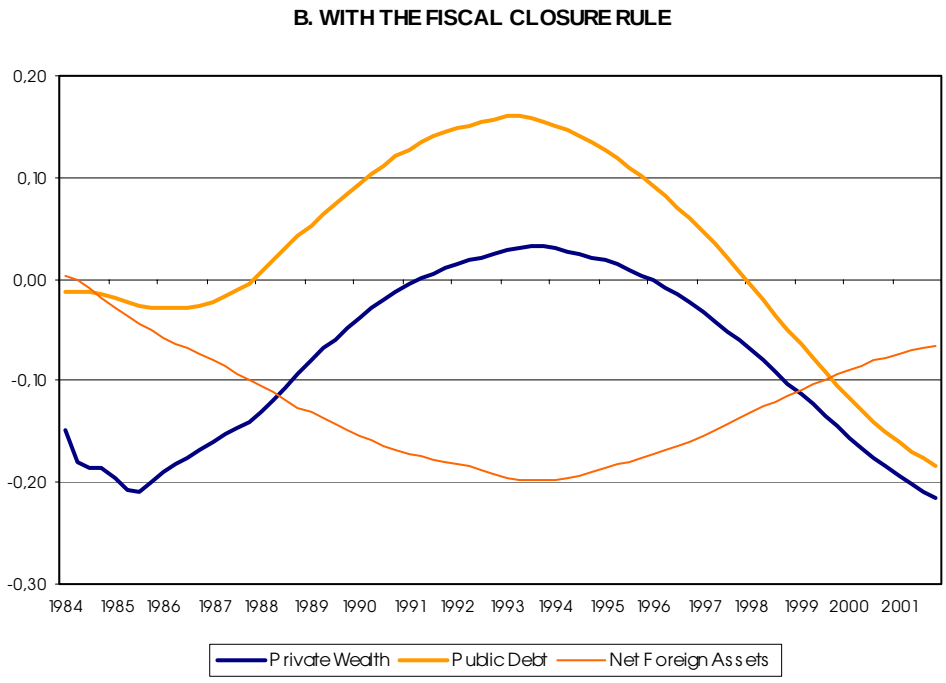
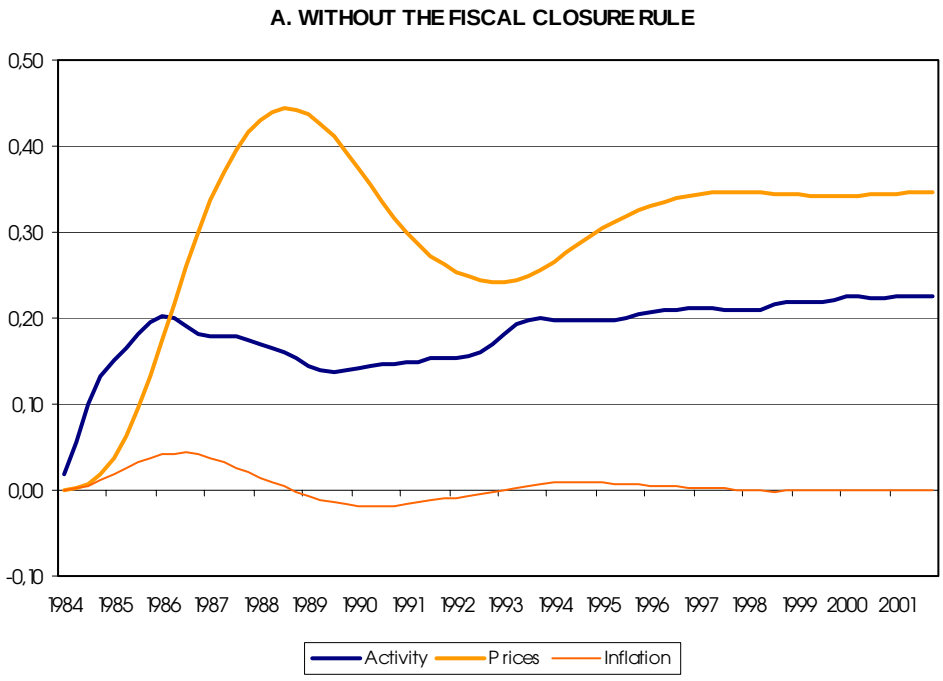


FIGURE 4.3. The effects of a 1% permanent increase in world demand on GDP, the GDP deflator and the inflation rate; percentage deviations from the baseline



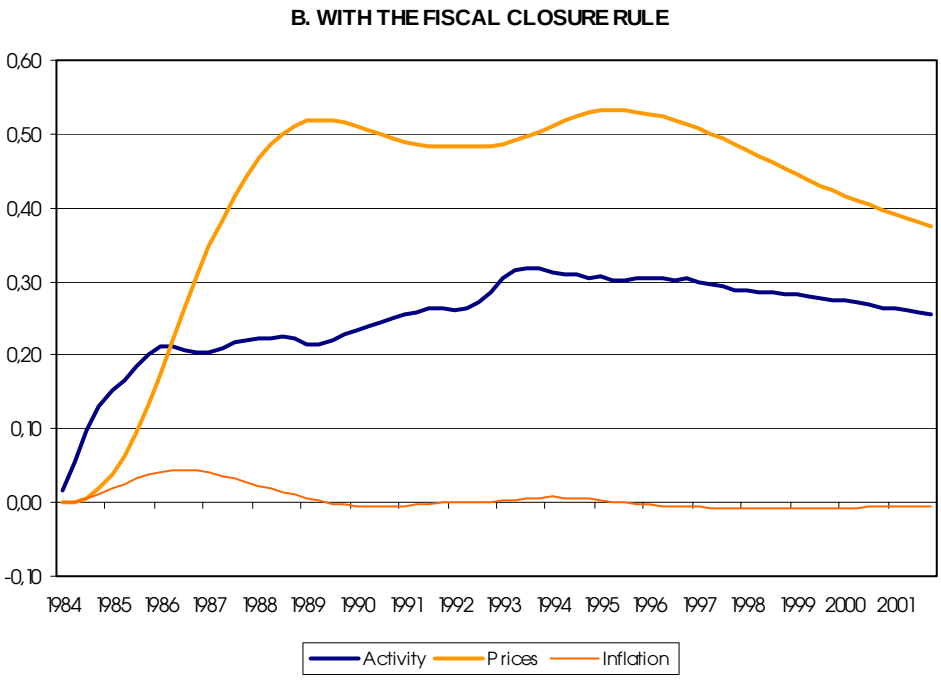
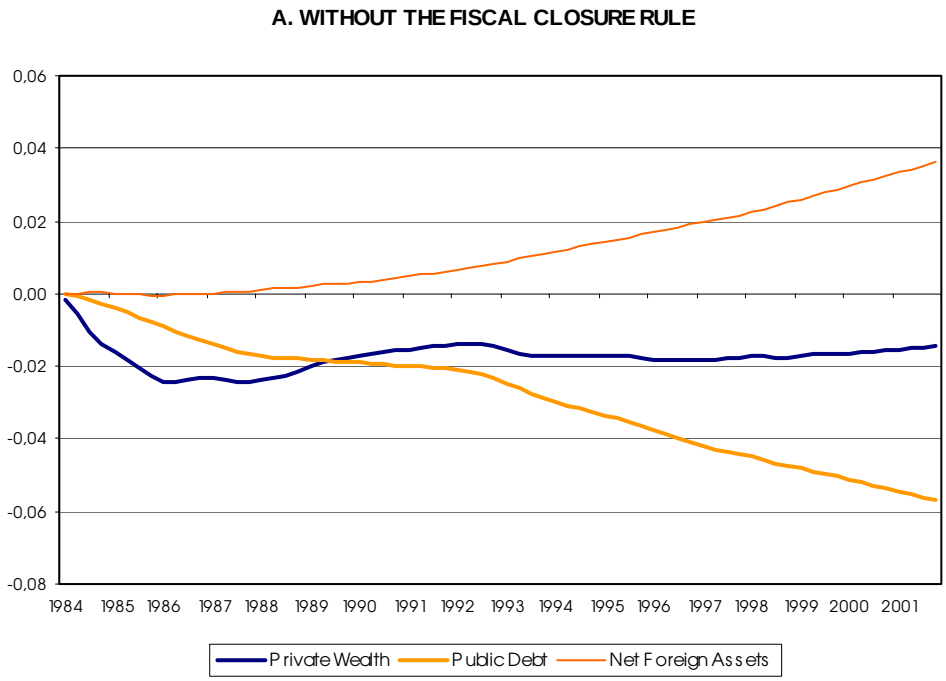


FIGURE 4.4. The effects of a 1% permanent increase in world demand on the government debt-to-GDP, net foreign assets-to-GDP and private wealth-to-GDP ratios; absolute deviations from the baseline



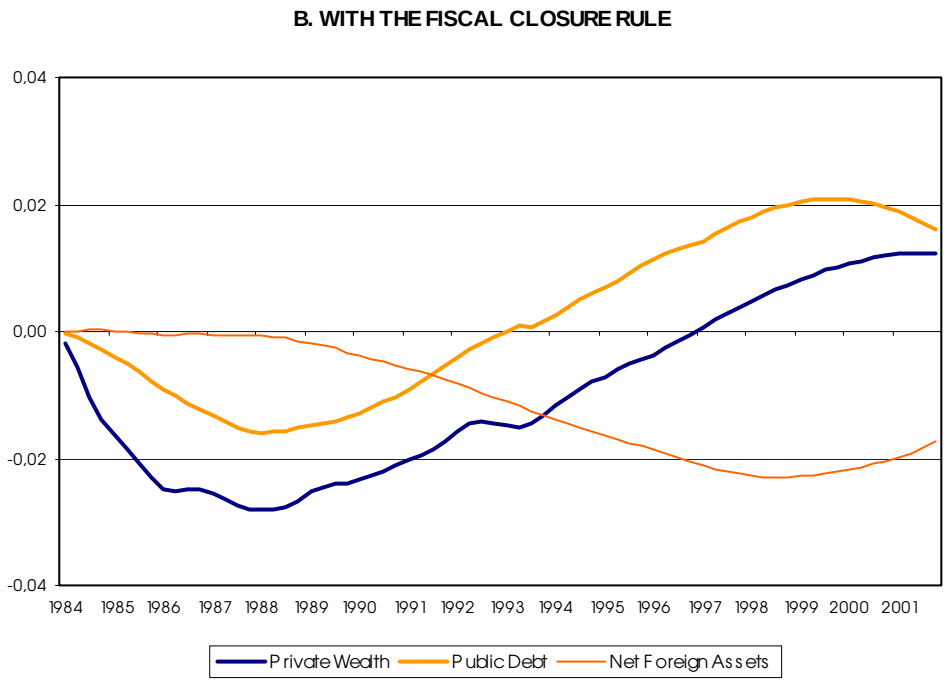


FIGURE 4.5. The effects of a 10% permanent increase in foreign prices on GDP, the GDP deflator and the inflation rate; percentage deviations from the baseline

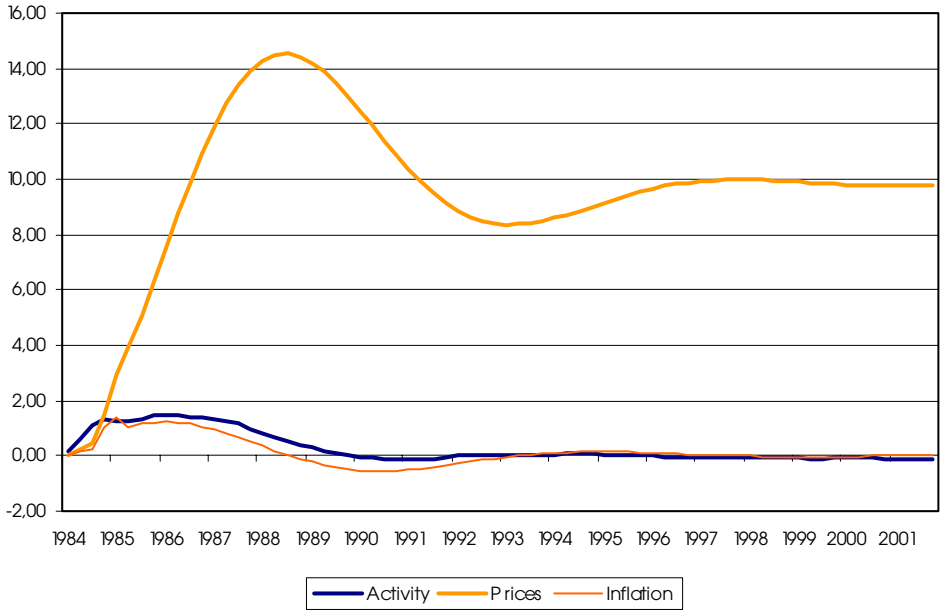


FIGURE 4.6. The effects of a one basis point increase in interest rates over 3 years on GDP, the GDP deflator and the inflation rate; percentage deviations from the baseline

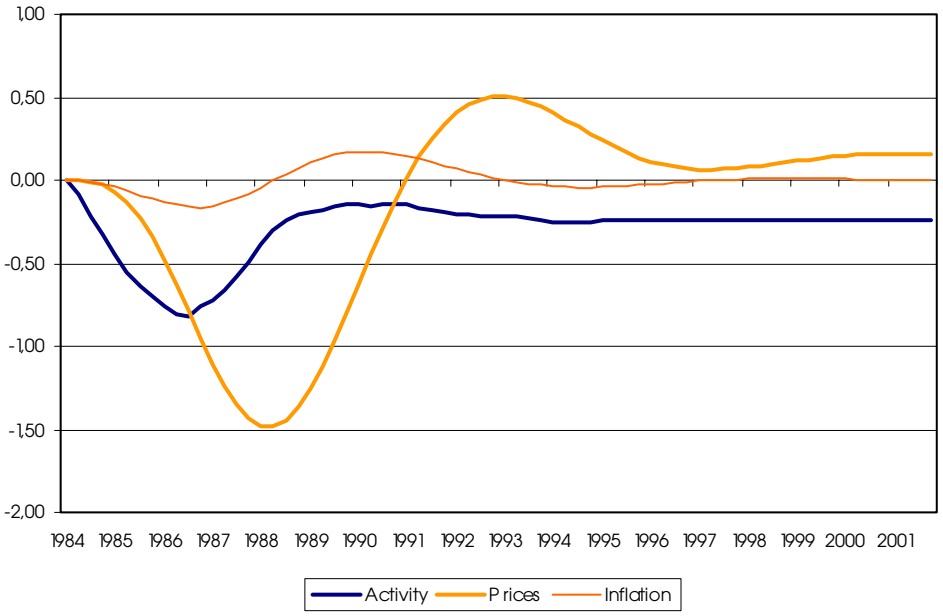


FIGURE 4.7. The effects of a 1% permanent increase in the labour force on GDP, the GDP deflator and the inflation rate; percentage deviations from the baseline

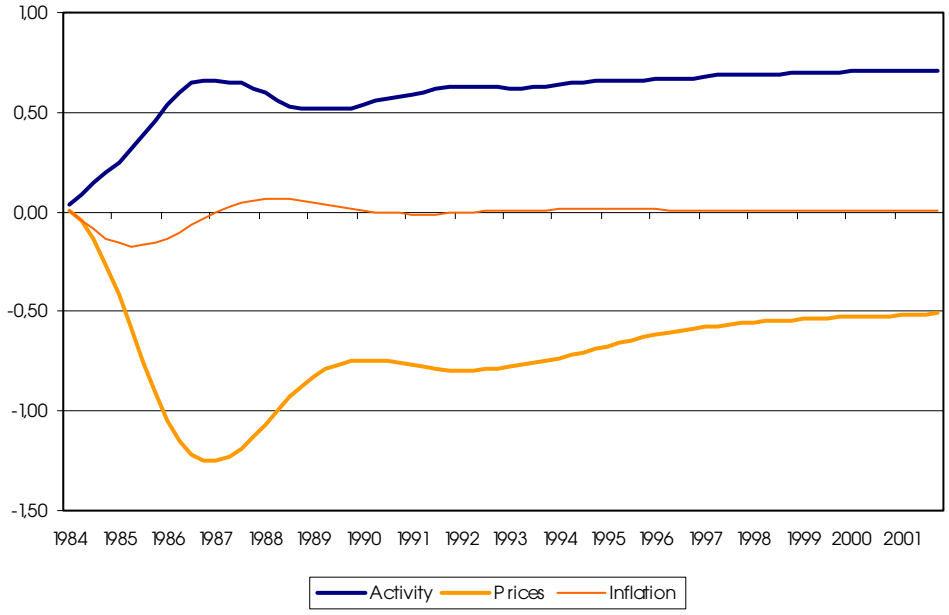


TABLE 4.1

Simulation Results, overview Table: SPAIN MCM: Public Consumption Multiplier Variant: +1% of GDP (without fiscal closure rule)

File: simvge

(deviations from baseline, percentage unless otherwise indicated)

		1984A	1985A	1986A	1987A	1988A	1989A	1990A	1991A	1992A	1993A	1994A	1995A	1996A	1997A	1998A	1999A	2000A	2001A
Economic Activity																			
GDP	E_ES_YER	1.79	1.96	1.57	1.22	0.98	0.82	0.80	0.85	0.87	0.93	0.91	0.88	0.86	0.84	0.83	0.82	0.80	0.79
Private consumption	E_ES_PCR	0.64	1.27	1.31	1.40	1.36	1.10	0.87	0.78	0.80	0.90	1.02	1.07	1.08	1.10	1.09	1.08	1.10	1.13
Government consumption	E_ES_GCR	7.16	6.96	6.82	6.62	6.69	6.47	6.30	6.10	5.90	5.69	5.83	5.92	6.05	6.16	6.30	6.41	6.54	6.68
Gross fixed capital formation	E_ES_ITR	5.01	5.50	4.22	3.16	2.09	1.12	0.76	0.75	0.87	1.14	1.25	1.34	1.36	1.27	1.18	1.14	1.10	1.09
Changes in inventories (% of GDP)	E_ES_SCRRATIO	0.11	0.19	0.08	0.00	-0.04	-0.05	-0.03	-0.01	0.00	0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
Exports	E_ES_XTR	-0.08	-0.71	-1.91	-3.09	-3.71	-3.60	-2.98	-2.25	-1.68	-1.40	-1.35	-1.42	-1.49	-1.50	-1.44	-1.36	-1.28	-1.22
Imports	E_ES_MTR	3.98	5.56	4.51	3.57	2.66	1.66	1.31	1.37	1.69	2.03	2.12	2.13	1.94	1.72	1.62	1.61	1.64	1.66
Wage and Price developments																			
Compensation per employee (nominal)	E_ES_WUN	0.45	2.56	4.74	5.51	4.83	3.45	2.15	1.43	1.29	1.51	1.82	2.01	2.03	1.93	1.80	1.70	1.64	1.61
GDP deflator	E_ES_YED	0.29	1.77	3.45	4.16	3.75	2.74	1.71	1.08	0.89	1.01	1.22	1.37	1.39	1.31	1.21	1.11	1.05	1.02
Private Consumption deflator	E_ES_PCD	0.24	1.58	3.17	3.85	3.48	2.53	1.57	0.98	0.81	0.92	1.12	1.26	1.28	1.21	1.11	1.02	0.97	0.94
Public Consumption deflator	E_ES_GCD	0.23	1.63	3.36	4.13	3.72	2.67	1.61	0.96	0.79	0.92	1.16	1.32	1.34	1.26	1.15	1.06	1.00	0.97
Total Investment deflator	E_ES_ITD	0.22	1.41	2.82	3.37	2.95	2.07	1.22	0.72	0.60	0.73	0.93	1.05	1.06	1.00	0.91	0.84	0.79	0.77
Private Investment deflator	E_ES_OID	0.21	1.45	2.83	3.36	2.93	2.04	1.18	0.69	0.58	0.71	0.92	1.04	1.05	0.99	0.90	0.83	0.78	0.76
Public Investment deflator	E_ES_GID	0.17	1.33	2.76	3.38	3.05	2.21	1.36	0.84	0.69	0.79	0.97	1.10	1.11	1.05	0.96	0.89	0.84	0.81
Exports deflator	E_ES_XTD	0.35	1.50	2.73	3.23	2.84	1.97	1.14	0.66	0.57	0.71	0.92	1.05	1.07	1.00	0.91	0.84	0.80	0.78
Imports deflator	E_ES_MTD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market developments																			
Total Labor Force	E_ES_LFN	0.15	0.37	0.42	0.39	0.34	0.28	0.24	0.22	0.20	0.20	0.20	0.19	0.18	0.17	0.17	0.16	0.16	0.15
Total employment	E_ES_LNN	1.39	2.01	1.81	1.51	1.26	1.02	0.91	0.86	0.82	0.83	0.81	0.77	0.74	0.72	0.69	0.66	0.63	0.61
Unemployment rate (deviation from baseline)	E_ES_URX	-1.00	-1.29	-1.09	-0.89	-0.75	-0.61	-0.56	-0.54	-0.51	-0.50	-0.47	-0.46	-0.44	-0.43	-0.43	-0.41	-0.40	-0.39
Government Net Lending and Current Account																			
Gen. Gov. Net Lending (% of GDP)	E_ES_GLNRATIO	-0.49	-0.34	-0.40	-0.58	-0.71	-0.85	-0.95	-1.03	-1.13	-1.19	-1.23	-1.30	-1.41	-1.52	-1.63	-1.75	-1.86	-1.98
Current account (% of GDP)	E_ES_CANRATIO	-0.79	-1.09	-0.86	-0.85	-0.90	-0.84	-0.84	-0.88	-0.93	-1.04	-1.12	-1.24	-1.30	-1.42	-1.46	-1.54	-1.63	-1.72
Real Stocks																			
Capital Stock	E_ES_KSR	0.11	0.45	0.76	0.99	1.14	1.19	1.18	1.15	1.13	1.13	1.15	1.17	1.20	1.22	1.24	1.25	1.25	1.25
Total Wealth (real)	E_ES_FWR	0.03	0.03	-0.07	-0.08	0.07	0.31	0.57	0.78	0.93	1.04	1.09	1.13	1.19	1.26	1.35	1.46	1.56	1.66

TABLE 4.2

Simulation Results, overview Table: SPAIN MCM: Public Consumption Multiplier Variant: +1% of GDP, (with fiscal closure rule)

File: simvge

(deviations from baseline, percentage unless otherwise indicated)

		1984A	1985A	1986A	1987A	1988A	1989A	1990A	1991A	1992A	1993A	1994A	1995A	1996A	1997A	1998A	1999A	2000A	2001A
Economic Activity																			
GDP	E_ES_YER	1.78	1.94	1.55	1.25	1.02	0.81	0.68	0.57	0.43	0.24	0.12	0.00	-0.09	-0.12	-0.14	-0.13	-0.10	-0.05
Private consumption	E_ES_PCR	0.63	1.22	1.28	1.44	1.44	1.09	0.56	0.00	-0.62	-1.28	-1.88	-2.39	-2.86	-3.17	-3.28	-3.21	-3.00	-2.59
Government consumption	E_ES_GCR	7.16	6.96	6.82	6.62	6.69	6.47	6.30	6.10	5.90	5.69	5.83	5.92	6.05	6.16	6.30	6.41	6.54	6.68
Gross fixed capital formation	E_ES_ITR	5.00	5.42	4.19	3.25	2.21	1.09	0.43	0.01	-0.32	-0.67	-0.84	-0.98	-1.09	-0.99	-0.85	-0.68	-0.46	-0.19
Changes in inventories (% of GDP)	E_ES_SCRRATIO	0.11	0.18	0.08	0.00	-0.03	-0.05	-0.04	-0.03	-0.03	-0.04	-0.04	-0.04	-0.03	-0.03	-0.02	-0.01	0.00	0.00
Exports	E_ES_XTR	-0.08	-0.71	-1.90	-3.07	-3.69	-3.61	-3.01	-2.23	-1.51	-0.95	-0.54	-0.20	0.09	0.35	0.55	0.68	0.73	0.71
Imports	E_ES_MTR	3.96	5.44	4.44	3.70	2.90	1.65	0.66	-0.20	-0.93	-1.72	-2.25	-2.58	-2.82	-2.73	-2.42	-2.00	-1.44	-0.75
Wage and Price developments																			
Compensation per employee (nominal)	E_ES_WUN	0.45	2.55	4.69	5.46	4.84	3.52	2.19	1.24	0.70	0.40	0.12	-0.16	-0.43	-0.65	-0.78	-0.81	-0.74	-0.61
GDP deflator	E_ES_YED	0.29	1.76	3.41	4.12	3.76	2.79	1.75	0.95	0.48	0.21	-0.02	-0.25	-0.46	-0.64	-0.74	-0.76	-0.70	-0.59
Private Consumption deflator	E_ES_PCD	0.24	1.58	3.14	3.82	3.48	2.58	1.60	0.87	0.43	0.19	-0.02	-0.23	-0.42	-0.59	-0.68	-0.70	-0.65	-0.55
Public Consumption deflator	E_ES_GCD	0.23	1.62	3.33	4.09	3.72	2.72	1.65	0.85	0.40	0.16	-0.05	-0.25	-0.45	-0.62	-0.72	-0.74	-0.68	-0.57
Total Investment deflator	E_ES_ITD	0.22	1.41	2.79	3.33	2.96	2.12	1.25	0.62	0.27	0.08	-0.08	-0.24	-0.40	-0.53	-0.60	-0.60	-0.55	-0.45
Private Investment deflator	E_ES_OID	0.21	1.45	2.81	3.33	2.93	2.08	1.21	0.59	0.24	0.06	-0.10	-0.25	-0.40	-0.53	-0.60	-0.60	-0.55	-0.45
Public Investment deflator	E_ES_GID	0.17	1.32	2.73	3.35	3.05	2.25	1.39	0.75	0.37	0.16	-0.02	-0.20	-0.36	-0.51	-0.60	-0.61	-0.57	-0.48
Exports deflator	E_ES_XTD	0.35	1.49	2.70	3.20	2.85	2.01	1.16	0.55	0.22	0.05	-0.10	-0.25	-0.39	-0.52	-0.58	-0.58	-0.52	-0.42
Imports deflator	E_ES_MTD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market developments																			
Total Labor Force	E_ES_LFN	0.15	0.37	0.42	0.39	0.34	0.28	0.23	0.18	0.13	0.08	0.03	-0.01	-0.04	-0.07	-0.08	-0.08	-0.08	-0.07
Total employment	E_ES_LNN	1.39	1.98	1.79	1.53	1.30	1.02	0.81	0.62	0.42	0.18	0.00	-0.15	-0.27	-0.34	-0.36	-0.34	-0.31	-0.24
Unemployment rate (deviation from baseline)	E_ES_URX	-0.99	-1.27	-1.08	-0.91	-0.77	-0.61	-0.49	-0.37	-0.24	-0.08	0.02	0.11	0.18	0.21	0.23	0.22	0.19	0.15
Government Net Lending and Current Account																			
Gen. Gov. Net Lending (% of GDP)	E_ES_GLNRATIO	-0.48	-0.33	-0.40	-0.60	-0.74	-0.81	-0.75	-0.55	-0.27	0.12	0.47	0.84	1.16	1.37	1.48	1.43	1.24	0.94
Current account (% of GDP)	E_ES_CANRATIO	-0.79	-1.07	-0.84	-0.87	-0.94	-0.84	-0.72	-0.59	-0.42	-0.26	-0.06	0.11	0.26	0.39	0.41	0.38	0.31	0.17
Real Stocks																			
Capital Stock	E_ES_KSR	0.11	0.45	0.75	0.98	1.14	1.20	1.17	1.10	1.00	0.90	0.79	0.67	0.55	0.44	0.34	0.25	0.18	0.13
Total Wealth (real)	E_ES_FWR	0.03	0.02	-0.07	-0.07	0.08	0.31	0.54	0.68	0.70	0.60	0.38	0.11	-0.25	-0.65	-1.08	-1.52	-1.91	-2.22

TABLE 4.3

Simulation Results, overview Table: SPAIN MCM: Increase in World Demand Variant: +1% (without fiscal closure rule)

File: simvw

(deviations from baseline, percentage unless otherwise indicated)

		1984A	1985A	1986A	1987A	1988A	1989A	1990A	1991A	1992A	1993A	1994A	1995A	1996A	1997A	1998A	1999A	2000A	2001A
Economic Activity																			
GDP	E_ES_YER	0.08	0.17	0.19	0.18	0.16	0.14	0.14	0.15	0.16	0.19	0.20	0.20	0.21	0.21	0.21	0.22	0.22	0.23
Private consumption	E_ES_PCR	0.02	0.09	0.12	0.14	0.15	0.15	0.13	0.12	0.13	0.14	0.16	0.16	0.18	0.19	0.19	0.20	0.21	0.21
Government consumption	E_ES_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_ES_ITR	0.20	0.48	0.53	0.48	0.41	0.29	0.26	0.25	0.26	0.34	0.36	0.37	0.41	0.39	0.37	0.38	0.39	0.39
Changes in inventories (% of GDP)	E_ES_SCRRATIO	0.00	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exports	E_ES_XTR	0.35	0.85	0.99	1.02	0.98	0.96	0.98	1.03	1.08	1.11	1.11	1.09	1.06	1.03	1.01	1.00	1.00	0.99
Imports	E_ES_MTR	0.30	0.97	1.12	1.10	1.02	0.87	0.77	0.75	0.78	0.88	0.97	0.96	0.97	0.98	0.93	0.92	0.91	0.90
World Demand	E_ES_WDR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wage and Price developments																			
Compensation per employee (nominal)	E_ES_WUN	0.01	0.12	0.33	0.51	0.58	0.54	0.44	0.37	0.33	0.35	0.40	0.44	0.47	0.49	0.49	0.49	0.49	0.50
GDP deflator	E_ES_YED	0.01	0.08	0.24	0.38	0.44	0.42	0.35	0.28	0.25	0.25	0.28	0.32	0.34	0.35	0.35	0.34	0.34	0.35
Private Consumption deflator	E_ES_PCD	0.01	0.07	0.22	0.35	0.41	0.39	0.32	0.26	0.23	0.23	0.26	0.29	0.31	0.32	0.32	0.31	0.32	0.32
Public Consumption deflator	E_ES_GCD	0.01	0.07	0.23	0.37	0.43	0.41	0.33	0.27	0.23	0.23	0.27	0.30	0.32	0.33	0.33	0.33	0.33	0.33
Total Investment deflator	E_ES_ITD	0.01	0.06	0.19	0.31	0.35	0.33	0.26	0.21	0.18	0.19	0.21	0.24	0.26	0.27	0.27	0.26	0.26	0.26
Private Investment deflator	E_ES_OID	0.00	0.07	0.20	0.31	0.35	0.33	0.26	0.21	0.18	0.18	0.21	0.24	0.26	0.26	0.26	0.26	0.26	0.26
Public Investment deflator	E_ES_GID	0.00	0.06	0.19	0.31	0.36	0.34	0.28	0.22	0.20	0.20	0.22	0.25	0.27	0.28	0.28	0.27	0.27	0.28
Exports deflator	E_ES_XTD	-0.12	-0.09	0.04	0.15	0.20	0.18	0.12	0.07	0.05	0.05	0.08	0.12	0.14	0.14	0.14	0.14	0.14	0.15
Imports deflator	E_ES_MTD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market developments																			
Total Labor Force	E_ES_LFN	0.00	0.02	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
Total employment	E_ES_LNN	0.05	0.16	0.20	0.20	0.19	0.17	0.16	0.16	0.16	0.18	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20
Unemployment rate (deviation from baseline)	E_ES_URX	-0.04	-0.11	-0.13	-0.12	-0.12	-0.10	-0.10	-0.10	-0.10	-0.11	-0.11	-0.11	-0.12	-0.12	-0.12	-0.13	-0.13	-0.13
Government Net Lending and Current Account																			
Gen. Gov. Net Lending (% of GDP)	E_ES_GLNRATIO	0.02	0.06	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.11	0.12	0.13	0.13	0.13	0.14	0.14	0.15	0.16
Current account (% of GDP)	E_ES_CANRATIO	-0.01	-0.03	-0.01	0.01	0.02	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.09	0.11	0.12	0.13	0.14
Real Stocks																			
Capital Stock	E_ES_KSR	0.00	0.02	0.06	0.09	0.12	0.14	0.16	0.17	0.18	0.19	0.20	0.21	0.23	0.25	0.26	0.27	0.29	0.30
Total Wealth (real)	E_ES_FWR	0.00	-0.01	-0.03	-0.05	-0.05	-0.04	-0.01	0.01	0.02	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.09	0.10

TABLE 4.4

Simulation Results, overview Table: SPAIN MCM: Increase in World Demand Variant: +1% (with fiscal closure rule)

File: simvw1

(deviations from baseline, percentage unless otherwise indicated)

		1984A	1985A	1986A	1987A	1988A	1989A	1990A	1991A	1992A	1993A	1994A	1995A	1996A	1997A	1998A	1999A	2000A	2001A
Economic Activity																			
GDP	E_ES_YER	0.08	0.18	0.21	0.21	0.22	0.22	0.24	0.26	0.27	0.31	0.31	0.30	0.30	0.29	0.29	0.28	0.27	0.26
Private consumption	E_ES_PCR	0.02	0.09	0.15	0.21	0.29	0.36	0.42	0.48	0.52	0.56	0.58	0.55	0.53	0.50	0.44	0.38	0.31	0.25
Government consumption	E_ES_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_ES_ITR	0.20	0.48	0.57	0.58	0.58	0.51	0.51	0.52	0.53	0.61	0.59	0.56	0.56	0.50	0.44	0.41	0.38	0.35
Changes in inventories (% of GDP)	E_ES_SCRRATIO	0.00	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exports	E_ES_XTR	0.35	0.85	0.99	1.01	0.95	0.90	0.87	0.87	0.87	0.87	0.85	0.83	0.82	0.82	0.83	0.86	0.88	0.91
Imports	E_ES_MTR	0.30	0.98	1.18	1.25	1.32	1.28	1.29	1.33	1.36	1.42	1.40	1.30	1.22	1.14	1.02	0.92	0.84	0.77
World Demand	E_ES_WDR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wage and Price developments																			
Compensation per employee (nominal)	E_ES_WUN	0.01	0.12	0.34	0.54	0.65	0.68	0.66	0.64	0.65	0.67	0.71	0.73	0.72	0.69	0.66	0.63	0.60	0.57
GDP deflator	E_ES_YED	0.01	0.08	0.24	0.40	0.49	0.52	0.50	0.49	0.48	0.49	0.52	0.53	0.52	0.50	0.47	0.43	0.41	0.38
Private Consumption deflator	E_ES_PCD	0.01	0.07	0.22	0.37	0.45	0.48	0.46	0.45	0.44	0.45	0.48	0.49	0.48	0.46	0.43	0.40	0.37	0.35
Public Consumption deflator	E_ES_GCD	0.01	0.07	0.23	0.39	0.48	0.51	0.49	0.46	0.46	0.47	0.50	0.51	0.50	0.48	0.44	0.41	0.39	0.36
Total Investment deflator	E_ES_ITD	0.01	0.06	0.20	0.33	0.40	0.41	0.39	0.37	0.37	0.38	0.40	0.41	0.40	0.38	0.35	0.33	0.31	0.29
Private Investment deflator	E_ES_OID	0.00	0.07	0.20	0.33	0.39	0.41	0.39	0.37	0.37	0.37	0.40	0.41	0.39	0.37	0.35	0.32	0.30	0.28
Public Investment deflator	E_ES_GID	0.00	0.06	0.19	0.32	0.40	0.42	0.40	0.39	0.39	0.39	0.42	0.43	0.42	0.40	0.37	0.35	0.32	0.31
Exports deflator	E_ES_XTD	-0.12	-0.09	0.04	0.17	0.25	0.26	0.25	0.23	0.23	0.24	0.26	0.28	0.27	0.25	0.23	0.20	0.18	0.17
Imports deflator	E_ES_MTD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market developments																			
Total Labor Force	E_ES_LFN	0.00	0.02	0.04	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.05
Total employment	E_ES_LNN	0.05	0.16	0.21	0.23	0.25	0.24	0.26	0.27	0.27	0.31	0.31	0.30	0.30	0.28	0.26	0.25	0.23	0.22
Unemployment rate (deviation from baseline)	E_ES_URX	-0.04	-0.11	-0.14	-0.14	-0.16	-0.15	-0.17	-0.18	-0.17	-0.19	-0.18	-0.18	-0.18	-0.17	-0.16	-0.16	-0.15	-0.14
Government Net Lending and Current Account																			
Gen. Gov. Net Lending (% of GDP)	E_ES_GLNRATIO	0.02	0.06	0.07	0.05	0.01	-0.03	-0.07	-0.11	-0.13	-0.14	-0.13	-0.12	-0.11	-0.09	-0.06	-0.02	0.04	0.09
Current account (% of GDP)	E_ES_CANRATIO	-0.01	-0.03	-0.01	-0.02	-0.04	-0.05	-0.06	-0.08	-0.09	-0.10	-0.10	-0.10	-0.08	-0.08	-0.04	-0.01	0.01	0.04
Real Stocks																			
Capital Stock	E_ES_KSR	0.00	0.02	0.06	0.10	0.14	0.17	0.20	0.23	0.26	0.29	0.32	0.34	0.36	0.38	0.39	0.40	0.40	0.40
Total Wealth (real)	E_ES_FWR	0.00	-0.01	-0.03	-0.04	-0.04	-0.01	0.03	0.09	0.14	0.20	0.25	0.29	0.32	0.36	0.39	0.41	0.42	0.42

TABLE 4.5

Simulation Results, overview Table: SPAIN MCM: Increase in foreign prices Variant: +10%

File: simvee

(deviations from baseline, percentage unless otherwise indicated)

		1984A	1985A	1986A	1987A	1988A	1989A	1990A	1991A	1992A	1993A	1994A	1995A	1996A	1997A	1998A	1999A	2000A	2001A
Economic Activity																			
GDP	E_ES_YER	0.79	1.31	1.43	1.18	0.60	0.16	-0.07	-0.10	0.02	0.01	0.07	0.03	-0.02	-0.04	-0.07	-0.08	-0.08	-0.10
Private consumption	E_ES_PCR	-0.04	-0.32	0.34	1.20	1.26	0.88	0.34	-0.14	-0.35	-0.46	-0.32	-0.22	-0.22	-0.15	-0.17	-0.22	-0.20	-0.18
Government consumption	E_ES_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_ES_ITR	2.13	4.04	5.31	5.20	2.94	0.54	-1.04	-1.89	-1.88	-1.85	-1.59	-1.46	-1.34	-1.26	-1.34	-1.39	-1.42	-1.52
Changes in inventories (% of GDP)	E_ES_SCRRATIO	0.04	0.20	0.13	0.03	-0.06	-0.10	-0.10	-0.07	-0.03	-0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.01	0.00	0.00
Exports	E_ES_XTR	3.05	5.77	3.95	1.15	-1.42	-2.67	-2.53	-1.49	-0.23	0.68	1.02	0.93	0.63	0.33	0.16	0.10	0.11	0.13
Imports	E_ES_MTR	1.43	3.73	4.19	4.67	2.40	-0.36	-2.26	-3.10	-2.66	-1.96	-1.11	-0.72	-0.70	-0.65	-0.82	-0.94	-0.91	-0.86
Wage and Price developments																			
Compensation per employee (nominal)	E_ES_WUN	0.41	4.11	9.99	14.55	16.10	14.73	12.01	9.56	8.26	8.15	8.71	9.45	9.95	10.10	10.02	9.85	9.72	9.68
GDP deflator	E_ES_YED	0.56	4.58	9.31	12.99	14.44	13.63	11.65	9.73	8.61	8.41	8.79	9.35	9.78	9.96	9.95	9.87	9.79	9.78
Private Consumption deflator	E_ES_PCD	0.67	4.64	9.27	12.79	14.16	13.41	11.55	9.74	8.69	8.51	8.87	9.40	9.80	9.97	9.96	9.88	9.81	9.80
Public Consumption deflator	E_ES_GCD	0.47	4.39	9.36	13.15	14.62	13.76	11.68	9.67	8.52	8.35	8.77	9.37	9.82	10.00	9.98	9.88	9.80	9.79
Total Investment deflator	E_ES_ITD	0.74	4.58	8.98	12.30	13.53	12.81	11.15	9.58	8.70	8.63	9.00	9.51	9.87	10.01	9.99	9.90	9.84	9.83
Private Investment deflator	E_ES_OID	0.71	4.53	8.92	12.26	13.49	12.77	11.09	9.52	8.67	8.61	9.00	9.52	9.88	10.02	9.99	9.90	9.84	9.83
Public Investment deflator	E_ES_GID	0.89	4.90	9.32	12.48	13.69	13.02	11.37	9.77	8.83	8.69	9.01	9.48	9.84	9.98	9.97	9.89	9.83	9.82
Exports deflator	E_ES_XTD	2.20	5.89	9.90	12.79	13.69	12.82	11.11	9.54	8.71	8.66	9.06	9.57	9.94	10.08	10.05	9.96	9.90	9.89
Imports deflator	E_ES_MTD	4.98	8.74	9.84	10.06	10.06	10.03	10.01	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Competitors Prices on domestic market	E_ES_CMD	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Competitors Prices on external markets	E_ES_CXD	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Nominal Effective Exchange Rate (export side)	E_ES_EEN	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Nominal Effective Exchange Rate (import side)	E_ES_EEN0	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Labour Market developments																			
Total Labor Force	E_ES_LFN	0.05	0.22	0.32	0.33	0.25	0.14	0.04	-0.02	-0.04	-0.05	-0.05	-0.04	-0.04	-0.04	-0.03	-0.02	-0.02	-0.01
Total employment	E_ES_LNN	0.53	1.39	1.53	1.31	0.77	0.25	-0.08	-0.23	-0.19	-0.22	-0.18	-0.17	-0.17	-0.14	-0.12	-0.08	-0.04	-0.02
Unemployment rate (deviation from baseline)	E_ES_URX	-0.39	-0.92	-0.96	-0.79	-0.42	-0.10	0.10	0.17	0.12	0.14	0.10	0.10	0.10	0.08	0.07	0.05	0.02	0.01
Government Net Lending and Current Account																			
Gen. Gov. Net Lending (% of GDP)	E_ES_GLNRATIO	0.22	0.52	0.76	0.74	0.58	0.41	0.23	0.12	0.11	0.11	0.16	0.19	0.15	0.09	0.02	-0.04	-0.07	-0.12
Current account (% of GDP)	E_ES_CANRATIO	-0.15	-0.04	0.09	-0.18	-0.12	0.08	0.20	0.23	0.23	0.23	0.35	0.21	0.34	0.23	0.39	0.45	0.46	0.50
Real Stocks																			
Capital Stock	E_ES_KSR	0.03	0.23	0.52	0.88	1.17	1.25	1.13	0.90	0.66	0.47	0.31	0.18	0.06	-0.04	-0.14	-0.24	-0.34	-0.45
Total Wealth (real)	E_ES_FWR	-0.01	-0.38	-0.72	-0.99	-1.06	-0.90	-0.64	-0.41	-0.28	-0.27	-0.34	-0.46	-0.59	-0.64	-0.64	-0.53	-0.40	-0.28

TABLE 4.6

Simulation Results, overview Taele: SPAIN MCM: **Interest Rate Variant: +1 ppt.**

File: simvie

(deviations from easeline, percentage unless otherwise indicated)

		1984A	1985A	1986A	1987A	1988A	1989A	1990A	1991A	1992A	1993A	1994A	1995A	1996A	1997A	1998A	1999A	2000A	2001A
Economic Activity																			
GDP	E_ES_YER	-0.16	-0.59	-0.79	-0.61	-0.28	-0.17	-0.15	-0.17	-0.21	-0.23	-0.25	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24
Private consumption	E_ES_PCR	-0.09	-0.51	-0.74	-0.69	-0.39	-0.25	-0.18	-0.07	-0.03	-0.03	-0.09	-0.10	-0.11	-0.13	-0.12	-0.09	-0.06	-0.03
Government consumption	E_ES_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_ES_ITR	-0.88	-3.33	-4.92	-4.66	-2.69	-1.56	-0.97	-0.66	-0.55	-0.49	-0.56	-0.58	-0.59	-0.57	-0.52	-0.48	-0.45	-0.42
Changes in inventories (% of GDP)	E_ES_SCRRATIO	-0.02	-0.06	-0.08	-0.04	0.02	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exports	E_ES_XTR	0.00	0.07	0.32	0.75	1.14	1.22	0.92	0.43	-0.03	-0.31	-0.40	-0.35	-0.25	-0.18	-0.14	-0.13	-0.15	-0.16
Imports	E_ES_MTR	-0.46	-2.47	-3.71	-3.43	-1.52	-0.41	-0.01	0.25	0.19	0.10	-0.13	-0.17	-0.12	-0.09	-0.02	0.03	0.07	0.09
Wage and Price developments																			
Compensation per employee (nominal)	E_ES_WUN	-0.01	-0.30	-1.03	-1.79	-1.96	-1.40	-0.56	0.09	0.36	0.31	0.10	-0.12	-0.24	-0.25	-0.21	-0.16	-0.12	-0.11
GDP deflator	E_ES_YED	-0.01	-0.20	-0.71	-1.28	-1.44	-1.03	-0.37	0.19	0.46	0.47	0.34	0.18	0.09	0.07	0.09	0.13	0.15	0.16
Private Consumption deflator	E_ES_PCD	-0.01	-0.17	-0.65	-1.19	-1.34	-0.97	-0.34	0.18	0.44	0.44	0.32	0.17	0.08	0.06	0.08	0.12	0.14	0.15
Puelic Consumption deflator	E_ES_GCD	-0.01	-0.17	-0.67	-1.25	-1.44	-1.04	-0.36	0.21	0.49	0.49	0.35	0.18	0.08	0.05	0.08	0.12	0.15	0.16
Total Investment deflator	E_ES_ITD	-0.01	-0.14	-0.58	-1.07	-1.18	-0.81	-0.24	0.21	0.42	0.40	0.28	0.14	0.06	0.04	0.07	0.10	0.12	0.12
Private Investment deflator	E_ES_OID	-0.01	-0.16	-0.58	-1.06	-1.17	-0.79	-0.23	0.23	0.43	0.41	0.28	0.14	0.06	0.04	0.07	0.10	0.12	0.12
Puelic Investment deflator	E_ES_GID	0.00	-0.13	-0.54	-1.04	-1.19	-0.86	-0.30	0.16	0.39	0.39	0.28	0.15	0.07	0.05	0.07	0.10	0.12	0.13
Exports deflator	E_ES_XTD	-0.02	-0.19	-0.58	-0.99	-1.05	-0.69	-0.15	0.29	0.47	0.44	0.30	0.15	0.06	0.04	0.07	0.10	0.11	0.12
Imports deflator	E_ES_MTD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LaBur Market developments																			
Total Laeor Force	E_ES_LFN	-0.01	-0.07	-0.14	-0.16	-0.12	-0.06	-0.01	0.01	0.02	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.02
Total employment	E_ES_LNN	-0.09	-0.50	-0.77	-0.67	-0.31	-0.07	0.05	0.11	0.13	0.15	0.14	0.15	0.15	0.14	0.12	0.11	0.10	0.09
Unemployment rate (deviation from easeline)	E_ES_URX	0.07	0.34	0.50	0.40	0.16	0.01	-0.05	-0.08	-0.09	-0.09	-0.08	-0.09	-0.09	-0.08	-0.08	-0.07	-0.06	-0.05
Government Net Lending and Current Account																			
Gen. Gov. Net Lending (% of GDP)	E_ES_GLNRATIO	-0.05	-0.23	-0.36	-0.32	-0.19	-0.11	-0.07	-0.05	-0.05	-0.05	-0.06	-0.07	-0.07	-0.07	-0.07	-0.07	-0.08	-0.08
Current account (% of GDP)	E_ES_CANRATIO	0.10	0.52	0.70	0.74	0.47	0.32	0.30	0.26	0.24	0.22	0.22	0.21	0.21	0.22	0.22	0.22	0.22	0.21
Real Stocks																			
Capital Stock	E_ES_KSR	-0.01	-0.13	-0.39	-0.73	-0.99	-1.10	-1.13	-1.11	-1.08	-1.05	-1.02	-1.00	-0.98	-0.96	-0.94	-0.92	-0.89	-0.86
Total Wealth (real)	E_ES_FWR	0.01	0.07	0.20	0.33	0.35	0.26	0.13	0.06	0.05	0.08	0.15	0.22	0.30	0.37	0.44	0.51	0.57	0.63
Interest rates and the cost of capital																			
3-month interest rate	E_ES_STI	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-year long-term interest rate	E_ES_LTI	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cost of Capital (average)	E_ES_CC0	7.90	8.59	7.94	-0.43	-1.39	-1.75	-1.36	-0.60	0.12	0.57	0.63	0.49	0.25	0.09	0.00	0.01	0.07	0.13

TABLE 4.7

Simulation Results, overview Table: SPAIN MCM: Labour Supply Variant: + 1%

File: simvle

(deviations from baseline, percentage unless otherwise indicated)

		1984A	1985A	1986A	1987A	1988A	1989A	1990A	1991A	1992A	1993A	1994A	1995A	1996A	1997A	1998A	1999A	2000A	2001A
Economic Activity																			
GDP	E_ES_YER	0.11	0.23	0.25	0.35	0.49	0.57	0.60	0.60	0.59	0.57	0.58	0.60	0.62	0.64	0.65	0.65	0.66	0.67
Private consumption	E_ES_PCR	0.16	0.29	0.13	0.05	0.15	0.27	0.37	0.45	0.50	0.48	0.47	0.45	0.45	0.47	0.48	0.49	0.50	0.51
Government consumption	E_ES_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_ES_ITR	0.29	0.50	0.23	0.20	0.47	0.68	0.74	0.74	0.67	0.52	0.48	0.46	0.46	0.48	0.48	0.50	0.52	0.53
Changes in inventories (% of GDP)	E_ES_SCRRATIO	0.00	0.01	0.01	0.02	0.03	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Exports	E_ES_XTR	0.01	0.21	0.68	1.20	1.56	1.63	1.44	1.14	0.85	0.67	0.60	0.61	0.64	0.65	0.64	0.61	0.58	0.55
Imports	E_ES_MTR	0.32	0.66	0.16	-0.05	0.26	0.49	0.52	0.47	0.32	0.06	-0.06	-0.09	-0.07	-0.01	0.02	0.03	0.03	0.03
Wage and Price developments																			
Compensation per employee (nominal)	E_ES_WUN	-0.23	-1.13	-1.98	-2.40	-2.32	-1.86	-1.29	-0.87	-0.68	-0.69	-0.80	-0.89	-0.93	-0.90	-0.85	-0.79	-0.76	-0.74
GDP deflator	E_ES_YED	-0.12	-0.70	-1.33	-1.67	-1.65	-1.32	-0.89	-0.56	-0.39	-0.38	-0.46	-0.53	-0.57	-0.56	-0.52	-0.48	-0.46	-0.44
Private Consumption deflator	E_ES_PCD	-0.10	-0.63	-1.22	-1.55	-1.53	-1.22	-0.82	-0.51	-0.35	-0.34	-0.42	-0.49	-0.52	-0.51	-0.48	-0.44	-0.42	-0.41
Public Consumption deflator	E_ES_GCD	-0.09	-0.64	-1.29	-1.65	-1.63	-1.29	-0.85	-0.51	-0.34	-0.34	-0.43	-0.51	-0.55	-0.54	-0.50	-0.46	-0.43	-0.42
Total Investment deflator	E_ES_ITD	-0.08	-0.57	-1.09	-1.36	-1.31	-1.02	-0.65	-0.38	-0.26	-0.26	-0.34	-0.41	-0.44	-0.43	-0.40	-0.36	-0.34	-0.33
Private Investment deflator	E_ES_OID	-0.08	-0.58	-1.09	-1.36	-1.30	-1.00	-0.64	-0.37	-0.25	-0.26	-0.33	-0.40	-0.43	-0.42	-0.39	-0.36	-0.34	-0.33
Public Investment deflator	E_ES_GID	-0.07	-0.53	-1.07	-1.36	-1.34	-1.07	-0.72	-0.44	-0.30	-0.30	-0.36	-0.43	-0.46	-0.45	-0.42	-0.38	-0.36	-0.35
Exports deflator	E_ES_XTD	-0.07	-0.50	-1.01	-1.30	-1.27	-0.99	-0.64	-0.38	-0.27	-0.28	-0.36	-0.43	-0.45	-0.44	-0.41	-0.38	-0.36	-0.35
Imports deflator	E_ES_MTD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market and cost developments																			
Total Labor Force	E_ES_LFN	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total employment	E_ES_LNN	0.08	0.26	0.33	0.43	0.56	0.66	0.70	0.72	0.71	0.70	0.71	0.72	0.74	0.76	0.77	0.78	0.78	0.79
Unemployment rate (deviation from baseline)	E_ES_URX	0.73	0.58	0.53	0.46	0.35	0.28	0.25	0.24	0.23	0.23	0.22	0.21	0.20	0.19	0.19	0.18	0.18	0.17
Government Net Lending and Current Account																			
Gen. Gov. Net Lending (% of GDP)	E_ES_GLNRATIO	-0.11	-0.08	-0.11	-0.08	-0.03	0.03	0.07	0.09	0.10	0.11	0.10	0.11	0.12	0.13	0.15	0.15	0.17	0.18
Current account (% of GDP)	E_ES_CANRATIO	-0.08	-0.21	-0.11	-0.04	-0.04	-0.05	-0.01	0.01	0.02	0.04	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07
Real Stocks																			
Capital Stock	E_ES_KSR	0.00	0.03	0.06	0.07	0.09	0.13	0.18	0.24	0.28	0.31	0.33	0.34	0.36	0.37	0.38	0.40	0.41	0.42
Total Wealth (real)	E_ES_FWR	0.03	0.11	0.22	0.34	0.39	0.37	0.32	0.28	0.27	0.27	0.29	0.31	0.33	0.33	0.31	0.29	0.28	0.27

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APPENDIX 1. ALPHABETICAL LIST OF THE VARIABLES IN THE ES-MCM BLOCK

Code	Description	Status
BTN	Balance of trade of goods and services	Definition
CAN	Current-account Surplus	Definition
CC1	User cost of capital (long-term interest rate)	Definition
CC2	User cost of capital (bank lending interest rate)	Definition
CC0	User cost of capital (average of CC1 and CC2)	Definition
CMD	External competitor price on the import side (ptas.)	Definition
CMUD	External competitor price on the import side (dollars)	Exogenous
COT	Social security contribution effective tax rate	Exogenous
CSTAR	Long-run level of private consumption	Definition
CXD	External competitor price on the export side (ptas.)	Definition
CXUD	External competitor price on the export side (dollars)	Exogenous
DREG	Step dummy (proxy for financial deregulation)	Exogenous
EMD	Import demand indicator deflator	Definition
EMN	Import demand indicator in nominal terms	Definition
EMR	Import demand indicator in real terms	Definition
ENN	Effective nominal exchange from the export side	Exogenous
EXR	Pta-US dollar nominal exchange rate	Exogenous
FWN	Private-sector financial wealth in nominal terms	Definition
FWR	Private-sector financial wealth in real terms	Definition
GCD	Government consumption deflator	Behavioural
GCN	Government consumption in nominal terms	Definition
GCR	Government consumption in real terms	Exogenous
GDN	Government net debt	Definition
GID	Government investment deflator	Behavioural
GIN	Government investment in nominal terms	Definition
GIR	Government investment in real terms	Exogenous
GLN	Government net lending	Definition
GON	Gross operating surplus	Definition
GSN	Government savings	Definition
GYN	Government disposable income	Definition
INFE	Backward-looking inflation expectations	Behavioural
INFQ	Quarterly inflation	Definition
INFA	Annual inflation	Definition
INN	Government net interest payments	Behavioural
ITD	Gross fixed capital formation deflator	Definition
ITN	Gross fixed capital formation in nominal terms	Definition
ITR	Gross fixed capital formation in real terms	Behavioural
KGR	Government capital stock	Definition

KSR	Capital stock	Definition
KSTAR	Long-run level of the capital stock	Definition
LFN	Labour force	Behavioural
LGN	Government employment	Exogenous
LNN	Employment	Behavioural
LSR	Level of inventories in real terms	Definition
LSSTAR	Long-run level of inventories	Definition
LSTAR	Long-run level of employment	Definition
LTI	Long-term nominal interest rate	Behavioural
LTR	Long-term real interest rate	Definition
MDSTAR	Long-run level of the import deflator	Definition
MTD	Import deflator	Behavioural
MTN	Imports in nominal terms	Definition
MSTAR	Long-run level of imports	Definition
MTR	Imports in real terms	Behavioural
NFA	Net foreign assets	Definition
NFN	Net factor income from the rest of the world	Behavioural
ODN	Other direct taxes	Behavioural
ODX	Effective tax rate for other direct taxes	Exogenous
OGN	Other government income	Exogenous
OID	Private gross fixed capital formation deflator	Behavioural
OIN	Private gross fixed capital formation in nominal terms	Definition
OIR	Private gross fixed capital formation in real terms	Definition
OPN	Other personal income	Behavioural
PCD	Private consumption deflator	Behavioural
PCN	Private consumption in nominal terms	Definition
PCOM	External competitor prices	Definition
PCR	Private consumption in real terms	Behavioural
PEI	Oil price in ptas.	Exogenous
PYN	Household disposable income in nominal terms	Definition
PYR	Household disposable income in real terms	Definition
RCC	Bank lending to firms: nominal interest rate	Behavioural
REALI	Real interest rate for inventories	Definition
SALE	Indicator of the sales of storable goods	Definition
SCAN	Cumulative current-account surplus	Definition
SCR	Change in inventories in real terms	Behavioural
SGLN	Cumulative government net lending	Definition
SMC	Short-term marginal costs	Definition
STI	Short-term nominal interest rate	Exogenous
SZN	Change in inventories in nominal terms	Definition

SZD	Change in inventories deflator	Definition
TCIB	Effective indirect tax rate on private consumption	Exogenous
TDN	Direct taxes of households (including Social Security)	Definition
TDNB	Tax base for direct taxes on households	Definition
TDX	Effective direct tax rate on households	Behavioural
TIIB	Effective indirect tax rate on investment	Exogenous
TIN	Indirect taxes net of subsidies	Definition
TIX	Effective indirect tax rate	Definition
TRN	Transfers to households	Definition
TRX	Effective transfers to households: rate	Behavioural
TWN	Other transfers from the rest of the world	Exogenous
UNN	Unemployment	Definition
URX	Unemployment rate	Definition
WDR	World demand	Exogenous
WIN	Compensation of employees	Definition
WUN	Wage rate	Behavioural
XDSTAR	Long-run level of the export deflator	Definition
XSTAR	Long-run level of exports	Definition
XTD	Export deflator	Behavioural
XTN	Exports in nominal terms	Definition
XTR	Exports in real terms	Behavioural
YDSTAR	Long-run level of the GDP deflator	Definition
YED	GDP deflator	Behavioural
YEN	GDP in nominal terms	Definition
YER	GDP in real terms	Definition
YNR	Normal level of production	Definition

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