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**THE ITALIAN BLOCK
OF THE ESCB
MULTI-COUNTRY MODEL**

by Elena Angelini,
Antonello D'Agostino
and Peter McAdam





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² European Central Bank, Kaiserstrasse 29, 60311 Frankfurt am Main, Germany; e-mail: Elena.Angelini@ecb.int

³ Central Bank and Financial Services Authority of Ireland, P.O. Box 559/Dame Street, Dublin 2, Ireland; e-mail: antonello.dagostino@centralbank.ie

⁴ European Central Bank, Kaiserstrasse 29, 60311 Frankfurt am Main, Germany; e-mail: peter.mcadam@ecb.int



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Address

Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address

Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone

+49 69 1344 0

Internet

<http://www.ecb.int>

Fax

+49 69 1344 6000

Telex

411 144 ecb d

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Abstract

This paper documents the structure, estimation and simulation properties of the Italian block of the ESCB-multi-country model (MCM). The model is used regularly as an input into Eurosystem projection exercises and, to a lesser extent, in simulation analysis. The specification of the Italian model follows closely that of the Area-Wide Model (AWM) and indeed the other MCM country blocks (in terms of specification and accounting framework). The MCM is a quarterly estimated structural macroeconomic model that treats the economy in a relatively closed manner. It has a long-run classical equilibrium with a vertical Phillips curve but with some short-run frictions in price/wage setting and factor demands. Consequently, activity is demand-determined in the short-run but supply-determined in the longer run with employment having converged to a level consistent with an exogenously given level of equilibrium unemployment. The precise properties of the model are illustrated using a number of standard variant simulations.

JEL Classification: C3, C5, E1, E2

Keywords: Macro-econometric Modelling, Italy

Non-technical Summary

This paper documents the structure, estimation and simulation properties of the Italian block of the ESCB-multi-country model (MCM). This model is regularly used as an input into Eurosystem projection exercises and, to a lesser extent, in simulation analysis. The specification of the model follows closely that of the Area-Wide Model (AWM) and indeed the other MCM country blocks (in terms of specification and accounting framework). Specifically, the MCM is a quarterly estimated macroeconomic model that treats the economy as essentially closed. It has a long-run classical equilibrium with a vertical Phillips curve but with some short-run frictions in price/wage setting and factor demands. Consequently, activity is demand-determined in the short-run but supply-determined in the longer run with employment having converged to a level consistent with the exogenously given level of equilibrium unemployment. To illustrate the precise properties of the model, we include a formal presentation of its theoretical and econometric underpinnings and analyse the effects of five exogenous permanent shocks to the economy.

1 Introduction

This paper documents the structure, estimation and simulation properties of the Italian block of the ESCB-multi-country model (MCM). This model is used regularly as an input into Eurosystem projection exercises and, to a lesser extent, in simulation analysis. The specification of the Italian model follows closely (in terms of specification and accounting framework) that of the Area-Wide Model (AWM) and indeed the other MCM country blocks (e.g., Willman and Estrada, 2002; Boissay and Villetelle, 2005; Angelini, Boissay, and Ciccarelli, 2006).¹ Consequently, and necessarily, this paper closely follows the exposition of other MCMs published so far.

The Italian MCM is a quarterly estimated macroeconomic model that treats the economy in a relatively closed nature. It has a long-run classical equilibrium with a vertical Phillips curve but with some short-run frictions in price/wage setting and factor demands. Consequently, activity is demand-determined in the short-run but supply-determined in the longer run with employment having converged to a level consistent with the exogenously given level of equilibrium unemployment. Stock-flow adjustments are accounted for by, for example, the inclusion of a wealth term in consumption. At present, the treatment of expectations in the model is limited given that the model embodies backward-looking expectations. The model has a total of 126 equations, of which 18 are estimated behavioural equations; the rest are identities, quasi-identities and policy rules. Production in the economy is modelled as a single aggregate sector, with demand being the sum of components: private and public consumption, investment, stock-building and net trade. As regards the nominal side, there is quite a rich structure of (pre- and post-tax) prices with the GDP deflator modelled as a (fixed) mark-up over production costs. This deflator is essentially the foundation for all other prices in the models. The (nominal) exchange rate is exogenous, whereas the (nominal) interest rate may follow a Taylor-type rule.

Although the Italian MCM belongs firmly in the AWM/MCM class of models, some points of departure (of various importance) are worth mentioning. First, and most obviously, the Italian MCM is estimated on its own national database and thus it will embody particular point estimates and polynomial lengths in equations and, thus, different response times and dynamic behaviour, relative to other MCM country blocks. Second, in the Italian model, dynamic homogeneity is only imposed where there is supporting statistical evidence; given that imposing dynamic homogeneity can render a model excessively cyclical. Third, our modelling of the supply side was done in terms of pre-tax concepts; thus for example in our wage equation the productivity / NAIRU nexus is derived under factor cost prices rather than market prices to maintain that unemployment is independent of taxes, similarly, the long-run level of potential output is independent of taxes.

The paper proceeds as follows. Section 2 presents an overview of the main features of the model and the theoretical specification, followed by a detailed equation 'by' equation presentation in section 3. Section 4 assesses the dynamic properties of the model through a set of standard variant simulations, and section 5 concludes.

¹Karlsson and McAdam (2005) give an overview of the MCM framework and the (trade) Link block.

2 The Theoretical Background of the Italian MCM: The Supply Side

2.1 An Overview

The structure of the Italian MCM is relatively standard, built on an aggregate demand/aggregate supply framework, with a well-defined long-run classical supply-side equilibrium, and a vertical long-run Phillips curve, with an exogenous natural rate (NAIRU). The steady-state real interest rate pins down the capital-to-output ratio of the unemployment rate, via the firm's marginal productivity optimality condition. Since the labour force is given in the long-run, steady-state output is then equal to the production-function outcome with a zero NAIRU gap. In that equilibrium, all real variables grow at the same rate as potential output, real wages grow in line with long-run labour productivity, and relative prices are constant, in particular the real exchange rate. The model also takes into account stock-flow consistency, so that for example households' wealth (comprising total capital stock, public debt and net foreign assets) is also determined in GDP points at the steady state. With the steady-state public debt ratio pinned down by a fiscal rule and the steady-state capital stock determined by the marginal productivity condition, this relation determines the steady-state ratio of net foreign assets to GDP.²

In the short-run, since variables do not immediately adjust to their steady-state values, the model has some Keynesian features, whereby output is constrained by the sum of demand components. The resulting departure from equilibrium in both the goods and labour markets exerts influence on short-run price and wage developments, via an output gap and an unemployment gap term, respectively. The convergence to the long run is ensured by the responses of policies to deviations from equilibrium. Fiscal policy is modelled as a change in direct tax rates responding to deviations from a target fiscal ratio to GDP and monetary policy is assumed to follow a Taylor-type rule, with a given nominal exchange rate.

2.2 The firm's programme

Firms maximize profits for a given technology and level of demand³.

The solution to the firms' profit-maximization problem is given by individual prices P_i , labour demand L_i , capital demand K_i , and output Y_i which depend on the aggregate production level Y , the general price level P , real wages w/P (w being the nominal wage) and the nominal cost of capital c . By definition:

$$c \equiv P(r + \delta) \tag{2.1}$$

where r is the real rate of interest and δ is the depreciation rate of capital. Assuming, no capital adjustment costs, this leads to,

²Typical long-run features and closures incorporated into macro models are discussed further in McAdam (1999).

³Given the existing literature on the MCM framework, the subsequent sections closely follow the treatment in Willman and Estrada (2002) and, more recently, Angelini, Boissay and Ciccarelli (2006) and Boissay and Villettele (2005).

$$\begin{cases} \max_{L_i, K_i} \Pi(Y_i) = P_i Y_i - w L_i - c K_i \\ s.t. \\ P_i = P \left(\frac{Y_i}{Y} \right)^{1/\varepsilon} \\ Y_i = A K_i^\beta (e^{\gamma t} L_i)^{1-\beta} \end{cases}$$

where $\varepsilon > 1$ is the elasticity of the demand for good i to its relative price and γ is the (exogenous) growth rate of technological progress. The new capital goods are homogenous to the consumption goods, and the price of new capital goods is P . Firms take the nominal capital cost and nominal wages as given, since the latter depend on the general level of price P .

$$\begin{cases} \max_{L_i, K_i} \Pi(Y_i) = P Y^{1/\varepsilon} Y_i^{\frac{\varepsilon-1}{\varepsilon}} - w L_i - c K_i \\ s.t. \\ Y_i = A K_i^\beta (e^{\gamma t} L_i)^{1-\beta} \end{cases}$$

The solution to this programme is given by its first order conditions and, in the symmetric equilibrium (where $P_i = P$, $Y_i = Y$, $L_i = L$ and $K_i = K \forall i$), we obtain:

$$\begin{cases} (a) : L = e^{-\gamma t} \left[\frac{Y}{A K^\beta} \right]^{\frac{1}{1-\beta}} \\ (b) : K = \frac{Y}{A e^{(1-\beta)\gamma t}} \left[\frac{\beta w}{(1-\beta) P (r+\delta)} \right]^{1-\beta} \\ (c) : \frac{w}{P} = \frac{(1-\beta)(\varepsilon-1) Y}{\varepsilon L} \end{cases} \quad (2.2)$$

At this stage, given our assumption of constant returns to scale, the level of aggregate output is undetermined. These three relations determine the optimal capital to labour ratio, labour productivity, and real wages. To determine the levels of output, employment and capital, one more condition has to be met on the labour market side. In a frictionless economy where real wages adjust to labour productivity, the level of employment would adjust to the (exogenous) labour force and full employment would prevail. In equilibrium, aggregate output and the stock of capital would be determined by the level of the labour force. However, in an economy where firms and unions bargain on nominal wages, real wages may not be only driven by labour productivity, but also by the rate of unemployment. In this situation, real wages are set above their frictionless equilibrium level and unemployment arises. The equilibrium rate of unemployment and the exogenous labour force then determine the level of employment, the aggregate output and the stock of capital.

2.3 Phillips curve and NAIRU

Nominal wages are indexed to the level of prices, but also depend on the unions' bargaining power, which depends on the unemployment rate. This is modelled through the following general Phillips curve:

$$\Delta \log w = \Delta \log \tilde{P} + \phi (\Delta \log Y - \Delta \log L) + \rho - \eta \log(u) \quad (2.3)$$

where ρ is a constant, η indicates the sensitivity of nominal wage increases to the unemployment rate (i.e. unions' bargaining power), u is the unemployment rate:

$$u \equiv \frac{\bar{L} - L}{\bar{L}} \quad (2.4)$$

and \tilde{P} is the price anticipations. In sum, this Phillips curve accounts for two types of rigidities. First, if inflation expectations are not perfect ($\Delta \log \tilde{P} \neq \Delta \log P$) then nominal wages are not fully indexed on prices, thus meaning that *nominal wage rigidities* exist in the economy. Second, although nominal wages are flexible, real wages may not adjust perfectly to the marginal productivity of labour, unless $\phi = 1$ and $\eta = 0$. If $\phi < 1$ and $\eta > 0$, labour productivity is partly taken into account within the bargaining process, and wage developments depend on the unemployment rate.

2.3.1 The Non-Accelerating Inflation Rate of Unemployment (NAIRU).

From equation (c) of system (2.2) and considering a constant mark-up, we have,

$$\Delta \log P = \Delta \log w - \Delta \log Y + \Delta \log L \quad (2.5)$$

which, once substituted into the Phillips curve (2.3), gives the following relationship between inflation and unemployment:

$$\Delta \ln P = \Delta \ln \tilde{P} + (\phi - 1)(\Delta \ln Y - \Delta \ln L) + \rho - \eta \log u$$

By definition, the *NAIRU* is the unemployment rate which solves for the steady-state expectation condition, $\Delta \ln P = \Delta \ln \tilde{P}$:

$$\log(\text{NAIRU}) = \frac{-(1 - \phi)(\Delta \log Y - \Delta \log L) + \rho}{\eta} \quad (2.6)$$

The equilibrium rate of unemployment thus depends negatively on labour productivity growth (e.g. lower labour productivity growth requires higher unemployment to warrant constant inflation). To arrive at the final expression for the *NAIRU*, we need to compute the long-term growth rates of Y and L . Assuming first that the *NAIRU* is constant in the long run then $\Delta \log L = \Delta \log \bar{L} = n$. Moreover, relation (2.1) implies that $\Delta \log c = \Delta \log P$, and relation (b) of system (2.2) implies that $\Delta \log K = \Delta \log w - \Delta \log P + \Delta \log L$, which, together with (2.5), yields $\Delta \log Y = \Delta \log K$. Thus,

$$\Delta \log Y = \gamma + n$$

so that:

$$\text{NAIRU} = e^{\frac{-(1-\phi)\gamma+\rho}{\eta}} > 0 \quad (2.7)$$

which implies $L^* < \bar{L}$. Consequently, real wage growth is given by,

$$\Delta \log (w/P) = \gamma$$

Of course, the constancy of the *NAIRU*, as here, can be over-turned if we declare market prices as the relevant deflator of real wages (in which case equilibrium

unemployment is a function of average taxes, which in fact accords with typical union bargaining models), or if the deflator used is the consumer price index (rather than simply the domestic deflator), in which case, it the *NAIRU* would vary with the terms of trade.

2.4 Calibration of the Supply Side Parameters

The theoretical model as just described contains 5 parameters, β , ε , γ , A , and n , (i.e., the elasticity of output with respect to capital; the price elasticity of demand; the growth rate of exogenous labour productivity; technical level in the production function; and the growth rate of the labour supply) and 5 real variables (Y , L , K , c/P , w/P). Denoting the sample mean operator by a bar above a variable, and using system (2.2), we calibrated these parameters as,

$$\hat{\beta} = \overline{\left(\frac{(r + \delta)K}{\frac{w}{P}L + (r + \delta)K} \right)}; \hat{\varepsilon} = \overline{\left(\frac{PY}{PY - wL - cK} \right)}; \hat{\gamma} = \overline{\left(\Delta \log \left(\frac{w}{P} \right) \right)}$$

and

$$\hat{A} = \overline{\left(\frac{Y}{K^{\hat{\beta}} (e^{\hat{\gamma}t} L)^{1-\hat{\beta}}} \right)}; n = \overline{(\Delta \log(\bar{L}))}$$

2.5 Solving the model

The relations (2.3) and (2.4) close the model and enable the whole *real* side of the steady state of the economy to be solved. These two relations determine the *NAIRU* and thereby the long-run level of labour. The latter being given, the solution of system (2.2) provides the steady state levels of Y , K , and w/P as functions of the parameters of the model and the real user cost of capital. The nominal variables of the model are not determined by the supply side and do not affect the real economy in the long run.

2.5.1 Desired level of capital, long run real wages, and potential output.

The desired level of capital, denoted by K^* , corresponds to the level of the capital stock that solves the maximization problem of the firm, for a given aggregate demand Y and a relative price of capital c/w (see equation (b) of system (2.2)):

$$K^* = \frac{Y}{Ae^{(1-\beta)\gamma t}} \left[\frac{\beta w}{(1-\beta)P(r+\delta)} \right]^{1-\beta} \quad (2.8)$$

In the MCM, the long run targets appear in logarithms in the error correction term of the short run dynamic equations:

$$\log(K^*) = \log(Y) + (1 - \hat{\beta}) \left[\log \left(\frac{\hat{\beta} w}{(1 - \hat{\beta}) P (r + \delta)} \right) - \hat{\gamma} t \right] - \log(\hat{A}) \quad (2.9)$$

Basically, K^* depends on the (calibrated) elasticity of output to capital, $\hat{\beta}$, and on labour productivity growth, $\hat{\gamma}$.⁴ The desired level of the capital stock is,

$$\log(K^*) = \log(Y) + (1 - \hat{\beta}) \left[\log \left(\frac{\hat{\beta}w}{(1 - \hat{\beta})P(r + \delta)} \right) - \hat{\gamma}t \right] \quad (2.10)$$

using the standard law of motion for capital,

$$K = (1 - \delta)K_{t-1} + I$$

we can derive long-run desired investment,

$$\log(I^*) = \log \left(\frac{\hat{\gamma} + \hat{n} + \delta}{1 + \hat{\gamma} + \hat{n}} \right) + \log(K^*) \quad (2.11)$$

where K^* is defined by equation (2.10), so that I^* also depends on the real cost of capital. Similarly, potential output and the target value of real wages are respectively drawn from relations (a) and (c) of system (2.2):

$$\log \left(\frac{w^*}{P} \right) = \log \left(\frac{(1 - \hat{\beta})(\hat{\varepsilon} - 1)}{\hat{\varepsilon}} \right) + \log \left(\frac{Y}{L} \right) \quad (2.12)$$

$$\log(Y^*) = \log(A) + \hat{\beta} \log(K) + (1 - \hat{\beta}) \log(L) + (1 - \hat{\beta})\hat{\gamma}t \quad (2.13)$$

2.5.2 The desired level of labour.

As mentioned earlier, the Phillips curve is vertical in the long run. The long run unemployment rate, together with the exogenous labour force, determine the long run level of labour: $L^{**} = (1 - NAIRU)\bar{L}$. With a constant *NAIRU* and an exogenous labour force, this specification will however generally not provide a relevant target for the dynamics of actual employment. The reason is that the relevant information necessary to model the labour force and labour participation in a satisfactory way is not available in the MCM framework, where labour force is modelled as a simple autoregressive process. In order to have a good fit of the short term dynamic employment equation, we will therefore not use L^{**} in the definition of the error correction term. Instead, the common practice in the MCM framework is to define the latter as the difference between actual employment L and an ad hoc reference level L^* , which is derived from the production function (see equation (a) of system (2.2)):

$$\log(L^*) = \frac{1}{1 - \hat{\beta}} \left[\log(Y) - \hat{\beta} \log(K) - \log(A) \right] - \hat{\gamma}t \quad (2.14)$$

Since this definition is a re-writing of relation (2.13), the employment gap $L - L^*$ that we will use in the short run dynamic equation of labour is in fact a re-writing of the output gap $Y - Y^*$ (see Section (2.3.1)). In the long run, the convergence process of

⁴Note, the gap between actual and desired variables may exhibit some drifts in-sample. To obtain a stationary gap, we have, where necessary, included constants and deterministic time trends over and above those required in the estimation, these ensure that the error correction terms are mean stationary.



the supply side to its steady state takes place as follows. First, actual employment will converge toward the reference level L^* . Given equations (2.13) and (2.15), this ensures, by construction, that the output gap closes in the long run. Finally, employment adjusts to its long term level L^{**} thanks to the Phillips curve, whose verticality in the long run warrants that the unemployment rate converges toward the *NAIRU* and, therefore, that L converges toward L^{**} .

2.6 The Demand Side and Output Components

In order to allow a flexible econometric estimation of GDP components, the specification of the demand side of the MCM is not formally derived explicitly from microeconomic theory.

2.6.1 Households' Behaviour

The households sector only includes one behavioural equation for private consumption, which is a fairly standard specification. We do not, for example, consider housing investment separately. Private consumption (PCR) is a function of real disposable income (PYR), comprising compensation, transfers of taxes and other income, and of real financial wealth (FWR), defined as cumulated savings under the assumption that households own all of the assets in the economy (i.e. public debt, net foreign assets, and private capital stock):⁵

$$\log(PCR^*) = a + b \log(PYR) + c \log(FWR) + \varepsilon \quad (2.15)$$

where a , b , c are coefficients and ε denotes all other factors, including relevant adjustments in terms of dummies or trends. This specification thus accommodates life-cycle theory and (Keynesian) liquidity-constrained features in determining aggregate consumption.

2.6.2 Trade

Real exports (XTR) and imports (MTR) are modelled in a standard fashion, whereby market shares (in terms of world demand, WDR , and domestic demand, WER , respectively) are a function of a competitiveness indicator involving export and domestic prices (XTD and YFD respectively) and competitors' prices on the import and the export side (MTD and CMD respectively):

$$\log(XTR^*) - \log(WDR) = c + \underset{(-)}{d} \log\left(\frac{XTD}{CMD}\right) + \varepsilon_{xtr} \quad (2.16)$$

$$\log(MTR^*) - \log(WER) = e + \underset{(-)}{f} \log\left(\frac{MTD}{YFD}\right) + \varepsilon_{mtr} \quad (2.17)$$

⁵Note, a full listing of all model mnemonics is given in appendix A.

3 The estimated equations

Equations were estimated using ESA-95 seasonally-adjusted quarterly macroeconomic aggregates over the sample 1980q1-2003q4. The econometric methodology relies on the familiar Engle-Granger two-step cointegration approach: first we estimate the long run relations, then we estimate the dynamic model equation by equation importing the long-run relationship as the relevant error-correction term. Dynamic homogeneity conditions have been tested throughout the estimation process and, where accepted statistically, have been implemented.

3.1 The Supply Side

The calibrated parameters are reported in the table below. These were calibrated on the basis on sample means, as discussed earlier in section 2.4. The inflation target is set consistent with a yearly 2% average, a condition, though, which was generally not met in the historical data. Thus,

Calibrated parameters		
factor share	$\hat{\beta}$	0.448
growth rate of productivity	$\hat{\gamma}$	0.001
growth rate of labour force	\hat{n}	0.001
demand elasticity	$\hat{\varepsilon}$	3.880
scale factor in C-D production	\hat{A}	1.015
target inflation rate	π^*	0.005
depreciation of capital	$\hat{\delta}$	0.010
NAIRU	<i>nairu</i>	0.085

From this table we can pin down key growth rates relevant for the steady state of the model: the real growth rate of the economy (e.g., the rate for output and consumption) is given by $(1 + \hat{n}) \cdot (1 + \hat{\gamma})$; price levels grow at $(1 + \pi^*)$; nominal volumes at $(1 + \pi^*) \cdot (1 + \hat{n}) \cdot (1 + \hat{\gamma})$; demographic variables at $(1 + \hat{n})$; and productivity (and, consequently, real wages) at $(1 + \hat{\gamma})$. Having pinned down these key components, the estimation of the long run amounts, where necessary, to accommodating additional data-fitting features such as additional constant and (linear and quadratic) time trends, which ensure that the error correction terms are mean stationary and that the (later) dynamic equations have sound tracking properties.

The long run (or desired values) on the supply side are thus: potential output, factor inputs and the real wage (i.e., the ratio of the nominal wage to the GDP deflator at factor cost). Their estimations are shown below. Some points to note: (i) our supply side is independent of taxes and, by definition, of relative prices; (ii) the production function is simply the constant-returns Cobb-Douglas production function with a given

exogenous technical progress; (iii) the target labour input is the inverse of the production function; (iv) desired capital is, in line with our above exposition, determined by real (producer) wages, potential output and the real user cost of capital. Real wages, finally, (v), are homogenous to (labour) productivity.

Potential Output		
Endog: $\log(YFT)$ -eq.(2.13)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	0.015	–
$\log(KSR)$	0.45	–
$\log(LNN)$	0.55	–
<i>TIME</i>	0.0006	–
<i>ONES</i>	–0.169	–28.06
<i>TIME_A</i>	0.0053	20.36
<i>TIME_A²</i>	–0.00003	–12.81

Labour Input		
Endog: $\log(LSTAR)$ -eq.(2.14)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	–0.027	–
$\log(KSR)$	–0.818	–
$\log(YER)$	1.818	–
<i>TIME</i>	–0.001	–
<i>ONES</i>	0.305	28.06
<i>TIME_A</i>	–0.00954	–20.36
<i>TIME_A²</i>	0.00005	12.81

Capital Input		
Endog: $\log(KSTAR)$ -eq.(2.10)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	–0.122	–
$\log(WUN/YFD)$	0.550	–
$\log(YER)$	1.000	–
$\log(CC0)$	–0.550	–
<i>TIME</i>	–0.0006	–
<i>ONES</i>	–0.21	–12.40

Real Wages		
Endog: $\log(RWUNSTAR)$ -eq.(2.12)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	–0.892	–
$\log(PRO)$	1.000	–
<i>ONES</i>	0.154	–
<i>TIME_A</i>	–0.0011	–12.95

3.2 Short run dynamics

To repeat, in estimation we follow the Engle-Granger (single-equation) cointegration methodology where the long run (as detailed above) becomes the relevant error correction between the actual series and its target. Moreover, where dynamic homogeneity is present, this has been tested for. Static homogeneity is an imposed feature of the model given the, for example, steady-state requirement that all nominal series grow at a common rate.

In estimation, note, polynomial lengths are relatively tight reflecting the properties of the data and our own modelling strategy. All equations residuals have been tested for stationarity and to improve the fit of the equations and to accommodate some outliers, dummies have been incorporated when statistically accepted (these are listed in appendix c). In what follows, we present the estimation of the equations followed by a graph of its in-sample residual, and then the contributions of each of the indicators to the in-sample development of the dependent variable.

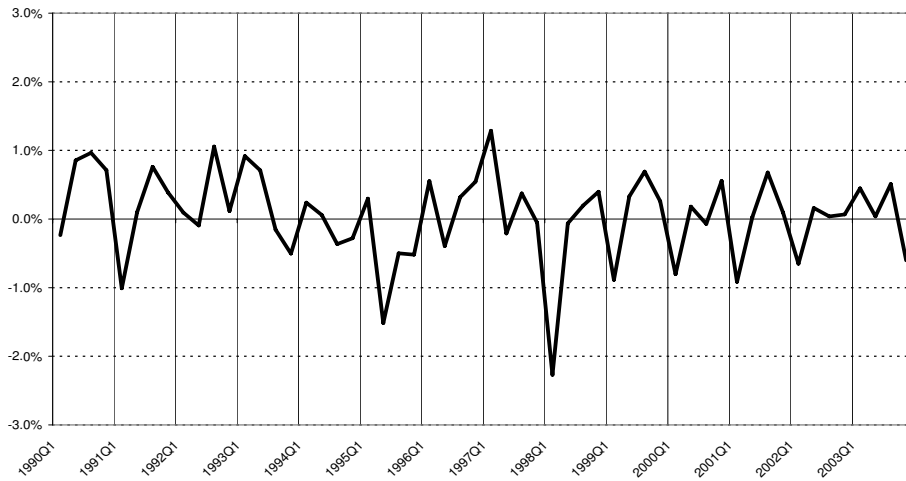
3.2.1 The Phillips curve

The first estimated equation we report here is the Phillips curve, which plays a crucial role in equilibrating the real and nominal sides of the economy (i.e., ensuring unemployment tends to its *NAIRU*, that real wages tend to labour productivity and that nominal variables grow at a common steady-state rate). Equation 2.3 is estimated using a long run relation whereby real wages match trend (labour) productivity growth. As can be seen from the estimation table, real wages are indexed in the short run on the consumer price deflator but, in the long run, on the producer price. The inclusion of the unemployment rate captures wage pressures coming from the probability of becoming unemployed and the consumer/producer price wedge measures the difference between the compensation paid by firms and that received by households (reflecting such things as taxes, terms of trade effects, relative bargaining powers etc.). As can be seen all parameters have the required sign with, notably, the productivity entering relatively strongly, although unemployment and wage terms are admittedly of borderline significance. The equation has been estimated under some restrictions on the coefficients reflecting 'dynamic homogeneity'. Accordingly, we ensure that productivity and real wages grow at rate $\hat{\gamma}$ in the long run, unemployment converges to a constant exogenous *NAIRU*, and that all deflators grow at a common steady state value, π^* . Consistently with these requirements, the coefficients of the equation satisfy the restriction $(1 - 0.081 - 0.355)\hat{\gamma} \simeq 0.0006$. The resulting Wald statistics for testing this restriction has a probability value of 0.1, and is thus accepted.

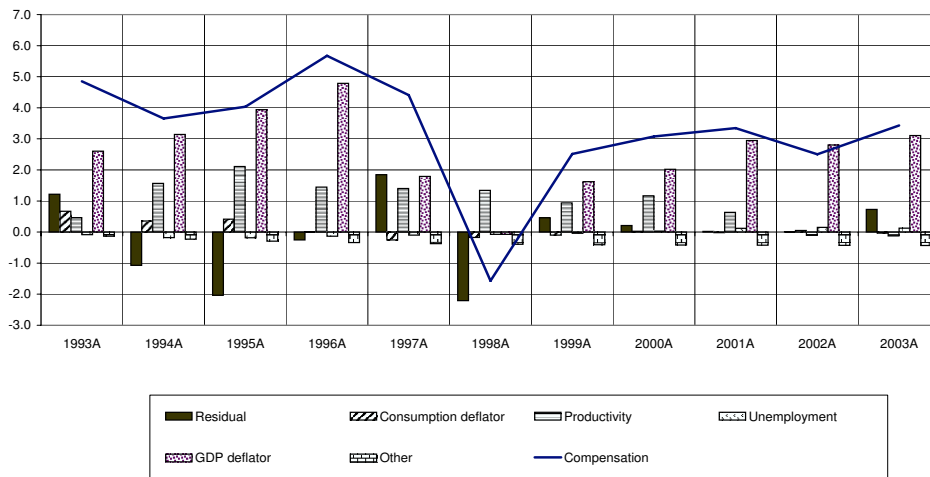
Phillips curve

Expl. Vars:	Endog: $\Delta \log \left(\frac{WUN}{PCD} \right)$	coefficient	t-stat
<i>cst</i>		0.0006	2.89
$\Delta \log \left(\frac{WUN(-1)}{PCD(-1)} \right)$		0.081	0.84
$\Delta \log(PCD)$		0.355	2.18
$\log(URX/100) - \log(NAIRU)$		-0.011	-1.64
$\Delta \log \left(\frac{PCD}{YFD} \right)$		-0.776	-1.92
$\log \left(\frac{WUN(-1)}{YFD(-1)} \right) - \log(RWUNSTAR(-1))$		-0.11	-2.03
$R^2 = 0.35, DW = 2.07, \sigma_\varepsilon = 0.007$			

ITALY
Compensation per Employee Residual



Contributions to the growth rate of nominal wages



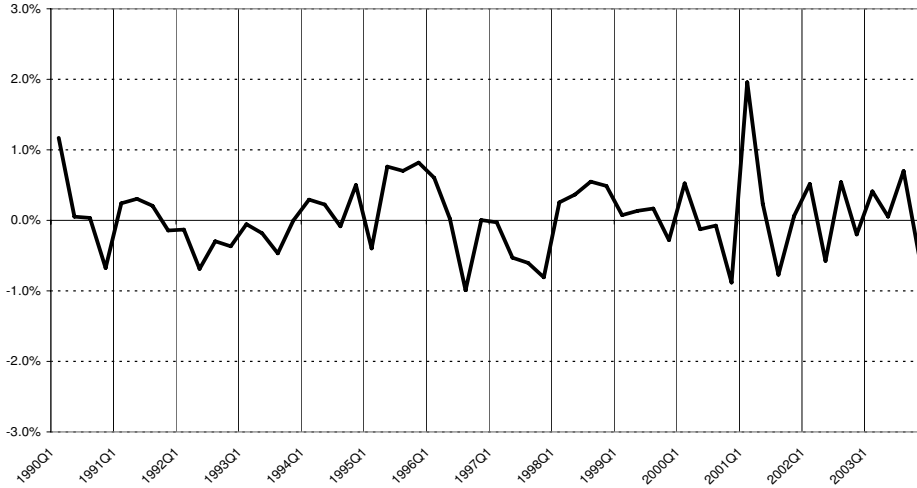
3.2.2 The value-added deflator

Next we present the GDP deflator at factor costs, which is the fundamental deflator of the model and from which all other deflators are essentially built up. The value-added deflator follows the equilibrium level defined by the value of *RWUNSTAR* but is subject to short term fluctuations implied by shifts in productivity and wage developments. Similar to the Phillips Curve, we have estimated this equation consistent with the fulfilment of dynamic homogeneity. Consequently, the coefficients satisfy the relation $(1 - 0.256) \cdot \pi^* \simeq 0.0003 + (0.291 + 0.297)(\pi^* + \hat{\gamma}) - 0.161\hat{\gamma}$, probability value = 0.163.

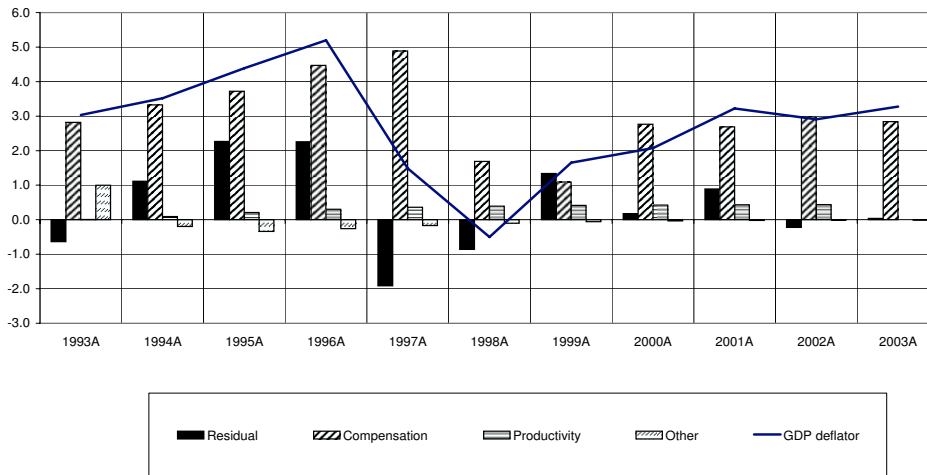
Price Equation

Expl. Vars:	Endog: $\Delta \log(YFD)$	coefficient	t-stat
<i>cst</i>		0.0003	0.94
$\Delta \log(YFD(-1))$		0.256	2.19
$\Delta \log(WUN(-1))$		0.291	3.02
$\Delta \log(WUN(-2))$		0.297	2.90
$\Delta \log(PRO(-1))$		-0.161	-2.06
$\log(RWUNSTAR(-5)) - \log\left(\frac{WUN(-5)}{YFD(-5)}\right)$		-0.06	-1.7
$R^2 = 0.83, DW = 2.03, \sigma_\varepsilon = 0.006$			

ITALY
GDP Deflator at Factor Cost Residual



Contributions to the growth rate of GDP deflator at factor costs

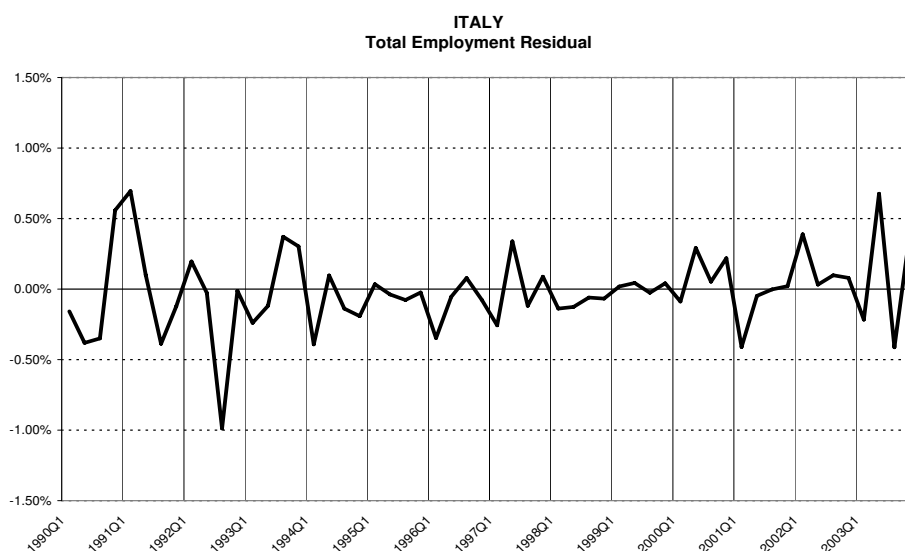


3.2.3 Employment, Labour Demand

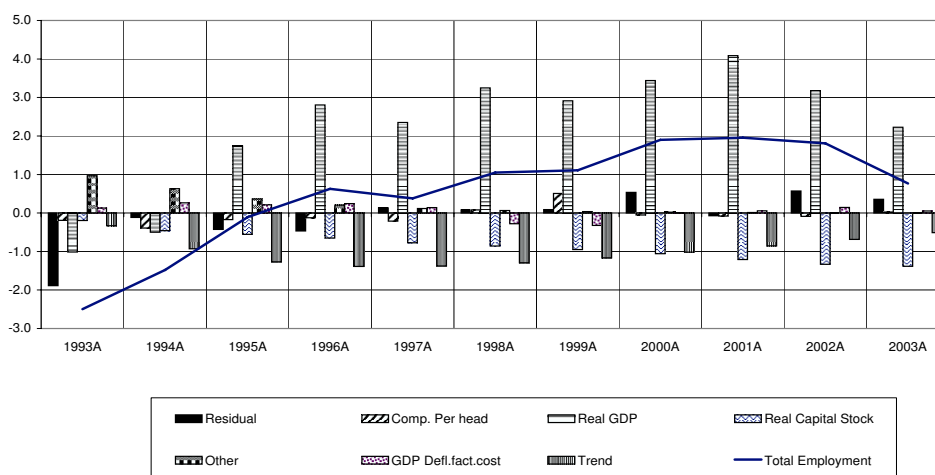
Finally, the dynamic labour demand equation is simply determined by accelerator effects and real wages (with the latter predicated on producer prices), with the equilibrium labour input defined, as discussed earlier, by the inverse of the production function.

Employment

Endog: $\Delta \log(LNN)$		
Expl. Vars:	coefficient	t-stat
<i>cst</i>	0.0004	3.17
$\Delta \log(LNN(-1))$	0.379	3.77
$\Delta \log(YER)$	0.159	4.12
$\Delta \log(WUN(-3)/YFD(-3))$	-0.067	-1.92
$\log(LNN(-2)) - \log(LSTAR(-2))$	-0.065	-4.06
$R^2 = 0.67, DW = 2.02, \sigma_\varepsilon = 0.0025$		



Contributions to the growth rate of total employment



3.3 Demand Components (Consumption, Investment, Trade) and Prices

In this section we describe both the long run and the short run dynamics of demand components (consumption and investment, trade volume), and prices.

3.3.1 Long-Run Targets

Private consumption (PCR), represented by a single aggregate good, is a weighted average of total real net financial wealth (FWR) and real disposable income (PYR). The former is defined as cumulated savings under the assumption that households own all assets in the economy, i.e. public debt, net foreign assets and private capital stock. Note, government consumption is exogenous.

For investment, the long run target is derived directly from equation (2.11). Note, government investment is exogenous.

Concerning long-run trade developments, exports (XTR) and real imports (MTR) are modelled in terms of market shares. i.e. as ratios of world demand (WDR) and domestic demand (WER) respectively. They are functions of a competitiveness indicator comprising export prices and export competitors' prices (XTD and CXD) for exports, and import and domestic price (YFD and MTD) for imports. Competitor prices are computed as weighted averages of external and internal prices.

It is well-known that Italy has been losing market shares for a number of years (i.e., export demand has fallen short of that of total world demand). This stylized fact is reflected by the very strong negative coefficient on relative prices, and out of

sample, but the dominance of the net trend. Note, our trade equations implicitly fulfil the Marshall-Lerner condition which states the (absolute) sum of price elasticities in export and imports should exceed unity.

Also shown are the estimation for the long run import and export prices (MTDSTAR and XTDSTAR, respectively). These equations are standard: long-run import prices depend on domestic prices, Competitors Import prices (in domestic currency), and energy import prices; whilst export prices depend on domestic and competitors export prices (in domestic currency). Note, the imposition of static homogeneity in both equations - i.e., the coefficients of the main regressors sum up to unity - which, of course, implies that at the steady state of the economy these deflators will grow at the common rate π^* .

Finally, regarding non-trade prices we report below the target for the HICP excluding energy, given that the GDP deflator at factor cost has already been shown. This, as in other deflators, is assumed to be a function of unit labour costs, with the static adding-up homogeneity condition (p-value=0.25).

Consumption

Endog: $\log(PCRSTAR)$ - eq. (2.15)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	-2.85	-
$\log(PYR)$	0.22	-
$\log(FWR/PYR)$	0.78	-

Investment

Endog: $\log(IPRSTAR)$ - eq. (2.11)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	-4.4126	-
$\log(KSTAR)$	1.000	-
<i>ONES</i>	-0.05	-0.72
<i>TIME_A</i>	-0.004	-4.56

Imports

Endog: $\log(MTRSTAR)$ -eq.(2.17)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	-0.430	-25.97
$\log(WER)$	1.000	-
$\log(MTD/YFD)$	-0.518	-12.33
<i>dumt01</i>	0.072	6.53
<i>TIME_A</i>	0.0027	9.22

Exports

Endog: $\log(XTRSTAR)$ -eq.(2.16)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	5.66	-10.22
$\log(WDR)$	1.000	-
$\log(XTD/CXD)$	-0.71	-9.50
<i>TIME_A</i>	0.0067	6.64
<i>TIME_A²</i>	-0.000079	-9.15

The Import Deflator

Endog: (<i>MTDSTAR</i>)		
Expl. Vars:	coeff	t-stat
<i>cst</i>	-4.280	-19.464
$\log(YFD)$	0.376	15.01
$\log(CMD)$	0.577	18.965
$\log(PEI)$	0.046	3.023
<i>dumt03</i>	0.054	9.380

The Export Deflator

Endog: $\log(XTDSTAR)$		
Expl. Vars:	coeff	t-stat
<i>cst</i>	-1.977	-9.46
$\log(CXD)$	0.274	9.56
$\log(YED)$	0.726	25.31
<i>TIME_A</i>	-0.001	-4.16
<i>dumt01</i>	0.0003	3.41

HICP (Excluding Energy)		
Endog: $\log(\text{HEXPSTAR})$		
Expl. Vars:	coeff	t-stat
<i>cst</i>	4.73	–
$\log(YFD)$	0.90	–
$\log(MTD)$	0.10	–
TIME_A	–0.004	–15.24
TIME_A^2	0.000025	11.20

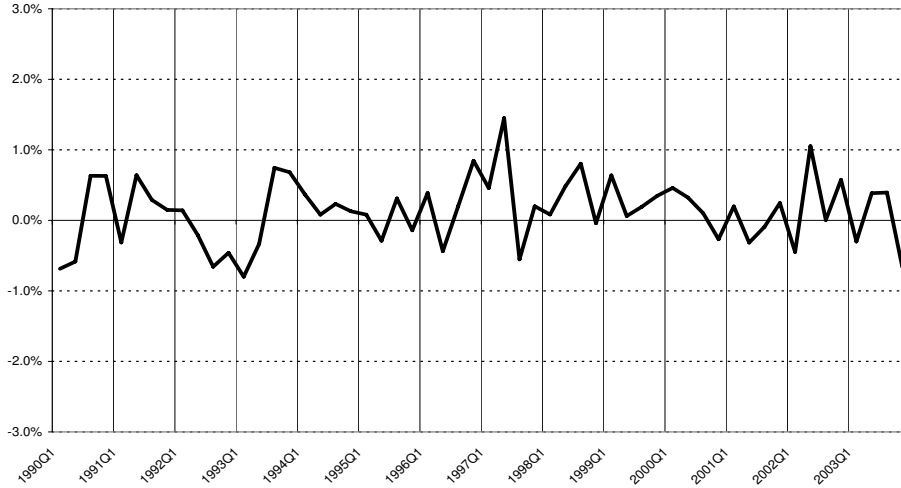
3.3.2 Short-run Dynamics

Consumption, in the short-run is driven by its own dynamics, growth in real disposable income, and unemployment. Note the unemployment rate was statistically insignificant (this may be due to collinearity with disposable income, since they both essentially capture the role of liquidity-constrained consumer) but has been retained for reasons relating to simulation properties. Similarly, the long-run error correction is insignificant; this reflects our general difficulties in pinning down the long run consumption profile of the Italian economy, which may be related in the past to the effects of financial liberalization, public debt positions and different inflation and tax regimes: identification of these effects however proved problematic.

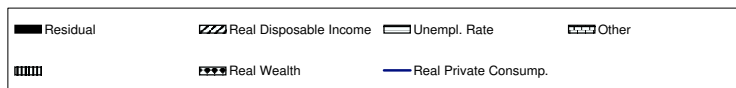
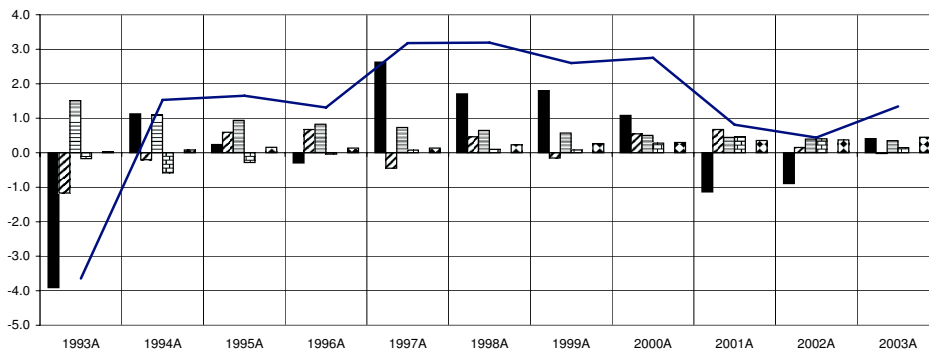
Real private consumption

Endog: $\Delta \log(PCR)$		
Expl. Vars:	coeff.	t-stat
<i>cst</i>	0.0016	1.46
$\Delta \log(PCR(-1))$	0.558	4.72
$\Delta \log(PYR)$	0.124	2.06
$\Delta \log(URX(-2/100))$	–0.02	–0.99
$\log(PCR(-1)) - \log(PCRSTAR(-1))$	–0.012	1.46
$R^2 = 0.63, DW = 1.88, \sigma_\varepsilon = 0.005$		

ITALY
Real Private Consumption Residual



Contributions to the growth rate of private consumption

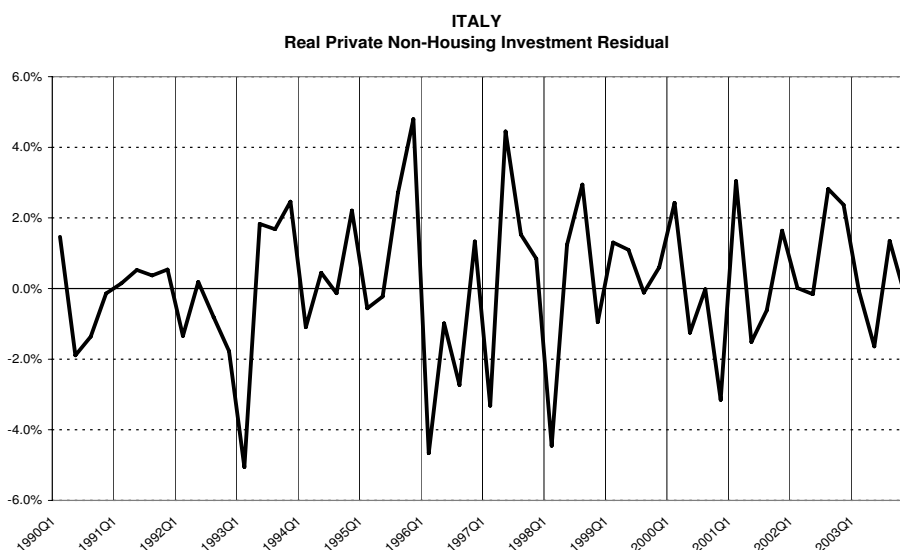


3.3.3 Real private non-housing investment

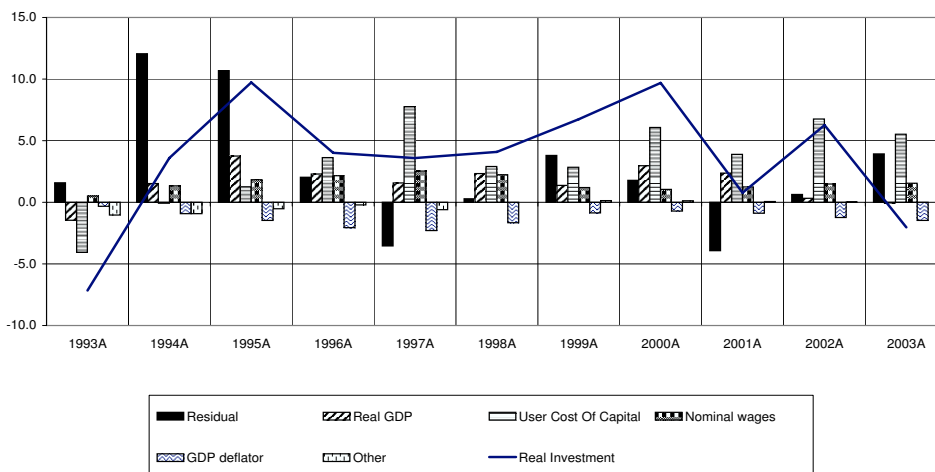
The specification used for investment is a very simple accelerator one, with a long run defined by *IPRSTAR*. However, other variables have considerable indirect effects, as it can be seen from the contribution chart. For instance the real cost of capital produces some impact on investment dynamics through the error correction specification.

Real private non-housing investment

Endog: $\Delta \log (IPR)$		
Expl. Vars:	coeff.	t-stat
<i>cst</i>	0.0018	0.35
$\Delta \log (IPR(-1))$	0.320	2.29
$\Delta \log (IPR(-2))$	0.275	2.94
$\Delta \log (YER)$	0.547	0.35
<i>dumt031</i>	-0.134	-4.73
$\log(IPR(-1)) - \log(IPRSTAR(-1))$	-0.06	-1.07
$R^2 = 0.53, DW = 2.17, \sigma_\varepsilon = 0.03$		



Contributions to the growth rate of real investment

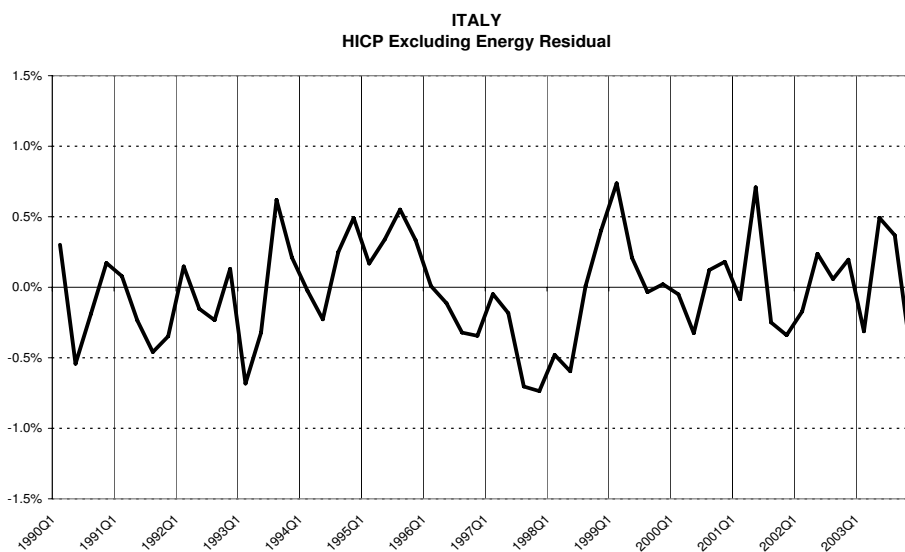


3.3.4 Harmonised Index of Consumer Prices

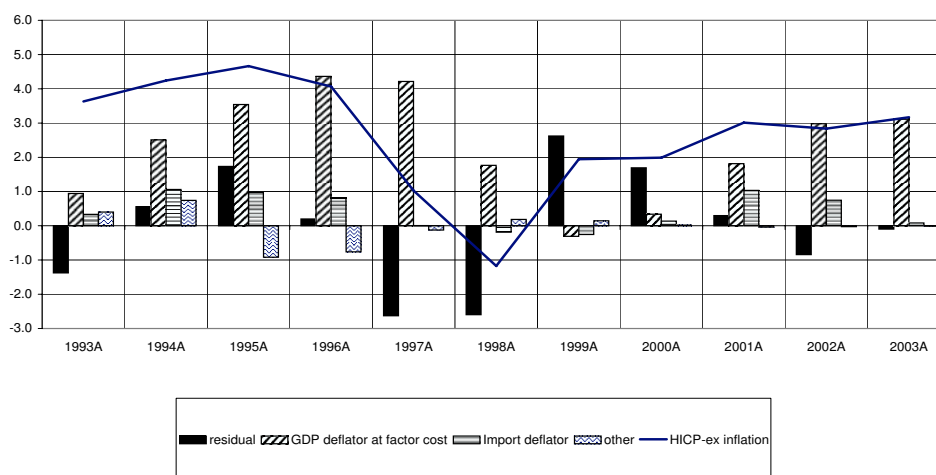
For simulation purposes, the HICP is not strictly needed since it is essentially a pass through of other prices. However, it is of course used in the context of projection exercises. In projections, the IT-MCM comprises three additional HICP variables: total HICP, HEG (HICP energy) and HEXP (HICP excluding energy). HEXP, the single behavioural equation of the three, is determined by its own lags and those of the GDP deflator at factor cost, import prices, and, since the HICP series were not seasonally adjusted, seasonal dummies.

HICP excluding energy (HEXP)

Endog: $\Delta \log (HEXP)$		
Expl. Vars:	coeff.	t-stat
<i>cst</i>	0.001	0.84
$\Delta \log (HEXP(-2))$	-0.626	3.48
$\Delta \log (YFD(-2))$	-0.036	-0.33
$\Delta \log (YFD(-3))$	-0.009	-0.06
$\Delta \log (MTD)$	-0.005	-0.25
<i>DUMMYQ1</i>	0.003	2.52
<i>DUMMYQ2</i>	0.004	2.51
<i>DUMMYQ3</i>	-0.0008	-0.55
$\log(HEXP(-3)) - \log(HEXPSTAR(-3))$	-0.142	-1.40
$R^2 = 0.85, DW = 1.31, \sigma_\varepsilon = 0.003$		



Contributions to the growth rate of HICP ex-energy



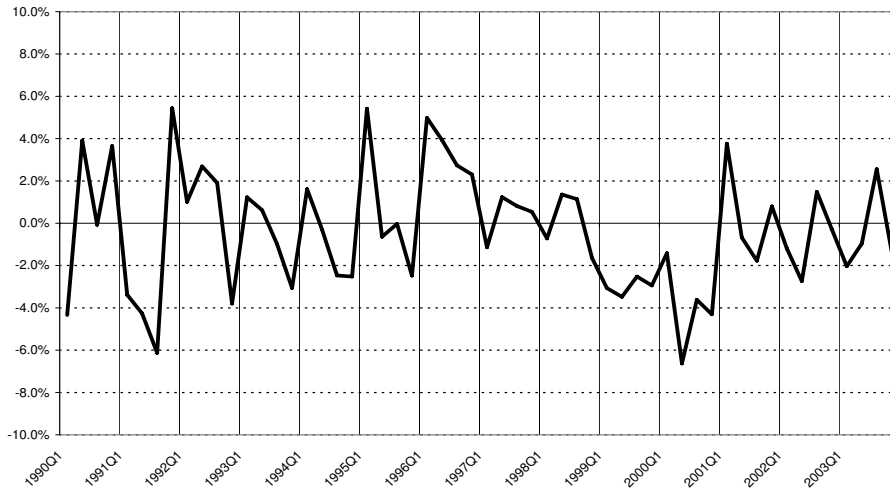
3.3.5 Trade: Volumes and Prices

The dynamics of real exports demand depend upon its own lags, world demand, relative prices and the real exchange rate. Imports demand are largely the corresponding equivalent of this. As regards trade prices, export prices are a dynamic function of their own lags, the GDP deflator at factor cost, and competitiveness. The dynamics of import prices, similarly, are a function of its own lags, competitiveness and the price of imported energy products.

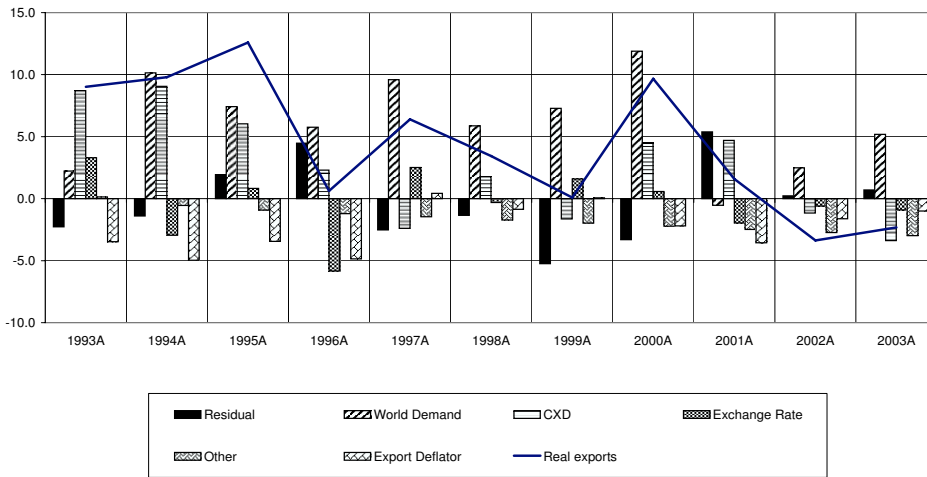
Real exports

Endog: $\Delta \log (XTR)$		
Expl. Vars:	coeff.	t-stat
cst	-0.016	-2.16
$\Delta \log (XTR(-1))$	-0.207	-1.09
$\Delta \log (WDR)$	1.729	3.18
$\Delta \log \left(\frac{XTD}{CXD}(-4) \right)$	-0.175	-1.67
$\Delta \log (EEN)$	0.743	1.87
$\log (XTR(-1)) - \log (XTRSTAR(-1))$	-0.431	-1.69
$R^2 = 0.25, DW = 1.72, \sigma_\varepsilon = 0.031$		

ITALY
Real Exports Residual

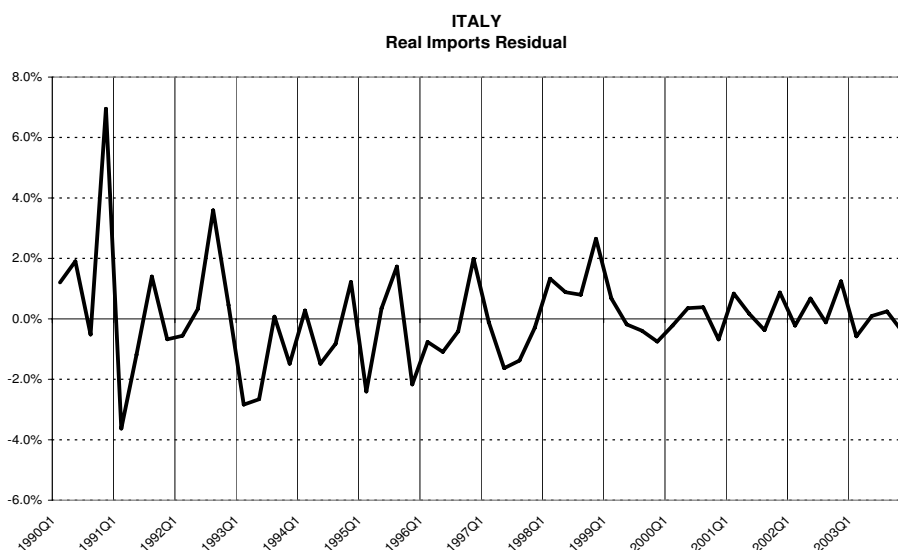


Contributions to the growth rate of real exports

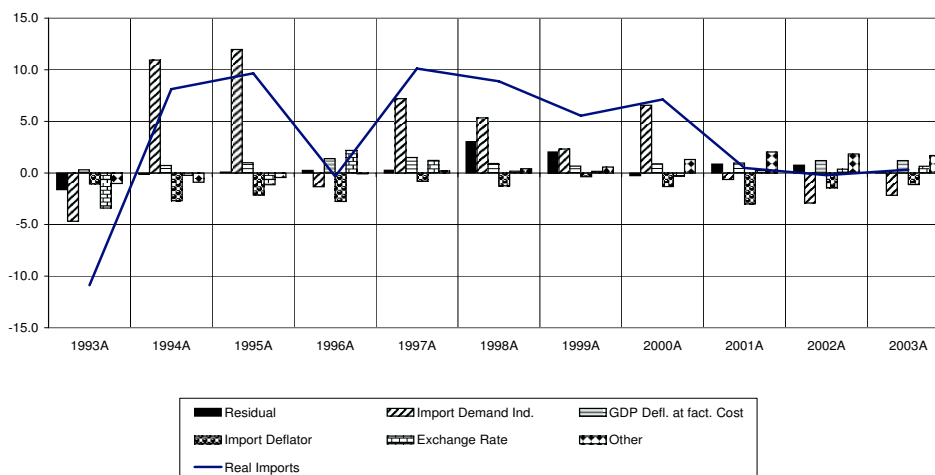


Real imports

Endog: $\Delta \log (MTR)$		
Expl. Vars:	coeff.	t-stat
<i>cst</i>	-0.0027	-1.004
$\Delta \log (MTR(-1))$	-0.299	-2.97
$\Delta \log (WER)$	1.932	5.04
$\Delta \log (WER(-1))$	0.83	3.83
$\Delta \log (MTD/YFD(-4))$	-0.069	-1.04
$\Delta \log (EEN0(-1))$	-0.277	-1.94
$\log (MTR(-1)) - \log (MTRSTAR(-1))$	-0.077	-1.44
$R^2 = 0.73, DW = 2.24, \sigma_\varepsilon = 0.019$		



Contributions to the growth rate of real imports



Export deflator

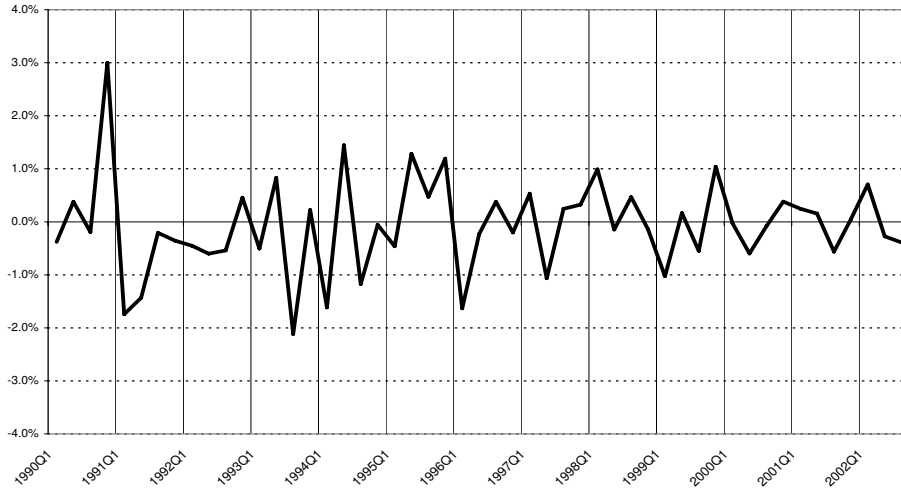
Endog: $\Delta \log(XTD)$

Expl. Vars:	coeff.	t-stat
cst	-0.001	-0.81
$\Delta \log(XTD(-1))$	-0.41	3.94
$\Delta \log(CXD)$	0.209	3.81
$\Delta \log(YFD)$	0.649	3.08

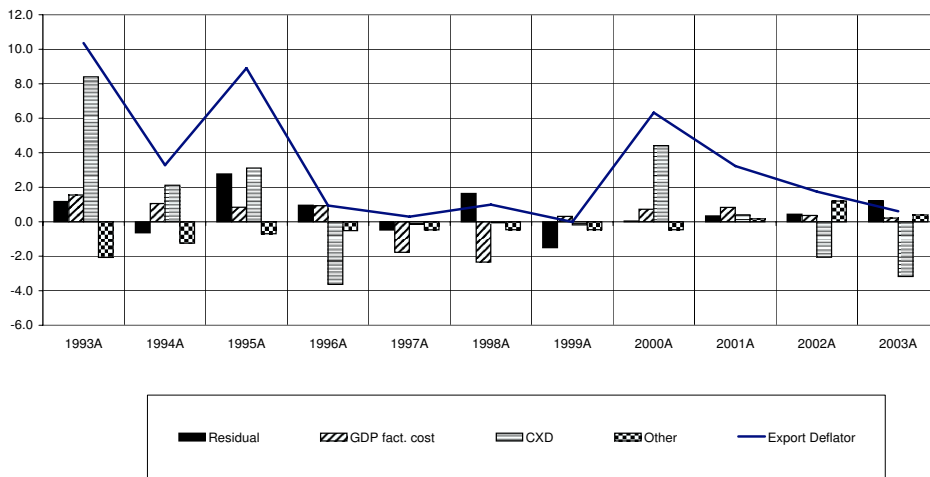
$\log\left(\frac{XTD_{(-1)}}{XTDSTAR_{(-1)}}\right)$	-0.295	-3.6
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$R^2 = 0.77, DW = 2.19, \sigma_\varepsilon = 0.008$

ITALY
Export Deflator Residual

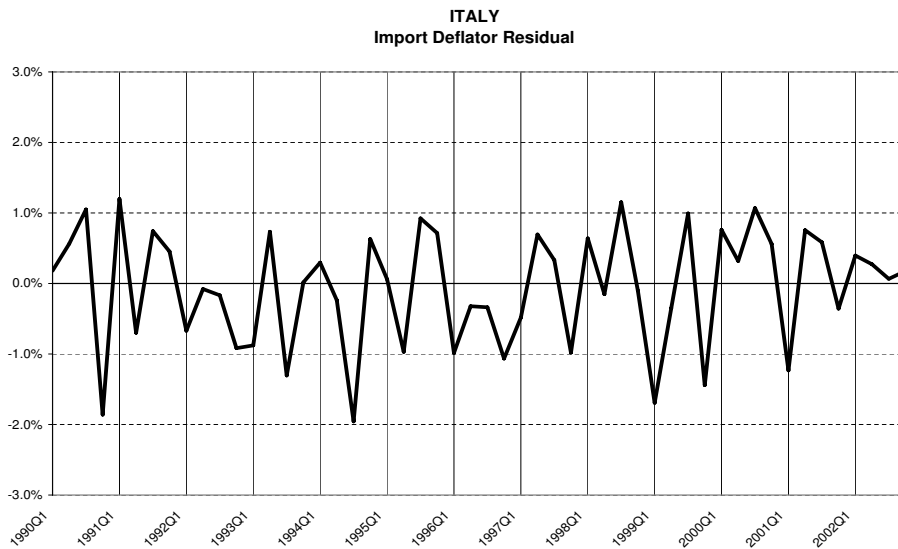


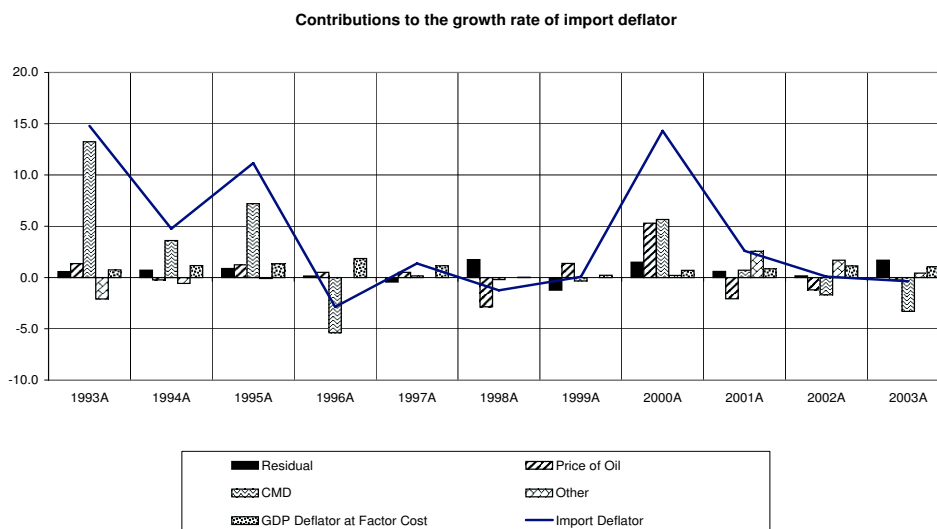
Contributions to the growth rate of export deflator



Import deflator

Expl. Vars:	coeff.	t-stat
<i>cst</i>	-0.0034	-2.00
$\Delta \log (MTD(-1))$	0.244	5.28
$\Delta \log (MTD(-2))$	0.137	3.05
$\Delta \log (YFD(-1))$	0.562	3.34
$\Delta \log (CMD)$	0.435	10.38
$\Delta \log (PEI)$	0.07	4.34
$\log \left(\frac{MTD_{(-1)}}{MTDSTAR_{(-1)}} \right)$	-0.5	-4.73
$R^2 = 0.92, DW = 2.22, \sigma_\varepsilon = 0.007$		





4 The Steady State and Simulation Properties of the Italian MCM

To illustrate dynamic and steady-state model properties, we have subjected the model to a number of standard simulations: permanent increases in (i) exogenous prices, (ii) government consumption, (iii) the price of oil, (iv) the nominal exchange rate, (v) world demand, (vi) labour supply. Our emphasis on permanent shocks reflects the fact that such shocks are the real test of the steady-state properties of the model. To anticipate our results, we can say that all demand shocks have essentially no long-run effect on the model's trajectory: the real growth rate (and indeed all real series) of the economy returns to its steady-state rate and all inflation rates return to their target exogenous value. Given the effect of base drift and the assumed absence of explicit price targeting by the monetary authorities, the level of prices, in general, do not return to their pre-shock level. Finally, whilst the level of GDP returns to base, its components need not: for example in any particular simulation, consumption can be below or above base reflecting the level of domestic-to-foreign prices and thus its implied import content.

4.1 Policy Rules

However, before coming to the simulations themselves, we fill out the remaining key relationships of the model, namely the monetary and fiscal policy rules.

4.1.1 Monetary Policy Rule

The Central bank is assumed to operate a Taylor-type rule and adjusts nominal interest rates to inflation deviations from the target and to the output gap (or more strictly, output growth⁶):

$$STI_t = \rho STI_{t-1} + (1 - \rho)400 \left[\hat{\gamma} + \hat{n} + \pi^* + 1.5 \left(PCD_t / PCD_{t-1} - \pi^* \right) + 0.5 \left(YER_t / YER_{t-1} - \hat{\gamma} - \hat{n} \right) \right] - (1 - \rho)$$

where the degree of interest-rate smoothing, ρ is typically set to 0.5. Clearly, in the long run, when the growth rate of GDP and inflation equate to their long run value target, the short-term rate is equal to the nominal growth rate of the economy ($\hat{\gamma} + \hat{n} + \pi^*$). Of course, in projection exercises, the nominal interest rate is held constant (as is the exchange rate).

4.1.2 Fiscal Policy Rule

The fiscal rule used in the model is flexible but straightforward:

$$PDX = \rho^{PDX} \cdot PDX_{t-1} + \lambda_1 (GDN/4 \cdot YEN - D^*) + \lambda_2 \left((GLN/4 \cdot YEN)_{t-1} - (GLN/4 \cdot YEN)_{t-2} \right)$$

where parameter λ measures the feedback of tax rates to deviations from policy objectives, whether that be the debt (D^*), the first deviation term, or the dynamics of deficit ratios, the second. The values of these fiscal targets were set in line with historical averages, which is just over 100 percent of GDP for Italy. The values of λ_1 and λ_2 were set to which appeared to generate plausible and stable tax trajectories, namely 0.1 and 0.01 respectively. Parameter ρ^{PDX} allows us to specify the rule as a proportional or integral control, although in most circumstance, we choose the latter.

4.2 Steady State

The procedure for setting up a steady state baseline is quite straight forward. First we divide all variables (excluding residuals) contained in the model into their underlying categories: real, nominal, demographic, constant etc. We then apply, to the end-point of the historical series, relevant extrapolations of these growth rates. Second, the out-of-sample residuals of all the equations are then inverted to produce a baseline

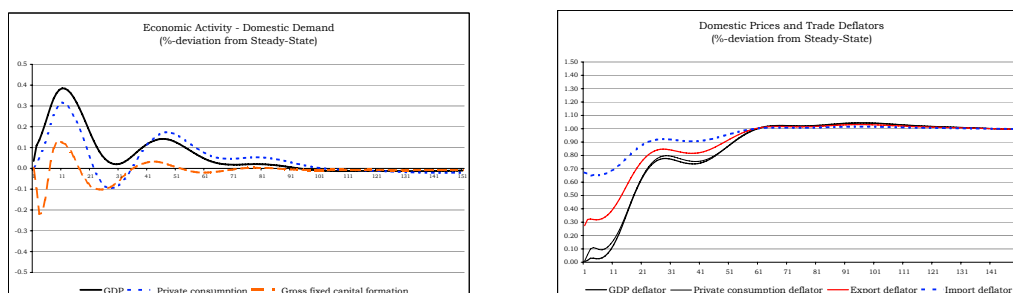
⁶Both output growth and the actual output gap can be used and results on the latter are available on request. However, the latter, tends to engender somewhat slower model dynamics, so we chose here to focus on the output growth concept. Indeed, this is also the case for the other MCM models and so we for consistency purposes we followed that approach. Moreover, much of the recent work on estimating policy rules has in fact used output growth instead of output gaps (which can be highly sensitive to detrending and calculation methods), see the recent work by Orphanides and other authors.

consistent with these implied paths. The model is then explicitly solved, to check for consistency, stability and that, in the absence of any perturbation, that the model does indeed return to a steady state with given growth characteristics. Once we have derived a model which displays suitable characteristics, we then apply standard simulations to ensure acceptable simulation properties. These are discussed below.

4.3 Illustrative Simulations

4.3.1 Shocks to Price and Nominal Variables

The purpose of this shock is to check that nominal neutrality holds in the steady state of the model. Accordingly, all exogenous and foreign prices of the model (e.g. oil, imported energy, competitors' prices, etc.) have been increased by 1% above the baseline. As expected, all of the endogenous prices react positively and converge to a higher steady state, in a fairly monotonic manner, with an eventual full pass-through of +1%. The shock also has an impact on the real economy in the short run: price competitiveness improves and GDP rises, initially. In particular, real trade variables keep on adjusting as long as relative prices (domestic/foreign) depart from their steady state (as they will when a positive output gap arises). The initial effects vanish as domestic agents adjust their own prices, and the operation of tax and interest rate come into effect. In the long run, all real variables of the economy go back to their baseline, as shown in the charts below. Inflation rates (for the various deflators) return to their long run rate, although, as said, there is necessarily a level effect on prices (of 1%).



4.3.2 Permanent shock to government consumption

In this simulation, real government consumption has been increased permanently by 1% above baseline GDP. The mechanics of this type of demand shock are relatively well known: through the operation of the multiplier and accelerator mechanism, the increase in public expenditure raises, respectively, consumption and investment and thus the overall level of output with the initial GDP multiplier effect is around 1% rising to a maximum of 1.5% (for a closed-economy model above-unity multipliers are not uncommon). Given rigidities in price and wage setting these effects persist for several quarters yielding higher real wages and additional employment.

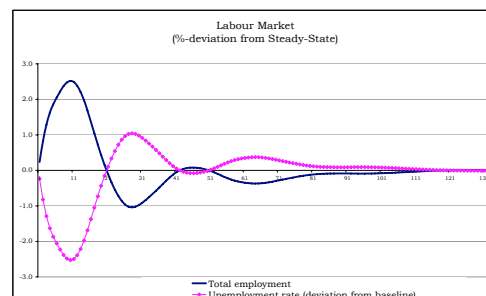
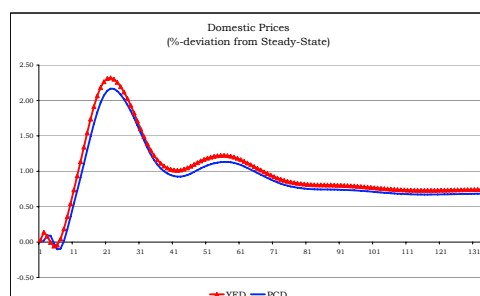
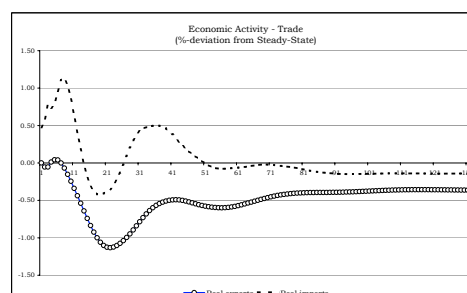
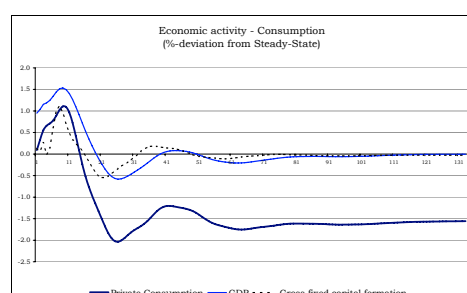
Table 1(a): Permanent increase in all foreign and exogenous prices

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Economic Activity (constant prices)									
GDP	0.04	0.11	0.14	0.17	0.21	0.26	0.30	0.34	0.36
Private consumption	0.00	0.02	0.05	0.08	0.12	0.17	0.21	0.26	0.29
Government consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	0.00	-0.10	-0.22	-0.21	-0.15	-0.06	0.04	0.10	0.12
Exports	0.23	0.48	0.48	0.48	0.48	0.48	0.48	0.47	0.46
Imports	0.11	0.06	-0.06	-0.12	-0.13	-0.11	-0.10	-0.09	-0.10
of which :									
Contribution of trade	0.03	0.12	0.15	0.17	0.17	0.17	0.16	0.16	0.16
Contribution of inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments									
HICP	0.02	0.06	0.09	0.11	0.10	0.10	0.09	0.10	0.12
GDP deflator	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.05	0.07
Private Consumption deflator	0.01	0.06	0.10	0.11	0.10	0.10	0.09	0.10	0.12
Exports deflator	0.27	0.32	0.32	0.32	0.32	0.32	0.33	0.34	0.35
Imports deflator	0.67	0.66	0.65	0.65	0.65	0.65	0.66	0.66	0.67
Competitors DIAG_PRICES on domestic market	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Competitors DIAG_PRICES on external markets	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Nominal Exchange Rate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market and Cost Developments									
Compensation per employee (nominal)	0.01	0.04	0.06	0.05	0.03	0.00	-0.02	-0.04	-0.05
Compensation per employee (real, GDP price)	0.00	0.02	0.03	0.02	0.00	-0.03	-0.05	-0.08	-0.12
Compensation per employee (real, Consumption price)	0.00	-0.02	-0.04	-0.06	-0.08	-0.09	-0.11	-0.14	-0.17
Productivity	0.01	0.01	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
ULC, whole economy	-0.02	-0.02	0.05	0.08	0.09	0.11	0.13	0.15	0.18
Total Labour Force	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment	0.01	0.05	0.13	0.20	0.28	0.36	0.45	0.52	0.59
Unemployment	-0.06	-0.60	-1.44	-2.27	-3.16	-4.08	-5.00	-5.88	-6.64
Unemployment rate (deviation from baseline)	-0.01	-0.05	-0.13	-0.20	-0.28	-0.37	-0.45	-0.53	-0.60

Table 1(a): Permanent increase in all foreign and exogenous prices

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Disposable Income (nominal) & Total Wealth									
Disposable income	0.04	0.13	0.19	0.23	0.30	0.38	0.47	0.53	0.57
Real disposable income	0.03	0.07	0.09	0.12	0.19	0.28	0.37	0.43	0.45
Compensation of employees	0.01	0.09	0.19	0.25	0.31	0.37	0.43	0.49	0.54
Transfers from Gal Gov.	0.04	0.12	0.17	0.20	0.24	0.28	0.33	0.38	0.43
Other Personal income	0.03	0.08	0.08	0.08	0.09	0.11	0.12	0.14	0.16
Direct Taxes (inc. SSC)	-0.01	-0.03	-0.02	-0.03	-0.09	-0.20	-0.31	-0.36	-0.31
Total Wealth	0.04	0.03	0.05	0.06	0.07	0.08	0.11	0.15	0.20
Real Total Wealth	0.03	-0.02	-0.05	-0.05	-0.03	-0.01	0.02	0.05	0.08
Saving ratio	0.02	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.01
Net Foreign Assets (ratio)	-0.05	-0.08	-0.03	0.03	0.10	0.16	0.23	0.29	0.35
Firms and Interest Rate									
Capital Stock	0.00	0.00	-0.01	-0.03	-0.04	-0.04	-0.04	-0.03	-0.02
Real Cost of Capital (average)	0.90	1.64	0.80	0.75	0.50	0.32	0.29	0.30	0.29
3-month interest rate	0.05	0.11	0.07	0.03	0.01	0.01	0.02	0.03	0.04
10-year long-term interest rate	0.04	0.10	0.06	0.04	0.02	0.01	0.02	0.03	0.03
Public Sector									
Gal Gov. Compensation of Employees	-0.01	-0.03	-0.02	-0.03	-0.09	-0.20	-0.31	-0.36	-0.31
Transfers from gal Gov.	0.04	0.12	0.17	0.20	0.24	0.28	0.33	0.38	0.43
Other Gov. Net Revenues	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Direct Taxes (inc. SSC)	-0.04	-0.12	-0.16	-0.20	-0.30	-0.44	-0.59	-0.68	-0.68
Other Direct Taxes	0.02	0.06	0.06	0.07	0.08	0.10	0.12	0.13	0.15
Indirect Taxes less Subsidies	0.05	0.07	0.08	0.11	0.14	0.18	0.23	0.28	0.32
Gen. Gov. Net Debt	0.00	0.09	0.15	0.17	0.18	0.20	0.26	0.35	0.45
Gen. Gov. Net Lending (% of GDP)	-0.02	-0.10	-0.05	-0.01	-0.01	-0.04	-0.08	-0.11	-0.11
Gen. Gov. Net Debt (% of GDP)	-0.04	-0.04	-0.02	-0.03	-0.07	-0.09	-0.08	-0.03	0.03

However, a number of mechanisms react such as to dissipate the positive effect of this shock. First, there is a deterioration of net trade, since output growth boosts import demand and, adverse competitiveness effects, rising from rising domestic price and cost pressure, curtail export demand. Second, there is the operation of tighter fiscal and monetary policies to contain the adverse movements in fiscal ratios, and inflation and output targets. In the long run, therefore, output and employment return to base, but consumption falls below base due to changes in relative prices (foreign and domestic) for a given level of import content. Finally, steady-state inflation necessarily returns to its target value there still remains price-level drift.



4.3.3 Permanent increase in oil prices

This simulation assumes that oil prices are increased permanently by 20% above baseline. This has an increase in the import deflator by 0.23% during the first year, and the increase feeds more into the private consumption deflator (the GDP deflator does not depend directly on import prices) which increase by 0.16 % above baseline, in the second year. The decline in real wages, 0.12% below baseline, causes the decline in real disposable income. This, with real financial wealth being a key determinant of private consumption, also declines in the short to medium run. The increase in prices has a negative effect on investment which is also negatively affecting demand. The increase in import prices and the slowdown in demand cause imports to decrease. Detailed results are reported below.

Table 2(a): Permanent increase in government consumption

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
<i>Economic Activity (constant prices)</i>									
GDP	0.95	1.04	1.15	1.19	1.25	1.34	1.44	1.51	1.53
Private consumption	0.09	0.33	0.55	0.66	0.71	0.78	0.89	1.02	1.10
Government consumption	5.53	5.53	5.53	5.53	5.53	5.53	5.53	5.53	5.53
Gross fixed capital formation	0.13	0.06	0.27	-0.01	0.14	0.61	1.01	1.12	0.97
Exports	0.00	-0.05	-0.05	0.01	0.04	0.04	0.00	-0.07	-0.15
Imports	0.48	0.57	0.78	0.74	0.79	0.96	1.11	1.14	1.04
of which :									
Contribution of trade	-0.13	-0.18	-0.24	-0.20	-0.21	-0.26	-0.31	-0.34	-0.34
Contribution of inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Price Developments</i>									
HICP	0.00	0.03	0.09	0.07	-0.02	-0.09	-0.07	0.03	0.19
GDP deflator	0.03	0.14	0.08	0.00	-0.06	-0.04	0.05	0.19	0.36
Private Consumption deflator	0.00	0.02	0.09	0.09	-0.01	-0.10	-0.09	0.01	0.18
Exports deflator	0.01	0.13	0.01	-0.05	-0.07	-0.03	0.05	0.16	0.29
Imports deflator	0.00	0.07	0.01	-0.03	-0.04	-0.02	0.02	0.08	0.15
Competitors Prices on domestic market	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competitors Prices on external markets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal Exchange Rate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Labour Market and Cost Developments</i>									
Compensation per employee (nominal)	0.15	0.35	0.25	0.03	-0.20	-0.34	-0.37	-0.33	-0.25
Compensation per employee (real, GDP price)	0.12	0.21	0.16	0.03	-0.14	-0.30	-0.42	-0.52	-0.61
Compensation per employee (real, Consumption price)	0.15	0.33	0.15	-0.06	-0.18	-0.24	-0.28	-0.34	-0.43
Productivity	0.18	0.05	-0.03	-0.11	-0.15	-0.17	-0.19	-0.21	-0.23
ULC, whole economy	-0.55	0.13	0.38	0.46	0.41	0.36	0.39	0.51	0.68
Total Labour Force	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment	0.24	0.82	1.28	1.62	1.86	2.05	2.22	2.37	2.47
Unemployment	-2.64	-9.19	-14.40	-18.20	-20.84	-22.97	-24.89	-26.56	-27.73
Unemployment rate (deviation from baseline)	-0.24	-0.82	-1.29	-1.63	-1.87	-2.06	-2.23	-2.38	-2.48

Table 2(a): Permanent increase in government consumption

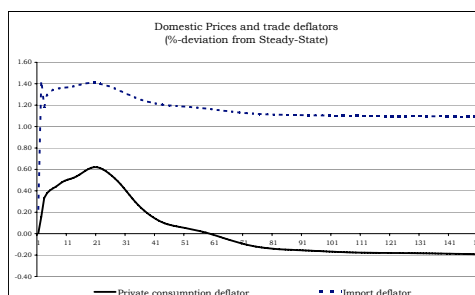
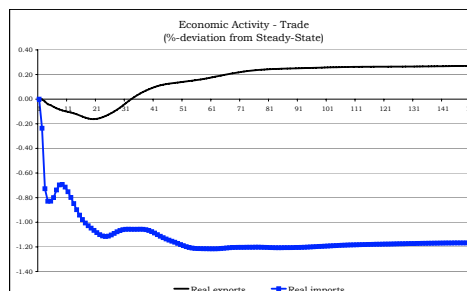
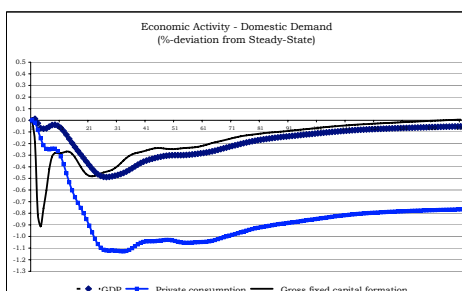
	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Disposable Income (nominal) & Total Wealth									
Disposable income	0.65	0.66	0.16	-0.54	-0.94	-0.80	-0.18	0.59	1.17
Real disposable income	0.65	0.64	0.07	-0.62	-0.93	-0.70	-0.09	0.57	1.00
Compensation of employees	0.39	1.17	1.53	1.65	1.66	1.71	1.84	2.03	2.22
Transfers from Gal Gov.	0.98	1.18	1.24	1.18	1.19	1.30	1.49	1.71	1.90
Other Personal income	0.66	0.51	0.39	0.29	0.30	0.37	0.48	0.59	0.68
Direct Taxes (inc. SSC)	0.46	1.64	3.69	5.93	7.27	7.10	5.68	3.88	2.61
Total Wealth	0.14	0.39	0.47	0.40	0.22	0.03	-0.06	-0.02	0.15
Real Total Wealth	0.14	0.37	0.37	0.31	0.23	0.13	0.03	-0.03	-0.03
Saving ratio	0.53	0.49	0.35	0.26	0.29	0.37	0.41	0.40	0.36
Net foreign assets (ratio)	-0.08	-0.20	-0.40	-0.61	-0.80	-1.02	-1.29	-1.57	-1.86
Firms and Interest Rate									
Capital Stock	0.01	0.01	0.02	0.03	0.03	0.05	0.10	0.16	0.21
Real Cost of Capital (average)	8.03	-1.40	5.05	1.45	-0.80	-1.13	-0.48	0.42	0.93
3-month interest rate	0.47	0.13	0.15	-0.04	-0.14	-0.05	0.11	0.22	0.26
10-year long-term interest rate	0.45	0.04	0.20	-0.01	-0.09	-0.04	0.07	0.17	0.22
Public Sector									
Gal Gov. Compensation of Employees	0.46	1.64	3.69	5.93	7.27	7.10	5.68	3.88	2.61
Transfers from gal Gov.	0.98	1.18	1.24	1.18	1.19	1.30	1.49	1.71	1.90
Other Gov. Net Revenues	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direct Taxes (inc. SSC)	-0.14	0.73	2.64	4.86	6.18	5.94	4.40	2.45	1.06
Other Direct Taxes	0.66	0.49	0.38	0.30	0.30	0.38	0.47	0.55	0.61
Indirect Taxes less Subsidies	1.16	1.36	1.54	1.50	1.49	1.58	1.77	1.99	2.18
Gen. Gov. Net Debt	0.99	1.87	2.41	2.28	1.60	0.86	0.50	0.70	1.35
Gen. Gov. Net Lending (% of GDP)	-1.45	-0.87	-0.39	0.38	0.83	0.71	0.19	-0.39	-0.80
Gen. Gov. Net Debt (% of GDP)	0.00	0.74	1.26	1.18	0.44	-0.47	-1.06	-1.07	-0.59

Table 3(a): Permanent oil price shock

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Economic Activity (constant prices)									
GDP	0.00	0.01	-0.03	-0.07	-0.07	-0.07	-0.05	-0.04	-0.04
Private consumption	0.00	-0.02	-0.08	-0.15	-0.21	-0.25	-0.25	-0.24	-0.24
Government consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	0.00	-0.19	-0.81	-0.91	-0.76	-0.60	-0.42	-0.31	-0.28
Exports	0.00	0.00	-0.02	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09
Imports	0.00	-0.24	-0.73	-0.83	-0.83	-0.80	-0.74	-0.70	-0.69
of which :									
Contribution of trade	0.00	0.07	0.20	0.22	0.22	0.21	0.19	0.17	0.17
Contribution of inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments									
HICP	0.01	0.19	0.31	0.37	0.41	0.42	0.44	0.46	0.48
GDP deflator	0.00	0.03	0.08	0.10	0.13	0.15	0.17	0.19	0.21
Private Consumption deflator	0.00	0.16	0.33	0.38	0.41	0.42	0.44	0.46	0.48
Exports deflator	0.00	0.01	0.05	0.07	0.08	0.10	0.11	0.13	0.14
Imports deflator	0.23	1.43	1.19	1.30	1.33	1.34	1.35	1.36	1.36
Competitors Prices on domestic market	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competitors Prices on external markets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal Exchange Rate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market and Cost Developments									
Compensation per employee (nominal)	0.00	0.03	0.08	0.08	0.08	0.09	0.10	0.11	0.11
Compensation per employee (real, GDP price)	0.00	0.00	0.01	-0.02	-0.04	-0.06	-0.07	-0.08	-0.10
Compensation per employee (real, Consumption price)	0.00	-0.12	-0.25	-0.29	-0.32	-0.33	-0.34	-0.35	-0.37
Productivity	0.00	0.00	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.03
ULC, whole economy	0.00	0.03	0.12	0.16	0.16	0.17	0.18	0.21	0.23
Total Labour Force	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment	0.00	0.00	0.01	0.00	0.00	0.01	0.03	0.06	0.09
Unemployment	0.00	-0.03	-0.16	-0.05	0.01	-0.09	-0.32	-0.64	-0.96
Unemployment rate (deviation from baseline)	0.00	0.00	-0.01	0.00	0.00	-0.01	-0.03	-0.06	-0.09

Table 3(b): Permanent oil price shock

	1	2	3	4	5	6	7	8	9
<i>Disposable Income (nominal) & Total Wealth</i>									
(deviations from baseline, percentage unless otherwise indicated)									
Disposable income	0.00	-0.03	-0.19	-0.36	-0.39	-0.25	-0.02	0.22	0.36
Real disposable Income	0.00	-0.18	-0.52	-0.74	-0.79	-0.68	-0.46	-0.24	-0.11
Compensation of employees	0.00	0.04	0.10	0.09	0.08	0.10	0.13	0.17	0.20
Transfers from Gal Gov.	0.00	0.04	0.05	0.04	0.05	0.08	0.12	0.15	0.17
Other Personal income	0.00	0.01	0.00	-0.01	0.01	0.03	0.05	0.06	0.06
Direct Taxes (inc. SSC)	0.00	0.20	0.80	1.33	1.44	1.10	0.46	-0.20	-0.60
Total Wealth	0.01	0.09	0.05	0.00	-0.10	-0.19	-0.25	-0.27	-0.26
Real Total Wealth	0.01	-0.07	-0.29	-0.38	-0.50	-0.61	-0.68	-0.73	-0.74
Saving ratio	0.00	-0.05	-0.12	-0.11	-0.08	-0.06	-0.04	-0.04	-0.04
Net foreign assets ratio	-0.02	-0.28	-0.45	-0.55	-0.67	-0.80	-0.94	-1.10	-1.26
<i>Firms and Interest Rate</i>									
Capital Stock	0.00	0.00	-0.04	-0.09	-0.14	-0.17	-0.19	-0.20	-0.21
Real Cost of Capital (average)	0.31	5.33	2.04	0.89	1.33	0.51	0.58	0.72	0.67
3-month interest rate	0.02	0.32	0.17	0.04	0.04	0.03	0.03	0.04	0.03
10-year long-term interest rate	0.01	0.27	0.14	0.06	0.07	0.03	0.03	0.04	0.03
<i>Public Sector</i>									
Gal Gov. Compensation of Employees	0.00	0.20	0.80	1.33	1.44	1.10	0.46	-0.20	-0.60
Transfers from gal Gov.	0.00	0.04	0.05	0.04	0.05	0.08	0.12	0.15	0.17
Other Gov. Net Revenues	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direct Taxes (inc. SSC)	0.00	0.17	0.75	1.29	1.39	1.03	0.37	-0.32	-0.74
Other Direct Taxes	0.00	-0.02	-0.03	-0.03	-0.01	0.01	0.03	0.04	0.04
Indirect Taxes less Subsidies	0.02	0.14	0.07	0.04	0.06	0.09	0.14	0.18	0.21
Gen. Gov. Net Debt	0.01	0.22	0.40	0.25	0.01	-0.19	-0.26	-0.17	0.02
Gen. Gov. Net Lending (% of GDP)	-0.03	-0.35	-0.05	0.23	0.25	0.19	0.03	-0.14	-0.24
Gen. Gov. Net Debt (% of GDP)	0.00	0.19	0.38	0.23	-0.05	-0.29	-0.41	-0.36	-0.16



4.3.4 Permanent appreciation of the euro

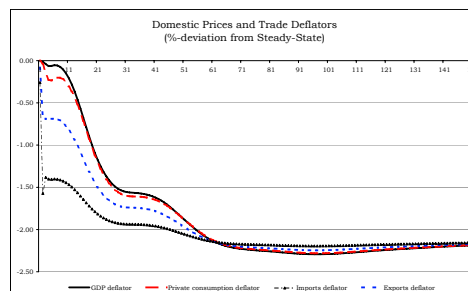
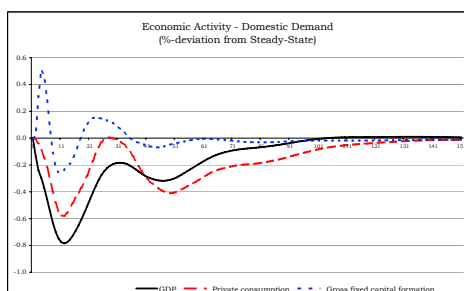
In this exercise euro appreciates permanently by 5% against all foreign currencies. Import prices are affected as well as export competitiveness. Real exports fall below baseline (-0.78% second year) following the appreciation of the euro and competitiveness losses dragging down investment and stock building through the accelerator mechanism. The decrease in activity determines the fall in imports through the multiplier effect and net trade becomes more favourable in the medium run. The fall in GDP and the rise in the unemployment rate cause private consumption to decrease. Private consumption is also affected by the decrease in real wealth, due to the decrease in capital stock. On the price side, there is a shift in all prices through imported inflation, in fact consumer prices decrease following the decline in import prices. In the long run the drop in domestic prices tends to offset the initial fall in competitiveness, quantitative and qualitative results are reported in the tables and charts below.

Table 4(a): Permanent appreciation of the euro

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Economic Activity (constant prices)									
GDP	0.00	-0.13	-0.24	-0.30	-0.37	-0.45	-0.54	-0.63	-0.70
Private consumption	0.00	-0.01	-0.04	-0.09	-0.14	-0.21	-0.30	-0.40	-0.48
Government consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	0.00	0.01	0.31	0.51	0.46	0.29	0.08	-0.11	-0.22
Exports	0.00	-0.78	-1.00	-1.03	-1.03	-1.04	-1.04	-1.03	-1.02
Imports	0.00	-0.33	0.00	0.21	0.31	0.33	0.30	0.26	0.26
of which :									
Contribution of trade	0.00	-0.13	-0.29	-0.35	-0.38	-0.39	-0.38	-0.37	-0.36
Contribution of inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments									
HICP	0.00	-0.06	-0.16	-0.22	-0.23	-0.22	-0.20	-0.20	-0.22
GDP deflator	0.00	-0.01	-0.04	-0.07	-0.06	-0.05	-0.06	-0.07	-0.11
Private Consumption deflator	0.00	-0.04	-0.15	-0.23	-0.24	-0.22	-0.20	-0.20	-0.22
Exports deflator	-0.08	-0.69	-0.69	-0.70	-0.69	-0.69	-0.69	-0.71	-0.74
Imports deflator	-0.26	-1.57	-1.38	-1.40	-1.41	-1.40	-1.40	-1.41	-1.43
Competitors Prices on domestic market	-0.54	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14
Competitors Prices on external markets	-0.54	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14	-2.14
Nominal Exchange Rate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market and Cost Developments									
Compensation per employee (nominal)	0.00	-0.02	-0.10	-0.12	-0.09	-0.04	0.02	0.06	0.10
Compensation per employee (real, GDP price)	0.00	-0.01	-0.06	-0.06	-0.03	0.02	0.07	0.13	0.20
Compensation per employee (real, Consumption price)	0.00	0.01	0.05	0.10	0.15	0.18	0.22	0.26	0.32
Productivity	0.00	-0.03	-0.02	0.00	0.02	0.04	0.06	0.08	0.10
ULC, whole economy	0.00	0.08	-0.01	-0.14	-0.18	-0.21	-0.23	-0.27	-0.32
Total Labour Force	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment	0.00	-0.03	-0.15	-0.31	-0.46	-0.63	-0.79	-0.96	-1.11
Unemployment	0.00	0.28	1.73	3.47	5.20	7.01	8.87	10.73	12.47
Unemployment rate (deviation from baseline)	0.00	0.03	0.15	0.31	0.47	0.63	0.79	0.96	1.12

Table 4(b): Permanent appreciation of the euro

(deviations from baseline, percentage unless otherwise indicated)	1	2	3	4	5	6	7	8	9
Disposable Income (nominal) & Total Wealth									
Disposable income	0.00	-0.10	-0.19	-0.20	-0.22	-0.34	-0.55	-0.79	-0.99
Real disposable income	0.00	-0.06	-0.04	0.03	0.01	-0.12	-0.35	-0.59	-0.77
Compensation of employees	0.00	-0.05	-0.25	-0.43	-0.55	-0.66	-0.78	-0.90	-1.02
Transfers from Gal Gov.	0.00	-0.14	-0.28	-0.36	-0.43	-0.51	-0.60	-0.70	-0.80
Other Personal income	0.00	-0.11	-0.16	-0.16	-0.17	-0.20	-0.23	-0.27	-0.30
Direct Taxes (inc. SSC)	0.00	-0.07	-0.32	-0.65	-0.85	-0.76	-0.41	0.02	0.32
Total Wealth	-0.01	-0.10	-0.11	-0.16	-0.17	-0.17	-0.20	-0.25	-0.34
Real Total Wealth	-0.01	-0.06	0.04	0.06	0.06	0.04	0.01	-0.05	-0.12
Saving ratio	0.00	-0.06	-0.05	-0.03	-0.03	-0.05	-0.06	-0.06	-0.06
Firms and Interest Rate									
Capital Stock	0.00	0.00	0.01	0.04	0.06	0.08	0.09	0.08	0.07
Real Cost of Capital (average)	-0.04	-3.09	-2.77	-1.64	-1.44	-0.87	-0.60	-0.61	-0.65
3-month interest rate	0.00	-0.19	-0.21	-0.11	-0.04	-0.01	-0.02	-0.05	-0.07
10-year long-term interest rate	0.00	-0.16	-0.18	-0.11	-0.07	-0.03	-0.03	-0.04	-0.06
Public Sector									
Gal Gov. Compensation of Employees	0.00	-0.07	-0.32	-0.65	-0.85	-0.76	-0.41	0.02	0.32
Transfers from gal Gov.	0.00	-0.14	-0.28	-0.36	-0.43	-0.51	-0.60	-0.70	-0.80
Other Gov. Net Revenues	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direct Taxes (inc. SSC)	0.00	0.02	-0.10	-0.34	-0.47	-0.31	0.11	0.63	1.02
Other Direct Taxes	0.00	-0.07	-0.13	-0.13	-0.15	-0.18	-0.21	-0.25	-0.28
Indirect Taxes less Subsidies	-0.02	-0.13	-0.14	-0.17	-0.22	-0.28	-0.37	-0.47	-0.56
Gen. Gov. Net Debt	0.00	-0.14	-0.39	-0.49	-0.45	-0.36	-0.34	-0.44	-0.65
Gen. Gov. Net Lending (% of GDP)	0.01	0.25	0.23	0.04	-0.08	-0.09	0.01	0.15	0.26
Gen. Gov. Net Debt (% of GDP)	0.00	0.01	-0.11	-0.14	-0.02	0.16	0.28	0.29	0.17



4.3.5 Permanent increase in world demand

In this experiment we let world demand (excluding euro area) increase permanently by 1% above baseline. The increase in export demand (exports increase above baseline by 0.57% in the first year) triggers an increase in GDP due to increases in investment and consumption. The increase in export prices, through domestic inflation, leads to a deterioration of net trade initiated by the increase of imports resulting from the initial positive demand shock. In the long run this deterioration causes GDP to decrease. Tables and charts below provide further qualitative and quantitative details.

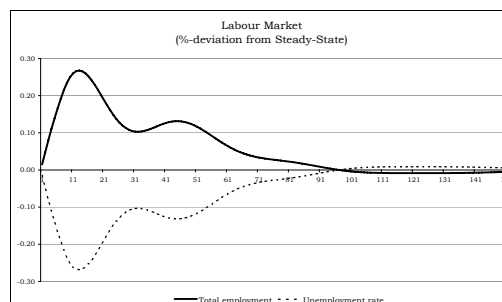
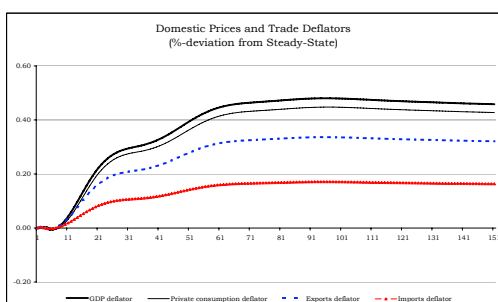
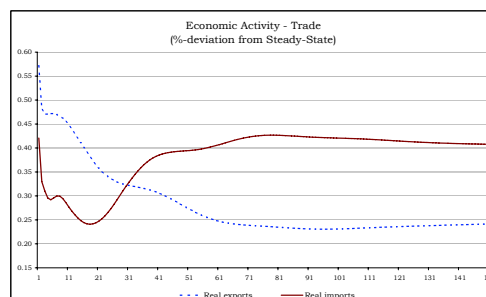
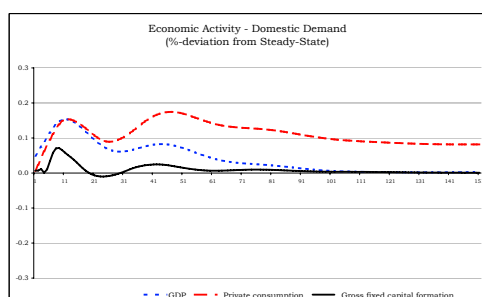


Table 5(a): Permanent increase in world demand

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Economic Activity (constant prices)									
GDP	0.05	0.06	0.08	0.09	0.10	0.12	0.13	0.14	0.15
Private consumption	0.01	0.02	0.04	0.06	0.08	0.10	0.11	0.13	0.14
Government consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	0.01	0.01	0.01	0.00	0.01	0.03	0.06	0.07	0.07
Exports	0.57	0.48	0.47	0.47	0.47	0.47	0.47	0.47	0.46
Imports	0.42	0.33	0.31	0.30	0.29	0.30	0.30	0.30	0.29
of which :									
Contribution of trade	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Contribution of inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments									
HICP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
GDP deflator	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.01	0.02
Private Consumption deflator	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Exports deflator	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.02
Imports deflator	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Competitors Prices on domestic market	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competitors Prices on external markets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal Exchange Rate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market and Cost Developments									
Compensation per employee (nominal)	0.01	0.02	0.01	0.00	-0.01	-0.02	-0.03	-0.03	-0.03
Compensation per employee (real, GDP price)	0.01	0.01	0.01	0.01	0.00	-0.01	-0.02	-0.04	-0.05
Compensation per employee (real, Consumption price)	0.01	0.02	0.01	0.00	-0.01	-0.02	-0.02	-0.03	-0.04
Productivity	0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02
ULC, whole economy	-0.03	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.06
Total Labour Force	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total employment	0.01	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.23
Unemployment	-0.17	-0.53	-0.89	-1.23	-1.55	-1.85	-2.14	-2.40	-2.62
Unemployment rate (deviation from baseline)	-0.01	-0.05	-0.08	-0.11	-0.14	-0.17	-0.19	-0.22	-0.24

Table 5(b): Permanent increase in world demand

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Disposable Income (nominal) & Total Wealth									
Disposable income	0.04	0.07	0.09	0.10	0.11	0.12	0.14	0.16	0.17
Real disposable income	0.04	0.07	0.09	0.10	0.11	0.13	0.14	0.16	0.16
Compensation of employees	0.02	0.06	0.09	0.11	0.13	0.15	0.16	0.18	0.20
Transfers from Gal Gov.	0.05	0.06	0.08	0.08	0.10	0.11	0.13	0.14	0.16
Other Personal income	0.04	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06
Direct Taxes (inc. SSC)	0.00	-0.02	-0.02	-0.01	0.00	0.01	0.01	0.01	0.02
Total Wealth	0.01	0.02	0.04	0.05	0.06	0.07	0.09	0.11	0.13
Real Total Wealth	0.01	0.02	0.03	0.04	0.06	0.08	0.09	0.11	0.12
Saving ratio	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Firms and Interest Rate									
Capital Stock	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Real Cost of Capital (average)	0.38	0.05	0.30	0.16	0.07	0.04	0.05	0.07	0.08
3-month interest rate	0.02	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.02
10-year long-term interest rate	0.02	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.02
Public Sector									
Gal Gov. Compensation of Employees	0.00	-0.02	-0.02	-0.01	0.00	0.01	0.01	0.01	0.02
Transfers from gal Gov.	0.05	0.06	0.08	0.08	0.10	0.11	0.13	0.14	0.16
Other Gov. Net Revenues	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direct Taxes (inc. SSC)	-0.03	-0.07	-0.09	-0.09	-0.08	-0.09	-0.10	-0.12	-0.12
Other Direct Taxes	0.04	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.06
Indirect Taxes less Subsidies	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11
Gen. Gov. Net Debt	0.03	0.04	0.07	0.09	0.10	0.10	0.12	0.14	0.17
Gen. Gov. Net Lending (% of GDP)	-0.03	-0.03	-0.03	-0.02	-0.01	-0.01	-0.02	-0.03	-0.03
Gen. Gov. Net Debt (% of GDP)	-0.02	-0.02	-0.01	0.00	0.00	-0.01	-0.01	-0.01	0.00

4.3.6 Permanent increase in labour supply

In this final experiment we have increases labour supply permanently by 1% above baseline. As shown numerically and graphically below, the initial effect is a slow adjustment in output and employment. The shock on labour force however results in opposite effects. On the one hand, the jump in the unemployment rate, resulting from the sudden labour-force expansion causes a drop in real wages. On the other, the resulting drop in inflation and increased investment (which, admittedly kicks in only very slowly) initiates a positive demand effect with a subsequent increase in employment. The net effect on consumption is the sum of these two different effects of opposite sign: the direct negative effect of real wages and the indirect positive effect of higher employment. In the long run, as expected, all real variables are permanently higher and all prices are permanently lower, as we would typically expect of a positive supply shock.

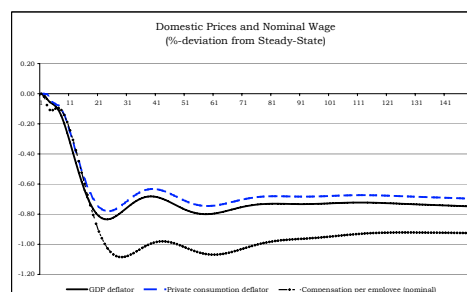
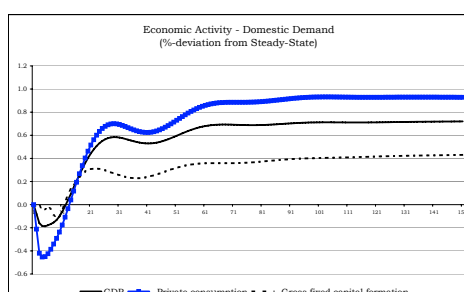


Table 6(a): Permanent increase in labour supply

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
<i>Economic Activity (constant prices)</i>									
GDP	0.00	-0.08	-0.16	-0.18	-0.19	-0.18	-0.17	-0.15	-0.13
Private consumption	0.00	-0.21	-0.42	-0.45	-0.45	-0.42	-0.39	-0.34	-0.29
Government consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	0.00	-0.02	0.00	-0.06	-0.04	-0.01	-0.04	-0.09	-0.12
Exports	0.00	0.00	0.01	0.03	0.03	0.04	0.05	0.07	0.09
Imports	0.00	-0.18	-0.32	-0.32	-0.29	-0.24	-0.21	-0.18	-0.15
of which :									
Contribution of trade	0.00	0.05	0.09	0.10	0.09	0.08	0.07	0.07	0.07
Contribution of inventories	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Price Developments</i>									
HICP	0.00	0.00	-0.01	-0.03	-0.05	-0.07	-0.08	-0.10	-0.14
GDP deflator	0.00	-0.01	-0.03	-0.06	-0.07	-0.08	-0.11	-0.15	-0.20
Private Consumption deflator	0.00	0.00	0.00	-0.03	-0.05	-0.07	-0.08	-0.10	-0.14
Exports deflator	0.00	0.00	-0.03	-0.04	-0.05	-0.06	-0.08	-0.12	-0.16
Imports deflator	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.04	-0.06	-0.08
Competitors Prices on domestic market	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competitors Prices on external markets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal Exchange Rate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Labour Market and Cost Developments</i>									
Compensation per employee (nominal)	0.00	-0.02	-0.08	-0.11	-0.11	-0.10	-0.09	-0.11	-0.14
Compensation per employee (real, GDP price)	0.00	-0.01	-0.04	-0.05	-0.04	-0.02	0.01	0.04	0.06
Compensation per employee (real, Consumption price)	0.00	-0.02	-0.07	-0.08	-0.06	-0.03	-0.02	-0.01	0.00
Productivity	0.00	-0.02	-0.02	0.00	0.01	0.02	0.03	0.03	0.04
ULC, whole economy	0.00	0.05	0.00	-0.09	-0.15	-0.19	-0.21	-0.24	-0.28
Total Labour Force	0.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total employment	0.00	-0.01	-0.08	-0.17	-0.23	-0.27	-0.29	-0.29	-0.27
Unemployment	2.80	11.28	12.11	13.05	13.77	14.19	14.36	14.37	14.22
Unemployment rate (deviation from baseline)	0.23	0.91	0.99	1.07	1.13	1.17	1.19	1.19	1.17

Table 6(b): Permanent increase in labour supply

	1	2	3	4	5	6	7	8	9
(deviations from baseline, percentage unless otherwise indicated)									
Disposable Income (nominal) & Total Wealth									
Disposable income	0.00	-0.07	-0.21	-0.31	-0.34	-0.31	-0.27	-0.25	-0.24
Real disposable Income	0.00	-0.07	-0.20	-0.28	-0.29	-0.24	-0.19	-0.15	-0.10
Compensation of employees	0.00	-0.03	-0.16	-0.28	-0.34	-0.37	-0.38	-0.39	-0.41
Transfers from Gal Gov.	0.00	-0.09	-0.19	-0.24	-0.26	-0.26	-0.28	-0.30	-0.33
Other Personal income	0.00	-0.06	-0.09	-0.08	-0.07	-0.06	-0.07	-0.09	-0.11
Direct Taxes (inc. SSC)	0.00	0.00	0.09	0.20	0.20	0.07	-0.10	-0.27	-0.39
Total Wealth	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.04	-0.05	-0.07
Real Total Wealth	0.00	0.00	-0.01	0.00	0.02	0.03	0.03	0.05	0.07
Saving ratio	0.00	0.08	0.14	0.14	0.15	0.14	0.11	0.08	0.06
Firms and Interest Rate									
Capital Stock	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02
Real Cost of Capital (average)	0.00	-0.89	0.03	-0.46	-0.54	-0.05	0.20	0.23	0.13
3-month interest rate	0.00	-0.06	-0.03	-0.05	-0.04	-0.01	-0.01	-0.03	-0.05
10-year long-term interest rate	0.00	-0.05	-0.03	-0.05	-0.04	-0.02	-0.02	-0.03	-0.05
Public Sector									
Gal Gov. Compensation of Employees	0.00	0.00	0.09	0.20	0.20	0.07	-0.10	-0.27	-0.39
Transfers from gal Gov.	0.00	-0.09	-0.19	-0.24	-0.26	-0.26	-0.28	-0.30	-0.33
Other Gov. Net Revenues	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direct Taxes (inc. SSC)	0.00	0.05	0.23	0.39	0.42	0.30	0.13	-0.01	-0.11
Other Direct Taxes	0.00	-0.06	-0.09	-0.07	-0.06	-0.05	-0.06	-0.07	-0.08
Indirect Taxes less Subsidies	0.00	-0.13	-0.27	-0.32	-0.33	-0.33	-0.33	-0.34	-0.36
Gen. Gov. Net Debt	0.00	-0.03	-0.09	-0.17	-0.28	-0.34	-0.36	-0.37	-0.38
Gen. Gov. Net Lending (% of GDP)	0.00	0.06	0.06	0.11	0.10	0.05	0.02	0.01	0.02
Gen. Gov. Net Debt (% of GDP)	0.00	0.06	0.11	0.07	-0.02	-0.09	-0.09	-0.07	-0.05

5 Conclusions

This paper has documented the structure, estimation and simulation properties of the Italian block of the ESCB-multi-country model. This model is used regularly as an input into Eurosystem projection exercises and, to a lesser extent, in simulation analysis. The model shares similar features with the AWM and the other MCM blocks. After outlining the theoretical and econometric underpinnings of the model, its dynamic and steady-state properties were illustrated using some standard diagnostic simulations. These essentially show the congruence of the model with respect to the exogenous neoclassical growth model. All demand shocks imply an eventual return of output and the inflation rate to base. However, the components of output (consumption, investment and net trade) depend on relative prices and so may or may not return to base individually. The adjustment properties of the model, in terms of impact multipliers for instance, are feasible and trajectories do not appear to be characterized by excessive volatility or cyclicity. The time profile for reversion to baseline is at time protracted, although this essentially relates to the backward-looking expectations embodied in the model and ad-hoc adjustment dynamics. Supply side shocks, such as an expansion of the labour force, whilst of course not returning the model trajectory to some pre-defined base, appear nevertheless reasonable in their properties.

Needless to say, the model (and this class of model) is not without its shortcomings. In this context, we can make four points. First, the absence of model-consistent expectations reduces the model's realism in capturing the consequences of certain shocks (e.g., permanent, pre-announced ones). Second, the effectively closed-economy nature of the model by definition cuts off feedback from home policies on the rest of the world and vice versa, one example of which is that the model implies that any level of consumption can be financed by external borrowing.⁷ Third, given its ad-hoc dynamics and lack of explicit micro-foundations, model properties and shock processes have no structural interpretation; the model is therefore potentially open to the Lucas Critique. Finally, on a more specific note, the assumption of constant factor income shares (and thus Cobb-Douglas technology) is, whilst extremely common in macro-models, controversial for many euro-area countries (and also for Italy) given the well-known downward trend in the labour income share since the mid-1970s. One possible remedy, namely using a CES production function⁸, however, involves a significant departure from the standard MCM framework. We leave treatment of these points open for possible future work.

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⁷However, when the model is run in forecast mode, its trade profile is made consistent with intra- and extra- euro area trade flows.

⁸See the discussion in Klump, McAdam and Willman (2004).

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6 Appendix A: Names of variables in the Italian MCM

Table 1: Acronyms associated to all variables used in the model

Names	Description
KRP	Capital Stock, private sector (Real)
KRW	Capital Stock, whole economy (Real)
LEX	Employees to Employment (Ratio)
LEN	Total Employees
LFN	Total Labour Force
LGN	General government employment
LNN	Whole Economy Employment
LNT	Trend Employment
LSR	Outstanding Inventories (Real)
LTI	Long term interest Rate
LTR	Long term interest Rate (Real)
MTD	Imports of Goods and Services (Deflator)
MTN	Imports of Goods and Services
MTR	Imports of Goods and Services (Real)
NFA	Net foreign Assets
NFN	Net Factor Income
ODN	Other Direct Taxes
OGN	Other Govt. Net. Revenue
OID	Private Gross Domestic Capital Formation (Deflator)
OIN	Private Gross Domestic Capital Formation
OIP	Private Gross Domestic Capital Formation Pre-Tax (Deflator)
OIR	Private Gross Domestic Capital Formation (Real)
OLN	Other Domestic Net Lending
OPN	Other Personal Income
OWN	Other sector compensation of employees
OYN	Other sector disposable income
PCD	Personal Consumer Expenditure (Deflator)
PCN	Personal Consumer Expenditure
PCP	Private Consumption Deflator Pre-Tax (Deflator)
PCR	Personal Consumer Expenditure (Real)
PEI	Price/unit value index for imports of energy
POIL	Price of Oil in US\$
PPYB	Permanent Income(backward looking) (Real)
PROD	Productivity per Head
PSN	Personal Sector Saving
PYN	Personal Disposable Income
PYR	Personal Disposable Income (Real)
RCC	Credit interest rate (corporate sector)
RCH	Credit interest rate (household sector)
RMT	Mortgage rate (representative)
SALE	Consumption plus Exports (Real)
SCD	Change in inventories (Deflator)
SCN	Change in inventories
SCR	Change in inventories (Real)
SGLN	Cumulated Current Account
SMC	Short-Run Marginal Cost of Production
STI	Short Term Interest Rate
SZD	Inventories and Stat. Discrepancy (Deflator)
SZN	Inventories and Stat. Discrepancy
TCI	Apparent Tax Rate on Consumption
TCIR	Apparent Tax Rate on Consumption (Rebased)
... continue	

...	
TDN	Direct Taxes incl. SSC
TDNB	Tax Base for Direct Taxes
TDX	Direct Taxes to the Tax Base (Ratio)
TGI	Apparent Indirect Tax Rate on Government Consumption
TGIR	Apparent Indirect Tax Rate on Government Consumption (Rebased)
TII	Apparent Indirect Tax Rate on Investment
TIIR	Apparent Indirect Tax Rate on Investment (Rebased)
TIN	Indirect Taxes less Subsidies
TIR	Indirect Taxes less Subsidies (Real)
TIX	Indirect Taxes less Subsidies (Ratio)
TRN	Transfers from Gen. Govt
TRX	Transfers from Gen. Govt (Ratio)
TWN	Transfers from ROW
ULA	ULC Adjusted (employees)
ULC	ULC
UNN	Unemployment (ILO concept)
URT	Equilibrium Unemployment Rate
URX	Unemployment Rate (ILO concept)
WED	Foreign Output in Domestic Currency (Deflator)
WEN	Compensation per Employee
WER	Weighted Import Demand Indicator
WEUD	Foreign Output in US\$ (Deflator)
WIN	Compensation to Employees, Total
WUN	Compensation to Employees, per Head
WUG	Government Compensation, per Head
WUR	Real Wage in terms of Consumption
XTD	Exports of Goods and Services (Deflator)
XTN	Exports of Goods and Services
XTR	Exports of Goods and Services (Real)
YED	GDP BY EXPENDITURE/INCOME (Deflator)
YEN	GDP BY EXPENDITURE/INCOME
YER	GDP BY EXPENDITURE/INCOME (Real)
YFD	GDP at Factor Cost (Deflator)
YFN	GDP at Factor Cost
YFR	GDP at Factor Cost (Real)
YFT	Potential Output
YGA	Output Gap
YNR	Production Using Available Inputs (Real)
ZCC1	Stat. Discrep. User Cost of Capital (LTI)
ZCC2	Stat. Discrep. User Cost of Capital (RCC)
ZED	Statistical discrepancy, GDP Expenditure
ZEN	Statistical discrepancy, GDP Expenditure
ZER	Statistical discrepancy, GDP Expenditure
ZGDN	Stat. Discrep. Government Net Debt
ZGLN	Stat. Discrep. Government Net Lending
ZID	Statistical discrepancy, GDP Income
ZIN	Statistical discrepancy, GDP Income
ZIR	Statistical discrepancy, GDP Income
ZKSR	Stat. Discrep. Total Real Capital Stock
ZNFA	Stat. Discrep. Net Foreign Assets
ZOLN	Stat. Discrep. Net Lending Other Private Sector

7 Appendix B: List of dummies and trends

The following dummies and trends have been used in the following equations:

dummy/trend	description	equation
DUMT003	Step dummy from 00q3 onward	MTDSTAR
DUMMYQ1 DUMMYQ2 DUMMYQ3	Seasonal dummies	{ $\Delta \log (PEI)$ $\Delta \log (HEXP)$
DUM031	Dummy for 2003q1	$\Delta \log (IPR)$
DUMT951	Step dummy from 95q1 onward	GIPSTAR
<i>TIME</i>	Trend	{ KSTAR IPRSTAR LSTAR SCRSTAR XTRSTAR XTDSTAR MTRSTAR MTDSTAR RWUNSTAR PCDSTAR HEXPSTAR
<i>TIME</i> ²	Quadratic Trend	{ YFT LSTAR XTRSTAR PCDSTAR

For the forecast exercise, all dummies and trends are kept constant over the forecast horizon. In the simulation exercise, instead, their treatment may be different as long as their effect decays over the future to ensure that all variables grow, in the long run, at their target growth rate.

Equations of Italian model

POTENTIAL OUTPUT AND OUTPUT GAP

$$\begin{aligned} \text{it_YFT: } \quad \text{it_YFT} &= \exp(+ \log(\text{it_alpha}) \\ &+ \text{it_beta} * \log(\text{it_KSR}) \\ &+ (1 - \text{it_beta}) * \log(\text{it_LNN}) \\ &+ (1 - \text{it_beta}) * (\text{it_gamma} * \text{it_TIME}) \\ &+ \text{it_yft.cst} \\ &+ \text{it_yft.time1} * \text{it_TIME} + \text{it_yft.time2} * \text{it_TIME2} \\ &+ \text{res_it_yft}, \end{aligned}$$

$$\text{it_YGA: } \quad \text{it_YGA} = \text{it_YER} / \text{it_YFT} + \text{res_it_yga},$$

MONETARY POLICY AND INTEREST RATES

NOMINAL INTEREST RATES

$$\begin{aligned} \text{it_STI: } \quad \text{it_STI} &= \text{it_dfor} * \text{it_ZZSTI} \\ &+ (1 - \text{it_dfor}) * (\text{it_taylor} * \text{it_STI}(-1) \\ &+ (1 - \text{it_taylor}) * 400 * (\text{it_gamma} + \text{it_demo} + \text{it_infl} - 1.5 * \text{it_infl} \\ &+ 1.5 * (\text{it_PCD} / \text{it_PCD}(-1) - 1) + 0.5 * (\text{it_YER} / \text{it_YER}(-1) - 1 - \text{it_gamma} - \text{it_demo}) \\ &- (1 - \text{it_taylor})) + \text{res_it_sti}, \end{aligned}$$

$$\begin{aligned} \text{it_LTI: } \quad \text{it_LTI} &= \text{it_dfor} * \text{it_ZZLTI} + (1 - \text{it_dfor}) * (\text{it_lti.cst} + \text{it_lti.ltl} * \text{it_LTI}(-1) + \text{it_lti2} * \text{it_LTI}(-2) \\ &+ \text{it_lti.sti1} * \text{it_STI} + \text{it_lti.sti1} * \text{it_STI}(-1) + \text{it_lti.sti2} * \text{it_STI}(-2) \\ &+ \text{it_lti.sti3} * \text{it_STI}(-3) + \text{it_lti.sti4} * \text{it_STI}(-4) \\ &+ \text{it_lti.sti5} * \text{it_STI}(-5)) \\ &+ \text{res_it_lti}, \end{aligned}$$

REAL INTEREST RATES

$$\text{it_LTR: } \quad \text{it_LTR} = 100 * ((1 + \text{it_LTI} / 100) / (\text{it_PCD} / \text{it_PCD}(-4)) - 1) + \text{res_it_ltr},$$

$$\text{it_STR: } \quad \text{it_STR} = 100 * ((1 + \text{it_STI} / 100) / (\text{it_PCD} / \text{it_PCD}(-4)) - 1) + \text{res_it_str},$$

NOMINAL USER COST OF CAPITAL

$$\text{it_CC0: } \quad \text{it_CC0} = \text{it_OID} * (\text{it_LTI} / 400 + \text{it_depkpr} - (\text{it_YFD} / \text{it_YFD}(-4) - 1) / 4) + \text{res_it_cc0},$$

REAL USER COST OF CAPITAL

$$\text{it_CCR: } \quad \text{it_CCR} = \text{it_CC0} / \text{it_OID} + \text{res_it_ccr},$$

FISCAL POLICY AND TAX RATES

DEFINITION OF PUBLIC DEBT-TO-GDP RATIO, PERCENT

$$\text{it_GDNRATIO} = 100 * \text{it_GDN} / (4 * \text{it_YEN}),$$

DEFINITION OF PUBLIC DEFICIT-TO-GDP RATIO, PERCENT

$$it_GLNRATIO = 100 * it_GLN / (it_YEN) ,$$

DEFINITION OF DEBT TARGET

$$it_DEBT_TARGET = it_debt.target * (IT_YEN/IT_YEN) ,$$

$$it_PDN: \quad it_PDN = it_dfor * it_ZZPDX * it_YEN \\ + (1 - it_dfor) * it_PDX * it_PDNB + res_it_pdn,$$

$$it_PDX: \quad it_PDX = it_fiscrule * (it_fisc.smooth * it_PDX(-1) \\ + it_fisc.exo * it_PDX \\ + it_fisc.gdn * (it_GDNRATIO - it_DEBT_TARGET)/100 \\ + it_fisc.gln * (it_GLNRATIO(-1) - it_GLNRATIO(-2))/100) \\ + (1 - it_fiscrule) * it_PDX \\ + res_it_PDX,$$

$$it_ODN: \quad it_ODN = it_dfor * it_ZZODX * it_YEN \\ + (1 - it_dfor) * it_ODX * it_ODNB + res_it_odn,$$

$$it_ODX: \quad it_ODX = it_fiscrule * (it_fisc.smooth * it_ODX(-1) \\ + it_fisc.exo * it_ODX \\ + it_fisc.gdn * (it_GDNRATIO - it_DEBT_TARGET)/100 \\ + it_fisc.gln * (it_GLNRATIO(-1) - it_GLNRATIO(-2))/100) \\ + (1 - it_fiscrule) * it_ODX \\ + res_it_ODX,$$

PRICE BLOCK

DOMESTIC WAGE-PRICE BLOCK

$$it_RWUNSTAR: \quad it_RWUNSTAR = \exp(\log((1 - it_beta) * (it_eps - 1) / it_eps) \\ + \log(it_YER / it_LNN) \\ + it_rwunstar.cst \\ + it_rwunstar.time * it_TIME) ,$$

$$it_WUN: \quad \text{del}(\log(it_WUN)) = \text{del}(\log(it_PCD)) \\ + it_wun.cst + \\ + it_wun.rwun1 * \text{del}(\log(it_WUN(-1) / it_PCD(-1))) \\ + it_wun.pro * \text{del}(\log(it_PRO)) \\ + it_wun.urx * (\log(it_URX / 100) - \log(it_nairu)) \\ + it_wun.ecm1 * (\log(it_WUN(-1) / it_YFD(-1)) - \log(it_RWUNSTAR(-1))) \\ + it_wun.pcyf * \text{del}(\log(it_PCD / it_YFD)) \\ + res_it_wun,$$

$$it_YFD: \quad \text{del}(\log(it_YFD)) = it_yfd.cst + \\ + it_yfd.ecm5 * (\log(it_YFD(-5) / it_WUN(-5)) + \log(it_RWUNSTAR(-5))) \\ + it_yfd.yfd1 * \text{del}(\log(it_YFD(-1))) \\ + it_yfd.wun1 * \text{del}(\log(it_WUN(-1))) \\ + it_yfd.wun2 * \text{del}(\log(it_WUN(-2))) \\ + it_yfd.pro1 * \text{del}(\log(it_PRO(-1))) \\ + res_it_yfd,$$

IMPORT PRICES

it_MTDSTAR: $it_MTDSTAR = \exp(+ it_mtdstar.cst$
 $+ it_mtdstar.cmd*\log(it_CMD)$
 $+ it_mtdstar.pei*\log(it_PEI)$
 $+ it_mtdstar.yfd*\log(it_YFD)$
 $+ it_mtdstar.dumT003*it_dumT003),$

it_MTD: $del(\log(it_MTD)) = it_mtd.cst$
 $+ it_mtd.mtd1*del(\log(it_MTD(-1)))$
 $+ it_mtd.mtd2*del(\log(it_MTD(-2)))$
 $+ it_mtd.pei*del(\log(it_PEI))$
 $+ it_mtd.cmd*del(\log(it_CMD))$
 $+ it_mtd.yfd*del(\log(it_YFD))$
 $+ it_mtd.ecm1*\log(it_MTD(-1)/it_MTDSTAR(-1))$
 $+ res_it_mtd,$

ENERGY PRICES

it_PEISTAR: $it_PEISTAR = \exp(+ it_peistar.cst$
 $+ it_peistar.poil*\log(it_POIL)$
 $+ it_peistar.t99*it_T99),$

it_PEI: $del(\log(it_PEI)) = it_pei.cst$
 $+ it_pei.pei1*del(\log(it_PEI(-1)))$
 $+ it_pei.poil1*del(\log(it_POIL(-1)))$
 $+ it_pei.ecm5*\log(it_PEI(-5)/it_PEISTAR(-5))$
 $+ res_it_pei,$

EXPORT PRICES

it_XTDSTAR: $it_XTDSTAR = \exp(+ it_xtdstar.cst$
 $+ it_xtdstar.cxd*\log(it_CXD)$
 $+ it_xtdstar.yfd*\log(it_YFD)$
 $+ it_xtdstar.t001*it_TIME1),$

it_XTD: $del(\log(it_XTD)) = it_xtd.cst$
 $+ it_xtd.xtd1*del(\log(it_XTD(-1)))$
 $+ it_xtd.cxd*del(\log(it_CXD))$
 $+ it_xtd.yfd*del(\log(it_YFD))$
 $+ it_xtd.ecm1*\log(it_XTD(-1)/it_XTDSTAR(-1))$
 $+ res_it_xtd,$

PRIVATE INVESTMENT DEFLATOR (PRE-TAX)

it_OIPSTAR: $it_OIPSTAR = \exp(+ it_oipstar.cst$
 $+ it_oipstar.yfd*\log(it_YFD)$
 $+ it_oipstar.mtd*\log(it_MTD)$
 $+ it_oipstar.time*it_TIME)$

it_OIP: $\text{del}(\log(\text{it_OIP})) = \text{it_oip.cst}$
 $+ \text{it_oip.oip1} * \text{del}(\log(\text{it_OIP}(-1)))$
 $+ \text{it_oip.yfd} * \text{del}(\log(\text{it_YFD}))$
 $+ \text{it_oip.mtd} * \text{del}(\log(\text{it_MTD}))$
 $+ \text{it_oip.ecm1} * \log(\text{it_OIP}(-1)/\text{it_OIPSTAR}(-1))$
 $+ \text{res_it_oip},$

GOVERNMENT INVESTMENT DEFLATOR (PRE-TAX)

it_GIPSTAR: $\text{it_GIPSTAR} = \exp(+ \text{it_gipstar.cst}$
 $+ \text{it_gipstar.yfd} * \log(\text{it_YFD})$
 $+ \text{it_gipstar.mtd} * \log(\text{it_MTD})$
 $+ \text{it_gipstar.dumT95I} * \text{it_DUMT95I}),$

it_GIP: $\text{del}(\log(\text{it_GIP})) = \text{it_gip.cst}$
 $+ \text{it_gip.gip1} * \text{del}(\log(\text{it_GIP}(-1)))$
 $+ \text{it_gip.mtd} * \text{del}(\log(\text{it_MTD}))$
 $+ \text{it_gip.yfd} * \text{del}(\log(\text{it_YFD}))$
 $+ \text{it_gip.ecm2} * \log(\text{it_GIP}(-2)/\text{it_GIPSTAR}(-2))$
 $+ \text{res_it_gip},$

GOVERNMENT CONSUMPTION DEFLATOR (PRE-TAX)

it_GCPSTAR: $\text{it_GCPSTAR} = \exp(+ \text{it_gcpstar.cst}$
 $+ \text{it_gcpstar.yfd} * \log(\text{it_YFD})$
 $+ \text{it_gcpstar.mtd} * \log(\text{it_MTD})$
 $+ \text{it_gcpstar.time} * \text{it_TIME}),$

it_GCP: $\text{del}(\log(\text{it_GCP})) = \text{it_gcp.cst}$
 $+ \text{it_gcp.gcp1} * \text{del}(\log(\text{it_GCP}(-1)))$
 $+ \text{it_gcp.yfd} * \text{del}(\log(\text{it_YFD}))$
 $+ \text{it_gcp.mtd} * \text{del}(\log(\text{it_MTD}))$
 $+ \text{it_gcp.ecm4} * \log(\text{it_GCP}(-4)/\text{it_GCPSTAR}(-4))$
 $+ \text{res_it_gcp},$

HICP EXCLUDING ENERGY

it_HEXSTAR: $\text{it_HEXPSTAR} = \exp(+ \text{it_hexpstar.cst}$
 $+ \text{it_hexpstar.ulc} * \log(\text{it_WUN}/\text{it_PRO})$
 $+ \text{it_hexpstar.timeI} * \text{it_TIMEI}),$

it_HEX: $\text{del}(\log(\text{it_HEXP})) = \text{it_hexp.cst}$
 $+ \text{it_hexp.hexp2} * \text{del}(\log(\text{it_HEXP}(-2)))$
 $+ \text{it_hexp.yfd2} * \text{del}(\log(\text{it_YFD}(-2)))$
 $+ \text{it_hexp.yfd3} * \text{del}(\log(\text{it_YFD}(-3)))$
 $+ \text{it_hexp.mtd} * \text{del}(\log(\text{it_MTD}))$
 $+ \text{it_hexp.ecm1} * \log(\text{it_HEXP}(-1)/\text{it_HEXPSTAR}(-1))$
 $+ \text{it_hexp.dumq1} * \text{it_DUMMYQ1}$
 $+ \text{it_hexp.dumq2} * \text{it_DUMMYQ2}$
 $+ \text{it_hexp.dumq3} * \text{it_DUMMYQ3}$
 $+ \text{res_it_hexp},$

HICP ENERGY

it_HEGSTAR: $it_HEGSTAR = \exp(+ it_hegstar.cst$
 $+ it_hegstar.yfd*log(it_YFD)$
 $+ it_hegstar.pei*log(it_PEI)$

it_HEG: $del(log(it_HEG)) = it_heg.cst$
 $+ it_heg.heg1*del(log(it_HEG(-1)))$
 $+ it_heg.pei*del(log(it_PEI))$
 $+ it_heg.yfd*del(log(it_YFD))$
 $+ it_heg.ecm1*log(it_HEG(-1)/it_HEGSTAR(-1))$
 $+ res_it_heg,$

PRIVATE CONSUMPTION DEFLATOR

it_PCDSTAR: $it_PCDSTAR = \exp(+ it_pcdstar.cst$
 $+ it_pcdstar.hic*log(it_HIC)$
 $+ it_pcdstar.time*it_TIME$
 $+ it_pcdstar.time2*it_TIME2$

it_PCD: $del(log(it_PCD)) = it_pcd.cst$
 $+ it_pcd.ecm1*log(it_PCD(-1)/it_PCDSTAR(-1))$
 $+ it_pcd.pcd1*del(log(it_PCD(-1)))$
 $+ it_pcd.hic*del(log(it_HIC))$
 $+ it_pcd.dumq1*it_DUMMYQ1$
 $+ it_pcd.dumq2*it_DUMMYQ2$
 $+ it_pcd.dumq3*it_DUMMYQ3$
 $+ res_it_pcd,$

REAL BLOCK

REAL PRIVATE CONSUMPTION

it_PCRSTAR: $it_PCRSTAR = \exp(+ it_pcrstar.cst$
 $+ it_pcrstar.pyr*log(it_PYR)$
 $+ it_pcrstar.fwr*log(it_FWR),$

it_PCR: $del(log(it_PCR)) = it_pcr.cst$
 $+ it_pcr.pcr1*del(log(it_PCR(-1)))$
 $+ it_pcr.pyr1*del(log(it_PYR(-1)))$
 $+ it_pcr.urx2*del(log(it_URX(-2)/100))$
 $+ it_pcr.ecm1*log(it_PCR(-1)/it_PCRSTAR(-1))$
 $+ res_it_pcr,$

REAL NON-HOUSING PRIVATE INVESTMENT

it_KSTAR: it_KSTAR = exp(+ log(it_YER)
 - log(it_alpha)
 + (1-it_beta)*log(it_WUN/it_YFD)
 - (1-it_beta)*log(it_CCR)
 - (1-it_beta)*(it_gamma*it_TIME)
 + (1-it_beta)*log(it_beta/(1-it_beta))
 + it_kstar.cst),

it_IPRSTAR: it_IPRSTAR = exp(+log((it_gamma + it_demo+ it_depkpr)/(1+it_gamma+it_demo))
 + log(it_YER)
 - log(it_alpha)
 + (1-it_beta)*log(it_WUN/it_YFD)
 - (1-it_beta)*log(it_CCR)
 - (1-it_beta)*(it_gamma*it_TIME)
 + (1-it_beta)*log(it_beta/(1-it_beta))
 + it_iprstar.cst
 + it_iprstar.time*it_TIME),

it_IPR: del(log(it_IPR)) = it_ipr.cst
 + it_ipr.ipr1*del(log(it_IPR(-1)))
 + it_ipr.ipr2*del(log(it_IPR(-1)))
 + it_ipr.yer*del(log(it_YER))
 + it_ipr.ecm1*log(it_IPR(-1)/it_IPRSTAR(-1))
 + res_it_ipr,

REAL EXPORTS

it_XTRSTAR: it_XTRSTAR = exp(+ it_xtrstar.cst
 + it_xtrstar.wdr*log(it_WDR)
 + it_xtrstar.xtd*log(it_XTD)
 + it_xtrstar.cxd*log(it_CXD)
 + it_xtrstar.time*it_TIME
 + it_xtrstar.time2*it_TIME2),

it_XTR: del(log(it_XTR)) = it_xtr.cst
 + it_xtr.xtr1*del(log(it_XTR(-1)))
 + it_xtr.wdr.*del(log(it_WDR))
 + it_xtr.een*del(log(it_EEN(-1)))
 + it_xtr.comp4*del(log(it_XTD(-4)) - log(it_CXD(-4)))
 + it_xtr.ecm1*log(it_XTR(-1)/it_XTRSTAR(-1))
 + res_it_xtr,

REAL IMPORTS

it_MTRSTAR: $it_MTRSTAR = \exp(+ it_mtrstar.cst$
+ it_mtrstar.wer*log(it_WER)
+ it_mtrstar.mtd*log(it_MTD)
+ it_mtrstar.mtd*(log(it_MTD)- it_mtrstar.pei*(log(it_PEI)/
(1- it_mtrstar.pei)-log(it_YFD))
+ it_mtrstar.yfd*log(it_YFD)
+ it_mtrstar.time*it_TIME
+ it_mtrstar.dumt9001*it_DUMT001),

it_MTR: $del(\log(it_MTR)) = it_mtr.cst$
+ it_mtr.ecm1*log(it_MTR(-1)/it_MTRSTAR(-1))
+ it_mtr.mtr1*del(log(it_MTR(-1)))
+ it_mtr.wer*del(log(it_WER))
+ it_mtr.wer1*del(log(it_WER(-1)))
+ it_mtr.comp4*del(log(it_MTD(-4)) - log(it_YFD(-4)))
+ it_mtr.een01* del(log it_EEN0(-1))
+ res_it_mtr,

TOTAL EMPLOYMENT

it_LSTAR: $it_LSTAR = \exp(+ \log(it_YER)/(1-it_beta)$
- log(it_alpha)/(1-it_beta)
- it_beta*log(it_KSR)/(1-it_beta)
- it_gamma*it_TIME
+ it_lstar.cst*
+ it_lstar.time*it_TIME
+ it_lstar.time2*it_TIME2),

it_LNN: $del(\log(it_LNN))$
+(it_lnn.cst
it_lnn.rwun3*it_gamma)*it_ONES
+ it_lnn.lnn1*del(log(it_LNN(-1)))
+ it_lnn.yer1*del(log(it_YER(-1)))
+ it_lnn.rwun3*del(log(it_WUN(-3)/it_YFD(-3)))
+ it_lnn.ecm2*log(it_LNN(-2)/it_LSTAR(-2))+ res_it_lnn,

TOTAL LABOUR FORCE

it_LFNSTAR: $it_LFNSTAR = \exp(+ it_lfnstar.cst$
+ it_lfnstar.lfn1*log(it_LFN(-1))
+ it_lfnstar.lfn2*log(it_LFN(-2))
+ it_lfnstar.lfn3*log(it_LFN(-3))
+ it_lfnstar.lfn4*log(it_LFN(-4))),

it_LFN: $del(\log(it_LFN)) = it_lfn.cst$
+ it_lfn.ecm4*log(it_LFN(-4)/it_LFNSTAR(-4))
+ it_lfn.lfn1*del(log(it_LFN(-1)))
+ it_lfn.lfn2*del(log(it_LFN(-2)))
+ it_lfn.lfn3*del(log(it_LFN(-3)))
+ it_lfn.urx1*del(log(it_URX(-1)/100-log(it_nairu)))
+ res_it_lfn,

REAL INVENTORIES

it_SCRSTAR: $it_SCRSTAR = (it_scrstar.yer + it_scrstar.time1 * it_TIME1) * it_YER,$

it_SCR: $del(it_SCR / it_YER) = it_scryer.cst$
 $+ it_scryer.ecm3 * ((it_SCR(-3) - it_SCRSTAR(-3)) / it_YER(-31))$
 $+ it_scryer.scryer1 * del(it_SCR(-1) / it_YER(-1))$
 $+ it_scryer.scryer2 * del(it_SCR(-2) / it_YER(-2))$
 $+ it_scryer.scryer3 * del(it_SCR(-3) / it_YER(-3))$
 $+ res_it_scr,$

ACCOUNTING RELATIONSHIPS

it_INFQ: $it_INFQ = 100 * (it_PCD / it_PCD(-1) - 1) + res_it_INFQ,$

it_INFA: $it_INFA = 100 * (it_PCD / it_PCD(-4) - 1) + res_it_INFA,$

it_POIL: $it_POIL = it_POILU * it_EXR + res_it_poil,$

it_CMD: $it_CMD = it_CMUD * it_EXR + res_it_CMD,$

it_CXD: $it_CXD = it_CXUD * it_EXR + res_it_CXD,$

it_WDR: $it_WDR = it_WDR_in * it_WDR_ex + res_it_WDR,$

it_CXUD: $it_CXUD = it_CXUD_in * it_CXUD_ex + res_it_CXUD,$

it_CXDIN: $it_CXD_IN = it_CXUD_in * (it_EXR ** it_betain) + res_it_CXD_IN,$

it_CXDEX: $it_CXD_EX = it_CXUD_ex * (it_EXR ** it_betaex) + res_it_CXD_EX,$

it_CMUD: $it_CMUD = it_CMUD_in * it_CMUD_ex + res_it_CMUD,$

it_CMDIN: $it_CMD_IN = it_CMUD_in * (it_EXR ** it_m2in) + res_it_CMD_IN,$

it_CMDEX: $it_CMD_EX = it_CMUD_ex * (it_EXR ** it_m2ex) + res_it_CMD_EX,$

it_EEN0: $it_EEN0 = it_EEN0_in * it_EEN0_ex + res_it_EEN0,$

it_EEN: $it_EEN = it_EEN_in * it_EEN_ex + res_it_EEN,$

it_OID: $it_OID = it_OIP * (1 - it_TIIR) / (1 - it_TII) + res_it_oid,$

it_GCD: $it_GCD = it_GCP * (1 - it_TGIR) / (1 - it_TGI) + res_it_gcd,$

it_GID: $it_GID = it_GIP * (1 - it_TIIR) / (1 - it_TII) + res_it_gid,$

it_YED: $it_YED = it_YEN / it_YER + res_it_yed,$

it_ITD: $it_ITD = it_ITN / it_ITR + res_it_itd,$

it_PCP: $it_PCD = it_PCP * (1 - it_TCIR) / (1 - it_TCI) + res_it_pcp,$

it_HEX: $it_HEX = it_HEXP * (1 - it_TCIR) / (1 - it_TCI) + res_it_hex,$

it_HIC: $it_HIC = it_WE * it_HEG + (1 - it_WE) * it_HEX + it_ZHIC + res_it_hic,$

$it_OIN: \quad it_OIN = it_OID * it_OIR + res_it_oin,$
 $it_GIN: \quad it_GIN = it_GID * it_GIR + res_it_gin,$
 $it_ITN: \quad it_ITN = it_OIN + it_GIN + res_it_itn,$
 $it_PCN: \quad it_PCN = it_PCD * it_PCR + res_it_pcn,$
 $it_GCN: \quad it_GCN = it_GCD * it_GCR + res_it_gcn,$
 $it_XTN: \quad it_XTN = it_XTD * it_XTR + res_it_xtn,$
 $it_MTN: \quad it_MTN = it_MTD * it_MTR + res_it_mtn,$
 $it_YFN: \quad it_YFN = it_YFD * it_YFR + res_it_yfn,$
 $it_YEN: \quad it_YEN = it_YFN + it_TIN + res_it_yen,$
 $it_ITR: \quad it_ITR = it_IHR + it_IPR + it_GIR + res_it_itr,$
 $it_OIR: \quad it_OIR = it_IPR + it_IHR + res_it_oir,$
 $it_YFR: \quad it_YFR = it_YER - it_TIR + res_it_yfr,$
 $it_MKUP: \quad it_MKUP = 100 * (1 - it_WIN / it_YFN) + res_it_mkup,$
 $it_SZD: \quad it_SZD = it_SZN / (it_ZER + it_SCR) + res_it_szd,$
 $it_UNN: \quad it_UNN = it_LFN - it_LNN + res_it_unn,$
 $it_URX: \quad it_URX = 100 * it_UNN / it_LFN + res_it_urx,$
 $it_PYR: \quad it_PYR = it_PYN / it_PCD + res_it_pyr,$
 $it_KGR: \quad it_KGR = it_GIR + (1 - it_depkgr) * it_KGR(-1) + res_it_KGR,$
 $it_KPR: \quad it_KPR = it_IPR + (1 - it_depkpr) * it_KPR(-1) + res_it_KPR,$
 $it_KSR: \quad it_KSR = it_ITR + (1 - it_depksr) * it_KSR(-1) + res_it_KSR,$
 $it_KHR: \quad it_KHR = it_KSR - it_KPR - it_KGR + res_it_KHR,$
 $it_FWN: \quad it_FWN = it_OID * it_KPR(-1) + it_IHD * it_KHR(-1) + it_GDN(-1) + it_NFA(-1) + res_it_fwn,$
 $it_FWR: \quad it_FWR = it_FWN / it_PCD + res_it_FWR,$
 $it_SALE: \quad it_SALE = it_PCR + it_XTR + it_ITR + res_it_SALE,$
 $it_YER: \quad it_YER = it_PCR + it_GCR + it_ITR + it_SCR + it_XTR - it_MTR + it_ZER + res_it_YER,$
 $it_SZN: \quad it_SZN = it_YEN - it_PCN - it_GCN - it_ITN - it_XTN + it_MTN + res_it_SZN,$
 $it_LEN: \quad it_LEN = it_LEX * it_LNN + res_it_LEN,$
 $it_PRO: \quad it_PRO = it_YER / it_LNN + res_it_PRO,$
 $it_WIN: \quad it_WIN = it_WUN * it_LNN + res_it_WIN,$
 $it_CEX: \quad it_CEX = it_WIN * it_LNN / it_LEN + res_it_CEX,$

$it_ULA: \quad it_ULA = it_WUN/it_PRO + res_it_ula,$
 $it_GON: \quad it_GON = it_YEN - it_WIN - it_TIN + it_ZIN + res_it_gon,$
 $it_PYN: \quad it_PYN = it_WIN + it_OPN + it_TRN - it_PDN + res_it_pyn,$
 $it_PSN: \quad it_PSN = it_PYN - it_PCN + res_it_psn,$
 $it_GYN: \quad it_GYN = it_PDN + it_ODN + it_TIN + it_OGN - it_TRN - it_INN + res_it_gyn,$
 $it_PDNB: \quad it_PDNB = (1+it_pnb.win)*it_WIN + it_TRN + it_OPN + res_it_pndb,$
 $it_INN: \quad it_INN = (1/400)*it_STI*it_GDN(-1) + res_it_inn ,$
 $it_GSN: \quad it_GSN = it_GYN - it_GCN + res_it_gsn,$
 $it_GLN: \quad it_GLN = it_GSN - it_GIN + res_it_gln,$
 $it_GDN: \quad it_GDN = it_GDN(-1) - it_GLN + it_ZGDN + res_it_gdn,$
 $it_ODNB: \quad it_ODNB = it_GON - 0.01*it_ITD*it_KSR(-1) + res_it_odnb,$
 $it_OLN: \quad it_OLN = it_CAN - it_PSN - it_GLN + it_IHN + res_it_oln,$
 $it_BTN: \quad it_BTN = it_XTN - it_MTN + res_it_btn,$
 $it_CAN: \quad it_CAN = it_XTN - it_MTN + it_NFN + it_TWN + it_ZCAN + res_it_can,$
 $it_NFN: \quad it_NFN = (1/400)*it_STI*it_NFA(-1) + res_it_nfn,$
 $it_NFA: \quad it_NFA = it_NFA(-1) + it_CAN + res_it_nfa,$
 $it_OYN: \quad it_OYN = it_GON + it_TWN + it_NFN + it_INN - it_ODN - it_OPN - it_OGN + res_it_oyn,$
 $it_PLN: \quad it_PLN = it_PSN - it_IHN + res_it_pln,$
 $it_TRN: \quad it_TRN = it_TRX*it_YEN + res_it_trn,$
 $it_OPN: \quad it_OPN = it_dfor*it_ZZOPX*it_YEN + (1-it_dfor)*it_OPX*it_GON + res_it_opn,$
 $it_WER: \quad it_WER = + it_wer.pcr*it_PCR$
 $\quad \quad \quad + it_wer.gcr*it_GCR$
 $\quad \quad \quad + it_wer.itr*it_ITR$
 $\quad \quad \quad + it_wer.xtr*it_XTR$
 $\quad \quad \quad + it_wer.scr*it_SCR$
 $\quad \quad \quad + res_it_wer,$
 $it_IHN: \quad it_IHN = it_IHR*it_IHD + res_it_ihn,$
 $it_TIN: \quad it_TIN = + it_TII*it_OIR*it_OID$
 $\quad \quad \quad + it_TII*it_GIR*it_GID$
 $\quad \quad \quad + it_TCI*it_PCR*it_PCD$
 $\quad \quad \quad + it_TGI*it_GCR*it_GCD$
 $\quad \quad \quad + res_it_tin,$
 $it_TIR: \quad it_TIR = + it_TIIR*it_OIR$
 $\quad \quad \quad + it_TIIR*it_GIR$
 $\quad \quad \quad + it_TCIR*it_PCR$
 $\quad \quad \quad + it_TGIR*it_GCR$
 $\quad \quad \quad + res_it_tir,$

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