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# THE ITALIAN BLOCK OF THE ESCB MULTI-COUNTRY MODEL

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by Elena Angelini [2],
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In 2006 all ECB publications will feature a motif taken from the €5 banknote.



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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 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.

[1] Karlsson 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 demand[3].

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 $\delta$ is the depreciation rate of capital. Assuming, no capital adjustment costs, this leads to,

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

[3]Given 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 Villetelle (2005).

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

where $\varepsilon > 1$ is the elasticity of the demand for good $i$ to its relative price and $\gamma$ 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 $P$.

$$\begin{cases} \max_{L_i,K_i} \Pi(Y_i) = PY^{1/\varepsilon} Y_i^{\frac{\varepsilon-1}{\varepsilon}} - wL_i - cK_i \\ s.t. \\ Y_i = AK_i^{\beta}\left(e^{\gamma t}L_i\right)^{1-\beta} \end{cases}$$

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:

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

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:

$$\Delta \log w = \Delta \log \widetilde{P} + \phi\left(\Delta \log Y - \Delta \log L\right) + \rho - \eta \log\left(u\right) \tag{2.3}$$

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

$$u \equiv \frac{\overline{L} - L}{\overline{L}} \tag{2.4}$$

and $\widetilde{P}$ is the price anticipations. In sum, this Phillips curve accounts for two types of rigidities. First, if inflation expectations are not perfect ($\Delta \log \widetilde{P} \neq \Delta \log P$) 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,

$$\Delta \log P = \Delta \log w - \Delta \log Y + \Delta \log L \tag{2.5}$$

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

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

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

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

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 $\Delta \log L = \Delta \log \overline{L} = n$. 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:

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

which implies $L^* < \overline{L}$. 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, $\beta$, $\varepsilon$, $\gamma$, $A$, 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,

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

and

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

### 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)):

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

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

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

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

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

using the standard law of motion for capital,

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

we can derive long-run desired investment,

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

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):

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

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

### 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: $L^{**} = (1-NAIRU)\overline{L}$. 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)):

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

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

[4] Note, 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]

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

where $a$, $b$, $c$ are coefficients and $\varepsilon$ 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):

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

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

[5]Note, 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 | $\widehat{\beta}$ | 0.448 |
| growth rate of productivity | $\widehat{\gamma}$ | 0.001 |
| growth rate of labour force | $\widehat{n}$ | 0.001 |
| demand elasticity | $\widehat{\varepsilon}$ | 3.880 |
| scale factor in C-D production | $\widehat{A}$ | 1.015 |
| target inflation rate | $\pi^*$ | 0.005 |
| depreciation of capital | $\widehat{\delta}$ | 0.010 |
| NAIRU | $nairu$ | 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 $(1+\widehat{n})\cdot(1+\widehat{\gamma})$; price levels grow at $(1+\pi^*)$; nominal volumes at $(1+\pi^*)\cdot(1+\widehat{n})\cdot(1+\widehat{\gamma})$;demographic variables at $(1+\widehat{n})$; and productivity (and, consequently, real wages) at $(1+\widehat{\gamma})$. 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 |
| $cst$ | 0.015 | – |
| $\log(KSR)$ | 0.45 | – |
| $\log(LNN)$ | 0.55 | – |
| $TIME$ | 0.0006 | – |
| $ONES$ | $-0.169$ | $-28.06$ |
| $TIME_A$ | 0.0053 | 20.36 |
| $TIME_A^2$ | $-0.00003$ | $-12.81$ |

**Labour Input**

| Endog: $\log(LSTAR)$-eq.(2.14) | | |
|---|---|---|
| Expl. Vars: | coeff | t-stat |
| $cst$ | $-0.027$ | – |
| $\log(KSR)$ | $-0.818$ | – |
| $\log(YER)$ | 1.818 | – |
| $TIME$ | $-0.001$ | – |
| $ONES$ | 0.305 | 28.06 |
| $TIME_A$ | -0.00954 | $-20.36$ |
| $TIME_A^2$ | 0.00005 | 12.81 |

**Capital Input**

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

**Real Wages**

| Endog: $\log(RWUNSTAR)$-eq.(2.12) | | |
|---|---|---|
| Expl. Vars: | coeff | t-stat |
| $cst$ | $-0.892$ | – |
| $\log(PRO)$ | 1.000 | – |
| $ONES$ | 0.154 | – |
| $TIME_A$ | $-0.0011$ | $-12.95$ |

### 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.

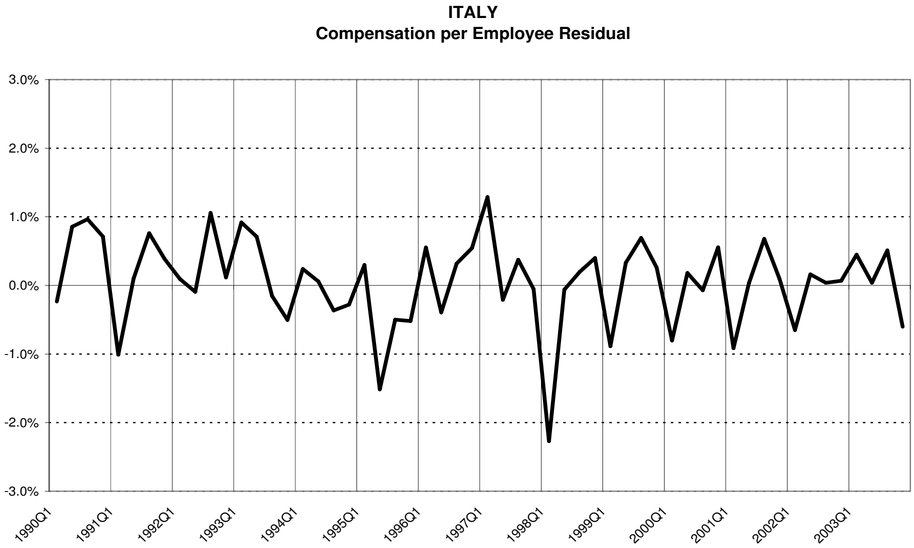
In estimation, note, polynomial lengths are relatively tight reflecting the properties of the data and our own modelling strategy. All equations residuals have been tested for stationarity and to improve the fit of the equations and to accommodate some outliers, dummies have been incorporated when statistically 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.

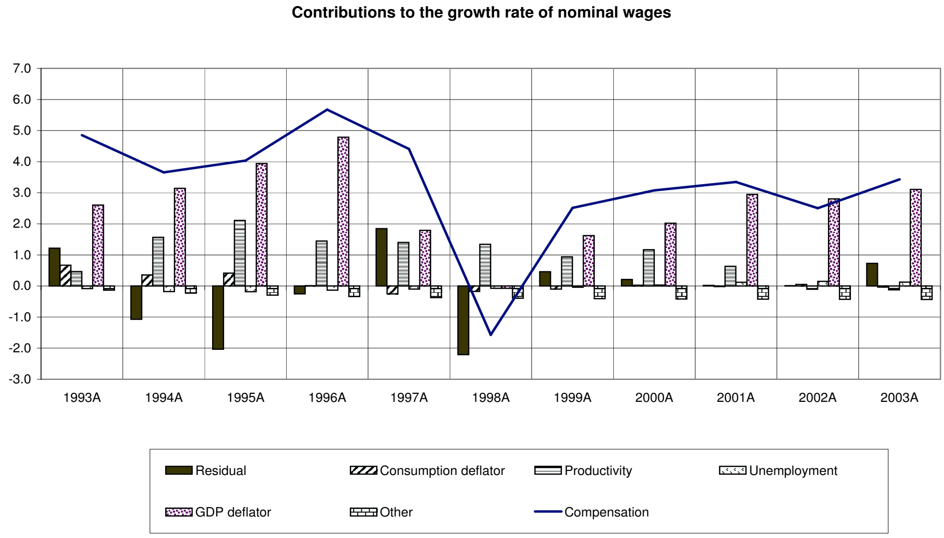
### 3.2.1 The Phillips curve

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 $\widehat{\gamma}$ in the long run, unemployment converges to a constant exogenous $NAIRU$, and that all deflators grow at a common steady state value, $\pi^*$. Consistently with these requirements, the coefficients of the equation satisfy the restriction $(1 - 0.081 - 0.355)\widehat{\gamma} \simeq 0.0006$. The resulting Wald statistics for testing this restriction has a probability value of 0.1, and is thus accepted.

*Phillips curve*

| Endog: $\Delta \log\left(\frac{WUN}{PCD}\right)$ | | |
|---|---|---|
| Expl. Vars: | coefficient | t-stat |
| $cst$ | 0.0006 | 2.89 |
| $\Delta \log\left(\frac{WUN(-1)}{PCD(-1)}\right)$ | 0.081 | 0.84 |
| $\Delta \log(PRO)$ | 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
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1
2003Q1

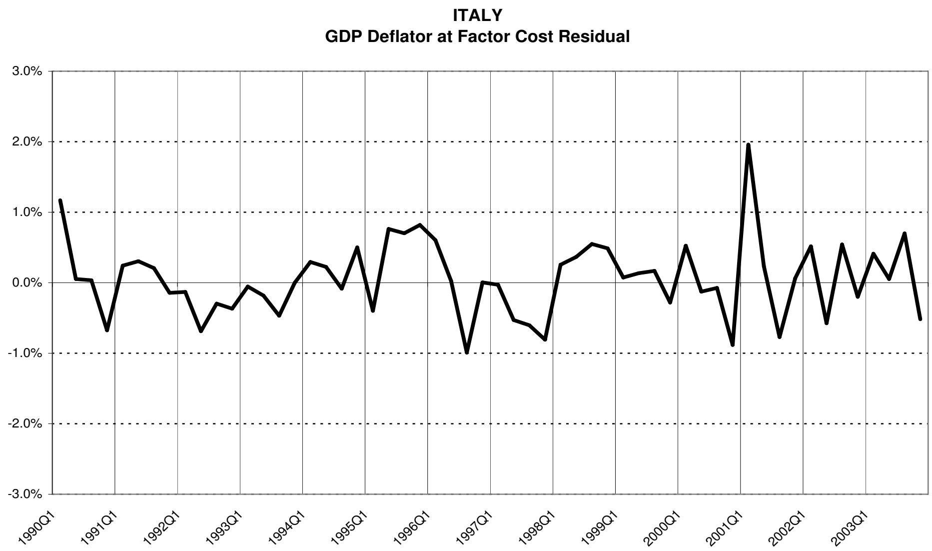

Contributions to the growth rate of nominal wages
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
1993A
1994A
1995A
1996A
1997A
1998A
1999A
2000A
2001A
2002A
2003A
Residual
Consumption deflator
Productivity
Unemployment
GDP deflator
Other
Compensation

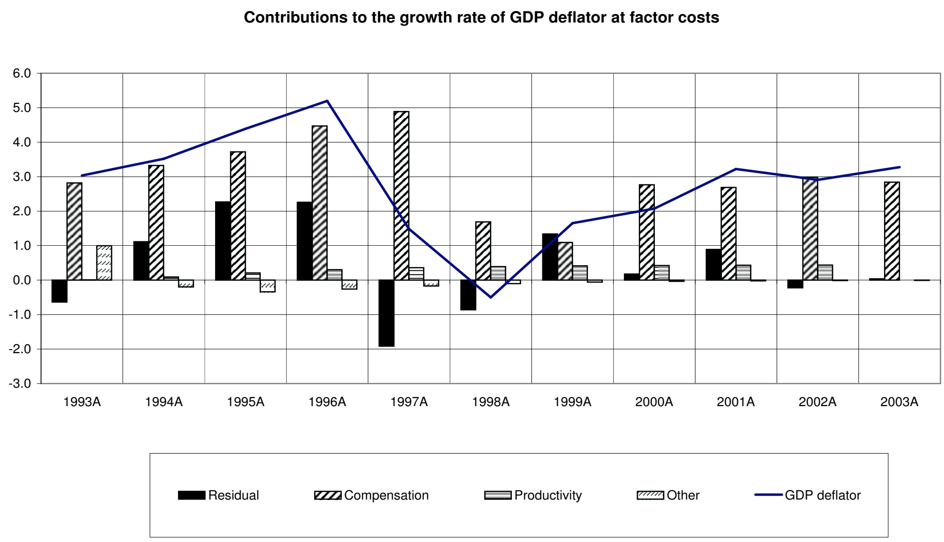
### 3.2.2 The value-added deflator

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 $(1-0.256)\cdot\pi^* \simeq 0.0003+(0.291+0.297)(\pi^*+\widehat{\gamma})-0.161\widehat{\gamma}$, probability value $=0.163$.

*Price Equation*

| Endog: $\Delta \log(YFD)$ | | |
|---|---|---|
| Expl. Vars: | coefficient | t-stat |
| $cst$ | 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
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1
2003Q1

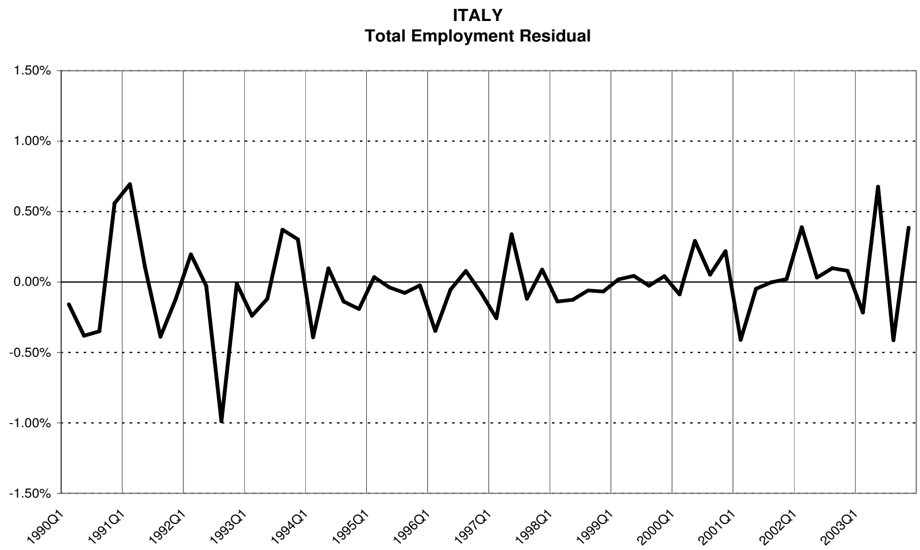

Contributions to the growth rate of GDP deflator at factor costs
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
1993A
1994A
1995A
1996A
1997A
1998A
1999A
2000A
2001A
2002A
2003A
Residual
Compensation
Productivity
Other
GDP deflator

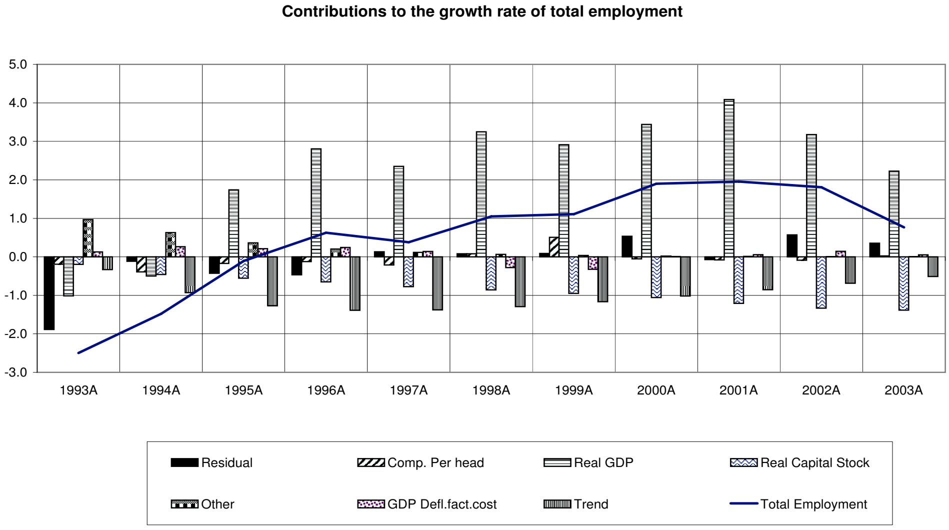
### 3.2.3 Employment, Labour Demand

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 |
| $cst$ | 0.0004 | 3.17 |
| $\Delta \log(LNN(-1))$ | 0.379 | 3.77 |
| $\Delta \log(YER)$ | 0.159 | 4.12 |
| $\Delta \log(WUN(-3)/YFD(-3))$ | $-0.067$ | $-1.92$ |
| $\log(LNN(-2)) - \log(LSTAR(-2))$ | $-0.065$ | $-4.06$ |
| $R^2 = 0.67,\ DW = 2.02,\quad \sigma_\varepsilon = 0.0025$ | | |






### 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 $\pi^*$.

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 |
| $cst$ | $-2.85$ | – |
| $\log(PYR)$ | 0.22 | – |
| $\log(FWR/PYR)$ | 0.78 | – |

**Investment**

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

**Imports**

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

**Exports**

| Endog: $\log(XTRSTAR)$-eq.(2.16) | | |
|---|---|---|
| Expl. Vars: | coeff | t-stat |
| $cst$ | 5.66 | $-10.22$ |
| $\log(WDR)$ | 1.000 | – |
| $\log(XTD/CXD)$ | $-0.71$ | $-9.50$ |
| $TIME_A$ | 0.0067 | 6.64 |
| $TIME_A^2$ | $-0.000079$ | $-9.15$ |

**The Import Deflator**

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

**The Export Deflator**

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

**HICP (Excluding Energy)**

| Endog: $\log(HEXPSTAR)$ | | |
|---|---|---|
| Expl. Vars: | coeff | t-stat |
| $cst$ | 4.73 | – |
| $\log(YFD)$ | 0.90 | – |
| $\log(MTD)$ | 0.10 | – |
| $TIME_A$ | $-0.004$ | $-15.24$ |
| $TIME_A^2$ | 0.000025 | 11.20 |

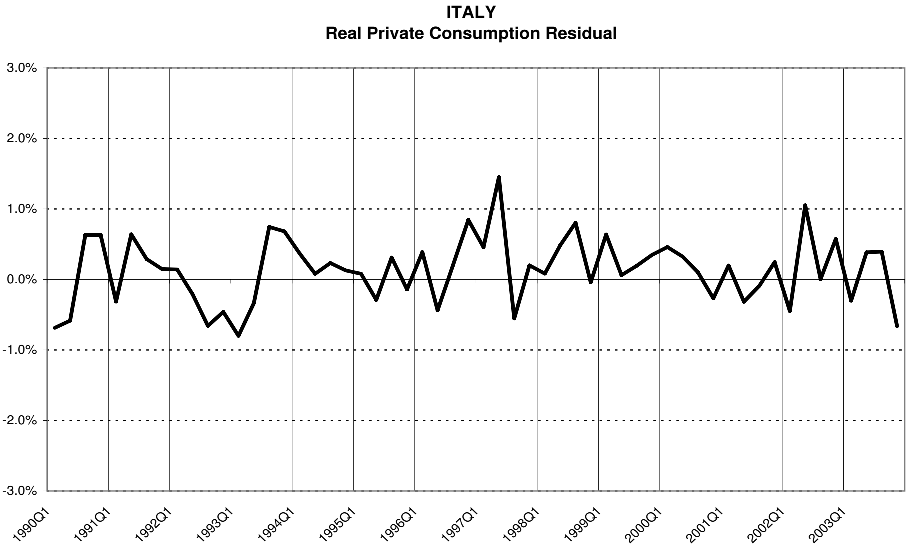
### 3.3.2 Short-run Dynamics

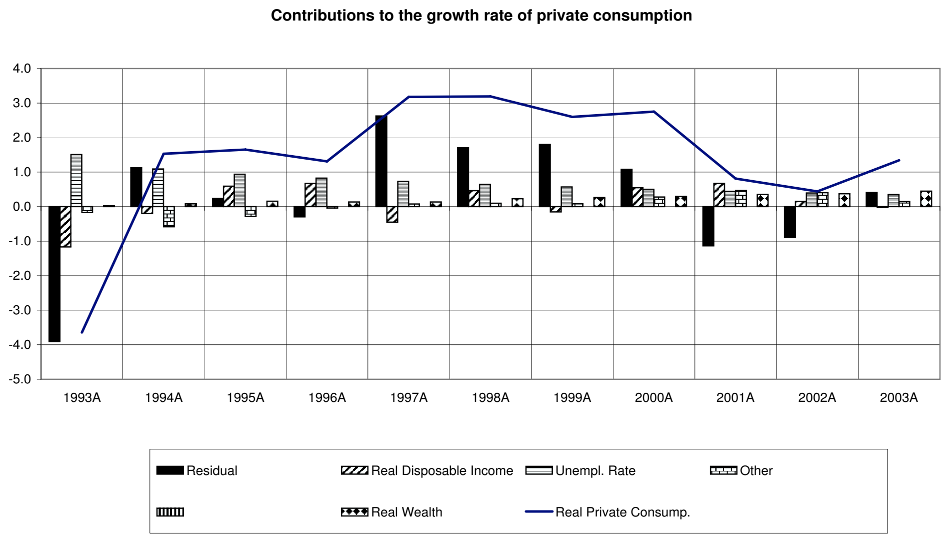
Consumption, in the short-run is driven by its own dynamics, growth in real disposable income, and unemployment. Note the unemployment rate was statistically insignificant (this may be due to collinearity with disposable income, since they both essentially capture the role of liquidity-constrained consumer) 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 |
| $cst$ | 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 |

$R^2 = 0.63,\ DW = 1.88,\quad \sigma_\varepsilon = 0.005$


ITALY
Real Private Consumption Residual
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1
2003Q1


Contributions to the growth rate of private consumption
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
1993A
1994A
1995A
1996A
1997A
1998A
1999A
2000A
2001A
2002A
2003A
Residual
Real Disposable Income
Unempl. Rate
Other
Real Wealth
Real Private Consump.

### 3.3.3 Real private non-housing investment

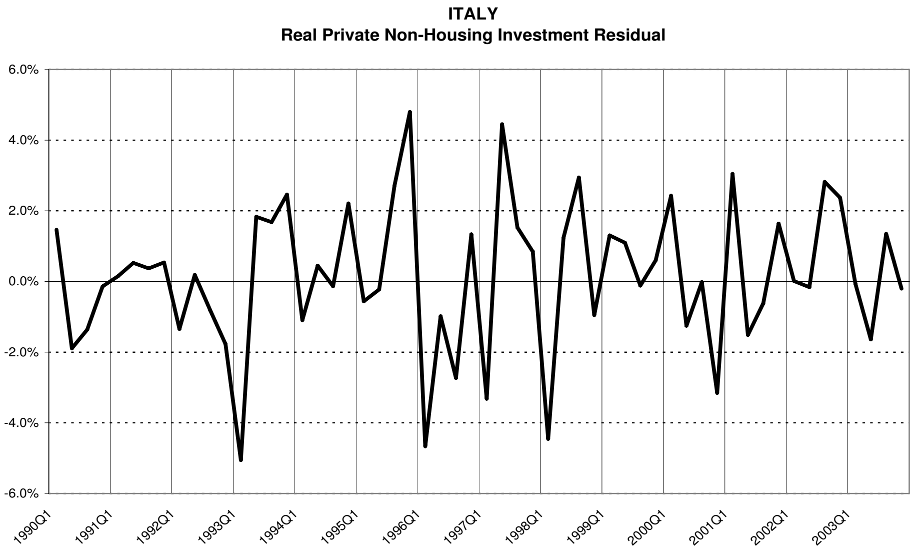
The specification used for investment is a very simple accelerator one, with a long run defined by $IPRSTAR$. However, other variables have considerable indirect effects, as it can be seen from the contribution chart. For instance the real cost of capital produces some impact on investment dynamics through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

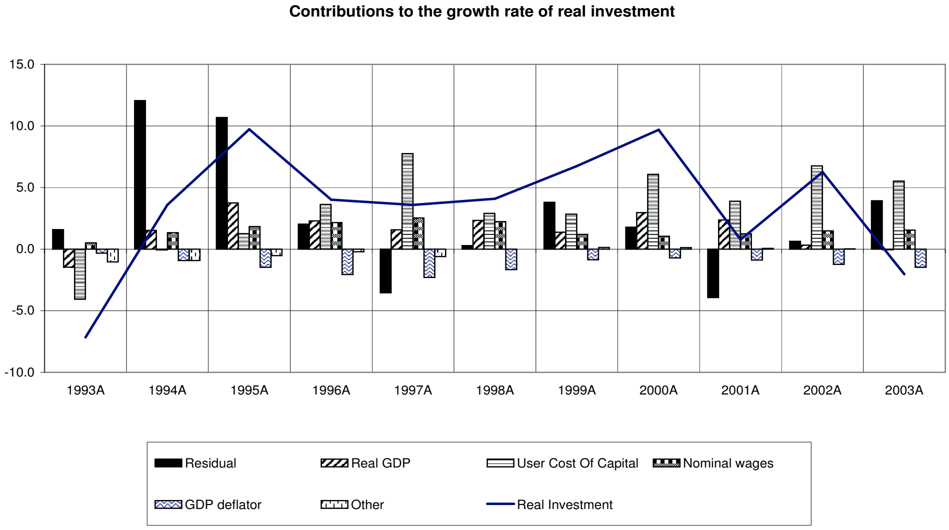
*Real private non-housing investment*

Endog: $\Delta \log (IPR)$

| Expl. Vars: | coeff. | t-stat |
|---|---|---|
| $cst$ | 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 |
| $dumt031$ | $-0.134$ | $-4.73$ |
| $\log(IPR(-1)) - \log (IPRSTAR(-1))$ | $-0.06$ | $-1.07$ |

$R^2 = 0.53,\ DW = 2.17,\ \sigma_\varepsilon = 0.03$





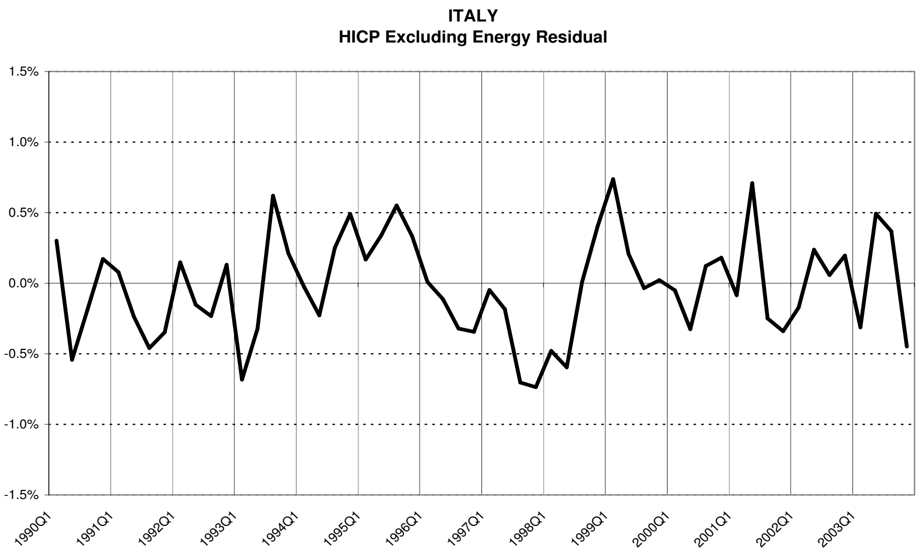

### 3.3.4 Harmonised Index of Consumer Prices

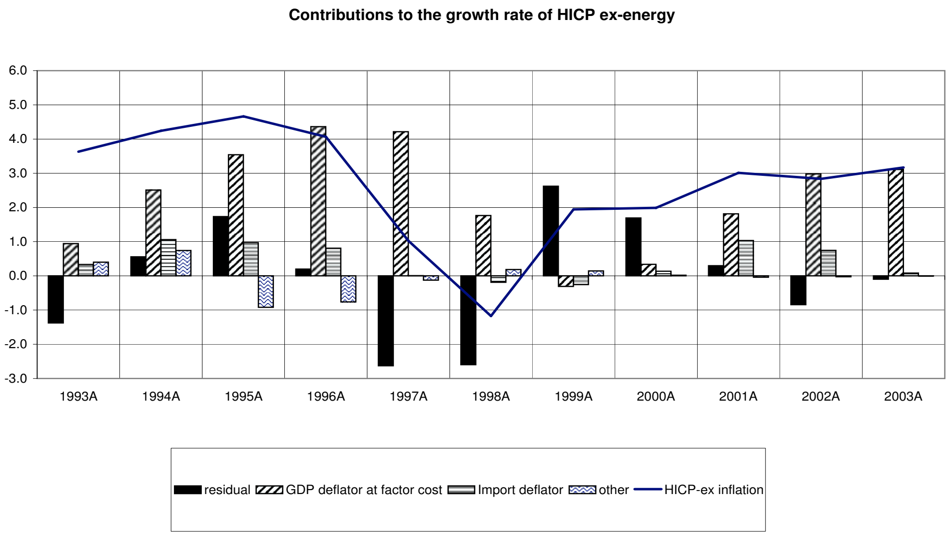
For simulation purposes, the HICP is not strictly needed since it is essentially a pass through of other prices. However, it is of course used in the context of projection exercises. In projections, the IT-MCM comprises three additional HICP variables: total HICP, HEG (HICP energy) and HEXP (HICP excluding 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 |
| $cst$ | 0.001 | 0.84 |
| $\Delta \log(HEXP(-2))$ | $-0.626$ | 3.48 |
| $\Delta \log(YFD(-2)$ | $-0.036$ | $-0.33$ |
| $\Delta \log(YFD(-3))$ | $-0.009$ | $-0.06$ |
| $\Delta \log(MTD)$ | $-0.005$ | $-0.25$ |
| $DUMMYQ1$ | 0.003 | 2.52 |
| $DUMMYQ2$ | 0.004 | 2.51 |
| $DUMMYQ3$ | $-0.0008$ | $-0.55$ |
| $\log(HEXP(-3)) - \log(HEXPSTAR(-3))$ | $-0.142$ | $-1.40$ |

$R^2 = 0.85,\ DW = 1.31,\quad \sigma_\varepsilon = 0.003$






### 3.3.5 Trade: Volumes and Prices

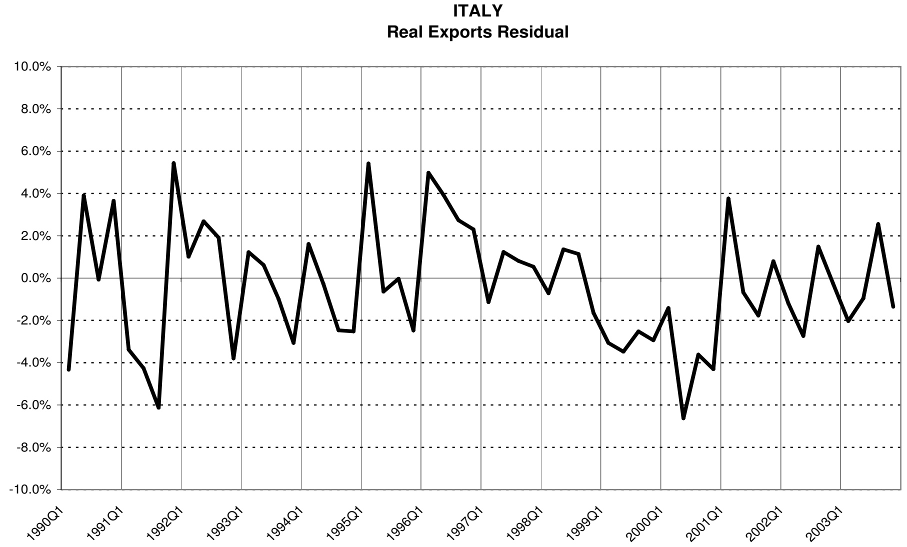
The dynamics of real exports demand depend upon its own lags, world demand, relative prices and the real exchange rate. Imports demand are largely the corresponding equivalent of this. As regards trade prices, export prices are a dynamic function of their own lags, the GDP deflator at factor cost, and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

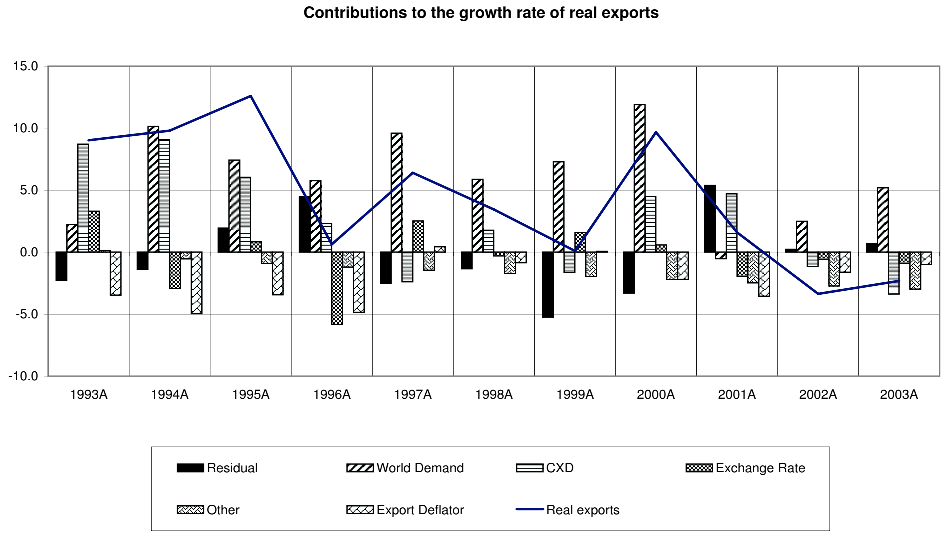
*Real exports*

Endog: $\Delta \log (XTR)$

| Expl. Vars: | coeff. | t-stat |
|---|---|---|
| $cst$ | $-0.016$ | $-2.16$ |
| $\Delta \log (XTR(-1))$ | $-0.207$ | $-1.09$ |
| $\Delta \log (WDR)$ | $1.729$ | $3.18$ |
| $\Delta \log \left(\frac{XTD}{CXD}(-4)\right)$ | $-0.175$ | $-1.67$ |
| $\Delta \log (EEN)$ | $0.743$ | $1.87$ |
| $\log(XTR(-1)) - \log (XTRSTAR(-1))$ | $-0.431$ | $-1.69$ |

$R^2 = 0.25,\ DW = 1.72,\ \sigma_\varepsilon = 0.031$

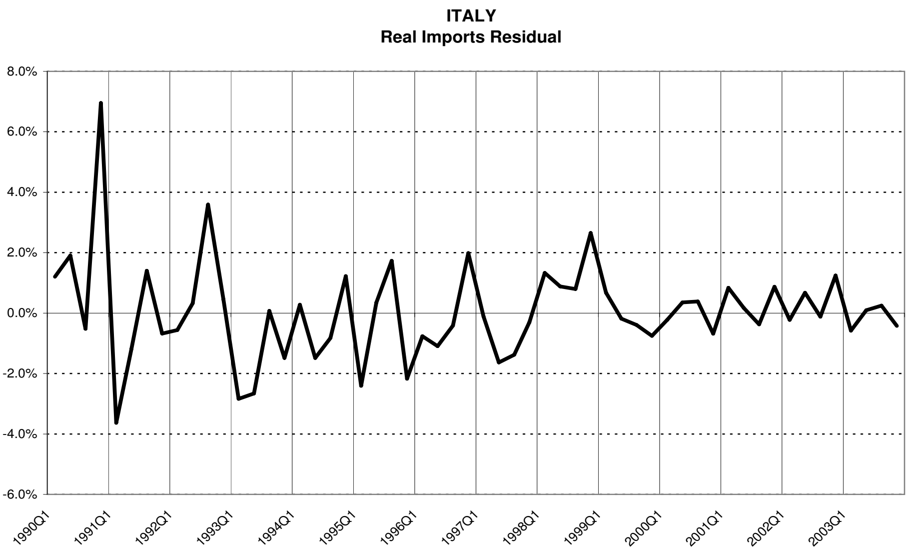

ITALY
Real Exports Residual
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
-2.0%
-4.0%
-6.0%
-8.0%
-10.0%
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1
2003Q1

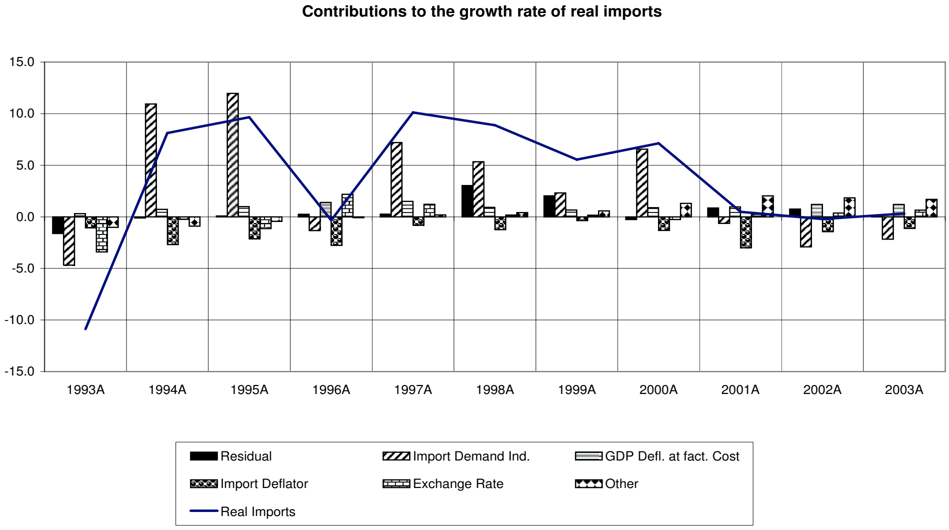

Contributions to the growth rate of real exports
15.0
10.0
5.0
0.0
-5.0
-10.0
1993A
1994A
1995A
1996A
1997A
1998A
1999A
2000A
2001A
2002A
2003A
Residual
World Demand
CXD
Exchange Rate
Other
Export Deflator
Real exports

*Real imports*

| Endog: $\Delta \log (MTR)$ | | |
|---|---|---|
| Expl. Vars: | coeff. | t-stat |
| $cst$ | $-0.0027$ | $-1.004$ |
| $\Delta \log (MTR(-1))$ | $-0.299$ | $-2.97$ |
| $\Delta \log (WER)$ | $1.932$ | $5.04$ |
| $\Delta \log (WER(-1))$ | $0.83$ | $3.83$ |
| $\Delta \log (MTD/YFD(-4))$ | $-0.069$ | $-1.04$ |
| $\Delta \log (EEN0(-1))$ | $-0.277$ | $-1.94$ |
| $\log(MTR(-1)) - \log (MTRSTAR(-1))$ | $-0.077$ | $-1.44$ |

$R^2 = 0.73,\ DW = 2.24,\ \sigma_\varepsilon = 0.019$



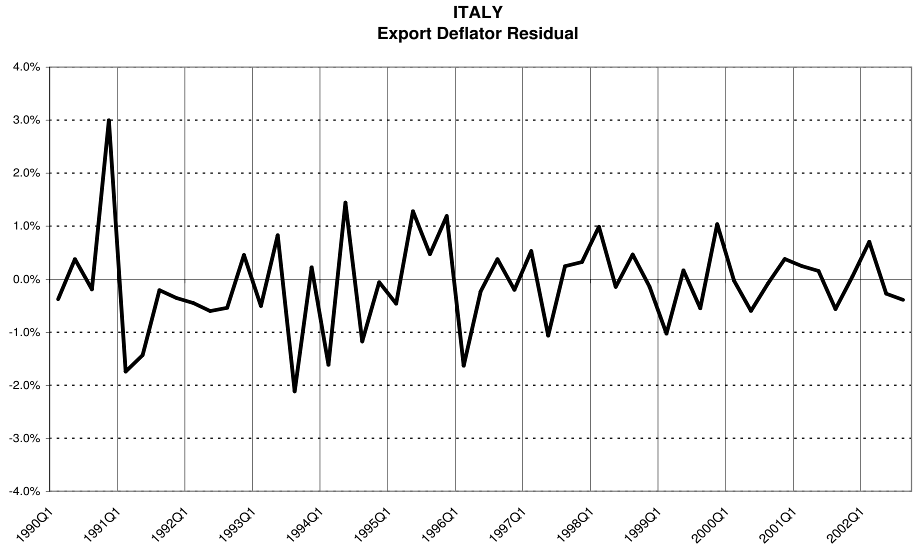


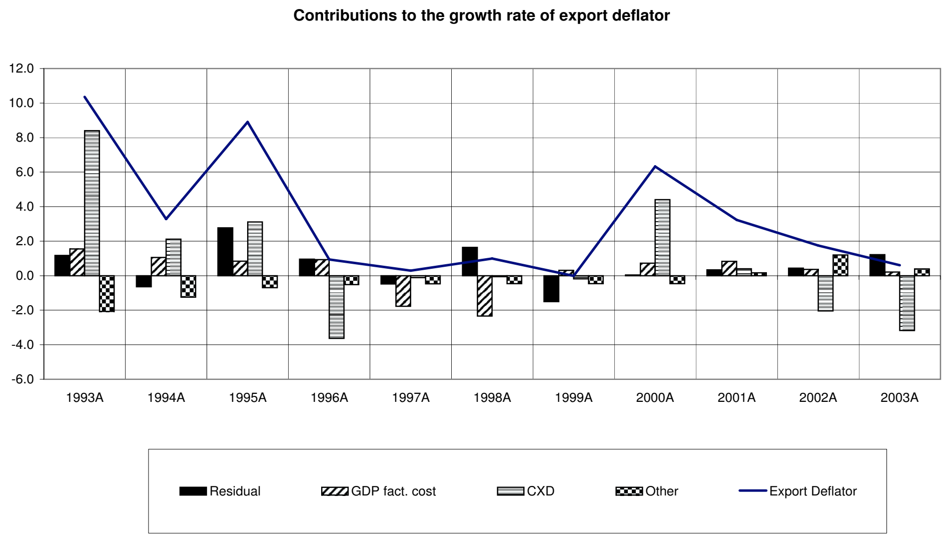

*Export deflator*

Endog: $\Delta \log(XTD)$

| Expl. Vars: | coeff. | t-stat |
|---|---|---|
| $cst$ | $-0.001$ | $-0.81$ |
| $\Delta \log(XTD(-1))$ | $-0.41$ | $3.94$ |
| $\Delta \log(CXD)$ | $0.209$ | $3.81$ |
| $\Delta \log(YFD)$ | $0.649$ | $3.08$ |
| $\log\left(\frac{XTD_{(-1)}}{XTDSTAR_{(-1)}}\right)$ | $-0.295$ | $-3.6$ |

$R^2 = 0.77,\ DW = 2.19,\quad \sigma_\varepsilon = 0.008$

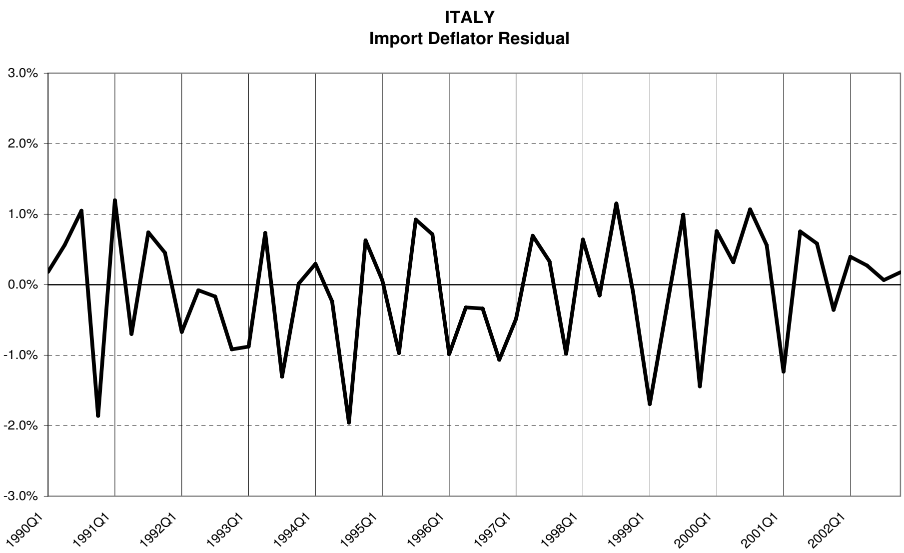

ITALY
Export Deflator Residual
4.0%
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
-4.0%
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1

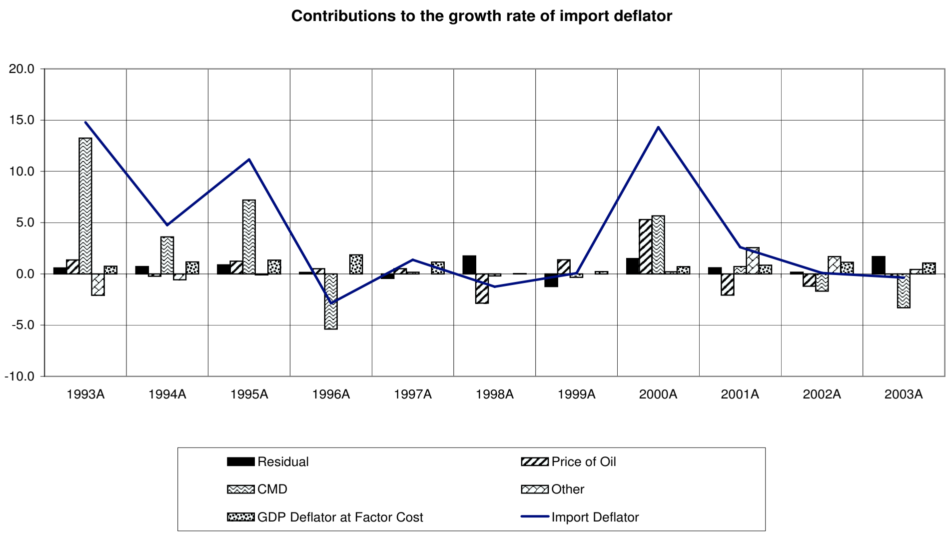

Contributions to the growth rate of export deflator
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
1993A
1994A
1995A
1996A
1997A
1998A
1999A
2000A
2001A
2002A
2003A
Residual
GDP fact. cost
CXD
Other
Export Deflator

*Import deflator*

| Endog: $\Delta\log(MTD)$ | | |
|---|---|---|
| Expl. Vars: | coeff. | t-stat |
| $cst$ | $-0.0034$ | $-2.00$ |
| $\Delta\log(MTD(-1))$ | 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 |
| $\log\left(\frac{MTD_{(-1)}}{MTDSTAR_{(-1)}}\right)$ | $-0.5$ | $-4.73$ |

$R^2 = 0.92,\ DW = 2.22,\quad \sigma_\varepsilon = 0.007$






# 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 form the target and to the output gap (or more strictly, output growth[6]):

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

where the degree of interest-rate smoothing, $\rho$ 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 $(\hat{\gamma}+\widehat{n}+\pi^*)$. 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:

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

where parameter $\lambda$ 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 $\lambda_1$ and $\lambda_2$ were set to which appeared to generate plausible and stable tax trajectories, namely 0.1 and 0.01 respectively. Parameter $\rho^{PDX}$ 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

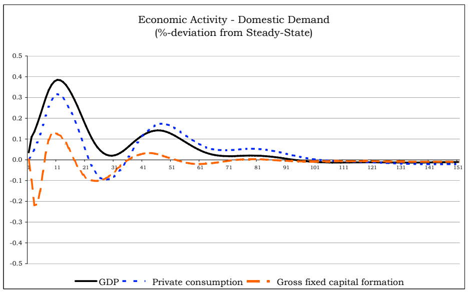
[6] Both output growth and the actual output gap can be used and results on the latter are available on request. However, the latter, tends to engender somewhat slower model dynamics, so we chose here to focus on the output growth concept. Indeed, this is also the case for the other MCM models and so 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.

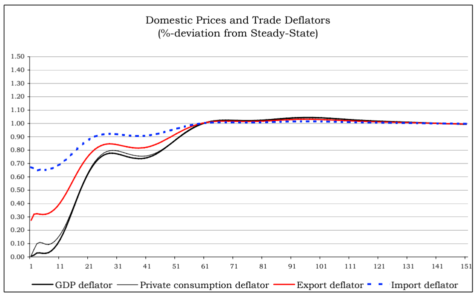
consistent with these implied paths. The model is then explicitly solved, to check for consistency, stability and that, in the absence of any pertubation, that the model does indeed return to a steady state with given growth characteristics. Once we have derived a model which displays suitable characteristics, 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.

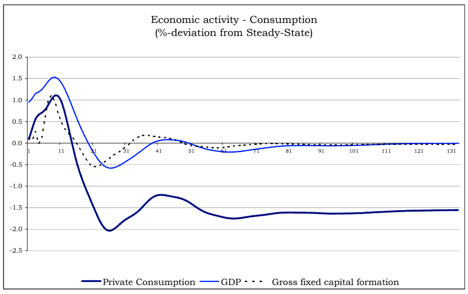
**Table 1(a): Permanent increase in all foreign and exogenous prices**

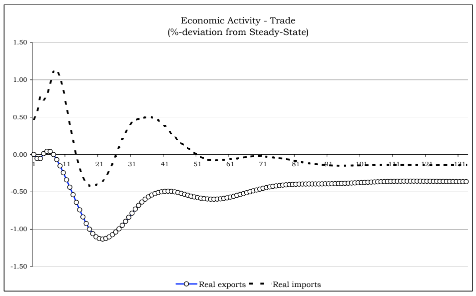
| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Economic Activity (constant prices)*** | | | | | | | | | | |
| GDP | E_IT_YER | 0.04 | 0.11 | 0.14 | 0.17 | 0.21 | 0.26 | 0.30 | 0.34 | 0.36 |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

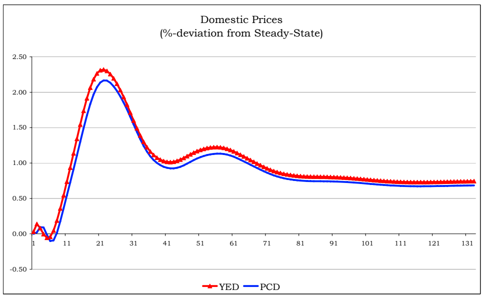
**Table 1(a): Permanent increase in all foreign and exogenous prices**

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

| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Economic Activity (constant prices)*** | | | | | | | | | | |
| GDP | E_IT_YER | 0.95 | 1.04 | 1.15 | 1.19 | 1.25 | 1.34 | 1.44 | 1.51 | 1.53 |
| Private consumption | E_IT_PCR | 0.09 | 0.33 | 0.55 | 0.66 | 0.71 | 0.78 | 0.89 | 1.02 | 1.10 |
| Government consumption | E_IT_GCR | 5.53 | 5.53 | 5.53 | 5.53 | 5.53 | 5.53 | 5.53 | 5.53 | 5.53 |
| Gross fixed capital formation | E_IT_ITR | 0.13 | 0.06 | 0.27 | -0.01 | 0.14 | 0.61 | 1.01 | 1.12 | 0.97 |
| Exports | E_IT_XTR | 0.00 | -0.05 | -0.05 | 0.01 | 0.04 | 0.04 | 0.00 | -0.07 | -0.15 |
| Imports | E_IT_MTR | 0.48 | 0.57 | 0.78 | 0.74 | 0.79 | 0.96 | 1.11 | 1.14 | 1.04 |
| of which : | | | | | | | | | | |
| Contribution of trade | E_IT_TRADE | -0.13 | -0.18 | -0.24 | -0.20 | -0.21 | -0.26 | -0.31 | -0.34 | -0.34 |
| Contribution of inventories | E_IT_SCRRATIO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | | |
| ***Price Developments*** | | | | | | | | | | |
| HICP | E_IT_HIC | 0.00 | 0.03 | 0.09 | 0.07 | -0.02 | -0.09 | -0.07 | 0.03 | 0.19 |
| GDP deflator | E_IT_YED | 0.03 | 0.14 | 0.08 | 0.00 | -0.06 | -0.04 | 0.05 | 0.19 | 0.36 |
| Private Consumption deflator | E_IT_PCD | 0.00 | 0.02 | 0.09 | 0.09 | -0.01 | -0.10 | -0.09 | 0.01 | 0.18 |
| Exports deflator | E_IT_XTD | 0.01 | 0.13 | 0.01 | -0.05 | -0.07 | -0.03 | 0.05 | 0.16 | 0.29 |
| Imports deflator | E_IT_MTD | 0.00 | 0.07 | 0.01 | -0.03 | -0.04 | -0.02 | 0.02 | 0.08 | 0.15 |
| Competitors Prices on domestic market | E_IT_CMD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Competitors Prices on external markets | E_IT_CXD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nominal Exchange Rate | E_IT_EEN | 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) | E_IT_WUN | 0.15 | 0.35 | 0.25 | 0.03 | -0.20 | -0.34 | -0.37 | -0.33 | -0.25 |
| Compensation per employee (real, GDP price) | E_IT_WUNY | 0.12 | 0.21 | 0.16 | 0.03 | -0.14 | -0.30 | -0.42 | -0.52 | -0.61 |
| Compensation per employee (real, Consumption price) | E_IT_WUNC | 0.15 | 0.33 | 0.15 | -0.06 | -0.18 | -0.24 | -0.28 | -0.34 | -0.43 |
| Productivity | E_IT_PRO | 0.18 | 0.05 | -0.03 | -0.11 | -0.15 | -0.17 | -0.19 | -0.21 | -0.23 |
| ULC, whole economy | E_IT_ULC | -0.55 | 0.13 | 0.38 | 0.46 | 0.41 | 0.36 | 0.39 | 0.51 | 0.68 |
| Total Labour Force | E_IT_LFN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total employment | E_IT_LNN | 0.24 | 0.82 | 1.28 | 1.62 | 1.86 | 2.05 | 2.22 | 2.37 | 2.47 |
| Unemployment | E_IT_UNN | -2.64 | -9.19 | -14.40 | -18.20 | -20.84 | -22.97 | -24.89 | -26.56 | -27.73 |
| Unemployment rate (deviation from baseline) | E_IT_URX | -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**

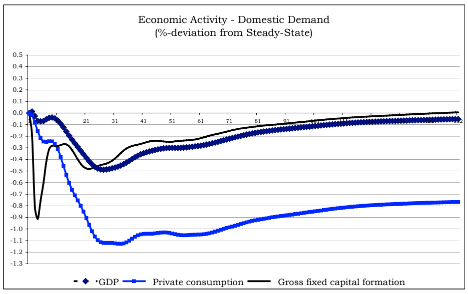
| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Disposable Income (nominal) & Total Wealth*** | | | | | | | | | | |
| Disposable income | E_IT_PYN | 0.65 | 0.66 | 0.16 | -0.54 | -0.94 | -0.80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

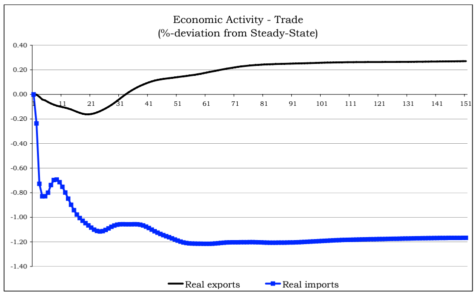
**Table 3(a): Permanent oil price shock**

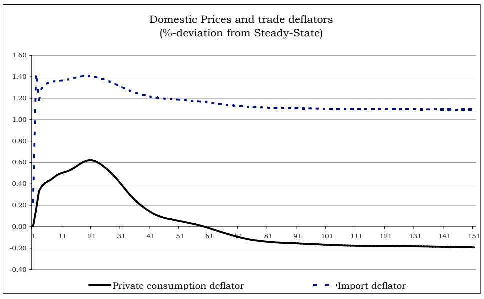
| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Economic Activity (constant prices)*** | | | | | | | | | | |
| GDP | E_IT_YER | 0.00 | 0.01 | -0.03 | -0.07 | -0.07 | -0.07 | -0.05 | -0.04 |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

| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Disposable Income (nominal) & Total Wealth*** | | | | | | | | | | |
| Disposable income | E_IT_PYN | 0.00 | -0.03 | -0.19 | -0.36 | -0.39 | -0.25 | -0.02 | 0.22 | 0.36 |
| Real disposible Income | E_IT_PYR | 0.00 | -0.18 | -0.52 | -0.74 | -0.79 | -0.68 | -0.46 | -0.24 | -0.11 |
| Compensation of employees | E_IT_WIN | 0.00 | 0.04 | 0.10 | 0.09 | 0.08 | 0.10 | 0.13 | 0.17 | 0.20 |
| Transfers from Gal Gov. | E_IT_TRN | 0.00 | 0.04 | 0.05 | 0.04 | 0.05 | 0.08 | 0.12 | 0.15 | 0.17 |
| Other Personal income | E_IT_OPN | 0.00 | 0.01 | 0.00 | -0.01 | 0.01 | 0.03 | 0.05 | 0.06 | 0.06 |
| Direst Taxes (inc. SSC) | E_IT_PDN | 0.00 | 0.20 | 0.80 | 1.33 | 1.44 | 1.10 | 0.46 | -0.20 | -0.60 |
| Total Wealth | E_IT_FWN | 0.01 | 0.09 | 0.05 | 0.00 | -0.10 | -0.19 | -0.25 | -0.27 | -0.26 |
| Real Total Wealth | E_IT_FWR | 0.01 | -0.07 | -0.29 | -0.38 | -0.50 | -0.61 | -0.68 | -0.73 | -0.74 |
| Saving ratio | E_IT_SRATIO | 0.00 | -0.05 | -0.12 | -0.11 | -0.08 | -0.06 | -0.04 | -0.04 | -0.04 |
| Net foreign asstes ratio | E_IT_NFARATIO | -0.02 | -0.28 | -0.45 | -0.55 | -0.67 | -0.80 | -0.94 | -1.10 | -1.26 |
| ***Firms and Interest Rate*** | | | | | | | | | | |
| Capital Stock | E_IT_KSR | 0.00 | 0.00 | -0.04 | -0.09 | -0.14 | -0.17 | -0.19 | -0.20 | -0.21 |
| Real Cost of Capital (average) | E_IT_CCR | 0.31 | 5.33 | 2.04 | 0.89 | 1.33 | 0.51 | 0.58 | 0.72 | 0.67 |
| 3-month interest rate | E_IT_STI | 0.02 | 0.32 | 0.17 | 0.04 | 0.04 | 0.03 | 0.03 | 0.04 | 0.03 |
| 10-year long-term interest rate | E_IT_LTI | 0.01 | 0.27 | 0.14 | 0.06 | 0.07 | 0.03 | 0.03 | 0.04 | 0.03 |
| ***Public Sector*** | | | | | | | | | | |
| Gal Gov. Compensation of Employees | E_IT_PDN | 0.00 | 0.20 | 0.80 | 1.33 | 1.44 | 1.10 | 0.46 | -0.20 | -0.60 |
| Tranfers from gal Gov. | E_IT_TRN | 0.00 | 0.04 | 0.05 | 0.04 | 0.05 | 0.08 | 0.12 | 0.15 | 0.17 |
| Other Gov. Net Revenues | E_IT_OGN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Direst Taxes (inc. SSC) | E_IT_PDX | 0.00 | 0.17 | 0.75 | 1.29 | 1.39 | 1.03 | 0.37 | -0.32 | -0.74 |
| Other Direct Taxes | E_IT_ODN | 0.00 | -0.02 | -0.03 | -0.03 | -0.01 | 0.01 | 0.03 | 0.04 | 0.04 |
| Indirect Taxes less Subsidies | E_IT_TIN | 0.02 | 0.14 | 0.07 | 0.04 | 0.06 | 0.09 | 0.14 | 0.18 | 0.21 |
| Gen. Gov. Net Debt | E_IT_GDN | 0.01 | 0.22 | 0.40 | 0.25 | 0.01 | -0.19 | -0.26 | -0.17 | 0.02 |
| Gen. Gov. Net Lending (% of GDP) | E_IT_GLNRATIO | -0.03 | -0.35 | -0.05 | 0.23 | 0.25 | 0.19 | 0.03 | -0.14 | -0.24 |
| Gen. Gov. Net Debt (% of GDP) | E_IT_GDNRATIO | 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

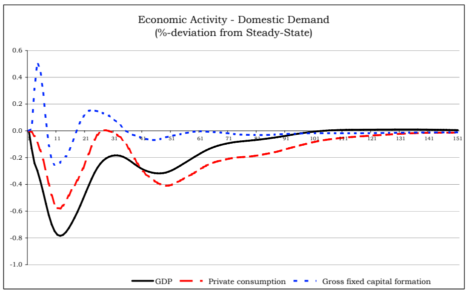
In this exercise euro appreciates permanently by 5% against all foreign currencies. Import prices are affected as well as export competitiveness. Real exports fall below baseline (-0.78% second year) following the appreciation of the euro and competitiveness losses dragging down investment and stock 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.

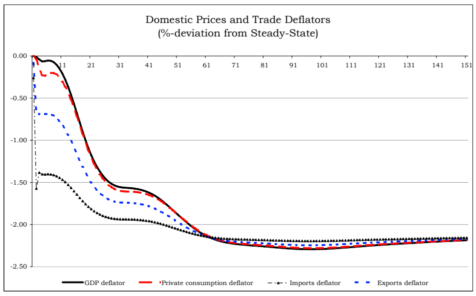
**Table 4(a): Permanent appreciation of the euro**

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

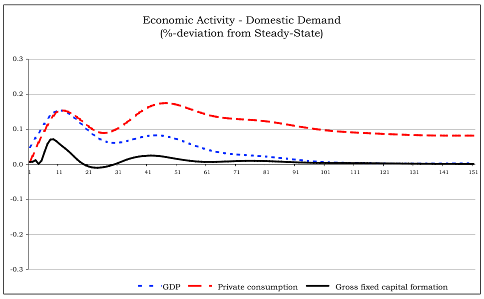
| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Disposable Income (nominal) & Total Wealth*** | | | | | | | | | | |
| Disposable income | E_IT_PYN | 0.00 | -0.10 | -0.19 | -0.20 | -0.22 | -0.34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

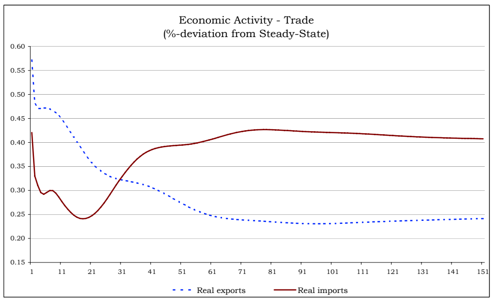


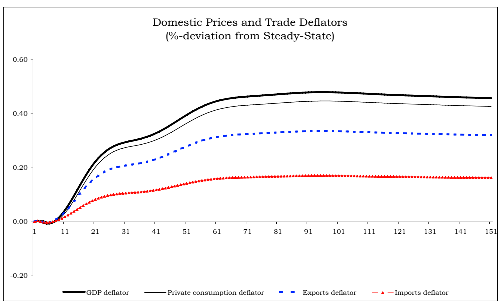




### 4.3.5 Permanent increase in world demand

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.



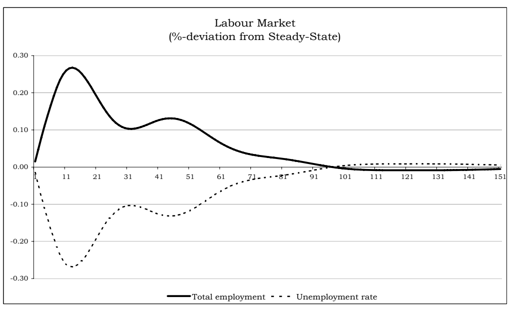



**Table 5(a): Permanent increase in world demand**

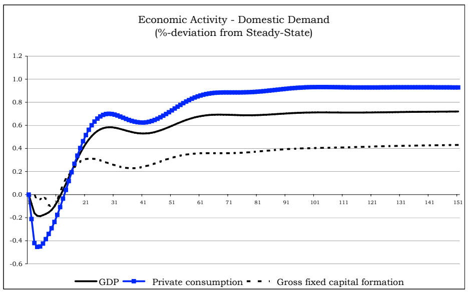
| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Economic Activity (constant prices)*** | | | | | | | | | | |
| GDP | E_IT_YER | 0.05 | 0.06 | 0.08 | 0.09 | 0.10 | 0.12 | 0.13 | 0.14 | 0.15 |
| Private consumption | E_IT_PCR | 0.01 | 0.02 | 0.04 | 0.06 | 0.08 | 0.10 | 0.11 | 0.13 | 0.14 |
| Government consumption | E_IT_GCR | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gross fixed capital formation | E_IT_ITR | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.03 | 0.06 | 0.07 | 0.07 |
| Exports | E_IT_XTR | 0.57 | 0.48 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.46 |
| Imports | E_IT_MTR | 0.42 | 0.33 | 0.31 | 0.30 | 0.29 | 0.30 | 0.30 | 0.30 | 0.29 |
| of which : | | | | | | | | | | |
| Contribution of trade | E_IT_TRADE | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Contribution of inventories | E_IT_SCRRATIO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Price Developments*** | | | | | | | | | | |
| HICP | E_IT_HIC | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| GDP deflator | E_IT_YED | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 | -0.01 | 0.00 | 0.01 | 0.02 |
| Private Consumption deflator | E_IT_PCD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Exports deflator | E_IT_XTD | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 |
| Imports deflator | E_IT_MTD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Competitors Prices on domestic market | E_IT_CMD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Competitors Prices on external markets | E_IT_CXD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nominal Exchange Rate | E_IT_EEN | 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) | E_IT_WUN | 0.01 | 0.02 | 0.01 | 0.00 | -0.01 | -0.02 | -0.03 | -0.03 | -0.03 |
| Compensation per employee (real, GDP price) | E_IT_WUNY | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | -0.01 | -0.02 | -0.04 | -0.05 |
| Compensation per employee (real, Consumption price) | E_IT_WUNC | 0.01 | 0.02 | 0.01 | 0.00 | -0.01 | -0.02 | -0.02 | -0.03 | -0.04 |
| Productivity | E_IT_PRO | 0.01 | 0.00 | 0.00 | -0.01 | -0.01 | -0.01 | -0.02 | -0.02 | -0.02 |
| ULC, whole economy | E_IT_ULC | -0.03 | 0.00 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.06 |
| Total Labour Force | E_IT_LFN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total employment | E_IT_LNN | 0.01 | 0.05 | 0.08 | 0.11 | 0.14 | 0.17 | 0.19 | 0.21 | 0.23 |
| Unemployment | E_IT_UNN | -0.17 | -0.53 | -0.89 | -1.23 | -1.55 | -1.85 | -2.14 | -2.40 | -2.62 |
| Unemployment rate (deviation from baseline) | E_IT_URX | -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**

| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Disposable Income (nominal) & Total Wealth*** | | | | | | | | | | |
| Disposable income | E_IT_PYN | 0.04 | 0.07 | 0.09 | 0.10 | 0.11 | 0.12 | 0.14 | 0.16 | 0.17 |
| Real disposible Income | E_IT_PYR | 0.04 | 0.07 | 0.09 | 0.10 | 0.11 | 0.13 | 0.14 | 0.16 | 0.16 |
| Compensation of employees | E_IT_WIN | 0.02 | 0.06 | 0.09 | 0.11 | 0.13 | 0.15 | 0.16 | 0.18 | 0.20 |
| Transfers from Gal Gov. | E_IT_TRN | 0.05 | 0.06 | 0.08 | 0.08 | 0.10 | 0.11 | 0.13 | 0.14 | 0.16 |
| Other Personal income | E_IT_OPN | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 | 0.06 | 0.06 |
| Direst Taxes (inc. SSC) | E_IT_PDN | 0.00 | -0.02 | -0.02 | -0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 |
| Total Wealth | E_IT_FWN | 0.01 | 0.02 | 0.04 | 0.05 | 0.06 | 0.07 | 0.09 | 0.11 | 0.13 |
| Real Total Wealth | E_IT_FWR | 0.01 | 0.02 | 0.03 | 0.04 | 0.06 | 0.08 | 0.09 | 0.11 | 0.12 |
| Saving ratio | E_IT_SRATIO | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| ***Firms and Interest Rate*** | | | | | | | | | | |
| Capital Stock | E_IT_KSR | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| Real Cost of Capital (average) | E_IT_CCR | 0.38 | 0.05 | 0.30 | 0.16 | 0.07 | 0.04 | 0.05 | 0.07 | 0.08 |
| 3-month interest rate | E_IT_STI | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 |
| 10-year long-term interest rate | E_IT_LTI | 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 | E_IT_PDN | 0.00 | -0.02 | -0.02 | -0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 |
| Tranfers from gal Gov. | E_IT_TRN | 0.05 | 0.06 | 0.08 | 0.08 | 0.10 | 0.11 | 0.13 | 0.14 | 0.16 |
| Other Gov. Net Revenues | E_IT_OGN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Direst Taxes (inc. SSC) | E_IT_PDX | -0.03 | -0.07 | -0.09 | -0.09 | -0.08 | -0.09 | -0.10 | -0.12 | -0.12 |
| Other Direct Taxes | E_IT_ODN | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 | 0.05 | 0.06 |
| Indirect Taxes less Subsidies | E_IT_TIN | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.08 | 0.09 | 0.11 |
| Gen. Gov. Net Debt | E_IT_GDN | 0.03 | 0.04 | 0.07 | 0.09 | 0.10 | 0.10 | 0.12 | 0.14 | 0.17 |
| Gen. Gov. Net Lending (% of GDP) | E_IT_GLNRATIO | -0.03 | -0.03 | -0.03 | -0.02 | -0.01 | -0.01 | -0.02 | -0.03 | -0.03 |
| Gen. Gov. Net Debt (% of GDP) | E_IT_GDNRATIO | -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.



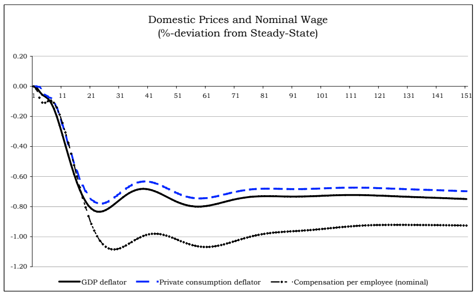



**Table 6(a): Permanent increase in labour supply**

| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Economic Activity (constant prices)*** | | | | | | | | | | |
| GDP | E_IT_YER | 0.00 | -0.08 | -0.16 | -0.18 | -0.19 | -0.18 | -0.17 | -0.15 | -0.13 |
| Private consumption | E_IT_PCR | 0.00 | -0.21 | -0.42 | -0.45 | -0.45 | -0.42 | -0.39 | -0.34 | -0.29 |
| Government consumption | E_IT_GCR | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gross fixed capital formation | E_IT_ITR | 0.00 | -0.02 | 0.00 | -0.06 | -0.04 | -0.01 | -0.04 | -0.09 | -0.12 |
| Exports | E_IT_XTR | 0.00 | 0.00 | 0.01 | 0.03 | 0.03 | 0.04 | 0.05 | 0.07 | 0.09 |
| Imports | E_IT_MTR | 0.00 | -0.18 | -0.32 | -0.32 | -0.29 | -0.24 | -0.21 | -0.18 | -0.15 |
| of which : | | | | | | | | | | |
| Contribution of trade | E_IT_TRADE | 0.00 | 0.05 | 0.09 | 0.10 | 0.09 | 0.08 | 0.07 | 0.07 | 0.07 |
| Contribution of inventories | E_IT_SCRRATIO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Price Developments*** | | | | | | | | | | |
| HICP | E_IT_HIC | 0.00 | 0.00 | -0.01 | -0.03 | -0.05 | -0.07 | -0.08 | -0.10 | -0.14 |
| GDP deflator | E_IT_YED | 0.00 | -0.01 | -0.03 | -0.06 | -0.07 | -0.08 | -0.11 | -0.15 | -0.20 |
| Private Consumption deflator | E_IT_PCD | 0.00 | 0.00 | 0.00 | -0.03 | -0.05 | -0.07 | -0.08 | -0.10 | -0.14 |
| Exports deflator | E_IT_XTD | 0.00 | 0.00 | -0.03 | -0.04 | -0.05 | -0.06 | -0.08 | -0.12 | -0.16 |
| Imports deflator | E_IT_MTD | 0.00 | 0.00 | -0.01 | -0.02 | -0.02 | -0.03 | -0.04 | -0.06 | -0.08 |
| Competitors Prices on domestic market | E_IT_CMD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Competitors Prices on external markets | E_IT_CXD | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nominal Exchange Rate | E_IT_EEN | 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) | E_IT_WUN | 0.00 | -0.02 | -0.08 | -0.11 | -0.11 | -0.10 | -0.09 | -0.11 | -0.14 |
| Compensation per employee (real, GDP price) | E_IT_WUNY | 0.00 | -0.01 | -0.04 | -0.05 | -0.04 | -0.02 | 0.01 | 0.04 | 0.06 |
| Compensation per employee (real, Consumption price) | E_IT_WUNC | 0.00 | -0.02 | -0.07 | -0.08 | -0.06 | -0.03 | -0.02 | -0.01 | 0.00 |
| Productivity | E_IT_PRO | 0.00 | -0.02 | -0.02 | 0.00 | 0.01 | 0.02 | 0.03 | 0.03 | 0.04 |
| ULC, whole economy | E_IT_ULC | 0.00 | 0.05 | 0.00 | -0.09 | -0.15 | -0.19 | -0.21 | -0.24 | -0.28 |
| Total Labour Force | E_IT_LFN | 0.25 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Total employment | E_IT_LNN | 0.00 | -0.01 | -0.08 | -0.17 | -0.23 | -0.27 | -0.29 | -0.29 | -0.27 |
| Unemployment | E_IT_UNN | 2.80 | 11.28 | 12.11 | 13.05 | 13.77 | 14.19 | 14.36 | 14.37 | 14.22 |
| Unemployment rate (deviation from baseline) | E_IT_URX | 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**

| (deviations from baseline, percentage unless otherwise indicated) | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Disposable Income (nominal) & Total Wealth*** | | | | | | | | | | |
| Disposable income | E_IT_PYN | 0.00 | -0.07 | -0.21 | -0.31 | -0.34 | -0.31 | -0.27 | -0.25 | -0.24 |
| Real disposible Income | E_IT_PYR | 0.00 | -0.07 | -0.20 | -0.28 | -0.29 | -0.24 | -0.19 | -0.15 | -0.10 |
| Compensation of employees | E_IT_WIN | 0.00 | -0.03 | -0.16 | -0.28 | -0.34 | -0.37 | -0.38 | -0.39 | -0.41 |
| Transfers from Gal Gov. | E_IT_TRN | 0.00 | -0.09 | -0.19 | -0.24 | -0.26 | -0.26 | -0.28 | -0.30 | -0.33 |
| Other Personal income | E_IT_OPN | 0.00 | -0.06 | -0.09 | -0.08 | -0.07 | -0.06 | -0.07 | -0.09 | -0.11 |
| Direst Taxes (inc. SSC) | E_IT_PDN | 0.00 | 0.00 | 0.09 | 0.20 | 0.20 | 0.07 | -0.10 | -0.27 | -0.39 |
| Total Wealth | E_IT_FWN | 0.00 | 0.00 | -0.01 | -0.02 | -0.03 | -0.04 | -0.04 | -0.05 | -0.07 |
| Real Total Wealth | E_IT_FWR | 0.00 | 0.00 | -0.01 | 0.00 | 0.02 | 0.03 | 0.03 | 0.05 | 0.07 |
| Saving ratio | E_IT_SRATIO | 0.00 | 0.08 | 0.14 | 0.14 | 0.15 | 0.14 | 0.11 | 0.08 | 0.06 |
| ***Firms and Interest Rate*** | | | | | | | | | | |
| Capital Stock | E_IT_KSR | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 | -0.01 | -0.01 | -0.01 | -0.02 |
| Real Cost of Capital (average) | E_IT_CCR | 0.00 | -0.89 | 0.03 | -0.46 | -0.54 | -0.05 | 0.20 | 0.23 | 0.13 |
| 3-month interest rate | E_IT_STI | 0.00 | -0.06 | -0.03 | -0.05 | -0.04 | -0.01 | -0.01 | -0.03 | -0.05 |
| 10-year long-term interest rate | E_IT_LTI | 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 | E_IT_PDN | 0.00 | 0.00 | 0.09 | 0.20 | 0.20 | 0.07 | -0.10 | -0.27 | -0.39 |
| Tranfers from gal Gov. | E_IT_TRN | 0.00 | -0.09 | -0.19 | -0.24 | -0.26 | -0.26 | -0.28 | -0.30 | -0.33 |
| Other Gov. Net Revenues | E_IT_OGN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Direst Taxes (inc. SSC) | E_IT_PDX | 0.00 | 0.05 | 0.23 | 0.39 | 0.42 | 0.30 | 0.13 | -0.01 | -0.11 |
| Other Direct Taxes | E_IT_ODN | 0.00 | -0.06 | -0.09 | -0.07 | -0.06 | -0.05 | -0.06 | -0.07 | -0.08 |
| Indirect Taxes less Subsidies | E_IT_TIN | 0.00 | -0.13 | -0.27 | -0.32 | -0.33 | -0.33 | -0.33 | -0.34 | -0.36 |
| Gen. Gov. Net Debt | E_IT_GDN | 0.00 | -0.03 | -0.09 | -0.17 | -0.28 | -0.34 | -0.36 | -0.37 | -0.38 |
| Gen. Gov. Net Lending (% of GDP) | E_IT_GLNRATIO | 0.00 | 0.06 | 0.06 | 0.11 | 0.10 | 0.05 | 0.02 | 0.01 | 0.02 |
| Gen. Gov. Net Debt (% of GDP) | E_IT_GDNRATIO | 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 cyclicality. 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 function[8], however, involves a significant departure from the standard MCM framework. We leave treatment of these points open for possible future work.

# References

[1] Angelini, E., F. Boissay, M. Ciccarelli (2006). The Dutch block of the ESCB Multi-Country Model, forth coming ECB WP.

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

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

[2] Boissay, F. and J.P. Villetelle (2005). The French block of the ESCB Multi-Country Model, ECB WP No. 456.

[3] Fagan, G., Henry, J. and R. Mestre (2001). An area-wide model (AWM) for the euro area, European Central Bank, ECB WP No. 42.

[4] Karlsson, T. and P. McAdam (2005). The EuroSystem's Multi-Country Model and the Link Block, in G. Fagan and J. Morgan, J. (Eds.), *Econometric Models of the Euro-area Central Banks*, Edward Elgar.

[5] Klump, R., P. McAdam and A. Willman (2006). Factor Substitution and Factor Augmenting Technical Progress in the US: A Normalized Supply-Side System Approach, forthcoming in *Review of Economics and Statistics*. (ECB Working Paper 367).

[6] McAdam, P. (1999). The Long Run In Macro Economic Modeling: A Guide, in Hughes-Hallett, A J, and P. McAdam, (eds) *Analyses In Macro Economic Modeling*, Kluwer Academic Press.

[7] Willman, A. and A. Estrada (2002). The Spanish block of the ESCB Multi Country Model, ECB WP no. 584.

# 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<br>DUMMYQ2<br>DUMMYQ3 | Seasonal dummies | $\Delta\log(PEI)$<br>$\Delta\log(HEXP)$ |
| DUM031 | Dummy for 2003q1 | $\Delta\log(IPR)$ |
| DUMT951 | Step dummy from 95q1 onward | GIPSTAR |
| $TIME$ | Trend | KSTAR<br>IPRSTAR<br>LSTAR<br>SCRSTAR<br>XTRSTAR<br>XTDSTAR<br>MTRSTAR<br>MTDSTAR<br>RWUNSTAR<br>PCDSTAR<br>HEXPSTAR |
| $TIME^2$ | Quadratic Trend | YFT<br>LSTAR<br>XTRSTAR<br>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

```
it_YFT:    it_YFT   = exp( + log(it_alpha)
                       + it_beta*log(it_KSR)
                       + (1-it_beta)*log(it_LNN)
                       + (1-it_beta)*(it_gamma*it_TIME)
                       + it_yft.cst
                       + it_yft.time1*it_TIME+ it_yft.time2*it_TIME2)
                       +res_it_yft,

it_YGA:    it_YGA   = it_YER/it_YFT + res_it_yga,
```

### MONETARY POLICY AND INTEREST RATES

NOMINAL INTEREST RATES

```
it_STI:    it_STI     = it_dfor*it_ZZSTI
                + (1-it_dfor)*(it_taylor*it_STI(-1)
                     + (1-it_taylor)*400*(it_gamma+it_demo+it_infl-1.5*it_infl
                     + 1.5*(it_PCD/it_PCD(-1)-1) + 0.5*(it_YER/it_YER(-1)-1-it_gamma-it_demo))
                      -(1-it_taylor) )+ res_it_sti,


it_LTI:    it_LTI = it_dfor*it_ZZLTI + (1-it_dfor)*(it_lti.cst+ it_lti.lt1*it_LTI(-1)+it_lti2*it_LTI(-2)
                              it_lti.sti*it_STI+ it_lti.sti1*it_STI(-1)+ it_lti.sti2*it_STI(-2)
                                  + it_lti.sti3*it_STI(-3)+ it_lti.sti4*it_STI(-4)
                                  + it_lti.sti5*it_STI(-5) )
                                  + res_it_lti,
```

REAL INTEREST RATES

```
it_LTR:    it_LTR     = 100*((1 + it_LTI/100)/(it_PCD/it_PCD(-4))-1) + res_it_ltr,

it_STR:    it_STR     = 100*((1 + it_STI/100)/(it_PCD/it_PCD(-4))-1) + res_it_str,
```

NOMINAL USER COST OF CAPITAL

```
it_CC0:    it_CC0  = it_OID*(it_LTI/400 + it_depkpr - (it_YFD/it_YFD(-4)-1)/4) + res_it_cc0,
```

REAL USER COST OF CAPITAL

```
it_CCR:    it_CCR  = it_CC0/it_OID + res_it_ccr,
```

### FISCAL POLICY AND TAX RATES

DEFINITION OF PUBLIC DEBT-TO-GDP RATIO, PERCENT

```
it_GDNRATIO = 100 * it_GDN / (4*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:     it_PDN  = it_dfor*it_ZZPDX*it_YEN
              + (1-it_dfor)* it_PDX * it_PDNB + res_it_pdn,

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


it_ODX:      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:   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:   del(log(it_WUN)) = del(log(it_PCD))
                                        it_wun.cst +
                + it_wun.rwun1*del(log(it_WUN(-1)/it_PCD(-1)))
                + it_wun.pro*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*del(log(it_PCD/it_YFD))
                + res_it_wun,


it_YFD:   del(log(it_YFD)) =  it_yfd.cst        +
                + it_yfd.ecm5*( log(it_YFD(-5)/it_WUN(-5))+log(it_RWUNSTAR(-5))
                + it_yfd.yfd1*del(log(it_YFD(-1)))
                  + it_yfd.wun1*del(log(it_WUN(-1)))
            + it_yfd.wun2*del(log(it_WUN(-2)))
             + it_yfd.pro1*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:   del(log(it_OIP)) =  it_oip.cst
                        + it_oip.oip1* del(log it_OIP(-1))
                        + it_oip.yfd*del(log(it_YFD))
                        + it_oip.mtd*del(log(it_MTD))
                        + it_oip.ecm1*log(it_OIP(-1)/it_OIPSTAR(-1))
                        + res_it_oip,
```

GOVERNMENT INVESTMENT DEFLATOR (PRE-TAX)

```
it_GIPSTAR:    it_GIPSTAR  = exp(  + it_gipstar.cst
                              + it_gipstar.yfd*log(it_YFD)
                              + it_gipstar.mtd*log(it_MTD)
                              + it_gipstar.dumT951*it_DUMT951),
```

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

GOVERNMENT CONSUMPTION DEFLATOR (PRE-TAX)

```
it_GCPSTAR:    it_GCPSTAR  = exp(  + it_gcpstar.cst
                              + it_gcpstar.yfd*log(it_YFD)
                              + it_gcpstar.mtd*log(it_MTD)
                              + it_gcpstar.time*it_TIME ),
```

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

HICP EXCLUDING ENERGY

```
it_HEXPSTAR:   it_HEXPSTAR = exp(  + it_hexpstar.cst
                              + it_hexpstar.ulc*log(it_WUN/it_PRO)
                              + it_hexpstar.time1*it_TIME1 ),
```

```
it_HEXP:   del(log(it_HEXP)) =  it_hexp.cst
                         + it_hexp.hexp2*del(log(it_HEXP(-2)))
                         + it_hexp.yfd2 del(log(it_YFD(-2)))
                         + it_hexp.yfd3 del(log(it_YFD(-3)))
                         + it_hexp.mtd del(log(it_MTD))
                         + it_hexp.ecm1*log(it_HEXP(-1)/it_HEXPSTAR(-1))
                         + it_hexp.dumq1*it_DUMMYQ1
                         + it_hexp.dumq2*it_DUMMYQ2
                         + it_hexp.dumq3*it_DUMMYQ3
                         + 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: it_OIN = it_OID*it_OIR + res_it_oin,

it_GIN: it_GIN = it_GID*it_GIR + res_it_gin,

it_ITN: it_ITN = it_OIN + it_GIN + res_it_itn,

it_PCN: it_PCN = it_PCD*it_PCR + res_it_pcn,

it_GCN: it_GCN = it_GCD*it_GCR + res_it_gcn,

it_XTN: it_XTN = it_XTD*it_XTR + res_it_xtn,

it_MTN: it_MTN = it_MTD*it_MTR + res_it_mtn,

it_YFN: it_YFN = it_YFD*it_YFR + res_it_yfn,

it_YEN: it_YEN = it_YFN + it_TIN + res_it_yen,

it_ITR: it_ITR = it_IHR + it_IPR + it_GIR + res_it_itr,

it_OIR: it_OIR = it_IPR + it_IHR + res_it_oir,

it_YFR: it_YFR = it_YER - it_TIR + res_it_yfr,

it_MKUP: it_MKUP = 100*(1-it_WIN/it_YFN) + res_it_mkup,

it_SZD: it_SZD = it_SZN/(it_ZER + it_SCR) + res_it_szd,

it_UNN: it_UNN = it_LFN - it_LNN + res_it_unn,

it_URX: it_URX = 100*it_UNN/it_LFN + res_it_urx,

it_PYR: it_PYR = it_PYN/it_PCD + res_it_pyr,

it_KGR: it_KGR = it_GIR + (1-it_depkgr)*it_KGR(-1) + res_it_KGR,

it_KPR: it_KPR = it_IPR + (1-it_depkpr)*it_KPR(-1) + res_it_KPR,

it_KSR: it_KSR = it_ITR + (1-it_depksr)*it_KSR(-1) + res_it_KSR,

it_KHR: it_KHR = it_KSR - it_KPR - it_KGR + res_it_KHR,

it_FWN: it_FWN = it_OID*it_KPR(-1) + it_IHD*it_KHR(-1) + it_GDN(-1) + it_NFA(-1) + res_it_fwn,

it_FWR: it_FWR = it_FWN/it_PCD + res_it_FWR,

it_SALE: it_SALE = it_PCR + it_XTR + it_ITR + res_it_SALE,

it_YER: it_YER = it_PCR + it_GCR + it_ITR + it_SCR + it_XTR - it_MTR + it_ZER + res_it_YER,

it_SZN: it_SZN = it_YEN - it_PCN - it_GCN - it_ITN - it_XTN + it_MTN + res_it_SZN,

it_LEN: it_LEN = it_LEX*it_LNN + res_it_LEN,

it_PRO: it_PRO = it_YER / it_LNN + res_it_PRO,

it_WIN: it_WIN = it_WUN*it_LNN + res_it_WIN,

it_CEX: it_CEX = it_WIN*it_LNN/it_LEN + res_it_CEX, it_ULA: it_ULA = it_WUN/it_PRO + res_it_ula,

it_GON: it_GON = it_YEN - it_WIN - it_TIN + it_ZIN + res_it_gon,

it_PYN: it_PYN = it_WIN + it_OPN + it_TRN - it_PDN + res_it_pyn,

it_PSN: it_PSN = it_PYN - it_PCN + res_it_psn,

it_GYN: it_GYN = it_PDN + it_ODN + it_TIN + it_OGN - it_TRN - it_INN + res_it_gyn,

it_PDNB: it_PDNB = (1+it_pdnb.win)*it_WIN + it_TRN + it_OPN + res_it_pdnb,

it_INN: it_INN = (1/400)*it_STI*it_GDN(-1) + res_it_inn ,

it_GSN: it_GSN = it_GYN - it_GCN + res_it_gsn,

it_GLN: it_GLN = it_GSN - it_GIN + res_it_gln,

it_GDN: it_GDN = it_GDN(-1) - it_GLN + it_ZGDN + res_it_gdn,

it_ODNB: it_ODNB = it_GON - 0.01*it_ITD*it_KSR(-1) + res_it_odnb,

it_OLN: it_OLN = it_CAN - it_PSN - it_GLN + it_IHN + res_it_oln,

it_BTN: it_BTN = it_XTN - it_MTN + res_it_btn,

it_CAN: it_CAN = it_XTN - it_MTN + it_NFN + it_TWN + it_ZCAN + res_it_can,

it_NFN: it_NFN = (1/400)*it_STI*it_NFA(-1) + res_it_nfn,

it_NFA: it_NFA = it_NFA(-1) + it_CAN + res_it_nfa,

it_OYN: it_OYN = it_GON + it_TWN + it_NFN + it_INN - it_ODN - it_OPN - it_OGN + res_it_oyn,

it_PLN: it_PLN = it_PSN - it_IHN + res_it_pln,

it_TRN: it_TRN = it_TRX*it_YEN + res_it_trn,

it_OPN: it_OPN = it_dfor*it_ZZOPX*it_YEN + (1-it_dfor)*it_OPX*it_GON + res_it_opn,

it_WER: it_WER = + it_wer.pcr*it_PCR
+ it_wer.gcr*it_GCR
+ it_wer.itr*it_ITR
+ it_wer.xtr*it_XTR
+ it_wer.scr*it_SCR
+ res_it_wer,

it_IHN: it_IHN = it_IHR*it_IHD + res_it_ihn,

it_TIN: it_TIN = + it_TII*it_OIR*it_OID
+ it_TII*it_GIR*it_GID
+ it_TCI*it_PCR*it_PCD
+ it_TGI*it_GCR*it_GCD
+ res_it_tin,

it_TIR: it_TIR = + it_TIIR*it_OIR
+ it_TIIR*it_GIR
+ it_TCIR*it_PCR
+ it_TGIR*it_GCR
+ res_it_tir,

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