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Abstract

This paper presents the French country block of the ESCB Multi-Country Model for the euro area, which has been built in collaboration by the ECB and the Banque de France. The theoretical structure of the model is in line with most current macroeconometric models, i.e. supply factors determine the long-run equilibrium, while in the short run aggregate demand determines aggregate output. The paper is structured as follows. We first present the theoretical background of the model. Then we review the long run relationships as well as the estimated short term dynamic equations. Finally, we simulate the effects of six exogenous shocks to the economy and discuss the dynamic properties of the model.

JEL classification: C3, C5, E1, E2.

Keywords: Macro-econometric Modelling, France.

Non-technical Summary

This paper presents the French country block of the ESCB Multi-Country Model (MCM) for the euro area, which has been built by the ECB and the Banque de France. The Frenck block of the ESCB models is similar to the ECB's Area-Wide Model (AWM, see Fagan et al. 2001). Both models are used in the quarterly Macroeconomic Projection Exercise of the ECB, and the aim of having a common statistical and theoretical structures was to ensure the comparability of the AWM and the MCM forecast figures. The theoretical structure of the French MCM block is in line with most current macroeconometric models, i.e. the supply factors determine the long-run equilibrium, while in the short run aggregate demand determines aggregate output. The current version of the French block is a traditional backward-looking model, in which expectations are treated implicitly by the inclusion of current and lagged values of the variables. The assumption by default concerning the policy regime is that of the monetary union, in which the interest rate, the exchange rate and foreign developments are exogenously given.

The paper is structured as follows. We first present the theoretical background of the model. Then we review the long run relationships and the estimated short term dynamic equations. Finally, we simulate the effects of six exogenous shocks to the economy (prices, government consumption, oil price, exchange rate, world demand, and monetary policy shocks) and discuss the dynamic properties of the model.

The present paper should be seen more as an intermediate report describing the current state of the work. The estimated equations of the model fit data reasonably well, and the adjustment paths to the long-run equilibrium are plausible. Among the problems that still need to be tackled is that the current model is backward-looking and thus eludes the treatment of expectations. In the current framework, notably, prices respond little to permanent shocks, and variations in wealth have no instantaneous effect on consumption. Another caveat of the current model is the absence of a financial block, which would probably allow for a finer analysis of the transmission of monetary policy.

1 Introduction

This paper presents the French country block of the ESCB Multi-Country Model (MCM) for the euro area. This model, which is mainly used for forecasting, is also designed for policy analysis. It was built in close cooperation between the Banque de France and the ECB. The guiding principle in designing the country blocks of the ESCB models was that of close compatibility with the ECB Area-Wide Model (AWM, see Fagan et al. 2001). The aim of having the same theoretical and statistical frameworks as the AWM was to ensure the comparability of the AWM and the aggregated MCM projections. The French MCM block contains 18 behavioural equations. The theoretical structure of the model is traditional. In the long-run prices adjust fully and the equilibrium is determined by supply factors. In the short-run, prices are slow to adjust, implying that demand determines output. The present version of the model is backward-looking. Expectations are treated implicitly by the inclusion of lagged values of the variables in the equations. The nominal exchange rate and foreign developments are exogenous. The paper is structured as follows. In Section 2 we present the theoretical framework underlying the equations of the model. In Section 3 we review the estimated behavioural equations. In Section 4 we describe the dynamic properties of the model. Section 5 concludes the paper.

2 Theoretical background

As in most traditional macroeconometric models, only the supply side of the MCM is rigorously derived from optimising neoclassical behaviour. By contrast, the demand side is not formally derived from microeconomic theory and does not refer to one particular theory, in order to allow for a more flexible econometric specification. In this section, we mainly focus on the theoretical background of the supply side, and briefly present the theories underlying the specification of the demand side.

2.1 Supply Side

2.1.1 The firm's programme

The supply side is of particular importance because labour and productivity drive aggregate output in the long-run, while demand adjusts to supply through prices. The theoretical behaviour underlying the specification of the supply side is that of a monopolistic firm. The latter faces a downward sloping demand function, and chooses the levels of labour, capital, and prices that maximise its profit.

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

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

where r is the real rate of interest and δ is the physical depreciation rate of capital. We assume that there is no capital adjustment cost, so that the programme of the firm is static:

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

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

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

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

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

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

2.1.2 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 ρ is a constant, η indicates the sensibility 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. Basically, 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, meaning that *nominal wage rigidities* exist in the economy. Second, even though 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 inside the bargaining process, and wage developments depend on the unemployment rate.

The non-accelerating inflation rate of unemployment (NAIRU). From equation (c) of system (2.2) and considering a constant mark-up rate, one has:

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

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 $\Delta \ln P = \Delta \ln \widetilde{P}$ (i.e. foresights are perfect in the long-run):

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

The equilibrium rate of unemployment depends negatively on labour productivity growth (e.g. lower labour productivity growth requires higher unemployment to warrant constant inflation). To get 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: $\Delta \log(NAIRU) = 0$ (to be checked *ex post*); 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 $\Delta \log Y = \Delta \log K$. Finally, one gets:

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

so that:

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

which is constant. It is also positive, implying that $L^* < \overline{L}$.[1] It follows that the growth rate of real wages is:

$$\Delta \log \left(\frac{w}{P}\right) = \gamma$$

[1] Note that if $\phi = 1$ and $\rho = 0$ then $NAIRU = 0$.

One critical reason why the $NAIRU$ is constant in the long-run is that we considered only one price in the model. In particular, wages are indexed on the (domestic) firms' prices. Some other specifications of the Phillips curve could involve, for example, the consumer price index, which depends on import prices. In this case, the $NAIRU$ would vary with the domestic/import price ratio.

2.1.3 Calibration of the Supply Side Parameters

The theoretical model contains 5 parameters (β, ε, γ, A, and n) and 5 real variables (Y, L, K, c/P, w/P). It is therefore possible to invert the model and solve it for the parameters. Denoting the sample mean operator by $\overline{(.)}$, and using system (2.2), we calibrated the parameters as follows:

$$\widehat{\beta} = \overline{\left(\frac{(r+\delta)K}{\frac{w}{P}L + (r+\delta)K}\right)} \quad \text{and} \quad \widehat{\varepsilon} = \overline{\left(\frac{PY}{PY - wL - cK}\right)}$$

$$\widehat{\gamma} = \overline{\left(\Delta \log\left(\frac{w}{P}\right)\right)} \quad \text{and} \quad \widehat{A} = \overline{\left(\frac{Y}{K^{\widehat{\beta}}\left(e^{\widehat{\gamma}t}L\right)^{1-\widehat{\beta}}}\right)}$$

By definition, we also have:

$$\widehat{n} = \overline{(\Delta \log(\overline{L}))}$$

2.1.4 Solving the model

Importantly, the relations (2.3) and (2.4) close the model and permit 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. Given the latter, 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 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.

Desired level of capital, long-run real wages, and potential output. The desired level (or, equivalently, long run target) 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 will 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, $\widehat{\gamma}$. Experience shows that the gap $\log(K/K^*)$ between the current capital stock and its desired level may exhibit some drifts in-sample. To obtain a stationary gap, we have adjusted the latter with a deterministic term, denoted by t^a.[2] The gaps between the current values and the long run targets play a crucial role in the estimation of the short-run dynamic behavioural equation as they serve to construct the error correction terms, which has to be mean stationary. Finally, the desired level of capital stock that we used in the short run regressions of the model is in the form:

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

where the coefficients a_k and b_k are estimated. In the sequel, we will refer to these deterministic components as the "adjustment deterministic trends", by contrast with the usual *demographic* and *productivity* deterministic trends. The specificity of these adjustment trends is that they progressively go back to zero in the out-of-sample simulations (we will discuss this point later on). Using the standard capital accumulation equation[3]

$$K' = (1-\delta)K + I'$$

one can also derive the long run target for investment (I):

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

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

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

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

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, determines the long-run level of labour: $L^* = (1 - NAIRU)\overline{L}$. With a constant $NAIRU$ and an exogenous labour force, this specification will in general not provide a relevant target for the dynamics of actual employment, however. (In particular, $L - L^*$ is probably not stationary.) For this reason, we will define the desired level of labour as follows (see equation (a) of system (2.2)):

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

This definition corresponds to the inverse of the production function (relation (a) of system (2.2)); it has two advantages. First, it links the target value of employment to the current level of output and thereby generates

[2] The superscript a stands for "adjustment". More precisely, the deterministic term t^a will be either a time trend or a dummy, according to what is necessary to have a good fit with the data.

[3] The prime refers to next period (quarter).

a meaningful current employment gap $L - L^*$. Second, together with equation (2.13), it links the output gap $Y - Y^*$ to the unemployment gap. The verticality of the Phillips curve in the long-run warrants that the output gap shrinks to zero in the long-run.

2.2 Demand Side

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

2.2.1 Households' behaviour

The households sector only includes one behavioural equation for private consumption, which is fairly standard (see e.g. Muellbauer (1994) for a survey of the currently used specification). We do not consider housing investment separately. Private consumption (PCR) is a function both of the 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):

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

where a, b, c, a_c and b_c are coefficients. (As in Section 2.1.4, we included an adjustment trend whenever necessary.) This specification is a compromise between the life-cycle theory, which relates consumption to permanent income, and the basic keynesian consumption theory, which relates consumption to current real disposable income.

2.2.2 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). The latter are computed as a weighted average of external and internal prices. This approach to modelling trade is in line with e.g. Goldstein & Kahn (1985). The external indicators for demand and prices as well as the effective exchange rate are based on weighted averages of indicators for the main trade partners of France. Therefore, the export and import equations take the following form:

$$\begin{aligned} \log(XTR^*) - \log(WDR) &= c + \underset{(-)}{d} \log\left(\tfrac{XTD}{CMD}\right) + a_x + b_x t^a \\ \log(MTR^*) - \log(WER) &= e + \underset{(-)}{f} \log\left(\tfrac{MTD}{YFD}\right) + a_m + b_m t^a \end{aligned} \tag{2.16}$$

where the coefficients d and f are (expected to be) negative.

3 The multi-country model (MCM)

In this Section, we describe the main features of the MCM. We first present the long run targets toward which the variables converge in the long-run. Then, we present and comment the 10 most important short-run dynamic behavioural equations. In our estimations of the model, we used ESA 95 quarterly data, from the first quarter of 1980 to the third quarter of 2003.

3.1 Long Run Targets

In this Section, we present the most important long run targets of the model. The rest of the targets are in the model codes given in the appendix. We adopted the following notation. When not explicit, the variable "$XSTAR$" will denote the long run target of the variable "X". All the dynamic behavioural equations of the model are estimated as error correction models. The error correction terms of these equations are the differences between the actual data and the long run targets. The error correction terms converge to zero as all (price) adjustments operate. As suggested in Section 2.1.4, one can identify two types of targets: those corresponding to supply behaviours, and those corresponding to demand behaviours. The main difference between these two types of targets is that targets on the supply side are rigorously derived from theory, while those on the demand side are not. Obviously, the definition of the long run targets is crucial as it is the first step of our estimation strategy. The second step, presented in Section 3.2, will be the derivation and estimation of the short-run dynamic equations.

Table 1: Names of the main variables in the MCM codes

YFT	:	potential output *(Y^* defined by equation (2.13))*
$LSTAR$	:	long run target for labour *(L^* defined by equation (2.14))*
$KSTAR$	:	long run target for capital *(K^* defined by equation (2.10))*
$RWUNSTAR$	:	long run target for real wage *($\frac{w}{p}^*$ defined by equation (2.12))*
KSR	:	real capital stock *(K in the theoretical model)*
LNN	:	total employment *(L in the theoretical model)*
YER	:	real GDP *(Y in the theoretical model)*
YGA	:	output gap
CCR	:	real cost of capital *(c/P in the theoretical model)*
PYR	:	real disposable income
FWR	:	real financial wealth
$TIME$	:	time trend (for productivity and demography)
WDR	:	world demand indicator
WER	:	weighted import demand indicator

ITR	:	real total investment
IPR	:	real private non-housing investment
PCR	:	real private consumption
GCR	:	real government consumption
PRO	:	apparent labour productivity ($\equiv YER/LNN$)
XTR	:	real exports
MTR	:	real imports
URX	:	unemployment rate
MTD	:	import deflator
XTD	:	export deflator
CXD	:	competitors' prices on the export side
$POIL$	:	price of oil
WUN	:	nominal compensation per head *(w in the theoretical model)*
PEI	:	price of imported energy
YFD	:	GDP deflator at factor cost *(P in the theoretical model)*
HIC	:	HICP
$HEXP$	:	HICP excluding energy
STI	:	nominal short term interest rate
ULA	:	nominal unit labour cost
CMD	:	competitors' prices on the import side
YED	:	GDP deflator

3.1.1 Supply side

The long run targets on the supply side are strictly based on the four behavioural equations (2.10), (2.14), (2.12), and (2.13). However, for various practical reasons (e.g. national accounting consistency, realism of the model ...), the empirical model obviously needs to be more detailed than its theoretical counterpart. It therefore includes various decompositions of the main aggregates. In particular, we make the distinction between the public and the private sectors (e.g. for capital, consumption, investment, labour, etc). Other important refinements include the heterogeneity of goods and a specific treatment of consumption goods, housing investment, non-housing investment, inventories, foreign goods, etc. The parameters used to compute the long run targets on the supply side are calibrated by using the sample means presented in Section 2.1.4. Their values are given in Table 2.

Table 2: Calibrated parameters

$\widehat{\beta}$	$\widehat{\gamma}$	$\widehat{n}$	$\widehat{\varepsilon}$	$\widehat{A}$	π^*	$\widehat{\delta}$
0.36	0.003	0.0016	6.4	1.77	0.005	0.01

The parameter π^* is the long-run inflation, which also corresponds to the growth rate of all foreign prices out-of sample. The long run targets on the supply side take the forms below.

$\log(YFT)$ - eq. (2.13)	
cst	0.570
$\log(KSR)$	0.360
$\log(LNN)$	0.640
$TIME$	0.002
$ONES$	0.025
$TIME^A$	-0.0003

$\log(LSTAR)$ - eq. (2.14)	
cst	-0.892
$\log(KSR)$	-0.562
$\log(YER)$	1.56
$TIME$	-0.003
$ONES$	0.040
$TIME^A$	0.0004

$\log(KSTAR)$ - eq. (2.10)	
cst	-0.570
$\log(WUN/YFD)$	0.360
$\log(YER)$	1.000
$\log(CCR)$	-0.360
$TIME$	-0.002
$ONES$	-0.039
$TIME^A$	-0.001

$\log(RWUNSTAR)$ - eq. (2.12)	
cst	-0.616
$\log(PRO)$	1.000
$ONES$	-0.0288
$TIME^A$	0.0002

The current user cost of capital is simply equal to the current short term nominal interest rate (as set by the monetary authorities), STI, deflated by the GDP deflator at factor cost, YFD, plus a constant (which includes the rate of depreciation of the capital stock). The variables $ONES$ and $TIME^A$ correspond to the *ad hoc* adjustment terms mentioned in Section 2.1.4. The coefficients of these adjustment trends are the only estimated coefficients of the supply side and were statistically significant. These terms play an important role in-sample as they improve the statistical fit of the model. However, as we wished these adjustments not to distort the long-run behaviour of the model, we made them progressively return to zero out-of-sample.

Remarks:

- $RWUNSTAR$ is the target of real wages defined as the nominal wage to GDP ratio deflator at factor cost. $RWUNSTAR$ therefore acts as a target for both the nominal wages and the GDP deflator at factor cost. This is the reason why it will be present in the Phillips curve *and* in the dynamic equation of the GDP deflator at factor cost.

- The long run target for the production (*i.e.* potential output) YFT will also be important in the model for it enters our definition of the output gap:

$$YGA \equiv \frac{YER}{YFT} \tag{3.1}$$

3.1.2 Domestic demand side

In the spirit of Fagan et al. (2001), the long run target of real consumption is a weighted average of total real net financial wealth (FWR) and real disposable income (PYR), and reflects heterogeneity among households.[4] This specification is based on the assumption that there are two types of households in the economy. Those who are liquidity constrained, and those who are not. The former consume a fraction of their current disposable income, while the latter consume a fraction of their wealth (see equation (2.15)). The long run target of investment is derived from equation (2.11).

$\log(PCRSTAR)$ - eq. (2.15)	
cst	-1.820
$\log(PYR)$	0.452
$\log(FWR)$	0.547
$TIME^A$	-0.002

$\log(IPRSTAR)$ - eq. (2.11)	
cst	0.0003
$\log(KSTAR)$	1.000
$ONES$	-0.344
$TIME^A$	-0.001

$\log(HEXPSTAR)$	
cst	-0.013
$\log(YFD)$	0.85
$\log(MTD)$	0.15
$ONES * \log(YFD)$	0.34

We present only the target for the HICP excluding energy. HICP excluding energy is supposedly a weighted average of domestic and import prices in the long-run. One feature of the French economy over the past decade is the difference in the trend in prices of services and that in prices of goods, implying that the GDP deflator exhibits a different trend than the import deflator. As a consequence, the latter is not significant in the long-run specification of the HICP excluding energy, and we had to impose a non-zero coefficient (0.15) on it.

3.1.3 Foreign demand side

We impose that, in the long-run, the elasticities of real exports and imports with respect to external demand and domestic demand respectively are equal to one. Price competitiveness also enters the long-run equations. The price elasticity of the desired level of imports is higher than that of the desired level of exports, and the Marshall-Lerner conditions are satisfied.[5]

[4] In the MCM, households' financial wealth is defined as the sum of the government's debt, firms' capital value and net foreign assets.

[5] As discussed in Section 4.2, these elasticities (in absolute value) need to be "high" enough in order the model to converge toward its steady state. (In practise, we found that the convergence properties of the model were better when the Marshall-Lerner conditions were met.)

log($MTRSTAR$) - eq. (2.16)	
cst	-0.089
log(WER)	1.000
log(MTD/YFD)	-1.189

log($XTRSTAR$) - eq. (2.16)	
cst	10.638
log(WDR)	1.000
log(XTD/CXD)	-0.377
$TIME^A$	-0.002

The import deflator is mostly driven by the domestic and competitors' prices. The price of energy also affects import prices. The coefficients of these variables sum up to one in the long-run equation, implying that, at the steady state of the economy, these deflators will grow at the same rate (π^*). Similarly, export prices are a weighted average of domestic and foreign competitors' export prices.

log($MTDSTAR$)	
cst	-0.850
log(YFD)	0.419
log(CMD)	0.516
log(PEI)	0.065
$TIME^A$	-0.004

log($XTDSTAR$)	
cst	-0.349
log(CXD)	0.367
log(YED)	0.633
$TIME^A$	-0.004

3.2 Short-term dynamic equations

The dynamic specification is standard and homogenous across all the equations. It takes the form of an error correction mechanism, where the error correction term is the gap between the actual series and its long run target. Again, one can identify two types of short-term dynamic equations: those corresponding to supply behaviours and those corresponding to demand behaviours. Like the Phillips curve, the dynamic equations of the supply side are estimated under constraints in order to have the steady state satisfy its theoretical foundations (see Sections 2.1.4 and 3.2.1). By contrast, the specification of the model on the demand side has not been rigorously derived from theory, and therefore does not require such stringent an estimation procedure. For the sake of the statistical fit, we will not impose any constraint on the dynamic error correction equations on the demand side, and these variables will not converge *exactly* to their long run targets in the long-run.[6] In some cases step dummies or seasonal dummies have been added to the specification (we did not include them in the tables).[7]

[6] There will be a *constant* difference in the levels. See the discussion in Section 3.2.1 on the dynamic homogeneity conditions.
[7] The full equations are given in the appendix.

3.2.1 Supply side

Denoting by M^4 the order four-moving average operator, the Phillips curve takes the following form:[8]

Phillips curve

Endogenous: $\Delta \log \left(\frac{WUN}{PCD} \right)$

Explanatory variables:	coefficient	t-stat
cst	0.003	4.36
$\Delta \log \left(\frac{WUN(-1)}{PCD(-1)} \right)$	−0.361	−3.62
$M^4 \Delta \log(PRO)$	0.437	2.25
$\log(URX/100) - \log(NAIRU)$	−0.0025	–
$\Delta \log \left(\frac{PCD(-1)}{YFD(-1)} \right)$	−0.348	−2.69
$\log \left(\frac{WUN(-4)}{YFD(-4)} \right) - \log(RWUNSTAR(-4))$	−0.212	−3.85

IV-estimator. $R^2 = 0.57$, $DW = 1.92$

Nominal wages are indexed on the private consumption deflator in the short-run and on the GDP deflator in the long-run. The wedge between these two deflators PCD/YFD captures the effects of taxes, administered prices, as well as those of relative import and energy prices on wage bargaining.[9] The coefficient of this wedge is significantly negative, meaning that nominal wage increases do not fully offset non-domestic and tax inflation.[10] The equation also includes the rate of unemployment as an indicator for firms' bargaining power. However, its coefficient was not statistically significant and we had to calibrate it.[11] We chose this coefficient so that the economy responds plausibly to a monetary policy shock in the short-run.[12] The Phillips curve has also been estimated under some restrictions on the coefficients, in order to ensure its "dynamic homogeneity" (see next paragraph). We indeed know, on the one hand, that both productivity and real wages should grow at rate $\widehat{\gamma}$ in the long-run. On the other hand, we want real wages to converge on their long run target, and

[8] Although we describe the Philips curve in this Section on the short run dynamics, it is important to bear in mind that this equation plays a critical role in the determination of the NAIRU and the steady state of the economy (see the discussion in Section 2.1.4).

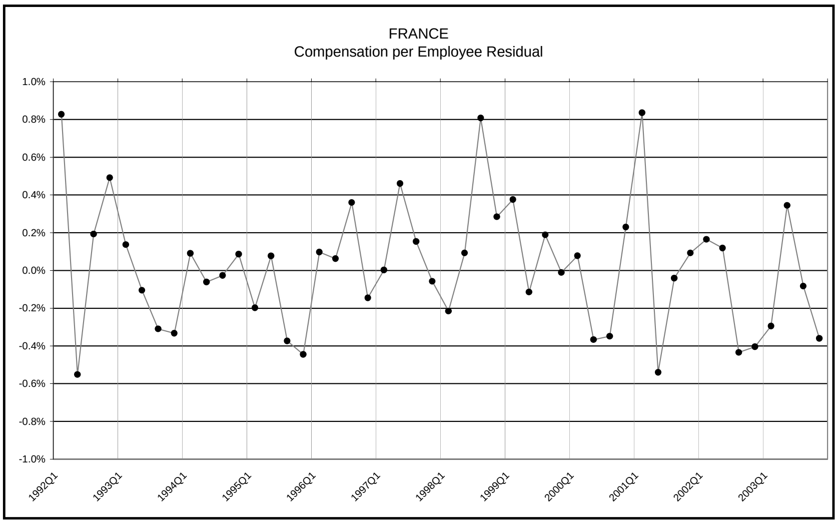
[9] Note that in the standard MCM framework WUN is the nominal compensation "per head" (not "per employee"). Therefore, variations in WUN are affected by the changes in the share of self-employed in total employment.

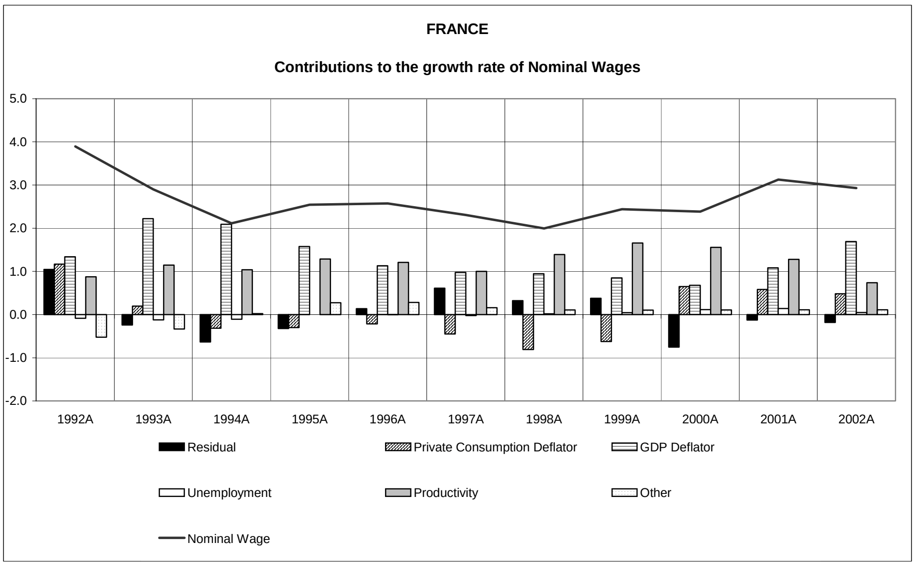
[10] One example of this imperfect indexation is that of the minimum wage increases, which are based on inflation *excluding* tobacco.

[11] We kept the unemployment rate in the wage equation in order to have a NAIRU.

[12] More precisely, too high a coefficient generated cyclicality in the model, while too low a coefficient implied a weak pass-through of unemployment to prices. The retained coefficient (−0.0025) is such that the dynamics of the model following an adverse monetary policy shock conform to what we expect (e.g. there is an instantaneous fall in prices) and also such that it is comparable with that of the model of the Banque de France (see Section 4.4.4).

the unemployment rate to converge on the $NAIRU$.[13] Hence, the coefficients of the equation have to satisfy the relation $(1+0.361-0.437)\widehat{\gamma} \simeq 0.003$ to be consistent with these requirements. Over the period 1992-2002, the main contributors to the growth of nominal wages were labour productivity and the GDP deflator (see Chart below).





Dynamic homogeneity conditions and convergence to the steady state. The aim of this paragraph is to explain why the supply side of the economy converges exactly on what theory predicts in the long-run. Consider the following general error correction model, with $\phi(.)$ and $\varphi(.)$ being lag-polynomials, y

[13] The free estimations of the Philips curve gave non-realistic values for the $NAIRU$. As a consequence, we calibrated the latter to 8.5% and constrained the coefficients in order to reach this value. (The coefficients of the Phillips curve satisfy relation (2.7).)

the endogenous variable, and x a vector of explanatory variables (in logarithm):

$$\phi(L)\Delta y_t = \varphi(L)\Delta x_t - \mu(y_{t-k} - \beta x_{t-k}) + \epsilon_t$$

The term in levels $y_{t-k} - \beta x_{t-k}$ is the error correction term and βx_{t-k} is what we called the long run target of y. Assume that a balanced growth path exists and that x and y grow at the constant rates g_x and g_y in the long-run. Then the steady state levels of x^* and y^* satisfy the relationship:

$$\phi(1)g_y = \varphi(1)g_x - \mu(y^* - \beta x^*)$$

Beside, the long-run relationship $y^* = \beta x^*$ implies that $g_y = \beta g_x$. It follows that the long-term relationship and the short-term dynamic equation are both consistent with a balanced growth path if, and only if, $\beta\phi(1) = \varphi(1)$. We impose this dynamic homogeneity constraint when estimating the dynamic equations on the supply side. However, such conditions will not be imposed on the demand side in order to have the best possible statistical fit. In this case, the steady state levels will be equal to the targets *modulo* a constant, which depends on the estimated coefficients of the short-run equation, as well as on the growth rate of the explanatory variable: $y^* = \beta x^* - \left[\frac{\beta\phi(1)-\varphi(1)}{\mu}\right] g_x$.

The most important price in the model is the GDP deflator at factor cost. All the other domestic prices present in the model are derived, explicitly or implicitly, from it. In the long-run, the GDP deflator at factor cost is driven by the pricing behaviour of firms modelled in Section 2.1.4. As shown in equation (2.12), firms set their prices with respect to nominal wages and to labour productivity, and $RWUNSTAR$ acts as an long run target for the GDP deflator. Like the Phillips curve, we have estimated this equation with constraints on its coefficients in order to ensure its dynamic homogeneity (the coefficients satisfy the relation $(1 - 0.143)\pi^* \simeq -0.0001 + (0.344 + 0.230)(\pi^* + \widehat{\gamma}) - 0.073\widehat{\gamma}$).

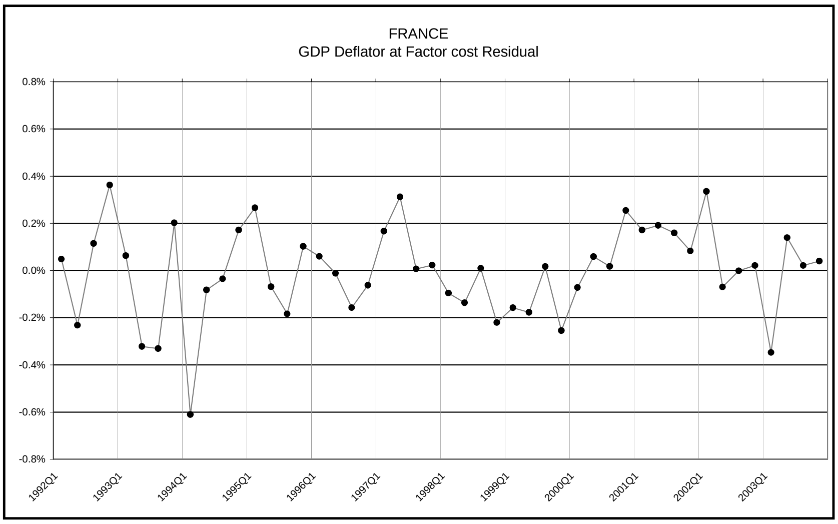
Price Equation

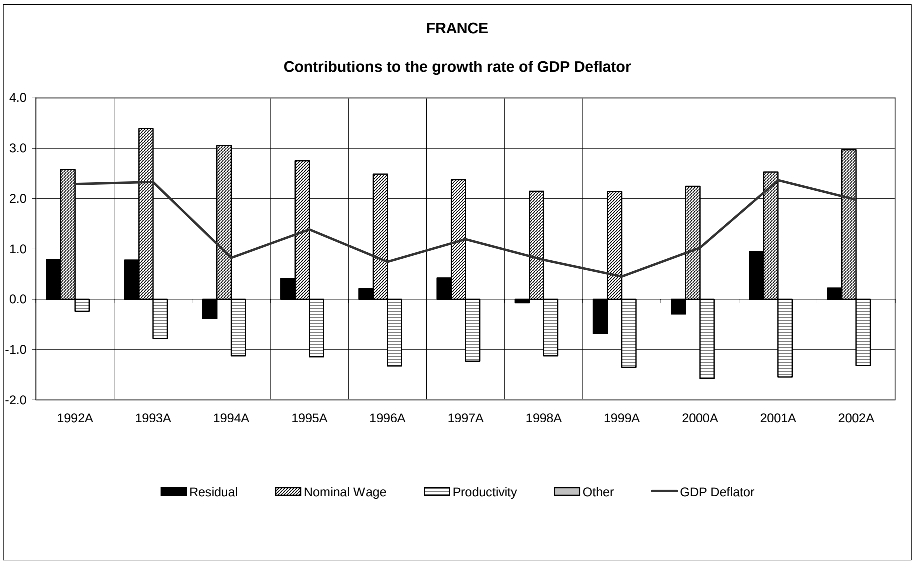
Endogenous: $\Delta \log (YFD)$

Explanatory variables:	coefficient	t-stat
cst	-0.0001	-0.165
$\Delta \log (YFD(-3))$	0.143	1.538
$\Delta \log (WUN(-1))$	0.344	3.944
$\Delta \log (WUN(-3))$	0.230	3.028
$\Delta \log (PRO(-1))$	-0.073	-1.465
$\log(RWUNSTAR(-5)) - \log\left(\frac{WUN(-5)}{YFD(-5)}\right)$	-0.101	-2.698

IV-estimator. $R^2 = 0.80$, $DW = 1.91$

In the period 1992-2002, the GDP deflator had been driven mainly by nominal wages and labour productivity. The contribution chart below shows that the nominal unit labour cost contributed positively to GDP deflator growth. However, nominal wages seem to have had a specific impact, as the contribution of wages is overall higher than that of labour productivity. This feature illustrates the short-run rigidities in price formation.





The variations in employment are mainly affected by the variations in output and real wages. The coefficients of this equation satisfy the relation $\widehat{n} - (0.310 + 0.119 + 0.091)(\widehat{\gamma} + \widehat{n}) + 0.058\widehat{\gamma} \simeq -0.001$.

Employment

Endogenous: $\Delta \log(LNN)$

Explanatory variables:	coefficient	t-stat
cst	-0.001	-4.938
$\Delta \log(YER)$	0.310	9.372
$\Delta \log(YER(-1))$	0.119	4.611
$\Delta \log(YER(-2))$	0.091	3.408
$\Delta \log(WUN(-3)/YFD(-3))$	-0.058	-1.876
$\log(LNN(-1)) - \log(LSTAR(-1))$	-0.0385	-3.713

IV-estimator. $R^2 = 0.88,\ DW = 1.42$

Remarks:

- The aim of constraining the estimation of the short-run dynamic equations of nominal wages (Phillips curve) and the GDP deflator is to have the unemployment rate converge to the $NAIRU$ in the long-run. The reason is the following. On the one hand, by constraining the GDP deflator equation we ensure that the error correction term converges to zero in the long-run, i.e. that real wages (WUN/YFD) converge to their target value ($RWUNSTAR$). On the other hand, given that real wages converge to their steady state, the constraint on the Phillips curve implies that the unemployment rate converges to the $NAIRU$.

- Similarly, the aim of constraining the estimation of the short-run dynamic equation of employment is to have the output gap close in the long-run. This is easy to see by comparing the expressions of YFT and $LSTAR$ on page 11, which both stem from the Cobb-Douglas production function (equation (a) of system (2.2)). YFT is defined with respect to LNN, while $LSTAR$ is defined with respect to YER. Therefore, by construction, when LNN converges to $LSTAR$, then YER converges to YFT.[14]

3.2.2 Domestic demand side

The short run dynamics of real private consumption is mainly driven by real disposable income, financial wealth, and the gap from the desired level of consumption $PCRSTAR$. The unemployment rate is statistically significant at a 10% threshold only.

[14] This explains why the error correction term in the employment equation is actually the mirror image of the output gap (see Section 7.4).

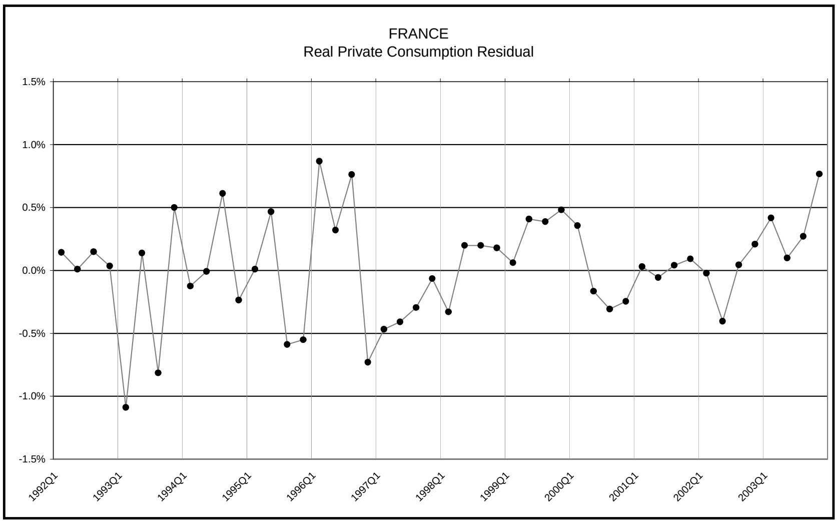
Real private consumption

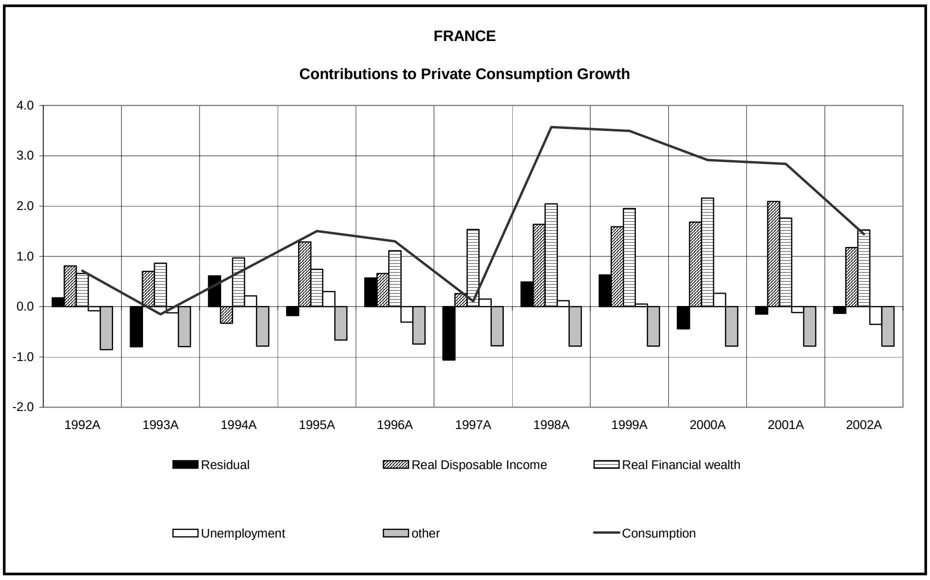
Endogenous: $\Delta \log(PCR)$

Explanatory variables:	coefficient	t-stat
cst	-0.0007	-0.551
$\Delta \log(PCR(-1))$	-0.109	-1.083
$\Delta \log(PYR)$	0.019	0.451
$\Delta \log(PYR(-2))$	0.080	1.711
$\Delta \log(PYR(-3))$	0.197	3.090
$\Delta \log(FWR)$	0.429	2.349
$\Delta \log(URX(-1)/100)$	-0.059	-1.884
$\log(PCR(-1)) - \log(PCRSTAR(-1))$	-0.478	-7.742

IV-estimator. $R^2 = 0.69$, $DW = 1.98$

In the period 1992-2002, private consumption had been driven mainly by real disposable income and real wealth. That the latter plays an important role in the behaviour of consumption is a key feature of our model, which is not present in the model MASCOTTE of the Banque de France (see Section 4).





In the short-run real private investment is driven by output and evolves around its desired level $IPRSTAR$ (the short-run elasticity of investment to GDP is about 3.25). Although the real cost of capital has no direct short-run effect on aggregate investment, it still has an impact on investment dynamics through the error correction term (see the contribution chart). In particular, the decrease in the real interest rate in the second half of the 1990s increased the desired level of capital and therefore had a positive effect on investment.

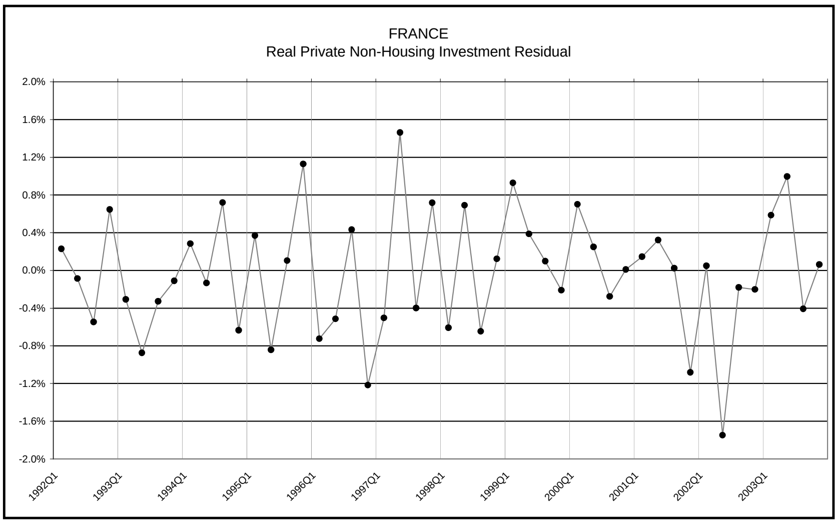
Real private non-housing investment

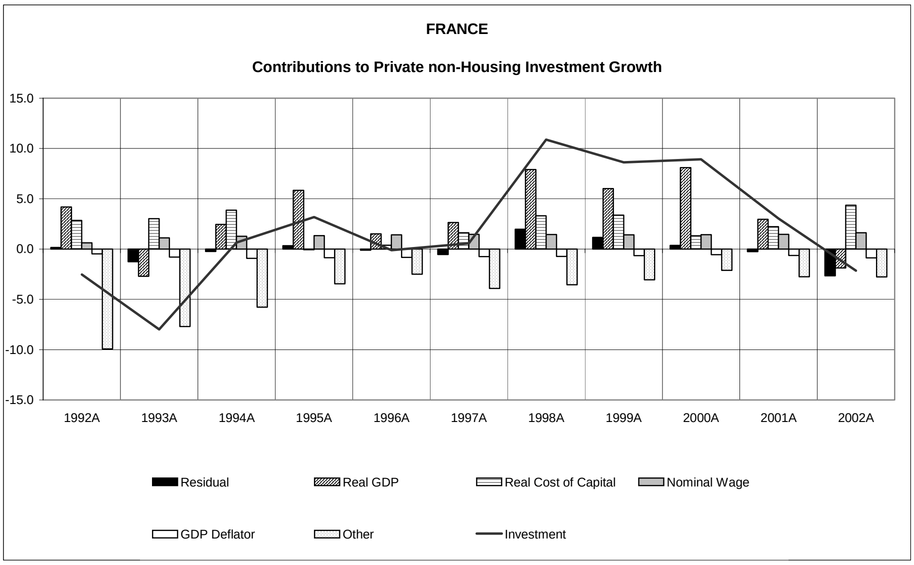
Endogenous: $\Delta \log (IPR)$

Explanatory variables:	coefficient	t-stat
cst	-0.008	-2.399
$\Delta \log (IPR(-1))$	0.460	2.863
$\Delta \log (YER)$	1.084	2.055
$\Delta \log (YER(-1))$	0.672	2.351
$\log(IPR(-1)) - \log (IPRSTAR(-1))$	-0.043	-3.858

IV-estimator. $R^2 = 0.84,\ DW = 2.09$

As relations (2.10) and (2.11) suggest, real wages also affect investment *via* capital/labour substitution effects. Overall, however, GDP proves to be the main determinant of investment.





The HICP excluding energy is closely linked to domestic prices. Import prices have an instantaneous impact (beyond the one they have through the error correction mechanism), while the output gap is not significant.

HICP excluding energy

Endogenous: $\Delta \log (HEXP)$		
Explanatory variables:	coefficient	t-stat
cst	0.002	3.48
$\Delta \log (HEXP(-1))$	-0.219	-1.041
$\Delta \log (YFD)$	0.805	7.060
$\Delta \log (YFD(-1))$	0.317	2.972
$\Delta \log (MTD)$	0.053	3.825
$\Delta \log (YGA(-2))$	0.027	0.814
$\log(HEXP(-2)) - \log (HEXPSTAR(-2))$	-0.219	-3.681

IV-estimator. $R^2 = 0.92,\ DW = 1.77$

3.2.3 Foreign demand side

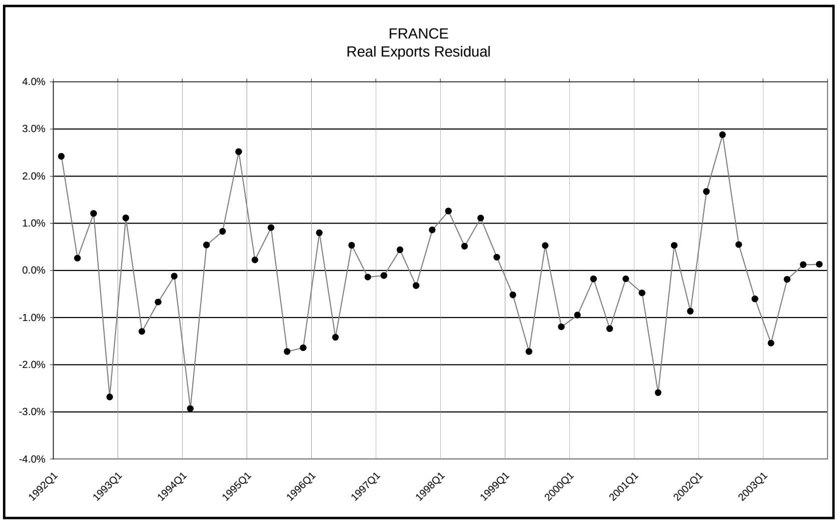
The equations of real exports and imports are very standard. Exports depend on world demand and price competitiveness on the export side.

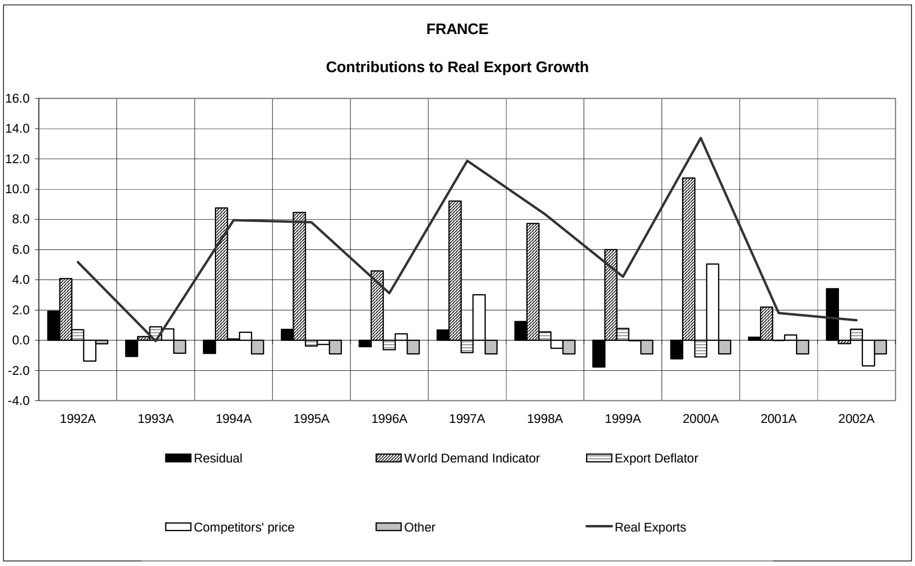
Real exports

Endogenous: $\Delta \log (XTR)$		
Explanatory variables:	coefficient	t-stat
cst	0.001	0.311
$\Delta \log (XTR(-1))$	-0.074	-5.348
$\Delta \log (WDR)$	0.512	2.414
$\Delta \log (WDR(-1))$	0.450	1.583
$\Delta \log (XTD/CXD)$	-0.259	-1.628
$\Delta \log (XTD(-1)/CXD(-1))$	-0.162	-1.561
$\log(XTR(-1)) - \log (XTRSTAR(-1))$	-0.415	-3.080

IV-estimator. $R^2 = 0.73,\ DW = 1.85$

The analysis of the contributions to export growth (see below) shows that the most important determinant of exports is world demand. To a lower extent, relative prices also contributed to real export growth, but this contribution seems mainly due to the changes in competitors' –rather than in domestic exporters'– prices.





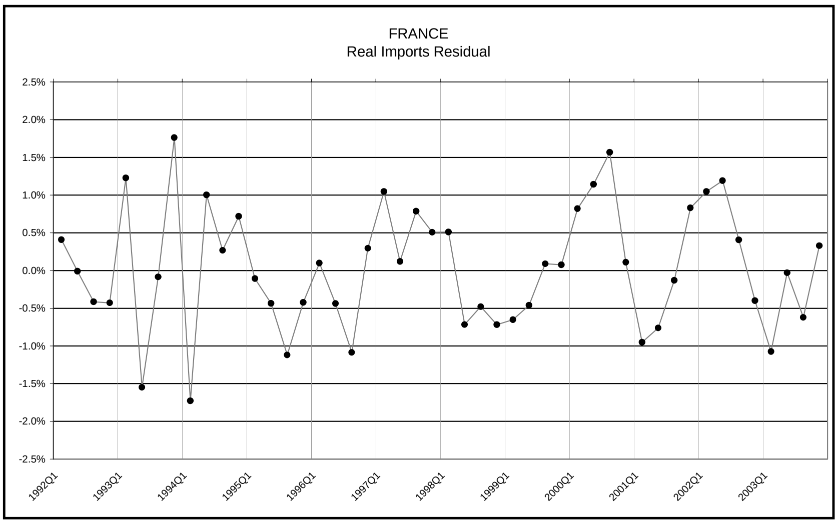
In the short-run, imports over-react to changes in domestic demand, with an elasticity of 1.55. The relative prices have no impact on real imports before four quarters.

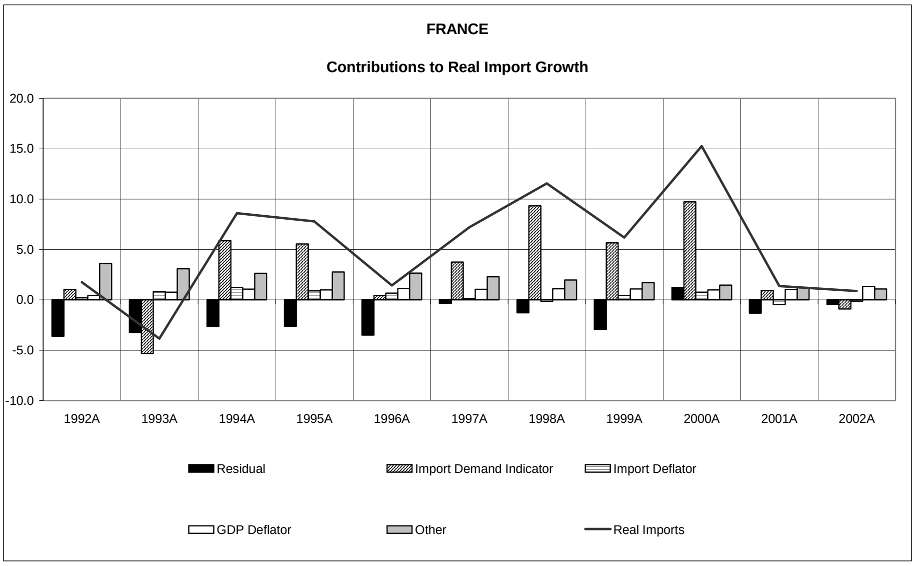
Real imports

Endogenous: $\Delta \log (MTR)$		
Explanatory variables:	coefficient	t-stat
cst	0.000	0.081
$\Delta \log (MTR(-1))$	-0.191	-1.057
$\Delta \log (WER)$	1.554	5.923
$\Delta \log (WER(-1))$	0.382	0.942
$\Delta \log (MTD(-4)/YFD(-4))$	-0.109	-2.255
$\log(MTR(-4)) - \log (MTRSTAR(-4))$	-0.039	-2.378

$R^2 = 0.89,\ DW = 1.99$

Overall, taking account of both long and short-run import behaviours, the contribution of prices is relatively limited (see chart below). It also appears notable that imports are overall less sensitive to price competitiveness than exports.





On the price side, the equations are also quite traditional. The export deflator depends on domestic price developments as well as to a lesser extent on competitors' prices. Where the import deflator is concerned, foreign prices have, as expected, a bigger impact that domestic prices, and energy prices are also statistically significant.

Export deflator

Endogenous: $\Delta \log (XTD)$

Exog. var.:	coeff.
cst	-0.0
$\Delta \log (XTD_{-2})$	0.26^{*}
$\Delta \log (CXD)$	0.15^{**}
$\Delta \log (CXD_{-1})$	0.07^{*}
$\Delta \log (YFD)$	0.41^{*}
$\log \left(\frac{XTD_{-1}}{XTDSTAR_{-1}} \right)$	-0.10^{*}

IV-estimator. $R^2 = 0.65$, $DW = 2.12$

Import deflator

Endogenous: $\Delta \log (MTD)$

Exog. var.	coeff.
cst	-0.0
$\Delta \log (MTD_{-1})$	-0.01
$\Delta \log (CMD)$	0.46^{*}
$\Delta \log (CMD_{-1})$	0.09^{*}
$\Delta \log (YFD_{-1})$	0.27^{*}
$\Delta \log (PEI)$	0.08^{*}
$\log \left(\frac{MTD_{-2}}{MTDSTAR_{-2}} \right)$	-0.19^{*}

IV-estimator. $R^2 = 0.73$, $DW = 2.17$

*,** Statistically significant at 5%, 10%

4 Simulations and properties of the model

The aim of this Section is to analyse the dynamic properties of the model. We proceed in four steps. First, we present the policy rules that will be used in the simulations. Then, we present the values of the steady state. In the third Sub-section, we show the response of the economy to two permanent shocks (namely an exogenous price shock and a public expenditure shock). This allows us to check the basic stability properties of the model. In the last Sub-section, we consider a series of shocks that had been-run by Baghli et al. (2004) with the Banque de France's model, and we compare the results of our simulations with theirs.

4.1 Policy rules

The government and the central bank play an active role in the economy: policy rules both depend and have an impact on the economy. Therefore, for the sake of realism, we have considered two policy rules in our simulations: a monetary rule and a fiscal rule.

The monetary policy rule takes the following form:

$$\begin{aligned} STI_t = \psi STI_{t-1} + (1-\psi)\{&STI^* \\ &+1.5 * 400 * [\Delta \log(PCD_t) - \pi^*] \\ &+0.5 * 400 * [\Delta \log(YER_t) - \widehat{\gamma} - \widehat{n}]\} \end{aligned} \tag{4.1}$$

where

$$STI^* \equiv 400 * (\widehat{\gamma} + \widehat{n} + \pi^*) - 1$$

is the long term level of the nominal interest rate. In order to ensure the sustainability of the public debt, the nominal interest rate is such that the real interest rate is lower than the growth rate of the economy by $1pp$ in the long run.[15] As in Clarida, Gali, and Gertler (2000), the current interest rate is a weighted average of the interest rate in the previous quarter and a target, which depends both on the interest rate that prevails in the long run (STI^*), and on short term inflation and output. In the short run, the monetary authorities raise the short term nominal interest rate whenever inflation is above its steady state level or the economy grows faster than at the steady state. This monetary policy rule warrants that the interest rate converges toward its long term target as inflation converges to π^* (second line) and that the growth rate of the economy converges toward $\widehat{\gamma} + \widehat{n}$ (third line). Note that the exogogeneity of the nominal exchange rate requires the domestic inflation target to be equal to foreign inflation. The smoothing parameter ψ was set to 0.7 in the simulations.

The fiscal rule is simple and such that the public debt to GDP ratio is equal to 50% in the steady state:

$$TAX_t = TAX_{t-1} + \lambda \left[\frac{GDN_t}{4 * YEN_t} - 0.5 \right]$$

[15] One can show that this is a sufficient condition.

where TAX is the tax rate on income (PDX) and profits (ODX). The parameter λ measures the intensity of the reaction of fiscal authorities to departures from their objective (we set $\lambda = 0.005$). We used these policy rules for all the simulations presented hereafter (appart from Section 4.4.4).

4.2 Steady state

In this paragraph, we characterise the steady state of the model and detail its construction. Several types of variables are at stake: real variables, prices, nominal variables, ratios, the various rates and the residuals of the equations. Under our assumptions of constant returns to scale and Cobb-Douglas production function, all the real variables must grow at the same rate in the long-run. The latter is the sum of the demographic and labour productivity growth rates, $\widehat{n}+\widehat{\gamma}$. Interest rates, tax rates, and ratios are constant. The domestic inflation rate is driven by the exogenous growth rate of foreign prices, π^*. The growth rate of nominal variables is equal to the sum of the real growth rate of the economy and the inflation rate, $\widehat{n}+\widehat{\gamma}+\pi^*$. Employment variables must grow as fast as the population, at rate $\widehat{n}$. In order to have the economy reach a balanced growth path, we have imposed consistent growth rates on all the exogenous variables out-of-sample, according to their type (e.g. real, demographic, etc). In addition, we made all the residuals go back to zero out-of-sample, as well as all the *ad hoc* deterministic adjustment trends ($ONES$, $TIME^A$). The out-of-sample simulation was entirely and solely model-based and therefore did not take into account all the available information, such as the foreseen population ageing, some effects of information technologies on labour productivity, etc. We have simulated the model over a long period of time, until the economy reaches its balanced growth path. The values of the main ratios of the economy in the steady state are given in Tables 3a-c.

Table 3a - Steady state ratios (in %)

	$\frac{PCR}{YER}$	$\frac{ITR}{YER}$	$\frac{GCR}{YER}$	$\frac{MTR}{YER}$	$\frac{XTR}{YER}$
Period 1985-2003	55.8	19.5	23.4	21.1	22.1
Third quarter 2003	55.2	19.7	23.8	27.0	28.3
Steady state	58.6	24.4	19.9	26	23.1

The composition of GDP at the steady state is fairly similar to that during the period 1985-2003 (Table 3a). There is relatively more private consumption and private investment, and less public expenditure, due to the public deficit being lower in the steady state (Table 3b).

Table 3b - Steady state ratios (in %)

	$\frac{GLN}{YEN}$	$\frac{GDN}{4*YEN}$	URX	Quarterly inflation (π^*)
Period 1985-2003	−3.2	28.5	10.2	0.06
Third quarter 2003	−4.0	42.9	9.3	0.05
Steady state	−1.9	50.0*	8.5*	0.05*

* Calibrated ratios.

Table 3c shows the composition of wealth and income. In the steady state, households hold more capital, more public debt and less foreign assets than in the past. The shares of wages and transfers in total income are slightly higher than in the past, while the share of other personal income is higher. In line with the fiscal ratios, the income tax represents a lower share of households' income in the steady state.

Table 3c - Steady state ratios (in %)

	$\frac{KSR}{FWR}$	$\frac{NFA}{FWN}$	$\frac{GDN}{FWN}$	$\frac{WIN}{PYN+PDN}$	$\frac{TRN}{PYN+PDN}$	$\frac{OPN}{PYN+PDN}$	$\frac{PDN}{PYN+PDN}$
Period 1985-2003	77.5	−4.0	6.9	56.4	21.3	22.2	45.2
Third quarter 2003	73.1	4.0	9.7	56.1	21.7	22.1	45.5
Steady state	115.02	−39.8	13.8	57.2	22.3	20.4	26.1

Remarks: There might be interest in practice in identifying the elements that help the model to converge toward its steady state. We identified two of them: the real trade block and the wage-price block. As mentioned in the introduction, a key feature of the MCM is that prices are flexible in the long-run, and therefore adjust along the transition path of the economy. The real side converges as it responds to relative prices. Most of the convergence issues occur when substantial variations in prices are required to make the real side adjust, because the transition then requires implausible values of prices.[16] It follows that the higher the price elasticities, the more likely the model converges to its steady state. In practise, we found that the model converges as soon as the Marshall-Lerner conditions are satisfied in the long-run[17], which implies that the adjustment of trade to prices is the main mechanism that drives the GDP gap to zero. Beside the trade block, the wage-price block also plays a critical role in the adjustment dynamics: since nominal wages depend of prices and vice-versa, one needs to check that the system of equations $(\Delta \log(WUN), \Delta \log(YFD))$ is not explosive.

[16] For example, it may require some negative prices, as there is no explicit boundaries in our TROLL model codes.

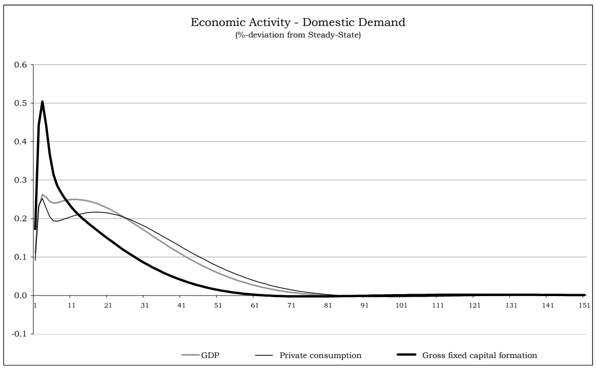
[17] In our model, the sum of the estimated export and import price elasticities is higher than one. (We did not impose any restriction in the estimations.)

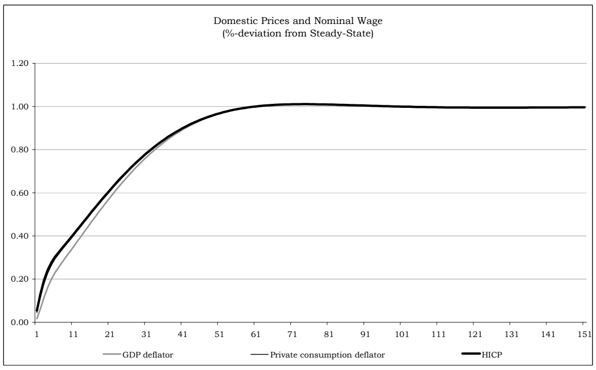
4.3 "Technical" shocks

In this Section we simulate the response of the economy to two "technical" shocks, in order to check that the long-term properties of the model conform to what we expect. In particular, we check that the price level has no impact on the real long-term equilibrium (i.e. there is no monetary illusion in the long-run), and that the output gap closes after a permanent government consumption shock. In these two simulations, we used the policy rules described in Section 4.1.

4.3.1 Prices and nominal variables

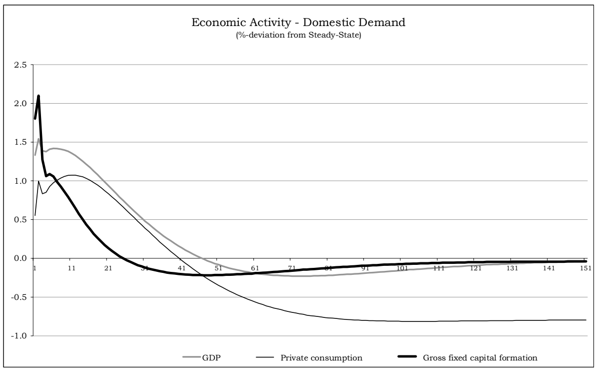
We simulate the model in the neighbourhood of the steady state (or "baseline") presented in Section 4.2. The aim of this exercise is to check that there is no anomaly on the nominal side. We have increased all the exogenous prices of the model (i.e. the price of oil, the price of imported energy, the competitors' prices, etc) by 1% above the steady state. As expected, all the endogenous prices of the model go up and converge toward a new steady state. The shock has an impact on the real economy in the short-run, until all the price adjustments are made. Following the shock, price competitiveness improves and GDP is stimulated. In particular, real trade variables keep on adjusting as long as relative (e.g. domestic/foreign) prices depart from their steady state. The initial effects vanish as domestic agents adjust their own prices. In the long-run, all the real variables of the economy go back to their baseline. There is no monetary illusion. (The speed of convergence is nevertheless slow owing to the protracted adjustment of the stock variables and the impact of the latter on wealth.)

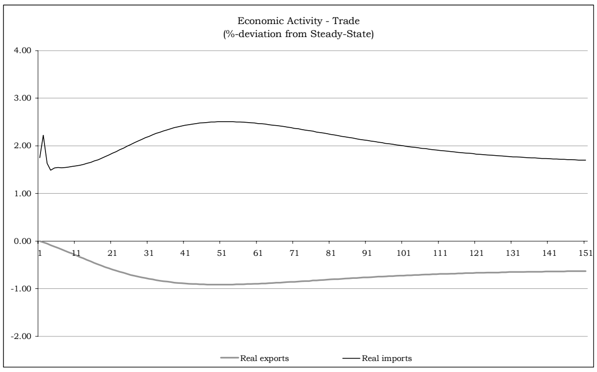


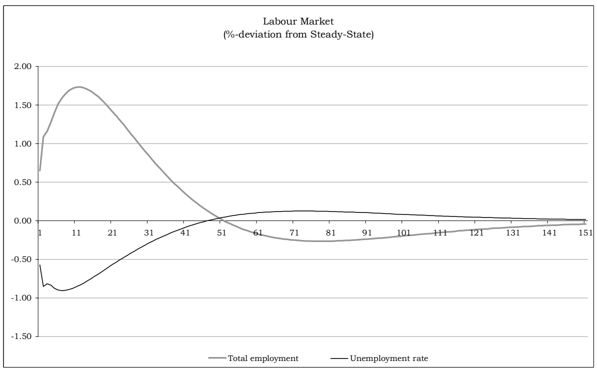


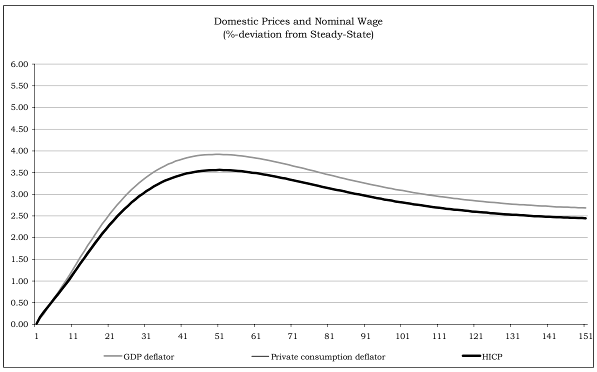
4.3.2 Government consumption

Real government consumption is increased permanently by 1% of GDP above the baseline. In this simulation, the nominal interest rate is driven by the monetary policy rule described above and the tax rates adjust in order to keep the debt-to-GDP ratio close to 50%. The nominal exchange rate are kept exogenous. The aim of this exercise is to illustrate the multiplier-accelerator properties, the crowding-out effect, and the role of prices in stabilising the model. Higher public spending first provides a direct stimulus to production and to corporate investment, through an acceleration effect. Employment adjusts slowly to activity, implying a rise in productivity. The negative effect of productivity on prices is more than offset by the Phillips effect, however. Overall, nominal wages and prices go up. Higher employment and wages cause households' income, and hence consumption, to rise. Higher investment and consumption lead to an increase in imports, which stay permanently above their baseline. The decrease in price competitiveness due to higher domestic inflation also feeds into the rise in real imports. On the export side, changes are relatively minor. Driven by price competitiveness, exports decrease below their baseline. The total effect on exports is weak because there is no feed-back from the rest of the world into our model. The deterioration in foreign trade gradually attenuates the beneficial effect of the initial shock. The output gap closes and the unemployment rate returns back to the $NAIRU$. Foreign prices and nominal exchange rates being exogenous, the changes in export and import deflators reflect the change in domestic prices and explain, together with the absence of a fiscal rule, the low speed of adjustment of the economy to the shock. In total, all the endogenous domestic components of GDP go back to their baseline. The permanent increase in government consumption is both absorbed by domestic consumers and by the rest of the world. The crowding out effect is complete.









4.4 Diagnostics

In this Section, we analyse the simulation properties of the MCM and also compare these properties with of the Banque de France's model. Such comparison is of particular relevance for the ESCB's bi-annual broad macroeconomic projection exercise, as MCM and MASCOTTE are the two models currently used for forecasting by the ECB and the Banque de France respectively. We simulate the same shocks in the MCM as the Banque de France's (see Baghli et al (2004)), namely three permanent shocks on oil prices, exchange rates, and world demand, as well a transitory monetary policy shock. In all the following tables and graphs, we will report the annual responses only. In the three first simulations, we used the policy rules described in Section 4.1. As for the simulation of the monetary policy shock, we exogenised the interest rates and only considered the fiscal rule.

4.4.1 Permanent increase in oil prices

Oil prices are increased permanently by 10% above the baseline, implying a 0.65% rise in import prices in the first year. This increase mechanically passes on to consumer prices, which rise by 0.16% above baseline, rather than onto the GDP deflator, which does not directly depend on import prices. Although wages are indexed on consumer prices and nominal wages increase in the short-run (+0.13% the first year), real wages staqy stable (0.03% below baseline). As Table 3c suggests, real wages represent the largest component of households' real disposable income, which, by going down, causes a decline in consumption. The decline in consumption is magnified by the decrease in real wealth. Investment decreases owing to the decrease in demand, and also owing to the increase in the user cost of capital, due to the reaction of the monetary authorities following the rise in inflation. On the side of trade, imports decrease due to the rise in import prices and to the domestic economic slowdown, while exports decrease owing to the loss of price competitiveness.

(deviations from baseline, percentage unless otherwise indicated)

		1	2	3	4	5	6	7	8	9
Economic Activity										
(constant prices)										
GDP	E_FR_YER	-0.05	-0.16	-0.21	-0.22	-0.22	-0.22	-0.20	-0.19	-0.17
Private consumption	E_FR_PCR	-0.07	-0.27	-0.36	-0.41	-0.44	-0.46	-0.46	-0.46	-0.45
Government consumption	E_FR_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_FR_ITR	-0.15	-0.59	-0.75	-0.74	-0.68	-0.60	-0.50	-0.41	-0.33
Exports	E_FR_XTR	-0.01	-0.03	-0.05	-0.06	-0.07	-0.07	-0.07	-0.07	-0.07
Imports	E_FR_MTR	-0.12	-0.59	-0.80	-0.87	-0.88	-0.87	-0.84	-0.81	-0.78
of which :										
Contribution of trade	E_FR_TRADE	0.03	0.14	0.19	0.20	0.20	0.20	0.19	0.18	0.18
Contribution of inventories	E_FR_SCRRATIO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments										
HICP	E_FR_HIC	0.19	0.34	0.43	0.48	0.50	0.51	0.51	0.51	0.50
GDP deflator	E_FR_YED	0.05	0.14	0.22	0.26	0.29	0.29	0.29	0.29	0.28
Private Consumption deflator	E_FR_PCD	0.16	0.30	0.40	0.46	0.49	0.50	0.50	0.51	0.50
Exports deflator	E_FR_XTD	0.02	0.07	0.12	0.16	0.18	0.18	0.18	0.18	0.18
Imports deflator	E_FR_MTD	0.65	0.68	0.70	0.71	0.72	0.72	0.72	0.72	0.72
Competitors Prices on domestic market	E_FR_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_FR_CXD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal Exchange Rate	E_FR_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_FR_WUN	0.13	0.19	0.18	0.19	0.21	0.23	0.24	0.25	0.25
Compensation per employee (real, GDP price)	E_FR_WUNY	0.08	0.05	-0.04	-0.08	-0.08	-0.07	-0.05	-0.04	-0.03
Compensation per employee (real, Consumption price)	E_FR_WUNC	-0.03	-0.11	-0.22	-0.27	-0.28	-0.27	-0.26	-0.25	-0.25
Productivity	E_FR_PRO	-0.03	-0.06	-0.06	-0.05	-0.04	-0.02	-0.01	0.00	0.01
ULC, whole economy	E_FR_ULC	0.15	0.25	0.24	0.24	0.24	0.25	0.25	0.25	0.24
Total Labour Force	E_FR_LFN	0.00	-0.01	-0.02	-0.04	-0.05	-0.06	-0.07	-0.08	-0.08
Total employment	E_FR_LNN	-0.02	-0.10	-0.15	-0.17	-0.19	-0.20	-0.20	-0.19	-0.18
Unemployment	E_FR_UNN	0.23	0.96	1.30	1.41	1.43	1.37	1.26	1.11	0.95
Unemployment rate (deviation from baseline)	E_FR_URX	0.02	0.08	0.11	0.12	0.13	0.12	0.11	0.10	0.09

Table 4a: 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_FR_PYN	0.01	0.00	0.02	0.04	0.05	0.07	0.08	0.09	0.10
Real disposible Income	E_FR_PYR	-0.14	-0.30	-0.38	-0.41	-0.43	-0.43	-0.43	-0.41	-0.40
Compensation of employees	E_FR_WIN	0.10	0.09	0.03	0.01	0.02	0.03	0.04	0.06	0.07
Transfers from Gal Gov.	E_FR_TRN	0.00	-0.02	0.01	0.04	0.06	0.08	0.09	0.10	0.11
Other Personal income	E_FR_OPN	-0.20	-0.18	0.01	0.12	0.17	0.18	0.19	0.19	0.19
Direst Taxes (inc. SSC)	E_FR_PDN	0.02	0.02	0.03	0.06	0.08	0.09	0.11	0.12	0.13
Total Wealth	E_FR_FWN	0.08	0.07	0.06	0.04	0.02	0.00	-0.01	-0.02	-0.02
Real Total Wealth	E_FR_FWR	-0.08	-0.24	-0.34	-0.41	-0.46	-0.49	-0.51	-0.52	-0.52
Saving ratio	E_FR_SRATIO	-0.05	-0.03	-0.01	0.00	0.01	0.02	0.03	0.03	0.04
Firms and Interest Rate										
Capital Stock	E_FR_KSR	0.00	-0.03	-0.07	-0.11	-0.14	-0.17	-0.19	-0.20	-0.21
Real Cost of Capital (average)	E_FR_CCR	2.20	1.15	0.80	0.69	0.54	0.42	0.34	0.29	0.24
3-month interest rate	E_FR_STI	0.18	0.17	0.13	0.09	0.06	0.03	0.02	0.01	0.01
10-year long-term interest rate	E_FR_LTI	0.18	0.17	0.13	0.09	0.06	0.03	0.02	0.01	0.01
Public Sector										
Gal Gov. Compensation of Employees	E_FR_PDN	0.02	0.02	0.03	0.06	0.08	0.09	0.11	0.12	0.13
Tranfers from gal Gov.	E_FR_TRN	0.00	-0.02	0.01	0.04	0.06	0.08	0.09	0.10	0.11
Other Gov. Net Revenues	E_FR_OGN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direst Taxes (inc. SSC)	E_FR_PDN	0.02	0.02	0.03	0.06	0.08	0.09	0.11	0.12	0.13
Other Direct Taxes	E_FR_ODN	-0.62	-0.68	-0.33	-0.08	0.03	0.09	0.13	0.15	0.16
Indirect Taxes less Subsidies	E_FR_TIN	0.05	-0.05	-0.06	-0.04	-0.02	0.01	0.03	0.05	0.07
Gen. Gov. Net Debt	E_FR_GDN	0.10	0.32	0.54	0.75	0.92	1.07	1.19	1.29	1.37
Gen. Gov. Net Lending (% of GDP)	E_FR_GLNRATIO	-0.09	-0.12	-0.12	-0.11	-0.10	-0.09	-0.08	-0.07	-0.06
Gen. Gov. Net Debt (% of GDP)	E_FR_GDNRATIO	0.05	0.17	0.26	0.35	0.43	0.50	0.55	0.59	0.63

Table 4b: Permanent oil price shock

Comparison with the Banque de France's model. We compare Tables 4a-b with Table 2 in Baghli et al. (2004, page 125). The two models exhibit very similar qualitative features. The first year, responses are the same, be it on the price side or on the real side. The major difference is the higher persistence in the MCM. The higher persistence of the real sphere is due to the fact that the Banque de France's model does not include wealth effects.

4.4.2 Permanent appreciation of the euro

The euro appreciates permanently by 10% against all the foreign currencies. Like the oil price shock, this shock affects import prices (in the opposite direction), but also decreases French exporters' competitiveness. Real exports plummet by 3.23% below the baseline the first year, and drag investment down. The decrease of activity and the following rise in unemployment cause consumption to go down. The latter is moreover negatively affected by the decrease in real wealth, especially in the long-run, due to the decrease of the stock of capital below its baseline. On the price side, the decrease in import prices has a direct impact on the consumption deflator. The deterioration of the labour market leads workers to accept lower increases in nominal wages, implying a decrease in unit labour costs below baseline, as well as in GDP and consumption deflators. In the long-run, the drop in domestic prices tends to partially offset the initial fall in price competitiveness. After ten years, however, GDP is still well below its baseline by 1.56%.

(deviations from baseline, percentage unless otherwise indicated)

		1	2	3	4	5	6	7	8	9
Economic Activity										
(constant prices)										
GDP	E_FR_YER	-0.78	-0.65	-0.54	-0.65	-0.83	-1.02	-1.21	-1.39	-1.56
Private consumption	E_FR_PCR	-0.41	-0.05	0.37	0.46	0.42	0.32	0.19	0.03	-0.14
Government consumption	E_FR_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_FR_ITR	-0.78	0.51	1.59	1.60	1.21	0.77	0.33	-0.08	-0.42
Exports	E_FR_XTR	-3.23	-2.44	-2.26	-2.18	-2.13	-2.09	-2.05	-2.01	-1.98
Imports	E_FR_MTR	-1.51	0.81	2.58	3.31	3.60	3.75	3.79	3.78	3.75
of which :										
Contribution of trade	E_FR_TRADE	-0.35	-0.75	-1.14	-1.31	-1.37	-1.39	-1.40	-1.39	-1.37
Contribution of inventories	E_FR_SCRRATIO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments										
HICP	E_FR_HIC	-0.58	-1.31	-1.80	-2.12	-2.35	-2.51	-2.66	-2.80	-2.94
GDP deflator	E_FR_YED	-0.19	-0.59	-0.99	-1.30	-1.53	-1.71	-1.86	-2.01	-2.17
Private Consumption deflator	E_FR_PCD	-0.48	-1.16	-1.66	-2.01	-2.26	-2.44	-2.60	-2.75	-2.89
Exports deflator	E_FR_XTD	-2.68	-3.96	-4.33	-4.55	-4.70	-4.82	-4.92	-5.01	-5.10
Imports deflator	E_FR_MTD	-6.18	-6.32	-6.31	-6.39	-6.47	-6.54	-6.61	-6.67	-6.73
Competitors Prices on domestic market	E_FR_CMD	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
Competitors Prices on external markets	E_FR_CXD	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
Nominal Exchange Rate	E_FR_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_FR_WUN	-0.52	-1.14	-1.37	-1.44	-1.58	-1.74	-1.90	-2.03	-2.15
Compensation per employee (real, GDP price)	E_FR_WUNY	-0.33	-0.55	-0.38	-0.14	-0.05	-0.04	-0.04	-0.02	0.01
Compensation per employee (real, Consumption price)	E_FR_WUNC	-0.04	0.01	0.30	0.58	0.69	0.72	0.72	0.74	0.76
Productivity	E_FR_PRO	-0.38	-0.17	-0.06	-0.05	-0.04	-0.02	0.01	0.05	0.11
ULC, whole economy	E_FR_ULC	-0.13	-0.98	-1.30	-1.40	-1.54	-1.72	-1.90	-2.08	-2.26
Total Labour Force	E_FR_LFN	-0.02	-0.08	-0.12	-0.15	-0.20	-0.26	-0.33	-0.41	-0.50
Total employment	E_FR_LNN	-0.40	-0.48	-0.48	-0.60	-0.79	-1.00	-1.22	-1.44	-1.67
Unemployment	E_FR_UNN	4.07	4.25	3.76	4.64	6.10	7.62	9.15	10.66	12.08
Unemployment rate (deviation from baseline)	E_FR_URX	0.35	0.37	0.33	0.41	0.54	0.67	0.81	0.95	1.08

Table 5a: 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_FR_PYN	-0.95	-1.33	-1.64	-2.03	-2.42	-2.78	-3.13	-3.46	-3.79
Real disposible Income	E_FR_PYR	-0.47	-0.18	0.02	-0.02	-0.17	-0.35	-0.54	-0.73	-0.92
Compensation of employees	E_FR_WIN	-0.91	-1.62	-1.84	-2.04	-2.35	-2.72	-3.09	-3.45	-3.79
Transfers from Gal Gov.	E_FR_TRN	-0.96	-1.24	-1.53	-1.94	-2.35	-2.71	-3.05	-3.38	-3.69
Other Personal income	E_FR_OPN	-1.00	-0.70	-1.28	-2.13	-2.70	-3.06	-3.36	-3.63	-3.90
Direst Taxes (inc. SSC)	E_FR_PDN	-0.94	-1.35	-1.67	-2.05	-2.45	-2.82	-3.16	-3.50	-3.81
Total Wealth	E_FR_FWN	-0.78	-0.77	-0.83	-0.96	-1.12	-1.30	-1.53	-1.79	-2.09
Real Total Wealth	E_FR_FWR	-0.30	0.39	0.84	1.07	1.17	1.17	1.10	0.98	0.83
Saving ratio	E_FR_SRATIO	-0.05	-0.02	-0.14	-0.24	-0.31	-0.36	-0.39	-0.41	-0.41
Firms and Interest Rate										
Capital Stock	E_FR_KSR	-0.03	-0.03	0.04	0.14	0.21	0.25	0.26	0.25	0.22
Real Cost of Capital (average)	E_FR_CCR	-12.62	-8.34	-5.32	-4.56	-4.07	-3.47	-2.97	-2.61	-2.33
3-month interest rate	E_FR_STI	-0.92	-0.94	-0.75	-0.62	-0.50	-0.40	-0.35	-0.32	-0.31
10-year long-term interest rate	E_FR_LTI	-0.92	-0.94	-0.75	-0.62	-0.50	-0.40	-0.35	-0.32	-0.31
Public Sector										
Gal Gov. Compensation of Employees	E_FR_PDN	-0.94	-1.35	-1.67	-2.05	-2.45	-2.82	-3.16	-3.50	-3.81
Tranfers from gal Gov.	E_FR_TRN	-0.96	-1.24	-1.53	-1.94	-2.35	-2.71	-3.05	-3.38	-3.69
Other Gov. Net Revenues	E_FR_OGN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direst Taxes (inc. SSC)	E_FR_PDN	-0.94	-1.35	-1.67	-2.05	-2.45	-2.82	-3.16	-3.50	-3.81
Other Direct Taxes	E_FR_ODN	-1.09	0.16	-0.76	-2.44	-3.59	-4.28	-4.82	-5.30	-5.73
Indirect Taxes less Subsidies	E_FR_TIN	-1.07	-1.06	-0.97	-1.24	-1.60	-1.94	-2.27	-2.60	-2.92
Gen. Gov. Net Debt	E_FR_GDN	-0.53	-1.37	-2.17	-2.88	-3.47	-3.90	-4.20	-4.40	-4.53
Gen. Gov. Net Lending (% of GDP)	E_FR_GLNRATIO	0.41	0.43	0.40	0.36	0.29	0.22	0.16	0.11	0.07
Gen. Gov. Net Debt (% of GDP)	E_FR_GDNRATIO	0.22	-0.07	-0.33	-0.48	-0.57	-0.61	-0.59	-0.53	-0.43

Table 5b: Permanent appreciation of the euro

Comparison with the Banque de France's model. We compare Tables 5a-b with Table 3 in Baghli et al. (2004, page 126). The two models exhibit very similar qualitative features in the short-to-medium-run. Quantitatively, the variations of prices are almost the same. On the real side, however, exports are much more sensitive to price competitiveness in the MCM than in MASCOTTE, causing investment to decrease by -0.78% in the MCM, against -0.27% in MASCOTTE the first year. Another noticeable difference is that the strong decrease in the capital stock in the MCM generates a higher persistence of consumption than in MASCOTTE, *via* the wealth channel.

4.4.3 Permanent increase in world demand

World demand (excluding the euro area) increases permanently by 1%. Real exports increase by 0.39% above baseline and stimulate investment. Real GDP increases, while the unemployment rate decreases and consumption goes up. Unemployment goes down and, with the improvement of the situation on the labour market, real wages increase, as well as domestic prices. The loss of competitiveness *vis-a-vis* foreign competitors limits exports in the medium-to-long-term, but the net trade contribution to GDP growth stays above its baseline.

(deviations from baseline, percentage unless otherwise indicated)

		1	2	3	4	5	6	7	8	9
Economic Activity										
(constant prices)										
GDP	E_FR_YER	0.09	0.13	0.12	0.12	0.12	0.12	0.13	0.13	0.13
Private consumption	E_FR_PCR	0.04	0.09	0.08	0.08	0.09	0.10	0.11	0.11	0.12
Government consumption	E_FR_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_FR_ITR	0.12	0.17	0.10	0.08	0.08	0.08	0.07	0.07	0.07
Exports	E_FR_XTR	0.39	0.43	0.43	0.42	0.42	0.42	0.42	0.41	0.41
Imports	E_FR_MTR	0.18	0.26	0.21	0.19	0.19	0.20	0.20	0.20	0.20
of which :										
Contribution of trade	E_FR_TRADE	0.04	0.03	0.04	0.05	0.05	0.04	0.04	0.04	0.04
Contribution of inventories	E_FR_SCRRATIO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments										
HICP	E_FR_HIC	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
GDP deflator	E_FR_YED	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
Private Consumption deflator	E_FR_PCD	0.00	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.07
Exports deflator	E_FR_XTD	0.00	0.00	0.01	0.02	0.02	0.03	0.04	0.04	0.05
Imports deflator	E_FR_MTD	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03
Competitors Prices on domestic market	E_FR_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_FR_CXD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal Exchange Rate	E_FR_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_FR_WUN	0.01	0.05	0.07	0.06	0.06	0.06	0.07	0.07	0.08
Compensation per employee (real, GDP price)	E_FR_WUNY	0.01	0.04	0.05	0.04	0.02	0.01	0.01	0.00	-0.01
Compensation per employee (real, Consumption price)	E_FR_WUNC	0.01	0.04	0.05	0.04	0.02	0.02	0.01	0.01	0.00
Productivity	E_FR_PRO	0.05	0.04	0.02	0.01	0.00	0.00	-0.01	-0.02	-0.02
ULC, whole economy	E_FR_ULC	-0.04	0.01	0.05	0.05	0.06	0.07	0.08	0.09	0.10
Total Labour Force	E_FR_LFN	0.00	0.01	0.02	0.03	0.03	0.04	0.05	0.05	0.06
Total employment	E_FR_LNN	0.04	0.09	0.09	0.10	0.12	0.13	0.14	0.15	0.15
Unemployment	E_FR_UNN	-0.45	-0.81	-0.78	-0.80	-0.85	-0.89	-0.91	-0.92	-0.93
Unemployment rate (deviation from baseline)	E_FR_URX	-0.04	-0.07	-0.07	-0.07	-0.08	-0.08	-0.08	-0.08	-0.08

Table 6a: 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_FR_PYN	0.09	0.14	0.15	0.15	0.17	0.18	0.20	0.21	0.22
Real disposible Income	E_FR_PYR	0.09	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.15
Compensation of employees	E_FR_WIN	0.06	0.14	0.16	0.17	0.18	0.19	0.20	0.22	0.23
Transfers from Gal Gov.	E_FR_TRN	0.09	0.14	0.13	0.14	0.16	0.17	0.19	0.20	0.21
Other Personal income	E_FR_OPN	0.17	0.15	0.11	0.13	0.15	0.17	0.18	0.19	0.21
Direst Taxes (inc. SSC)	E_FR_PDN	0.09	0.14	0.14	0.15	0.17	0.18	0.19	0.20	0.21
Total Wealth	E_FR_FWN	0.00	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16
Real Total Wealth	E_FR_FWR	0.00	0.01	0.02	0.03	0.05	0.06	0.07	0.08	0.09
Saving ratio	E_FR_SRATIO	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Firms and Interest Rate										
Capital Stock	E_FR_KSR	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.04
Real Cost of Capital (average)	E_FR_CCR	0.65	0.37	0.11	0.09	0.11	0.11	0.10	0.10	0.10
3-month interest rate	E_FR_STI	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
10-year long-term interest rate	E_FR_LTI	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Public Sector										
Gal Gov. Compensation of Employees	E_FR_PDN	0.09	0.14	0.14	0.15	0.17	0.18	0.19	0.20	0.21
Tranfers from gal Gov.	E_FR_TRN	0.09	0.14	0.13	0.14	0.16	0.17	0.19	0.20	0.21
Other Gov. Net Revenues	E_FR_OGN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direst Taxes (inc. SSC)	E_FR_PDN	0.09	0.14	0.14	0.15	0.17	0.18	0.19	0.20	0.21
Other Direct Taxes	E_FR_ODN	0.39	0.34	0.21	0.24	0.28	0.30	0.32	0.33	0.35
Indirect Taxes less Subsidies	E_FR_TIN	0.05	0.11	0.09	0.10	0.11	0.13	0.14	0.15	0.16
Gen. Gov. Net Debt	E_FR_GDN	0.02	0.03	0.01	0.00	-0.01	-0.03	-0.04	-0.05	-0.07
Gen. Gov. Net Lending (% of GDP)	E_FR_GLNRATIO	-0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Gen. Gov. Net Debt (% of GDP)	E_FR_GDNRATIO	-0.04	-0.05	-0.06	-0.07	-0.09	-0.10	-0.11	-0.13	-0.14

Table 6b: Permanent increase in world demand

Comparison with the Banque de France's model. We compare Tables 6a-b with Table 5 in Baghli et al. (2004, page 128). On the real side, the behaviour of the MCM and MASCOTTE are similar. On the nominal side, the quantitative results differ in the medium-to- long-run, owing to a difference productivity gains sharing. The latter benefit more to firms in the MCM than in MASCOTTE, where nominal wages and unit labour costs increase by more. As a consequence, the capital/labour substitution effect is stronger in the MCM, and causes investment to be more reactive in the medium-term than in MASCOTTE.

4.4.4 Transitory monetary policy shock

In this Section we simulate a monetary policy shock, as considered in the context of the Monetary Transmission Network.[18] The shock is a two-year increase by 100 basis points of the short-term interest rate. In addition, some exogenous hypotheses regarding the adjustment of the long-term interest rate and the exchange rate have been made. The long-term interest rate responds to this change according to an interest parity condition, while the exchange rate of the euro appreciates according to an uncovered interest rate parity condition. After these two-year changes, these variables go back to and stay at their baseline value. Given that the model is-run in isolation (i.e. France is the only country where the shock occurs), all the external variables stay at their baseline values. (There is no international spillover effect.)

(deviations from baseline, percentage unless otherwise indicated)

		1	2	3	4	5	6	7	8	9
Economic Activity										
(constant prices)										
GDP	E_FR_YER	-0.10	-0.19	-0.23	-0.23	-0.19	-0.15	-0.12	-0.10	-0.09
Private consumption	E_FR_PCR	-0.03	-0.11	-0.17	-0.20	-0.19	-0.17	-0.16	-0.15	-0.14
Government consumption	E_FR_GCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross fixed capital formation	E_FR_ITR	-0.27	-0.79	-0.94	-0.80	-0.57	-0.36	-0.23	-0.15	-0.10
Exports	E_FR_XTR	-0.29	-0.04	0.05	0.02	0.02	0.02	0.02	0.02	0.03
Imports	E_FR_MTR	-0.20	-0.32	-0.39	-0.38	-0.28	-0.18	-0.12	-0.09	-0.08
of which :										
Contribution of trade	E_FR_TRADE	-0.02	0.05	0.09	0.08	0.06	0.04	0.03	0.02	0.02
Contribution of inventories	E_FR_SCRRATIO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Developments										
HICP	E_FR_HIC	-0.06	-0.10	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
GDP deflator	E_FR_YED	-0.02	-0.05	-0.07	-0.08	-0.09	-0.09	-0.10	-0.10	-0.11
Private Consumption deflator	E_FR_PCD	-0.05	-0.09	-0.09	-0.09	-0.08	-0.09	-0.09	-0.09	-0.09
Exports deflator	E_FR_XTD	-0.25	-0.22	-0.08	-0.06	-0.06	-0.06	-0.06	-0.06	-0.07
Imports deflator	E_FR_MTD	-0.50	-0.20	-0.01	-0.02	-0.03	-0.04	-0.04	-0.04	-0.04
Competitors Prices on domestic market	E_FR_CMD	-0.71	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competitors Prices on external markets	E_FR_CXD	-0.94	-0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal Effective Exchange Rate	E_FR_EEN	-0.71	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour Market and Cost Developments										
Compensation per employee (nominal)	E_FR_WUN	-0.05	-0.11	-0.14	-0.14	-0.14	-0.11	-0.10	-0.09	-0.09
Compensation per employee (real, GDP price)	E_FR_WUNY	-0.04	-0.06	-0.06	-0.06	-0.05	-0.02	0.00	0.01	0.01
Compensation per employee (real, Consumption price)	E_FR_WUNC	0.00	-0.02	-0.05	-0.06	-0.05	-0.03	-0.01	0.00	0.00
Productivity	E_FR_PRO	-0.05	-0.08	-0.07	-0.04	-0.01	0.01	0.02	0.02	0.01
ULC, whole economy	E_FR_ULC	0.00	-0.03	-0.07	-0.10	-0.13	-0.12	-0.11	-0.11	-0.11
Total Labour Force	E_FR_LFN	0.00	-0.01	-0.03	-0.04	-0.06	-0.06	-0.07	-0.07	-0.06
Total employment	E_FR_LNN	-0.05	-0.12	-0.17	-0.19	-0.18	-0.16	-0.14	-0.12	-0.10
Unemployment	E_FR_UNN	0.47	1.10	1.46	1.49	1.26	0.96	0.72	0.53	0.37
Unemployment rate (deviation from baseline)	E_FR_URX	0.04	0.10	0.13	0.13	0.11	0.09	0.07	0.05	0.04

Table 7a: Transitory monetary policy shock

[18] See van Els et al. (2001).

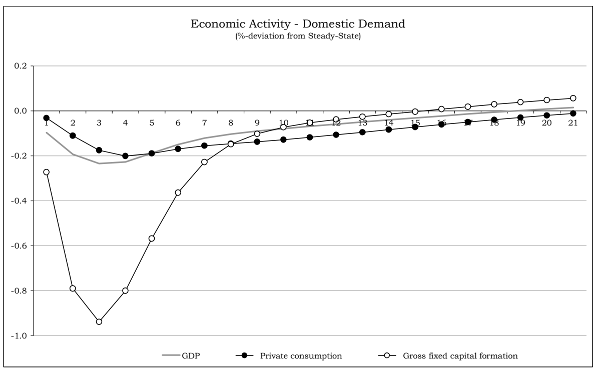
(deviations from baseline, percentage unless otherwise indicated)

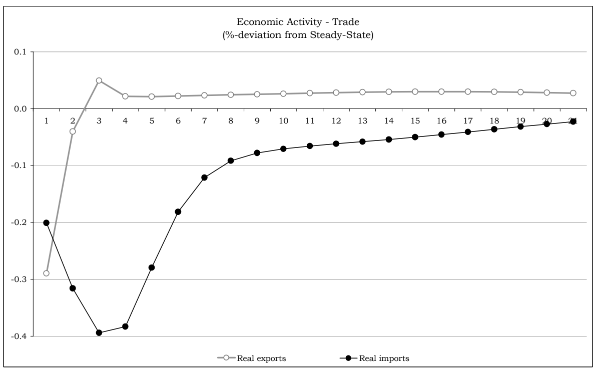
		1	2	3	4	5	6	7	8	9
Disposable Income (nominal) & Total Wealth										
Disposable income	E_FR_PYN	-0.11	-0.23	-0.30	-0.31	-0.28	-0.25	-0.22	-0.20	-0.19
Real disposible Income	E_FR_PYR	-0.06	-0.15	-0.21	-0.22	-0.19	-0.16	-0.13	-0.12	-0.10
Compensation of employees	E_FR_WIN	-0.10	-0.23	-0.30	-0.33	-0.31	-0.27	-0.24	-0.21	-0.20
Transfers from Gal Gov.	E_FR_TRN	-0.12	-0.25	-0.31	-0.31	-0.28	-0.24	-0.22	-0.20	-0.20
Other Personal income	E_FR_OPN	-0.13	-0.24	-0.27	-0.23	-0.18	-0.17	-0.18	-0.19	-0.19
Direst Taxes (inc. SSC)	E_FR_PDN	-0.11	-0.23	-0.30	-0.31	-0.28	-0.25	-0.22	-0.20	-0.19
Total Wealth	E_FR_FWN	-0.09	-0.18	-0.25	-0.27	-0.28	-0.28	-0.27	-0.27	-0.26
Real Total Wealth	E_FR_FWR	-0.04	-0.09	-0.16	-0.18	-0.19	-0.19	-0.19	-0.18	-0.17
Saving ratio	E_FR_SRATIO	-0.02	-0.03	-0.03	-0.02	0.00	0.01	0.02	0.02	0.02
Firms and Interest Rate										
Capital Stock	E_FR_KSR	-0.01	-0.04	-0.09	-0.14	-0.17	-0.18	-0.19	-0.19	-0.18
Real Cost of Capital (average)	E_FR_CCR	2.70	1.52	0.38	0.15	0.10	0.09	0.09	0.08	0.07
3-month interest rate	E_FR_STI	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-year long-term interest rate	E_FR_LTI	0.16	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Public Sector										
Gal Gov. Compensation of Employees	E_FR_PDN	-0.11	-0.23	-0.30	-0.31	-0.28	-0.25	-0.22	-0.20	-0.19
Tranfers from gal Gov.	E_FR_TRN	-0.12	-0.25	-0.31	-0.31	-0.28	-0.24	-0.22	-0.20	-0.20
Other Gov. Net Revenues	E_FR_OGN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Direst Taxes (inc. SSC)	E_FR_PDN	-0.11	-0.23	-0.30	-0.31	-0.28	-0.25	-0.22	-0.20	-0.19
Other Direct Taxes	E_FR_ODN	-0.18	-0.38	-0.41	-0.26	-0.12	-0.06	-0.06	-0.08	-0.08
Indirect Taxes less Subsidies	E_FR_TIN	-0.14	-0.33	-0.41	-0.40	-0.34	-0.28	-0.24	-0.22	-0.21
Gen. Gov. Net Debt	E_FR_GDN	0.63	1.67	2.11	2.18	2.24	2.29	2.31	2.33	2.33
Gen. Gov. Net Lending (% of GDP)	E_FR_GLNRATIO	-0.51	-0.56	-0.08	-0.08	-0.08	-0.07	-0.06	-0.05	-0.05
Gen. Gov. Net Debt (% of GDP)	E_FR_GDNRATIO	0.37	0.96	1.21	1.25	1.26	1.27	1.27	1.27	1.27

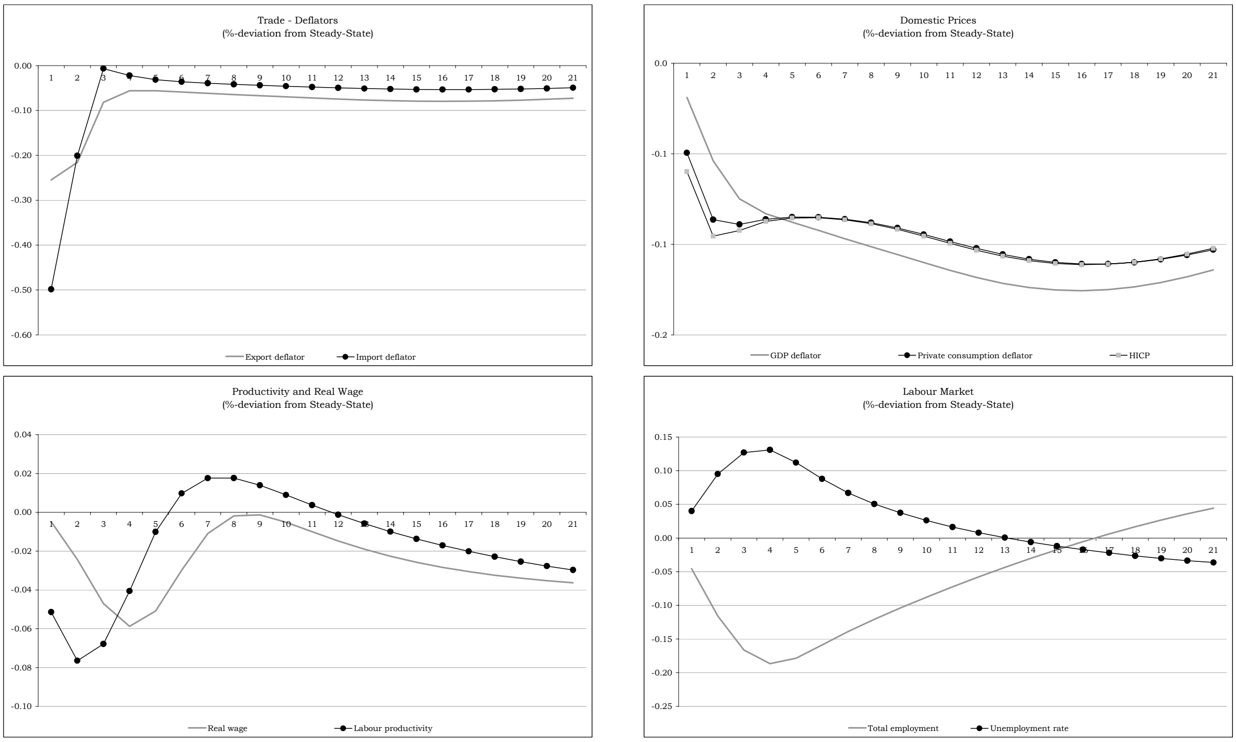
Table 7b: Transitory monetary policy shock

The main effect of the shock is to reduce activity over the short-to-medium-term, before the whole system progressively goes back to the baseline. The decrease in GDP the first year is mainly due to the decrease in exports that follows the loss in price competitiveness, and to the fall in investment. Firms reduce their investment because of the lower exports, but also owing to the rise in the real user cost of capital. As a consequence, unemployment goes up, real disposable income goes down, and consumption decreases. The fall in prices, which follows the fall in import prices, is not large enough to offset the effect of the decrease in nominal wages and income on real consumption.

On the real side, the contraction is persistent owing to the wealth channel. The fall in investment implies a decrease in the capital stock and, therefore, in households' wealth, which hinders consumption. The rise in exports the third year onward after the exchange rate goes back to baseline only partially offsets these adverse developments on the domestic side. Employment adjusts slowly to the activity, implying a fall in productivity, which exerts downward pressure on wages and prices even after the shock. The competitivity gains thus generated have a beneficial effect on exports, which stay persistently above baseline, driving the GDP back to its baseline in the long-run.







Comparison with the Banque de France's model. We compare Tables 7a-b with Table 12 in Baghli et al. (2004, page 135). The real side of the economy is much less sensitive to the shock in MASCOTTE than in the MCM, essentially because exports do not react as much to price competitiveness in MASCOTTE. As in the previous simulations, wages are more sensitive to unemployment in MASCOTTE than in the MCM, implying that the decrease in prices is stronger and more persistent in MASCOTTE than in the MCM over the whole simulation period.

5 Conclusion

Model development is a continuous process. Therefore, this paper should be seen more as an intermediate report describing the current state of the work. Hitherto, the main focus has been on building a model, the long-run properties of which are in line with standard neoclassical theory. The estimated equations of the model fit data reasonably well, and the adjustment paths to the long-run equilibrium are plausible. Among the problems that need to be tackled is that the current model is backward-looking and thus eludes the treatment of expectations. In the current framework, for example, prices respond little to permanent shocks, and variations in wealth have no instantaneous effect on consumption. Another caveat of the current model is the absence of a financial block, which would probably allow for a finer analysis of the transmission of monetary policy to the activity.

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7 Appendix

7.1 Names of the variables in the MCM

Names	Description
BTN	*Balance of Goods and Services*
CAN	Current Account Surplus
CC0	*User Cost of Capital (average LTI and RCC)*
CC1	*User Cost of Capital (LTI)*
CC2	*User Cost of Capital (RCC)*
CCR	*Real User Cost of Capital (deflated by GDP deflator)*
CMD	*Competitors' Import Price in Domestic Currency*
CXD	*Competitors' Export Price in Domestic Currency*
CMUD	*Competitors' Import Price in US$*
CXUD	*Competitors' Export Price in US$*
EEN	*Effective Exchange Rate, Export Side*
EEN0	*Effective Exchange Rate, Import Side*
EXR	*Exchange Rate vis-à-vis the US$*
FWN	*Financial Wealth*
FWR	*Financial Wealth (Real)*
GCD	Government Consumption (Deflator)
GCN	Government Consumption
GCP	*Government Consumption Pre-Tax (Deflator)*
GCR	Government Consumption (Real)
GDN	General Government Net Debt
GID	Gen. Govt Domestic Capital Formation (Deflator)
GIN	Gen. Govt Domestic Capital Formation
GIP	*Gen. Govt Domestic Capital Formation Pre-Tax (Deflator)*
GIR	Gen. Govt Domestic Capital Formation (Real)
GLN	Gen. Govt Net Lending
GON	Gross Operating Surplus
GOR	*Gross Operating Surplus (Real)*
GSN	Govt savings
GWN	General government compensation to employees
GYN	Govt disposable income
HE	*HICP Energy*
HEX	*HICP Excluding Energy*
HEXP	*HICP Excluding Energy Pre-Tax*
HICP	*HICP*
IHD	Housing Investment (Deflator)
IHN	Housing Investment
IHR	Housing Investment (Real)
INFA	*Inflation on PCD Deflator (Annuual)*
INFE	*Inflation on PCD Deflator (Expected)*
INFQ	*Inflation on PCD Deflator (Quarterly)*
INN	National Debt Interest
IPD	Private-sector Investment (Deflator)
IPN	Private-sector Investment
IPR	Private-sector Investment (Real)
IPX	*Industrail Production to GDP (Ratio)*
ITD	Investment (Deflator)
ITN	Investment
ITR	Investment (Real)
KGR	*General Government Capital Stock (Real)*
KSR	*Total Capital Stock (Real)*

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)*

Names	Description
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*

7.2 The Accounting Framework

It is very useful to bear in mind the main economic flows that take place between the four agents of our economy: households, firms, the public sector and the rest of the world (RoW). The table below synthesises the main accounting relationships.

The main accounting relationships

EXPENDITURES					RECEIPTS			
Households	**Public sector**	**Firms**	**RoW**		**Households**	**Public Sector**	**Firms**	**RoW**
PCN+IHN	GCN+GIN	ITN+SCN	XTN	**I- Operations on Goods and Services**		GWN	YEN-GWN	MTN
				II- Distribution of Income				
			BTN	Value Added		GWN	YEN-GWN	
	GWN	WIN-GWN		Compensations	WIN			
		TIN		Net Indirect Taxes		TIN		
	TRN			Social contributions	TRN			
			NFN	Net Foreign Income			NFN	
			TWN	Net Transfers			TWN	
		OGN		Other Net Transfers to Public Sector		OGN		
		OPN		Other Net Transfers to Households	OPN			
	INN			Interests			INN	
TDN				Direct Taxes		TDN		
		ODN		Other Direct Taxes		ODN		
PYN	GYN	OYN		*Balance: Gross Disposable Income*				CAN
				III- Savings and Consumption				
			CAN	Gross Disposable Income	PYN	GYN	OYN	
PCN	GCN			Final Consumption				
PSN	GSN	OYN		*Balance: Gross Savings*				CAN
				IV- Capital Accumulation				
				Gross Savings	PSN	GSN	OYN	
IHN	GIN	IPN		Gross Fixed Capital Formation				
		SCN		Variations of Stocks				
			CAN	Foreign Trade				
PLN	GLN	OLN		*Balance: Net Lending*				CAN

The purchases of goods and services by households, government, firms and foreign agents match the sales of goods and services by the government, firms and the rest of the world (block I in the table). The aggregate income thus generated is redistributed as compensations (to households) and gross operating surplus (to firms), and gives rise to a number of transfers among the domestic agents and the rest of the world (block II of the table). Once these transfers are made, domestic agents are left with a gross disposable income, which is allocated to consumption and gross savings (block III). The gap between gross aggregate savings and domestic capital formation is filled by the current account surplus, which can also be viewed as net (flow of) lending to the rest of the world (block IV).

7.3 The equations of the MCM

EXOGENOUS VARIABLES

fr_DUMMYQ1 fr_DUMMYQ2 fr_DUMMYQ3 fr_DUMT951 fr_DUMT991 fr_DUMT0001 fr_DUMT021 fr_ONES fr_TIME1 fr_TIME961 fr_TIME991 fr_CMUD_EX fr_CMUD_IN fr_CXUD_EX fr_CXUD_IN fr_EEN0_EX fr_EEN0_IN fr_EEN_EX fr_EEN_IN fr_GCR fr_GIR fr_IHD fr_IHR fr_LEX fr_ODX fr_OGN fr_OPX fr_PDX fr_POILU fr_TCI fr_TCIR fr_TGI fr_TGIR fr_TII fr_TIIR fr_TIME fr_TRX fr_TWN fr_WDR_EX fr_WDR_IN fr_WE fr_ZCAN fr_ZER fr_ZGDN fr_ZHIC fr_ZIN fr_ZINN fr_ZLTI fr_ZNFA fr_ZNFN fr_ZSTI fr_ZEXR fr_ZZODX fr_ZZOPX fr_ZZPDX

ENDOGENOUS VARIABLES

fr_EXR fr_EXR_in fr_EXR_ex fr_STI fr_LTI fr_LTR fr_STR fr_CC0 fr_CCR fr_PDN fr_ODN fr_OPN fr_WUN fr_YFD fr_MTD fr_PEI fr_XTD fr_OIP fr_OIR fr_GIP fr_GCP fr_HEXP fr_HEG fr_PCD fr_PCR fr_IPR fr_XTR fr_MTR fr_LNN fr_LFN fr_SCR fr_INFQ fr_INFA fr_POIL fr_CMD fr_CXD fr_WDR fr_CXUD fr_CXD_IN fr_CXD_EX fr_CMUD fr_CMD_IN fr_CMD_EX fr_EEN0 fr_EEN fr_OID fr_GCD fr_GID fr_YED fr_ITD fr_PCP fr_HEX fr_HIC fr_OIN fr_GIN fr_ITN fr_PCN fr_GCN fr_XTN fr_MTN fr_YFN fr_YEN fr_ITR fr_YFR fr_MKUP fr_SZD fr_UNN fr_URX fr_PYR fr_KGR fr_KPR fr_KSR fr_KHR fr_FWR fr_FWRH fr_SALE fr_YER fr_SZN fr_LEN fr_PRO fr_WIN fr_CEX fr_ULA fr_WUG fr_GON fr_PYN fr_PSN fr_GYN fr_PDNB fr_INN fr_GSN fr_GLN fr_GDN fr_ODNB fr_OLN fr_BTN fr_CAN fr_NFN fr_NFA fr_OYN fr_PLN fr_TRN fr_WER fr_FWN fr_IHN fr_TIN fr_TIR fr_ZODX fr_ZOPX fr_ZPDX

DEFINITIONS

fr_YFT fr_LSTAR fr_RWUNSTAR fr_KSTAR fr_MTDSTAR fr_PEISTAR fr_XTDSTAR fr_OIPSTAR fr_GIPSTAR fr_GCPSTAR fr_HEXPSTAR fr_HEGSTAR fr_PCDSTAR fr_PCRSTAR fr_IPRSTAR fr_XTRSTAR fr_MTRSTAR fr_LFNSTAR fr_SCRSTAR fr_YGA

PARAMETERS

fr_lambda fr_rule fr_dfor fr_taylor fr_nairu fr_infe fr_depksr fr_depkpr fr_depkgr fr_wer.pcr fr_wer.gcr fr_wer.itr fr_wer.scr fr_wer.xtr fr_pdnb.win fr_betain fr_betaex fr_m2in fr_m2ex

COEFFICIENTS

fr_demo fr_alpha fr_beta fr_gamma fr_eps fr_kstar.cst fr_kstar.time961 fr_iprstar.cst fr_iprstar.time1 fr_rwunstar.cst fr_rwunstar.time1 fr_lstar.cst fr_lstar.time1 fr_yft.cst fr_yft.time1 fr_lfnstar.cst fr_lfnstar.lfn1 fr_lfnstar.lfn2 fr_lfnstar.lfn3 fr_lfnstar.lfn4 fr_lfnstar.time fr_wun.cst fr_wun.rwun1 fr_wun.pro fr_wun.urx fr_wun.pcdyfd1 fr_wun.ecm fr_wun.dumq1 fr_wun.dumq2 fr_wun.dumq3 fr_wun.dumt951 fr_yfd.cst fr_yfd.yfd3 fr_yfd.wun1 fr_yfd.wun3 fr_yfd.pro1 fr_yfd.ecm fr_yfd.dumt951 fr_yfd.dumt991 fr_mtdstar.cst fr_mtdstar.yfd fr_mtdstar.cmd fr_mtdstar.pei fr_mtdstar.time1 fr_mtd.cst fr_mtd.ecm fr_mtd.mtd1 fr_mtd.cmd fr_mtd.cmd1 fr_mtd.yfd1 fr_mtd.pei fr_mtd.dumq1 fr_mtd.dumq2 fr_mtd.dumq3 fr_mtd.dumt951 fr_peistar.cst fr_peistar.poil fr_peistar.time991 fr_pei.cst fr_pei.ecm fr_pei.pei1 fr_pei.poil fr_pei.poil1 fr_pei.dumq1 fr_pei.dumq2 fr_pei.dumq3 fr_pei.dumt951 fr_xtdstar.cst fr_xtdstar.cxd fr_xtdstar.yed fr_xtdstar.time1 fr_xtd.cst fr_xtd.ecm fr_xtd.xtd2 fr_xtd.yfd fr_xtd.cxd fr_xtd.cxd1 fr_xtd.dumq1 fr_xtd.dumq2 fr_xtd.dumq3 fr_xtd.dumt951 fr_oipstar.cst fr_oipstar.yfd fr_oipstar.mtd fr_oipstar.time1 fr_oip.cst fr_oip.ecm fr_oip.oip1 fr_oip.yfd fr_oip.mtd fr_oip.dumt951 fr_gipstar.cst fr_gipstar.yfd fr_gipstar.mtd fr_gip.cst fr_gip.ecm fr_gip.gip1 fr_gip.yfd fr_gip.mtd fr_gip.dumt951 fr_gcpstar.cst fr_gcpstar.yfd fr_gcpstar.mtd fr_gcpstar.time1 fr_gcp.cst fr_gcp.ecm fr_gcp.gcp1 fr_gcp.yfd fr_gcp.mtd fr_gcp.dumq1 fr_gcp.dumq2 fr_gcp.dumq3 fr_gcp.dumt951 fr_hexpstar.cst fr_hexpstar.ones fr_hexpstar.yfd fr_hexpstar.mtd fr_hexp.cst fr_hexp.ecm fr_hexp.hexp1 fr_hexp.yfd fr_hexp.yfd1 fr_hexp.mtd fr_hexp.yga2 fr_hexp.dumq1 fr_hexp.dumq2 fr_hexp.dumq3 fr_hexp.dumt951 fr_hegstar.cst fr_hegstar.poil fr_hegstar.pei fr_hegstar.yfd fr_heg.cst fr_heg.ecm fr_heg.heg1 fr_heg.yfd fr_heg.pei fr_heg.dumq1 fr_heg.dumq2 fr_heg.dumq3 fr_heg.dumt951 fr_pcdstar.cst fr_pcdstar.hic fr_pcdstar.dumt021 fr_pcd.cst fr_pcd.ecm fr_pcd.pcd2 fr_pcd.hic fr_pcd.dumq1 fr_pcd.dumq2 fr_pcd.dumq3 fr_pcd.dumt951 fr_pcd.dumt991 fr_pcrstar.cst fr_pcrstar.pyr fr_pcrstar.fwr fr_pcrstar.time1 fr_pcr.cst fr_pcr.ecm fr_pcr.pcr1 fr_pcr.pyr fr_pcr.pyr2 fr_pcr.pyr3 fr_pcr.urx1 fr_pcr.fwr fr_pcr.dumt951 fr_ipr.cst fr_ipr.ecm fr_ipr.ipr1 fr_ipr.yer fr_ipr.yer1 fr_ipr.dumt0001 fr_ipr.dumt951 fr_xtrstar.cst fr_xtrstar.wdr fr_xtrstar.xtd fr_xtrstar.cxd fr_xtrstar.time1 fr_xtr.cst fr_xtr.ecm fr_xtr.xtr1 fr_xtr.wdr fr_xtr.wdr1 fr_xtr.comp fr_xtr.comp1 fr_xtr.dumt951 fr_mtrstar.cst fr_mtrstar.wer fr_mtrstar.mtd fr_mtrstar.yfd fr_mtr.cst fr_mtr.ecm fr_mtr.mtr1 fr_mtr.wer fr_mtr.wer1 fr_mtr.comp4 fr_mtr.dumt951 fr_lnn.cst fr_lnn.ecm fr_lnn.yer fr_lnn.yer1 fr_lnn.yer2 fr_lnn.rwun3 fr_lnn.dumt951 fr_lfn.cst fr_lfn.ecm fr_lfn.lfn1 fr_lfn.lfn2 fr_lfn.urx1 fr_lfn.dumq1 fr_lfn.dumq2 fr_lfn.dumq3 fr_lfn.dumt951 fr_scrstar.yer fr_scryer.cst fr_scryer.ecm fr_scryer.scryer1 fr_scryer.scryer2 fr_scryer.scryer3 fr_scryer.dumq1 fr_scryer.dumq2 fr_scryer.dumq3 fr_scryer.dumt951 fr_lti.cst

POTENTIAL OUTPUT AND OUTPUT GAP

```
fr_YFT:     fr_YFT        = exp( + log(fr_alpha)
                           + fr_beta*log(fr_KSR)
                           + (1-fr_beta)*log(fr_LNN)
                           + (1-fr_beta)*(fr_gamma*fr_TIME)
                           + fr_yft.cst*fr_ONES
                           + fr_yft.time1*fr_TIME1),

fr_YGA:     fr_YGA        = fr_YER/fr_YFT,
```

MONETARY POLICY AND INTEREST RATES

NOMINAL INTEREST RATES

```
fr_STI:     fr_STI        = fr_dfor*fr_ZSTI
                         + (1-fr_dfor)*( fr_taylor*fr_STI(-1)
                                   + (1-fr_taylor)*400*( fr_gamma + fr_demo + fr_infe
                                                   + 1.5*(fr_PCD/fr_PCD(-1)-1-fr_infe)
                                                   + 0.5*(fr_YER/fr_YER(-1)-1-fr_gamma-fr_demo) )
                                   - (1-fr_taylor) )
                         + res_fr_sti,

fr_LTI:     fr_LTI        = fr_dfor*fr_ZLTI + (1-fr_dfor)*(fr_STI+fr_lti.cst) + res_fr_lti,
```

REAL INTEREST RATES

```
fr_LTR:     fr_LTR        = 100*((1 + fr_LTI/100)/(fr_YED/fr_YED(-4))-1) + res_fr_ltr,

fr_STR:     fr_STR        = 100*((1 + fr_STI/100)/(fr_YED/fr_YED(-4))-1) + res_fr_str,
```

NOMINAL USER COST OF CAPITAL

```
fr_CC0:     fr_CC0  = fr_OID*(fr_LTI/400 + fr_depkpr - (fr_YFD/fr_YFD(-4)-1)/4) + res_fr_cc0,
```

REAL USER COST OF CAPITAL

```
fr_CCR:     fr_CCR  = fr_CC0/fr_OID + res_fr_ccr,
```

FISCAL POLICY

```
fr_PDN:     fr_PDN  = fr_dfor*fr_PDX*fr_YEN + (1-fr_dfor)*fr_ZPDX*fr_PDNB + res_fr_pdn,

fr_ZPDX:    fr_ZPDX = fr_rule*(fr_ZPDX(-1) + fr_lambda*(fr_GDN/(4*fr_YEN)-0.5))
              + (1-fr_rule)*fr_ZZPDX + res_fr_ZPDX,

fr_ODN:     fr_ODN  = fr_dfor*fr_ODX*fr_YEN + (1-fr_dfor)*fr_ZODX*fr_ODNB + res_fr_odn,

fr_ZODX:    fr_ZODX = fr_rule*(fr_ZODX(-1)+fr_lambda*(fr_GDN/(4*fr_YEN)-0.5))
              + (1-fr_rule)*fr_ZZODX + res_fr_ZODX,
```

PRICE BLOCK

DOMESTIC WAGE-PRICE BLOCK

```
fr_RWUNSTAR:  fr_RWUNSTAR     = exp( + log((1-fr_beta)*(fr_eps-1)/fr_eps)
                              + log(fr_PRO)
                              + fr_rwunstar.cst*fr_ONES
                              + fr_rwunstar.time1*fr_TIME1),
```

```
fr_WUN:   del(log(fr_WUN)) =   del(log(fr_PCD))
                        + (1-fr_wun.rwun1-fr_wun.pro)*fr_gamma
                        + (fr_wun.cst-(1-fr_wun.rwun1-fr_wun.pro)*fr_gamma)*fr_ONES
                        + fr_wun.rwun1*del(log(fr_WUN(-1)/fr_PCD(-1)))
                        + fr_wun.ecm*( log(fr_WUN(-4)/fr_YFD(-4))-log(fr_RWUNSTAR(-4)) )
                        + fr_wun.pro*del(4:log(fr_PRO))/4
                        + fr_wun.urx*(log(fr_URX/100)-log(fr_nairu))
                        + fr_wun.pcdyfd1*del(log(fr_PCD(-1)/fr_YFD(-1)))
                        + fr_wun.dumq1*fr_DUMMYQ1
                        + fr_wun.dumq2*fr_DUMMYQ2
                        + fr_wun.dumq3*fr_DUMMYQ3
                        + fr_wun.dumt951*fr_DUMT951
                        + res_fr_wun,


fr_YFD:   del(log(fr_YFD)) =   fr_infe-fr_yfd.yfd3*fr_infe-(fr_yfd.wun1+fr_yfd.wun3)*(fr_gamma+fr_infe)-fr_yfd.pro1*fr_gamma
                        + (fr_yfd.cst-(fr_infe-fr_yfd.yfd3*fr_infe-(fr_yfd.wun1+fr_yfd.wun3)*(fr_gamma+fr_infe)-
fr_yfd.pro1*fr_gamma))*fr_ONES
                        + fr_yfd.ecm*( log(fr_YFD(-5)/fr_WUN(-5))+log(fr_RWUNSTAR(-5)) )
                        + fr_yfd.yfd3*del(log(fr_YFD(-3)))
                        + fr_yfd.wun1*del(log(fr_WUN(-1)))
                        + fr_yfd.wun3*del(log(fr_WUN(-3)))
                        + fr_yfd.pro1*del(log(fr_PRO(-1)))
                        + fr_yfd.dumt951*fr_DUMT951
                        + fr_yfd.dumt991*fr_DUMT991
                        + res_fr_yfd,
```

<u>IMPORT PRICES</u>

```
fr_MTDSTAR:   fr_MTDSTAR      =  exp( + fr_mtdstar.cst
                              + fr_mtdstar.yfd*log(fr_YFD)
                              + fr_mtdstar.cmd*log(fr_CMD)
                              + fr_mtdstar.pei*log(fr_PEI)
                              + fr_mtdstar.time1*fr_TIME1 ),

fr_MTD:       del(log(fr_MTD)) =  fr_mtd.cst
                           + fr_mtd.ecm*log(fr_MTD(-2)/fr_MTDSTAR(-2))
                           + fr_mtd.mtd1*del(log(fr_MTD(-1)))
                           + fr_mtd.cmd*del(log(fr_CMD))
                           + fr_mtd.cmd1*del(log(fr_CMD(-1)))
                           + fr_mtd.yfd1*del(log(fr_YFD(-1)))
                           + fr_mtd.pei*del(log(fr_PEI))
                           + fr_mtd.dumq1*fr_DUMMYQ1
                           + fr_mtd.dumq2*fr_DUMMYQ2
                           + fr_mtd.dumq3*fr_DUMMYQ3
                           + fr_mtd.dumt951*fr_DUMT951
                           + res_fr_mtd,
```

<u>ENERGY PRICES</u>

```
fr_PEISTAR:   fr_PEISTAR      =  exp( + fr_peistar.cst
                              + fr_peistar.poil*log(fr_POIL)
                              + fr_peistar.time991*fr_TIME991 ),
```

```
fr_PEI:       del(log(fr_PEI)) =  fr_pei.cst
                        + fr_pei.ecm*log(fr_PEI(-1)/fr_PEISTAR(-1))
                        + fr_pei.pei1*del(log(fr_PEI(-1)))
                        + fr_pei.poil*del(log(fr_POIL))
                        + fr_pei.poil1*del(log(fr_POIL(-1)))
                        + fr_pei.dumq1*fr_DUMMYQ1
                        + fr_pei.dumq2*fr_DUMMYQ2
                        + fr_pei.dumq3*fr_DUMMYQ3
                        + fr_pei.dumt951*fr_DUMT951
                        + res_fr_pei,
```

EXPORT PRICES

```
fr_XTDSTAR:   fr_XTDSTAR      =  exp( + fr_xtdstar.cst
                             + fr_xtdstar.cxd*log(fr_CXD)
                             + fr_xtdstar.yed*log(fr_YED)
                             + fr_xtdstar.time1*fr_TIME1 ),


fr_XTD:       del(log(fr_XTD)) =  fr_xtd.cst
                        + fr_xtd.ecm*log(fr_XTD(-1)/fr_XTDSTAR(-1))
                        + fr_xtd.xtd2*del(log(fr_XTD(-2)))
                        + fr_xtd.cxd*del(log(fr_CXD))
                        + fr_xtd.cxd1*del(log(fr_CXD(-1)))
                        + fr_xtd.yfd*del(log(fr_YFD))
                        + fr_xtd.dumq1*fr_DUMMYQ1
                        + fr_xtd.dumq2*fr_DUMMYQ2
                        + fr_xtd.dumq3*fr_DUMMYQ3
                        + fr_xtd.dumt951*fr_DUMT951
                        + res_fr_xtd,
```

PRIVATE INVESTMENT DEFLATOR (PRE-TAX)

```
fr_OIPSTAR:   fr_OIPSTAR      =  exp( + fr_oipstar.cst
                             + fr_oipstar.yfd*log(fr_YFD)
                             + fr_oipstar.mtd*log(fr_MTD)
                             + fr_oipstar.time1*fr_TIME1 ),

fr_OIP:       del(log(fr_OIP)) =  fr_oip.cst
                        + fr_oip.ecm*log(fr_OIP(-2)/fr_OIPSTAR(-2))
                        + fr_oip.oip1*del(log(fr_OIP(-1)))
                        + fr_oip.yfd*del(log(fr_YFD))
                        + fr_oip.mtd*del(log(fr_MTD))
                        + fr_oip.dumt951*fr_DUMT951
                        + res_fr_oip,
```

GOVERNMENT INVESTMENT DEFLATOR (PRE-TAX)

```
fr_GIPSTAR:   fr_GIPSTAR      =  exp( + fr_gipstar.cst
                             + fr_gipstar.yfd*log(fr_YFD)
                             + fr_gipstar.mtd*log(fr_MTD) ),

fr_GIP:       del(log(fr_GIP)) =  fr_gip.cst
                        + fr_gip.ecm*log(fr_GIP(-2)/fr_GIPSTAR(-2))
                        + fr_gip.gip1*del(log(fr_GIP(-1)))
                        + fr_gip.yfd*del(log(fr_YFD))
                        + fr_gip.mtd*del(log(fr_MTD))
                        + fr_gip.dumt951*fr_DUMT951
                        + res_fr_gip,
```

GOVERNMENT CONSUMPTION DEFLATOR (PRE-TAX)

```
fr_GCPSTAR:   fr_GCPSTAR     = exp( + fr_gcpstar.cst
                              + fr_gcpstar.yfd*log(fr_YFD)
                              + fr_gcpstar.mtd*log(fr_MTD)
                              + fr_gcpstar.time1*fr_TIME1 ),

fr_GCP:       del(log(fr_GCP)) =  fr_gcp.cst
                         + fr_gcp.ecm*log(fr_GCP(-2)/fr_GCPSTAR(-2))
                         + fr_gcp.gcp1*del(log(fr_GCP(-1)))
                         + fr_gcp.yfd*del(log(fr_YFD))
                         + fr_gcp.mtd*del(log(fr_MTD))
                         + fr_gcp.dumq1*fr_DUMMYQ1
                         + fr_gcp.dumq2*fr_DUMMYQ2
                         + fr_gcp.dumq3*fr_DUMMYQ3
                         + fr_gcp.dumt951*fr_DUMT951
                         + res_fr_gcp,
```

HICP EXCLUDING ENERGY

```
fr_HEXPSTAR:  fr_HEXPSTAR     = exp( + fr_hexpstar.cst
                              + (fr_hexpstar.yfd + fr_hexpstar.ones*fr_ones)*log(fr_YFD)
                              + fr_hexpstar.mtd*log(fr_MTD) ),


fr_HEXP:      del(log(fr_HEXP)) = fr_hexp.cst
                         + fr_hexp.ecm*log(fr_HEXP(-2)/fr_HEXPSTAR(-2))
                         + fr_hexp.hexp1*del(log(fr_HEXP(-1)))
                         + fr_hexp.yfd*del(log(fr_YFD))
                         + fr_hexp.yfd1*del(log(fr_YFD(-1)))
                         + fr_hexp.mtd*del(log(fr_MTD))
                         + fr_hexp.yga2*log(fr_YGA(-2))
                         + fr_hexp.dumq1*fr_DUMMYQ1
                         + fr_hexp.dumq2*fr_DUMMYQ2
                         + fr_hexp.dumq3*fr_DUMMYQ3
                         + fr_hexp.dumt951*fr_DUMT951
                         + res_fr_hexp,
```

HICP ENERGY

```
fr_HEGSTAR:   fr_HEGSTAR     = exp( + fr_hegstar.cst
                              + fr_hegstar.yfd*log(fr_YFD)
                              + fr_hegstar.poil*log(fr_POIL)
                              + fr_hegstar.pei*log(fr_PEI) ),

fr_HEG:       del(log(fr_HEG)) =  fr_heg.cst
                         + fr_heg.ecm*log(fr_HEG(-1)/fr_HEGSTAR(-1))
                         + fr_heg.heg1*del(log(fr_HEG(-1)))
                         + fr_heg.yfd*del(log(fr_YFD))
                         + fr_heg.pei*del(log(fr_PEI))
                         + fr_heg.dumq1*fr_DUMMYQ1
                         + fr_heg.dumq2*fr_DUMMYQ2
                         + fr_heg.dumq3*fr_DUMMYQ3
                         + fr_heg.dumt951*fr_DUMT951
                         + res_fr_heg,
```

PRIVATE CONSUMPTION DEFLATOR

```
fr_PCDSTAR:   fr_PCDSTAR     = exp( + fr_pcdstar.cst
                              + fr_pcdstar.hic*log(fr_HIC)
                              + fr_pcdstar.dumt021*fr_DUMT021 ),
```

```
fr_PCD:      del(log(fr_PCD)) =  fr_pcd.cst
                 + fr_pcd.ecm*log(fr_PCD(-1)/fr_PCDSTAR(-1))
                 + fr_pcd.pcd2*del(log(fr_PCD(-2)))
                 + fr_pcd.hic*del(log(fr_HIC))
                 + fr_pcd.dumq1*fr_DUMMYQ1
                 + fr_pcd.dumq2*fr_DUMMYQ2
                 + fr_pcd.dumq3*fr_DUMMYQ3
                 + fr_pcd.dumt951*fr_DUMT951
                 + fr_pcd.dumt991*fr_DUMT991
                 + res_fr_pcd,
```

REAL BLOCK

REAL PRIVATE CONSUMPTION

```
fr_PCRSTAR:   fr_PCRSTAR      = exp( + fr_pcrstar.cst
                   + fr_pcrstar.pyr*log(fr_PYR)
                   + fr_pcrstar.fwr*log(fr_FWR)
                   + fr_pcrstar.time1*fr_TIME1 ),

fr_PCR:      del(log(fr_PCR)) =  fr_pcr.cst
                 + fr_pcr.ecm*log(fr_PCR(-1)/fr_PCRSTAR(-1))
                 + fr_pcr.pcr1*del(log(fr_PCR(-1)))
                 + fr_pcr.pyr*del(log(fr_PYR))
                 + fr_pcr.pyr2*del(log(fr_PYR(-2)))
                 + fr_pcr.pyr3*del(log(fr_PYR(-3)))
                 + fr_pcr.fwr*del(log(fr_FWR))
                 + fr_pcr.urx1*del(log(fr_URX(-1)/100))
                 + fr_pcr.dumt951*fr_DUMT951
                 + res_fr_pcr,
```

REAL NON-HOUSING PRIVATE INVESTMENT

```
fr_KSTAR:    fr_KSTAR        = exp( + log(fr_YER)
                   - log(fr_alpha)
                   + (1-fr_beta)*log(fr_WUN/fr_YFD)
                   - (1-fr_beta)*log(fr_CCR)
                   - (1-fr_beta)*(fr_gamma*fr_TIME)
                   + (1-fr_beta)*log(fr_beta/(1-fr_beta))
                   + fr_kstar.cst*fr_ONES
                   + fr_kstar.time961*fr_TIME961 ),

fr_IPRSTAR:   fr_IPRSTAR      = exp( + log((fr_gamma + fr_demo+ fr_depkpr)/(1+fr_gamma+fr_demo))
                       + log(fr_YER)
                       - log(fr_alpha)
                       + (1-fr_beta)*log(fr_WUN/fr_YFD)
                       - (1-fr_beta)*log(fr_CCR)
                       - (1-fr_beta)*(fr_gamma*fr_TIME)
                       + (1-fr_beta)*log(fr_beta/(1-fr_beta))
                       + fr_kstar.cst*fr_ONES
                       + fr_kstar.time961*fr_TIME961
                   + fr_iprstar.cst
                   + fr_iprstar.time1*fr_TIME1 ),

fr_IPR:      del(log(fr_IPR)) =  fr_ipr.cst
                 + fr_ipr.ecm*log(fr_IPR(-1)/fr_IPRSTAR(-1))
                 + fr_ipr.ipr1*del(log(fr_IPR(-1)))
                 + fr_ipr.yer*del(log(fr_YER))
                 + fr_ipr.yer1*del(log(fr_YER(-1)))
                 + fr_ipr.dumt0001*fr_DUMT0001
                 + fr_ipr.dumt951*fr_DUMT951
                 + res_fr_ipr,
```

REAL EXPORTS

```
fr_XTRSTAR:   fr_XTRSTAR      = exp( + fr_xtrstar.cst
                                 + fr_xtrstar.wdr*log(fr_WDR)
                                 + fr_xtrstar.xtd*log(fr_XTD)
                                 + fr_xtrstar.cxd*log(fr_CXD)
                                 + fr_xtrstar.time1*fr_TIME1 ),

fr_XTR:       del(log(fr_XTR)) =  fr_xtr.cst
                             + fr_xtr.ecm*log(fr_XTR(-1)/fr_XTRSTAR(-1))
                             + fr_xtr.xtr1*del(log(fr_XTR(-1)))
                             + fr_xtr.wdr*del(log(fr_WDR))
                             + fr_xtr.wdr1*del(log(fr_WDR(-1)))
                             + fr_xtr.comp*del(log(fr_XTD/fr_CXD))
                             + fr_xtr.comp1*del(log(fr_XTD(-1)/fr_CXD(-1)))
                             + res_fr_xtr,
```

REAL IMPORTS

```
fr_MTRSTAR:   fr_MTRSTAR      = exp( + fr_mtrstar.cst
                                 + log(fr_WER)
                                 + fr_mtrstar.mtd*log(fr_MTD)
                                 + fr_mtrstar.yfd*log(fr_YFD) ),


fr_MTR:       del(log(fr_MTR)) =  fr_mtr.cst
                             + fr_mtr.ecm*log(fr_MTR(-4)/fr_MTRSTAR(-4))
                             + fr_mtr.mtr1*del(log(fr_MTR(-1)))
                             + fr_mtr.wer*del(log(fr_WER))
                             + fr_mtr.wer1*del(log(fr_WER(-1)))
                             + fr_mtr.comp4*del(log(fr_MTD(-4)/fr_YFD(-4)))
                             + fr_mtr.dumt951*fr_DUMT951
                             + res_fr_mtr,
```

TOTAL EMPLOYMENT

```
fr_LSTAR:     fr_LSTAR        = exp( + log(fr_YER)/(1-fr_beta)
                                 - log(fr_alpha)/(1-fr_beta)
                                 - fr_beta*log(fr_KSR)/(1-fr_beta)
                                 - fr_gamma*fr_TIME
                                 + fr_lstar.cst*fr_ONES
                                 + fr_lstar.time1*fr_TIME1 ),

fr_LNN:       del(log(fr_LNN)) =  fr_demo-(fr_lnn.yer+fr_lnn.yer1+fr_lnn.yer2)*(fr_demo+fr_gamma)-fr_lnn.rwun3*fr_gamma
                             + (fr_lnn.cst-(fr_demo-(fr_lnn.yer+fr_lnn.yer1+fr_lnn.yer2)*(fr_demo+fr_gamma)-
fr_lnn.rwun3*fr_gamma))*fr_ONES
                             + fr_lnn.ecm*log(fr_LNN(-1)/fr_LSTAR(-1))
                             + fr_lnn.yer*del(log(fr_YER))
                             + fr_lnn.yer1*del(log(fr_YER(-1)))
                             + fr_lnn.yer2*del(log(fr_YER(-2)))
                             + fr_lnn.rwun3*del(log(fr_WUN(-3)/fr_YFD(-3)))
                             + fr_lnn.dumt951*fr_DUMT951
                             + res_fr_lnn,
```

TOTAL LABOUR FORCE

```
fr_LFNSTAR:   fr_LFNSTAR     = exp( + fr_lfnstar.cst
                              + fr_lfnstar.lfn1*log(fr_LFN(-1))
                              + fr_lfnstar.lfn2*log(fr_LFN(-2))
                              + fr_lfnstar.lfn3*log(fr_LFN(-3))
                              + fr_lfnstar.lfn4*log(fr_LFN(-4))
                              + fr_lfnstar.time*fr_TIME ),

fr_LFN:       del(log(fr_LFN)) =  fr_lfn.cst
                          + fr_lfn.ecm*log(fr_LFN(-1)/fr_LFNSTAR(-1))
                          + fr_lfn.lfn1*del(log(fr_LFN(-1)))
                          + fr_lfn.lfn2*del(log(fr_LFN(-2)))
                          + fr_lfn.urx1*(log(fr_URX(-1)/100)- log(fr_nairu))
                          + fr_lfn.dumq1*fr_DUMMYQ1
                          + fr_lfn.dumq2*fr_DUMMYQ2
                          + fr_lfn.dumq3*fr_DUMMYQ3
                          + fr_lfn.dumt951*fr_DUMT951
                          + res_fr_lfn,
```

REAL INVENTORIES

```
fr_SCRSTAR:   fr_SCRSTAR     = fr_scrstar.yer*fr_YER,

fr_SCR:       del(fr_SCR/fr_YER) =  fr_scryer.cst
                           + fr_scryer.ecm*( (fr_SCR(-3)-fr_SCRSTAR(-3))/fr_YER(-3) )
                           + fr_scryer.scryer1*del(fr_SCR(-1)/fr_YER(-1))
                           + fr_scryer.scryer2*del(fr_SCR(-2)/fr_YER(-2))
                           + fr_scryer.scryer3*del(fr_SCR(-3)/fr_YER(-3))
                           + fr_scryer.dumq1*fr_DUMMYQ1
                           + fr_scryer.dumq2*fr_DUMMYQ2
                           + fr_scryer.dumq3*fr_DUMMYQ3
                           + fr_scryer.dumt951*fr_DUMT951
                           + res_fr_scr,
```

ACCOUNTING RELATIONSHIPS

```
fr_EXR:       fr_EXR  = fr_ZEXR + res_fr_exr,

fr_EXR_in:    fr_EXR_in  = fr_ZEXR + res_fr_exr_in,

fr_EXR_ex:    fr_EXR_ex  = fr_ZEXR + res_fr_exr_ex,

fr_INFQ:      fr_INFQ = 100*(fr_PCD/fr_PCD(-1)-1) + res_fr_INFQ,

fr_INFA:      fr_INFA = 100*(fr_PCD/fr_PCD(-4)-1)/4 + res_fr_INFA,

fr_POIL:      fr_POIL = fr_POILU*fr_EXR_ex + res_fr_poil,

fr_CMD:       fr_CMD  = fr_CMD_in*fr_CMD_ex + res_fr_CMD,

fr_CXD:       fr_CXD  = fr_CXD_in*fr_CXD_ex + res_fr_CXD,

fr_WDR:       fr_WDR  = fr_WDR_in*fr_WDR_ex + res_fr_WDR,

fr_CXUD:      fr_CXUD = fr_CXUD_in*fr_CXUD_ex + res_fr_CXUD,

fr_CXDIN:     fr_CXD_IN = fr_CXUD_in*(fr_EXR_in**fr_betain) + res_fr_CXD_IN,

fr_CXDEX:     fr_CXD_EX = fr_CXUD_ex*(fr_EXR_ex**fr_betaex) + res_fr_CXD_EX,
```

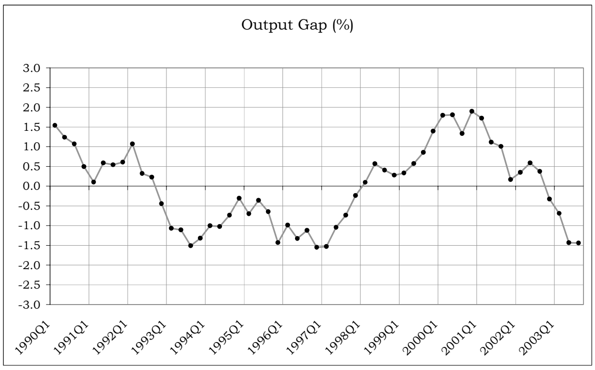
```
fr_CMUD:    fr_CMUD = fr_CMUD_in*fr_CMUD_ex + res_fr_CMUD,
fr_CMDIN:   fr_CMD_IN = fr_CMUD_in*(fr_EXR_in**fr_m2in) + res_fr_CMD_IN,
fr_CMDEX:   fr_CMD_EX = fr_CMUD_ex*(fr_EXR_ex**fr_m2ex) + res_fr_CMD_EX,
fr_EEN0:    fr_EEN0 = fr_EEN0_in*fr_EEN0_ex + res_fr_EEN0,
fr_EEN:     fr_EEN  = fr_EEN_in*fr_EEN_ex + res_fr_EEN,
fr_OID:     fr_OID  = fr_OIP*(1-fr_TIIR)/(1-fr_TII) + res_fr_oid,
fr_GCD:     fr_GCD  = fr_GCP*(1-fr_TGIR)/(1-fr_TGI) + res_fr_gcd,
fr_GID:     fr_GID  = fr_GIP*(1-fr_TIIR)/(1-fr_TII) + res_fr_gid,
fr_YED:     fr_YED  = fr_YEN/fr_YER + res_fr_yed,
fr_ITD:     fr_ITD  = fr_ITN/fr_ITR + res_fr_itd,
fr_PCP:     fr_PCD  = fr_PCP*(1-fr_TCIR)/(1-fr_TCI) + res_fr_pcp,
fr_HEX:     fr_HEX  = fr_HEXP*(1-fr_TCIR)/(1-fr_TCI) + res_fr_hex,
fr_HIC:     fr_HIC  = fr_WE*fr_HEG + (1-fr_WE)*fr_HEX + fr_ZHIC + res_fr_hic,
fr_OIN:     fr_OIN  = fr_OID*fr_OIR + res_fr_oin,
fr_GIN:     fr_GIN  = fr_GID*fr_GIR + res_fr_gin,
fr_ITN:     fr_ITN  = fr_OIN + fr_GIN + res_fr_itn,
fr_PCN:     fr_PCN  = fr_PCD*fr_PCR + res_fr_pcn,
fr_GCN:     fr_GCN  = fr_GCD*fr_GCR + res_fr_gcn,
fr_XTN:     fr_XTN  = fr_XTD*fr_XTR + res_fr_xtn,
fr_MTN:     fr_MTN  = fr_MTD*fr_MTR + res_fr_mtn,
fr_YFN:     fr_YFN  = fr_YFD*fr_YFR + res_fr_yfn,
fr_YEN:     fr_YEN  = fr_YFN + fr_TIN + res_fr_yen,
fr_ITR:     fr_ITR  = fr_IHR + fr_IPR + fr_GIR + res_fr_itr,
fr_OIR:     fr_OIR  = fr_IPR + fr_IHR + res_fr_oir,
fr_YFR:     fr_YFR  = fr_YER - fr_TIR + res_fr_yfr,
fr_MKUP:    fr_MKUP = 100*(1-fr_WIN/fr_YFN) + res_fr_mkup,
fr_SZD:     fr_SZD  = fr_SZN/(fr_ZER + fr_SCR) + res_fr_szd,
fr_UNN:     fr_UNN  = fr_LFN - fr_LNN + res_fr_unn,
fr_URX:     fr_URX  = 100*fr_UNN/fr_LFN + res_fr_urx,
fr_PYR:     fr_PYR  = fr_PYN/fr_PCD + res_fr_pyr,
fr_KGR:     fr_KGR  = fr_GIR + (1-fr_depkgr)*fr_KGR(-1) + res_fr_KGR,
fr_KPR:     fr_KPR  = fr_IPR + (1-fr_depkpr)*fr_KPR(-1) + res_fr_KPR,
```

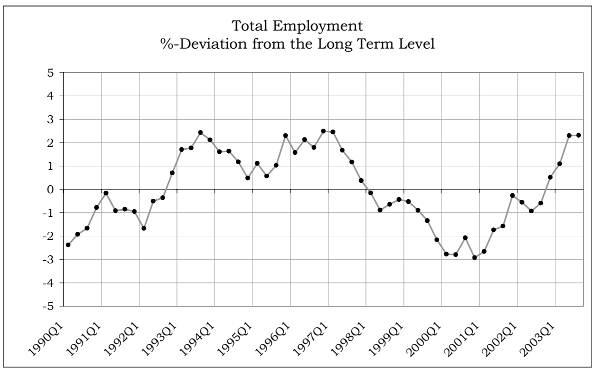
```
fr_KSR:     fr_KSR  = fr_ITR + (1-fr_depksr)*fr_KSR(-1) + res_fr_KSR,
fr_KHR:     fr_KHR  = fr_KSR - fr_KPR + fr_KGR + res_fr_KHR,
fr_FWN:     fr_FWN  = fr_OID*fr_KPR(-1) + fr_IHD*fr_KHR(-1) + fr_GDN(-1) + fr_NFA(-1) + res_fr_fwn,
fr_FWR:     fr_FWR  = fr_FWN/fr_PCD + res_fr_FWR,
fr_FWRH:    fr_FWRH = fr_FWR + res_fr_FWRH,
fr_SALE:    fr_SALE = fr_PCR + fr_XTR + fr_ITR + res_fr_SALE,
fr_YER:     fr_YER  = fr_PCR + fr_GCR + fr_ITR + fr_SCR + fr_XTR - fr_MTR + fr_ZER + res_fr_YER,
fr_SZN:     fr_SZN  = fr_YEN - fr_PCN - fr_GCN - fr_ITN - fr_XTN + fr_MTN + res_fr_SZN,
fr_LEN:     fr_LEN  = fr_LEX*fr_LNN + res_fr_LEN,
fr_PRO:     fr_PRO  = fr_YER / fr_LNN + res_fr_PRO,
fr_WIN:     fr_WIN  = fr_WUN*fr_LNN + res_fr_WIN,
fr_CEX:     fr_CEX  = fr_WUN*fr_LNN/fr_LEN + res_fr_CEX,
fr_ULA:     fr_ULA  = fr_WUN/fr_PRO + res_fr_ula,
fr_WUG:     fr_WUG  = fr_WUN + res_fr_wug,
fr_GON:     fr_GON  = fr_YEN - fr_WIN - fr_TIN + fr_ZIN + res_fr_gon,
fr_PYN:     fr_PYN  = fr_WIN + fr_OPN + fr_TRN - fr_PDN + res_fr_pyn,
fr_PSN:     fr_PSN  = fr_PYN - fr_PCN + res_fr_psn,
fr_GYN:     fr_GYN  = fr_PDN + fr_ODN + fr_TIN + fr_OGN - fr_TRN - fr_INN + res_fr_gyn,
fr_PDNB:    fr_PDNB = (1+fr_pdnb.win)*fr_WIN + fr_TRN + fr_OPN + res_fr_pdnb,
fr_INN:     fr_INN  =  (1/400)*fr_STI*fr_GDN(-1) + fr_ZINN + res_fr_inn ,
fr_GSN:     fr_GSN  = fr_GYN - fr_GCN + res_fr_gsn,
fr_GLN:     fr_GLN  = fr_GSN - fr_GIN + res_fr_gln,
fr_GDN:     fr_GDN  = fr_GDN(-1) - fr_GLN + fr_ZGDN + res_fr_gdn,
fr_ODNB:    fr_ODNB =  fr_GON - 0.01*fr_ITD*fr_KSR(-1) + res_fr_odnb,
fr_OLN:     fr_OLN  = fr_CAN - fr_PSN - fr_GLN + fr_IHN + res_fr_oln,
fr_BTN:     fr_BTN  = fr_XTN - fr_MTN + res_fr_btn,
fr_CAN:     fr_CAN  = fr_XTN - fr_MTN + fr_NFN + fr_TWN + fr_ZCAN + res_fr_can,
fr_NFN:     fr_NFN  = (1/400)*fr_STI*fr_NFA(-1) + fr_ZNFN + res_fr_nfn,
fr_NFA:     fr_NFA  = fr_NFA(-1) + fr_CAN + fr_ZNFA + res_fr_nfa,
fr_OYN:     fr_OYN  = fr_GON + fr_TWN + fr_NFN + fr_INN - fr_ODN - fr_OPN - fr_OGN + res_fr_oyn,
fr_PLN:     fr_PLN  = fr_PSN - fr_IHN + res_fr_pln,
fr_TRN:     fr_TRN  = fr_TRX*fr_YEN + res_fr_trn,
```

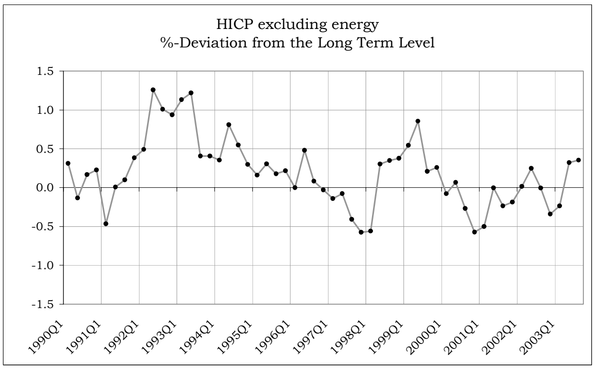
```
fr_OPN:    fr_OPN = fr_dfor*fr_OPX*fr_YEN + (1-fr_dfor)*fr_ZOPX*fr_GON + res_fr_opn,

fr_WER:    fr_WER = + fr_wer.pcr*fr_PCR
              + fr_wer.gcr*fr_GCR
              + fr_wer.itr*fr_ITR
              + fr_wer.xtr*fr_XTR
              + fr_wer.scr*fr_SCR
              + res_fr_wer,

fr_IHN:    fr_IHN = fr_IHR*fr_IHD + res_fr_ihn,

fr_TIN:    fr_TIN = + fr_TII*fr_OIR*fr_OID
              + fr_TII*fr_GIR*fr_GID
              + fr_TCI*fr_PCR*fr_PCD
              + fr_TGI*fr_GCR*fr_GCD
              + res_fr_tin,

fr_TIR:    fr_TIR = + fr_TIIR*fr_OIR
              + fr_TIIR*fr_GIR
              + fr_TCIR*fr_PCR
              + fr_TGIR*fr_GCR
              + res_fr_tir,
```

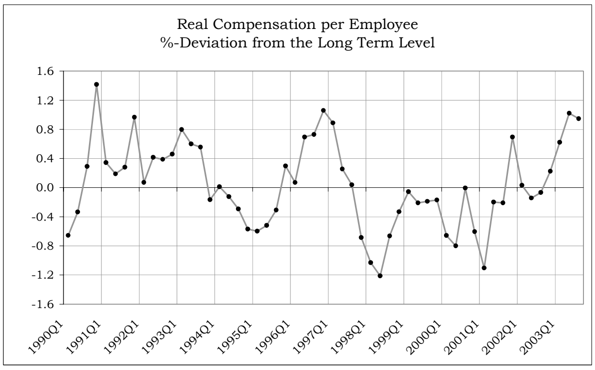
7.4 Some Selected Error Correction Terms.

The charts below show some of the error correction terms (adjusted with the *ad hoc* deterministic trends) present in the short run dynamic equations. All the error correction terms are mean-stationary over the sample period (1980Q1-2003Q3). The logarithm of the output gap, as defined by relation (3.1) is similar with the one computed by Baghli et al. (2004).






HICP excluding energy
%-Deviation from the Long Term Level
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1
2003Q1


Real Compensation per Employee
%-Deviation from the Long Term Level
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1
2003Q1

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