# DOCUMENT
# DE TRAVAIL
# N° 262

## FORECASTING INFLATION IN FRANCE

Claire CÉLÉRIER

December 2009

BANQUE DE FRANCE

EUROSYSTÈME

DIRECTION GÉNÉRALE DES ÉTUDES ET DES RELATIONS INTERNATIONALES

DIRECTION GÉNÉRALE DES ÉTUDES ET DES RELATIONS INTERNATIONALES

# FORECASTING INFLATION IN FRANCE

Claire CÉLÉRIER

December 2009

# Forecasting inflation in France*

Claire Célérier†

December 2009

*The views expressed here are those of the author and do not necessarily reflect those of the Banque de France. Comments by V. Chauvin, O. De Bandt and J.P. Villetelle as well as S. Ginefri's contribution are gratefully acknowledged.

†Banque de France, DGEI, DCPM-SEMAP, email: claire.celerier@banque-france.fr

**Abstract**

The paper develops a model for forecasting inflation in France. As this model has to be integrated in the Eurosystem projection exercises, the projections are conditional to specific assumptions and must be consistent with the Macroeconomic projection exercise of the Banque de France. The specification of the model is thus highly constrained. The theoretical foundations of the model are based on the markup model for prices, but the resulting empirical model also has elements relating to the purchasing power parity and the Phillips curve. The model aggregates forecasts of the main HICP subcomponents. We show that the model exhibits better performance than a standard AR(4) model.



*Keywords*: Inflation, Out-of-sample forecast, Economic modelling

*JEL codes*: C52, C53, E37



**Résumé**

Cet article présente un modéle de prévision d'inflation pour la France. Ce modèle ayant vocation à être intégré au sein de l'exercice de prévisions macroéconomiques de l'Eurosytème, il a été développé dans un cadre contraint. Ainsi, les prévisions dépendent d'hypothèses spécifiques et doivent être en ligne avec l'exercice de prévisions macro-économiques de la Banque de France. Par ailleurs, l'approche empirique a été priviligiée à une stricte application des modèles théoriques. Le modèle s'inspire initialement du modèle de mark-up de formation des prix, mais la maquette finale est également en lien avec la théorie de parité du pouvoir d'achat et la courbe de Phillips. Ce modèle présente de meilleures performances qu'un simple modèle autorégressif.



*Mots clés*: Inflation, Prévisions hors échantillon, Modélisation économique

*Codes JEL*: C52, C53, E37

# 1 Introduction

Structural changes such as the euro changeover, new regulations, and econometric considerations lead us to reestimate the Banque de France model for forecasting inflation in France (model described in Jondeau, Le Bihan & Sédillot (1999)).

This article develops a model which fits three criteria. First, this model must be used for the Eurosystem projection exercises, which takes place four times a year. This constraints the specification of the model: the projections are conditional to common assumptions shared by the National Central Banks of the Eurosystem and the European Central Bank (ECB), and the forecast exercise must be consistent with the Macroeconomic projections of the Banque de France. Second, we offer a conceptual framework in order to estimate a semi-structural model. The aim is to understand better the behaviour of inflation using standard economic theory. Third, our model has to provide good forecasting performances. Conciliating data adequacy and theory consistency was a challenge.

In the medium run (18 months), the overall price index (HICP) is divided into five components: industrial goods, services, processed food, unprocessed food and energy. The industrial goods, services and processed food HICP are modelled with a single equation error correction model (ECM). The theoretical foundations of these equations are based on the markup model for prices, but the resulting empirical models also have elements relating to purchasing power parity and the Phillips curve. The energy HICP and the unprocessed food HICP are modelled in a more disaggregated approach. In order to improve the inclusion of specific information, a modelling approach based on disaggregated time series models (52) is specified in the short run (3 months).

Section 2 develops the institutional framework in which our model is used and the constraints it induces. The theoretical foundations of the structural model are exposed in Section 3. Section 4 describes the econometric strategy. Section 5 analyzes the properties of the data. The equations are described in section 6 and section 7 presents the forecasting performance of the model. The specific short run approach is detailed in section 8. Section 9 concludes.

OVERVIEW OF THE MODEL

The overall structure of the model is as follows:

1. In the short run, the overall HICP is disaggregated into 52 components
2. In the medium run, the overall HICP is disaggregated into six main components: UNPFOOD, PFOODXT, IGXE, PSER, ENRGY and ADM HICP

With:
$UNPFOODHICP$= Unprocessed food HICP
$PFOODXTHICP$= Processed food excluding tobacco HICP
$IGXEHICP$= Industrial Good excluding energy HICP
$PSERHICP$= Private services HICP
$ENRGYHICP$= Energy HICP
$ADMHICP$= Administered prices which are communication, transport and tobacco prices

1. In the short run, the 52 subcomponents are mainly forecast with ARIMA and high frequency information is included
2. In the long run, the non volatile HICP components are forecast as a function of cost and fluctuation indicators.

The PFOOXT HICP (10% of overall HICP)
$\Delta \log P_t = f(FOODEURO, PPRODXE, U)$

The IGXE HICP (31% of overall HICP)
$\Delta \log P_t = f(PPRODXE, U)$

The PSER HICP (35% of overall HICP)
$\Delta \log P_t = f(ULC, U)$

Where:
$P_t$=The relevant endogenous variable
$PPRODXE$=Production Prices excluding energy (whole economy)
$FOODEURO$=International food prices in Euro
$U$=Unemployment
$ULC$=Unit Labor Cost

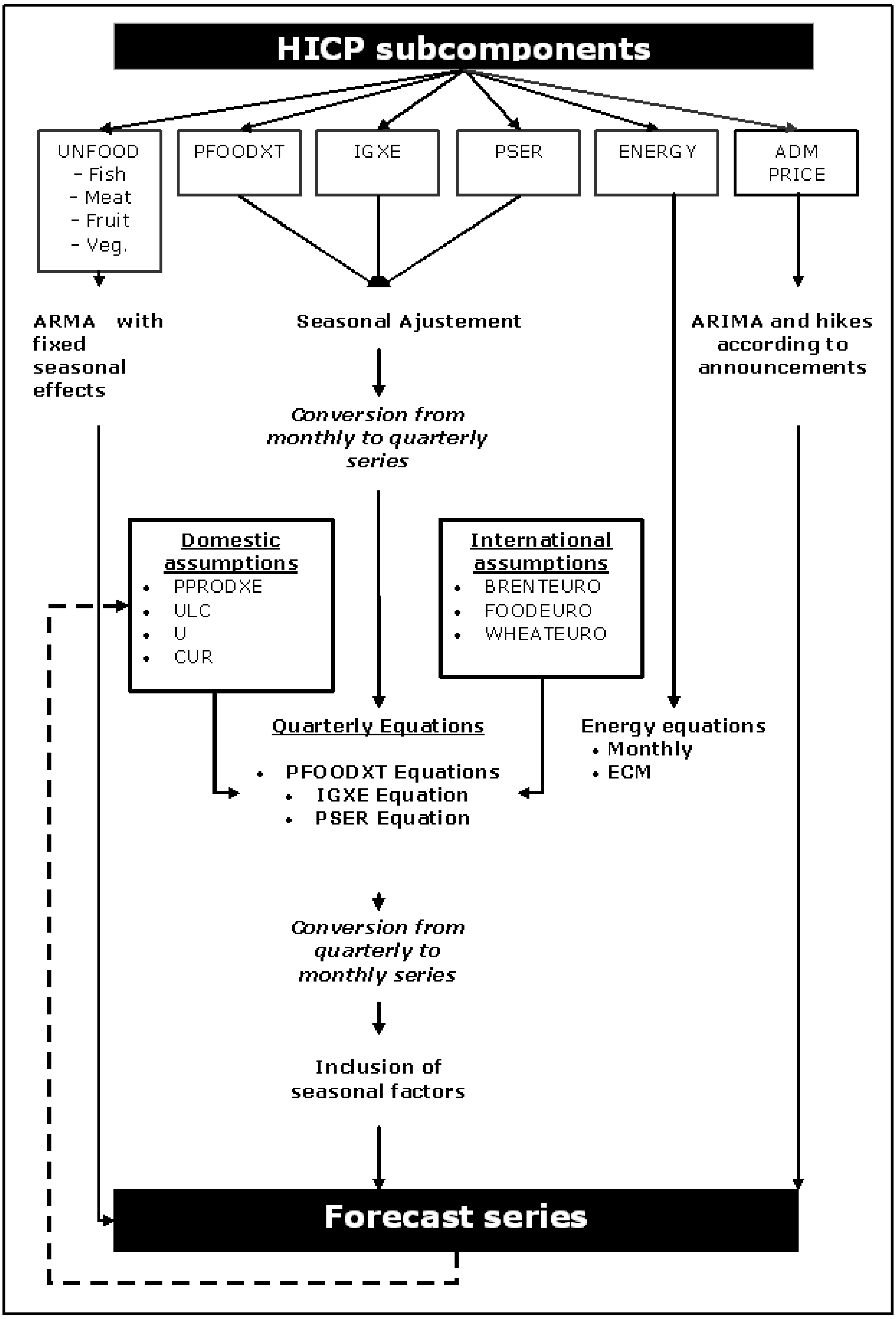


Figure 1: *General Overview of the model*

# 2 The institutional framework

This section describes the institutional framework in which the projections are produced. The Banque de France inflation projection exercise is integrated in first, the Eurosystem projection exercise, and second, the Banque de France macroeconomic projection exercise. This induces constraints on both the explanatory variables and the projection figures.

## 2.1 Setting the explanatory variables

The model we develop here is used four times a year within the Eurosystem inflation projection exercises, which involves all the National Central Banks of the Eurosystem. These projections, "(...) play an important role within the economic analysis in the ECB's monetary policy strategy as a tool for aggregating and organising existing information on current and future economic developments" (ECB 2001). In order to be integrated in an overall euro area framework they must be consistent with other euro area country projections. As a result, a set of common assumptions is agreed and shared by the National Central Banks and the ECB. This set of assumptions concerns the international environment covering Brent prices, international food prices, international raw material prices and the exchange rate.
In parallel, an iterative process aims at making consistent the inflation forecast and the Banque de France macroeconomic projections for France, which include the projection of the National Account deflators, specially the consumption deflator. Hence, forecast domestic assumptions come from the Baghli et al. (2004)'s macroeconomic model Mascotte for the French economy and, at a given stage, the inflation projections are integrated in.

## 2.2 Deriving the projection figures

Because the projection figures must be provided to the ECB and aggregated with other National Central Bank projections, the format is standardised. It determines the forecast horizon, the level of aggregation and the data frequency. First, the forecast horizon is up to 18 months. Second, the overall HICP must be divided into 5 main components: the industrial good excluding energy, the service, the processed food, the unprocessed food and the energy HICP. Finally, the projection must be monthly data, which has induced some frequency adjustments we describe below.

This institutional framework highly constrains the specification of the model. It gives the priority to predictive performance and data adequacy. It also requires a structural model using macroeconomic indicators. In this context, we consider a mark-up model for prices as a relevant theoretical structure.

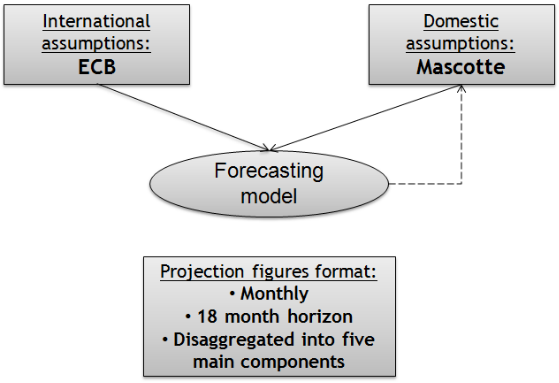


Figure 2: *The institutional constraints of the forecasting model*

# 3 The theoretical framework

Specifying, estimating and testing a model strictly and fully founded from a theoretical view point is beyond the scope of this paper. Nevertheless, a theoretical background is required in order to propose a sound specification, to give some hints as regards the choice of the explanatory variables and to provide some suggestions about possible constraints on the coefficients.
Given the constraints we have described above, the structure of the model we have decided to refer to is based on the so called mark-up model, which has a long tradition in empirical work starting from Eckstein and Fromm (1968). We first describe how the prices of home produced consumer goods and services are formed. Second, because final consumption also includes imported consumer goods and services, we discuss the relevance of introducing import prices. Finally, we give some hints on how the mark-up model can be augmented with additional variables.

## 3.1 A mark-up model for home produced good and service prices

In an imperfect competition environment, a firm $i$ determines its market share $Y_i/Y$ by setting its price $P_i$ relatively to the average price of its competitors price $P$ on the basis of the demand function it faces, supposed to exhibit a price elasticity $\epsilon$ ($\epsilon > 1$) with respect to the relative price $P_i/P$:

$$P_i = P * \left(\frac{Y}{Y_i}\right)^{\frac{1}{\epsilon}}$$

The profit maximizing condition implies that, in equilibrium, the marginal revenue equals the marginal cost $C_{m_i}$. The firm's revenue being $R_i = P_i * Y_i$, its marginal revenue is:

$$\frac{dR_i}{dY_i} = \frac{dP_i}{dY_i} * Y_i + P_i$$

$$= P_i(1 - \frac{1}{\epsilon})$$

The equilibrium condition for the firm can hence be written:

$$P_i = (1 + \frac{1}{\epsilon - 1}) * C_{m_i}$$

In the symmetric equilibrium, this leads in the aggregate to the fundamental equation:

$$P = (1 + \mu) * C_m \tag{1}$$

The price level is thus defined by a mark-up $\mu$ over the marginal cost, with $\mu = \frac{1}{\epsilon-1}$

In a Cobb-Douglas framework, where the aggregate production function could be described by:

$$Y = AK^{\beta}(\Gamma N)^{1-\beta} \tag{2}$$

$\Gamma$ denoting the labour productivity, it can be shown that the cost function has the form:

$$C(Y) = \frac{Y}{A}(\frac{\rho}{\beta})^{\beta}(\frac{w}{(1-\beta)\Gamma})^{1-\beta} \tag{3}$$

$w$ and $\rho$ being respectively the labour and cost of capital per unit. In that case, the log of equation (1) gives:

$$\ln(P) = \ln(1 + \mu) + \beta \ln(\rho) + (1 - \beta)\ln(\frac{w}{\Gamma}) + a \tag{4}$$

with $a = -\beta \ln \beta - (1 - \beta)\ln(1 - \beta) - \ln(A)$

From a statistical view point, equation (4) can be seen as the relationship that has to hold in the long run and that could be used as the error correction term in an error correction framework.

## 3.2 The role of imported good and service prices

The previous paragraph relates to the formation of domestic prices. Final consumption $C$ is made of home produced $(Y)$ and imported $(M)$ consumer goods and services, respectively at price $P_c$, $P$ and $P_M$. This leads to the accounting relationship:

$$P_c = (1 - \alpha) * P + \alpha * P_M \tag{5}$$

with $\alpha = \frac{M}{C}$, the share in volume of imported goods and services in total consumption. Log-linearising (6) gives:

$$\ln P_c = (1 - \lambda)\ln P + \lambda * \ln P_M + \delta \tag{6}$$

with $\lambda = \frac{P_M * M}{P_C * C}$, the share in value of imported goods and services in total consumption.

This feature is important to keep in mind since, if substantial, a price shock can lead to a distortion in these shares and lead to an apparent instability of the specification if $\lambda$ was supposed to be fixed. More generally, for a given structure of consumption in volumes, the relative impact on the aggregate of a price shock on one of these components is not the same depending on the price level.
Finally, regarding consumption price indexes, most equations in empirical work are a reduced form of (4) and (6):

$$\ln P_c = \theta_0 * \ln(1+\mu) + \theta_1 * \ln(\rho) + \theta_2 * \ln(\frac{w}{\Gamma}) + \theta_3 * \ln(P_M) + \theta \tag{7}$$

with:

$$\theta_0 = (1-\lambda)$$
$$\theta_1 = (1-\lambda) * \beta$$
$$\theta_2 = (1-\lambda) * (1-\beta)$$
$$\theta_3 = \lambda$$
$$\theta = \delta + a * (1-\lambda)$$

From these constraints, it can be seen that $\theta_1 + \theta_2 + \theta_3 = 1$, which represents a static homogeneity condition.

The empirical work usually elaborates on the basis of this specification, adopting an eclectic approach regarding the choice of the explanatory variables, the possible sources (or the absence) of fluctuations during the business cycle in some key variables, like the mark-up (Britton, Larsen, Small (2000)) or the labour productivity $\Gamma$, and also the changes in regulations that could be at the root of some changes in competition, leading to a structural change in the mark-up .

## 3.3 From the mark up model to the empirical price equations: the choice of explanatory variables and indicators of fluctuations

The explanatory variables in the various equations of the model we propose depend on the sector. The unit labour cost (ULC, denoted by $w/\Gamma$ in equation (4)) is the corner stone of this type of equation. On the contrary, the cost of capital is usually difficult to identify, especially for forecasting in the short to medium term. But other variables can be of interest, especially in a sectoral framework since in some sectors, the price of intermediate goods (such as agricultural producer prices (PAG) in the model) or import prices appear to have an important role. Production Prices excluding energy (PPRODXE) can stand both for ULC and hard raw material import prices excluding energy. Finally, when stable, the mark-up cannot be identified, since a constant is also present in the equation.

It is also common practice to introduce variables such as the capacity utilisation rate (CUR) and/or the unemployment rate (U) in this type of equations. Several interpretations for the presence of these additional variables exist. First, some sectors can be highly competitive, in which case the price dynamics adjusts as a function of the discrepancy between supply and demand: the CUR can be a proxy for a measure of disequilibrium between supply and demand. For the other sectors, the CUR can also be an indicator of fluctuations in the mark-up. In those cases a positive link is expected between prices and the CUR once we assume that the markup is procyclical. Regarding the unemployment rate U, besides its behaviour over the business cycle, in which case the choice between this variable and the CUR in the equation would only be an empirical matter, it could also measure a source of costs of adjustment, due to rigidities in the labour market, not fully reflected by the labour cost variable. In those cases a negative link is expected between prices and U, in line with the Phillips curve.

Concerning imported goods, we consider the inclusion of import prices and the prices of imported goods excluding energy. Ciccarelli and Mojon (2005) demonstrate that the common factor of inflation in 22 of OECD coutries has strong predictive performance for the French HICP.

As a conclusion, in an error equation framework, the long run relationship could be:

$$\ln P_c = \sum \theta_i * \ln(P_i) + \theta_{i+1} * \ln(\frac{w}{\Gamma}) + \theta \tag{8}$$

$P_i$ denoting different variables depending on the sector and the empirical significance: Unit Labor Costs (ULC), Producer Prices Excluding Energy (PPRODXE), Agricultural Prices (PAG)... Concerning the short run relationship, the CUR or U could be indicators of business cycle fluctuations.

# 4 The econometric strategy

As we have seen before, the institutional framework not only constrains the theoretical framework but also the econometric strategy, concerning the level of aggregation for example. Our econometric strategy both aims at improving the predictive performance of the model and leads to an easy-to-handle projection tool. This section deals with the main features of the econometric strategy: the level of aggregation, the specification of the equations and the explanatory variables.

## 4.1 The level of aggregation

The debate about aggregation versus disaggregation in economic modeling is summarized in Hendry and Hubrich (2007). There are three arguments for aggregating forecast components rather than forecasting an aggregated index. The first one is that each disaggregated variable has its own determinants and dynamic properties. The second one is that forecast errors could cancel out. Finally, it allows including detailed information available in the short run. On the opposite, forecasting an aggregated index may improve the estimation of diffusion effects. Moreover, since the model for the disaggregate variables will in practice not be perfectly specified, the aggregate model would not reduce the forecast performance. Then, it is more likely to fit theory. Finally, from a practical point of view it is easier when producing forecasts to handle a model with few equations and to justify any judgmental corrections (residuals etc).

The comparison of a direct versus an indirect approach to forecast HICP in the medium-run has been explored in the literature: results depend on the type of model used and on the forecasting horizon (Hendry and Hubrich, 2007). Duarte and Rua (2007) find an inverse relationship between the forecast horizon and the amount of information underlying the forecast, when minimizing the Root Mean Square Forecast Error. Bruneau et al. (2006) show that for France it is better to use a model on the subcomponents of the overall index, i.e. the HICP excluding energy and unprocessed food, the unprocessed food index and the energy index, and to recompose the overall index, rather than forecast it directly. Concerning inflation excluding unprocessed food and energy prices, Hubrich (2003) demonstrates that it improves forecast accuracy to model the main components separately and then to aggregate them. Hendry and Hubrich (2007) show that including disaggregates helps forecasting the aggregate if the disaggregates follow different stochastic structures and are interdependent.

Our model is consistent with these results as we use a disaggregated model in the short run, which is described in Section 8, whereas our medium run model is more aggregated. It is also in line with the Eurosystem projection exercise requirements on the format of the projection figures. Thus, our model aggregates the forecast of the main components of the HICP: the processed and unprocessed food HICP, the manufactured goods HICP, the services HICP and the energy HICP. Because they are subject to particular dynamics, some components such as tobacco, combined transports and communications are modeled separately. Besides, the most volatile HICP components, energy and unprocessed food HICP, are disaggregated and their subcomponents are forecast separately. As a result, the components that we project with a structural model are exactly the private services HICP (PSER HICP), the manufactured goods HICP (IGXE HICP) and the processed food excluding tobacco HICP (PFOODXT HICP). They represent more than 70% of the overall HICP.

Table 1: *Components of the overall HICP modeled in the medium run*

| **Name** | **Weight (2009)** | **Model** |
|---|---|---|
| ***Underlying inflation*** | | |
| Processed food excluding tobacco | 10% | Error Correction Model |
| Tobacco | 2% | Hikes according to announcement |
| Industrial goods excluding energy | 31% | Error Correction Model |
| Private services | 35% | Error correction model |
| Transports and communication | 6% | ARMA with fixed seasonal effects |
| ***Volatile components*** | | |
| Unprocessed food | 8% | ARMA with fixed seasonal effects |
| Energy | 8% | Error Correction equations and hikes according to announcements (gaz and electricity) |

## 4.2 The specification of the model

Except for unprocessed food prices, energy prices, and some components subject to particular dynamics (tobacco, combined transports and communications) which represents only 22% of the overall HICP, the specification refers to the theoretical benchmark we have developed in section 1. Thus, on the basis of equation (8) which will act as an error correction term, and referring implicitly to adjustment costs and the role of expectations as a source of dynamics in economic variable, we will use a general specification of the form:

$$\phi(L)\Delta lnP_c = -\gamma[\ln(P_{C-1}) - \delta' z_{t-1}] + \theta(L)\Delta z_t + \eta_t \qquad (9)$$

$z_t$ represents $k$ explanatory variables that could be envisaged from the theoretical background presented above, $\phi(L)$ a scalar polynomial and $\theta(L)$ a vector of scalar polynomials.

Three general approaches are used for estimating dynamic equations such as (9) : single-equation regressions, in the two step procedure due to Engle and Granger, (1987), vector autoregressions, as formulated by Johansen (1988, 1995) and single-equation conditional error correction models, initially proposed by Phillips (1954) and further developed by Sargan (1964) and Ericsson and Mackinnon (2002). In our model we choose to use the method considered by Ericsson and Mackinnon (2002). Indeed, the other approaches are less appropriate. First, given the conditional nature of the forecast that has to be delivered, the multivariate framework formulated by Johansen is beyond the scope of the kind of model envisaged here. Second, in the conditional framework used here, the two step procedure proposed by Engle-Granger (1987) could have been envisaged, but this method is known to suffer from estimation bias with short samples and one way to reduce this bias is to consider the short term dynamics together with the long run relationship. Consequently, we will use the method considered by Ericsson and Mackinnon (2002) which amounts to develop the ECM term and estimate by ordinary least squares the equation:

$$\phi(L)\Delta lnP_c = -\gamma \ln(P_{C-1}) + \beta' z_{t-1} + \theta(L)\Delta z_t + \eta_t \qquad (10)$$

where $\beta' = \gamma * \delta'$.

## 4.3 The explanatory variables

In the structural model, in line with the conceptual framework described above, we consider three kinds of explanatory variables: cost indicators, tension indicators and import price indicators. These indicators are listed and described in Table 2. Concerning domestic assumptions they are taken from the National accounts when realised and the Mascotte model for forecast figures.

Table 2: *The explanatory variables*

| **Label** | **Name** | **Source** | **Frequency** | **Range** |
|---|---|---|---|---|
| *Cost variables* | | | | |
| $PPRODXE$ | Producer Prices excluding Energy | Mascotte | Quarterly | 1984q1 2007q2 |
| $ULC$ | Smoothed (with a trend productivity variable) Unit Labour Cost | Mascotte | Quarterly | 1984q1 2007q2 |
| $CUR$ | Capacity Utilization Rate | Mascotte | Quarterly | 1984q1 2007q2 |
| $U$ | Unemployment Rate | Mascotte | Quarterly | 1984q1 2007q2 |
| $PAG$ | Agricultural Prices | National Accounts | Quarterly | 1990q1 2007q2 |
| $FOODEURO$ | International food prices in euro | ECB | Monthly | 1997m1 2007m6 |
| $WHEATEURO$ | International wheat prices in euro | ECB | Monthly | 1997m1 2007m6 |
| *Fluctuation variables* | | | | |
| $CUR$ | Capacity Utilization Rate | Mascotte | Quarterly | 1984q1 2007q2 |
| $U$ | Unemployment Rate | Mascotte | Quarterly | 1984q1 2007q2 |
| $VAT$ | Standard Value Added Tax Rate | European Commission | Quarterly | 1984q1 2007q2 |
| *Import Prices variables* | | | | |
| $IMPP$ | Import Prices | Mascotte | Quarterly | 1984q1 2007q2 |
| $GXEIMPP$ | Good excluding energy import prices | Mascotte | Quarterly | 1984q1 2007q2 |

Because our HICP forecasts are integrated in the consumption deflator equation of the macroeconomic model Mascotte, domestic assumptions are not fully exogenous. Concerning international prices, we take their strong exogeneity as given, as domestic inflation should not impact international prices.

# 5 The data

This section describes the specificities of both the HICP data and the exogenous ones. First, HICP data have been built from the Eurostat HICP series and backdated to 1984. Second, since we favour specifications which make use of quarterly changes from one period to the next, rather than year-on-year changes, we describe how the HICP data are seasonally adjusted. Third, as most of the exogenous variables are quarterly data, the HICP components are also converted from monthly to quarterly data. Nevertheless, since the forecast series have to be presented in terms of a monthly profile, the quarterly results will need to be interpolated. This section briefly describes the conversion from quarterly to monthly data and the reasons for this frequency adjustment choice. Finally, it presents unit-root tests for all the variables of interest and demonstrates that they are integrated of order one, which induces to model the variation in prices.

## 5.1 Data origination

The industrial good excluding energy (IGXE), the private service (PSER) and the processed food excluding tobacco (PFOODXT) HICP series are provided by Eurostat. However, these series have only been computed since 1990 and even 1997 for the PFOODXT HICP. As a result we backdate them to 1984. For this purpose, we use the Laspeyres-chain INSEE National Price Indexes that exist on this sample.
We proceed in fourth steps. First, we compute basic "non chain" price indexes for each single included in the sectorial indexes PSER, IGXE or PFOODXT HICP using the Laspeyres-chain INSEE national price series. Second, for each year we aggregate the weight of these subindexes to obtain the total weight of each sector PSER, IGXE and PFOODXT HICP. Third, the weighted sum of the "non chain" sub-indexes gives the "non chain" sectorial indexes. Finally, we chain these "non chain" sectorial indexes and reevaluate them with base 100 in 1990.

## 5.2 Seasonal adjustment

Defining the seasonal pattern of the series is necessary to model the variation of the price index from one period to the next. Indeed, contrary to the explanatory variables, price indexes are not seasonally adjusted. Seasonal adjustment of the series is preferred to the inclusion of seasonal dummy variables which allows for less flexible adjustments as seasonal patterns have changed over the period. Concerning seasonal adjustment, we have chose to focus on Tramoseats seasonal adjustment method.

The series we have seasonally are the IGXE, PSER and PFOODXT HICP. Table 3 reports the sample seasonally adjusted and the outliers for each series.

Concerning unprocessed food prices, they are seasonally adjusted through fixed seasonal effects.

Table 3: *Seasonal adjustment of price series*

| **Price series** | **Sample** | **Outliers** |
|---|---|---|
| IGXE HICP | 1984-2007q2 | |
| PSER HICP | 1984-2007q2 | • Change in VAT in August 1995 and in April 2000 (level shifts) |
| PFOODXT HICP | 1990-2007q2 | • January 1997: transitional changes and level shifts due to the impact of the Galland and Raffarin laws,<br>• May 2002: Level shift due to the increase in international food prices,<br>• September 2004: Level shift due to the impact of the Sarkozy agreements,<br>• January and February 2007: Level shift and outliers because of the impact of the Chatel Law and of the increase in international food prices |

## 5.3 Temporal aggregation-disaggregation

As most of the explanatory variables are quarterly series, we face the problem of forecasting a monthly indicator with quarterly variables. We have two possibilities: either we convert our monthly price series into quarterly series and we model quarter-on-quarter changes in prices, or we interpolate the explanatory variables into monthly series and model month-on-month changes in prices. Because the second method would imply introducing a noise and not a genuine information on the explanatory variables, we decide to model quarter-on-quarter changes in prices. A third possibility could also be contemplated in the perspective of modeling month-on-month change in prices. Indeed, the recent literature has focused on state-space models estimated with extended Kalman Filter. However, as our model must be easy to handle, this kind of models does not seem applicable.

In order to convert monthly price series into quarterly price series, two methods are considered: the quarterly value is either one of the values of the quarter or the quarterly average. Chauvin and Devulder (2007) show that taking the last value of the quarter possibly leads to a systematic bias. This may be due to the fact that averaging observations over the quarters gives more robustness to the results, as the impact of exceptional evolution in one month is divided by 3 and may even be compensated for by the evolution observed in the months that are not the last one of a quarter. As a result, the quarterly value is the quarterly average.

Once the quarterly values of the HICP components are projected, they have to be converted into monthly data. Different techniques of temporal disaggregation have been developed in the literature. We can distinguish two kinds of procedures: procedures without indicators and procedures with indicators. Procedures using indicators estimate the high frequency series on the basis of high frequency information on logically or economically related variables (Di Fonzo, 2003). The most standard approaches of this procedure have been developed in Chow-Lin (1971), Fernandez (1981), Litterman (1983) and more recently Di Fonzo (2003). The problem is that we are in a forecasting context, which invalidates the relevance of such procedures, as we have not the forecast of the indicators. As a result, we are only interested in procedures without indicators. Among these are the time series procedures using an ARIMA model (Al-Osh, 1989; Wei and Stram, 1990). As Di Fonzo (2003) explains, these procedures require high computational resources and an active role of the user, which is not relevant given that our model must be an easy-to-handle forecasting tool. As a result, we only consider smoothing procedures. We distinguish two of them: the "quadratic match average method" and the Boot et al. (1967)'s one. The "quadratic match average method" fits a local quadratic polynomial for each observation of the quarterly series, then uses this polynomial to fill in all observations of the monthly series so that the average of the monthly data matches the quarterly data. The Boot et al. (1967)'s one minimizes the sum of squares of the differences between the successive high frequency values subject to the constraint that during each period the increase should equal the sum of the sub period-increases. For convenience, we use the first method, the "quadratic match average one". However, the Boot et al. (1967)'s one may certainly improve the performance of our model, and should be considered in the future.

Then, the seasonal component is added to convert the series into a seasonal one.

## 5.4 Stationarity

Before modeling the components of the HICP, it is useful to determine the orders of integration for the variables we consider. The stationarity of the quarterly seasonally adjusted series (in logarithm) has been tested over the estimation period (1984-2008) using the Augmented Dickey-Fuller algorithm (ADF) in three steps (Dickey and Fuller, 1979) and the Ng-Perron test (Ng and Perron, 2001). Table 4 reports the results.

Both the ADF and the Ng Perron tests conclude that except for ULC, IGXE and PSER HICP the series are integrated of order one. Consider ULC as the Ng Perron test outperforms the ADF one, we can conclude that the series is integrated of order one. The fact that IGXE and PSER HICP may be thought as being integrated of order 2 may be as a result of changes in INSEE statistical methodology (Section 6) or breaks related to the integration process into the Eurosystem. However, the stationarity of inflation in the recent past and in our forecasts is not questionable. Hence, and in order to be able to build a consistent and interpretable model, we have considered that all series used in the model are integrated to order one.

Table 4: *Stationarity tests*

| **Variables** | **Augmented Dickey-Fuller** | **Ng-Perron (with constant)** |
|---|---|---|
| *Dependant variables* | | |
| Industrial Good excluding energy HICP (s.a.) | I(1)***, 1 lag | I(2)*** |
| Private Service HICP (s.a.) | I(2)*** | I(1)*, 2 lags |
| Processed Food excluding tobacco HICP (s.a.) | I(1)***, c, 1 lag | I(1)*** |
| *Explanatory variables* | | |
| ULC | I(2)*** | I(1)*** |
| PPRODXE | I(1)***, 1 lag | I(1)**, 1 lag |
| VAT standard rate | I(1)*** | I(1)*** |
| CUR | I(1)*** | I(1)*** |
| U | I(1)***, 1 lag | I(1)*, 1 lag |
| PAG | I(1)*** | I(1)*** |
| Food prices in euro | I(1)*** | I(1)*** |
| Wheat prices in euro | I(1)*** | I(1)*** |
| Import prices | I(1)*** | I(1)*** |
| Import prices of goods excluding energy | I(1)*** | I(1)*** |
| Import prices of row material | I(1)*** | I(1)*** |

*c stands for constant, the default number of lag is zero, *,**,*** are respectively the 10%, 5% and 1% thresholds*

# 6 The model

While specifying the equations, we follow the econometric strategy described above. For each sectorial HICP, we test to which extent the "best" theory-fitted equation has good predictive performances. The fit of the equation is assessed by dynamic simulations, the R-square, the t-statistics and the absence of autocorrelation to order 1 in the residuals (Durbin-Watson statistics being close to 2 (DW), and a serial Breusch Godfrey correlation LM-test). P-values of the error correction term herein were obtained using the responses surfaces in Ericsson and Mackinnon (1999) as implemented in the program ECMtest.xls (v1). In addition, we have also tested for the heteroscedaticity of residuals with the autoregressive conditional heteroscedasticity (ARCH, Engle (1982)) model. When the "best" model is not satisfying, we consider other related explanatory variables. We demonstrate that the equation we have chosen is the best compromise between theory adequacy and predictive performance.

Beyond the theoretical structure, we have also considered the following issues. First, because of persistence effects and price rigidity, we have systematically tested for different lags in the long term relationship. When it improves the fit in sample of the equation and when it is coherent with diffusion effects from producer prices to consumer prices we have chosen up to three lags, which allow us to work as long as possible with actual observations. Second, we have tried to build equation including autoregressive terms. It improves the theoretical meanings of the equation and the possible expert evaluation.

## 6.1 The industrial good excluding energy HICP model

### 6.1.1 Data characteristics

One can distinguish between three kinds of exogenous shocks that have impacted the IGXE HICP: changes in the composition of the index, the euro cash change over and changes in the VAT. On the one hand, a change in the composition of the index in 1991 has induced a temporary level shift in the IGXE HICP year-on-year inflation. In 2005, the weight of computer goods in the overall HICP is increased by 200%: because the inflation for this HICP component is lower, this change has induced a permanent level shift in the IGXE HICP inflation rate.
On the other hand, from 2001 to 2002, the euro cash changeover has had a temporary impact on the IGXE HICP inflation, affecting in particular the timing of the price changes. Attal-Toubert et al. (2002) demonstrate that the euro cash changeover has increased price changes for IGXE with a positive effect on prices in January 2001 and January 2002 and a negative impact in April 2002 through durable goods.
These changes are included in our equations through dummy variables (when it is not specified, the value of the dummy variables is zero):

Table 5: *Dummy variables used in the model*

| **Name** | **Value** |
|---|---|
| Dum1991 | =1 from 1991 $1^{st}$ quarter to 1991 $4^{th}$ quarter |
| Dumeuro | =1 in 2001 $1^{st}$ quarter,=1 in 2002 $1^{st}$ quarter and -1 in 2002 $2^{nd}$ quarter |
| Dum05 | =1 from 2005 $1^{st}$ quarter to the end of the horizon |

Finally, changes in the value added tax rate ($VAT$) have also impacted industrial goods prices. As a result a VAT series has been designed with the following values:

- From 1987 to July 1995: $VAT$= 18.6%
- From August 1995 to March 2000: $VAT$=20.6%
- From April 2000 on $VAT$ = 19.6%

### 6.1.2 Specifying the equation

The equation has been built in line with the econometric strategy described above: the model is an error correction one with a constant, estimated with the single equation method, in one step. As we have described above, we have first tested what we consider to be the best theory-fitted equation (Model 1) then we have substituted some explanatory variables with related ones, or even considered their exclusion to improve the predictive performance of the model (Model 2 and 3). We first assumed that the best theory fitted equation for the IGXE HICP would include, in the long-term relationship, labor costs and hard raw material prices as cost indicators and good excluding energy import prices and, in the short-term relationship, both the capacity utilisation rate and the VAT rate as fluctuation indicators, added to the dummy variables described above.

Table 6 describes why this equation is dismissed and how the predictive performances are improved in model 2 and 3. We observe that changes in import prices are empirically correlated with changes in home produced prices, which can be justified by the purchasing power theory.

Table 6: *IGXE HICP models*

| **Explanatory variables** | **Model 1** | **Model 2** | **Model 3** |
|---|---|---|---|
| *Long term relationship - Dependant variable* | | | |
| IGXE HICP, log, 3 lags | -0.061***[-5.7] | -0.054*** [-12.6] | -0.039*** [-12] |
| *Long term relationship - Cost variables* | | | |
| Unit labor cost, log, 3 lags | 0.027* [2.7] | - | - |
| Raw material import prices, log, 3 lags | -0.000 [-0.2] | - | - |
| Production prices excluding energy, log, 3 lags | - | 0.047*** [7.46] | 0.020*** [3.07] |
| Good ex. energy import prices, log, 3 lags | 0.026* [2.9] | -0.007* [-1.87] | - |
| *Fluctuation variables - Short term relationship* | | | |
| Change in capacity utilisation rate, log, 3 lags | -0.036** [-1.99] | -0.021 [-1.36] | - |
| Unemployement, 3 lags | - | - | -0.001*** [-5.01] |
| Change in value added tax rate, 1 lag | 0.358*** [5.0] | 0.32*** [5.1] | 0.363*** [5.9] |
| *Dummy variables* | | | |
| Dum05 | -0.001* [-1.97] | -0.00 [-1.36] | - |
| Dum1991 | - | - | 0.004*** [3.9] |
| Dumeuro + dum1991 | 0.003*** [4.6] | 0.003*** [5.4] | - |
| *Statistics* | | | |
| Sample | 1987q1-2008q4 | 1987q1-2008q4 | 1987q1-2008q4 |
| $R^2$ | 0.79 | 0.82 | 0.83 |
| Durbin Watson | 1.07 | 1.26 | 1.7 |
| Breusch Godfrey correlation LM-test, 4 lags | 10[p-value=0] | 5.3[p-value=0] | 1.2[p-value=0.26] |
| ARCH, 4 lags | 1.4[p-value=0.24] | 0.5[p-value=0.99] | 2.2[p-value=0.072] |
| White test | 0.3[p-value=0.97] | 0.4[p-value=0.96] | 0.6[p-value =0.76] |

*Tstats are given between squared brackets. The significance threshold are ***=1%, **=5%,*=10%. P-values of the error correction term herein were obtained using the responses surfaces in Ericsson and Mackinnon (1999) as implemented in the program ECMtest.xls (v1)*

The tests confirm the good performance of Model 3. The number of lags (3) of the regressors minimizes uncertainty as we can work with realized series up to a three quarter horizon. We can distinguish three main differences from Model 1. First, we substitute unit labor cost and raw materials import prices with production prices excluding energy, which improves the robustness of the long term relationship. Second, as the sign of the coefficient of good excluding energy import prices dismisses it as a significant variable (Model 2) we exclude it. In fact, based on the purchasing power parity, we consider that changes in home produced prices are correlated with changes in foreign prices. Third, also based on the sign of the coefficient, unemployment is considered as a better fluctuation indicator than the utilisation capacity rate.

Table 7: *The IGXE HICP equation*

$$\Delta \log(P_t) = -0.039^{***}_{[-12]} * \log(P_{t-3}) + 0.02^{***}_{[3.0]} * \log(PPRODXE_{t-3})$$

$$-0.001^{***}_{[-5.0]} * (U_{t-3}) + 0.36^{***}_{[5.9]} * \Delta(VAT) + 0.004^{***}_{[3.9]} * Dum91 + 0.18^{***}_{[12.9]}$$

*Tstats are given between squared brackets. The significance threshold are $^{***}$=1%, $^{**}$=5%,$^{*}$=10%.*

### 6.1.3 Explaining IGXE inflation

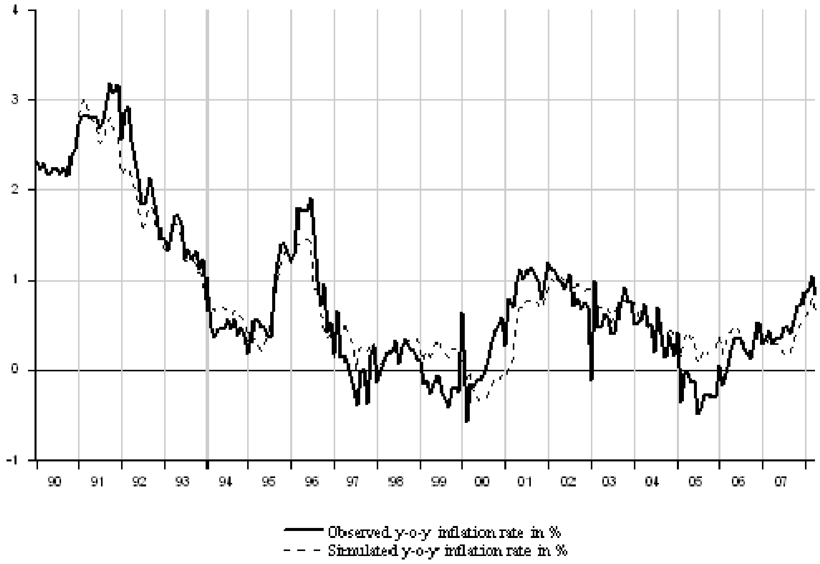


Figure 3: *IGXE HICP year on year growth rate (in %)*

Figure 3 displays the dynamic simulations of the model over the 1991q1-2008q4 period: the IGXE HICP is successively seasonally adjusted, converted into a quarterly series, forecast with the equation described above, the forecast series is converted into a monthly one and finally seasonal components are included. This illustrates the good performance of the model. In Figure 4 appear the contributions of each explanatory variable to the y-o-y inflation of the industrial goods HICP. One can notice the increasing contribution of production prices from the year 2005 on, associated with the acceleration of production prices during the oil price shock.

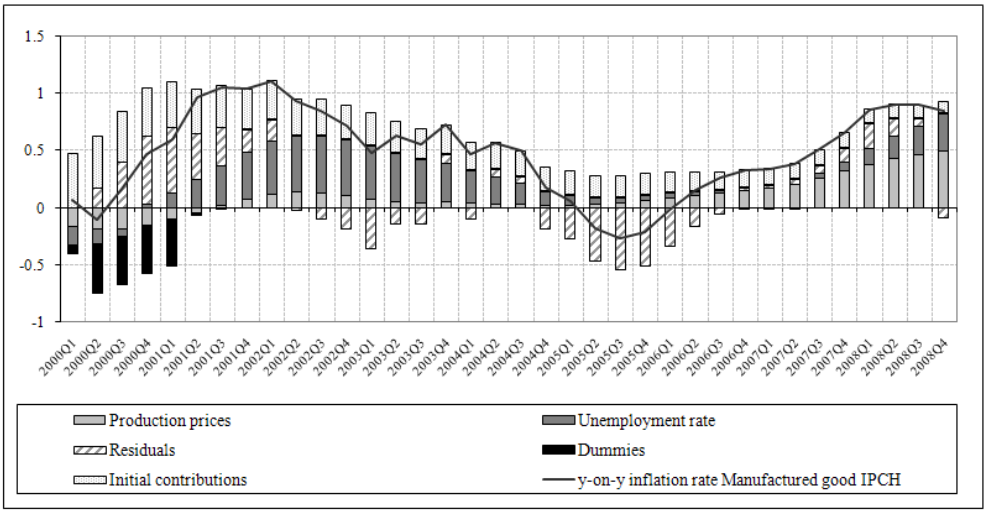


Figure 4: *Contributions of the explanatory variables to IGXE HICP year on year growth rate (in pp)*

## 6.2 The private services HICP

### 6.2.1 Description of the data

The modeled private services HICP (PSER HICP) includes housing and water supply. Communication as well as transports are modeled separately, because, except for transport by air, they are considered as administered prices. Indeed, these tariffs are decided in France at a very centralised level and mostly change by seasonal steps. Concerning the price of transport by air, they are modeled with an ECM including Brent prices in euro as explanatory variable.

One can distinguish two structural changes that have impacted the PSER HICP profile. The first one is in 1993 and is due to a change in the weight of the housing component in the services HICP. It was revised downwards by nearly 10%. Because the inflation in housing was higher than the inflation of overall private services, this downward revision had a negative impact on the services HICP inflation. However, from 1994 on housing inflation is closed to PSER inflation, the downward effect disappears.

The second one, in the $1^{st}$ quarter of 2002, is due to the impact of the euro cash changeover: as it is described in Attal-Toubert and al. (2002) the price of few services such as hotels and restaurants, and personal care increased considerably. In order to take into account these structural changes in our model we have included the following dummy variables:

Table 8: *Dummy variables used in the PSER HICP model*

| Name | Value |
|---|---|
| Dum93 | =1 in 1993 $1^{st}$ quarter and 1994 $2^{nd}$ quarter, =2 from 1993 $2^{nd}$ quarter to 1994 $1^{st}$ quarter |
| Dum02q1 | =1 in the $1^{st}$ quarter of 2002 |

### 6.2.2 Specifying the equation

For the private service HICP, our best theory-fitted equation (Model 1) includes unit labor cost as a cost indicator, and both the unemployment rate and the value added rate as tension indicators. Table 9 describes the predictive performances of the model.

Table 9: *PSER HICP model*

| **Explanatory variables** | **Model 1** |
|---|---|
| *Long term relationship - Dependant variable* | |
| PSER HICP, log, 3 lags | -0.078*** [-14.3] |
| *Long term relationship - Cost variables* | |
| Unit labor cost, log, 3 lags | 0.1*** [12.3] |
| *Fluctuation variables - Short term relationship* | |
| Unemployement, 3 lags | -0.0008*** [6.5] |
| Change in value added tax rate, 1 lag | 0.18*** [3.4] |
| *Dummy variables* | |
| Dum93 | -0.0007*** [-3.1] |
| Dum02q1 | 0.004*** [4.6] |
| *Statistics* | |
| Sample | 1990q1-2008q4 |
| $R^2$ | 0.9 |
| Durbin Watson | 1.7 |
| Breusch Godfrey correlation LM-test, 4 lags | 0.9[p-value =0.37] |
| ARCH, 4 lags | 0.5[p-value =0.7] |
| White test | 0.4[p-value =0.9] |

*Tstats are given between squared brackets. The significance threshold are ***=1%, **=5%,*=10%. P-values of the error correction term herein were obtained using the responses surfaces in Ericsson and Mackinnon (1999) as implemented in the program ECMtest.xls (v1)*

The tests confirm the good performance of the model we consider in line with theory. As for IGXE equation, the number of lags allows forecasting up to three quarters using actual data from the National Accounts.

Table 10: *The PSER HICP Equation*

$$\Delta \log(P_t) = -0.078^{***}_{[-14.3]} * \log(P_{t-3}) + 0.1^{***}_{[12.3]} * \log(ULC_{t-3}) - 0.0008^{***}_{[6.5]} * U_{t-3}$$

$$+0.18^{***}_{[3.4]} * \Delta(VAT) - 0.0007^{***}_{[3.1]} * Dum93 + 0.004^{***}_{[4.6]} * Dum02Q1 + 0.36_{[12.3]} + 0.4^{***}_{[14.8]}$$

### 6.2.3 Dynamic simulation and contribution

The dynamic simulations of the model over the 1990q1 2008q4 period on Figure 5 illustrates its good performance. In Figure 6 appear the contributions of the different

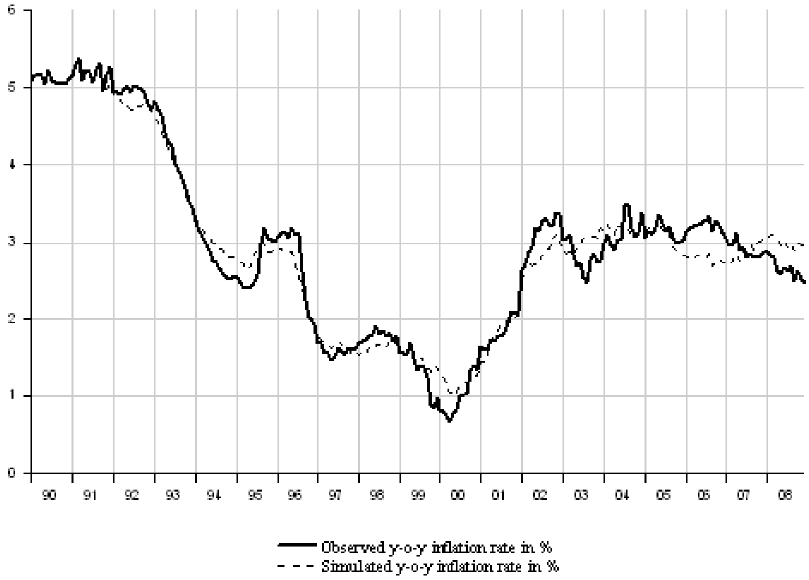


Figure 5: *Service HICP year on year growth rate (in %)*

variables to the y-o-y inflation of the PSER HICP. It demonstrates first than ULC contributes substantially to the profile of PSER inflation. Second, the positive contribution of U from the third quarter of 2007 is offset by the contribution of the residuals. This would be due to the increased flexibilisation of the labor market. With more temporary jobs, a decrease in unemployment would induce fewer tensions on the labor market.

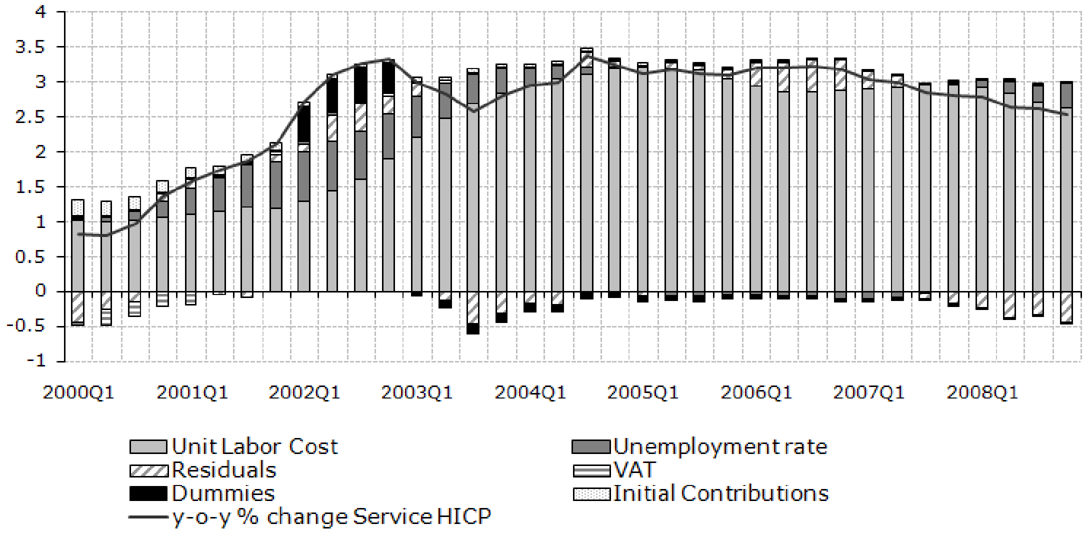


Figure 6: *Contributions of the explanatory variables to service HICP year on year growth rate (in pp)*

## 6.3 The processed food excluding tobacco HICP

Our model for processed food excluding tobacco prices (PFOODXT) takes into account changes in profit margins behaviour due to changes in regulation and the impact of the Common Agricultural Policy (CAP). Indeed, the specificities of the French retail sector and the changes in its regulation as well as the CAP intervention prices have significantly impacted on consumer prices.

### 6.3.1 Description of the data

*A. Impact of the specificities of the retail sector on consumer prices*

The profile of the PFOODXT HICP is highly determined by the retail sector legislation, through the behaviour of profit margins. Askenazy, Weidenfeld (2007) divide the evolution of the retail sector legislation into three periods (Figure 6):

- From 1973 to July 1996, the retail sector was regulated by the Royer law: processed food HICP inflation was lower than in the 15 country euro area.
- From July 1996 to September 2004, two new laws determined the profile of the processed food HICP: the Raffarin law and the Galland law. The PFOODXT HICP inflation was higher than in the 15 country euro area.
- From September 2004 on, the Raffarin law and the Galland laws were discussed, assessed and reformed with the September 2004 Sarkozy agreements, the Jacob

law and the Chatel law: the PFOODXT HICP inflation was lower than in the 15 country euro area.

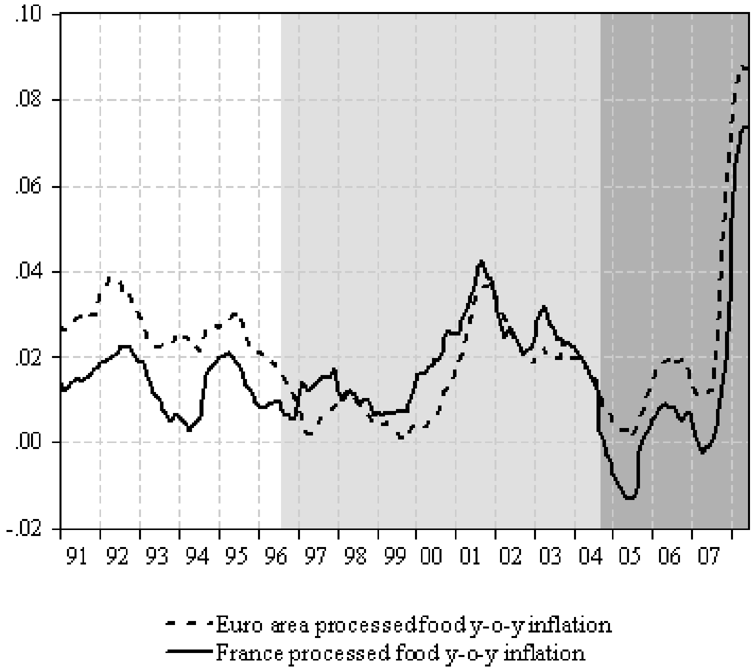


Figure 7: *France and euro area processed food year on year inflation*

See Annex A for more details on legislation. The consequence of these reforms was a decrease in the sale at a loss threshold that enhanced retailers to decrease their profit margins. From then on, inflation in processed food prices has been lower in France than in the euro area.

*B. The intervention prices of the CAP and their impact on agricultural prices and on consumer prices*

As it is explained in the National Bank of Belgium Economic Review (2008), the effects of the food commodity price increase recorded since mid 2007 have been substantial. The main reason is that the common agricultural policy no longer smoothes out world market price fluctuations. First, guaranteed prices have been revised downwards. Second, European agricultural prices are more correlated to international prices when the latter go above the CAP intervention prices. Finally, the CAP reform was conceived in order to give more importance to market mechanisms. As a result, from 2000, the variance in agricultural prices has increased: the standard deviation increased from 2.2% for the sample 1997q1- 1999q4 to 4.4% for the sample 2000q1-2007q4. Consequently, we have decided to test for breakpoints when using international food prices in euro in our equation using a Quandt-Andrews breakpoint test. We have selected the points where the Chow F-statistics is maximal. When necessary we introduce a multiplicative dummy variable called DUMCAP including these breakpoints.

Table 11 listed and described the dummy variables we have introduced to take into account changes in legislation and the CAP reform. In the French retail sector, negotiations from producers to retailers mostly occur in January and February, that is why the impact of the reforms could be more important in the first quarter.

Table 11: *Dummy variables used in the PFOODXT HICP model*

| **Label** | **Value** | **Explanation** |
|---|---|---|
| $DumAccords$ | =2/3 in 2004q3 and 2005q2; =1 in 2004 4th quarter and 2005q1 | Impact of the Sarkozy agreements |
| $DumJacobchatel$ | =1 in 2007q1 and $\frac{1}{2}$ in 2007q2; =1 from 2008q2 to 2004q4 | Impact of the Jacob and Chatel laws |
| $DumJacobchatel$ | =1 in 2007q1 and $\frac{1}{2}$ in 2007q2; =1 from 2008q2 to 2004q4 | Impact of the Jacob and Chatel laws |
| $Dumvf$ | =1 in 2001q2 and q3; -1 in 2001q4 and 2002q1 | Mad Cow Disease |
| $Dum08$ | =1 in 2008q1 | Impact of the increase in international food prices |
| $DumCAP$ | =0.2 from 2006q3 to 2007q2 and 1 from 2007Q3 | Impact of the increase in international food prices |

### 6.3.2 Specifying the equation

The model we first tested was, in line with our econometric strategy, a VECM with cost and fluctuation indicators. We consider that relevant cost indicators for PFOODXT HICP would be PPRODXE and FOODEURO. Concerning tension indicators, we consider the change in international food prices, in Brent prices in euro and, because of the share of wages in retail sector cost structure the unemployment rate. As PPRODXE in the long-term relationship is not a significant variable, we test it in the short term one. As a result, because FOODEURO is a significant variable only from 2006q3 onwards, we constrained the long-term relationship from then on. We also omit changes in Brent prices in euro. The second model performs well.

Table 12: *The PFOODXT HICP model*

| **Explanatory variables** | **Model 1** | **Model 2** |
|---|---|---|
| *Long term relationship - Dependant variable* | | |
| PFOODXT HICP, log, 2 lags | -0.009*** [-1.9] | -0.001*** [-3.5] |
| *Long term relationship - Cost variables* | | |
| FOODEURO, log, 2 lags | 0.0009* [1.8] | 0.0018*** [4.7] |
| PPRODXE, log, 2 lags | -0.008 [-0.2] | - |
| *Fluctuation variables - Short term relationship* | | |
| Change in FOODEURO, log, 4 lags | 0.06*** [3.4] | 0.05*** [2.7] |
| Change in oil prices in euro, log, 1 lags | 0.02 [1.0] | - |
| Unemployment, 1 lag | -0.001*** [-3.3] | -0.0001*** [-3.5] |
| Change in PPRODXE, log, 2 lags | - | 0.05 [1.1] |
| *Dummy variables* | | |
| DumAccords | -0.007*** [-4.9] | -0.007*** [-5]- |
| DumJacobchatel | -0.007*** [-3.8] | -0.007*** [-4.5] |
| Dum08 | 0.02*** [7.4] | 0.02*** [7.5] |
| DumVF | 0.002** [2.2] | 0.003** [2.5] |
| *Breakpoints* | | |
| 2006q3 and 2007q3, Chow statistic | 9.8[p-value =0] | 34[p-value =0] |
| Dumcap | 0.5 from 2006q3 to 2007q2 and then 1 | 0.2 from 2006q3 to 2007q2 and then 1 |
| *Statistics* | | |
| Sample | 1990q3-2008q4 | 1990q3-2008q4 |
| $R^2$ | 0.78 | 0.80 |
| Durbin Watson | 1.55 | 1.6 |
| Breusch Godfrey correlation LM-test, 4 lags | 5.7[p-value=0.22] | 5[p-value=0.27] |
| ARCH, 4 lags | 0.9[p-value=0.91] | 0.3[p-value=0.89] |
| White test | - | 0.8[p-value=0.74] |

*Tstats are given between squared brackets. The significance threshold are ***=1%, **=5%,*=10%. P-values of the error correction term herein were obtained using the responses surfaces in Ericsson and Mackinnon (1999) as implemented in the program ECMtest.xls (v1)*

Table 13: *The PFOODXT HICP Equation*

$$\Delta\log(P_t) = Dumcap * [-0.001^{***}_{[-3.5]} * \log(P_{t-2}) + 0.002^{***}_{[4.7]} * \log(FOODEURO_{t-2})]$$

$$-0.0001^{***}_{[3.4]} * U_{t-1} + 0.05^{***}_{[2.7]} * \Delta\log(FOODEURO_{t-4}) + 0.05_{[1.1]} * \Delta\log(PPRODXE_{t-2})$$

$$-0.007^{***}_{[5]} * Dumaccords - 0.007^{***}_{[4.5]} * DumJacobChatel + 0.02^{***}_{[7.5]} * Dum08 + 0.003^{***}_{[2.5]} * Dumvf$$

### 6.3.3 Dynamic simulations and contributions

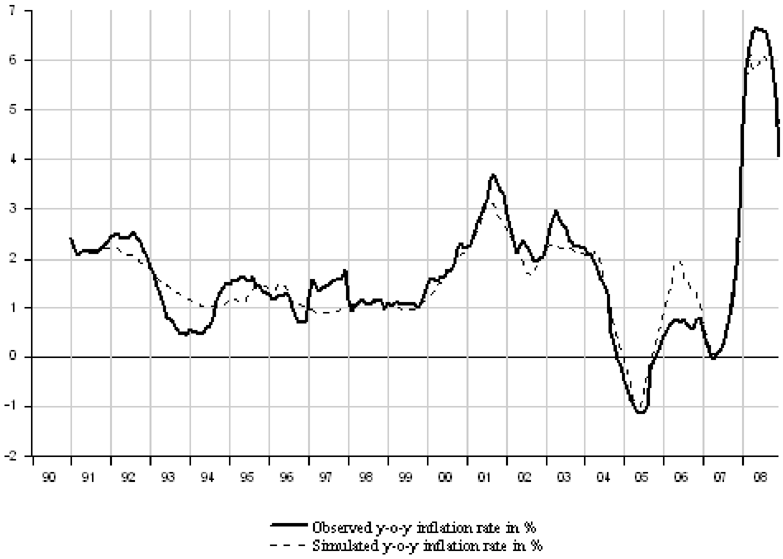


Figure 8: *Processed food HICP year on year growth rate (in %)*

The dynamic simulations of our model over the 1990q1-2008q4 period show that our model predicts reversals but is not as performant as our IGXE good and PSER HIPC equations. The difficulty of modeling processed food prices in the euro area and in France lays on the structural changes in the sector due to legislation and the CAP. Figure 9 displays the contributions of the different variables to the y-o-y inflation of the private services HICP. One can notice the importance of dummies in the PFOODXT HIPC behaviour, mainly because of these changes.

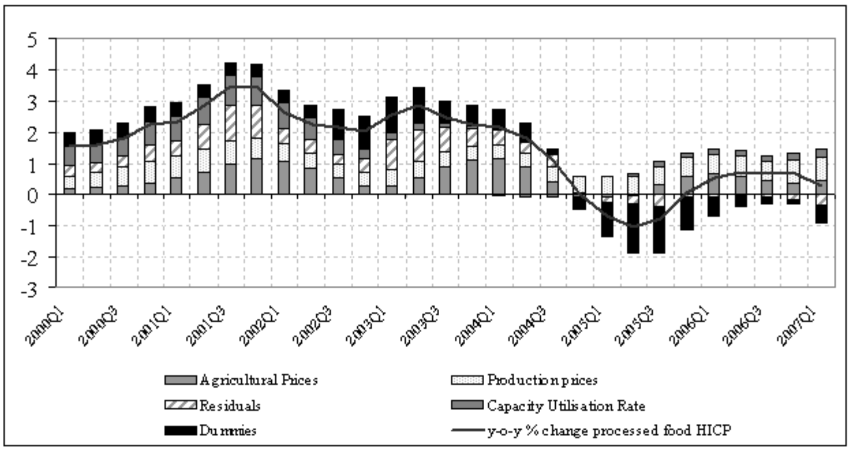


Figure 9: *Contributions of the explanatory variables to processed food HICP year on year growth rate (in pp)*

## 6.4 The energy HICP

The energy HICP is divided into three subcomponents:

- oil product, including liquid fuels, fuels and lubricants;
- gas, including gas, solid fuel and hot water HICP;
- electricity.

The HICP component for gas and electricity are projected without breakdown whereas oil products are divided into three subcomponents: oil fuels, diesel oil and unleaded oil.

Because of different price behaviour, oil product, gas and electricity prices are modeled differently. Indeed, gas and electricity prices incur irregular hikes, subject to the approval of the government whereas oil product prices vary monthly with Brent prices. First, concerning gas prices, they are modeled with Brent prices with lags of 3 quarters and 9 quarters. When it is necessary, we adjust the timing of the hikes according to public announcements. Second, concerning electricity prices, headline inflation has been considered as the upper limit for price increases over the year since the public agreement of the 24th of October 2005. Subsequently, there is no equation for this component, we just include a hike each summer by less than 2%.
Finally, the oil product HICP is divided into three components that are modeled in two steps. First, they are modeled excluding taxes. Second, taxes are integrated to rebuild the components. There are two kinds of taxes on oil products in France: the oil product domestic tax (TIPP) that is linked to volumes (excise tax) and the VAT that is linked to prices, including the TIPP .
The liquid fuel for heating HICP, the diesel oil HICP and the unleaded oil HICP excluding taxes are modeled with an ECM. In the long term specification, the explanatory variable is the price of the Brent in euro. Thus, the margin behaviour is taken into account. The short term specification includes as well the price of the Brent through two variables:

one with one lag, the other without lag. For the diesel oil and oil fuels there is also an autoregressive component, with one lag. Thus, refining margins as well as transport and retail margins are taken into account in the long term specification of the Error Correction Model. Contrary to the other equations of the model these equations are monthly equations since all the series in the information set are available on a monthly basis.

Table 14: *The unleaded oil excluding tax equation*

$$\Delta \log(P_t) = 0.39^{***}_{[14.4]} * \Delta \log(Pbrenteuro_t) + 0.21^{***}_{[7.2]} * \Delta \log(Pbrenteuro_{t-1})$$

$$-0.15^{***}_{[14.4]} * \log(P_{t-1}) + 0.10^{***}_{[4.2]} \log(Pbrenteuro_{t-1}) + 0.16^{***}_{[3.8]}$$

*Tstats are given between squared brackets. The significance thresholds are $^{***}$=1%, $^{**}$=5%,$^{*}$=10%. P-values of the error correction term herein were obtained using the responses surfaces in Ericsson and Mackinnon (1999) as implemented in the program ECMtest.xls (v1)*

- Estimation period=1991$m$7 2007$m$12
- $R^2 = 0.7$
- $DW = 1.97$
- $LM(4) = 0.25$, p-value= 0.89
- $ARCH(4) = 7$, p-value= 0

Table 15: *The diesel oil excluding tax equation*

$$\Delta \log(P_t) = 0.4^{***}_{[15.2]} * \Delta \log(Pbrenteuro_t) + 0.11^{***}_{[2.9]} * \Delta \log(Pbrenteuro_{t-1})$$

$$-0.2^{***}_{[5.3]} * \log(P_{t-1}) + 0.16^{***}_{[5.4]} \log(Pbrenteuro_{t-1})$$

$$+0.18^{***}_{[3.4]} * \Delta \log(P_{t-1}) + 0.16^{***}_{[4.8]}$$

*Tstats are given between squared brackets. The significance thresholds are $^{***}$=1%, $^{**}$=5%,$^{*}$=10%.P-values of the error correction term herein were obtained using the responses surfaces in Ericsson and Mackinnon (1999) as implemented in the program ECMtest.xls (v1)*

- Estimation period=1991$m$7 2007$m$12
- $R^2 = 0.7$
- $DW = 2.05$ *Not appropriate because of the lagged-dependent variable, see the LM test.*
- $LM(4) = 0.25$, *p-value*= 0.91

Table 16: *The oil fuel excluding tax equation*

$$\Delta \log(P_t) = 0.4^{***} * \Delta \log(Pbrenteuro_t)_{[17.7]} - 0.13^{***} * \log(P_{t-1})_{[4.7]}$$

$$+0.1^{***} \log(Pbrenteuro_{t-1})_{[4.8]} + 0.26^{***} * \Delta \log(P_{t-1})_{[6.1]} + 0.12^{***}_{[4.0]}$$

*Tstats are given between squared brackets. The significance thresholds are ***=1%, **=5%,*=10%. P-values of the error correction term herein were obtained using the responses surfaces in Ericsson and Mackinnon (1999) as implemented in the program ECMtest.xls (v1)*

- $ARCH(4) = 0.75$, *p-value*$= 0.54$

- Estimation period=1991$m$7 2007$m$12
- $R^2 = 0.7$
- $DW = 1.7$ *Not appropriate because of the lagged-dependent variable, see the LM test.*
- $LM(4) = 2.3$, *p-value*$= 0.03$
- $ARCH(4) = 4.1$, *p-value*$= 0.00$

### 6.5 The unprocessed food HICP

The unprocessed food HICP is divided into four sub-indexes: meat products, fish, fruits and vegetables. The change in prices is modeled monthly as an ARMA with fixed seasonal effects. It is estimated with OLS.

## 7 Forecasting performance

As it is commonly done in the literature, the forecasting performance of the main equations is assessed in comparison to benchmark models. We have considered four benchmark models. The first one is a single 4-lag autoregressive equation (AR(4)), to which all the dummy variables that have been identified are added, in order to make a fair comparison. Such non-informative models are known to have satisfactory forecasting accuracy and are frequently used by central banks to forecast short term inflation (see the three-month model described in Section 8). However, their major drawback is that they do not allow for any economic interpretation of price developments. The second benchmark model is a vector autoregressive model with four lags. The endogenous variable are the other HICP components and are selected following a Granger causality test. The third model is a non-constrained model (NC) using the same explanatory variables as our equation. Finally, the fourth model is the former one the Banque de France used to forecast inflation (FMOD).

One can assess the performance of our model with two different methods. The first one consists in estimating the forecast performance within the estimation sample. The other one evaluates the forecast performances of the model out of the estimation sample. The literature generally agrees that forecasting methods should be assessed using out-of-sample tests rather than in-sample tests. First, it is in line with a forecasting model utility and applications. Second, because of structural changes post-sample performance is often lower than in-sample performance as in in-sample test the equation is estimated including these potential structural changes. Bartolomei and Sweet (1989) provide evidence on the fact that methods selected by best in-sample fit may not best predict post-sample data.

Two different statistics are computed through recursive estimates projections: the Root Mean Square Error (RMSE) and the Diebold Mariano (DB) statistics. Because the sample is quite limited we use the modified Diebold Mariano statistic $S'$ (Harvey, Leybourne and Newbold, 1997)) which is estimated with Newey-West corrected standard errors that allow for heteroskedastic autocorrelated errors. We reject the null hypothesis of equal predictive accuracy at the 5% level if

$$|S'| > 1.96$$

## 7.1 Methodology

We assess the out-of-sample performance in 33 rolling samples, the first one is 2000q1-2001q2 and the last one is 2008q1 - 2009q2. We test 18 different horizons (or 6 quarters). Note that, in any case, the starting point of estimates is set at the beginning of our estimation sample (between 1987Q1 and 1990Q4, depending on the equation).

## 7.2 Results

For each model, we have included the dummy variables in the autoregressive equation. Indeed, we want to be sure that the forecasting performance of our model does not only come from the correction of outliers. Nevertheless, our model is designed to produce conditional forecasts. In this exercise, the conditionary variables are taken equal to the observations over the projection horizon. This represents a bias in favour of our model when the benchmark model is the AR(4).
Table 17 presents the results for the three main equations of our model. As the performance of the VAR is not significantly better than that of the AR(4), the RMSE relative to this equation are not presented in the table.

The forecasting errors of our equations are lower than of all the benchmark models on average. However, the Diebold-Mariano statistics reveals the relative fragility of our model. In fact, it has been argued in the literature that inflation has become harder to forecast especially over the 10-15 years in the sense that "it has become much more difficult for an inflation forecaster to provide value added beyond a univariate model" (Stock and Watson, 2007). It is a proof of the importance of the expert judgment. The fact that our model underperforms in the short run is one of the reason for developing a different model in the three month horizon. This type of model is described in the next section.

Table 17: *RMSE of the IGXE equation relative to the benchmark models and Diebold Mariano Statistics (for horizons h from 3 to 18 months)*

| | **IGXE** | | | **PSER** | | | **PFOODXT** | | |
|---|---|---|---|---|---|---|---|---|---|
| *h* | AR(4) | NC | FMOD | AR(4) | NC | FMOD | AR(4) | NC | FMOD |
| 3 | 0.80 | 0.81 | 0.27 | 0.98 | 1.01 | 0.55 | 1.05 | 1.04 | 0.96 |
| | (1.1) | (1.1) | (4.8) | (0.3) | (-0.1) | (2.9) | (-0.4) | (-0.9) | (0.3) |
| 6 | 0.84 | 0.87 | 0.44 | 0.82 | 0.86 | 0.62 | 0.97 | 0.99 | 0.95 |
| | (1) | (1.1) | (3.8) | (1.5) | (0.9) | (3.8) | (0.2) | (0.2) | (0.3) |
| 9 | 0.8 | 0.84 | 0.55 | 0.73 | 0.80 | 0.58 | 0.97 | 0.98 | 0.97 |
| | (1.2) | (1.2) | (2.5) | (1.7) | (1.2) | (2.9) | (0.2) | (0.4) | (0.2) |
| 12 | 0.79 | 0.80 | 0.70 | 0.66 | 0.76 | 0.56 | 0.94 | 0.99 | 0.94 |
| | (1.3) | (1.2) | (2.4) | (1.8) | (1.3) | (2.1) | (0.4) | (0.3) | (0.2) |
| 15 | 0.78 | 0.77 | 0.81 | 0.60 | 0.70 | 0.56 | 0.90 | 0.98 | 0.88 |
| | (1.4) | (1.3) | (1.6) | (1.8) | (1.7) | (1.5) | (1) | (0.1) | (0.6) |
| 18 | 0.78 | 0.73 | 0.93 | 0.54 | 0.64 | 0.53 | 0.9 | 1 | 0.85 |
| | (1.3) | (1.4) | (1.4) | (1.8) | (1.8) | (1.2) | (1.2) | (0.2) | (0.6) |

# 8 The short run model

Our forecasting strategy includes a specific model for the short run (three month horizon). In this model, the HICP is modeled in a very disaggregated approach: it is disaggregated into 52 subcomponents which are forecast with ARIMA models. This section details these estimations.

## 8.1 The econometric strategy at the three month horizon

At the three month horizon, the overall HICP is disaggregated into 52 components. This is consistent with Duarte and Rua (2007) who find an inverse relationship between the forecast horizon and the amount of information underlying the forecast, when minimizing the Root Mean Square Forecast Error. The monthly variations of each of the 52 subcomponents of the HICP, except energy prices, are forecast with an ARIMA process. Food prices are also modeled with producer prices as explanatory variables. Concerning energy prices, the heating oil and the fuel and lubricant HICP are modeled excluding taxes as a function of Brent prices in dollar and the exchange rate, estimated by OLS.

Table 18: *Subcomponents of the overall HICP modeled in the short run*

| **Name** | **Weight** | **Model** |
|---|---|---|
| ***FOOD*** | | |
| ***Unprocessed food*** | | |
| Meat | 4.3% | ARIMA |
| Unprocessed fish | 0.4% | ARIMA |
| Processed fish | 0.4% | ARIMA |
| Unprocessed fruits | 1% | ARIMA |
| Processed fruits | 1.1% | ARIMA |
| Unprocessed vegetables | 0.9% | ARIMA |
| Processed vegetables | 0.5% | ARIMA |
| ***Processed food*** | | |
| Bread and cereals | 2.3% | ARIMA and bridge equation with producer prices |
| Milk products | 2.4% | ARIMA and bridge equation with producer prices |
| Oils and fats | 0.4% | ARIMA and bridge equation with producer prices |
| Sweet products | 1% | ARIMA and bridge equation with producer prices |
| Salt and Spices | 0.6% | ARIMA and bridge equation with producer prices |
| Non alcoholic beverages | 1.4% | ARIMA and bridge equation with producer prices |
| Alcoholic beverages | 1.7% | ARIMA and bridge equation with producer prices |
| Tobacco | 2% | Irregular hikes according to announcements |

| **Name** | **Weight** | **Model** |
|---|---|---|
| ***INDUTRIAL GOODS XE*** | | |
| Clothing and Footwear | 5.5% | ARIMA |
| Health Products | 1.9% | ARIMA |
| Purchase of vehicles | 4.7% | ARIMA |
| Accessories for personal vehicles | 3.2% | ARIMA |
| Furnishing | 1.6% | ARIMA |
| House equipment | 1% | ARIMA |
| Other manufactured goods | 13.7% | ARIMA |
| ***ENERGY CONSUMPTION PRODUCTS*** | | |
| Heating oil | 0.9% | Bridge equation with Brent prices as explanatory variable |
| Liquid Fuel | 4.3% | Bridge equation with Brent prices as explanatory variable |
| Lubricant | 0.03% | Bridge equation with Brent prices as explanatory variable |
| Gas | 1.2% | Irregular hikes according to announcement |
| Solid Fuel | 0.05% | ARIMA |
| Heat energy | 0.2% | ARIMA |
| ***SERVICES*** | | |
| ***Private Services*** | | |
| Housing rentals | 6.8% | Information on social rentals |
| Water supply | 0.4% | ARIMA |
| Refuse collection | 0.5% | ARIMA |
| Hospital services | 0.6% | ARIMA |
| Medical services | 0.6% | ARIMA |
| Paramedical services | 0.5% | ARIMA |
| Restaurants | 5.6% | ARIMA |
| Hotels | 1.3% | ARIMA |
| Social protection | 1.4% | ARIMA |
| Insurance | 2.5% | ARIMA |
| Maintenance and repair of vehicles | 2.3% | ARIMA |
| Other private services | 8% | ARIMA |
| ***Communications*** | | |
| Telecommunications | 3% | ARIMA |
| Postal services | 0.2% | Announcements |
| ***Transports*** | | |
| Transport services by railway | 0.5% | ARIMA |
| Transport services by road | 0.6% | ARIMA |
| Transport services by air | 0.9% | ARIMA |
| Combined passenger transport | 0.2% | ARIMA |
| Transport services by sea | 0.1% | ARIMA |

Then, the forecast series are evaluated, and possibly modified, through three axes:

- The monthly variation is compared with the mean of the past three and five year monthly variation.
- Charts are used to analyze the recent behaviour of the price series
- Available information is included (Table 18)

In a forecast exercise, from 40% up to 70% of the subcomponents forecast are modified through this process. Information is regularly available for the following indexes:

Table 19: *Information on HICP subcomponents*

| **Name** | **Source** | **Description** |
|---|---|---|
| Fruits and Vegetables | Ministry of Agriculture | Weekly price series for the main categories of fruits and vegetables |
| Tobacco | Government announcement | Irregular hikes according to announcements |
| Oil products | Ministry of Industry | Weekly price series for oil products including and excluding VAT |
| Gaz and electricity | Government announcement | Irregular hikes according to announcements |
| Health Products | Legislation and market evolutions | Legislation on social security reimbursements or generics |
| House rents | INSEE | Three month forecast |
| Health services | Legislation and government announcement | Irregular hikes and change in legislation concerning reimbursements |

## 8.2 The real time forecasting performance of the short run model

Because in the short run the included information is more important than in a longer horizon, the projection process cannot be simulated. As a result we test the forecast performance of the model in a real time framework. We use the forecast series from the past NIPE to assess the forecast performance of our model. The latter are available from January 2001 to September 2008. Because of the NIPE calendar, there is not a forecast series at each date. Moreover, because we are not sure about the origins of these forecast series, they are excluded when they look like outliers. These series are compared to the autoregressive model described above.

Table 20: *RMSE of the forecast series relative to the autoregressive model (for horizons from 1 to 3 months)*

| **Equation** | **Average** | **1** | **2** | **3** |
|---|---|---|---|---|
| IGXE HICP | 0.66 | 0.31 | 0.64 | 1.017 |
| PSER HICP | 0.87 | 0.55 | 1.32 | 0.76 |
| PFOOD HICP | 1.12 | 2.20 | 0.49 | 0.67 |

# 9 Conclusion

The present model for forecasting inflation in France is based on a theoretical framework that is a mix between a markup model for prices and the Phillips curve. The model was designed to provide good forecast performance, but also to be included in the Eurosystem forecast exercises. The latter induces first, the use of specific assumptions, second, the issue of forecast for the main HICP subcomponents. After the systematic investigation of a large set of equations, based on this theoretical framework and under these constraints, the model we obtained proves to be performing reasonably well. We provide evidence for the robustness of our equations, the stability of our results, their ability to anticipate turning points in inflation and the quality of dynamic simulations. We show that our model, conditionally on the exogenous variables, outperforms a standard AR(4), a VAR and a non-constrained model as well as the former one used by Banque de France (Jondeau et al., 1999).

# References


Al-Osh M. (1989). “A dynamic linear model approach for disaggregating time series data”. *Journal of Forecasting*, vol. 8, p. 85-96.

Allain Marie-Laure, Chambolle Claire, Vergé Thibaud (2008). “La loi Galland sur les relations commerciales, jusqu’où la réformer?”. *Cepremap*, juillet 2008.

Allain Marie-Laure, Chambolle Claire (2005). “Loss-Leaders Banning Laws as Vertical Restraints”. *Journal of Agricultural & Food Industrial Organization*, 1092.

Attal-Toubert Ketty, de Belleville Lous-Marie, Pluyaud Bertrand (2002). “L’impact à court terme sur les prix du passage à l’euro fiduciaire”. *Banque de France Working Paper*, no. 105, September 2002.

Askenazy Philippe, Weidenfeld K. (2007) ”Les soldes de la loi Raffarin. Le contrôle du grand commerce alimentaire”. *Opuscule CEPREMAP*, Paris.

Baghli Mustapha , Brunhes-Lesage Véronique , De Bandt Olivier , Fraisse Henri and Villetelle Jean-Pierre (2004). “Model for analysing and forecasting short term devlopments”. *Banque de France Working Paper*, no. 106, February 2004.

Benlalal Nicholai, Diaz del Hoyo Juan Luis, Landau Bettina, Roma Moreno, Frauke Skudelny (2000). “To aggregate or not to aggregate?”. *European Central Bank Working Paper*, no. 374.

Bertrand M., Kramarz F. (2002). “Does entry regulation hinder job creation? Evidence from the French retail industry”. *Quarterly Journal of Economics*, no. 108.

Biscourp Pierre, Boutin Xavier, Vergé Thibaud (2008). “The effect of retail regulation on prices: Evidence from the Loi Galland”. *INSEE*, February.

Boot J.C.G., Feibes W. and J.H.C. Lisman (1967). “Further methods of derivation of quarterly figures from annual data”. *Applied Statistics*, vol. 16, p. 65-75.

Britton Erik, Larsen D J Jens, Small Ian (2000). “Imperfect competition and the dynamics of mark-ups”. *Bank of England.*

Brouwer Gordon, Ericsson Neil (1998). “Distributions of error correction tests for cointegration”. *Journal of Business and Economic statistics*, vol. 16, no. 4.

Bruneau C., De Bandt O., Flageollet A., Michaux E. (2007). “Forecasting Inflation Using Economic Indicators: the Case of France”. *Journal of Forecasting*, January.

Chauvin Valérie, Devulder Antoine (2007). “An aggregated inflation forecasting model for France”. *Banque de France Working Paper.*

Chow, G., Lin A.L. (1971).“Best Linear Unbiased Interpolation, Distribution, and Extrapolation of Time Series by Related Series”. *The Review of Economics and Statistics*, vol. 53, issue 4, 372-375.

Ciccarelli, M., Mojon B. (2008). "Global inflation". *European Central Bank Working Paper*, vol. 537, October 2005.

Di Fonzo T. (2003)."Temporal disaggregation of economic time series: towards a dynamic extension". *European Central Bank Working Paper.*

Dickey, D. A., and W. A. Fuller (1979)."Distribution of the Estimators for Autoregressive Time Series with a Unit Root". *Journal of the American Statistical Association*, vol. 74, p. 427-431

Diebold, F.X., Mariano R.S. (1995). "Comparing predictive accuracy ". *Journal of Business and Economic Statistics*, 13, 253-263.

Duarte Claudia, Rua Antonio (2007). "Forecasting inflation through a bottom-up approach: How bottom is bottom? ". *Economic Modelling*, March.

Eckstein Otto, Fromm Gary (1968). "The Price Equation". *The American Economic Review*, December, n. 5, part 1.

Engle R.F. (1982). "Autoregressive Conditional Heteroscedaticity with Estimates of the Variance of UK inflation". *Econometrica*, 50, 987-1008.

Engle R.F., Granger C.W.J. (1987). "Co integration and error correction: representation, estimation and testing". *Econometrica*, 55, 251-276.

Ericsson Neil, MacKinnon James (2002). "Distributions of error correction tests for cointegration". *International finance discussion paper, Board of Governors of the Federal Reserve System*, no. 655.

Ericsson Neil, MacKinnon James (2002). "Distributions of error correction tests for cointegration". *Econometrics Journal*, vol. 5.

European Central Bank (2001). "A guide to eurosystem staff macroeconomic projection exercises".

Fernández R.B. (1981). "A methodological note on the estimation of time series". *The Review of Economics and Statistics*, vol. 63, p.471-478.

Gallot Philippe, Heitz Benoît (2004). "L'inflation en France et en zone euro: une approche macro sectorielle". *INSEE.*

Harvey D., Leybourne S., Newbold P. (1997), "Testing the quality of prediction mean square error". *International Journal of Forecasting*, 13, 281-291.

Hendry David, Hubrich Kirstin (2007). "Combining disaggregate forecasts or combining disaggregate information to forecast an aggregate ". *European Central Bank Working Paper*, May.

Hubrich Kirstin (2003). "Forecasting euro area inflation: does aggregating forecasts by HICP component improve forecast accuracy? ". *European Central Bank Working Paper*, August.

Johansen S. (1988). “Statistical analysis of cointegration vector ”. *Journal of Economic Dynamics and Control*, 12, 231-54.

Johansen S. (1995). “Likelihood-based Inference in Cointegratd Vector Autoregresssive Models ”. *Oxkord University Press.*

Jondeau Eric, Le Bihan Hervé, Sédillot Franck (1999). “Modélisation et prévision des indices de prix sectoriels”. *Banque de France Working Paper*, september, NER 68.

Johnston J. (1972). “Pricing in the trade cycle”. *The economic journal*, September, p. 853.

Litterman R.B. (1983). “A random walk, Markov model for the distribution of time series”. *Journal of Business and Economic Statistics*, vol. 1, p. 169-173.

Ng S. and Perron P. (2001). ”Lag Length Selection and the Construction of Unit Roots Tests with Good Size and Power”. *Econometrica*, vol. 69, no. 6, p. 1519-1554.

Philipps, A.W. (1954). “Stabilisation Policy in a closed Economy”. *Economic journal*, 64, 290-323.

Sargan, J.D. (1964). “Wages and prices in the United Kingdom: a study in econometric methodology”. *Econometric Analysis for National Economic Planning,*, 16, 25-54.

Richard Benjamin, Roos William (2008). “Prévoir l’inflation en zone euro”. *DGPTE Working paper*, Juin, n. 2008/3.

Stock J., Watson M. (2007). “Why has U.S. inflation become harder to forecast?”. *Journal of Money, Banking and Credit*, 39, 3-34.

Wei W.W.S., Stram (1990) D.O. (1990). “Disaggregation of time series models”. *Journal of the Royal Statistical Society*, vol. 52, p. 453-467.

# A The legislation in the retail sector

1. The Royer law

   Since 1973, the retail sector was regulated by the Royer law. An authorization was needed to implement a retail shop of more than 1000 square meters. The authorization was given by a commission essentially composed with elected representatives. As a result, biased decision making, in favour of incumbents, was a risk. Moreover, Bertrand Kramarz (2001) demonstrates that the requirements have created barriers to entry. In order to fight against it, new laws were voted, the Sapin law (1993) and then the Raffarin law (July 1996), bringing down the relative number of these representatives in these commissions. However, the Raffarin law, together with the Galland law, that was also voted in July 1996, did not enhance competition and worse, had a reverse effect on prices.

2. From 1996 to September 2004, the Raffarin and the Galland laws reduced competition in the French retail sector.

   In addition to the decrease in the number of representatives in the commissions, another measure was included in the Raffarin law: the threshold above which an authorization was required to open a retail shop was reduced down to 300 square meters. As a result, as we can see on the graph below (Askenazy,Weidenfeld (2007)), the number of new retail shops substantially decreased from 1996.

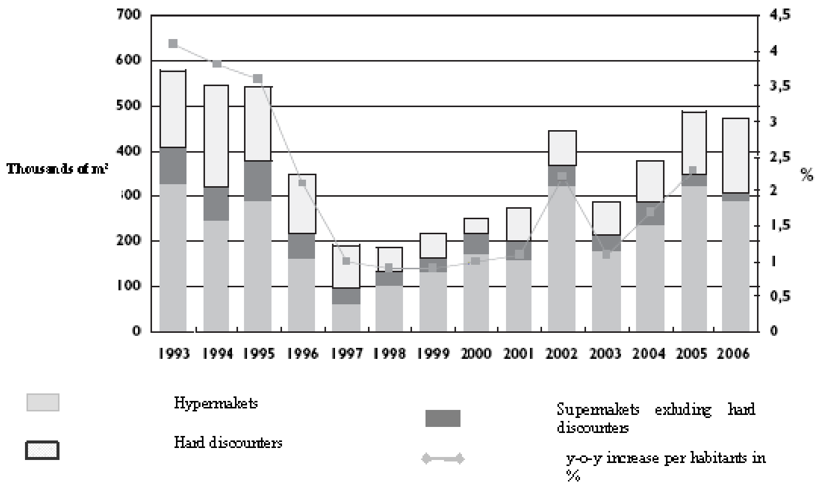


Figure 10: *Surface of new retail shops from 1996 to 2006*
*Source: Philippe Askenazy (2007)*

   Moreover, added to the Raffarin law, the Galland law reinforced the ban to sell at a loss that has been existing in France since 1963: the retail sector profit margins due to commercial cooperation services to producers were not included in the sell at a loss threshold. During these years, retailers increased these profit margins, which led producers to mechanically increase their unit cost: both consumer prices and retail sector profit margins have increased whereas producer profit margins have remained constant. Allain, Chambole (2005) explains how it induced increasing prices.
   As a result, from 1996 to 2004 competition was reduced in the retail sector, and the inflation in processed food prices was higher than in the euro area.

3. The reforms: from the Sarkozy agreements in September 2004 to the Chatel law in March 2008. In September 2004, because of producer and consumer complaints, the government favoured agreements between producers and retailers that led to a decrease by 1.2% of the prices in supermarkets.

In July 2005, the Jacob law redefined the threshold of sale at a loss, partly deducting the profit margins due to commercial cooperation services. In January 2007, the Chatel law further deducted these profit margins to the sale at a loss threshold.

Finally, in March 2008, the second part of the Chatel law totally deducted these profit margins to the sale at a loss threshold. Moreover, the economy modernisation law, voted in July 2008, reformed the Raffarin law: the threshold above which an authorization was required to open a retail shop was re-established up to 1000 square meters.

The consequence of these reforms was a decrease in the sale at a loss threshold that enhanced retailers to decrease their profit margins. From then on, the inflation in processed food prices has been lower in France than in the euro area.

**Documents de Travail**

250. A. Monfort, «Une modélisation séquentielle de la VaR,» Septembre 2009

251. A. Monfort, "Optimal Portfolio Allocation under Asset and Surplus VaR Constraints," September 2009

252. G. Cette and J. Lopez, "ICT Demand Behavior: An International Comparison," September 2009

253. H. Pagès, "Bank Incentives and Optimal CDOs," September 2009

254. S. Dubecq, B. Mojon and X. Ragot, "Fuzzy Capital Requirements, Risk-Shifting and the Risk Taking Channel of Monetary Policy," October 2009

255. S. Frappa and J-S. Mésonnier, "The Housing Price Boom of the Late '90s: Did Inflation Targeting Matter?" October 2009

256. H. Fraisse, F. Kramarz and C. Prost, "Labor Court Inputs, Judicial Cases Outcomes and Labor Flows: Identifying Real EPL," November 2009

257. H. Dixon, "A unified framework for understanding and comparing dynamic wage and price-setting models," November 2009

258. J. Barthélemy, M. Marx and A. Poisssonnier, "Trends and Cycles: an Historical Review of the Euro Area," November 2009

259. C. Bellégo and L. Ferrara, "Forecasting Euro-area recessions using time-varying binary response models for financial variables," November 2009

260. Guillaume Horny and Matteo Picchio, "Identification of lagged duration dependence in multiple-spell competing risks models," December 2009

261. J-P. Renne, "Frequency-domain analysis of debt service in a macro-finance model for the euro area," December 2009

262. Claire Célérier, "Forecasting inflation in France," December 2009

Pour accéder à la liste complète des Documents de Travail publiés par la Banque de France veuillez consulter le site :
http://www.banque-france.fr/fr/publications/documents_de_travail/documents_de_travail_09.htm

For a complete list of Working Papers published by the Banque de France, please visit the website:
http://www.banque-france.fr/fr/publications/documents_de_travail/documents_de_travail_09.htm

Pour tous commentaires ou demandes sur les Documents de Travail, contacter la bibliothèque de la Direction Générale des Études et des Relations Internationales à l'adresse suivante :

For any comment or enquiries on the Working Papers, contact the library of the Directorate General Economics and International Relations at the following address :

BANQUE DE FRANCE
49- 1404 Labolog
75049 Paris Cedex 01
tél : 0033 (0)1 42 92 49 55 ou 62 65 ou 48 90 ou 69 81
email : thierry.demoulin@banque-france.fr
jeannine.agoutin@banque-france.fr
veronique.jan-antuoro@banque-france.fr
nathalie.bataille-salle@banque-france.f