Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

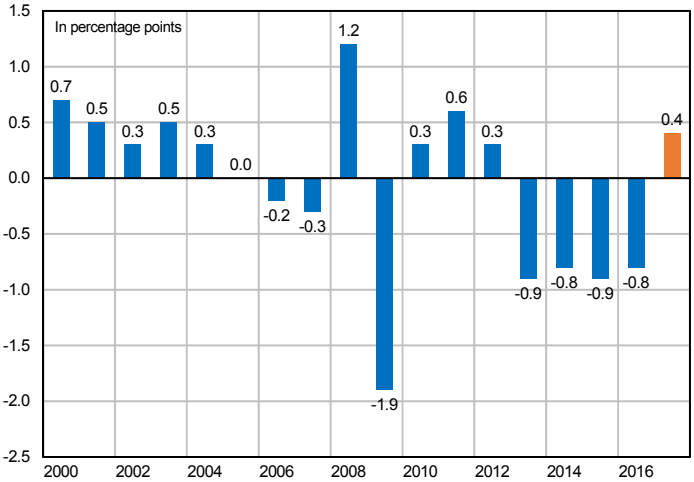
No. 198
May 2017

TRÉSOR-ECONOMICS

An examination of inflation forecasts in budget bills

- Between 2013 and 2016, inflation, within the meaning of the consumer price index (CPI), was almost one percentage point lower than budget bill (PLF) projections. This can either be put down to an increased difficulty in forecasting inflation in an extraordinary economic environment (very low inflation, European Central Bank key interest rates constrained by the zero lower bound, rollout of new instruments) or to other more usual reasons such as unforeseen exchange rate and energy price fluctuations.
- Since 2000, budget bill inflation forecasts have been unbiased: on average, there were no differences between forecasts and actual figures although, for some years, these were significant (refer to the chart below). For the same period, deviations from budget bill projections were always approximately the same as those of other forecasting bodies such as the International Monetary Fund, the European Commission and Consensus Economics, with an average absolute deviation of 0.6 pt.
- The majority of the forecast gap is due to unforeseen variations in energy prices. Oil price and exchange rate fluctuations, that occurred after the freeze applied in a standard manner when the budget bill forecast was made, accounted for over a half of the total inflation forecast gap for the period 2007-2016 in absolute terms.
- The aforesaid fluctuations have an impact on both energy inflation and core inflation. As a result, a depreciation of the euro increases businesses' intermediate consumption prices. Similarly, a rising oil price causes an increase in businesses' input prices as well as, over time, a rise in wage demands as employees look to protect their purchasing power faced with higher pump prices. In both cases, companies will offset a proportion of their increased costs against sale prices.
- The rollout of disinflationary economic policies (Competitiveness and Employment Tax Credit and the Responsibility and Solidarity Pact) and the larger-than-expected effect on prices of growing competition in a number of sectors (mobile telephones, mass retail) also account for part of the forecast gap on core inflation noted since 2013.
- For 2017, the Stability Programme of April 2017 revised inflation upward from the 2017 Budget Bill figure of 0.8% to 1.2%. This is mainly a reflection of the upswing in oil prices between autumn 2016 and spring 2017.

Gaps between actual inflation figures and the inflation forecasts in the budget bills



Sources: Insee, budget bills, Stability Programmes.
Note to the reader: the inflation forecast gap is actual inflation minus forecasted inflation; the orange bar for 2017 shows the upward revision of the inflation forecast between the 2017 Budget Bill (0.8%) and the 2017 Stability Programme (1.2%).

MINISTÈRE DE L'ÉCONOMIE
ET DES FINANCES

Forecasting is shrouded in uncertainty. When differences are noted after the fact between the forecast and actual figures for an economic indicator, forecasters attempt to understand the origin of these deviations. The aim is to bolster analysis methods and the tools used to improve the accuracy of forecasts.

To this end, this paper will firstly cover differences in forecasts for the volatile components of inflation, which are especially tied in with changes to the prices of oil and agricultural commodities. In turn, these gaps may have indirect effects by spreading to other price and wage components. This may cause deviations in core inflation forecasts and this will be dealt with in the second part. Lastly, core inflation forecast gaps may also be due to the stronger-than-expected impact of disinflationary initiatives and to a number of sector-based price scenarios.

1. The contribution of the volatile component to the gaps between inflation forecasts and actual inflation figures

1.1 On average, the budget bill inflation forecast gaps have zero bias and are comparable with those put forward by private forecasters and international organizations

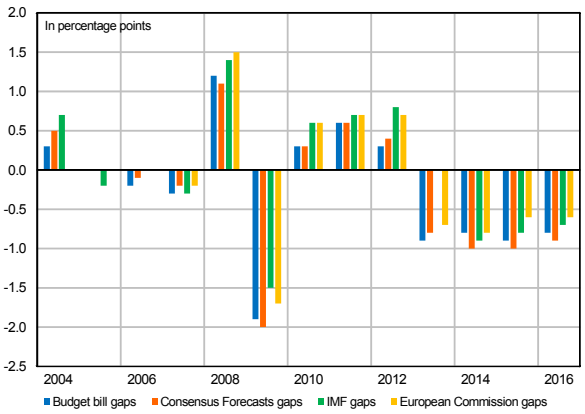
From 2000 to 2016, the average deviation of budget bill inflation forecasts was almost zero (refer to table 1).

Table 1: Features of the distribution of budget bill inflation forecast gaps

Average	0.0
Absolute Average	0.6
Median	0.3
Ranges	[–1.9; 1.2]

A comparison with the projections of private economists, the IMF and the European Commission shows that the CPI forecast gaps with the budget bills are broadly similar to those made by other forecasters: every year, inflation forecast gaps have both the same sign and are of similar size in light of the average absolute deviation (refer to chart 1).

Chart 1: Comparison of total inflation forecast gaps



Sources: Insee, budget bills, Consensus Forecasts, IMF, European Commission.

Box 1: How are inflation forecast gaps calculated?

Inflation is measured by changes in the CPI, which is Insee's benchmark index. For each budget bill, the gap is calculated as the average annual difference between actual inflation in year N and the inflation projected in September of year N–1 for year N when the budget bill for year N is drafted.

The forecasts made by private economists were measured by the average CPI forecast for year N in September of year N-1 of the technical group of the National Economic Council, comprising the main private and public economic institutes, then of the Consensus Forecasts since 2014. To ease country comparisons, international organizations choose to calculate inflation on the basis of changes in the Harmonised Index of Consumer Prices (HICP) based on a common methodology. The IMF issues an HICP France forecast for year N in the World Economic Outlook of October of year N–1 and this projection is compared with the actual HICP France figure provided by Insee. Lastly, the European Commission's forecast is the HICP France forecast for year N contained in the European Economic Forecast of November of year N-1 which is also compared with the actual HICP France figure provided by Insee (since 2007).

It can be expected that the variance of the forecast gap will increase according to the length of the forecast period: it is harder to forecast inflation for year N in September of year N–1 than in October or November of that year.

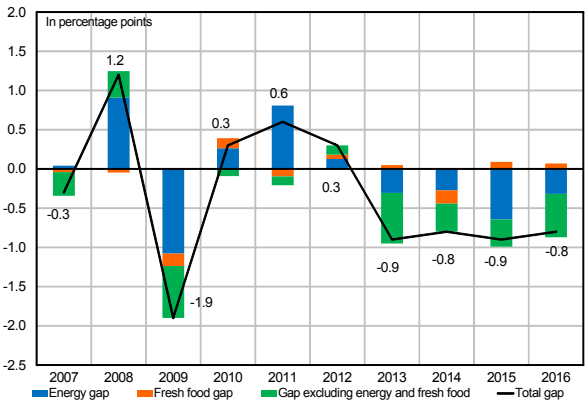
1.2 Forecast gaps are essentially due to products with volatile prices

The CPI can be decomposed between a volatile component and an underlying component:

- The core inflation index is a seasonally-adjusted index showing the underlying trend for price changes. It does not include prices subject to government intervention (electricity, gas, tobacco, health services, etc.) and products with volatile prices (fresh food, energy). The index is adjusted to reflect tax measures such as variations in VAT. In 2017, it accounts for around 61% of the total CPI scope.
- The volatile component is comprised of energy inflation and fresh food product inflation which are both subject to fluctuations that may be extreme owing to weather conditions or to tightening global markets. Despite having comparatively little weight, energy and fresh food prices are key to determining inflation fluctuations.

Since 2007, the majority of the inflation forecast gap can be put down to its volatile component (refer to chart 2). On average, the energy inflation forecast gap accounted for 0.5 point of the total inflation forecast gap from 2007 to 2016 (in absolute terms). The fresh food product inflation gap also contributed substantially to the forecast gap on total inflation: 0.1 point in 2010 and 0.2 point in 2014.

Chart 2: Accounting decomposition of the inflation forecast gap



Sources: Insee, budget bills

1.3 Forecasts are based on unchanged oil prices and exchange rates in accordance with the empirical economic literature, what explains the forecast gaps for the volatile component

Energy inflation, that is to say the change in energy CPI, is strongly linked to fluctuations in the price of the barrel of crude oil. Changes in the Brent oil price have a limited impact on pump prices as the price of a barrel only accounts for around 25% of the pump price inclusive of taxes. Also of significance are changes in taxes (in particular, the domestic consumption tax on energy products, TICPE (on volumes) and VAT (in percentage of sale prices)) which together account for 60% of pump prices, as well as the profit margins of refineries. Empirical research shows that oil prices can be better represented by a random walk without drift meaning that the best forecast of future prices is the price today. Other techniques, such as using futures contracts, do not significantly increase the accuracy of forecasts from a statistical standpoint. This conclusion has been backed up by recent contributions including the work of Hamilton (2009)[1] and Alquist and Kilian (2010)[2].

At a constant barrel price in dollars, fluctuations in the euro/dollar exchange rate have an effect on the energy CPI. As with the oil price, and for the same reason, exchange rate forecasts are based on a no change forecast. This strategy relies on Meese and Rogoff's seminal article (1983)[3] which demonstrates that, up to a period of 12 months, the random walk provides a more accurate forecast than structural models. This was confirmed up to a two-year period by Chinn and Meese (1995)[4] and Cheung, Chinn and Garcia-Pascual (2005)[5].

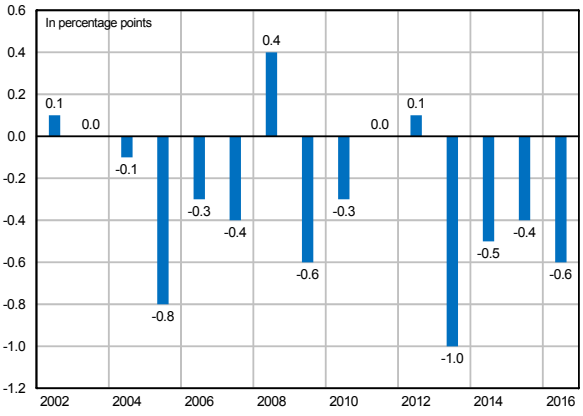
2. Changes in oil prices and exchange rates affect core inflation

2.1 The underlying component of the CPI also contributes to forecast variations

If we estimate core inflation using the CPI excluding energy, fresh food and public tariffs[6] (refer to chart 3), we see that its contribution to the overall CPI gap has been both substantial and constantly negative since 2013 (0.6 point in 2013, 0.3 point in 2014, 0.2 point in 2015 and 0.4 point in 2016).

As inflation forecasts are based on price projections at sector level, the forecast gap can be broken down based on the gap for each item *ex-post*. As a result, at sector level, inflation for services has been systematically overestimated since 2009, except for 2014 when it was slightly underestimated, most probably owing to the increase in VAT having a faster-than-expected effect on prices (on 1 January 2014, the standard rate increased from 19.6% to 20% and the intermediate rate from 7.0% to 10.0%). On average, between 2007 and 2016, services inflation weighed in at 0.2 point in respect of the total gap (in absolute terms).

Chart 3: Core inflation forecast gaps



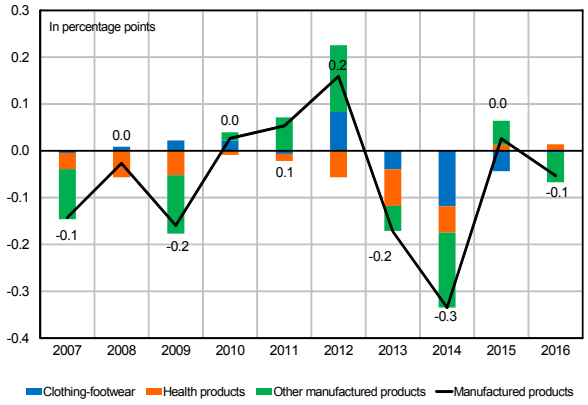
Sources: Insee, budget bills, DG Trésor calculations

In 2013 and 2014, inflation in manufactured products was especially overestimated and contributed 0.1 point in absolute terms to the total inflation forecast gap for the period 2007-2016. For these products, inflation in "other manufactured products" made the most telling contribution (in absolute terms) to the forecast gap between 2007 and 2016 (refer to chart 4). Other manufac-

(1) Hamilton, J. (2009), "Understanding Crude Oil Prices", *Energy Journal*, vol. 30, no. 2, pp. 179-206.
(2) Alquist, R., Kilian, L. (2010), "What Do We Learn from the Price of Crude Oil Futures?", *Journal of Applied Econometrics*, vol. 25, no. 4, pp. 539-573.
(3) Meese, R., Rogoff, K. (1983), "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?", *Journal of International Economics*, vol. 14, pp. 3-24.
(4) Chinn, M., Meese, R. (1995), "Banking on Currency Forecasts: How Predictable Is Change in Money?", *Journal of International Economics*, vol. 38, pp. 161-178.
(5) Cheung, Y., Chinn, M., Garcia-Pascual, A. (2005), "Empirical Exchange Rate Models of the Nineties: Are Any Fit to Survive?", *Journal of International Money and Finance*, vol. 24, no. 7, pp. 1150-1175.
(6) Unlike the index published by Insee, this reconstituted underlying index is not adjusted to neutralize the impact of new tax measures on inflation.

tured products cover manufactured products excluding clothing-footwear and health products. This is a very diverse item as it includes automobiles, audiovisual equipment and furniture. As a large proportion of these goods are imported, their price is influenced by the exchange rate, and directly by production costs in the euro area. As national manufacturers are also subject to international competition, their sale prices are also affected by foreign prices converted into domestic currency.

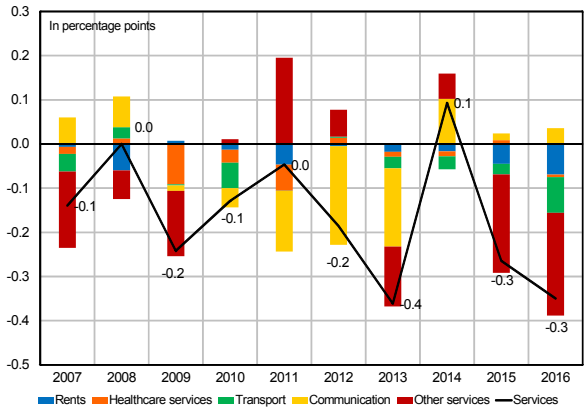
Chart 4: Contributions of manufactured products to the total inflation gap



Sources: Insee, budget bills.

As regards services inflation, the main contribution to the total gap is tied in with the forecasted prices for "other services" (refer to chart 5). This is also a very diverse item which covers, inter alia, restaurants and hotels, social protection services, financial services and even cultural services. Despite having comparatively little weight in the CPI (2.4%), telecoms services have also tellingly contributed to the overestimation of forecasted inflation since 2011 (refer to section 3.2.).

Chart 5: Contributions of services to the total inflation gap



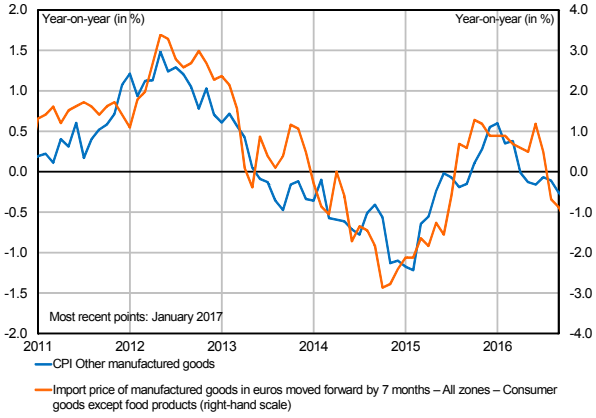
Sources: Insee, budget bills.

2.2 Oil prices and Forex rates have effects that go beyond the energy component

Changes in oil prices and forex rates affect core inflation in various ways.

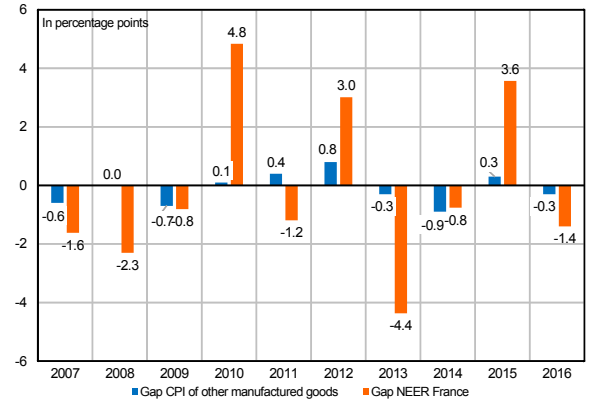
Forex rates play an important role in the price of manufactured consumer goods, some of which are imported[7]. Since 2011, the change in prices of other manufactured goods has provided a strong positive correlation to the prices of imported consumer goods (see chart 6). Thus, inflation of other manufactured products was overestimated whenever France's nominal effective exchange rate (NEER) grew, and vice versa, with the exception of 2011 (see chart 7).

Chart 6: CPI of other manufactured goods and the import price of industrial consumer goods



Source: Insee.

Chart 7: Forecast gap of the CPI of other manufactured goods and of France's nominal effective exchange rate



Sources: Insee, budget bills.

How to read this chart: the NEER forecast is calculated as the difference between forecast and actual NEER growth; a negative NEER gap means that the exchange rate increased more than expected.

(7) The import penetration rate in volume of manufactured goods, calculated as the ratio of imports to national consumption, came to 43% in 2015.

In all, the exchange rate pass-through into consumer prices is dependent on both microeconomic and macroeconomic factors[8]. With respect to businesses, the pass-through depends on the structure of the market (market power of businesses, the existence of substitutes, etc.), the invoice currency, menu costs and companies' financial hedging strategies. With respect to the macroeconomic conditions, the degree to which an economy is open to the outside (in particular the import penetration rate), the sector-based structure of imports and the inflation regime (in connection with the credibility of monetary policy) all play an important role.

Over and beyond this initial impact via the price of imported consumer goods, the exchange rate and the price of oil[9] also indirectly affect prices:

- in the medium-term, via the production process when businesses pass on increases in their intermediate consumption costs into their sale prices;
- and in the long-term, via the wage-price loop: employees integrate price changes with the goal of maintaining purchasing power during wage negotiations. These second-round effects, primarily in labour-intensive sectors, amplify the transmission of volatile inflation to total inflation.

2.3 In some years, changes in oil prices and forex rates can account for up to 0.1/0.2 percentage point in the core inflation forecast gap

Using a macro-sectoral wage-price spiral model similar to the one developed by Thornary and De Loubens (2010)[10], we examine the response of core inflation to permanent shocks in a bid to quantify the impact of fluctuating oil price and forex rates on core inflation. To do so, we compare the behaviour over time of core CPI simulated using *ex-post* observations of oil prices and foreign exchange rates on one hand, and assuming frozen prices in each budget bill on the other hand.

Since 2007, average core inflation forecast gaps – assuming frozen oil prices and foreign exchange rates – have been around zero, but can be significant for certain years (see tables 2 and 3). Thus, in 2013 and 2016, changes in oil prices and forex rates accounted for about 0.1/0.2 percentage point in the absolute value of the core CPI forecast gap. In 2015, on the other hand, changes in the forex rate had an opposite effect on inflation from that of the price of oil, so that the two effects basically offset each other.

Given the many assumptions required, these results are preliminary, but they suggest that the overall effect of forex rates and oil prices on the CPI is significantly greater than its transitory effect on the most volatile part of CPI.

Table 2 and 3: Effects of oil price and forex freezes on total inflation, energy inflation, core inflation and average wages

Impact of an oil price freeze on…	Average annual growth rates (in percentage points)									
Budget Bill	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total CPI(100%)	−0.1	0.5	−1.0	0.1	0.6	0.0	−0.1	−0.1	−1.1	−0.4
Energie CPI (7.5%)	−0.5	5.6	−10.9	1.8	6.3	0.3	−0.5	−1.5	−10.8	−4.2
Core CPI (61.3%)	0.0	0.1	−0.2	0.0	0.1	0.0	0.0	0.0	−0.1	−0.1
Average wage (per employee)	−0.2	0.5	−0.9	0.1	0.4	0.0	0.0	−0.1	−0.8	−0.4

Impact of a foreign exchange rate freeze on…	Average annual growth rates (in percentage points)									
Budget Bill	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total CPI(100%)	−0.1	−0.1	0.1	0.1	−0.1	0.2	−0.1	0.0	0.2	0.0
Energie CPI (7.5%)	−0.8	−1.0	0.7	1.1	−0.9	1.2	−0.7	0.0	2.0	−0.1
Core CPI (61.3%)	0.0	−0.1	0.0	0.1	−0.1	0.1	−0.1	0.0	0.1	−0.1
Average wage (per employee)	−0.1	−0.1	0.1	0.1	−0.1	0.1	−0.1	0.0	0.2	0.0

Source: Macro-sectoral spiral model, author's calculations.

(8) European Central Bank (2016), "Exchange Rate Pass-through into Euro Area Inflation", *Economic Bulletin*, Issue 7/2016, pp. 27-47.
(9) Camatte H., Darmet-Cucchiarini M., Gillet T., Masson E., Meslin O., Padieu Y et Tavin A. (2016), "Impact of the oil price decline on France and the global economy", *Trésor-Economics*, no. 168.
(10) De Loubens A. and Thornary B. (2010), "Modélisation de la boucle prix-salaires pour la France par une approche macrosectorielle", *DG Trésor Working Document*, no. 2010/04, 43 pages.

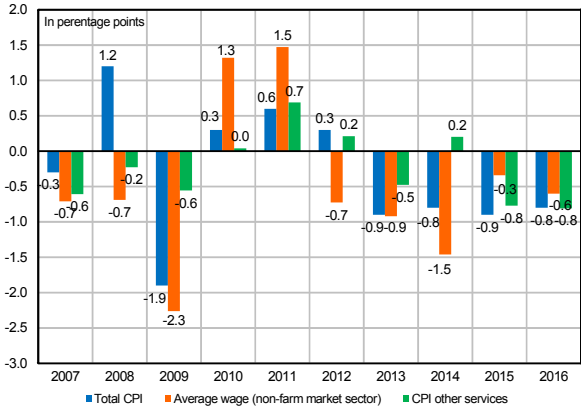
3. Over and beyond effects connected to oil prices and forex rates, some disinflationary measures appear to have had a greater impact than expected

3.1 Wage and price formation mechanisms appear to have deferred the average behaviours estimated in the past

Inflation and wage surprises have almost always trended in the same direction over the past 10 years (see chart 8). This is particularly the case with respect to inflation surprises in the "other services" sector.

The simultaneity of these movements can be partly attributed to oil and forex surprises, which have an effect on wages and prices. Nevertheless, even when these effects are taken into account, the core inflation forecast gap remains significant. Thus, particularly in 2014 and 2016, the exogenous variables of the wage-price spiral model can only partly explain the core inflation forecast gap (see Box 2).

Chart 8: Average wage (per employee) surprises in the non-farm market sector and inflation surprises



Sources: Insee, budget bills.

Box 2: **A post-mortem analysis of the forecast gap**

An econometric model specifies the behaviour of a variable - the "explained variable" – (for example inflation in the "other services" sector), based on other observed or forecast variables, the so-called "explanatory variables" (for example average wage per employee). A forecaster can deviate from the results of the model's spontaneous dynamic projection by adding an "ex-ante add-factor" that reflects his or her judgment, which corresponds to the part of the forecast not explained by the model. If the realized value of the "explained variable" deviates from the forecast, this difference can be attributed to two sources: (1) the realized value of the explanatory variables may differ *ex-post* from their projections and (2) the "*ex-post* add-factor", i.e. the part of the dynamics of the explained variable that remains unexplained by the model, is likely to differ from that which was chosen for the forecast (i.e. "the ex-ante add-factor"). The post-mortem analysis decomposes the forecast gap according to these two sources.

To illustrate, let's take the example of core inflation. Forecasting core inflation involves aggregating forecasts of its various parts. The core inflation forecast gap is partly due to gaps observed in the explanatory variables, particularly oil prices and forex rates (whose effects are given in tables 2 and 3). The remainder is due to the spread between the ex-ante and *ex-post* add-factors in the model's equations, particularly those specifying "other manufactured goods", "other services" and wages dynamics.

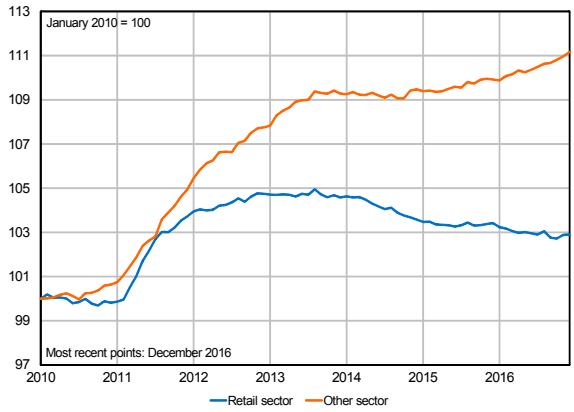
Let us take the example of "other services" inflation. The inflation observed in 2016 for this sector was lower than the budget bill forecast (see chart 8). This gap was partly due to the fact that wages (which are an important determinant in the price of services) had less momentum than expected. The remaining forecast gap was due to the spread between the ex-ante and the *ex-post* add-factors with respect to the "other services" equation. This add-factors gap has an effect on core inflation via two channels. On the one hand, it affects core inflation directly, because the other services inflation is part of core inflation, in accounting terms. On the other hand, it contributes to the core inflation forecast gap via the model's feedback effects. It gives rise to a forecast gap concerning total inflation, which has an influence on wages, and thus on "other services" inflation that are labour-intensive. The total effect of the add-factors gap for "other services" inflation dynamics thus has a potentially greater impact than its accounting effect on core inflation. In all, the add-factors spread for "other services" inflation contributed –0.2 percentage point to the core inflation forecast gap in 2016 (see table 4).

These behavioural changes, particularly concerning other services inflation (0.2 percentage point of core inflation in 2014, –0.1 point in 2015 and –0.2 point in 2016) should be compared with the difficulty in assessing the impact of measures aiming at lowering labour costs (the Competitiveness and Employment Tax Credit (CICE) and the Responsibility and Solidarity Pact) on sale prices. The transmission of lower labour costs to prices depends on sector-specific factors, such as the degree of competition, labour intensity, the financial situation of sector businesses, how production processes are structured, and so on. Moreover, in times of low inflation, the connection between nominal wages and inflation can be distended, given the existence of declining nominal rigidities, and the prices of services have been less dynamic than the robustness of wages in recent years would suggest.

3.2 It is especially difficult to evaluate price changes ex-ante in certain sectors that are undergoing mutations, particularly when competition sharpens

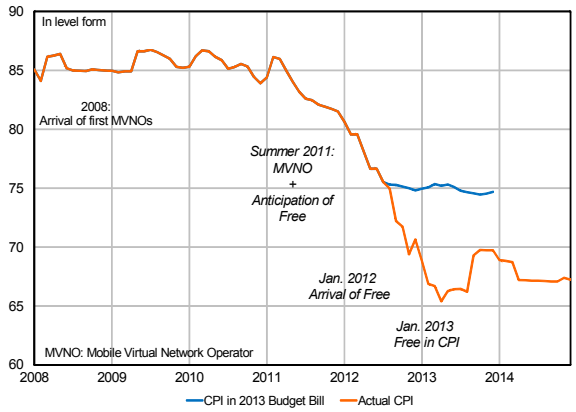
First of all, the competition between major food retailers since 2013 has reined in consumer prices for food products (excluding fresh food products) more than expected (see chart 9).

Chart 9: price indexes for convenience goods in the retail sector and other sectors



Source: Insee.

Chart 10: price index for the telecoms services sector



Sources: Insee, budget bill.

Subsequently, the arrival of a fourth mobile telecom operator in early 2012 led to a 10.4% drop in the price of communications in 2013 (after a 9.5% drop in 2012), whereas the 2013 budget bill called for prices in this sector to stabilise starting in mid-2012 (see chart 10).

Finally, the price index for the clothing/footwear sector was affected by the data collection period, which took place entirely during the sale season in 2014, in contrast to other years. This was not factored in at the time of forecast, and accounts for a 0.2 percentage point gap between 2014 core IPC and its forecast level.

These elements, which are difficult to predict, have contributed substantially to the forecast gap concerning core IPC in absolute terms: 0.6 percentage point in 2013, 0.1 point in 2014, 0.3 point in 2015 and 0.2 point in 2016 (see table 4).

In all, the full range of elements listed above can help explain the lion's share of the gap between forecast core inflation in the various budget bills, and the actual results (since the residual gap is of limited scope).

Table 4: Complete decomposition of the core inflation forecast gap

PLF	2013	2014	2015	2016
Core inflation forecast gap	−1.0	−0.5	−0.4	−0.6
Contribution of oil price and forex rate freezes	−0.1	0.0	0.0	−0.1
Contributions of add-factors gaps				
Inflation of other manufactured goods	0.0	−0.3	0.1	0.0
Inflation of other services	0.0	0.2	−0.1	−0.2
Average wage in the non-farm market sector	−0.1	−0.2	0.1	0.0
Sectoral contributions				
Telecoms	−0.3	0.2	0.0	0.0
Retail sector (food products)	−0.2	−0.1	−0.2	−0.2
Clothing/footwear	−0.1	−0.2	−0.1	0.0
Residual gap	−0.3	−0.1	−0.1	−0.1

Source: macro-sectoral spiral model, author's calculations.

Romain FAQUET

Publisher:
Ministère de l'Économie
et des Finances

Direction Générale du Trésor
139, rue de Bercy
75575 Paris CEDEX 12

Publication manager:
Michel Houdebine

Editor in chief:
Jean-Luc Schneider
+33 (0)1 44 87 14 22
tresor-eco@dgtresor.gouv.fr

English translation:
Centre de traduction des
ministères économique
et financier

Layout:
Maryse Dos Santos

ISSN 1962-400X
eISSN 2417-9698

Recent Issues in English

Mai 2017

No. 197. Green electricity: the advantages of a European approach
Mathilde Didier, Alexis Loublier, Arthur Souletie

March 2017

No. 196. A contribution to the work on deepening the Banking Union
Vincent Alhenc-Gelas, Lucie Castets, Thomas Ernoult, Nathanaël Mason-Schuler

No. 195. Impact of foreign exchange policies for commodity-exporting countries
Thomas Gillet, Myriam Morin Wang, Mathilde Tisseyre

No. 194. The world economic situation in spring 2017: a gradual improvment amid high uncertainty
Jean-Baptiste Bernard, Laetitia François, Thomas Gillet, Julien Lecumberry, Yasmne Osman, Morgane Salomé

No. 193. Patents and Technical Standardisation: Recordin Competition and Innovation
Louise Rabier

No. 192. The G20's accomplishments, 10 years after the crisis
Flavien Dupuis, David Nahoum

https://www.tresor.economie.gouv.fr/Ressources/tresor-economics