Extracting the inflation trend: a comparison of core inflation measures in France

Guillaume Guerrero
Matthieu Olivier
Tuotuo Yu*

Short-Term Economic Analysis Division

(*worked in the division when the report was written)

Inflation can be volatile. For example, in the space of barely 18 months from July 2008 to December 2009, retail prices in France are likely to vary by more than 4 points year-on-year, from a high point of 3.6% in July 2008 to a low point forecast at -0.7% in July 2009, before climbing back to around 0.6% in December 2009.

For the monetary authorities, whose main objective is to keep inflation at a low level over the medium term, it is therefore important to be able to distinguish the volatile part of inflation from its trend. Economists call this trend "core" inflation. This report examines the various indicators that these economists have put forward to estimate core inflation. Ideally, a core inflation indicator should meet three criteria: it has to play the role of "attractor" of future inflation, which should thus converge towards core inflation providing there is no later shock; it should help forecast future inflation; and it must be sufficiently simple to construct.

In France, it would appear that the indicator already published by INSEE, i.e. the index which is measured excluding indirect taxes, oil prices, seasonal food products and public tariffs, does possess these properties: 1) actual inflation does indeed tend to converge towards this indicator if there is not a shock at a later date; 2) it has a certain ability to forecast future inflation; and 3) it is easy to construct and to explain to the public. This observation will have to be reviewed if, as certain analysts fear, oil prices should follow an upward trend, which was not the case over the period when the tests were conducted here.

In March 2009, all the measures of core inflation studied in this report range from 1.3% to 1.9%, year-on-year. The medium-term risk of deflation is therefore minimal.

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High inflation has high economic and social costs...

Most economists agree that in its most extreme manifestations, inflation brings about high social costs. When prices rise very quickly (hyperinflation), the currency loses value rapidly. As the currency loses value from month to month, retailers end up refusing it as a method of payment. In this case, the currency no longer fulfils its role of trading intermediary. Without being quite so damaging, stable but high inflation is also a source of economic inefficiency. In particular, this is because it makes it more difficult to evaluate the prices of goods since they are permanently changing: the choices made by agents become less efficient in cases, for example, of consumption or allocation of capital between productive activities.

... as does a lasting drop in prices

In the event of deflation, that is, when prices and price expectations are heading downwards over the long term, agents postpone their purchases, triggering a spiral in which activity drops and then prices fall, thereby causing expectations to fall once again.

The monetary authorities have to rid inflation statistics of temporary fluctuations...

Today, the community of economists therefore broadly agrees that inflation should be kept at a low but positive level and that this is the role of the monetary authorities. These authorities do indeed possess the most effective instruments for influencing price rises. However, monetary policy is only efficient over a time horizon of one to two years. Before acting, the authorities therefore have to rid inflation statistics of the temporary fluctuations whose effects will quickly fade. They will only retain the longest-lasting trends which will have a persistent effect on inflation, providing there is no reaction from the authorities. Reactions to one-off shocks with transitory effects on inflation are likely to destabilise the economy. Conversely, failure to react to persistent shocks could result in inflation straying from its optimum path, which is characterised by a moderate, regular rise in prices.

According to our forecasts, inflation should drop from a high point of 3.6% in July 2008 to a low point of -0.7% in July 2009 before rising to 0.6% in December. One year ago, the figure of 3.6% was probably higher than "real" core inflation as inflation has clearly declined since then. Similarly, the figure of -0.7% is most likely lower than core inflation since a rise in inflation is expected.

... in other words estimate "core" inflation

So how can we measure the underlying trend commonly known as "core inflation"? This is the purpose of this report. To begin with, it presents the two core inflation concepts currently used by economists. It then describes the methods used to extract the core inflation rate. The third part presents the three quality criteria for a core inflation indicator. Last, the report applies the various extraction methods to France, using long series, in order to deduce the best indicator of core inflation.

What is core inflation?

Core inflation is generally defined as a signal of the "real" medium-term inflation trend. The aim is to remove the noise which alters the data and scrambles the medium-term message relating to changes in prices. However, it is not easy to distinguish the noise from the signal as neither of them is directly measurable; they have to be "extracted" from the price changes that are observed.

Even among economists, the way the signal should be extracted and the noise defined is still a matter of debate.

One concept defines core inflation as the constant part of inflation that allows a forecast of future inflation

According to one concept, inflation can be broken down into one part that progresses at a more-or-less constant rate and another part that varies more erratically. The stable element in inflation is said to represent the long-term inflation expectations of the economic agents. As such, it may constitute a good indicator of future inflation.

Three types of mechanisms may be at the origin of a rise in the general price index.

Inflation can vary greatly: due to a one-off supply shock...

The first mechanism has its origins in a one-off supply shock. This is the case of an increase in oil and fuel prices following a specific event in a producing country.(1) This causes a transitory rise in the general price index but in theory does not affect the inflation trend. Once the situation has returned to normal, oil prices are restored to their initial levels. In this respect, such a rise must be excluded from the scope of core inflation. It corresponds to the component that undergoes shocks which are sometimes large but usually transitory.

... a lasting supply shock...

The second mechanism comes into play when there is a long-lasting supply shock. If the increase in oil prices is seen as likely to last, the agents incorporate it into their expectations. They therefore negotiate a rise in their wages, bringing about an increase in production costs. Entrepreneurs then pass on this increase to their sale prices, and so on. In this case, the length of time that the oil price-rise lasts has a longer-term effect on the variation in general price levels. The price rise that results from this type of shock must be included in the core inflation indicator. The oil crises of 1974 and 1979 are good examples of lasting supply shocks followed by a persistent rise in core inflation.

...or a demand pull.

The third mechanism emerges in the event of a demand pull. When the economy is using all its production capacity (labour and equipment), a persistent increase in demand for goods and services also generates a long-lasting rise in prices. Indeed, as all the production capacity is being used, the supply of goods and services can no longer increase and it is therefore the prices that are adjusted.

Among the possible definitions of core inflation, one excludes supply shocks while the other integrates them.

A supply shock is not always incorporated into the definition of core inflation. According to the time horizon, we can distinguish two definitions of core inflation which share the characteristic of relying on macroeconomic concepts of global supply and demand. To illustrate these two visions, we shall take the following formula:

$$\pi_t = \pi_t^{LT} + X_t + \nu_t \qquad (1)$$

(1) For example, the damage caused to oil rigs and refineries by Hurricane Katrina.

Inflation π_t can be broken down into its long-term trend (π_t^{LT}), demand pull (X_t) and one-off exogenous supply shocks ν_t, for example a transitory rise in the prices of seasonal food products owing to weather conditions.

A first definition of core inflation (see Eckstein, 1981) corresponds to the inflation rate that would occur on the long-term growth path of the economy. Deviations from this path, reflecting fluctuations in demand or exogenous shocks, are therefore excluded from it. In the formula (1), core inflation is equal to π_t^{LT}.

Another definition of core inflation (see *Quah and Vahey, 1995*) also includes cyclical movements in inflation associated with demand pressure. Here, core inflation is equal to $\pi_t^{LT} + X_t$.

The choice of one or other definition consequently depends on the time horizon: in the medium term, i.e. the horizon on which the demand shocks still have effects, the Quah and Vahey definition is appropriate. Over the longer term, i.e. when these effects have dissipated, the Eckstein definition is more pertinent.

According to a second concept, core inflation corresponds to a general price movement

According to a second concept, core inflation captures the price-change component which is common to all goods and services and excludes relative price changes. As before, this shared component reflects the expectations of agents and their drivers, but the theoretical approach used to isolate core inflation is different.

The components showing excessive price movements must be excluded from core inflation

In this approach, each price change in a sector at an elementary level is broken down into two parts: one is common to all sectors and the other is specific to the sector. The first component is representative of the general price rise and therefore of input prices and wages. If a producer expects an inflation π_t^C of his costs, he will increase his prices by the same amount, all else being equal. But a sector-specific event may occur. For example, a drought may cause wheat production to nosedive. At constant demand, the price of wheat increases. This rise, captured by π_{it}^s, is specific only to the food products concerned (flour, pasta, etc).

Inflation in a sector can therefore be summarised as follows: $\pi_{it} = \pi_t^C + \pi_{it}^s$.

Core inflation according to this second concept is equal to π_t^C and excludes those products whose price movements might blur the more general inflation trend, in other words the products for which component π_{it}^s is excessive.

However, this notion is quite controversial. According to the neoclassical theory, in a flexible economy a rise in certain relative prices (π_{it}^s) should be compensated for by a reduction in others, so that the general price level remains unaffected. As a result, aggregate inflation should reflect true core inflation. But in practice, there are at least three reasons why relative price movements can affect measures of aggregate inflation.

In practice, headline inflation can give a deceptive view of true core inflation

In the first place, the theoretical index in neoclassical theory cannot be constructed in practice. It is a "super" aggregate index whereas in practice partial indices are built, such as the INSEE index for example. Indeed, the theoretical index takes account of all the price variations with the exact weightings for each period. The INSEE index is only an imperfect estimator because in practice, it is

impossible to cover all products on the territory. In this case, a rise in the price of Brent may not be fully compensated for because the relative price drops that it may bring about are not all incorporated into the index calculated by INSEE.

Secondly, even if the price index did allow complete coverage, the existing price indices would not instantly take into account the effects of substitution by consumers between goods following the price changes. The weightings of items in the price index are based on consumption expenditure in value observed at a fine level, and they are only calculated once a year. For a given month, an increase in the price of a product may immediately lead to a reduction in the volume consumed in favour of other substitutable products, a factor which brings down the share of this item in total consumption expenditure. In theory, the effect on the aggregate index is lessened since the price rise is attenuated by the drop in consumption of this good. In practice, as the weighting remains constant over the year, the price rise has a greater effect on the general price index than it should do in theory.

Thirdly, prices may not be entirely flexible in the short term, particularly if there are "adjustment costs". It may be too costly for a restaurant owner to reprint all his menus if the price rise for ingredients is not large enough. It could also be expensive to acquire the information required to judge how long the shocks suffered by the producer will last (Mankiw and Reis, 2002). In this case, the price adjustments are not necessarily instantaneous and the price movements between various goods may not compensate for each other exactly. Aggregate inflation will therefore be affected by the changes to certain prices without this reflecting the general rise once all adjustments have been made. To observe core inflation, we have to be able to distinguish these relative price movements from the general price rise itself.

How is core inflation estimated?

In practice, two types of methods have been developed to estimate core inflation. Each one stems from one of these two concepts presented above to define core inflation.

Measuring persistent inflation: separate the trend from the cycle

A first approach which is closely linked to the concept of persistent inflation consists in using one of the many existing statistical filters (Hodrick & Prescott, Christiano & Fitzgerald, etc.) to extract the inflation trend. This approach has one major drawback. It requires arbitrary hypotheses to be made about the trend process, about the correlation between trend and cycle, or about the properties of the cycle itself. As a result, a substantial number of different estimates can be obtained according to the technical choices made.

Quah & Vahey proposed an economic model to isolate core inflation. In the long term (in the absence of disequilibrium between supply and demand), inflation is determined by the monetary regime, while production is driven by real factors only. However, in the short term, inflation may stray from its equilibrium path.[2] The authors' aim was therefore to break inflation down into a long-run process (core inflation) and a deviation from equilibrium which is transitory and provides little information for the purposes of monetary policy. This breakdown is based on a structural model which includes consumer prices and a measure of GDP.[3]

(2) Neo-Keynesians evoke problems of nominal rigidities, while the Neo-classicals see transitory expectation errors.
(3) For further details, see the article by Quah & Vahey (1995).

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Measuring common inflation: exclude excessive price movements or reduce their weight

The alternatives to the measures that separate trend from cycle consist in excluding or giving less weight to the price index components which are most sensitive to external shocks (weather conditions, oil prices, etc.).

Among these, a first measure permanently excludes certain pre-identified components from the consumer price index. For example, the INSEE core inflation indicator excludes seasonal food products, energy and public tariffs from the scope of the index. As these products are the most sensitive to external shocks, their relative prices can swing sharply. They must therefore be disregarded.

A second method known as "truncation" does not systematically exclude these components but instead each month eliminates the items whose price changes are the greatest, both upwards and downwards. The items removed in this way are thus likely to be different each month.

A third way consists in replacing the initial weights of these components by weightings that are inversely proportional to their volatility.(4)

These methods could be accused of still containing an arbitrary factor, in particular relating to the choice of the optimum proportion of components to be excluded. Additionally, the truncation method may result in exclusion of a variable that is informative about the medium-term trend. For example, computer products, the inflation rate of which has been strongly negative in recent times, would regularly be discounted with this method. But the inflation rate of computer products reflects the elevation of technological progress that agents have probably incorporated into their expectations, and it should have a lasting effect on headline inflation.

How can we judge the quality of core inflation?

To judge the quality of these different methods, we should first look at the two main uses of core inflation. Firstly, it can be used by the monetary authorities to conduct their policy. Secondly, it can help us judge the efficacy of this policy. Both these uses should be taken into account when determining the desirable properties of core inflation.

In this context, a relevant inflation indicator must not be too difficult to construct and understand. A core inflation indicator must also have good predictive ability, should be subject to little revision, and must be credible.

The indicator must be a good medium-term inflation predictor...

The measure must be able to distinguish persistent movements from transitory movements. Otherwise, the Central Bank may react too quickly to variations in the measure, as it will believe it to be permanent when it is actually only reflecting transitory movements. Two tests presented in the methodological annex are often used in the literature to check this point. The first test assesses the propensity of inflation to converge on average towards the core inflation indicator (measured by the methods described above): if it does, then it represents the inflation trend. The second test evaluates the predictive power of the core inflation indicator: does it provide additional information for the medium-term forecasting of inflation, relatively to that contained in the recent past of inflation?(5)

(4) All these methods are presented in detail in the methodological annex.
(5) In an article by Catte and Slok (2005), these tests were applied in order to assess the quality of core inflation indicators in the USA, the Euro Zone, the United Kingdom and Canada.

... should not be subject to revision...

Additionally, if the measure is regularly revised, its availability will be delayed and the indicators available for monetary policy will deteriorate. It therefore should not be revised much. This criterion irremediably disqualifies statistical filters.

... and be credible

As well as its technical quality, the credibility of the core inflation measure can be assured if it is built by a different body from the Central Bank or if it can be verified by an independent agent. For the purposes of credibility, it must also be easily understood by the public so that the authorities can explain the difference between core inflation and observed inflation in simple, concrete terms.

Which core inflation indicator should be used for France?

Ultimately, the choice of the right method can only be decided on an empirical basis. This is why we are going to apply the methods that exclude or weight the excessively volatile components to the monthly consumer price index data in France.(6) Up to now, the data available to extract the trend started in 1990 (1998 base). To be able to conduct tests properly on the quality of the estimators, it was indispensable to have longer series covering the periods in the 1970s when inflation rose, and the 1980s with the disinflation movement. We therefore retropolated the 36 items composing the 1998 base back to 1972 (*see box*). In this way we can cover several inflationist episodes and check the ability of the various measures to detect them.

All the indicators detect the key events of the last 40 years

All the core inflation indicators (30% trimmed mean, 40% trimmed mean, Jarque & Bera, Huber, volatility-weighted mean, double weighted mean, INSEE core inflation, INSEE core inflation corrected for tax measures; see methodological annex) highlight the key events of the last 40 years (*see Graphs 1 to 5*). We find the two oil crises of the 1970s.(7) The extent of these crises was so great that they also spread to items other than energy. This spread was almost instantaneous, as shown by the perfect coincidence between the peaks of headline inflation and those of the core indicators. We can also recognise the "competitive disinflation" started in the early 1980s.(8)

This led to a decrease in inflation up to the end of the 1990s. It was a policy that brought core inflation to below 2% in the 1990s, a level compatible with the Maastricht Treaty ratified in 1992. We can also see the "mini oil crisis" of 1999-2000 which, combined with a sharp rise in the prices of food commodities, caused the core inflation indicators to increase. This latter shock seems to have taken time to spread to items other than energy and food: most indicators rose a few months after headline inflation. Last, we identify the sharp rise in oil and food commodity prices in 2008. This price boom was so great that it substantially raised the core inflation indicators.

(6) We shall not be addressing the methods that separate trend from cycle. They are difficult for the public to understand and therefore do not satisfy the simplicity criterion described above.
(7) On 16 and 17 October 1973 during the Yom Kippur War, the Arab member countries of OPEC, meeting in Kuwait, announced an oil embargo against the "States which support Israel". The second oil crisis occurred in 1979. Under the combined effects of the Iranian revolution and the Iran-Iraq War, the price of oil was multiplied by 2.7 between mid 1978 and 1981.
(8) Competitive disinflation was applied from 1983 and lasted until 1997, with the country attempting to align its inflation level on that of Germany, as part of an objective aiming for stability of exchange rates within the European monetary system.

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In periods of oil shocks and counter-shocks, the indicators are less affected than headline inflation

As expected and by definition, all core inflation indicators are far less affected by exogenous shocks than headline inflation. Their level was far lower than that of headline inflation in the 1970s when the oil crises occurred. And the 1986 oil counter-shock was not followed by a drop in the indicators to the same extent as that of headline inflation (see *Graphs 1 to 5*).

The indicators differ visibly from the index built by INSEE

In the 1990s the indicator published by INSEE deviated from the other indicators. This discrepancy can be explained, among other things, by the fact that the INSEE index is corrected for tax measures, unlike the other indicators. The cut in the normal VAT rate from 25% to 22% in the early 1990s was not neutralised by these indicators, while by definition it was in the INSEE index. Conversely, the change in the normal VAT rate from 18.6% to 20.6% in 1995 was not incorporated into the core inflation indicator calculated by INSEE, explaining why it was at a lower level.

For at least two reasons, it appears appropriate to correct a core inflation indicator for the mechanical impact of tax measures, as INSEE does. First, since the mechanical effects of these measures disappear from the year-on-year values after one year, they do not affect the long-term inflation trend. Second, the price rise that comes after a tax increase is not a signal of higher production costs or a modification of the medium-term expectations of agents.

We conducted quality tests over two different periods. The core inflation index as published by INSEE has only been available since 1990 and a retropolation to the period prior to that would assume knowledge of the exact impact of the changes to indirect taxation over the period, which we did not have. We were therefore able to compare its properties to those of the other indicators over the 1990-2009 period only. However, we built an approximate core index going back to 1972 which excludes the same components as the one published today by INSEE, but which is not corrected for the mechanical impact of tax measures. For this index and the other indicators, the two tests covered the 1973-2009 period.

The core inflation indicator published today by INSEE best captures the medium-term inflation trend

Over the 1990-2009 period, the indicator published by INSEE and the one which excludes the same components but is not corrected for tax measures are those that best capture the medium-term trend over the two estimation periods (see *tables, Test 1*). Indeed, it is only for these indicators that the convergence of headline inflation towards core inflation over a one-year time horizon and in the absence of shocks could be accepted at statistical thresholds close to 1%. Over the longest period (1973-2009), it is the core inflation indicator closest to that published by INSEE which also turns out to be the most satisfactory: it is the only one for which the hypothesis of convergence can be accepted at usual statistical thresholds. On the basis of these performances, the core inflation indicator published by INSEE or the one which excludes energy, seasonal food products and public tariffs must therefore be preferred.

The best inflation forecasts are obtained with indicators that exclude extreme components on a case-by-case basis

As regards the ability of the indicators to forecast medium- and long-term inflation, the Huber and the 30% trimmed mean indicators are the best-performing over the 1990-2009 period.[9] The performances of the index published by INSEE are nowhere near as good, whether the time horizon is for 6, 12 or 18 months.

(9) The Huber estimator excludes at each date t the components whose price variation moves too far away from the median variation. The 30% trimmed mean estimator excludes from the price index the 30% of components with the most positive price variation and the 30% of components with the most negative price variation.

Over the 1973-2009 period, the volatility-weighted mean dominates the others over a 6- or 12-month time horizon. With a longer horizon of 18 months, however, the estimator that excludes the same components as that of the INSEE and which is not corrected for tax measures is the one that has the best predictive power.

All in all, the core index published by INSEE or the one very close to it which excludes the prices of energy, seasonal food products and public tariffs turns out to have the most satisfactory properties. They both show themselves to be advanced indicators of the headline inflation trend and, over the long term, have a certain ability to predict inflation to a horizon of 12 to 18 months. Additionally, the way they are constructed is easy to explain to the public. This statement will have to be reviewed if, as certain analysts fear, oil prices follow an upward trend, which was not the case over the period when the tests were conducted here.

The risks of deflation within a one-year time horizon remain limited.

Since the collapse of oil prices in July 2008 and the start of the recession in the main developed economies, inflation has declined. This situation sometimes brings fears of a medium-term deflationary episode. Anticipating a drop in prices, agents may delay their purchases and thereby cause a second round of price cuts, once again encouraging them to postpone their purchases. *Kumar et al.* (2003) developed a deflation vulnerability index. Among the criteria, two concern inflation and core inflation. According to these authors, if these two values are lower than 0.5, there will be a risk of deflation in the medium term.

All the core inflation indicators are between 1.3% and 1.9%

All the core inflation indicators presented in this report lie within a range of 1.3% to 1.9% in March 2009 (*see Graphs 1 to 5*). The risk of deflation can therefore be discounted over the time horizon of one year, all the more so since oil prices have recently picked up and the first signs of economic recovery are starting to appear.■

Alpha = 0 and beta = 1 tests

	Test 1 (1990-2009)			Test 1 (1973-2009)		
	p-value	**alpha**	**beta**	**p-value**	**alpha**	**beta**
30% trimmed mean	7.1.e-10	0.002	1.77	4.4.e-7	0.003	1.55
40% trimmed mean	3.3.e-9	0.002	1.73	1.4.e-6	0.003	1.52
Median	4.6.e-8	0.002	1.67	5.4.e-6	0.003	1.47
Jarque & Bera	4.0.e-10	0.000	1.87	1.4.e-7	0.002	1.59
Huber	1.0.e-7	0.001	1.55	1.3.e-7	0.003	1.48
Volatility-weighted mean	1.1.e-8	0.001	1.47	6.1.e-8	-0.001	1.49
Double weighted mean	8.5.e-7	-0.009	1.44	2.8.e-8	-0.004	1.43
Insee core inflation	0.007	0.001	1.30	ND	ND	ND
Insee core inflation not corrected for tax measures	0.008	-0.001	1.31	0.56	-0.005	0.96

	Test 2 (1990-2009)			Test 2 (1973-2009)		
	h = 18	**12**	**6**	**h = 18**	**12**	**6**
30% trimmed mean	+	++	+++			+++
40% trimmed mean	+		+			++
Median						+
Jarque & Bera	+	++	++			+++
Huber	++	+	+++		++	++
Volatility-weighted mean			++		+++	++
Double weighted mean		++	++		+	+++
Insee core inflation		+		ND	ND	ND
Insee core inflation not corrected for tax measures	+		+++	+++	++	

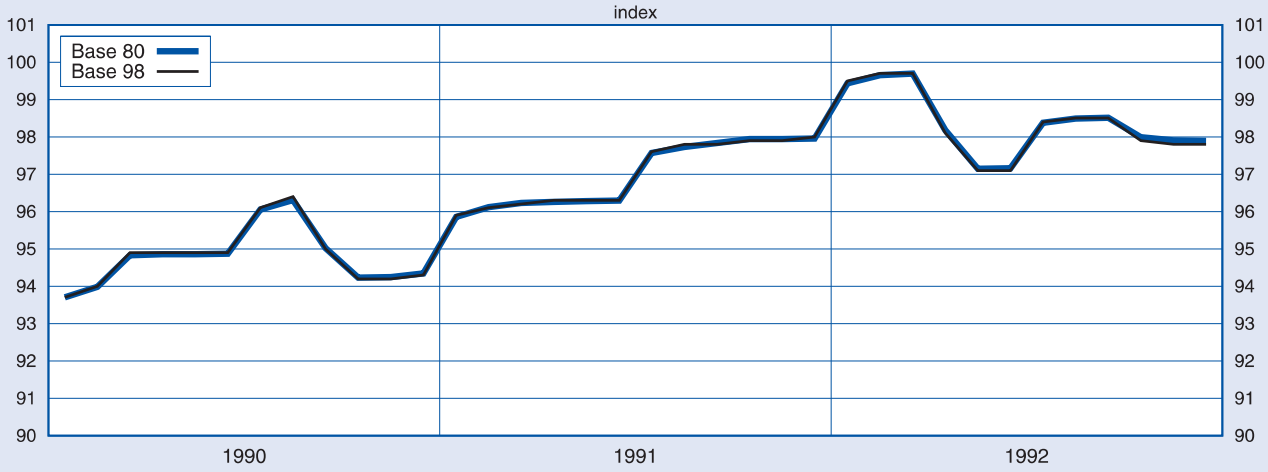
Note : Test 1 checks whether inflation, on average, tends to converge towards the core inflation indicator under consideration. The closer β is to 1 and α is to zero, the better the core inflation indicator. For each of the measures of core inflation, if the p-value is lower than 10%, 5%, 1%, the hypothesis $(\beta,\alpha) = (1,0)$ is rejected at a level of 90, 95, 99% respectively. The hypothesis $(\beta,\alpha) = (1,0)$ is therefore only accepted for the INSEE core inflation, non corrected for tax measures, over the period 1973-2009.
Test 2 checks whether the indicator provides information to forecast medium-term and long-term inflation apart from the information contained in the recent past of inflation. For each of the core inflation indicators, +, ++,+++, indicates whether the coefficients of the lagged variables of core inflation and the force of the movement towards core inflation are significant to levels of 90, 95, 99% respectively. The explained variable is the year-on-year change in prices brought forward by 18, 12, 6 months for h =18, 12, 6 respectively.

Box - Retropolation of series to 1972

In order to reconstruct long series over the period 1971-2009, we had to retropolate 36 aggregates composing the consumer price index of the 98 base (which started in 1990) using elementary indices from the 80 base (which started in 1970 and ended in 1992). Below are two examples of retropolation over the overlapping period of 1990-1992 (*see Graphs A and B*). Concerning the "purchases of vehicles" item, the index reconstructed with the elementary indices from the 80 base and the existing index from the 98 base are very close. For the "audiovisual, photographic and computer equipment" item, the indices move further and further away from each other. The introduction of computers into the item from 1990 (98 base series) is responsible for a greater drop in prices. To correct this bias, we applied to the reconstructed index (1980 base) the mean of the difference in growth rates between the two indices over the overlapping period.

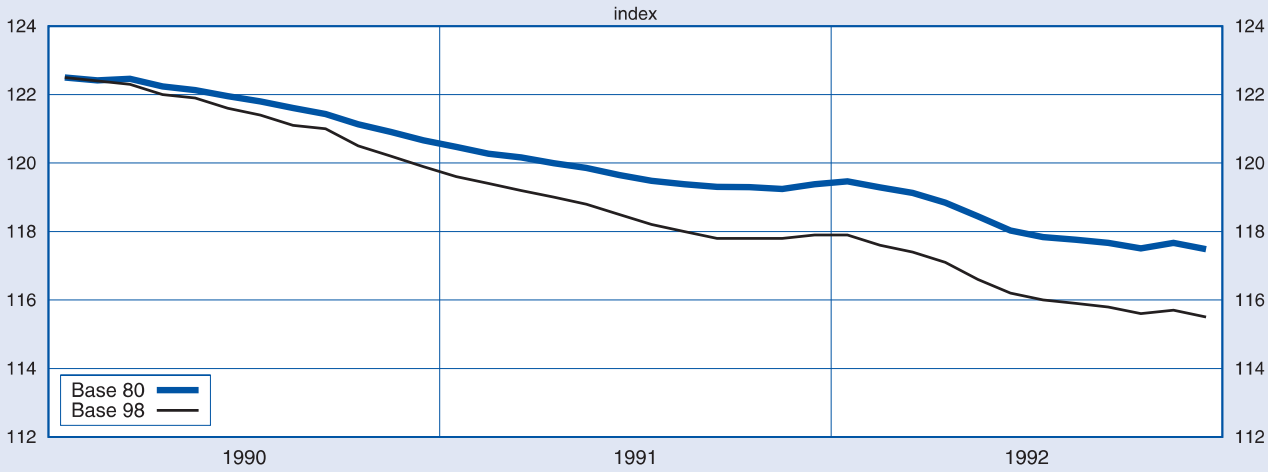
Three items present in the 98 base could not be retropolated because they had no 80 base equivalent. They are "insurance", "social protection" and "other services". We therefore redistributed their weighting to the other items in such a way that the weightings of the remaining 36 items were equal to 100. Additionally, three items were splintered. The food item was split into non-seasonal and seasonal food products. We isolated flowers and plants which were originally present in aggregate 26 (*see table below*). Last, we removed fuels from item 21 and included them in a new energy item along with electricity, gas and other combustibles. This new composition enabled the exclusion of products whose prices appeared to us to be volatile from the items containing information about the medium-term inflation trend. Initially, the "use of private vehicles" component could have been discounted from the scope of core inflation simply because of the excessive fluctuations in fuel prices, while the other groups present in this aggregate (such as maintenance and repairs of private vehicles) may be informative about the medium-term trend. ■

A - Purchases of vehicles (4.3%)



Source: Insee, Insee estimations

B - Audiovisual, photographic and computer equipment (2.2%)

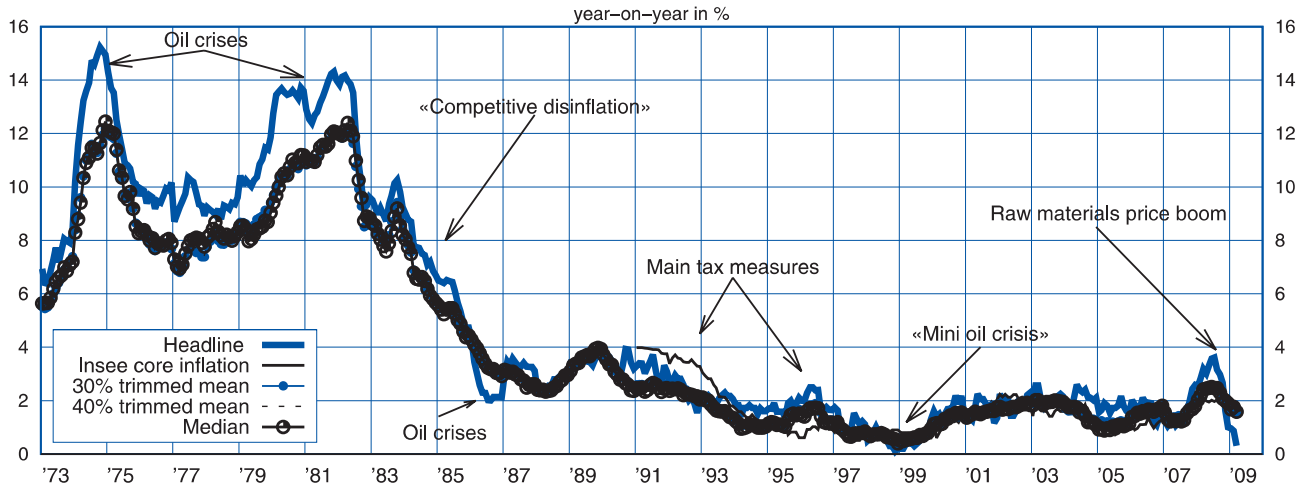


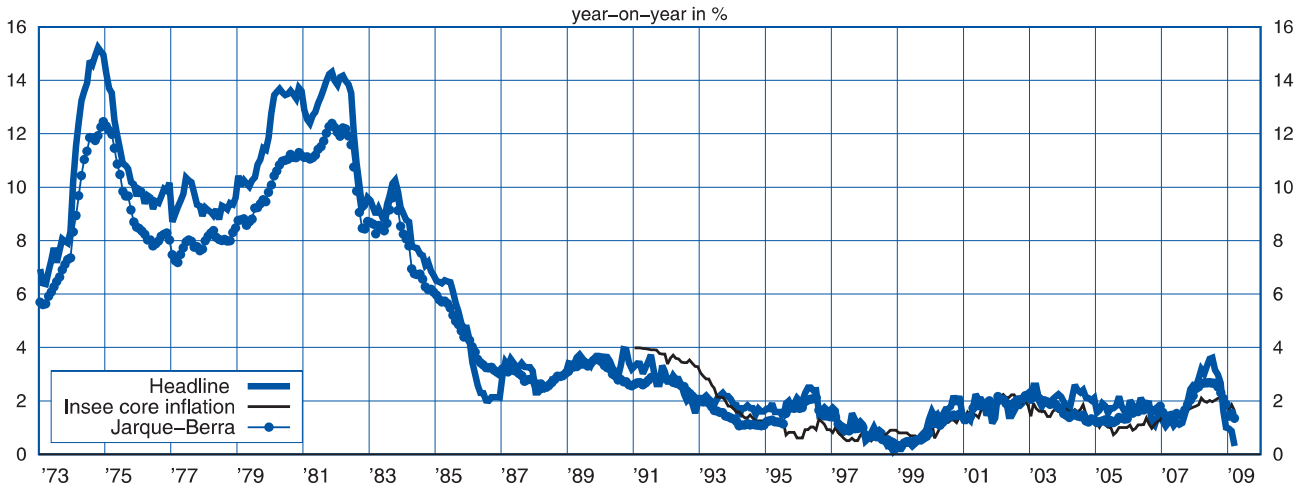
Source: Insee, Insee estimations

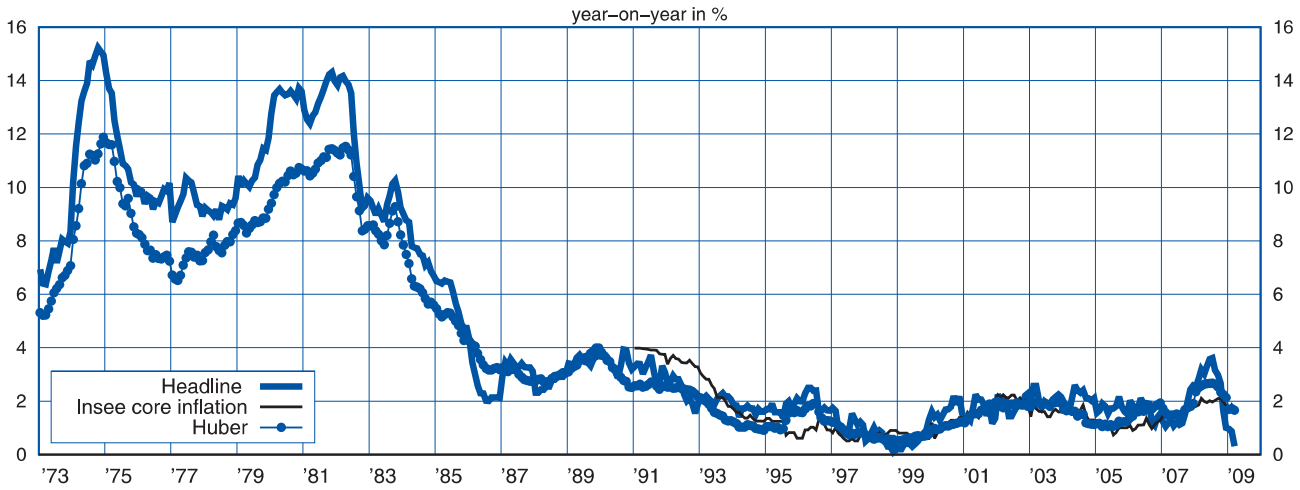
The 36 components of the price index: December 1971 - March 2009

	Components	2009 weightings
1	Non-seasonal food products	14.5
2	Seasonal food products	2.1
3	Non-alcoholic beverages	1.3
4	Alcoholic beverages	1.6
5	Tobacco	1.7
6	Apparel	4
7	Footwear including repairs	1
8	Lodging rent	6.3
9	Maintenance and everyday repair of lodging	1.6
10	Water supply and other services relating to lodging	1.7
11	Energy	7.2
12	Furnishings, furnishing items, carpeting and other flooring including repairs	1.7
13	Household textiles	0.4
14	Household appliances	0.9
15	Glassware, crockery, household utensils	0.7
16	Tools and other equipment for house and garden	0.5
17	Goods and services for everyday home maintenance	1.9
18	Medication and other pharmaceuticals, therapeutic apparatus and equipment	4.8
19	Non-hospital medicine and paramedical services (outpatient services)	5.1
20	Purchases of vehicles	4.3
21	Use of private vehicles excluding fuel	6.4
22	Transport services	2.4
23	Communications	3
24	Audiovisual, photographic and computer equipment	2.2
25	Other important durables for leisure and culture including repairs	0.2
26	Other leisure items and equipment and companion animals	1.6
27	Flowers, plants and seeds	0.6
28	Recreational and cultural services	2.7
29	Press, books and stationery	1.5
30	Holiday packages	0.3
31	Education service	0.2
32	Restaurants and cafés	5.5
33	Accommodation services	1.3
34	Personal care	3
35	Personal articles not classified elsewhere	1.3
36	Financial services	0.6

Graphs 1 to 5 - Year-on-year prices

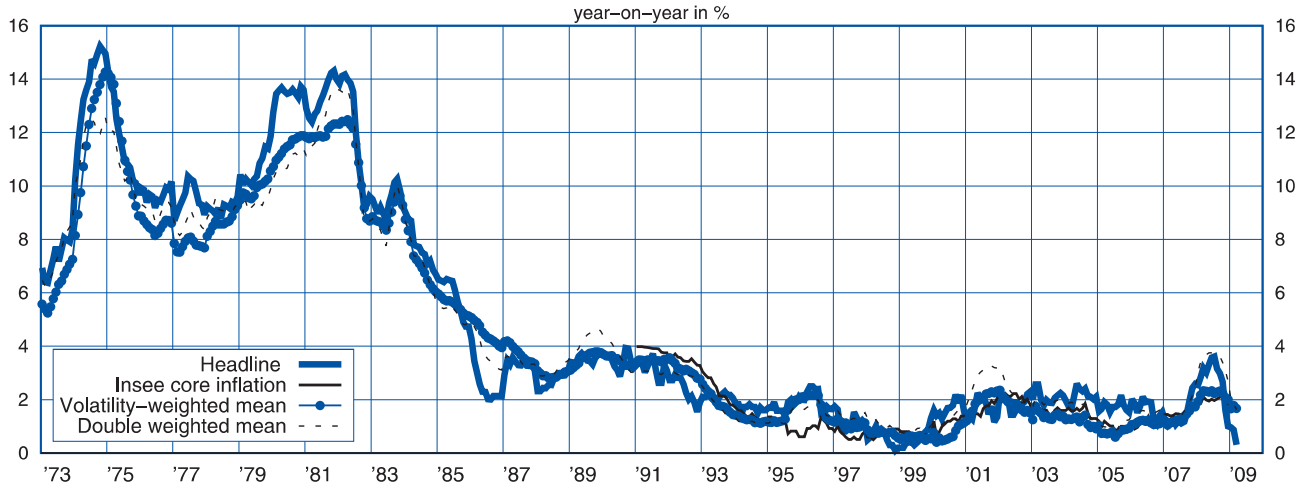


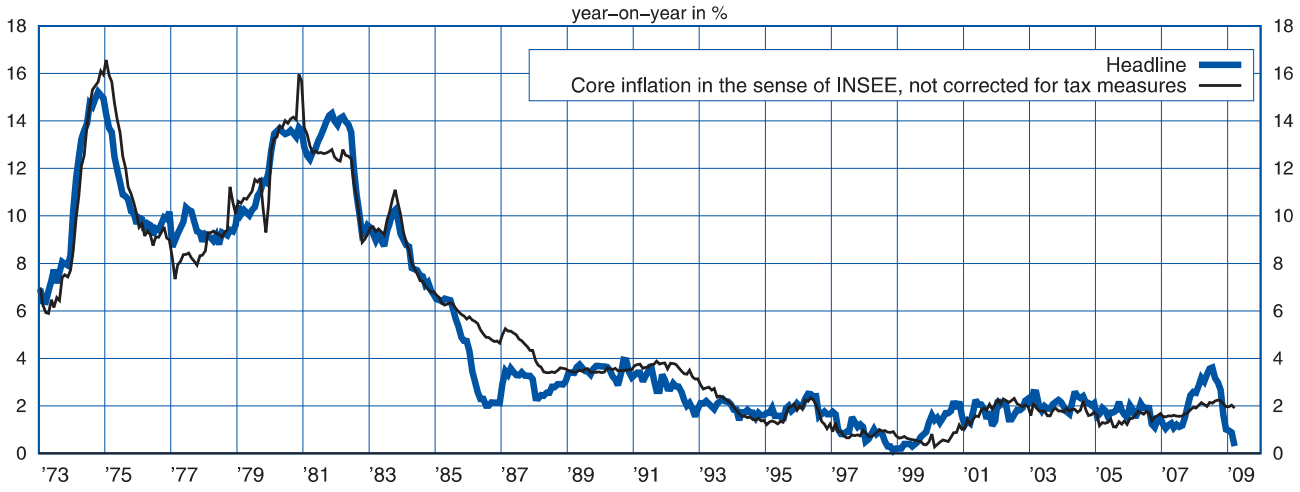




Source: Insee, Insee estimations

Graphs 1 to 5 - Year-on-year prices (cont'd)





Source: Insee, Insee estimations

Methodological Annex

Statistical methods of exclusion and weighting

• Trimmed mean

This method consists in discarding, period by period, the CPI components whose price variations are too great. In practice, for each date t we rank the components in ascending order of price variation. The price variations chosen for the study are the monthly variations in deseasonalised series. They are preferred to year-on-year variations, because the deseasonalisation techniques allow us to discard the outliers; these outliers disturb the year-on-year figures when they occur and again a year later when they are no longer included. The ranked variations are noted $\{\pi_{(1),t}, \pi_{(2),t}, \ldots, \pi_{(36),t}\}$ and their corresponding weightings are noted $\{\omega_{(1),t}, \omega_{(2),t}, \ldots, \omega_{(36),t}\}$. Next we discard α% of these components at the high and low end of the distribution.

Which is to say $W_{(i),t}$ the cumulative weighting:

$$W_{(i),t} = \sum_{j=1}^{(i)} w_{j,t}$$

The set of components that we keep is given by the following expression: $I_{t,\alpha} = \left\{(i) / \frac{\alpha}{100} < W_{(i),t} < 1 - \frac{\alpha}{100}\right\}$

The core inflation indicator is written:

$$\hat{\Pi}_t(\alpha) = \frac{1}{1 - 2\frac{\alpha}{100}} \sum_{(i)\in I_t(\alpha)} w_{(i),t}\pi_{(i),t}$$

The trimmed mean is a simple method, but the best trimming percentage is still unknown. *Bryan et al.* (1997) suggested choosing the percentage which minimises the spread between core inflation and the centred moving average of order 36. However, this optimum percentage depends on the study period and may seem somewhat arbitrary.

• The method based on the statistical method of Jarque & Bera.

Aucremanne (2000) suggested adjusting the trimming percentage period by period. To do so, he symmetrically excluded the sorted data until the distribution of the remaining data comes close to a normal distribution. The similarity to normal distribution is tested using the Jarque & Bera test calculated on the remaining data. However, in the presence of small samples, there is a not-inconsiderable risk of wrongly accepting the normality hypothesis.

• The Huber-type weighted mean

To resolve the problem posed by the previous method, Aucremanne (2000) built a statistic based on the median[10] of the price variation distribution:

$$y_{i,t} = \frac{\pi_{i,t} - med(\pi_{i,t})}{1{,}4826.\, med\left|\pi_{i,t} - med(\pi_{i,t})\right|}$$

where $med(\pi_{i,t})$ is the price variation distribution median.[11] The components for which $|y_{i,t}|$ exceeds 1.96 are excluded. The Huber-type weighted mean is thus written:

$$\hat{\Pi}_t = \frac{\sum_{i=1}^{36} w_{i,t}.\pi_{i,t}.1_{|y_{i,t}|<1,96}}{\sum_{i=1}^{36} w_{i,t}.1_{|y_{i,t}|<1,96}}$$

• The volatility-weighted mean and the double weighted mean

The three previous methods exclude, at each period, the components whose price variations are excessive. An alternative method assigns these components with a non-zero weighting equal to the inverse of their volatility.

In a last method, the previous weighting is multiplied by the weight of the component within the overall index.

Tests to discriminate between different measures of core inflation

Test 1: Quality of the medium term inflation estimate.

We estimate the following regression:

$$\pi_{t+12}^{12} - \pi_t^{12} = \alpha + \beta.(\hat{\Pi}_t^{12} - \pi_t^{12}) + \varepsilon_t$$

where π_t^{12} is headline inflation in t year-on-year and $\hat{\Pi}_t^{12}$ is the core inflation indicator, also year-on-year, and we test α=0 and $\beta = 1$: in this case, $\hat{\Pi}_t^{12}$ is the inflation towards which actual inflation converges over the time horizon of one year in the absence of a new shock.

Test 2: Additional information contained in core inflation

We evaluate whether the information provided by core inflation helps forecast future inflation better. To do so, the following regression is used:

$$\pi_{t+h}^{12} = \alpha + \sum_{i=0}^{11}\beta_i.\pi_{t-i}^{1} + \beta_{12}.\pi_{t-12}^{12} + \sum_{i=0}^{11}\gamma_i.\hat{\Pi}_{t-i}^{1} + \gamma_{12}.\hat{\Pi}_{t-12}^{12} + \eta_t$$

The variable modelled is the year on year change in prices, advanced by h months (h=6,12,18), and the explanatory variables are the lagged values of the inflation rate and the core inflation rate as a monthly variation $(\pi_{t-i}^{1}, \hat{\Pi}_{t-i}^{1})$ and year-on-year $(\pi_{t-12}^{12}, \hat{\Pi}_{t-12}^{12})$.[12]

If the coefficients of the lagged values of core inflation are significant, core inflation will allow a better medium and long term forecast of headline inflation than the lagged terms of inflation alone.

(10) The median is a more robust central tendency estimator than the empirical weighted mean used for the Jarque & Bera test.
(11) For further information about the value of median absolute deviation, see Rousseeuw and Croux (1993)
(12) In order not to introduce redundant information, the year-on-year is included as an explanatory variable with a time lag of 12.

However, the year-on-year figures are not stationary over the two study periods.[13] In this case, the significance test for the coefficients is not standard. In other words, we cannot rely on the Fisher distribution to test the significance of the coefficients. We prefer to estimate the following error correction equation[14]:

$$\Delta\pi^{12}_{t+h} = \alpha + \sum_{i=0}^{11}\beta_i.\Delta\pi^{1}_{t-i} + \beta_{12}.\Delta\pi^{12}_{t-12} + \sum_{i=0}^{11}\gamma_i.\Delta\hat{\Pi}^{1}_{t-i} + \gamma_{12}.\Delta\hat{\Pi}^{12}_{t-12} + \lambda.(\pi^{12}_{t+h-1} - \hat{\Pi}^{1}_{t-1}) + \eta_t$$

where all the variables are stationary. Consequently, the significance test for $(\gamma_0, \ldots, \gamma_{12}, \lambda)$ is once again possible using standard laws. ■

(13) Whether by the Dickey-Fuller test or the KPSS test.
(14) As the residuals are autocorrelated and heteroscedastic, we used a Marquardt nonlinear least squares fitting algorithm and corrected the coefficient variance estimators using the White method.

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