Bulletin
de la Banque de France
234/7 - MARCH-APRIL 2021

BANQUE DE FRANCE
EUROSYSTÈME

What explains the persistent weakness of euro area inflation since 2013?

Annual inflation in the euro area, as measured by the Harmonised Index of Consumer Prices (HICP), fell by an average of 1.1 percentage points between the period 1999-2007, which preceded the financial crisis, and the period 2013-19 which followed it. In this bulletin, the authors evaluate the contributions to this decline of two standard determinants of inflation: economic slack and the trend in commodity prices, especially oil prices. To do so, they use an augmented Phillips curve that incorporates these determinants as well as the impact of the non-standard monetary policy measures implemented since 2014. The authors show that the bulk of the decline in inflation can be explained by the disinflationary nature of the two determinants since 2013. Their average contribution to the decline is at least 1 percentage point, of which 0.25 percentage point is offset by the non-standard monetary policy measures. The unexplained part of the average decline in inflation is at most 0.3 percentage point.

Pavel Diev, Yannick Kalantzis, Antoine Lalliard and Matteo Mogliani
Macroeconomic Analysis and Forecasting Directorate

JEL codes
E31, E32, E58

–1.1 percentage points

average difference between the level of euro area inflation before the 2007 crisis and its level since 2013

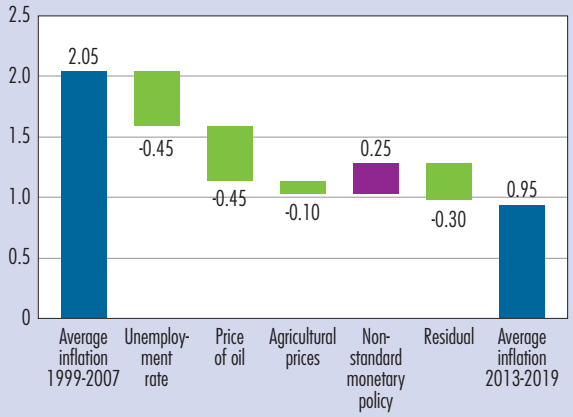
–1 percentage point

fall in average inflation linked to the recession and the decline in commodity prices after 2013

0.25 percentage point

support to average inflation provided by non-standard monetary policy measures after 2013

Breakdown of the decline in average inflation between 1999-2007 and 2013-2019 (Phillips curve with the unemployment rate)



Source: Authors' calculations.
Note: All values are rounded to the nearest 0.05.

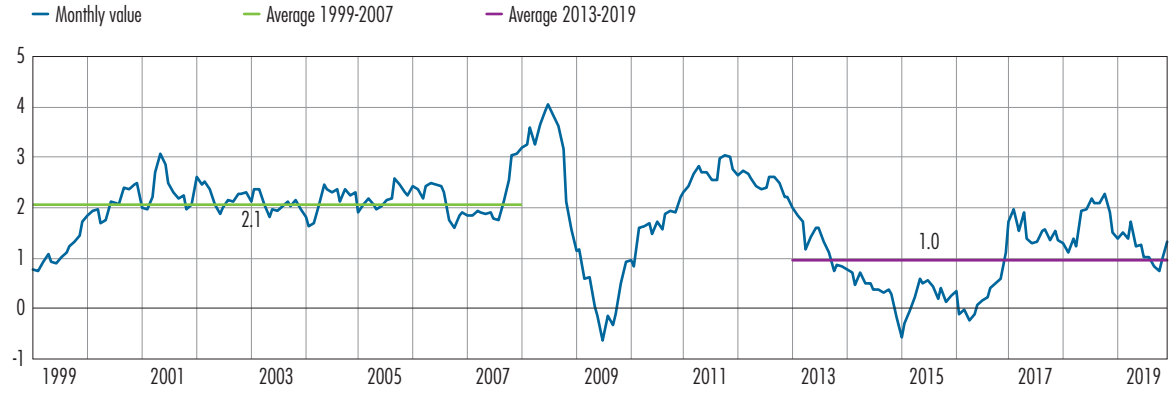
The persistent weakness in inflation since the 2008 financial crisis is one of the most striking macroeconomic developments in the euro area. Inflation, as measured by the annual change in the Harmonised Index of Consumer Prices (HICP), has declined from an average of 2.1% in the period 1999-2007 to an average of 1.0% for the period 2013-19[1] (see Chart 1). This fall of 1.1 percentage points in average terms between the pre- and post-crisis periods has sparked a renewed debate over the determinants of price setting. In addition to the usual macroeconomic drivers, some analyses suggest that structural changes, related for example to the globalisation and digitalisation of our economies, may also be playing a role.

This article proposes a simple decomposition of the fall in average euro area inflation since the crisis, making it possible to quantify the role played by the standard determinants used in existing models, and to identify possible new determinants that may need to be studied in greater depth. The authors use an augmented Phillips curve that incorporates commodity prices (including the indirect effect of oil prices on the production cost of goods and services), along with the impact of the non-standard monetary policy measures implemented since 2014, i.e. asset purchases and negative interest rates.

The findings suggest that the bulk of the inflation decline is due (i) to the increase in economic slack after the double-dip recession suffered by the euro area between 2008 and 2012, and (ii) to the fall in the price of commodities, especially oil, after the sharp rise observed in the 2000s. These two disinflationary factors are found to have lowered annual inflation by an average of at least 1 percentage point since the crisis, although 0.25 percentage point of this impact has been offset by non-standard monetary policy measures. The unexplained portion of the 1.1 percentage-point decline in inflation therefore amounts to close to 0.3 percentage point, and is concentrated in recent years. In addition to the structural factors described above, the fall in inflation may also reflect a drift of long-run inflation expectations, the impact of the euro's appreciation in 2017 and 2018,[2] and the compression of profit margins in the services sector that has absorbed the wage rises since 2017.

C1 Euro area inflation

(year-on-year % change in the HICP)



Source: Eurostat.
Note: HICP, Harmonised Index of Consumer Prices

1 Excluding the period 2008-12, which was marked by strong volatility in commodity prices, especially oil prices, and fluctuations in activity caused by the double-dip recession.

2 All other things being equal, an appreciation in the euro leads to a decline in imported goods prices.

1 Inflation fell after the financial crisis in the context of a reversal in commodity prices

Conventional inflation models emphasize two factors that play a role in price setting. First, economic slack, as measured by the output gap or the unemployment rate, affects domestic inflation, in line with the framework provided by the Phillips curve. Second, consumer prices are also shaped by imported inflation, and in particular by developments in the price of oil. These two factors became disinflationary in the euro area after 2013.

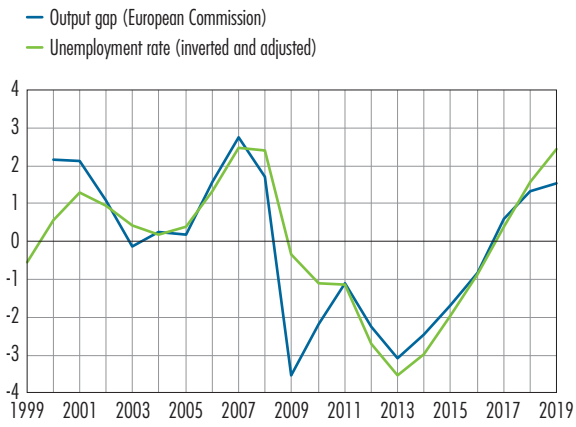
Chart 2 shows two measures of slack: the output gap as estimated by the European Commission (available since 2000), and the unemployment rate (plotted on an inverted scale and adjusted for comparability with the output gap). These two measures show that the economic outlook was on average more favourable, in relative terms, before the crisis. The double-dip recession between 2008 and 2012 had a lasting negative impact on economic activity, and the output gap and unemployment rate have only come back to near pre-crisis levels since 2017. The unemployment rate rose by around 1 percentage point, from an average of 8.8% between 1999 and 2007 to an average of 9.9% between 2013 and 2019. The output gap in turn deteriorated by around 2 percentage points between the two periods, from an average of 1.2% to –0.7%.

According to the Phillips curve, the economic deterioration suggested by these two indicators should have contributed to a lowering of average inflation since the crisis.

Measuring the output gap is, of course, complex and uncertain as it relies on the notion of potential output, which is unobservable and hence has to be calculated using modelling assumptions. As a result, estimates of the output gap may vary significantly across institutions. In addition, unlike with the unemployment rate, current estimates of past output gaps are constructed with the benefit of hindsight and may thus differ from estimates made in real time. In practice, however, both measures provide a similar assessment of the economy's trajectory up to 2017 (see Chart 2). Since 2018 they have diverged slightly: employment has remained dynamic while the output gap has increased to a lesser extent due to the slowdown in gross domestic product (GDP) growth. Both measures are taken into account in the rest of this article, for the sake of robustness.

The price of a barrel of oil increased steadily between 1999 and 2007, rising by an average of EUR 5 per year over the period (see Chart 3). Since the crisis, however, it has followed a downward trend, declining by an average of EUR 4 per year over the period 2013-19. Whereas oil helped to support consumer prices before the crisis, it has since had a downward impact on inflation.

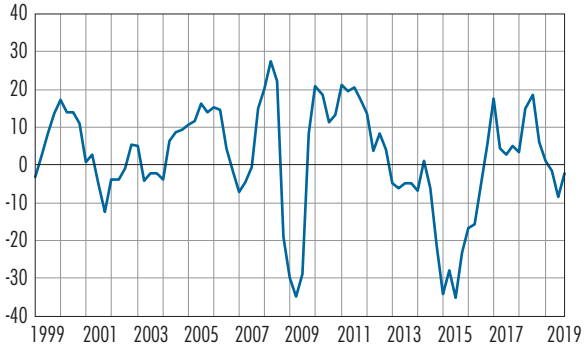
C2 Output gap and unemployment rate



Sources: European Commission, Eurostat; authors' calculations.

C3 Price of oil

(in euro, change over four quarters)



Source: Eurosystem.

2 Economic slack and the fall in commodity prices explain the bulk of the disinflation observed since 2013

To quantify the impact of these factors on inflation, the authors use a conventional Phillips curve equation.[3] Inflation is explained by: (i) economic slack as measured by the output gap or unemployment rate; (ii) the price of oil in euro; (iii) agricultural commodity prices in euro; and (iv) lagged inflation capturing inflation stickiness. The equation only takes into account the direct impact of oil prices on inflation via fuel prices. This impact is hence augmented with an estimate of the indirect impact of oil prices via the change in production costs. Box 1 describes the methodology used.

BOX 1

An augmented Phillips curve equation to take into account the indirect impact of oil prices on production costs

Inflation is modelled at a quarterly frequency using the following equation:

$$HICP_t = c_0 + c_1 \cdot HICP_{t-1} + c_2 \cdot x_{t-1} + c_3 \cdot Brent_t + c_4 \cdot Agri_t + Brent\_indirect_t + \varepsilon_t,$$

where HICP is the logarithmic quarterly growth rate of the Harmonised Index of Consumer Prices, x is a measure of economic slack (output gap or unemployment rate), Brent is the quarterly difference of the price of a barrel of Brent crude oil in euro, Agri is the logarithmic quarterly growth rate of agricultural commodity prices, Brent_indirect is the indirect contribution of the price of oil to inflation via the change in production costs, and ε is a residual. The price index variable is seasonally adjusted (using the X12 method). The authors use the annual output gap as computed by the European Commission, which they extend to the period 1998-99 using the unemployment rate, based on an Okun law, and interpolate to quarterly frequency via the Chow-Lin method, using the logarithmic deviation of GDP from its linear trend as the quarterly indicator. In a first step, the equation is estimated for the period from the second quarter of 1998 (in order to include the year-on-year change for the first quarter of 1999) to the fourth quarter of 2019, without taking into account Brent_indirect (see table).

Estimated coefficients of the Phillips curves

Variable	Measure of economic slack (x)	
	Unemployment	Output gap
Constant	0.26***	0.28***
$IPCH_{t-1}$	0.33***	0.28***
x_{t-1}	-0.04**	0.04***
$Brent_t$	0.03***	0.03***
$Agri_t$	0.013***	0.013***
Adjusted R^2	0.61	0.63

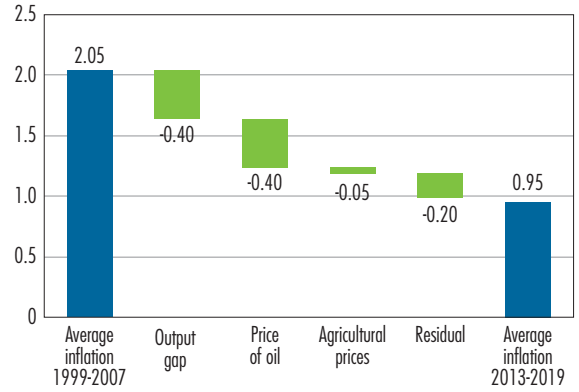
Source: Authors' calculations.
Note: The asterisks ***, ** and * indicate the respective significance of the 1%, 5% and 10% thresholds.

The estimated equation correctly measures the immediate impact of oil prices on fuel prices, which is included in the energy component of the HICP, but does not measure the indirect effect on the other HICP components via production costs (oil products used as inputs in production processes, such as the manufacture of plastics and transportation). In a second step, this indirect effect is estimated independently and subtracted from the econometric residual of the estimated equation. According to Kalantzis and Ouvrard (2018), the indirect effect on prices amounts to 0.1 percentage point for every EUR 10 rise in the price of a barrel of Brent. To obtain an effect on quarterly inflation, the authors assume that the impact is transmitted linearly over eight quarters.

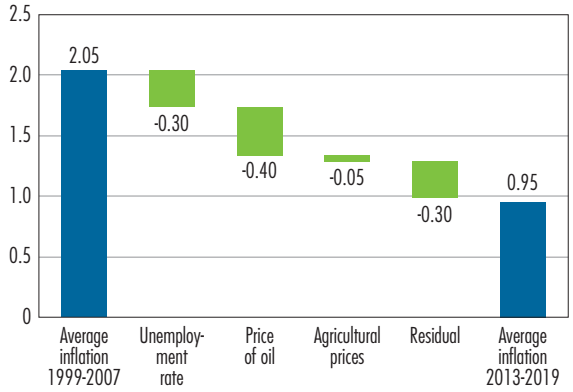
3 See Chatelais et al. (2015) and Berson et al. (2018).

C4 Breakdown of the average decline in inflation using a Phillips curve

a) With the output gap



b) With the unemployment rate



Source: Authors' calculations.
Note: Values are rounded to the nearest 0.05. Individual contributions may not add up to the difference in inflation as figures have been rounded.

Charts 4a and 4b show the average contributions of the explanatory variables to the decline in inflation between the pre- and post-crisis periods (i.e. 1999-2007 and 2013-19) when slack is measured, respectively, with the output gap and the unemployment rate. The economic deterioration following the double-dip recession explains between 0.3 and 0.4 percentage point of the decline, whereas the price of oil accounts for around 0.4 percentage point in both cases. These two factors alone account for the bulk of the 1.1 percentage-point decline in inflation between the two periods. The slowdown in agricultural commodity prices explains another 0.1 percentage point of the decline. The unexplained part (residual) is between 0.2 and 0.3 percentage point. The residual is higher when slack is measured using the unemployment rate, due to the fact that the labour market proved dynamic in 2018-19 while inflation remained low.

Charts 5a and 5b show the quarterly contributions to the annual change in consumer prices as a deviation from the average trend for the entire sample. The fluctuations in short-term inflation are mainly due to oil prices, with a marked decline concentrated in 2015-16. Slack also plays an important role, and has a prolonged negative impact after the double-dip recession of 2008-12. The unexplained residuals have turned negative on average since the crisis, but have been particularly large since 2017. Compared with its traditional determinants, therefore, inflation has been very low in recent years.

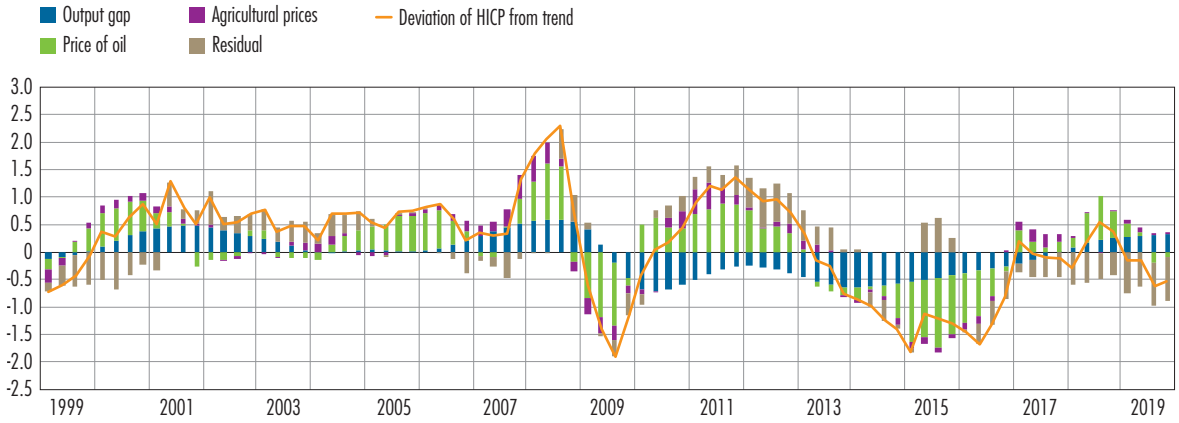
Several factors may explain the large negative residuals observed over recent years. First, wages have lagged behind in the euro area, and only began to gain momentum as of 2017 even though unemployment had been falling since 2014. This lagged acceleration may have offset the downward rigidity in nominal wages, which limited their fall at the height of the crisis. Second, as of 2017, wage increases were in part offset by the compression of corporate profit margins. This was notably the case in market services where margins contracted markedly in 2017-18 just as average compensation per employee was beginning to accelerate (see Chart 6 below). In the same period, the euro effective exchange rate appreciated sharply, rising by close to 10% between the start of 2017 and end of 2018, which, all other things being equal, improved terms of trade in the euro area and curbed inflation (Diev et al., 2019).

Another factor frequently referred to as an explanation for these negative residuals is the possible drift of long-run inflation expectations after a prolonged period of low inflation.

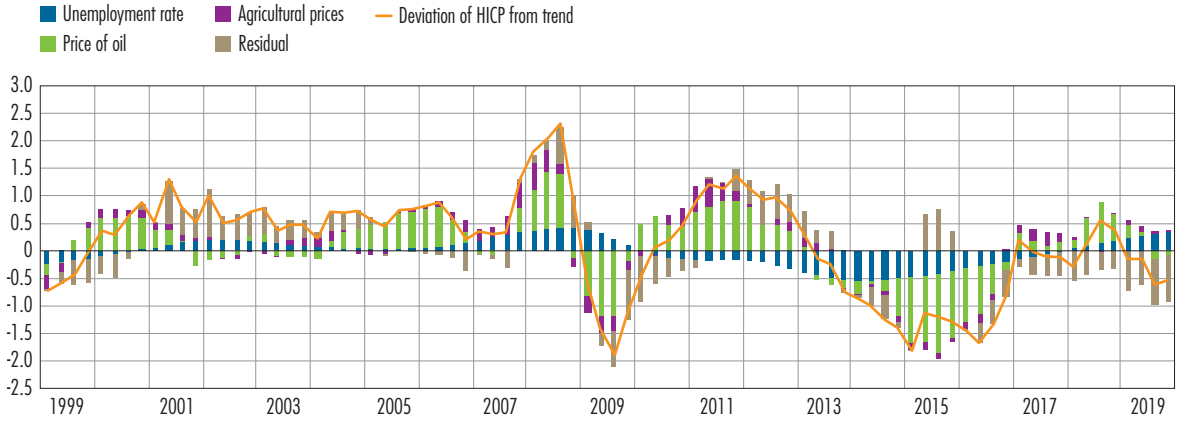
C5 Quarterly breakdown of econometric contributions to the annual change in the HICP

(percentage points)

a) Phillips curve with the output gap



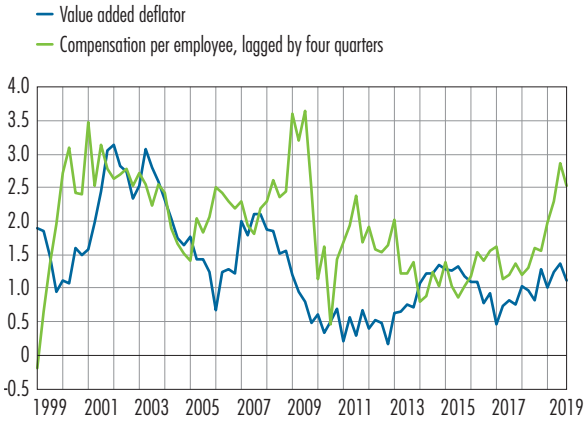
b) Phillips curve with the unemployment rate



Source: Authors' calculations.
Note: HICP, Harmonised Index of Consumer Prices

C6 Value added deflator and compensation per employee in market services (excluding business services), year-on-year change

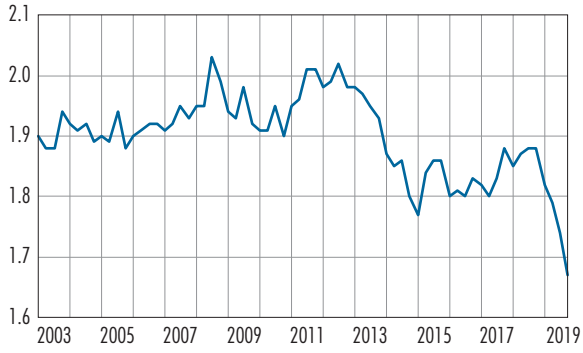
(%)



Sources: Eurostat, authors' calculations.

C7 Professional forecasters' expectations for long-term inflation, annual average rate

(average of individual forecasts, %)



Source: ECB Survey of Professional Forecasters.

Five-year ahead inflation expectations from the ECB Survey of Professional Forecasters were slightly lower on average in the period after the crisis (1.8% compared with 1.9% before the crisis), and the divergence became more marked as of end-2018 (1.7% at end-2019), which is when the residuals are very negative (see Chart 7 above). Last, the price and wage setting process may have been affected by structural changes in an increasingly digitalised and globalised economy.

3 Non-standard monetary policy measures helped to support inflation after the crisis

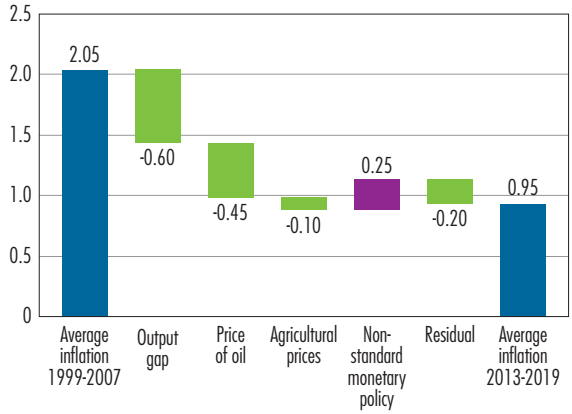
According to this analysis, the decline in average inflation since 2013 is largely explained by economic slack and commodity prices in euro. However, these two factors have themselves benefited from the non-standard monetary policy measures put in place by the Eurosystem since 2014. Without these measures, the slack would have worsened more markedly, placing downward pressure on domestic inflation, while a sharper appreciation of the euro would have further reduced imported inflation. To quantify these effects, the authors construct a counterfactual showing the trajectory of inflation in the absence of non-standard measures, and analyse it again using Phillips curves.

Drawing on recent studies (Dedola et al., 2018; Eser et al., 2019), they evaluate the impact of non-standard measures on long-run interest rates and on the euro exchange rate. They then use the response of the exchange rate to estimate the impact on commodity prices in euro. The response of economic activity is derived from macroeconomic elasticities taken from the models used by Eurosystem central banks for their macroeconomic projections (ECB, 2016). The Phillips curve described previously (see Section 2) is then used to obtain the impact on inflation. The analysis is described in detail in Box 2 below.

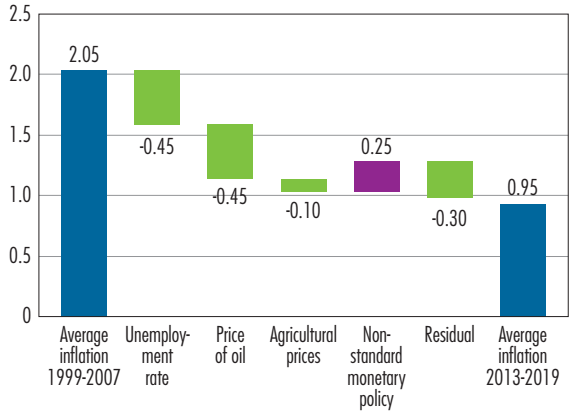
The findings show that economic slack and commodity prices would have had an even more disinflationary impact after 2012 without the non-standard measures (see Charts 8a and 8b). The measures are found to have buoyed inflation by an average of 0.25 percentage point per year over the period 2013-19, since, without them, the slack would have made an additional negative contribution of –0.2 percentage point to inflation (–0.6 percentage point compared with –0.4 percentage point for the output gap, and –0.5 percentage point compared with –0.3 percentage point for the unemployment rate). Overall, without the non-standard measures, economic slack and the evolution in commodity prices together would have lowered inflation by 1.0-1.1 percentage points between the periods before and after the crisis.

C8 Breakdown of the decline in average inflation, taking into account non-standard monetary policy measures

a) Phillips curve with the output gap



b) Phillips curve with the unemployment rate



Source: Authors' calculations.
Note: All values are rounded to the nearest 0.05. Individual contributions may not add up to the difference in inflation as figures have been rounded.

BOX 2

Incorporation of non-standard monetary policy measures into the augmented Phillips curve

The non-standard measures taken into account are the asset purchase programmes (APP) and the negative interest rate policy (NIRP).

Based on Dedola et al. (2018) and Eser et al. (2019), the authors assume that, over the period 2014-19, the APP led to a cumulative and permanent reduction of 100 basis points in the term premium and a depreciation of 12% in the EUR/USD bilateral exchange rate. Assuming that extra-euro area European Union exchange rates (excluding the pound sterling) remained anchored to the euro, the authors obtain an impact of –9% on the euro nominal effective exchange rate. The impact of the NIRP on short-run rates is set at –40 basis points, which is equivalent to the decline in the deposit facility rate (DFR). In the Phillips curves, these shocks are propagated as follows:

- the shock to the nominal effective exchange rate impacts agricultural commodity prices in euro, assuming foreign currency-denominated prices remain constant;
- similarly, the shock to the EUR/USD bilateral exchange rate impacts the price of oil in euro;
- the shocks to interest rates (short and long-term) and to exchange rates are used to estimate the impact on economic activity via the elasticities taken from the Eurosystem projection models (European Central Bank, 2016).

The changes obtained for agricultural commodity and oil prices, and for economic activity are then incorporated into the Phillips curve to obtain the counterfactual change in inflation. The shocks have a combined cumulative effect of +1.8% on inflation for the period 2014-19, which is in line with the median Eurosystem estimate for 2015-18 (+1.9%; Rostagno et al., 2019), representing an average contribution of 0.25 percentage point per year between 2013 and 2019.

References

Berson (C.), Charsonville (L. de), Diev (P.), Faubert (V.), Ferrara (L.), Guilloux-Nefussi (S.), Kalantzis (Y.), Lalliard (A.), Matheron (J.) and Mogliani (M.) (2018)
"Does the Phillips curve still exist?", *Rue de la Banque*, Banque de France, No. 56, April.
Download the document

Chatelais (N.), De Gaye (A.) and Kalantzis (Y.) (2015).
"Low inflation in the euro area: import prices and domestic slack", *Rue de la Banque*, Banque de France, No. 6, May.
Download the document

Dedola (L.), Georgiadis (G.), Gräb (J.) and Mehl (A.) (2018)
"Does a big bazooka matter? Central bank balance-sheet policies and exchange rates", *Working Paper Series*, European Central Bank, No. 2197, November.

Diev (P.), Kalantzis (A.) and Lalliard (A.) (2019)
"Why have strong wage dynamics not pushed up inflation in the euro area?", *Banque de France Bulletin*, No. 225/6, September-October.
Download the document

Eser (F.), Lemke (W.), Nyholm (K.), Radde (S.) and Vladu (A. L.) (2019)
"Tracing the impact of the ECB's asset purchase programme on the yield curve", *Working Paper Series*, European Central Bank, n° 2293, July.

European Central Bank, 2016
A guide to the Eurosystem/ECB staff macroeconomic projection exercises, July.

Kalantzis (Y.) and Ouvrard (J.-F.) (2018)
"The impact of oil prices on inflation in France and the euro area", *Eco Notepad*, Banque de France, No. 50.
View blog post

Rostagno (M.), Altavilla (C.), Carboni (G.), Lemke (W.), Motto (R.), Saint Guilhem (A.) and Yiangou (J.) (2019)
"A tale of two decades: the ECB's monetary policy at 20", *Working Paper Series*, European Central Bank, No. 2346, December.

Published by
Banque de France

Managing Editor
Gilles Vaysset

Editor-in-Chief
Claude Cornélis

Editor
Alexandre Capony

Translator/English Editor
Vicky Buffery

Technical production
Studio Creation
Press and Communication

ISSN 1952-4382

To subscribe to the Banque de France's publications
https://publications.banque-france.fr/en
"Subscription"