III.1. Inflation developments in the euro area — an update ([33])

This section reviews recent inflation developments in the euro area, using a simple open-economy version of the Phillips curve. It also discusses the inflation outlook in the near future.

Inflation has been exceptionally low for a prolonged period in the euro area and the other main economic areas. Our results show that the current subdued inflation in the euro area can be explained in large part by the fall in oil prices, but subdued domestic cost pressures due to weak economic activity have also played a role. The weaker euro has only partly dampened these downward price pressures.

Looking forward, positive base effects stemming from energy-price and core inflation are expected to raise headline inflation. Particularly strong base effects in December 2015 and January 2016 are expected to raise it by around 0.5 pps in each of those months. Although various inflation expectation measures remain below historical averages, they point to gradually increasing inflation in the euro area in the coming years.

Introduction

Inflation in the euro area, as measured by the harmonised index of consumer prices (HICP) has been exceptionally low in 2015. It bottomed out in January at -0.6 % and is currently hovering around zero, whereas in 2013 and 2014 it had averaged 1.4 % and 0.4 % respectively. These levels are significantly below the long-term average of 1.8 %. The subdued inflation is largely driven by a strong fall in commodity prices, but sizeable economic slack in some Member States has also contributed.

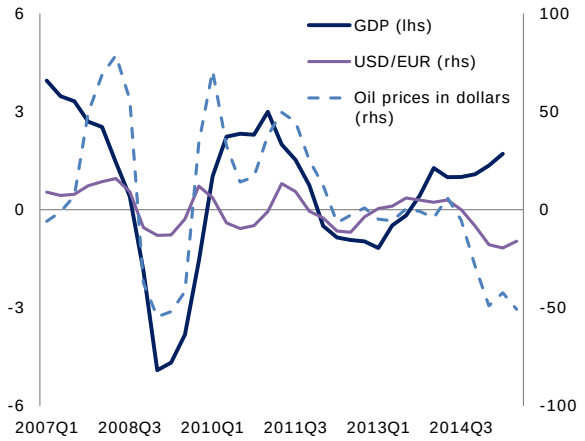
The first part of this section explains recent low inflation rates using a Phillips curve framework which shows the relationship between inflation and real economic activity or domestic cost pressures. The curve can be augmented with several factors, such as expectations, exchange rates or oil prices, reflecting price rigidities and the effects of imported goods on inflation, for example. ([34])

We first estimate a backward-looking Phillips curve, which includes, as explanatory variables, the output gap (as a gauge of cyclical price pressures), oil prices and the exchange rate, to examine the respective contributions of these variables to the current subdued inflation rates. ([35])

The second part of the section reviews the inflation outlook. In particular, we estimate base effects which measure the extent to which atypical HICP movements 12 months earlier contribute to the annual inflation rate in coming months if the month-on-month change follows the normal trend. ([36]) The discussion on the inflation outlook is further informed by an overview of recent developments in inflation expectations.

Recent inflation developments in a Phillips curve perspective

Graph III.1.1: **Main factors affecting inflation**
(2006Q1 — 2015Q3, y-o-y, %)



Source: Data Insight.

The main external factors impacting inflation rates have faced exceptional volatility since 2014 (see

([33]) Section prepared by Lauri Vilmi.

([34]) For an overview of the Phillips curve literature, see Gordon, R. J. (2011), 'The history of the Phillips curve: consensus and bifurcation', *Economica*, Vol. 78, No 309, pp. 10-50.

([35]) We do not try to measure expectations and their role in price-setting, but assume that expectations are formed with an autoregressive process based on past inflation rates.

([36]) For further discussion, see 'Box 6: Base effects from the volatile component of the HICP and their impact on HICP inflation in 2014', *ECB Monthly Bulletin*, February 2014, pp. 51-53.

Graph III.1.1). Oil prices have fallen strongly since the third quarter of 2014, with Brent crude dropping from around USD 110 to around USD 50 per barrel in September 2015 on the back of increased supply, particularly in the United States and weaker-than-expected demand for commodities. Other commodity prices have also plunged, adding negative price pressures.

The weakening of the euro from almost USD 1.40 in March 2014 to around USD 1.10 in September 2015 has dampened the downward impact of lower commodity prices on inflation. The previous appreciation of the euro has been reversed as euro-area and US monetary policies are diverging in response to differing cyclical conditions.

In addition to external factors, large economic slack in some Member States has also contributed to low inflation. Although economic growth has picked up somewhat in 2015, domestic cost pressures have remained weak, reflecting a still-negative output gap. ([37]) Estimates in the European Commission's spring forecast, based on the production function methodology, show a negative output gap of -2.8 % for 2014, narrowing to -1.1 % by 2016.

The estimated open-economy Phillips curve for the euro area is produced as follows:

$$\pi_t = c + \alpha\pi_{t-1} + \beta gap_t + \gamma\Delta oil_t + \delta\Delta exr_t + \varepsilon_t$$

where quarterly changes in HICP (π_t) are explained by its lag (π_{t-1}), constant term (c) and other explanatory variables. ([38]) Country-specific estimations for the four largest Member States use the same variables, but have slightly different lag structures depending on the model diagnostics. Domestic cost pressures are measured by the output gap (gap_t), which, under certain assumptions as regards production technology and labour-market structure, approximates real marginal costs. ([39]) As energy and imported goods account for a significant degree of volatility in the HICP series, we control these factors by augmenting the Phillips curve with the quarterly percentage change of Brent crude prices in dollars (Δoil_t) and the EUR/USD exchange rate (Δexr_t). The last term is an independently and identically distributed error term. ([40])

We use a purely backward-looking Phillips curve rather than the hybrid version, as market-based inflation expectations have recently correlated strongly with oil price developments. ([41]) A hybrid Phillips curve for the euro area would provide very similar results as regards the drivers of recent inflation rates, but would emphasise more the role of falling inflation expectations and ascribe a smaller role to other factors. However, it would not explain inflation developments significantly better than the specification used here. ([42])

Estimation results show that the simple backward-looking Phillips curve provides a good explanation of observed inflation in the euro area (see Table III.1.1). All estimated parameters have the expected signs and are statistically significant. ([43]) According to the Phillips curve estimates, lower oil prices account for a significant proportion of the most recent fall in inflation (see Graph III.1.2). In the first half of 2015, they reduced inflation by an average of around 1.4 pps. Negative output gap is also a driver of weak inflation, with an estimated average contribution of -0.4 pp since the second quarter of 2014. Meanwhile, the depreciation of the euro against the dollar has started to add positive price pressures, with an estimated positive impact of around 0.7 pp in the second quarter of 2015.

The drivers of inflation dynamics vary significantly across Member States. Inflation has been affected more strongly by oil-price and EUR/USD exchange-rate movements in Spain than in other large Member States. According to country-specific

([37]) For example, growth of unit labour costs has been subdued in the euro area since the beginning of 2013. Also, annual producer price inflation (excluding construction and energy) remained negative in July.

([38]) We use quarterly data for the period 2005Q1 to 2015Q2 for all variables. Only data for the past 10 years are used, as there is evidence of a steepening of the Phillips curve since the mid-2000s. See, for example, 'Analysing euro-area inflation using the Phillips curve', *Quarterly report on the euro area,* Vol. 13, No 2, pp. 21-26. The curve is estimated with the method of ordinary least squares.

([39]) The Hodrick-Prescott filtered real GDP is used as a proxy for the output gap; the spring forecast data for real GDP growth for 2015 and 2016 and stable trend to 2020 are added to the series in order to mitigate end-point problems.

([40]) A specification using nominal effective exchange rates (against a narrow basket excluding some emerging economy currencies, e.g. Russia) provides very similar estimates, though the specification using the EUR/USD exchange rate has a slightly higher coefficient of determination.

([41]) See the discussion at the end of the section.

([42]) With one-year-forward two years ahead inflation expectations, the coefficient of determination would increase from 0.84 to 0.89.

([43]) We tested different lag structures for explanatory variables, but only the previous month's inflation rate seems to have a statistically significant impact on current inflation rates.

Phillips curve estimations, oil prices contributed close to -2 pps to the inflation rate in the second quarter of 2015 in Spain, but only around -1 pp in Germany. (44) The estimated contribution of the exchange rate in the second quarter of 2015 was lowest in Italy, but this is due to a slower estimated inflation process there, whereby past euro depreciations are expected to contribute positively to inflation in Italy in the coming quarters. Larger negative output gaps (economic slack) are estimated to have contributed an average of around -0.3 pp to Italian and Spanish inflation since 2013, whereas output gaps have had only a minor impact on inflation in Germany and France.

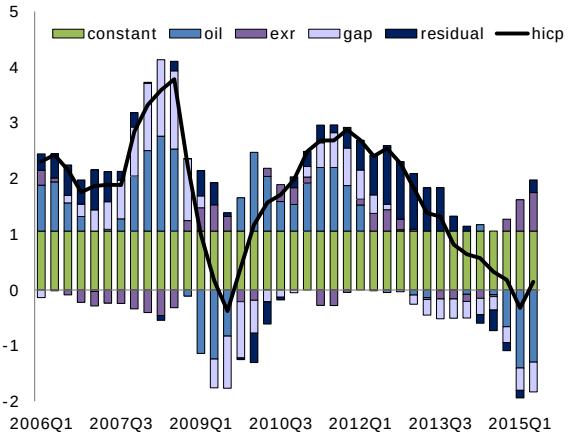
Table III.1.1: **Estimated parameters**

	Estimated Phillips Curve parameters	(p-values)
Euro area		
Constant	0.264	(0.000)
Lagged inflation	0.242	(0.000)
Output gap	0.093	(0.000)
Oil prices	0.021	(0.000)
USD/EUR	0.025	(0.003)
Period	2005Q1 to 2015Q2	
R^2	0.84	
Germany		
Constant	0.339	(0.000)
Output gap	0.078	(0.000)
Oil prices	0.014	(0.000)
Lagged oil prices	0.008	(0.007)
Lagged USD/EUR	0.02	(0.039)
Period	2005Q1 to 2015Q2	
R^2	0.71	
France		
Constant	0.287	(0.000)
Output gap	0.112	(0.000)
Oil prices	0.017	(0.000)
Lagged oil prices	0.008	(0.003)
2 Periods Lagged Oil prices	0.008	(0.000)
Lagged USD/EUR	0.027	(0.001)
Period	2005Q1 to 2015Q2	
R^2	0.82	
Italy		
Constant	0.238	(0.001)
2 Periods Lagged inflation	0.362	(0.002)
Output gap	0.084	(0.003)
Oil prices	0.009	(0.001)
Lagged oil prices	0.009	(0.006)
Lagged USD/EUR	0.017	(0.125)
Period	2005Q1 to 2015Q2	
R^2	0.7	
Spain		
Constant	0.396	(0.000)
Output gap	0.101	(0.024)
Oil prices	0.022	(0.000)
Lagged oil prices	0.016	(0.005)
Lagged USD/EUR	0.039	(0.043)
Period	2005Q1 to 2015Q2	
R^2	0.58	

Source: DG ECFIN calculations.

The estimated Phillips curves fail to explain a relatively large part of negative inflation, particularly in Spain, but also in Italy, since the end of 2013 and this is reflected in a large residual term in that period. This may be due to a larger-than-assumed contribution from the economic slack than assumed in the estimation or to the effects of exchange rate changes being larger and emerging more slowly. (45)

Graph III.1.2: **Impact of different factors on annual HICP inflation**
(2006Q1 — 2015Q2, %)



Source: DG ECFIN calculations, Data Insight.

Positive base effects affecting inflation in the near future

To shed light on expected inflation developments in the near future, we estimate the base effects of headline HICP and break them down into effects stemming from the core, energy and food-price components. (46) The base effect for each month is calculated as the difference between the average monthly change in the seasonally adjusted price indices for January 1996-August 2015 and actual monthly change 12 months earlier. There is no single uniformly agreed methodology for calculating base effects, but our approach closely follows that used in the ECB *Monthly Bulletin* (2008). (47)

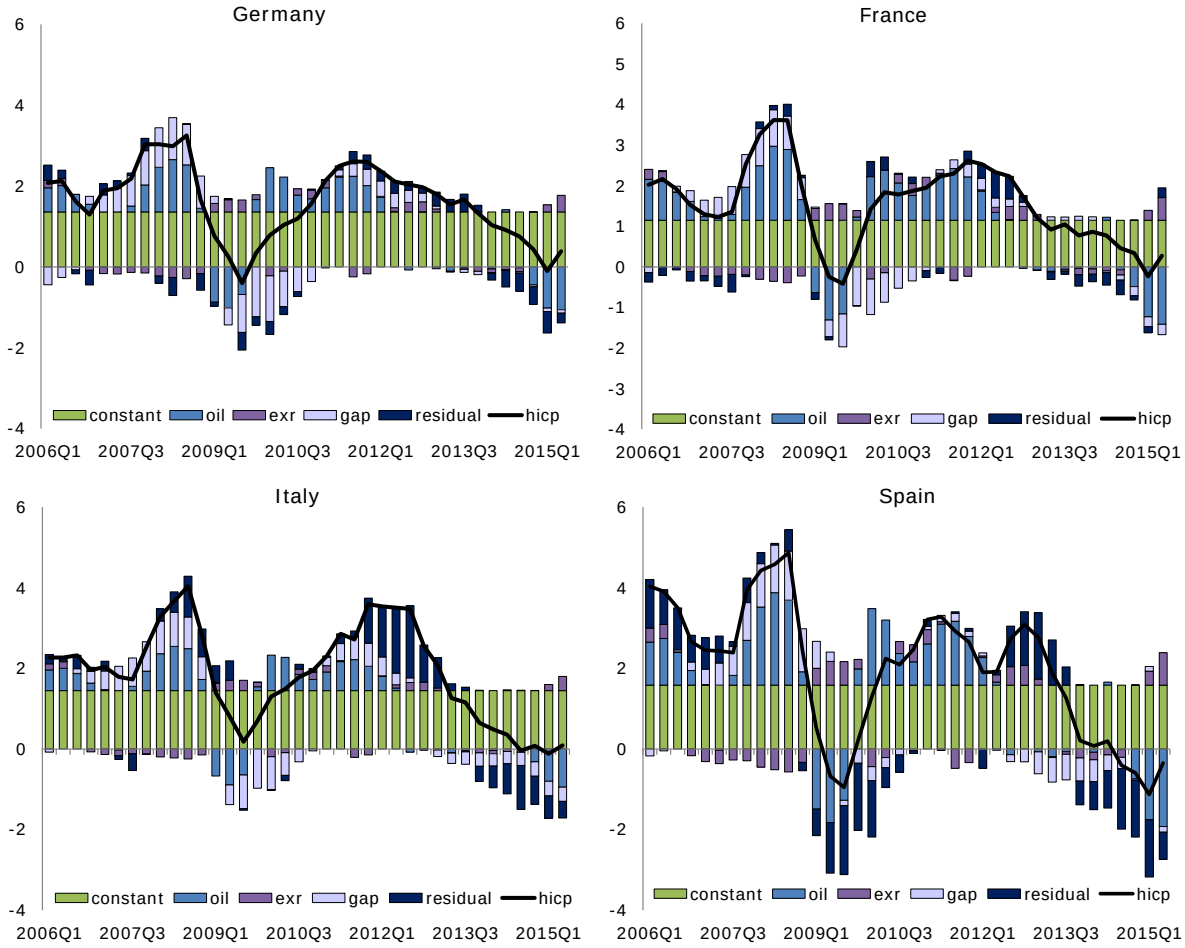
(44) Higher energy intensity and possible larger second-round effects in Spain could explain these differences. See also Balta N., K. Fischer, P. Nikolov and L. Vilmi 'Member State vulnerability to changes in the euro exchange rate', *Quarterly report on the euro area,* Vol. 13, No 3, pp. 27-33.

(45) A larger contribution from the economic slack might reflect larger slack than estimated, a structural change in the Phillips curve or possible non-linearities in the curve. For a discussion of the possible steepening of the Phillips curve, see Jordan C. and L. Vilmi 'Analysing euro-area inflation using the Phillips curve', *Quarterly report on the euro area*, Vol. 13, No 2, pp. 21-26.

(46) The breakdown does not sum up to the aggregate figure, as the base effect and seasonal adjustment is calculated separately from each component. Therefore, it merely illustrates the sources of the base effects.

(47) For a further discussion of base effects, see for example, 'Box 6: Accounting for recent and prospective movements in HICP inflation: the role of base effects', *ECB Monthly Bulletin*, December 2008, pp. 63-64.

Graph III.1.3: **Inflation drivers: four largest euro-area Member States**
(2006Q1 — 2015Q2, %)

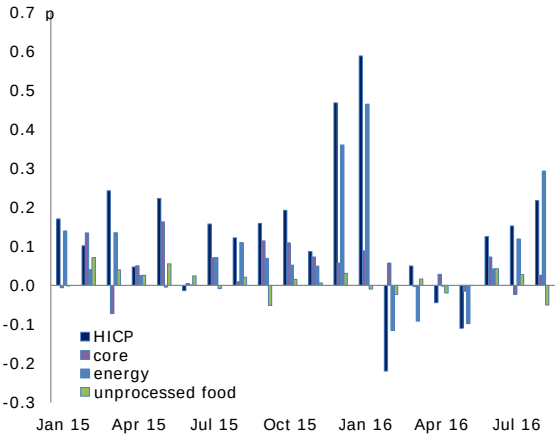


Source: DG ECFIN calculations, Data Insight

Base effects are expected to raise inflation rates in the second half of 2015 (see Graph III.1.4), particularly in December (estimated base effects of 0.45 pp), and January 2016 (0.6 pp). Later in 2016, the estimated base effects are relatively small, reflecting the normalisation of month-on-month inflation rates 12 months earlier but the slump in oil prices from July to September 2015 will lead to further positive base effects in the HICP energy component in the third quarter of 2016.

A large part of the positive base effects stems from energy price developments, reflecting the significant fall in oil prices since the second quarter of 2014. However, base effects in core inflation are also expected to add price pressures, especially from September to November 2015, as processed food and non-energy industrial goods prices fell 12 months earlier. On the other hand, the base effects stemming from unprocessed food prices are expected to be modest. The base effects from core

Graph III.1.4: **Estimated base effects from various subcomponents**
(Jan 2015 — Aug 2016, pps)

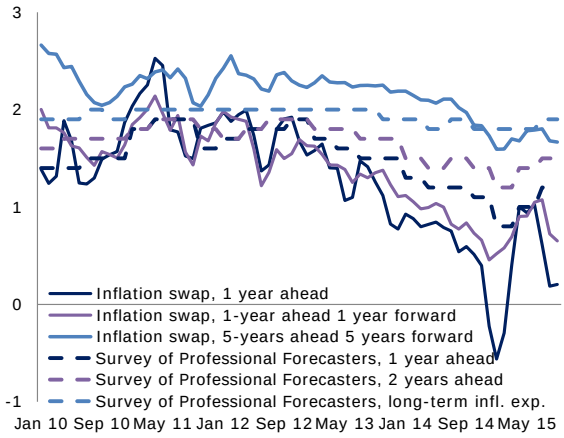


Source: DG ECFIN calculations, Eurostat.

inflation are expected to be close to zero from February 2016, which reflects smaller month-on-month price changes in core categories since February 2015.

Positive base effects point to increasing inflation over the next 12 months. Although base effects provide useful information on expected inflation developments, they cannot be taken as actual projections, as they technically assume that future monthly inflation will follow its historical average. Therefore, they do not take into account changes in inflation trends or temporary factors such as oil price movements or tax measures. However, the upward trend in inflation is consistent with both market- and survey-based inflation expectations (see Graph III.1.5).

Graph III.1.5: **Market and survey-based inflation expectations**
(Jan 2010 — Sep 2015, %)



Source: Bloomberg, DG ECFIN calculations, ECB

Inflation expectations in the euro area fell gradually from mid-2013 and bottomed out in January 2015 at historically low levels, following the slump in oil prices and weak domestic cost pressures. They recovered gradually in spring 2015 amid stabilising oil prices, the weaker euro and the improved short-term economic outlook in the euro area, against the background of further monetary accommodation by the ECB. In summer 2015, a further fall in oil prices and market turmoil relating to uncertainty in Asian economies triggered a drop in short-term swap-based expectations and added volatility in medium- and longer-term expectations.

Both short- and long-term inflation expectations remain below their historical averages, but point to a gradual rise in inflation towards the historical average in the coming years. For example, the ECB's Q3 2015 *Survey of Professional Forecasters* points to inflation of 1.5 % in two years' time and 1.9 % in five years' time. Similarly, swap-based inflation expectations show average inflation of 1.1 % one-year forward two years ahead, but around 1.7 % five-year forward five years ahead. ([48]) The Commission's spring forecast also foresees steadily increasing inflation rates in the coming years, though the path of the rebound in the short term is significantly influenced by ongoing volatility in oil prices.

Conclusions

Inflation in the euro area is currently very low, with lower oil prices adding downward price pressures and large economic slack, particularly in some Member States. These factors have had an especially strong impact in Spain, where inflation seems to be particularly sensitive to oil price movements and economic slack has been sizeable.

Looking forward, inflation is expected to pick up gradually in the euro area, supported by the weaker euro, positive base effects and gradually narrowing output gap. Base effects are estimated to be particularly strong in December 2015 and early 2016, when they may cause swings in the inflation rate.

([48]) Market-based inflation expectations such as inflation swap-rates are also influenced by inflation risk and liquidity premiums, so the measured rate does not necessarily reflect underlying inflation expectations directly.