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Inflation in the Euro Area

and Why It Matters

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Inflation in the euro area and why it matters

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Jakob de Haan, Marco Hoeberichts, Renske Maas and Federica Teppa[1]

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1 Introduction

This study provides an overview of the academic and policy debates about inflation. It is written in a non-technical way. We aim to explain the role of inflation in monetary policy making for a broad audience. Why do central banks care about inflation? How is inflation measured? Why are inflation expectations so important for monetary policymakers? How are inflation expectations measured? What can central banks do to realize their objective of price stability? These issues are all addressed in the present study, with a focus on the euro area.

Most central banks in advanced countries aim for price stability. Chapter 2 starts by explaining why. Next, chapter 2 digs into the measurement of inflation. There is not a unique way to measure inflation and the pros and cons of the two most important inflation concepts (i.e. headline and core inflation) are discussed. Whereas the general public often think that price stability means no increase in prices, central banks generally aim for an inflation rate around 2 per cent. The European Central Bank (ECB), which is responsible for monetary policy in the euro area, is no exception; it strives for an inflation rate of 'below, but close to 2 per cent' for the euro area in the medium term. Chapter 2 explains the reasons why central banks do not aim for an inflation rate of zero.

Chapter 3 discusses how successful the ECB has been in realising its objective. It is shown that inflation in the euro area is not only affected by ECB policies and economic developments in the euro area, but also by global factors, such as the development of oil prices. Although all countries in the euro area have the same monetary policy, their inflation rates may differ. Chapter 3 explains why.

Chapter 4 is about inflation expectations. Inflation expectations are important, as they will affect actual inflation. Very simply, if economic agents (this is economists' jargon for individuals and organizations participating in the economy, such as employees, employers, etc.) expect an inflation rate of, say, 2 per cent and behave accordingly, actual inflation will move towards this rate. Central banks therefore aim to, what they call, 'anchor' inflation expectations. This means that inflation expectations are in line with the central bank's inflation objective. Chapter 4 explains how inflation expectations can be measured and how they have evolved.

Chapter 5 is about monetary policy making. What can the ECB do to realise its objective of price stability? In addressing this question, policymakers rely on economic theory. The main model used in academic research and for policymaking is explained. Next, the chapter touches upon the ECB's policies, focusing on the most recent episode during which inflation in the euro area turned out to be very low, occasionally even below zero.

Chapter 6 is about inflation forecasts. As it takes a while before monetary policy actions affect the economy, central banks base their decisions on forecasts of inflation and real GDP growth in the years ahead. The chapter explains the ECB's forecasts and discusses why they were off the mark during most recent years.

Finally, chapter 7 offers the conclusions.

2 Why price stability?

2.1 Central banks aim for price stability

Most central banks in advanced countries aim for price stability, which is generally defined as an inflation rate around 2 per cent (see Table 1).

Table 1 Price stability objective of some central banks in 2016

Country/area	Objective	Definition
Canada	The Bank of Canada aims to keep inflation at the 2% midpoint of a range of 1 to 3%	Inflation measured using year-on-year rate of change in the Consumer Price Index (CPI)
Euro area	The ECB aims at an inflation close to but below 2% in the medium term for the euro area	Year-on-year increase in the Harmonized Index for Consumer Prices (HICP) for the euro area
Japan	The Bank of Japan has set its price stability target at 2%	Measured in terms of the year-on-year rate of change in CPI
UK	For the Bank of England the operational target for monetary policy is an inflation rate of 2%	Inflation measured as 12-month increase in CPI

US	The inflation objective of the Federal Reserve is 2% over the medium term[2]	Inflation measured by the annual change in the price index for personal consumption expenditures (PCE)
Sweden	The Riksbank's objective is to keep inflation around 2% per year	Inflation measured as annual change in CPI
Switzerland	Price stability is defined by the Swiss National Bank as a rise in the national consumer price index (CPI) of less than 2% per annum	Inflation measured as annual change in CPI

Source: Artemis (2015)

Price stability is important for several reasons. First, price stability preserves the purchasing power of money. When prices are stable, people can hold money for transaction and other purposes without having to worry that inflation will reduce the real value of their money balances. Equally important, stable prices allow people to rely on money as a measure of value when making long-term contracts, engaging in long-term planning, or borrowing or lending for long periods (Bernanke, 2006).

2 The Federal Reserve has a so-called dual mandate. Its objectives are: 'to promote effectively the goals of maximum employment, stable prices and moderate long-term interest rates.' The Fed announced a 2 per cent inflation target on January 25, 2012.

Second, price stability makes it easier for people to disentangle changes in relative prices (i.e. movements in prices of individual goods and services reflecting changes in demand and supply conditions) from changes in the general price level. That is, under price stability price changes give information about the relative scarcity of certain goods and services. This will help households and firms to make well-informed consumption and investment decisions so that markets can allocate resources efficiently (ECB, 2011a).

Third, price stability leads to stable, long-term, interest rates. Interest rates tend to move in tandem with changes in expected inflation because lenders require compensation for the loss in purchasing power of their principal due to inflation. If there is a lot of uncertainty about future inflation, they will also demand an inflation risk premium. However, if lenders can be sure that prices will remain stable in the future, they will not demand this risk premium. This will keep interest rates stable as well. In addition, price stability may also reduce other premiums that lenders charge for bearing risk, lowering the overall level of interest rates (Bernanke, 2006).

Fourth, price stability reduces distortions of tax systems and social security systems. Tax and welfare systems can create perverse incentives which distort economic behaviour. In most cases, these distortions are exacerbated by inflation (or deflation), as fiscal systems are generally not indexed to inflation. For instance, a nominal increase of income to compensate for inflation may cause someone to move to a higher marginal tax rate which, in turn, may affect this person's labour supply (ECB, 2011a).

Fifth, (unanticipated) changes in prices can lead to redistribution of wealth. As inflation lowers the real value of nominal assets and liabilities, it redistributes wealth from lenders to borrowers. Typically, the weakest

groups of society often suffer the most from inflation because they have only limited possibilities for hedging against it.

Sixth, stable prices contribute to social cohesion and social stability. History has proven that large changes in prices, such as hyperinflation, can lead to social tensions and instability (Bernholz, 2006).

Seventh, with stable prices individuals and firms will less likely divert resources from productive uses in order to hedge against inflation, or deflation for that matter. For example, high inflation provides an incentive to stockpile real goods, as they retain their value better in such circumstances than money or financial assets. Inflation acts as a tax on holdings of cash, because households have an incentive not to use cash in order to reduce transaction costs. This leads to transaction costs, so-called shoe-leather costs, because individuals have to visit the bank (or a cash machine) more frequently to withdraw banknotes (ECB, 2011a).

Finally, volatile inflation may lead to sudden revaluations of financial assets which may undermine the soundness of the banking sector's balance sheets and decrease households' and firms' wealth, leading to financial instability.

As Table 1 shows, most central banks define price stability as an inflation rate around two per cent. This does not square well with the view of large parts of the public that price stability means that the general price level does not increase (i.e. an inflation rate of zero per cent). There are several reasons why central banks apply this definition of price stability (Billi and Kahn, 2008; Schmitt-Grohe and Uribe, 2011; see Marty and Thornton, 1995 for a critical discussion).

First, a little inflation may make it easier for firms to reduce real wages in the face of declining demand. If inflation is close to zero, it will be difficult (or even impossible) for firms to lower workers' real wages under downward nominal wage rigidity. Firms may instead lay off workers to reduce costs, resulting in a higher unemployment rate. In contrast, with a little inflation firms can lower workers' real wages by keeping nominal wage increases below the rate of inflation so that unemployment does not rise (Akerlof et al., 1996).

Second, a low rate of inflation might be desirable to insure against persistently falling prices, i.e. deflation. Protracted or persistent deflation is widely perceived as being more harmful than inflation (Fratzscher, 2016). Consequently, debtors may be forced to sell assets or they may default on their loans. So deflation creates a vicious cycle of rising real debt burdens and financial distress, which, in turn, may cause more downward pressure on prices. Likewise, persistent deflation may turn into a deflationary spiral of falling prices, output, profits, and employment. If firms and consumers expect prices to decline, they will postpone spending and thereby put further downward pressure on prices. According to Kuroda (2013), the governor of the Bank of Japan (BoJ), this is what happened during Japan's deflation since the latter half of the 1990: 'behaviour based on recognition that 'prices would not rise' or 'prices would moderately decline' has been embedded in the economy.'[3]

3 Although the view that deflation is very costly is widely shared, a recent study by Borio et al. (2015) questions this view. The authors test the historical link between output growth and deflation in a sample covering 140 years for up to 38 economies. Their evidence suggests that this link is weak and derives largely from the Great Depression.

Third, at very low levels of inflation, nominal short-term interest rates will also be close to zero, limiting a central bank's ability to ease policy in response to economic weakness. Once the monetary policy rate reaches the effective lower bound (ELB[4]), conventional monetary policy (i.e. reducing policy rates; see section 6.2) no longer works. Before the global financial crisis (GFC), it was widely believed that 2 per cent inflation would be sufficient to minimize the probability that the ELB would be a constraint and that if it occurred the likely damage would be small (Krugman, 2014).

Finally, there may be a bias in official estimates of inflation (see section 2.2). One of the reasons provided by BOJ's Governor Kuroda (2013) for adopting a 2 per cent target in Japan is mis-measurement of actual inflation. This mis-measurement may result from several factors such as inadequate adjustments for improvement in the quality of goods and services, difficulties in incorporating new goods into the price index, changes in consumers' shopping patterns that may favour discount retailers, and consumers substituting cheaper goods and services for similar products that have become more expensive (Billi and Kahn, 2008).

2.2 How to measure inflation?

2.2.1 Price indexes

The ECB uses the Harmonized Index of Consumer Prices (HICP) to measure consumer price inflation and hence price stability. The inflation rate based on this measure is often referred to as *headline inflation*. Eurostat and the national statistical offices of the euro area member states compile this measure on a monthly and harmonized basis. The choice for HICP was

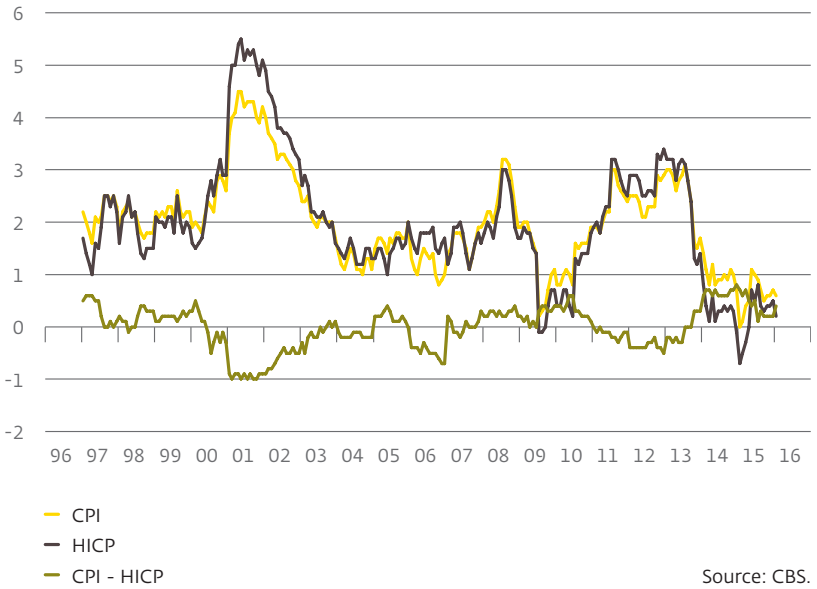
4 For a while it was thought that policy rates could not drop below zero. That is why the term Zero Lower Bound is often used. As policy rates in some countries have become negative, we prefer using the term effective lower bound.

based on several criteria, such as the credibility and transparency of the index (it should be easily understood by the general public), a high level of reliability (it should not be subject to frequent revisions) and that it should be provided with sufficient timeliness and frequency (ECB, 2003).

Besides the HICP almost all countries in the euro area also have a national Consumer Price Index (CPI) that is used for national purposes, such as indexation or income policies. These national CPIs differ, especially in their treatment of price developments in owner-occupied houses, healthcare and education.

Figure 2.1 CPI and HICP in the Netherlands

Percentage annual mutations



Source: CBS.

Figure 2.1 shows the development of CPI and HICP in the Netherlands. In recent years HICP-inflation in the Netherlands is lower than CPI-inflation.

The HICP consists of five broad categories of goods and services: energy, which counts for 9.7% in the euro area basket, unprocessed food (7.4%), processed food (12.1%), non-energy industrial goods (NEIG)(26.5%) and services (44.2%). The HICP does not contain the cost of living in owner-occupied houses. Other indices, like the CPI in the Netherlands, impute the rental rate that homeowners would have to pay to live in their own house as their cost of housing. Although CPI-inflation and HICP-inflation in the Netherlands tend to move in line over the long term, CPI-inflation is on average slightly higher. This suggests that the HICP underestimates inflation by ignoring the cost of housing for homeowners.[5]

Measuring inflation in the euro area is not an easy task. The HICP is based on a common basket of goods and services across all EU countries. However, the prices of the goods and services in the basket in each country are weighted according to the expenditure patterns in that country. And these patterns are sometimes very different across countries. For instance, inflation in services has a 52% weight in total HICP in Ireland and only 32% in Slovakia. Determining the appropriate weights of the goods and services in the basket is one source of measurement error.

Apart from the choice for a specific basket of goods and services, several other potential measurement errors can be distinguished (Sibert, 2003). First, price indices are calculated by comparing the price of a basket of goods and services consumed in a base year with the price of the same basket

5 See Goodhart (2001) for an extensive discussion of the pros and cons of several ways to include owner-occupied dwellings in consumer price indexes.

consumed in the current year. This may overstate inflation, because it does not take into account that consumers may substitute goods and services if prices rise. Second, improvements in the quality of goods may cause price changes to be overestimated. If, for instance, the price of a good remains fixed but its quality improves, the buyer gets a better product for the same price. So, on a constant-quality basis, the price of the good has fallen. Statistical agencies try to adjust for such quality change in computing price indexes but if quality improvements are understated, the indexes overstate inflation (Billi and Kahn, 2008).

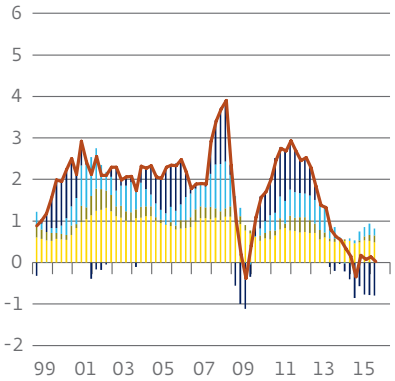
Third, prices of new goods and services often fall rapidly in the first few years after their introduction. However, it may take several years before new goods and services are included in the basket of goods and services used to calculate the price index, and thus the fall in their prices may be missed. An important problem in handling new goods and services is also that there is no price in the base year that can serve as a reference. Finally, there may be an outlet bias resulting from shifts in market shares among retailers that are not reflected in the composition of the sample outlets used in the survey.

The Boskin-commission (1996) concluded that – at the time – US CPI was overstating the annual rise in the cost of living by about 1.1 percentage-points. As far as we know, there are no similar studies of the accuracy of European consumer price indices. However, as pointed out by Wynne and Rodríguez-Palenzuela (2002), after the appearance of the Boskin Report several studies have been conducted for European countries to assess the extent of mis-measurement in national CPIs. Although conclusions differed across countries, the effects reported for European countries were generally (much) smaller than for the US. By defining price stability at an inflation rate higher than zero, the ECB explicitly takes into account the possible measurement errors in the HICP (Cecchetti and Wynne, 2003).

Figure 2.2 Contributions to headline inflation

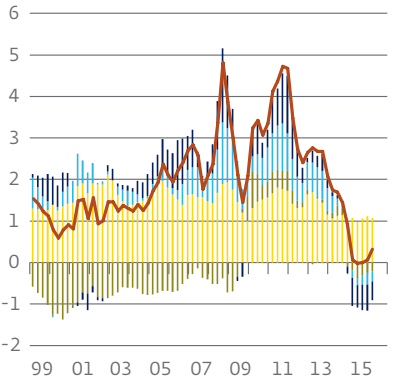
Euro area (HICP)

Percentage contributions



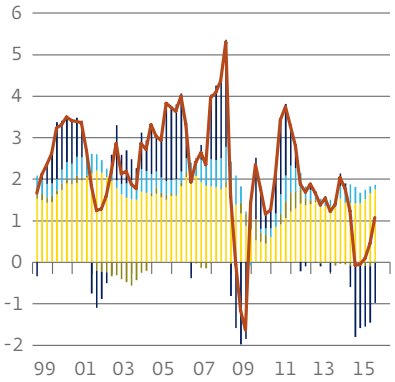
United Kingdom (HICP)

Percentage contributions



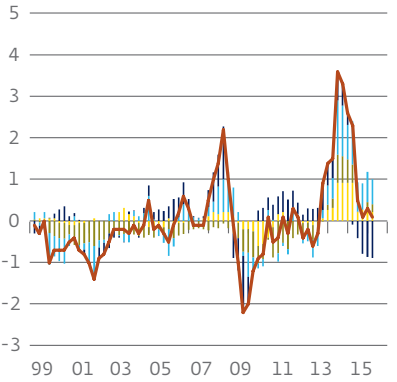
United States (CPI)

Percentage contributions



Japan (CPI)

Percentage contributions



Energy
Services
Food
Total
NEIG (non-energy industrial goods)

Source: Thomson Reuters.

2.2.2 Core inflation

Prices for energy and unprocessed food, which together count for about 17% of the basket of goods, are among the most volatile items in the HICP. Energy prices are, sometimes with a lag, driven by oil prices that are determined on international markets. Energy, which includes fuel, electricity and gas, makes up only 10% of the HICP basket. Nevertheless, higher energy prices have affected HICP to a large extent since the start of the euro area. The contribution of energy inflation to euro area HICP-inflation was on average +0.50 percentage points between 2000 and 2014 (see Figure 2.2). According to central bank model estimates, lower oil prices since the summer of 2014 have contributed more than 1.0 percentage point to lower headline inflation in the euro area. This is not unique for the euro area. As Figure 2.2 shows, lower prices for energy have contributed significantly to low inflation in the US, the UK and Japan as well. Note that the graphs only show the direct effects of lower energy prices and not the indirect effects of lower costs for transportation or heating on the prices of other services and non-energy industrial goods (NEIG), ranging from clothes and shoes to furniture and cars.

The presence of volatile items in the consumer price index, like food and energy, has led to the development of measures of underlying inflation. One of the most popular measures is *core inflation* that excludes energy and food. The idea is that by dropping the most volatile items, the underlying measure of inflation would give a better indication of where inflation is heading to in the medium term. However, the ECB rejects a definition of price stability based on core inflation as it, no doubt, would invite considerable criticism of arbitrariness, since there is no unique or uncontroversial method of deriving such a measure (ECB, 2003). Still, nowadays the ECB also publishes core inflation, next to headline inflation.

Although popular in practice, several studies have criticized core inflation, because its predictive power for future CPI-inflation is relatively low. In a

sample that runs to 2000, Marques et al. (2002) show that for the US, Germany and France core inflation is not a good leading indicator of CPI inflation. More recently, Crone et al. (2013) have found that for the US, predictions of total CPI inflation based on core measures of inflation are not significantly better than predictors based on total CPI. Bullard (2011) also criticizes the use of core inflation on more fundamental grounds than its predictive power. His main argument is that, since central banks aim to stabilize consumer prices including food and energy, the focus on measures that exclude these items is misguided. He concedes that CPI inflation is more volatile than core inflation, but argues that there are better ways for policymakers to deal with this volatility. Bullard also stresses that shifts in energy prices, which are often characterized as 'temporary', sometimes reflect a long-term shift in relative prices. And if that is the case, a monetary policy maker should not ignore them.

Monetary policy should also react when oil price movements feed into inflation expectations and wages. When trade unions negotiate a new wage agreement for the next one or two years, they set a path for nominal wage developments taking expected inflation into account. As soon as wage setters see rising oil prices not as temporary phenomena but include them in their wage demands, this may be a reason for central bank action, as these so-called second round effects of a temporary oil price hike may then lead to persistently higher inflation (see chapter 5).

In conclusion, this chapter has shown that central banks in most advanced countries aim for price stability, which is generally defined as an inflation rate around two per cent. This also holds true for the ECB. There are several reasons why central banks do not aim for an inflation rate of zero per cent, including reducing the risk of hitting the so-called effective lower bound and mis-measurement of inflation. There are several ways to measure inflation. In contrast to headline inflation, core inflation does not include several components, such as energy prices, that are very volatile.

3 Inflation in the euro area

3.1 The ECB mandate for price stability

Since 1999, the European Central Bank (ECB) is in charge of monetary policymaking in the euro area. The ECB's mandate, as specified by the Treaty on the Functioning of the European Union (TFEU) is 'to maintain price stability' (Article 127). Without prejudice to the primary objective, the ECB shall also support the general economic policies in the Union. These 'secondary' objectives are laid down in Article 3 of the Treaty, and include balanced economic growth and full employment.

Although the Treaty provides a clear primary objective to the ECB, it has been left to the Governing Council of the ECB to give a precise meaning to price stability. The primary objective, first specified by the ECB as inflation less than 2 per cent in the euro area, was made more precise in 2003 following an internal evaluation of the ECB's monetary policy strategy. The ECB then clarified that it aims for maintaining inflation 'below but close to 2 per cent in the euro area.' So the ECB does not focus on inflation in individual countries in the euro area. The ECB has also frequently stressed that price stability is to be maintained over the medium term, thereby acknowledging that price levels may be temporarily distorted by short-term factors, such as oil price shocks. As Issing (2001, p. 10) states:

> 'the track record of the ECB .... cannot be assessed on the basis of temporary deviations from price stability caused by external and unavoidable shocks. In view of the lags with which monetary policy affects the economy, a central bank cannot ensure price stability at each and every moment in time in the face of exogenous shocks.'

The medium-term horizon is not defined as a precise time period. This provides some flexibility in responding to shocks that cause inflation to deviate from the target. For instance, it provides the possibility for a more

gradual adjustment path when deviations from the target are primarily driven by supply rather than demand shocks. Often it is not clear whether a supply shock, such as a hike in oil prices, is temporary or permanent. In the first case, the ECB may decide to accept a temporary higher inflation rate, because once oil prices get back to normal levels, so will inflation. As Praet (2013) points out, the flexibility grants the ECB sufficient time to identify whether the shock is transitory or permanent before changing course. However, repeatedly postponing the dates by which the aim of inflation rates below but close to 2 per cent is achieved bears a risk: it may cause long-term inflation expectations to become de-anchored, i.e. deviate from this target. If economic agents have sufficient confidence that the central bank will realise its inflation target, their long-term inflation expectations will be in line with this target. But if the central bank does not meet this target over an extended period, agents may change their expectations, which in turn will affect inflation (see also section 4.1).

In line with the increased emphasis on price stability, several central banks have introduced *inflation targeting* as their monetary policy strategy. Inflation targeting (hereafter IT) has three characteristics: i) an announced numerical inflation target, ii) monetary policy decisions are primarily based on differences between inflation forecasts and this numerical target, and iii) a high degree of transparency and accountability. IT was introduced in 1989 in New Zealand. Since then, many countries followed. For instance, the Bank of England and the Riksbank (the central bank of Sweden) apply this strategy. The distinctive feature of IT is a forward-looking decision-making process known as 'inflation-forecast targeting' (Svensson, 1997). It means that the central bank sets its policy instruments in such a way that its inflation forecast (after some time) equals the inflation target (inflation forecasts are discussed in chapter 6). Central banks using this approach communicate monetary policy decisions in terms of a reaction to deviations

in a forecast for inflation from the inflation target at a particular horizon. The central bank's forecast for inflation is therefore centrepiece both when it comes to decision-making and in communicating to the public.

There is a large body of literature examining the consequences of IT, notably for inflation, which frequently comes to different conclusions.[6] After discussing this literature, Blinder et al. (2008, p. 935) conclude that

> 'inflationary expectations appear to be generally well anchored,[7] and inflation forecast errors small, in IT countries. And studies of countries undergoing regime changes suggest a causal link between adopting IT and anchoring inflation expectations. However, cross-sectional comparisons yield more ambiguous results; the choice of the control group is apparently crucial. So communication of an explicit inflation target is surely not the only way to anchor expectations.'

The ECB (2011) provides several arguments against using IT. Most importantly, relying on a single forecast would not be appropriate, given the considerable uncertainty relating to the structure of the euro-area economy. The ECB prefers a diversified approach in analysing economic data, based on a variety of analytical methodologies, to assess threats to price stability. As Trichet (2003) states:

> 'By contrast with the practice typically observed in inflation-targeting regimes, the ECB has not specified a fixed policy horizon. There are many reasons for this decision. The lags with which monetary policy

6 Also the literature on the factors that make a switch towards IT more likely yields very diverging results. See Samaryna and de Haan (2014) for a discussion.

7 This means that inflation expectations are in line with the central bank's objective; see section 4.1 for a further discussion.

affects price developments vary and are unpredictable. Moreover, the optimum monetary policy response always depends on the specific type and magnitude of the shocks affecting the economy. A medium-term horizon allows central bankers the necessary flexibility to respond appropriately to economic shocks of a specific type. A medium-term orientation helps to avoid introducing unnecessary volatility into the economy and to stabilise output and employment. Our monetary policy framework acknowledges the need to flexibly take into account the nature of shocks hitting the economy and the prevailing economic circumstances. Monetary policy needs to focus on the period covering the whole transmission process, bearing in mind that this may sometimes span a protracted period of time.'

The Treaty makes it clear that price stability is the most important contribution monetary policy can make to economic prosperity in the euro area. By maintaining price stability, the ECB creates the conditions for a favourable economic development and a high level of employment. The basic economic thinking behind the primary focus on price stability hinges on two lines of reasoning. First, it is the task of other economic agents than the central bank to enhance the growth potential of the economy. Second, as monetary policy has no real effects in the long term, it would be problematic to have real income or employment as the primary objective of the ECB (Scheller, 2004).

The ECB does not have an explicit *financial stability objective*, although the ECB is supposed to 'contribute to the smooth conduct of policies pursued by the competent authorities relating to the prudential supervision of credit institutions and the stability of the financial system' (Article 127.5 TFEU). After the GFC, financial stability has gained importance, as the crisis had made clear that sustained price stability is no guarantee that financial

instability will be avoided. In fact, dangerous imbalances often build up under the calm surface of price stability. Some authors even argue that monetary policy played an important role in creating the crisis by keeping interest rates too low for too long in the run up to the crisis (cf. Taylor, 2009), which fuelled an asset price boom and spurred financial intermediaries to increase leverage and take on excessive risks (Borio and Zhu, 2008).

Before the GFC, there was a consensus among central bankers that while they were clearly concerned about financial stability, primary responsibility for action should rest elsewhere to avoid the central bank having conflicting objectives (Cukierman, 2013; Group of Thirty, 2015). It was believed that financial stability concerns should only be taken into account by the central bank if they would affect the medium term outlook for price stability. Nowadays central bankers consider financial stability to be an important objective as the costs of financial crises are very large and their consequences are problematic also for monetary policy and price stability (Laeven, 2016). Financial instability may, for instance, impair the monetary policy transmission mechanism (see section 5.2).[8] Still, there is also widespread consensus among central bankers that monetary policy should not be the main instrument for maintaining financial stability. As Poloz (2015), the governor of the Bank of Canada, puts it: 'The Bank of Canada's view is that monetary policy should be the last line of defense against threats to financial stability, behind the joint responsibility of borrowers and lenders, appropriate regulatory oversight within the financial sector, and sound macro-prudential policies.'

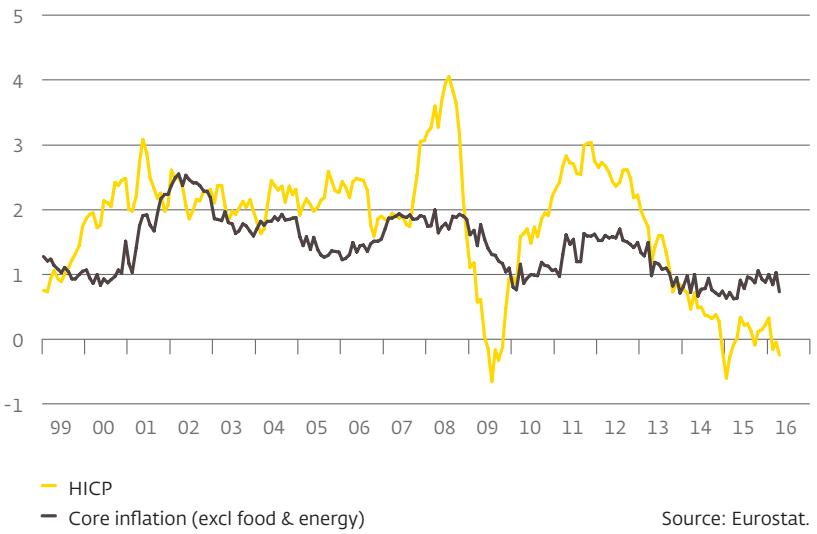
8 Acharya et al. (2015) provide evidence that the transmission mechanism of monetary policy in the euro area was impaired due to financial instability. As a consequence, lose monetary policy that increases liquidity in financial markets does not reach the real sector if the banking sector is undercapitalized.

3.2 Inflation in the euro area

Some European countries have had very high inflation in the past. A prominent example is the hyperinflation in Germany during the Weimar Republic in the 1920s. During the 1970s and the early 1980s several European countries experienced periods of relatively high inflation. For example, the Netherlands faced high inflation (and low growth) during the 1980s. At the end of the 1980s and the early 1990s, inflation in the euro area declined steadily as central banks started emphasising price stability as their main objective.

Figure 3.1 Inflation euro area

Annual percent change



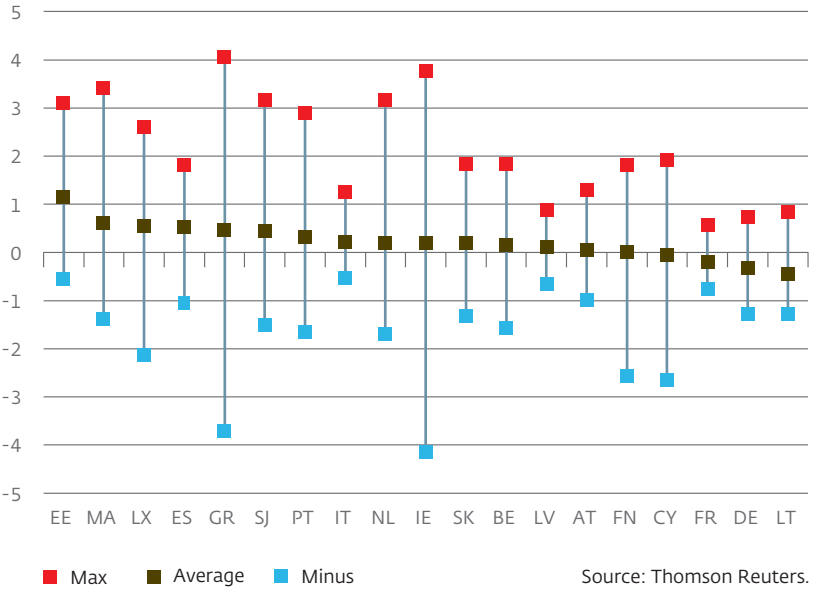
Source: Eurostat.

During the 1990s, many European Union (EU) countries pursued disinflationary policies in order to comply with the convergence criteria to become member of the European Economic and Monetary Union (EMU). This led to a convergence of European inflation rates. Inflation rates in these countries became particularly similar after 1995, when they hovered around 2 per cent (Busettie et al., 2007). However, after the introduction of the euro, inflation rates between the different euro countries started diverging again (see section 3.2 for a further discussion).

Figure 3.1 shows inflation in the euro area (based on HICP; see section 2.2 for an explanation). Inflation patterns in the euro area are not only driven by European events. Ciccarelli and Mojon (2010) showed that over 70% of the variance of inflation between 1960 and 2008 in 22 OECD countries was caused by two factors. First, many central banks have since the 1990s adopted an explicit or implicit inflation target centred at or close to 2 per cent (see section 2.1). Second, global forces influenced domestic inflation. For instance, oil prices are an important driver of global inflation. Between 2003 and 2008, oil (and other commodity) prices were subject to a sequence of positive shocks (Brent oil prices more than doubled), providing continuous upward pressure on euro area inflation. After the unexpected collapse of oil prices after the financial crisis, inflation fell sharply. In 2010, oil prices turned to their pre-crisis levels. As oil prices declined again to very low levels from 2014 onward, inflation also dropped (Riggi and Venditti, 2015). Inflation in the euro area has been falling steadily since early 2013, even turning negative in the late 2014 and again in 2016. Although part of the decline is due to oil prices, the weakness of aggregate demand also plays a significant role (Conti et al., 2015). To get inflation in the euro area in line with its objective (inflation should be close but below 2 per cent), the ECB took several measures (see chapter 6).

Figure 3.2 Inflation differentials versus EMU average 1999-2016*

Percent points



Source: Thomson Reuters.

* 1999-2016 original 11 euro countries. Other countries from euro participation date.

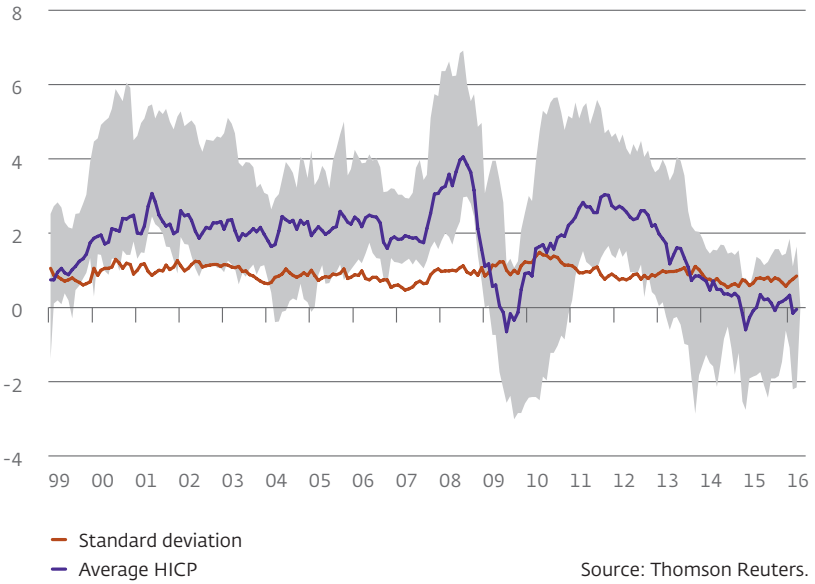
3.3 Inflation differentials in the euro area[9]

Figure 3.2 shows for each country in the euro the extent to which its inflation rate differed from inflation in the euro area for the period 1999-2016 (the figure shows the highest, the lowest and the average inflation differentials), while figure 3.3 presents the inflation variation over

9 The following part heavily draws on de Haan (2010).

Figure 3.3 EMU inflation variations

Percent annual change



Source: Thomson Reuters.

time. The latter figure shows the highest and the lowest rate of inflation in each year (the grey area) and also the standard deviation (red line), which measures the extent to which inflation across the countries in the euro area differs in each year (a higher number means more variability). Figure 3.3 shows that inflation variability across countries in the euro area has not decreased since the start of EMU.

In the absence of the possibility of nominal exchange rate adjustment and the presence of low labour mobility, inflation differentials play an important role as a macroeconomic adjustment mechanism in a monetary union (Berk and

Swank, 2011). For instance, countries facing a competitiveness problem need lower price increases to improve their position. From this perspective, inflation differentials 'are not only unavoidable, but also desirable' (ECB, 2005, p. 61).

However, they may also be problematic. Even if an inflation objective of 'close to 2 per cent' seems high enough to forego deflation in the euro area as a whole, it is possible that deflation occurs in an individual country, depending on how large inflation differentials are in the monetary union. In case of significant inflation differentials within the euro area it is possible for some countries to experience deflation, even if the euro area as a whole does not (if some countries have inflation above 2 per cent, others must have inflation below 2 per cent if the euro area average is close to but below 2 per cent). Furthermore, inflation differentials within the euro area may also have a destabilizing effect on monetary policymaking. Since short-term nominal interest rates are identical in the euro area, differences in inflation rates across member countries cause differences in real interest rates. As a consequence, member countries with relatively high inflation rates experience relatively low real interest rates, which will boost investment and consumption and thus aggregate demand, which, in turn, may lead to even higher inflation rates. This effect will probably be offset by the equilibrating effect of changes in national competitiveness triggered by an increase in inflation differentials (Angeloni and Ehrmann, 2007). Countries with higher-than-average inflation rates suffer a loss in price competitiveness, while countries with relatively low inflation rates gain in price competitiveness. The consequence is that export demand in countries with higher inflation rates tends to decline, which has a dampening impact on price developments in those countries. Furthermore, due to their higher prices domestic producers lose domestic market share, which also has a dampening impact on inflation. Conversely, demand tends to increase in countries with lower inflation rates.

Inflation differentials in the euro area are quite persistent (Berk and Swank, 2011). Several factors may explain the size and the dynamics of inflation differentials in EMU that we capture in five categories, namely (1) convergence, (2) business cycle differences, (3) asymmetric demand and supply shocks and asymmetric adjustment mechanisms to common shocks, (4) characteristics of domestic product and labour markets, and (5) wage and price rigidities. These explanations are not mutually exclusive. For instance, asymmetric shocks may not only lead to inflation differentials, but also to differences in business cycle synchronization. Likewise, the impact of shocks on inflation differentials depends on wage and price rigidities. For expository purposes, however, we will distinguish between these categories.

First, inflation rates of countries in the currency union could initially diverge because of a 'catch-up' mechanism from different price levels *(convergence)*. If price levels differed initially across countries forming a monetary union, price level convergence will generate temporary inflation differentials. Increased market integration and price transparency associated with the adoption of a common currency reduce the scope for deviations from the law of one price.[10] Honahan and Lane (2003) conclude that a considerable part of the inflation differentials in the euro area in the early years of EMU can be explained by price level convergence.

10 Faber and Stokman (2009) examine to what extent price levels are different in European countries. They find that European price levels converged substantially over the last 40 years. Their evidence also suggests that harmonization of indirect taxes and convergence of traded and non-traded input costs contributed to price level convergence.

Box 1 Balassa-Samuelson effect

One reason why countries may have different inflation rates that has attracted much academic attention is the so-called Balassa-Samuelson effect. This effect hinges on differences in labour productivity growth between the tradable and non-tradable sector. If productivity is higher in the tradable than in the non-tradable sector, wages will tend to increase in the tradable sector without leading to higher unit labour costs. However, in case of high labour mobility between sectors wages will also tend to increase in the non-tradable sector, where – given the lower average labour productivity growth – prices will exhibit higher average increases. Therefore, countries with a large difference between labour productivity growth rates in the tradable and non-tradable sectors will also experience a higher inflation rate. The Balassa-Samuelson effect is often associated with the process of convergence in living standards across economies: countries that are in the process of catching up normally display strong productivity growth in the tradable sector, while productivity developments in the non-tradable sector are normally more similar across countries (ECB, 2005). However, empirical evidence suggests that the Balassa-Samuelson effect can only provide a partial explanation for euro area inflation differentials. Honahan and Lane (2003) argue that little if any of the Irish inflation deviation is due to the Balassa-Samuelson effect. Likewise, Rabanal (2009) concludes that the Balassa–Samuelson effect has not been an important source of inflation differentials between Spain and the rest of the euro area during the EMU period.

Second, *business cycle differences* among the countries in the euro area may contribute to inflation differentials.[11] Countries with output above trend tend to have upward pressure on inflation, while countries with output below trend will experience downward pressure on inflation (Berk and Swank, 2011). Honahan and Lane (2003) find that the effect of the output gap on inflation differentials is positive and statistically significant. Likewise, Andersson et al. (2009) find that inflation differentials are primarily driven by different business cycle positions and to some extent by changes in product market regulations (to be discussed below).

Third, an important reason for continuing inflation differentials in the euro area are price reactions to constantly recurring *asymmetric supply and demand shocks* (i.e. shocks that affect countries in different ways). Relative prices should fluctuate across countries – for example, in response to asymmetric productivity shocks – when the countries' consumption baskets are not identical; in a currency union, these fluctuations are necessarily reflected in inflation differentials (Duarte and Wolman, 2008). Likewise, different national fiscal policy shocks can create or reinforce inflation differentials.

Also differences in the transmission mechanisms to common shocks (i.e. shocks that hit all countries, like an oil price shock) could lead to inflation differentials. Different countries may be affected in different ways by the same shock due to differences in nominal rigidities (see below) or differences in their pattern of specialisation. For instance, differences in energy intensity across countries imply that they will be differently affected by an oil price shock. For another, they may react differently to common shocks because of differences in market structures.

11 De Haan et al. (2008) provide a survey of research on business cycle synchronization.

The final factors that can lead to inflation differentials are: *characteristics of domestic product, labour and other factor markets*, and *nominal wage and price rigidities*. The importance of these factors is generally examined in conjunction with (symmetric or a-symmetric) economic shocks.

If wages diverge across countries due to structural inefficiencies in labour markets, also production costs and therefore goods prices may diverge. Labour market institutions may play a role here. According to Calmfors and Driffill (1988) differences in labour market institutions can give rise to different inflation rates because economies with either strong centralization or strong decentralization of wage bargaining are better equipped to face supply shocks than economies with an intermediate degree of centralization. Likewise, the presence of rigidities affecting the price and wage formation mechanism delays the necessary adjustment to shocks and gives rise to distortions in relative prices after such shocks, contributing to lasting inflation differentials. These differences can lead to relative price distortions and thus inefficient allocations of households' spending. There is evidence that retail prices in the euro area are stickier than in the US.[12] Sticky prices prevent firms from changing prices so that prices adjust more slowly to shocks.

Beck et al. (2009) estimate a model explaining regional inflation differentials in the euro area. Their results suggest that labour market characteristics do not play an important role in explaining regional inflation differentials. However, they lent support to the importance of the costs of non-wage input factors. Also the extent of competitiveness of the economy seems to play an important role for inflation differentials.

12 Evidence presented by Dhyne et al. (2006) for the euro area suggests that prices are changed on average every 13 months.

Other studies, however, suggest that labour market institutions do play a role in explaining inflation differentials in the euro area. For instance, the results of D'Amado and Rovelli (2015), based on a study of 26 EU countries from 1994 to 2012, suggest that different labour market institutions are associated with important heterogeneity in inflation adjustment across countries. In general, stronger wage coordination and higher union density increase inflation. These results are broadly in line with those of Jaumotte and Morsy (2012). For a smaller set of countries, these authors find that high employment protection, intermediate coordination of collective bargaining, and high union density increase the persistence of inflation. Oil and raw materials price shocks are also more likely to be accommodated by wage increases when the degree of coordination in collective bargaining is intermediate.

Using the OECD's index for product market regulations, Andersson et al. (2009) find that national differences in changes of product market regulations help explain inflation differentials in the euro area. In particular, an increase in product market regulations in a country relative to the euro area, ceteris paribus, leads to higher inflation relative to the euro area average.

In conclusion, this chapter has shown that the ECB has been able to realise its mandate to keep inflation in the euro close to but below two per cent in the medium term during most of its time in existence. But more recently inflation has been below target, partly because of global developments, such as declining oil prices. Although all countries in the euro area have the same monetary policy, their inflation rates may differ for several reasons, including differences in labour market institutions.

4 Inflation expectations

4.1 Anchoring inflation expectations: why do we care?

Inflation expectations influence decisions about saving, investment and consumption as they affect the real interest rate, i.e. the nominal interest rate minus expected inflation (Englander and Stone, 1989). In addition, inflation expectations play a central role in wage negotiations. Higher expected inflation will lead to calls for higher nominal wages, which in turn may lead to higher prices for goods and services if firms raise their prices in response to higher costs. Inflation expectations are thus important for monetary policymakers (chapter 5 will explain in more detail how this works in modern macro-economic models). Inflation expectations therefore play a key role in central bank decision-making. At the same time, central banks try to influence inflation expectations through their policies.

Nowadays, most central banks communicate about their inflation objective (Blinder et al., 2008).[13] They publicly announce which inflation rate they aim for (see section 2.1). This may help anchoring inflation expectations (Bernanke, 2007; Ball and Mazumder, 2011). If monetary policy is credible, i.e. economic agents believe that the central bank is determined and able to maintain the announced inflation target, inflation expectations remain close to the officially announced inflation target. (The focus is generally on longer-term rather than shorter-term inflation expectations because inflation can be heavily affected by shocks that cannot be counteracted by monetary policy within a short time horizon.)

To what extent are inflation expectations well anchored (i.e. in line with the central bank's inflation objective)? Studies using forecasts of financial market participants or professional forecasters (see section 4.2 for details) generally find that explicit numerical inflation targets help anchoring inflation

13 The following part heavily draws and de Haan and Sturm (2016).

expectations. These studies are based on the idea that if expectations are well-anchored, long-run inflation expectations should be stable in response to macroeconomic developments and policy announcements (Gürkaynak et al. 2007; Ball and Mazumder 2011; Beechey et al. 2011; Galati et al. 2011). For instance, Galati et al. (2011) examine whether long-run inflation expectations in the United States, the euro area, and the United Kingdom have changed around the financial crisis that erupted in mid-2007. They find that survey-based measures of long-run inflation expectations (that will be explained in section 4.2) remained fairly stable around 2 per cent in the euro area, fluctuated above 2 per cent in the United States, and drifted up to about 2.5 per cent in the United Kingdom. Ehrmann (2015) shows that under persistently low inflation, inflation expectations are not as well anchored as when inflation is around target: inflation expectations are more dependent on lagged inflation; forecasters tend to disagree more; and inflation expectations get revised downward in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation.

However, studies on knowledge about the central bank's objective and inflation expectations of households and firms come to much more sobering conclusions (see Easaw et al., 2012 for an overview of the literature). For instance, van der Cruijsen et al. (2015) study the general public's knowledge about the ECB in the Netherlands, using a survey of Dutch households. They presented participants with eleven statements about the ECB's objective. Four of these statements were based on the ECB's specification of its objective, while the remaining seven were false. The authors find that respondents' knowledge about the ECB's policy objectives is far from perfect: the average number of correct answers is less than five. The authors also examine the inflation expectations of the respondents. Expectations range between 1 and 10 per cent; the mode and median are at 2 per cent, while the mean is around 2.7 per cent. At the time

of the survey, the actual rate of increase in Dutch consumer prices turned out to be 1.1 per cent. Respondents' knowledge about the ECB's objective for monetary policy is negatively related to their absolute inflation forecast errors (in other words, better informed respondents make more accurate inflation forecasts).

Likewise, Binder (2015) finds that Americans are generally unable to identify recent inflation dynamics with any degree of precision. Barely half of consumers expect long-run inflation to be near the Fed's 2 per cent target. This evidence is based on data from the Michigan Survey of Consumers. In interpreting her findings, Binder distinguishes between informedness and credibility, where the former refers to the Fed's ability to capture the attention of households to convey basic information about its policies, while the latter refers to the Fed's success in convincing households that it is committed to its goals. Binder's results suggest that both low credibility and low informedness are major barriers to well-anchored inflation expectations among the general public.

Also expectations of firms may not be anchored as a recent study by Kumar et al. (2015) suggests. These authors performed a survey of managers of firms in New Zealand, asking a wide range of questions about their inflation expectations, their individual and firm's characteristics, as well as about their knowledge and understanding of monetary policy. Despite twenty-five years of inflation targeting in New Zealand, the survey suggests that managers of firms have been forecasting much higher levels of inflation than actually occurred, at both short-run horizons and very long-run horizons. Their average perception of recent inflation is also systematically much higher than actual inflation. Furthermore, there is tremendous disagreement in the forecasts of firms, at all horizons, as well as disagreement about recent inflation dynamics. Firms also express far more uncertainty in their

inflation forecasts than do professional forecasters. The authors also find that managers commonly report large revisions in their forecasts, suggesting that expectations are not well anchored.

4.2 Measuring inflation expectations

Inflation expectations have been measured in several ways in the literature (see Galati et al., 2011). Whereas some studies employ financial markets data (section 4.2.1), others use surveys, either among professional forecasters, households or firms (section 4.2.2). Both are relevant for central banks. Inflation expectations of financial market participants will be reflected in nominal interest rates and therefore affect the real interest rate which matters for saving and investment decisions. Inflation expectations of households and firms matter as well, because they will effect nominal wage developments.

4.2.1 Inflation expectations from markets

Market expectations about inflation reflect the expectations of investors. As investors have real money at stake, an inaccurate assessment of future inflation may result in losses. Hence, investors have a strong incentive to make proper inflation predictions. If markets are efficient, market prices reflect all publicly available information, including forecasts in the public domain. Market-based measures of inflation expectations can be derived from financial instruments that are directly linked to inflation, such as inflation-linked bonds and derivatives like inflation swaps or inflation options. Inflation-linked bonds are bonds whose coupon payments and principal are protected against inflation. An inflation swap is a derivative contract under which one counterparty is entitled to receive a payment equal to the nominal value times the realized inflation rate over an agreed period (e.g. one year) in exchange for the nominal value times a given fixed

rate of inflation. Inflation options offer protection against inflation being higher than the strike rate. An inflation option can be either a cap or a floor. An inflation cap (floor) offers protection against inflation being higher (lower) than a given rate of inflation, and can therefore be used by investors to insure against such inflation outcomes (Grothe and Mayer, 2015).

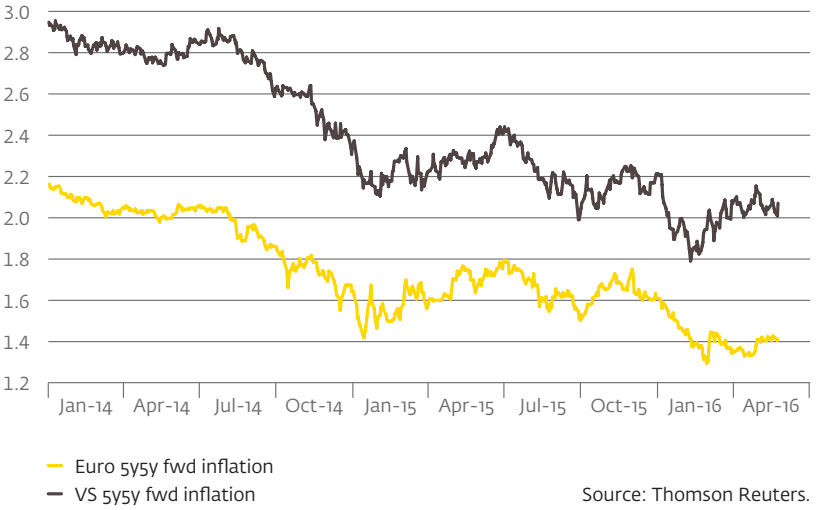
The inflation expectations of market participants can be derived from these financial instruments. The break-even inflation rate (BEIR), i.e. the spread between nominal and inflation-linked bonds, is an important indicator of inflation expectations as it reflects the inflation compensation requested to hold nominal bonds. In addition, inflation swaps reflect the expected rate of inflation over the contract horizon (Grothe and Mayer, 2015). Finally, option prices can be used to extract so-called risk-neutral probability densities for future inflation outcomes (ECB, 2013b). Figure 4.1 shows market based inflation expectations 5y5y forward in the US and the euro area, based on inflation swaps for 5 and 10 years. Expectations in the euro area and the US declined since 2014. Still, the level of expected inflation in the euro is lower than in the US.

However, deriving inflation expectations from these financial instruments is not straightforward. Often the derived inflation expectations comprise a risk premium. For example, the BEIR comprises both the expected level of inflation and a premium to compensate for inflation risks (Ciccarelli and García, 2009). The same holds for inflation swaps. Furthermore, option-implied risk-neutral probability densities are not equivalent to the actual probabilities of inflation perceived by market players, because they also incorporate a risk premium component (ECB, 2013b).

Inflation expectations derived from inflation swap contracts come with an additional caveat. For the euro area, the inflation underlying an inflation

Figure 4.1 Market based inflation 5y5y fwd euro area and US

percent



Source: Thomson Reuters.

swap contract is calculated using the euro area HICP (excluding tobacco) three months before the current date of the contract (indexation lag). This means, for example, that a 1-year swap rate at time t would measure a market-based expectation of inflation over one year from t–3 months to t+9 months. This implies that information included in a 1-year inflation swap reflects 3 months of actual inflation data and expectations over a 9-month horizon (Grothe and Mayer, 2015).

Although the information derived from inflation bond and swap markets is similar, in recent years the pricing of inflation swaps has been somewhat less volatile than the pricing of inflation-linked and nominal bonds. This is due to specific market effects, in particular related to the liquidity effects

and the supply/demand effects in bond markets (Ejsing et al., 2015). For this reason, usually inflation expectations based on inflation swaps are used.

4.2.2 Inflation expectations from surveys

Private sector inflation expectations are elicited at high frequency (mostly monthly) by several institutions. The United States have a long tradition in this field. The Survey of Professional Forecasters began in 1968 and was conducted by the American Statistical Association and the National Bureau of Economic Research. The Federal Reserve Bank of Philadelphia took over the survey in 1990. Another well-known survey is the Reuters/Michigan Survey of Consumers. This survey has been administered since 1953, initially three times per year, then quarterly from 1960 through 1977, and monthly since 1978 (Ludvigson, 2004). The one-year inflation expectations data is derived from the responses to two questions. The first is categorical, while the second one elicits a percentage response: 1. 'During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are right now?' 2. 'By about what per cent do you expect prices to go (up/down) on average during the next 12 months?'[14]

Consensus Economics delivers monthly compilations of forecasts from the world's leading forecasters starting from 1989. The sample includes more than 85 countries.

Probably the best-known survey in Europe is the ECB Survey of Professional Forecasters (SPF) which started in 1999. It is a quarterly survey of

14 Other surveys are the monthly Conference Board's Consumer Confidence Survey, the recent New York Fed's Survey of Consumer Expectations and the Livingston Survey. The latter was started in 1946 and summarizes the forecasts of economists from industry, government, banking, and academia. The Federal Reserve Bank of Philadelphia took responsibility for this survey in 1990.

expectations for the rate of inflation, real GDP growth and unemployment in the euro area for several horizons. The participants are experts from financial or non-financial institutions based within the European Union (Garcia, 2003). Another survey is the Eurobarometer of the European Commission, in which respondents are asked, among other things, about their macroeconomic assessment for Europe, including inflation. Although respondents are questioned only about the expected direction of change for inflation, inflation expectations can be extracted from this source by exploiting that the question regarding future price movements 'links' the answer about the expected rate of inflation to the rate currently perceived and that some options are quantitative in nature (e.g. the 'no change in inflation' option) (see Berk, 1999). Figure 4.2 shows Consensus, Eurobarometer and SPF inflation expectations in the euro area for the 5-year horizon (the Eurobarometer-based data refer to a one-year horizon). The figure also shows a market-based measure based on swap prices. The figure illustrates that these different measures for expected inflation sometimes differ substantially.

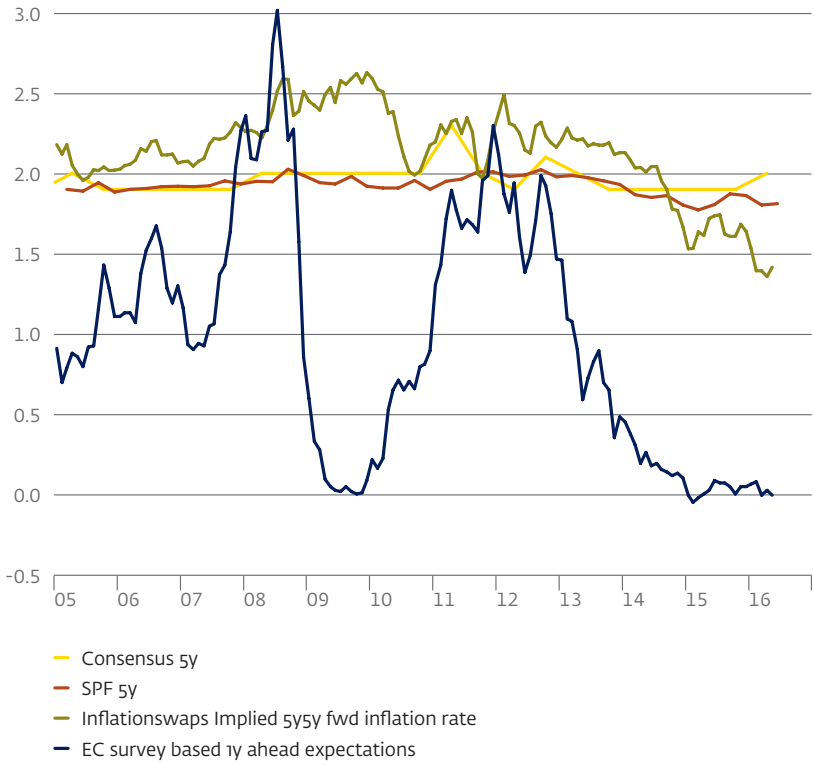
The Bank of England/GfK Inflation Attitudes Survey, since February 2016 called the Bank of England/TNS Inflation Attitudes Survey, started in February 2001. The nine questions asked in these quarterly surveys seek information on public knowledge, understanding and attitudes toward the Bank of England, as well as expectations of interest rates and inflation and also measures satisfaction with the way the Bank of England is 'doing its job'.

4.2.3 Issues in surveys

Armantier et al. (2013) show that different consumer surveys often show large variation in the reported medians and dispersions of inflation expectations. Survey design features, including question wording, administration mode, and whether or not participants receive an explicit

Figure 4.2 Inflation expectations euro area

Percent



Source: ECB, European Commission, Consensus Economics and Thomson Reuters.

opportunity to rethink and revise their answers can be responsible for these differences (see Bruine de Bruin et al., 2016).

For instance, how the question is raised may create some bias in reported inflation expectations. Participants can be asked about 'prices in general,' or 'inflation'. Bruine de Bruin et al. (2012) find that participants consider the 'inflation' wording as more difficult, and that compared to questions that use the simple 'prices in general' wording, questions about 'inflation' produce less dispersion in reported expectations. One explanation is that participants tend to focus on large price changes, such as those for gas, that are most salient.

Outcomes are also influenced by the mode of the survey, i.e. face-to-face versus web-based surveys. The main difference between face-to-face (or over the telephone) and web-based surveys is the presence of an interviewer, who has the opportunity to interact with the participants, to motivate them and to clarify difficult questions (Conrad and Schober, 2000). It has been shown that the presence of an interviewer may bias the reported answers on particularly sensitive topics (Dillman and Christian, 2005). Inflation expectations do not represent a sensitive topic, per se. However, if online surveys yield higher response rates, also individuals who are uncertain about future inflation may provide a response, rather than choosing to skip the question. This may lead to higher inflation expectations with online surveys than with other modes (Bruine de Bruin et al., 2011a).

Finally, the opportunity for respondents to revise their initial answer may affect outcomes. For instance, the Michigan interview protocol requires that if respondents answer that future inflation will be above 5 per cent, they are asked another question that allows them to rethink and revise their answer. If this leads participants to recognize that their response is perceived as an error, they may revise their answer to a lower number that is more in line with recent inflation.

4.3 What drives inflation expectations?

The influence of macroeconomic variables on inflation expectations is well documented in the literature (see Galati et al., 2011 for a review). A large body of empirical work on inflation dynamics documents that variables like unemployment or output gaps have little explanatory power for inflation expectations (e.g. Stock and Watson, 2009). For instance, Berk (1999; 2002) shows that inflation expectations do not react in a systematic way to changes in inflation and unanticipated changes in short-term interest rates. Mankiw et al. (2004) also examine whether inflation expectations are influenced by actual inflation, unemployment and output. Their findings suggest at best a weak effect of these variables on expectations about price changes.

However, the sharp fall in oil prices that started in the second half of 2014 has affected market-based inflation expectations in the US, the UK and the euro area. The direct effect of higher oil prices on inflation is obviously relevant for short-term inflation expectations. Short-term expectations are also affected by the indirect first-round effects that arise partly through the impact of higher oil prices on producers' production costs, for instance through energy inputs or transportation costs. Another indirect first-round effect works in the opposite direction. Lower oil prices bolster (domestic) spending thereby reducing the output gap (i.e. the difference between potential and actual output), causing upward pressure on prices. Second-round effects capture the reaction of wage and price setters to higher oil prices. A recent internal analysis by DNB finds a relationship between changes in oil prices and long-term inflation expectations as measured by the 5y5y forward inflation. This result is in line with the findings of similar research done by other central banks. Oil prices and long-term inflation expectations move in tandem for the euro area and the US. The relationship is statistically significant since the second half of 2011 in a model with weekly data for the euro area, the US and also for the UK. Although this

co-movement has been confirmed by several studies, it is still puzzling why oil prices have a significant impact on inflation expectations so far into the future. Since this correlation is absent in survey-based measures of expectations, one explanation could be that the inflation risk-premium that is included in market-based measures for inflation expectations (see section 4.2.1) is responsible for the correlation with oil prices.[15]

A lot of research has been done on the effects of education and demographic characteristics, such as age and gender, on inflation expectations. Individuals with lower levels of education, singles, females and respondents belonging to ethnic minorities tend to report higher inflation (see, for instance, Bruine de Bruin et al., 2010 and Easaw et al., 2012). The role of age is less clear, as the effect is not robust across studies (see Bruine de Bruin et al., 2010). One potential explanation why demographic differences may cause differences in individual inflation expectations is that different subgroups of consumers are confronted with different prices for their daily purchases (Bryan and Venkatu, 2001). However, this hypothesis has not been confirmed in the literature: differences in expectations are not explained by differences in the prices of the product baskets consumed by different demographic groups (Bruine de Bruin et al., 2010). Some other studies suggest that demographic differences are correlated with the level of financial literacy. Low financial literacy may indicate that individuals are not able to correctly form price expectations. For instance, van der Cruijsen et al. (2015) report that better knowledge of respondents' about the objectives of the ECB's monetary policy leads to better inflation predictions. Burke and Manz (2014) also find a positive relationship between financial literacy and unbiased price expectations: respondents who use higher quality information and use the information efficiently are predicting inflation much better.

15 See also http://bruegel.org/2016/01/oil-prices-and-inflation-expectations/.

In conclusion, this chapter has shown that central banks closely monitor inflation expectations and try to anchor inflation expectations (i.e. inflation expectations are in line with the central bank's inflation target). Although research suggests that inflation expectations of financial market participants (at least if expectations based on surveys are used) are generally well anchored, this is less so for inflation expectations of households and firms. Inflation expectations can be measured using financial market prices and surveys. These measures generally differ from each other. Even survey-based measures may differ due to differences in survey design features, such as question wording, administration mode, and whether or not participants receive an explicit opportunity to rethink and revise their answers. Recent research suggests that oil prices affect inflation expectations. Higher financial literacy is associated with more accurate inflation expectations.

5 How can the ECB influence inflation (expectations)?

5.1 Theory

Central banks do not directly control inflation. The level of inflation is the result of decisions that other agents, such as firms, consumers and employees, make. Through its policies, the central bank can affect these decisions. Nowadays, most central banks base their economic analysis on the New Keynesian framework (see, for instance, Woodford, 2003 and Galí, 2008). This section outlines a very simplified version of this framework for a closed economy (i.e. the model does not include trade and there is no exchange rate).

In the New Keynesian economic model, firms maximize current and future profits. Firms face monopolistic competition[16] so that they can set a mark-up on the marginal cost of production. They can, however, not adjust their prices anytime they like but only at certain times (price rigidities). This can be at fixed intervals (Taylor pricing) or with a certain probability (Calvo pricing). An alternative way to introduce price rigidities is to make price changes costly (menu costs). A consequence of price rigidities, in combination with monopolistic competition, is that firms adjust their production volume when demand changes. Higher demand, in turn, leads to higher marginal production costs for firms, e.g. because the labour market becomes tighter and workers demand a higher wage. Not all firms can pass these higher costs immediately into their prices because of price rigidities. And when firms adjust their prices, they do so in a forward-looking way, knowing that their prices will not be changed for a while after they have reset their prices. From this price-setting behaviour, one can derive the New Keynesian Phillips curve (NKPC) showing that current inflation depends on future expected inflation

16 Form of imperfect competition where firms sell products that are similar, but not perfect substitutes. This gives firms some degree of market power and enables them to charge a price that is higher than the marginal costs.

and expected developments of real marginal costs. This equation describes the supply side of the economy. Since real marginal costs are unobservable, many researchers use either unit labour costs or a measure for economic slack, like the output gap or the unemployment gap (i.e. the difference between natural and actual unemployment) in empirical studies of the NKPC. The idea is that when unemployment (output) is relatively low (high), competition for labour pushes up real marginal costs.

Households maximize their utility by choosing an optimal path for consumption now and in the future. On this optimal path, the consumer is indifferent between consuming one more unit today and saving one unit and consume tomorrow. This intertemporal choice is affected by the real interest rate: a higher interest rate makes it more attractive to postpone consumption, save one unit more and consume later. This optimal path determines the demand side of the economy in this stylized model. Together with the NKPC and an equation that describes monetary policy, this three-equation model can be used to analyse the effects of monetary policy.

The relationship between slack in the economy and the level of inflation is an important link in the transmission of monetary policy to inflation. Lower interest rates stimulate economic activity, thereby reducing slack. Less slack, i.e. lower unemployment and a smaller output gap, puts upward pressure on costs and prices and leads to higher inflation. If unemployment drops below a certain threshold, a level that is called the natural rate of unemployment, a tight labour market gives rise to higher wages. Higher wages imply higher production costs for firms, which they will try to pass on to consumers by charging higher prices.

The analysis of the relationship between inflation and unemployment has a long history. Although there are even earlier hints, the first papers date back to Phillips (1958) for the relationship between wage inflation and

unemployment in the UK and to Samuelson and Solow (1960) who extended the analysis to price inflation and to the US. Phelps (1967) and Friedman (1968) both criticised the original Phillips curve arguing that, for rational workers and employers, not the nominal but the real wage matters. In the long run, real wages would adjust so that unemployment reaches its equilibrium level, the natural rate of unemployment. Any attempt by the government to push unemployment below the natural rate by increasing inflation, would be compensated by higher inflation expectations and higher nominal wages. In the long run, there is no trade-off between inflation and unemployment and the Phillips curve is vertical.

In empirical applications of the New Keynesian Phillips curve, real marginal costs faced by the firm are usually proxied by unit labour costs. This measure is close to the theoretical concept of marginal costs, and it can also be linked to measures of slack, like the output gap or the unemployment gap. In their review of the vast literature on the empirical evidence of the NKPC, Mavroeidis et al. (2014) show, however, that results are very sensitive to small changes in the econometric setup. These authors conclude that 'the literature has reached a limit on how much can be learned about the new Keynesian Phillips curve from aggregate macroeconomic time series' (p. 124). A DNB analysis of inflation in the Netherlands, in which 56 different specifications of the Phillips curve were estimated (including specifications with time-varying coefficients), suggests that the empirical relationship between slack and inflation in the Netherlands also appears to be quite weak, at least in recent years. Chapter 6 will discuss the implications of this weakened relationship between slack and inflation for inflation forecasts.

5.2 Conventional monetary policy

During 'normal' times, the central bank influences money market conditions by changing its policy rates and by providing (or extracting) liquidity to (from)

the banking system. For instance, the ECB made use of its interest rates on the marginal lending facility, the main refinancing operations (MROs) and the deposit facility. The changes in the official interest rates directly affect money-market interest rates and, indirectly, lending and deposit rates, which are set by banks to their customers. Through refinancing operations (see below) the ECB could steer the money market.

The ECB affects money market interest rates by providing more (or less) liquidity to banks if it wants to decrease (increase) interest rates. It allocates an amount of liquidity that allows banks to fulfil their liquidity needs at a price that is in line with the ECB policy intentions. To manage liquidity in the money market and steer short-term interest rates, it uses *open market operations*. These operations are carried out by the National Central Banks (NCBs) in the euro area. The most important open market operations of the ECB are the *main refinancing operations* (MROs).[17] Lending through open market operations normally takes place in the form of reverse transactions. In these reverse transactions, the central bank buys assets from a bank under a repurchase agreement (i.e. the bank buys the asset back) or grants a loan against collateral. Reverse transactions therefore provide funds for a limited, pre-specified period only. The ECB accepts instruments issued by both private and public debtors as collateral. The interest rate on the MROs is the most important policy rate of the ECB.

The ECB provides two *standing facilities*, i.e. the marginal lending facility and the deposit facility. Banks can use these facilities if they (unexpectedly) need additional liquidity or if they want to stall liquidity. Both facilities have

17 In addition, the ECB uses Long-term Refinancing Operations (LTROs). These operations are aimed at providing longer-term liquidity to the banking system. After October 2008, the weight of the refinancing operations shifted towards LTROs (see section 5.3).

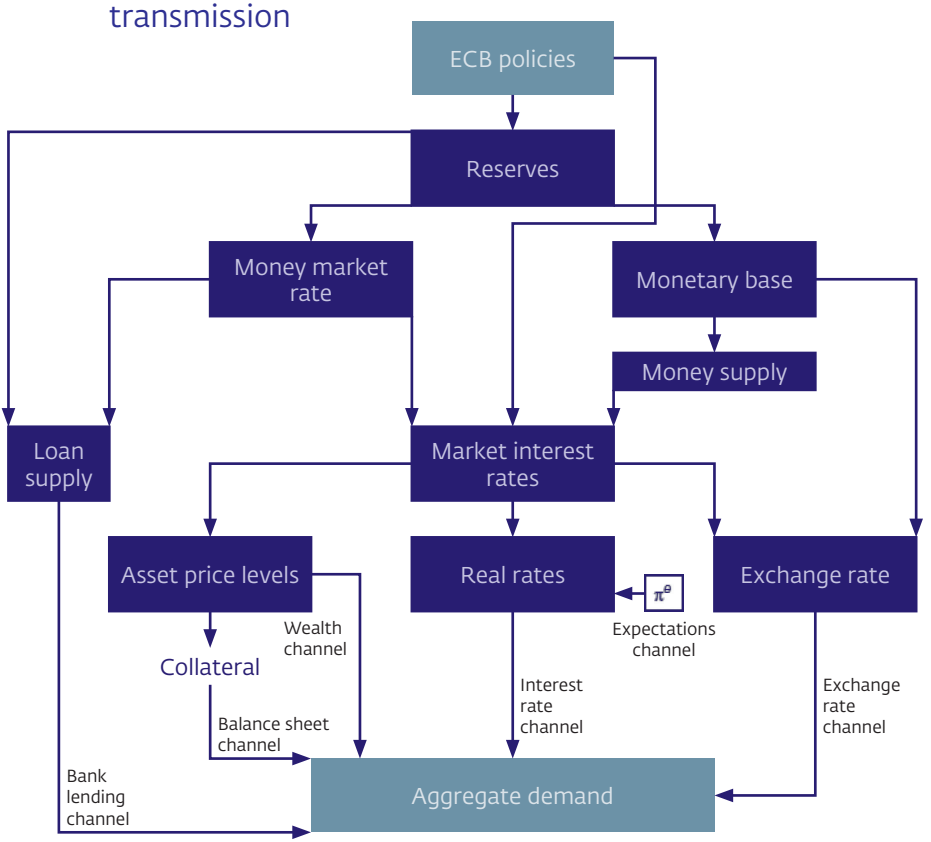
an overnight maturity and are available to banks on their own initiative. The deposit facility is used for mopping up liquidity from the banks, while the marginal lending facility provides liquidity to the banks to cater for unforeseen liquidity needs.

As the interest rates on the standing facilities are normally substantially higher (for borrowing) or lower (for depositing) than the corresponding money market rate, banks normally only use the standing facilities in the absence of other alternatives. As there are no limits on access to these facilities (except for the collateral requirements of the marginal lending facility), the rate on the marginal lending facility and the rate on the deposit facility normally provide a ceiling and a floor, respectively, for the overnight rate in the inter-bank money market. The interest rates on the standing facilities thus constitute a corridor for the inter-bank money market rate.

Monetary policy affects inflation via the monetary transmission mechanism. Typically, two broad stages are considered in the transmission mechanism. In the first stage, changes in money market conditions due to the central bank's monetary policy affect financial markets. This is reflected in asset prices, overall liquidity and credit conditions (ECB, 2000). In the second stage, changes in financial market conditions affect spending. In the short run, these changes in nominal spending may have an impact on real economic activity. The extent to which this happens depends on nominal wage and price rigidities and on the flexibility of the economy more generally. The full transmission process of monetary policy can take about 1-2 years, or sometimes even longer. Due to this lag in the monetary transmission mechanism, monetary policy needs to be forward-looking, i.e. policy decisions are based on forecasts of future economic developments, such as inflation (see chapter 6).

The monetary transmission mechanism consists of the various channels through which monetary policy actions affect the economy and the price level in particular. Figure 5.1 shows these channels in a schematic way.

Figure 5.1 Schematic overview of monetary policy transmission



Source: based on Kuttner and Mosser (2002), adapted for the ECB

Under the *interest rate channel* monetary policy influences output via the nominal interest rate. A monetary expansion decreases nominal interest rates. As prices are sticky in the short run, the real interest rate drops as well. This lowers the cost of capital, causing a rise in investment and consumption spending, thereby leading to an increase in aggregate demand and a rise in output (Mishkin, 1996).

In recent studies, it has been pointed out that low interest rates may induce financial institutions to take more risk (*risk-taking channel*); see, for instance, Dell'Ariccia et al. (2015) and Jimenez et al. (2014). This channel is not shown in Figure 5.1. Mishkin (2011) provides four reasons why low interest rates might promote excessive risk taking. First, low interest rates can increase the incentives for asset managers in financial institutions to search for yield and hence increase risk-taking. Second, low interest rates increase net interest margins, collateral values and the value of financial firms, thereby increasing their capacity to increase their leverage and take on risk. Third, if interest rates are low for a long time this may reduce uncertainty and encourage asset managers to underestimate risk. Fourth, low interest rates can increase systemic risk as it encourages investors to pursue similar strategies, thereby increasing the correlation of returns.

The *expectations channel* works through the impact of monetary policy on expectations of households and firms. Inflation expectations, for example, play a pivotal role by influencing interest rates, exchange rate movements, wages, aggregate demand, and domestic prices (Taylor, 1995). A reduction in policy rates may not cause long-term interest rates market to decline if it is thought that the expansionary monetary policy will cause inflation to rise in future. In this case, investors will factor in the expected higher inflation rates into the returns they expect to receive. Enterprises setting prices and social partners negotiating about wages act in much the same way.

Under the *wealth* or equity price *channel*, consumption and investment are also affected by movements in asset prices and effects on the value of collateral. For example, when equity prices rise in response to monetary policy, households which own shares become wealthier and may choose to increase their consumption. Conversely, when equity prices fall, households may reduce consumption. Under the *exchange rate channel*, changes in the exchange rate in response to monetary policy can affect inflation directly, insofar as imported goods are directly used in consumption (ECB, 2000). In addition, a change in the exchange rate has an impact on trade. For example, a depreciation of the home currency makes domestic goods relatively cheaper against foreign goods. This increases foreign demand for domestic goods, thereby leading to higher domestic output.

Finally, under the *credit channel* monetary policy has effect due to existing frictions in financial markets. This channel consists of two separate channels, namely the balance sheet channel and the bank-lending channel. The *balance sheet channel* stresses the potential impact of changes in monetary policy on borrowers' balance sheets and income statements, including variables such as borrowers' net worth, cash flow and liquid assets. Expansionary monetary policy, causing an increase in equity prices, raises the net worth of firms and thereby leads to higher investment spending and aggregate demand (ECB, 2000). The *bank-lending* channel focuses on the possible effect of monetary policy on the supply of loans by banks (Bernanke and Gertler, 1995). Expansionary monetary policy, which increases bank reserves and bank deposits, increases bank loans. Given banks' role as lenders to borrowers, this increase in loans will cause investment (and possible consumer) spending to rise (Mishkin, 1996).

5.3 Monetary policy since the crisis

The ECB, as well as other central banks, has resorted to unconventional monetary policy since the GFC in 2007/08. As pointed out by Borio and Disyatat (2010), the distinguishing feature of these measures is that the central bank actively uses its balance sheet to affect market prices and conditions. For instance, after the Federal Open Market Committee (FOMC) of the Federal Reserve had lowered the target for the federal funds rate to a range of 0 to 25 basis points in December 2008, US policymakers faced the challenge of how to further ease the stance of monetary policy as the economic outlook deteriorated. The Federal Reserve decided to purchase substantial quantities of assets with medium and long maturities in an effort to drive down private (long-term) borrowing rates.

Whereas the Federal Reserve introduced unconventional monetary policy after policy rates could not be reduced any further, i.e. when the effective lower bound was hit, the ECB for a while combined conventional and unconventional monetary policies. By using unconventional measures the ECB tried to prevent reaching the effective lower bound. Initially the ECB measures mainly focused on sustaining the banking sector. The main reason is that the banking sector plays a fundamental role in the monetary transmission mechanism in the euro area, because non-financial corporations are highly depending on bank credit. For instance, the ECB provided unlimited liquidity through 'fixed rate tenders with full allotment' in both the main refinancing operations (MROs) and the long-term refinancing operations (LTROs). Full allotment means that banks had unlimited access to central bank liquidity at the main refinancing rate, subject to adequate collateral. In addition, there was an extension of the list of collateral assets. Furthermore, an extension of the maturity of LTROs was introduced, initially to six months, and then, in late June 2009, to twelve months (and later on even to three years). Also several other measures were introduced later on

(see Pattipeilohy et al., 2013). All these measures adopted by the ECB were to ensure that monetary policy continues to be effectively transmitted to the real economy, thereby supporting the ability of banks to maintain and expand lending to euro area households and non-financial corporations. This is essential to safeguard price stability in the euro area.

During the European debt crisis that started in 2010, the ECB took several steps. In May 2010 the Securities Markets Program (SMP) was introduced with the goal to support the transmission of monetary policy decisions focusing on disfunctioning segments of financial markets, with a view to ensure price stability for the euro area as a whole. In 2012, as the crisis intensified in the euro area, the ECB announced Outright Monetary Transactions (OMTs).[18] The immediate aim of the OMTs was to eliminate redenomination risk, that is the possibility that some European countries would abandon the euro and adopt a local currency at a depreciated exchange rate. This was sufficient to calm markets at the time without a single euro being spent under this programme.

5.4 Monetary policy in a period of low inflation

As shown in section 3.2, since the beginning of 2013 HICP inflation in the euro area deviates from the ECB's target of below but close to 2 per cent. In order to bring inflation back towards target, the ECB introduced new monetary policy measures. For instance, after the ECB Governing Council

18 A necessary condition for OMTs is strict and effective conditionality attached to an appropriate European Financial Stability Facility/European Stability Mechanism (EFSF/ESM) programme or a precautionary programme (Enhanced Conditions Credit Line). This means that the ECB would wait for the euro area governments collectively to be ready to put their money first before deciding whether central bank money would be used in the sovereign bond markets, if this is warranted from a monetary policy perspective. With OMTs the SMP was terminated.

meeting of June 5, 2014 the ECB announced that the interest on the deposit facility was lowered to -0,1%.

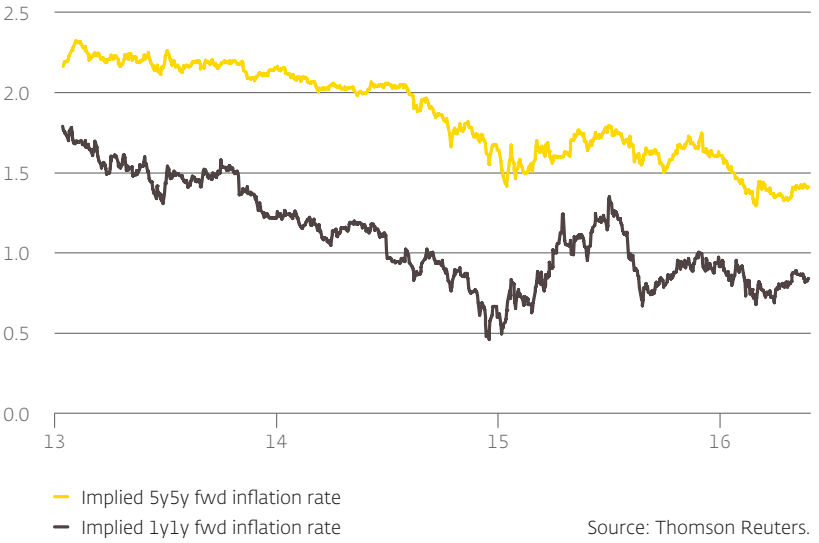
At the end of 2014 HICP inflation in the euro area dropped below 0 per cent. Inflation expectations also seemed to be less anchored (see Figure 5.2). The ECB was worried that the decline of oil prices, which played an important role in reducing inflation, would have indirect and second-round effects. In January 2015, the ECB's Governing Council therefore decided to launch the expanded asset purchase programme (EAPP), better known as quantitative easing (QE). Under this programme, each month public and private sector securities will be purchased up to € 60 billion. Initially it was announced that the programme would run until end-September 2016, 'and will in any case be conducted until we see a sustained adjustment in the path of inflation which is consistent with our aim of achieving inflation rates below, but close to, 2 per cent over the medium term'.[19] At its December 2015 meeting, the Governing Council decided to extend it until March 2017. At the meeting of March 2016, the EAPP was expanded with € 20 billion each month, bringing the monthly purchases to € 80 billion. In addition, it was decided that also bonds of investment-grade non-financial corporations will be purchased.

With QE, the focus of the ECB's unconventional monetary policy shifted from supporting the monetary transmission mechanism to fighting persistently low inflation. Increasing the central bank's balance sheet may lift inflation expectations through the *signalling channel* (Van den End and Pattipeilohy, 2015). It can reinforce the signal of the central bank to keep interest rates low for an extended period and so stimulate aggregate

19 Introductory statement to the press conference (with Q&A), Mario Draghi, Frankfurt am Main, 22 January 2015.

Figure 5.2 Inflation expectations euro area

Percentage



Source: Thomson Reuters.

demand and inflation. An additional channel through which QE can affect inflation is the *portfolio rebalancing channel*. By substituting government bonds for cash, banks will use the extra liquidity to buy other assets, as long as these assets are not a perfect substitute for government bonds. In the end, banks will have more incentives to lend to the private sector households and companies.[20] Another channel through which QE can affect the real economy is the *exchange rate channel*. If markets expect that due to

20 Introductory statement to the press conference (with Q&A), Mario Draghi, Frankfurt am Main, 22 January 2015.

QE interest rates will be low for longer, they will shift their portfolio towards regions with higher yields. This will lead to a depreciation of the euro.

Most evidence suggests that financial markets were affected in the intended direction by other central banks' asset purchase programmes.[21] Altavilla et al. (2015) use an event-study methodology to assess the impact of the ECB's EAPP. Because the January 2015 ECB's announcement was expected by financial markets, the authors consider a broad set of events comprising ECB's official announcements that, starting from September 2014, could have affected market expectations about the programme. The authors draw two main conclusions. First, the EAPP has significantly lowered yields for a broad set of market segments, with effects that generally rise with maturity and riskiness of assets. For instance, for long-term sovereign bonds yields declined by about 30-50 basis points at the 10-year maturity and by roughly twice as much in higher-yield member countries such as Italy and Spain. The authors argue that the low degree of financial stress prevailing at announcement of the programme has facilitated spill-overs to non-targeted assets. For instance, spreads relative to risk-free rates have declined by about 20 basis points for both euro area financial and non-financial corporations.

21 Altavilla et al. (2015) summarize the literature on the impact of asset purchase programmes of central banks as follows: First, the impact of programmes carried out in the aftermath of the collapse of Lehman is generally found to be stronger than the one exerted by subsequent programmes. Second, 'narrow channels' of transmission are generally more important than 'broad channels' – channels are defined as 'narrow' when the impact is concentrated on the assets targeted by the programme, with little spill-overs to other market segments. Third, the bulk of the impact of purchase programmes is found to arise at announcement.

Although financial market effects have thus been in the intended direction, this does not imply that these unconventional policies have been able to increase short-term inflation (expectations). To assess the impact of QE on the economy, one needs a counterfactual, that is, what would have happened absent policy action. Yet, 'building an explicit counterfactual to be used in empirical work comes down to guess work' (IMF 2013, p. 11), notably during periods with financial stress. Models are notoriously poor at capturing crises (such as boom and bust cycles, rational runs, and other large deviations and nonlinear responses).

This has not discouraged the ECB to assess the impact of its measures. Praet (2016) explains what the ECB has done. He points out that the ECB has used a large and diverse suite of models, reflecting alternative modelling traditions, and capturing different transmission channels. The assessments share the idea that the relevant variable in modelling the impact of the EAPP is the expected future path of central bank asset holdings (i.e. the evolution of the 'stock' of assets) under the programme. Consistent with event studies, in some models the full path of the central bank portfolio enters the decision problem of economic agents upon announcement of the programme. Other models assume that that the asset purchase programme affects the behaviour of economic agents only gradually. This assumption is compatible with a situation in which financial markets learn over time the implications of the central bank's asset purchases, or in which such purchases trigger changes in local liquidity conditions. According to Praet (2016), the results from this

> 'comprehensive exercise suggest that, relative to the counterfactual scenario, our measures (excluding the March 2016 decisions) have provided significant support to output and inflation. In the absence of our policy package inflation would have been negative in 2015.

> In 2016 it would have been at least half a percentage point lower than we forecast currently and around half a percentage point lower in 2017. The impact of the policy measures on euro area GDP is also sizeable (again excluding the March 2016 decisions). According to the staff assessment, our policy is contributing to raise euro area GDP by around 1.5% in the period 2015-18. In sum, while this staff assessment must be qualified, the results of our counterfactual simulations show that the expected return of inflation to levels closer to our objective relies to a significant extent on continued monetary accommodation. If inflation has remained weak, it is not because policy has been ineffective, but rather because new shocks have hit the economy in the meantime. The scaling-up of our policy measures has hence been the appropriate response in the face of intensifying headwinds; indeed, had it not been for these measures, the economic environment would likely be considerably more troubling today.'

Recently also Wieladek and Pascual (2016) examined the real effects of the ECB's EAPP, adopting the methodology that Weale and Wieladek (2016) previously used to study the effects of asset purchase programmes of the Bank of England and the Federal Reserve. The authors assess the macroeconomic impact of the ECB's QE by comparing data outturns to a counterfactual where it is not announced. They also explore the impact of this policy country-by-country. Using monthly data from 2012M6 to 2016M4, the authors conclude that in absence of the first round of ECB QE, real GDP and core CPI would have been 1.3%-points and 0.9%-points lower, respectively. The effect is roughly 2/3 times smaller than those of asset purchase programmes in the UK and the US. Impulse response analysis suggests that the policy is transmitted via the portfolio rebalancing,

the signalling, credit easing and exchange rate channels. Spanish real GDP benefited the most and Italian the least.[22]

However, other studies cast some doubt about the effectiveness of these policies. For instance, Van den End and Pattipeilohy (2015) find that QE is associated with declining short-term inflation expectations in the US and UK, which may reflect adverse signalling effects, while the effect of a central bank balance sheet size shock on inflation expectations in the euro area is negligible.

Reviewing the evidence, Blinder et al. (2016) conclude that there is increasing evidence that asset purchase programmes have modest but not negligible effects on inflation. Still, they also point out that effects of asset purchase programmes will depend on the economic circumstances at the time when the program is introduced. When the ECB started its full-fledged QE programme in 2015, short-term and long-term interest rates were already at low levels not least because of previous unconventional ECB policies. This may explain why the effects of the ECB asset purchase programmes are sometimes found to be less than those of earlier programmes of the Fed and the Bank of England.

22 Pariès et al. (2016) examine the effects of the ECB's QE via the balance sheet of banks and conclude that these policies have the potential to lift inflation. The strength of the portfolio rebalancing channel through the banking system proves highly dependent on bank balance sheet conditions, and from this perspective, can have diverse impacts across euro area countries. Overall, however, the macro implications in terms of higher economic growth and inflation arising due to bank portfolio rebalancing effects are found to be positive for the euro area and for individual countries.

5.5 Central bank communication

Many central banks nowadays consider communication as an important policy instrument. Blinder et al. (2008) define central bank communication as the provision of information by the central bank to the general public on the objectives of monetary policy, the monetary policy strategy, the economic outlook, and the (outlook for future) policy decisions. Before the 1990s, central banks believed it was optimal not to talk about their policy actions. The conventional wisdom was that financial markets needed to be 'surprised' if monetary policy was to be more effective. However, from the 1990s onward transparency in central bank decision-making became the new norm with the adoption of inflation targeting by the central banks of New Zealand, Canada, the U.K. and Sweden (see section 3.1). Also central banks that had different monetary strategies became more transparent. The financial crisis and the resulting period of low inflation provided further stimulus for central banks to become even more transparent, which resulted in a further transformation in monetary policy communication (see Blinder et al. 2016 and de Haan and Sturm, 2016).

Communication can make monetary policy more effective by helping markets to better understand the systematic response of monetary policy to economic developments and shocks – known as the central bank's 'reaction function'. Improved understanding of the latter allows markets to better anticipate future changes in the policy interest rate. So, even though central banks have control only over short-term interest rates, they can use communications to influence expectations about long-term interest rates. Long-term interest rates, reflecting expected future short-term interest rates, affect saving and investment decisions by households and firms. Therefore, the public's perception of future policy rates is critical for the effectiveness of monetary policy (Blinder et al., 2008).

In addition, central bank transparency may increase the credibility of the central bank. If a central bank is very credible, the link between current and expected inflation will be weak. Van der Cruijsen and Demertzis (2011) find that in countries with low-transparency central banks a significant positive links exists between inflation and inflation expectations, while this relationship is absent in countries having highly transparent central banks. They also show that more transparency is associated with less inflation persistence.

The current emphasis on transparency is based on the insight that monetary policy to a very large extent is 'management of expectations' (Svensson, 2007). Modern central banks also frequently use communication about their future policy rates to influence expectations; this type of communication is called *forward guidance* (Moessner et al., 2016). The Governing Council of the ECB introduced forward guidance following its meeting on 4 July 2013. After the meeting it was communicated that the Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time.

Forward guidance has been argued to make monetary policy effective even at the ELB (Eggertsson and Woodford, 2003). By committing to future levels of the policy rate, the central bank can address the ELB issue by credibly committing to monetary accommodation, even after the ELB ceases to be a constraint. Drawing on Moessner et al. (2016), the intuition can be explained as follows. Even if current short-term policy rates are at the ELB, the central bank can still influence macroeconomic outcomes by steering future expectations of the policy rate. The central bank can reduce long-term interest rates by promising to keep the policy interest rate 'lower for longer', i.e. keep the future policy rates below levels consistent with its normal reaction function when policy rates are no longer constrained by the ELB. If the monetary policy authority can do so credibly, long-term rates

(reflecting expected future short-term rates) will be reduced already in the current period. Through these long-term rates, the central bank can provide monetary policy accommodation, even though it can no longer do so directly by reducing today's short-term policy rate. However, this policy is time-inconsistent, since the costs of higher inflation due to this expansionary monetary policy arise only later, so that the central bank has an incentive to renege on its promise in the future. The effectiveness of this policy therefore depends on the central bank's ability and willingness to commit. Moessner et al. (2016) show that in practice central banks do not commit.

Although most evidence suggests that financial markets were affected in the intended direction by forward guidance (see Moessner et al., 2016), this does not imply that forward guidance has been able to increase short-term inflation (expectations). As with other unconventional monetary policies, the jury is still out on the effectiveness of forward guidance, especially since we have little experience to date with exit from forward guidance (Blinder et al., 2016).

5.6 Higher inflation targets?[23]

The most important argument for raising the inflation target is avoiding the problem of the effective lower bound. Ball (2014), for instance, argues in favour of a target of 4 per cent as it 'would ease the constraints on monetary policy arising from the zero bound on interest rates, with the result that economic downturns would be less severe. This benefit would come at minimal cost, because four per cent inflation does not harm an economy significantly.' However, Blinder et al. (2016) conclude that the case for higher inflation targets to avoid hitting the ELB is not very strong. First, papers seeking to quantify the risks and costs of hitting the ELB by simulating 'New Keynesian' models of the economy generally find that the ELB problem

23 This part heavily draws on de Haan and Sturm (2016) and Blinder et al. (2016).

is not serious enough to justify a higher rate of inflation. Second, when proposals for higher inflation targets were introduced, the ELB was thought to be zero. By now, several central banks have reduced interest rates further, leaving them more room to operate. Third, the crisis has shown that central banks have alternative tools once the ELB is hit, such as forward guidance and large-scale purchases of securities.

Another motivation for a higher inflation target is that it may increase inflation expectations. There is only limited empirical evidence to what extent short-term inflation expectations are affected if the central bank announces a higher inflation target. This, of course, is due to the fact that central banks hardly raise their inflation objective. The experience of Japan and the US (which at some point introduced an explicit inflation target) and New Zealand (which has changed its inflation target a couple of times) may shed some light on this issue.

The study by Nakazono (2016) on Japan does not come to very optimistic conclusions. He finds that survey data indicate that long-term forecasts of Japanese inflation of economic agents are not in line with those of the Bank of Japan, despite the adoption of a 2 per cent inflation target in January 2013 and the introduction of quantitative and qualitative monetary easing (QQE) in April 2013. De Michelis and Iacoviello (2016) examine how macroeconomic variables respond to an identified inflation target shock. The authors apply these findings to calibrate the effect of a shock to the inflation target in two models of the Japanese economy. The main findings of the analysis are that increasing an inflation target can have powerful effects on activity and inflation, especially when the economy is in a liquidity trap, but these effects can be smaller if the policy is not fully credible.

Turning to the US, using several survey measures and the Nelson-Siegel model[24] to construct a term structure of inflation expectations, Aruoba (2016) finds that the announcement of a formal inflation target of 2 per cent (based on annual changes in the personal consumption expenditures price index) on January 25, 2012 by the Federal Reserve did not affect inflation expectations (or real interest rates) in any significant way. But this may also reflect that the announcement did not provide any new information to financial market participants.

Finally, having changed its inflation target a number of times since 1990, New Zealand provides a natural laboratory to understand the macroeconomic consequences of changing an inflation target. Lewis and McDermott (2016) apply the Nelson-Siegel model on inflation expectations data in New Zealand to generate inflation expectations curves fitted over various time-horizons. Examining such curves enables them to assess how expectations have shifted in response to changes in the inflation target. The results from the Nelson-Siegel model suggest that changes to the inflation target change inflation expectations significantly. Particularly striking is the estimated 0.45 percentage point increase in inflation expectations when the target midpoint was increased 0.5 percentage points in 2002.

A major concern about higher inflation targets, be it to reduce the likelihood of hitting the ELB or to increase inflation (expectations) while the ELB is

24 The Nelson-Siegel model can be thought of as a dynamic factor model with pre-specified factors that describe the shape of the curve. With only three factors determining the level, slope and curvature of the curve, the Nelson-Siegel model is a parsimonious way to obtain a curve from expectation surveys (Lewis and McDermott, 2015).

a constraint, is that it may undermine the credibility of the central bank. Blinder et al. (2016) argue that

> 'raising the inflation objective may threaten a central bank's credibility, which is widely believed to be among central bank's most important assets. Perhaps more central banks would opt for higher inflation targets if they were starting from scratch. But they are not. Once an inflation target is raised, it may generate expectations that it will be raised again. This worry, we believe, is one major reason why most central bankers are hesitant to raise their inflation objectives.'

In conclusion, this chapter has outlined that under normal circumstances ECB policies can affect inflation through various transmission channels. After the GFC, the ECB also introduced unconventional monetary policy measures. This includes the introduction of QE and negative policy rates after inflation had dropped to a very low (and sometimes even negative) level and inflation expectations appeared to be less anchored than they used to be. By purchasing government and certain private sector securities the ECB aims to stimulate the economy and raise inflation (expectations). In addition, the ECB uses its communication policies, including forward guidance. As with other unconventional monetary policies, the jury is still out on the effectiveness of forward guidance, especially since we have little experience to date with exit from forward guidance. Some economists have argued for higher inflation targets to reduce the likelihood that the effective lower bound will be hit and/or to increase inflation expectations, but most central banks fear that this may undermine their credibility.

6 Inflation forecasts

6.1 How to forecast

As it takes a while before monetary policy actions affect the economy, central banks base their decisions on forecasts of inflation and real GDP growth in the years ahead. The ECB publishes projections four times a year, but there is a difference in the way these forecasts are made. The forecasts published in June and December (Broad Macroeconomic Projection Exercise, BMPE) are made in collaboration with the national central banks, while the forecasts published in March and September (Macroeconomic Projection Exercise, MPE) are made by ECB staff. In all these forecasts, HICP inflation and GDP growth (and its main components) are forecasted for the current year and one and two years ahead, as well as many other economic variables such as unemployment. In December each year, an additional year is made available in the projections (ECB, 2013a).

Each round of forecasts starts with setting the underlying assumptions covering interest rates, exchange rates, the international environment and fiscal policy. Short-term rates are measured by the three-month EURIBOR, with market expectations derived from future rates (ECB, 2010b, p. 85). For long-term interest rates, it is assumed that ten-year interest rates evolve in accordance with the prevailing market expectations. Assumptions regarding the exchange rate are based on averaged recent rates. Oil and non-oil commodity price assumptions are based on futures market prices (ECB, 2001). The assumptions for fiscal policy are based on individual euro countries' national budget plans. They include all policy measures that have already been approved by national parliaments or that have been specified in detail by governments and are likely to pass the legislative process (ECB, 2010b, p. 85). Most models used for forecasting over a longer horizon are based on New-Keynesian insights (see chapter 5).

Figure 6.1 Euro area HICP: forecast versus outcome

Annual percent change, quarterly averages

Source: Thomson Reuters.

6.2 Forecast performance

Between 2001 and 2009, HICP inflation 2 years ahead was usually underestimated. Particularly during the recession in 2009, projection errors for HICP were very high (ECB, 2013a). Inflation did not fall as much as the Phillips curve, which shows the relationship between slack in the economy and inflation (see chapter 5), and past experiences would predict, given the severity and the length of the recession (Riggi and Venditti, 2015). During this period, core inflation in the euro area never fell much below 1 per cent

despite a large output gap and high unemployment. This is sometimes called the missing disinflation. The opposite happened since 2013 in the euro area. Although the output gap slowly started to close and unemployment dropped, inflation declined as well. And this was not forecasted (see Figure 6.1). The same problem occurred in other economies, such as the US, UK and Japan, which show similar inflation dynamics as the euro area.

The forecast errors discussed above may be due to structural changes in the economy. A good example of research on structural changes is the work by Cogley and Sargent (2002) who analyse inflation-unemployment dynamics in the US after World War II. They look at the persistence, variance and predictability of inflation and find that inflation was weakly persistent in the 1960s and the 1990s, but strongly persistent in the late 1970s. Inflation persistence peaked in 1979-1980, at the same time as the peak in core inflation. They distinguish two explanations for the pattern of inflation. One view is that the broad movements of the inflation rate were the result of the monetary authorities' changing views about the Phillips curve. In the late 1960s and the 1970s, central banks believed that they could exploit the trade-off between inflation and unemployment. This belief induced policymakers to inflate more and more. This resulted in high inflation until the Fed under Chairman Volcker realized that monetary policy could not push unemployment below the natural rate and started to tighten monetary policy to reduce inflation. Another view is that the inflation-unemployment dynamics were not driven by changes in monetary policy but by changes in the natural rate of unemployment. Parkin (1993) and Ireland (1999) claim that changes in the natural rate of unemployment, due to demographic factors, caused the inflation rate to vary. Cogley and Sargent (2005) confirm their earlier findings and also find evidence that the variance of the

innovations to US inflation was substantially higher in the late 1970s than in other periods. These findings might also explain the gradual downward sloping trend of inflation not only in the US, but also in Europe during the last decades. In a globalised world, inflation is becoming less responsive to domestic economic conditions but is instead increasingly determined by global factors (Draghi, 2015). Demographic changes might be one of the structural changes that have caused the gradual downward movement of inflation. An increase in the working population, which occurred in the last decades with among others the large increase of available workers in China, is correlated with lower inflation (Juselius and Takáts, 2015). Also e-commerce is sometimes mentioned to explain lower inflation, but there is no strong evidence for this (see Box 2).

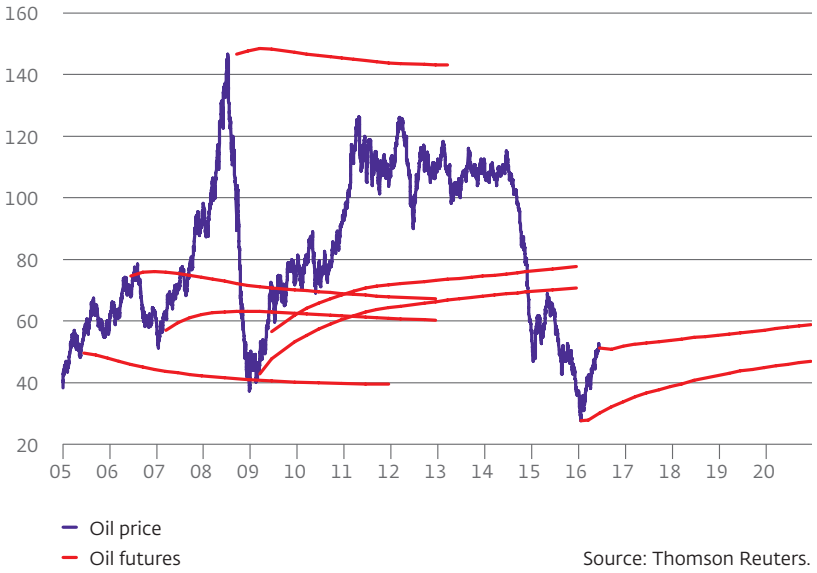
Models of the Phillips curve that are estimated with data from the past may no longer be a good representation of the economy, which could explain the forecast errors as well. The relationship between the amount of slack in the economy and price changes is what the coefficient for the slope of the Phillips curve represents. Some studies suggest that the Phillips curve has become flatter in recent years, i.e. inflation is less sensitive to changes in output (Iakova, 2007). Globalization, leading to increasing international competition, and better anchoring of inflation expectations are often cited as reasons. A possible flattening of the Phillips curve makes the monetary transmission, i.e. the way monetary policy decisions such as changing policy rates affect the economy (see section 5.2), less powerful. Others claim that the Phillips curve has become steeper as a result of structural reform measures. These measures tend to make prices more flexible and more sensitive to changes in demand and the amount of slack in the economy.

Most of the inflation forecast errors were however caused by swings in oil prices. Although energy items have a weight of less than 10% in the

HICP-index, changing oil prices can have a substantial impact on inflation and inflation expectations (see section 4.3). Energy prices are assumed exogenous in the forecasting exercise; oil price futures are used as input for the assumptions for oil price developments. Unfortunately, these forecasts are often wrong (see Figure 6.2). This makes it difficult to come up with reliable macroeconomic projections for periods with volatile energy prices.

Figure 6.2 Oil futures and oil price

US dollars



Source: Thomson Reuters.

Box 2 The impact of internet

Increased e-commerce can put downward pressure on prices via two channels. First, compared to standard distribution channels, e-commerce opens scope for cost savings for both producers and retailers, which both traditional and online retailers may pass on to their customers. Second, e-commerce may lead to lower prices through increased price transparency, which will affect both traditional and online suppliers.

Despite the very dynamic increase of e-commerce, evidence suggests that the effects of e-commerce can explain only a very small part of the recent significant decline in inflation. According to ECB data, electronic sales by enterprises in 2014 were on average 14% of total turnover of companies in the euro area. While internet sales may not seem very substantial, the share of people using internet for either information about the characteristics and prices of goods and services or actually purchasing them has more than doubled over the last 10 years. In 2014 on average in the euro area, 65 per cent of people looked for purchase information online compared to only 30 per cent a decade before.

The presence of internet prices can also be used for other purposes. The Billion Prices Project uses online data collection in order to construct daily price indexes in multiple countries. A direct comparison between online and offline prices reveals a high degree of similarity in price levels. Furthermore, even though prices do not change at the same time online and offline, online and offline price changes do have similar frequency and average sizes (Cavallo and Rigobon, 2016).

In conclusion, this chapter has explained that forecasting inflation has been very difficult in recent years. This reflects that the Phillips curve, which describes the relation between slack in the economy and inflation, is not very stable so that it became more difficult to forecast inflation. Another reason why forecasts were off the mark is the volatility of oil prices.

7 Conclusions

For some time, central banks around the world have been successful in keeping inflation low, while inflation expectations have become much better anchored than before. After the GFC, central banks were faced with a new challenge. In many countries, inflation fell below target and sometimes even became negative. Instead of keeping inflation low, the new challenge is to push inflation up to the target.

Central bank policy aimed at influencing inflation expectations and inflation is not an exact science. Although models that are used to forecast inflation have become increasingly advanced over the years, it remains hard to forecast the dynamics of the economy, which ultimately determine inflation. Unexpected changes in the underlying price dynamics, such as oil prices, have proven this. Furthermore, inflation is not only a national phenomenon, but is driven by global factors as well. The global financial crisis led to even larger challenges for central banks. As many central banks reached the effective lower bound, policy makers had to resort to unconventional measures in order to fulfil their mandate of price stability. This has led to a new debate about the appropriate level of inflation that the central bank should target. So far, most central banks seem reluctant to increase their inflation target, as they are not convinced that the benefits of such a policy will be larger than the costs (see Blinder et al., 2016).

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