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The First 20 Years of the European Central Bank: Monetary Policy

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The first 20 years of the European Central Bank:

Monetary Policy

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Abstract:

On 1 May 2018 the ECB celebrated its 20th anniversary. This paper provides a comprehensive view of the ECB's monetary policy over these two decades. The first section provides a chronological account of the macroeconomic and monetary policy developments in the euro area since the adoption of the euro in 1999, going through four cyclical phases "conditioning" ECB monetary policy. We describe the monetary policy decisions from the ECB's perspective and against the background of its evolving monetary policy strategy. We also highlight a number of the key critical issues that were the subject of debate at the time. The second section contains a partial assessment. We first analyse the achievement of the price stability mandate and developments in the ECB's credibility. Next, we investigate the ECB's interest rate decisions through the lens of a simple empirical interest rate reaction function. This is appropriate until the ECB hits the zero-lower bound in 2013. Finally, we present the ECB's framework for thinking about non-standard monetary policy measures and review the evidence on their effectiveness. One of the main themes of the paper is how ECB monetary policy responded to the challenges posed by the European twin crises and the subsequent slow economic recovery, making use of its relatively wide range of instruments, defining new ones where necessary and developing the strategic underpinnings of its policy framework.

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1. Introduction

European Economic and Monetary Union is an unprecedented historical project in which initially eleven European Union (EU) countries introduced a common currency – the euro –, with a single central bank – the European Central Bank (ECB) – and a single monetary policy. By the time of writing nineteen quite diverse EU countries have joined the euro area, meaning that the ECB runs the monetary policy for 340 million citizens (compared, for example, to the 325 million citizens for the United States Federal Reserve System) or an economic area that constitutes 11% of world GDP (compared to 16% for the US or 18% for China, all in purchasing power parity terms). The motivation for this paper is that on 1 May 2018 the ECB celebrated its 20th anniversary. As two economists who have been on the staff of the ECB almost from the beginning, we take this opportunity to look back at the first two decades of our institution describing and assessing its experience with monetary policy.

From the euro's introduction in January 1999 (the start of “stage 3” of EMU), the ECB was conferred a range of tasks (European Union 2012a,b):¹

- defining and implementing monetary policy;
- conducting foreign exchange operations;
- holding and managing official foreign reserves;
- promoting the smooth operation of payment systems;
- contributing 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;
- authorizing the issue of euro banknotes;
- advising EU bodies and national authorities in its fields of competence; and
- collecting the statistical information necessary for its tasks.

By implication, the ECB started with a strong and self-contained monetary policy mandate. In other areas, however, it had more indirect or contributing roles, notably in the prudential and financial stability arena. Latest in November 2014 this changed, as it assumed a role as banking supervisor for the countries that joined the European Banking Union (congruent with the euro area).

The main theme of this paper is how ECB monetary policy responded to the enormous challenges posed by the European twin crises and the subsequent slow economic recovery, making use of its relatively wide range of instruments, defining new ones where necessary and developing the strategic underpinnings of its policy framework. The overall objective is to provide a rigorous and comprehensive view of what the ECB was concerned with, how its monetary policy evolved during its first 20 years and how it performed in achieving its primary objective of maintaining price stability.

Before we delve deeper into the details of the ECB's monetary policy mandate and conduct, it is however useful to look at the broader historical evolution of the ECB through two perspectives. A first perspective is its staffing over time (Figure 1). The first message is that the ECB's human

¹ For simplicity we are abstracting from the legally precise distinctions between the ECB, the Eurosystem (comprising the ECB and the national central banks of countries that have joined the EMU) and the European System of Central Banks (ESCB, comprising the all EU central banks).

resources more than quadrupled during the first two decades. It grew from a relatively small central bank of about 737 employees in 1999 to a sizeable institution of about 3,280 employees in 2017. Second, while the staffing of the monetary policy function always consumed a sizeable share of the total, illustrating its central importance from the beginning, human resources working on financial stability functions were very limited during the first decade. This is in line with the interpretation that the ECB started with a relatively “narrow” central bank model (e.g. Folkerts-Landau and Garber 1992), at least in what concerns prudential supervisory and financial stability activities.

Only with the “meltdown” of 2008/2009 financial stability staff increased tangibly. But the most fundamental change happened after the European sovereign debt crisis when the establishment of the European Banking Union incorporated the Single Supervisory Mechanism in the ECB. This required the hiring of about 1,000 banking supervisors in three years (a number that is still increasing at the time of writing).

Moving from the inside to the outside, a second perspective is to look at the broad themes that ECB Executive Board members addressed in their public communications.² Figure 2 shows the number of public speeches Board members held every year between 1999 and 2017. The colours refer to the shares of these speeches that were dedicated to any of nine different themes, respectively. We did not pre-determine the themes. We rather applied a machine learning approach to uncover them from the texts of the 1,892 Board speeches displayed on the ECB website for the period May 1998 to April 2018. (As of 2014, the data set also includes the speeches by the Chair, Vice-Chair and the four ECB representatives of the Supervisory Board of the Single Supervisory Mechanism at the ECB.) Using the Latent Dirichlet Allocation method for textual analysis (Blei et al. 2003) and the Cao et al. (2009) metric for the optimal number of topics, we identify 50 specific topics that have been addressed in these speeches over time. For the purpose of the first general overview in Figure 2 we group the rather large number of topics in the nine general themes displayed. (For a more detailed description of the methodologies applied and how Figure 2 has been derived, please see the Annex [still to be added].)

The results give a good impression of the breadth of issues that the ECB was concerned with (via the external communication of Board members) and how they changed over time. First, the core theme of “monetary policy and inflation” covered a sizeable share most of the time, but it was particularly important at the start of the ECB, when the financial crisis hit in 2008 and during the recent low-inflation recovery. Second, financial stability and supervisory issues received particular attention when the financial crisis struck and after the agreement about the European Banking Union that granted supervisory responsibility to the ECB. Third, growth and productivity, international developments and fiscal matters, which all have implications for the conduct of monetary policy, received regular attention. But the attention paid to public debt and sovereign risk was most pronounced when the financial crisis morphed into the European sovereign crisis. Structural and competitiveness issues were very much discussed before the breakout of the financial crisis.

² The Board comprises the ECB President, Vice-President and four further members, which are appointed by the European Council usually for a period of 8 years (ECB 2012a,b). They are collectively responsible for the current business of the ECB and play an important role in the Governing Council, the main decision-making body of the ECB and the Eurosystem. The other Governing Council members are the governors of the euro area national central banks.

Board members also addressed a number of other themes of great importance for the ECB that we will not cover in this paper. For example, one can see in Figure 1 that in 2001 – before the introduction of euro notes and coins in 2002 – Board Members prepared the public for the cash changeover. In 2004 and 2005, at the time of a major eastern enlargement of the EU, they communicated more about accession and convergence issues. Finally, payment and settlement issues played a greater role in Board Members’ external communications shortly before the ECB’s initial TARGET large-value payment system migrated to the single-platform TARGET2 system and during the year when the TARGET2-Securities project was launched to establish a single, pan-European platform for securities settlement.

Digging a bit deeper into the topics of monetary policy related speeches, Figure 3 shows the decomposition in ten topics of all monetary policy related speeches. There have been three waves of intensified monetary policy communication as indicated by the number of speeches. If we take a minimum of 15 speeches per year as the cut-off point, these periods are i) the starting period (1999-2000) ii) the financial crisis period (2007-2009) and the post-sovereign-debt crisis, low-inflation recovery period (2013-2017). For obvious reasons, in all three periods there was an increased need to communicate. In the beginning period the largest focus was on explaining the monetary policy strategy (including the monetary analysis) of the new institution. In the financial crisis period, the focus was on the ECB’s response to the financial crisis through abundant liquidity provision and the associated changes in its market operations. In the last period, the focus was on how the ECB used non-conventional measures such as large-scale asset purchases and negative interest rates to overcome the fragility of the recovery and the risk of deflation in an environment of interest rates at the zero lower bound. Not surprisingly, the general topics of inflation, the Phillips curve and monetary policy received significant attention throughout the EMU period.

The rest of the paper is organised in two main sections. The first provides a chronological account of the macroeconomic and monetary policy developments in the euro area since the adoption of the euro in 1999, going through four cyclical phases “conditioning” ECB monetary policy. In this section, we describe the monetary policy decisions from the ECB’s perspective and against the background of its evolving monetary policy strategy. We also highlight a number of the key critical issues that were the subject of public debate at the time. In the second section, we provide a partial assessment of the ECB’s monetary policy. We first analyse the achievement of the price stability mandate and developments in the ECB’s credibility and discuss possible implications for the ECB’s inflation aim. Next, following earlier work, we analyse the ECB’s interest rate decisions through the lens of a simple empirical interest rate reaction function. This is appropriate until the ECB hits the zero-lower bound in 2013. Finally, we present the ECB’s framework for thinking about non-standard monetary policy measures and review the evidence on the effectiveness of the non-standard monetary policy instruments the ECB has used.

2. Two decades of ECB monetary policy: from the two pillars to quantitative easing

This section discusses the ECB’s monetary policy over the past two decades. It contains a chronological overview of the main economic and monetary developments in the euro area since the adoption of the euro in January 1999 and how the ECB responded to them in pursuit of its price stability mandate. We do this against the background of the ECB’s monetary policy strategy and its

evolution in response to the challenges of the time. Four episodes are identified: the initial period of a growth slow-down following the collapse of the dotcom-bubble accompanied by a weak euro exchange rate (1999-2003); the boom period in money and credit growth accompanied by a stable inflation and growth outlook (2004-2007); followed by the double-dip recession due to the outbreak of the US financial crisis and the emergence of the euro area sovereign debt crisis (2008-2013); and finally, the most recent low-inflation recovery period (2014-2017). As shown in Figure 4 which depicts measures of the euro area output gap and unemployment, these episodes correspond to troughs and peaks in the business cycle. We also briefly pay attention to divergences across countries which emerged in particular in the middle boom/bust period, which was characterised by widening current account imbalances followed by a sudden-stop of capital flows and a sovereign debt crisis and complicated the pursuit of the single monetary policy.

2.1. A new stability-oriented monetary policy strategy and the ECB's first interest rate cycle (January 1999 – June 2003)

The Treaty creating the monetary union established price stability as the primary objective of monetary policy in the euro area.³ Under the leadership of Otmar Issing, its first chief economist, the ECB early on developed a monetary policy strategy with the aim of providing a solid basis for the conduct and communication of monetary policy in pursuit of price stability.⁴ There were two main challenges. The first challenge was to establish as quickly as possible the credibility of the newly established institution for maintaining price stability. A high level of initial credibility would facilitate the transition to EMU and reduce the potential costs of having to build such credibility.⁵ The second challenge was to ensure a consistent and systematic approach to the conduct of monetary policy in an uncertain economic environment following a fundamental regime change and where the constituting NCBs had different frameworks and traditions. Robustness in the face of pervasive uncertainty was seen as an important guiding principle for the design of the new strategy (Issing, Gaspar, Tristani and Vestin, 2005). In response to these two challenges, three main components were developed: first, a quantitative definition of the ECB's primary objective of price stability as a clear yardstick for accountability; second, a two-pillar framework as the organising principle for the analysis underlying the assessment of the outlook for price developments; and third, an elaborate communication and accountability framework. These three building blocks have remained in place over the past two decades, although, as we will discuss below, some elements have evolved responding to the challenges of the time (Constancio, 2017). Before describing the economic and monetary developments in this initial phase, we briefly describe these three elements.

³ Article 127 of the Treaty on the Functioning of the European Union says: "The primary objective of the ESCB shall be to maintain price stability. Without prejudice to the objective of price stability, the ESCB shall support the general economic policies in the Union with a view to contributing to the objectives of the Union." Union objectives include: "balanced economic growth and price stability", "a highly competitive social market economy", "full employment and social progress" [Article 3 Treaty on European Union]

⁴ See ECB (1999) and Issing, Gaspar, Angeloni and Tristani (2000) for an extensive presentation and justification of the original two-pillar stability-oriented monetary policy strategy. The monetary policy strategy was developed on the basis of extensive preparatory work carried out by the European Monetary Institute (the predecessor of the ECB).

⁵ Whether the ECB would have a deflationary bias in order to establish its anti-inflation credibility was hotly debated at the time. See, for example, the various "Monitoring the ECB" reports.

The quantitative definition of price stability

In December 1998, the Governing Council of the ECB adopted a quantitative definition of price stability, which reads: “Price stability shall be defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%. Price stability is to be maintained over the medium term.” This definition, which has been maintained over the past two decades, allows economic agents and observers to assess the ECB’s performance at any time and over any horizon. It enhances the ECB’s accountability by forcing the central bank to explain why inflation has at times deviated from its definition and it thereby helps anchoring medium- to long-term expectations. The definition focuses on the euro area as a whole, reflecting the fact that, within a monetary union, monetary policy cannot address country-specific inflation developments. It makes clear that medium-term inflation above 2% is not consistent with price stability. However, it also implies that very low inflation rates, and especially deflation, are not consistent with price stability either. Following criticism of the perceived asymmetry of the quantitative definition, this was clarified, for example, by President Duisenberg in an early speech explaining the new strategy.⁶

Another important feature is the medium-term orientation of the ECB’s strategy. Since monetary policy can affect price developments only with significant and variable time lags, and only to an extent that is uncertain, it is impossible to maintain a specific predefined inflation rate at all times or to bring it back to a desired level within a very short period of time. Consequently, monetary policy needs to act in a forward-looking manner and focus on the medium term. This helps to avoid excessive activism and the introduction of unnecessary volatility into the real economy thereby contributing to the stabilisation of output and employment. Against the background of inflation forecast targeting strategies that were popular at the time, two aspects of the ECB’s medium-term orientation are worth mentioning. First, the ECB has always emphasised that there is no fixed time-horizon over which price stability has to be re-established, as monetary policy should react differently to different sources of economic shocks (e.g. demand versus supply shocks).⁷ Secondly, the medium-term orientation implies a lengthening of the monetary policy horizon beyond the usual two years associated with inflation forecasts and the lags in monetary policy transmission. For example, Trichet (2003) states that, “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”. As a result, also the horizon for evaluating the credibility of the central bank should extend beyond two years. In section 3.1 we will take a 5-year horizon which typically should be enough to let the effects of the shocks the central bank cannot control wash out.

The two-pillar framework

⁶ Duisenberg (1999): “Some observers have criticised the strategy as “asymmetric”. In other words, they argue that the Eurosystem is more concerned about inflation than it is about deflation. In their view, such asymmetry will impose a drag on the overall performance of the euro area economy as a whole because monetary policy will be overly restrictive on average, and risks triggering a damaging deflationary spiral in some circumstances. ... I reject this criticism. The use of the word “increases” in the definition imposes a floor of at least zero for the lower bound. ... Let me state categorically, as I have often done in the past, that neither prolonged inflation nor prolonged deflation in the euro area would be deemed by the Governing Council to be consistent with the maintenance of price stability.”

⁷ This feature of the ECB’s monetary policy strategy became increasingly popular among inflation-targeting central banks, which have recognised the need for a more flexible policy horizon.

In the original formulation, the “two pillars” of the strategy were described as i) a prominent role for money, as signalled by the announcement of a quantitative reference value for the growth rate of a broad monetary aggregate (M3), and ii) a broadly based assessment of the outlook for price developments and risks to price stability in the euro area as a whole. The two-pillar framework was a unique feature of the ECB’s monetary policy strategy and seen as a partial answer to the two challenges described above. First, the prominent role for money would help the ECB to gain rapid credibility by borrowing some of the elements of the Bundesbank’s monetary policy strategy. Second, the two-pillar framework would allow bringing different traditions under one roof and providing a robust framework in an environment of large uncertainty and structural change. In Issing’s words it was also a matter of openness and honesty as “it is hard to find a satisfactory way to integrate money into traditional macro-economic analysis” (Issing, 2005).

The reference for M3 growth underlined both the relative importance of the role of money as well as the medium-term orientation of the ECB’s strategy. At the press conference of October 13, 1998, President Duisenberg was asked about the relative weight of the two pillars and replied: “... it is not a coincidence that I have used the words that money will play a *prominent* role. So if you call it the two pillars, one pillar is thicker than the other is, or stronger than the other, but how much I couldn’t tell you”. The choice of M3 was based on the evidence that this monetary aggregate exhibited a close relationship with the price level. At the same time, it was made clear from the very beginning that monetary policy would not react mechanically to deviations of M3 growth from the reference value; it was not a monetary growth target (ECB, 1999).

From the start the prominent role for money was also a controversial feature of the ECB’s strategy. For example, Alesina et al (2001) thought the ECB should abandon the two pillars and adopt a simple flexible inflation-targeting strategy. In their view, the M3 pillar stood in the way of effective communication.

The reference value for M3 growth of 4.5% also revealed the ECB’s implicit operational inflation aim. As in this period the trend growth rate of GDP was assumed to lie in the range of 2 to 2.5% and the trend rate of decline in the velocity of circulation of M3 in the range of -0.5 to -1%, the arithmetic of the quantity equation of money suggests an operational inflation aim between 1 to 2%. This was consistent with the emphasis on positive, but uncertain measurement biases in HICP inflation (up to 1%) as an explanation for why the ECB did not formulate a clear lower bound in the quantitative definition of price stability (Issing et al, 2000).

The communication and accountability framework

The ECB is probably one of the most independent central banks in the world because its independence is not simply a result from domestic law, but is enshrined in an international treaty (the Treaty on European Union).⁸ Transparency and clear communication are a natural complement to strong independence, as it makes it easier to hold the central bank accountable, which in turn is a key element to maintain the political support for the high degree of independence.⁹ Clear

⁸ The Treaty gives the ECB and the members of its decision-making bodies (the Governing Council) a very high degree of institutional (vis-à-vis Community institutions or bodies and any government of a Member State), personal (relatively long fixed-term contracts), financial (own budget) and functional (exclusive competence for monetary policy in the euro area and prohibition of monetary financing) independence.

⁹ See Tucker (2018) for a recent in-depth discussion of the political economy of central bank independence.

communication is also important for an effective conduct of monetary policy as it helps anchoring inflation expectations, reducing policy induced uncertainty and making the transmission process of policy decisions more effective.

From the very outset, the ECB put great emphasis on communicating its policy actions and the economic rationale underlying its decisions to financial market participants and the general public in a transparent and timely manner. Since the start the main communication vehicle has been the monetary policy press conferences held by the President and the Vice-President immediately after each monetary policy Governing Council.¹⁰ On this occasion, the introductory statement is presented by the President on behalf of the Governing Council. It provides a summary of the policy-relevant assessment of economic and monetary developments, as well as the monetary policy stance, and it is structured along the lines of the ECB's monetary policy strategy. The press conference includes a question-and-answer session, which is attended by various media representatives from across the euro area and beyond. The press conference was seen as an effective means of presenting and explaining in a very timely manner the discussions in the Governing Council, and thus the monetary policy decision-making process. In the context of a global trend towards more detailed and transparent communications by central banks, this feature of the ECB's communication strategy has increasingly been adopted by other central banks (such as the Fed). Other important communication channels used by the ECB are the Monthly Bulletin (Economic Bulletin since January 2015) with a detailed and comprehensive analysis of the economic environment and monetary developments, the quarterly appearances of the ECB President before the European Parliament's Committee on Economic and Monetary Affairs and a large number of public speeches and interviews by members of the Executive Board.

Although opinions differ about the degree of the ECB's transparency (also compared to other central banks), the ECB generally scores quite high on central bank transparency and over time has increased its transparency also in response to demands from the European Parliament and other advocacy groups (Geraats, 2000). For example, early on in 2001 the ECB decided to publish its macro-economic projections. Nevertheless, two elements of criticism coming mostly from the inflation targeting proponents were prominent in the early years. First, the ECB did neither release the minutes of its policy deliberations, nor the votes and their attribution to members of the Governing Council (See debate between Buiter, 1999 and Issing, 1999). It argued that the press conference gave a real-time account of the discussion and could therefore be seen as a substitute, and that publishing the minutes could expose the individual members of the Governing Council to pressures from their national constituencies and undermine the consensual nature of the ECB's decision making and the "one voice" communication strategy. As communication became more complex following the financial crisis, this was partly addressed in January 2015 when the Governing Council decided to publish an account of its monetary policy deliberations approximately four weeks after the meeting.

The second criticism was that the ECB did not publish its own interest rate forecasts (e.g. Alesina et al, 2001). Instead the ECB focussed on trying to explain its reaction function. It argued that in view of the effects of various unexpected shocks that can hit the economy and the long and variable time

¹⁰ The frequency of the monetary policy Governing Council meeting was monthly (the first Governing Council meeting of the month) till December 2014 and was changed to eight times a year as of 2015.

lags with which monetary policy actions are transmitted to prices, the precise timing, and sometimes even the direction, of an interest rate decision is difficult to predict. Instead, by publicly announcing its monetary policy strategy and communicating its regular assessment of economic developments in a transparent manner, it might achieve a high degree of predictability, making monetary policy more effective (Blattner et al, 2008). The ECB often emphasised the need to maintain a full-information, state and data-driven policy approach and that it did not want to communicate or commit to future policy actions given the large uncertainties about the state of the economy in the future. This changed in 2013 when the ECB started giving forward guidance on its future policy actions (Section 3.3).

January 1999 – June 2003: the ECB's first interest rate cycle

Against this background, we next describe the first business cycle experienced by the ECB.¹¹ When describing the economic developments we take the ECB's perspective as also reflected in the introductory statements of the monthly press conferences and its Monthly Bulletin. The main economic and monetary developments we will refer to are depicted in Figures 5 to 15.

When EMU started in January 1999, the ripples of the financial crises in Asia in 1997 and Russia in August 1998, together with the near collapse of the LTCM hedge fund in September 1998, were still visible in high volatility in financial markets. The high level of uncertainty clouded the prospects for economic growth in the euro area. In a coordinated move on 3 December 1998 all the NCBs in the euro area had lowered their key central bank interest rates to 3%, which de facto determined the level of short-term interest rates with which the ECB started Stage Three of EMU. In early 1999, it became increasingly clear that, on balance, the risks to price stability over the medium term were mainly on the downside. Inflation rates were very low by historical standards and significantly below the ceiling of the ECB's definition of price stability amidst emerging signs of a strong economic slowdown (Figure 5). In spite of rising oil prices from mid-February 1999, a depreciating effective euro exchange rate, buoyant loan growth around 10% and headline M3 growth above the reference value (Figure 7), the Governing Council reduced the policy rate by 50 basis points on 8 April 1999, from 3.0% to 2.5% (Figure 11).

However, as sharp increases in oil prices and a general rise in import prices continued to exert upward pressure on prices in the short term in the context of robust economic growth, the risks of indirect and second-round effects on consumer price inflation via wage-setting rose significantly in the course of 2000. These concerns were compounded by a trend depreciation of the euro exchange rate, especially in the second half of 2000 when it moved further out of line with the sound fundamentals of the euro area (Figure 10). Economic activity in the euro area expanded very rapidly in early 2000 and was set to continue along this path due to the strong dynamism of the world economy, especially in the sectors of the "new economy" (Figure 6). Also the protracted monetary expansion above the reference value was increasingly pointing to upside risks to price stability at medium to longer-term horizons over the course of 1999 and in early 2000 (Figure 7). Against this background, the Governing Council raised the key ECB interest rates by a total of 225 basis points in a series of interest rate hikes between November 1999 and October 2000, bringing the main policy rate to a level of 4.75% in October 2000 (Figure 11).

¹¹ See ECB (2008) for a review of the first 10 years of the ECB.

As of 2001 the prospects for economic growth deteriorated in the wake of severe shocks that hit the world economy and global financial markets such as the collapse of the dot-com bubble, the terrorist attacks in the United States on 11 September 2001 and the escalation of geopolitical tensions related to Iraq, all of which increased the degree of economic uncertainty and undermined confidence. Overall, economic growth in the euro area turned rather weak in 2002, remaining below potential in both 2001 and 2002 and this performance did not change fundamentally in 2003.¹² Initially annual HICP inflation rose further in 2000 and the first half of 2001, despite a marked fall in oil prices and a significant appreciation of the euro exchange rate against all major currencies after concerted central bank interventions in the foreign exchange market in September and November 2000. However, the concerns about second-round effects gradually dissipated over time as the outlook for the euro area economy continued to deteriorate. Average annual HICP inflation remained slightly above 2% from 2000 to the first half of 2003, but the subdued pace of economic activity and the significant appreciation of the euro since spring 2002 were expected to dampen inflationary pressures. Looking at the monetary developments, annual M3 growth accelerated strongly from mid-2001 onwards. However, this increase was not interpreted as implying risks to price stability at medium to longer horizons as it was mostly due to sizeable shifts in private investors' portfolios from shares and other longer-term financial assets towards safe and more liquid monetary assets included in M3 in the aftermath of the global stock market correction and the terrorist attacks of 11 September 2001 (Figure 7). This assessment was supported by the fact that annual growth of loans to the private sector continued to decline, especially to non-financial corporations, in a context of rather subdued economic activity. In this period, the Governing Council lowered the key ECB interest rates by a total of 275 basis points, with the policy rate reaching an – at that time - historically low level of 2% in June 2003. At the same time, the sustained growth in M3 corrected for the estimated impact of portfolio shifts was seen as an important indicator arguing against the emergence of deflationary risks for the euro area in 2002 and 2003 and served to resist a further easing of policy rates as advocated by a number of analysts.

Overall, the ECB's first interest rate cycle contained a first test of the ECB's anti-inflation credibility as the euro exchange rate depreciated - only stopped by the concerted interventions in September and November 2000 -, and annual headline inflation peaked at 3%. The sources of the initial depreciation of the euro against the dollar (from a peak of 1.19 in January 1999 to a historic low of 0.83 in October 2000) were heavily discussed. Corsetti and Pesenti (1999) and Alesina et al (2001) pointed to fundamentals such as revisions in the forecasts of the output growth rate differential in the US and in the euro area as the main source. Nevertheless, the ECB intervened together with the U.S. Federal Reserve, the Bank of Japan, the Bank of England and the Bank of Canada based on "a shared concern about the potential implications of recent movements in the euro exchange rate for the world economy". The ECB's main fear was that a disorderly depreciation would add to the inflationary pressures in an environment of record high oil prices, and affect its credibility (Section 3.1).

Once the cycle turned following the crash of the dot-com bubble, the policy and academic debate turned to the consequences of the zero lower bound constraint on interest rates for monetary policy objectives, as interest rates dropped to a historically low level of 2% in the euro area. The other

¹² Note that in contrast to the NBER business cycle dating committee for the United States, the CEPR committee never called a recession in the euro area in the early years of the new millennium.

feature of this period was the decoupling of money and credit growth which undermined the credibility of the prominent role for money. The ECB nevertheless used robust money growth to argue against further cuts in interest rates in 2003. Both issues featured in the review of the ECB's monetary policy strategy in 2003 which we will discuss next.

2.2. Review of the strategy, recovery and growing imbalances (July 2003 – July 2007)

The 2003 review of the strategy

In 2003 after approximately four years of experience with the new strategy, Otmar Issing initiated a review of the strategy, which led to three main changes: i) a clarification of the definition of price stability: the Governing Council would aim at a year-on-year HICP inflation rate of below, *but close to* 2% over the medium term; ii) the end of the annual review of the reference value for M3 growth; and iii) a restructuring of the introductory statement of the President at the monthly monetary policy press conference which now started with the economic analysis followed by the monetary analysis (ECB 2003a,b).

The *first change* was a response to the strengthened need to establish a sufficient inflation buffer as a discussion of deflation risks took place in 2002-2003. Such a buffer was deemed to be necessary for two reasons. First, a small positive steady state inflation rate would reduce the probability of hitting the zero-lower-bound on nominal interest rates. Second, a positive inflation rate also greases the wheels of the labour market particularly in a monetary union with still segmented labour markets as it reduces the need for wage deflation in the face of asymmetric economic developments. Such wage deflation was thought to be costly in the presence of widespread evidence of downward nominal wage rigidity in the euro area.¹³ A number of studies had shown that an inflation buffer of close to 2% would significantly reduce the probability of hitting the ZLB or DNWR constraints (Issing, 2003 and references therein). The ZLB discussion had become prominent following the Japanese experience with very low interest rates and the low interest rate levels in the US (at 1%) and the euro area (at 2%) following the collapse of the dot-com bubble.

The specific formulation of the inflation aim of “below, but close to 2% over the medium term” was the result of a compromise that maximised the buffer, while remaining consistency with the definition of price stability and not giving a “sense of unwarranted precision” associated with inflation targeting regimes. The sense of continuity was made clear by Otmar Issing at the press conference in May 2003 explaining the outcome of the review. When asked whether the aim of “below but close to 2%” is a change, he replied: “This “close to 2 percent” is not a change, it is a clarification of what we have done so far, what we have achieved – namely inflation expectations remaining in a narrow range of between roughly 1.7 and 1.9% - and what we intend to do in our forward-looking monetary policy”. However, as a result of this formulation the perceived asymmetry in the inflation objective remained an issue of discussion. Symmetry was seen as important by the proponents of inflation targeting (e.g. Bernanke et al, 1999), but even German monetarists like Manfred Neumann thought that “... the lack of a lower bound as part of the definition was an unnecessary drawback” (Neumann, 2008).

¹³ See, for example, the findings of the Wage Dynamics Network.

The *second and third changes* mentioned above de facto meant a downgrade of the prominent role of money relative to the weight put by Duisenberg as cited earlier. This reflected the reality that on a monthly basis monetary policy decisions were mostly driven by the broadly based assessment of the outlook for price developments and the risks to price stability (the “economic analysis”), of which the macro-economic projections were an important part.¹⁴ It also reflected evidence on instability in money demand and the need to explain “distortions” or “portfolio adjustments” in M3 growth which were not linked to medium-term risks to price stability as discussed above. A revamped monetary analysis was now presented as a cross-check of the economic analysis from a medium to long-term perspective given the long-run monetary nature of inflation. It clarified that the main challenge facing the monetary analysis is to see through the inevitable short-term disturbances of the underlying relationship between money and prices, so as to extract the longer-term inflationary risks. This was also reflected in the changed structure of the introductory statement at the monetary policy press conferences which now started with the economic analysis and ended with a cross-check with monetary analysis.

The rearrangement of the pillars was applauded by academics favouring inflation targeting (e.g. Svensson, 2003), while at the same time it was acknowledged that the money pillar had been useful during the first years of the ECB as it made it easier for it to gain credibility as a sign of “the new institution’s fidelity to principles stressed earlier by the Bundesbank, which had in turn played a critical role as the anchor of the previous European Monetary System” (Woodford, 2005). But the debate around the role of the monetary analysis and the need to have two separate pillars continued (Issing, 2005). On 9-10 November 2006, the ECB held a symposium to discuss this from both an academic and practitioners’ point of view (Beyer and Reichlin, 2008). At the conference, Fischer et al (2008) reviewed the actual ECB experience with its monetary analysis from 1999 till 2006 and emphasised the real-time and comprehensive nature of the monetary analysis that was performed in the Quarterly Monetary Assessment since December 1999. These authors described the tools used making a distinction between money demand equations, judgemental analysis and money-based inflation forecasts. They also assessed the forecasting performance of money-based tools and found that there was information value in addition to the BMPE forecasts and that the bias in the forecasts corrects an opposite bias in the BMPE forecast. Finally, based on an in-depth analysis of the monetary analysis input, they concluded that the economic pillar prevailed in influencing the decision when the monetary pillar gave a blurred signal. This finding will be confirmed in the analysis of Section 3.2 below.

The broader discussion at the symposium pointed to two ongoing developments in the nature and the role of monetary analysis. First, the monetary analysis was evolving from a simple framework based on the quantity theory of money to a much more comprehensive set of analyses focusing on the role of financial frictions and financial intermediation in macroeconomic developments. This revamped the debate on why the two pieces of analysis should be kept separately given the intimate linkages between financial and real factors. At the symposium, Vice President Lucas Papademos conjectured that if “in the future, we will be in a position to develop and reliably estimate a single empirical approximation of a general theoretical framework in which money is of central importance” ... “it may be possible to merge the two pillars of our analysis into a single one. But this will be a larger pillar in which money will continue to play a prominent role in guiding our monetary

¹⁴ See also the evidence presented in Section 2.2.2 below.

policy decision-making” (Papademos, 2008). The Governing Council in 2007 endorsed a research programme to further enhance monetary analysis including by building structural models that embody an active role for money and credit in the determination of inflation dynamics (Papademos and Stark, 2010).¹⁵

The second theme that received increasing attention during this period was the link between money and credit, asset price developments and financial stability. While this financial stability angle was not taken up as an explicit justification for the two-pillar approach in the 2003 review, the ECB paid increasing attention both in research and policy communication to this link and the associated view promoted by the Bank for International Settlements that it may be necessary for monetary policy to lean against the wind of growing financial imbalances (See, for example, Detken and Smets, 2004 and Issing, 2003). This also became part of the research programme mentioned above (Detken, 2010). In a speech on “Asset price bubbles and monetary policy” in 2005, President Trichet conjectured that while “a leaning against the wind” approach is “compelling in many theoretical aspects, in practice ... it is likely that the circumstances in which a policy-maker will embark with confidence upon an explicit leaning against the wind policy will occur rarely.” But he also argued that the monetary analysis helps incorporating emerging financial stability risks with implications for price stability from a medium term perspective: “The fact that our monetary analysis uses a comprehensive assessment of the liquidity situation that may, under certain circumstances, provide early information on developing financial instability is an important element ...”. This became part of the rationale for the monetary analysis (e.g. Issing, 2005).

July 2003 – July 2007: Recovery and growing imbalances

As from June 2003, the ECB kept interest rates steady for two and a half years, with the policy rate remaining at the – at that time - historically low level of 2.0%, nurturing the economic recovery. The overall picture of economic activity brightened during the second half of 2003 when euro area exports increased significantly as a result of the renewed dynamism of the world economy. Domestic demand and investment followed in 2004, not least in view of the low level of interest rates and the generally favourable financing conditions (Figure 8). The recovery in economic activity moderated somewhat in the second half of 2004 and the first half of 2005 partly on account of rising oil prices, low consumer confidence, a temporary deceleration in world economic growth and the lagged effects of the past appreciation of the euro. However, in the second half of 2005, the expansion of economic activity in the euro area regained momentum. On the price side, HICP inflation did not fall as swiftly and strongly as previously expected, largely due to adverse food price developments and higher than expected oil prices – although the latter were attenuated by the appreciation of the euro. Annual HICP inflation remained above 2% in 2005, but underlying domestic inflationary pressures were contained throughout 2004 and most of 2005, justifying the prolonged accommodative monetary policy stance (Figure 5).

As 2005 progressed, the economic analysis suggested that upside risks were increasing, especially due to potential second-round effects in wage and price-setting that stemmed from higher oil prices. But this time it was the monetary analysis that carried the day. As of mid-2004, robust credit and monetary expansion reflected the stimulating effect of the then prevailing very low level of interest rates in the euro area and, later on, renewed dynamism of the euro area economy, rather than the

¹⁵ One of those models was the model developed by Cristiano, Motto and Rostagno (2010).

portfolio shifts between 2001 and 2003, indicating increasing upside risks to price stability at medium to longer horizons towards the end of 2005 (Figure 7). In response, the ECB started raising its policy rate as of December 2005 eventually by a total of 200 basis points to a level of 4% by the end of June 2007.

Overall, the gradual withdrawal of monetary accommodation took place against the background of solid economic growth and continued strong money and credit expansion in the euro area. The economic expansion gained momentum in the first half of 2006 and became gradually more broad-based and self-sustaining, with domestic demand as the main driver. Notwithstanding the impact of high and volatile oil prices, real GDP rose by 2.8% in 2006, compared with 1.6% in 2005 and 2.1% in 2004 and continued to expand at a solid rate of 2.7% in 2007 (Figure 6). As regards prices, average annual HICP inflation was slightly above 2% in 2006 and 2007, mainly driven by domestic demand as underlying inflation developments were largely in line with the ECB's inflation aim. Money and credit expansion became increasingly vigorous throughout this phase, supported by a persistently strong growth of bank loans to the private sector (Figure 7).

Overall, this second phase was characterised by a solid expansion of economic activity and vigorous money and credit growth (double the reference value) following a longish period of low interest rates. Against the background of the discussion on the “leaning against the wind” approach above and with the benefit of hindsight, the question emerges to what extent the monetary analysis was useful in guiding monetary policy in the face of growing financial imbalances. At the time Issing (2005) warned for the potential for misalignments to emerge due to strong money and credit growth.¹⁶ And Trichet (2008) pointed to the December 2005 episode as one where the monetary pillar was crucial in driving the monetary policy decision. Indeed, based on a reading of the introductory statements at the end of 2005, Neumann (2008) argues that monetary analysis was one of the driving forces behind the decision to start raising interest rates in 2005. As we will argue in Section 3.2 below, it is however difficult to detect significant deviations from the ECB's usual reaction to the growth and inflation outlook in this period. This suggests that unusually low interest rates were not the source of the growing imbalances; neither did the tightening of policy rates in 2005 go beyond what would be suggested by the growth and inflation outlook as might have been the case in a leaning against the wind approach.

A second important feature of this period is that underlying the aggregate euro area output and credit boom there were growing imbalances between euro area countries, which showed up in diverging intra-euro area current account balances. These imbalances were at the root of the subsequent euro area sovereign debt crisis which we will discuss in the next section. As shown in Figures 16, the countries that, leading up to 2007, had accumulated large current account deficits as well as high unit labour cost and credit and house price growth differentials relative to their euro area peers were also among the ones that suffered the highest fall-out from the financial crisis, as for example measured by the subsequent level of the unemployment rate in 2013 (Constancio, 2010, Smets, 2014 and Martin and Philippon, 2017). Or put differently, all the countries that ultimately ended up in bailout programmes – Greece, Ireland, Portugal and Spain – ran substantial

¹⁶ “Moreover, strong money and credit growth in a context of already ample liquidity in the euro area implies that asset price developments, particularly in housing markets, need to be monitored more closely, given the potential for misalignments to emerge.” Issing (2005).

current account deficits in 2007. The ECB's communication focused primarily on the need to address divergencies in competitiveness across the different euro area countries (e.g. Trichet, 2005).

One narrative behind these boom and bust developments runs as follows (Baldwin and Giavazzi, 2015). Easy global financial conditions (partly driven by the global savings glut) and greater integration of wholesale financial markets within the monetary union (with disappearing risk premia) encouraged cross country capital flows from the "core" to the "periphery" (Blanchard and Giavazzi, 2003 and Lane, 2010). Although the euro area current account was in balance throughout most of this period, large intra-euro area current account imbalances were building up, feeding non-tradable sectors like government consumption and housing in the "periphery" countries, driving up wages and costs and resulting in competitiveness losses that undermined the traded goods sectors and validated the current account deficit. With the exception of Greece, public debt was not the first problem, although ex post building up of higher buffers may have been advisable as shown by Martin and Philippon (2017). Instead the private debt build-up was very significant, mimicking some of the developments in the US and other OECD countries. Moreover, there was a mismatch between the longer-term loans to households and firms made by domestic banks and the short-term cross-country interbank funding that financed this debt.

The start of the global financial crisis in September 2008, which revealed the exposure of European banks to some of the toxic sub-prime mortgages in the US, and the revelation of the Greek deficit deceit in October 2009 were the triggers that led to a sudden stop in the cross-country capital flows and exposed the private and, in some cases, public debt overhang in some of the euro area countries. Several negative propagation mechanisms then took place. First, the need to back-stop the weakened banks in the absence of a clear resolution framework undermined the credit rating of national governments. Second, the Deauville agreement in October 2010 to promote "private sector involvement" in handling public debt overhang spread contagion towards other sovereigns as a euro area back-stop for governments was lacking. Third, weakened sovereigns and a faltering economy further increased the fragility and the undercapitalisation of the national banking sector leading to further deleveraging and giving rise to a doom loop between national sovereign and banking risks. Finally, weakened sovereigns also led to a pro-cyclical fiscal policy from 2011 to 2014 deepening the recession in the absence of fiscal policy coordination and a common budget. As a result, the sudden stop turned into a crisis and a prolonged double-dip recession (Corsetti, 2016 and Dedola and Corsetti, 2016), which we turn to in the next section.

2.3. The global financial crisis and the double-dip recession (August 2007 – June 2013)¹⁷

The third phase can be subdivided in three subperiods. The first period from August 2007 to September 2008 is characterised by financial turmoil during which tensions focused on ABS markets (in particular, those for subprime mortgages) and spilt over via the exacerbation of liquidity and credit risk into global interbank money markets. The second period from October 2008 to May 2010 covers the intense global financial crisis following the failure of Lehman Brothers and the ensuing Great Recession and collapse of international trade. The third period from June 2010 to June 2013

¹⁷ For a recent description and chronology of the ECB's monetary policy responses since the onset of the crisis, see Camba-Mendez and Mongelli (2017).

starts with the emergence of the sovereign crisis specific to the euro area, when the Greek fiscal situation deteriorated significantly.

August 2007 – September 2008: Financial turmoil

Financial turmoil first erupted in Europe with the emergence of money market tensions on 9 August 2007, following the announcement that a number of investment funds had to close as they could no longer value their portfolios owing to the illiquidity of asset backed securities markets. The uncertainty about the values of structured products and the asymmetric information about their location among banks led to adverse selection, liquidity hoarding and the freezing of interbank and other short-term funding markets (such as asset-backed commercial paper; e.g. Cassola et al. 2008). One indicator of these difficulties (mixing credit and liquidity risks) is the spread between the interbank rate, which is unsecured, and the overnight swap rate, which is only subject to a minimum amount of counterparty risk (Figure 13). After remaining very close to zero for years, these spreads rose to around 60 bps. The ECB's reaction was to satisfy the increased demand for liquidity by adjusting both the timing and the maturity of open market operations, while keeping the overall policy stance unchanged and geared at maintaining price stability. The distinction between monetary policy decisions and liquidity operations was characterised by the ECB as a “separation principle”, in line with the traditional analysis in Poole (1970), according to which stabilising the short-term interest rate in the face of purely financial shocks is the best way to insulate the real economy from the effects of those shocks (Fahr et al, 2011 and ECB, 2008).

With the advent of the financial turmoil, the outlook for economic activity became clouded and the balance of risks to the growth outlook tilted to the downside. Nevertheless, euro area growth remained solid, with corporate profitability sustained, employment growth strong and the unemployment rate declining to 7.4%, a level not seen for 25 years. At the same time, annual inflation rose sharply towards the end of 2007, reaching levels significantly above 2%, driven largely by substantial increases in international oil and food prices. While moderate wage developments and anchored medium to longer-term inflation expectations helped to dampen inflationary pressures, the risks to price stability over the medium term were judged to be on the upside. A cross-check with the monetary analysis appeared to confirm this (Figure 7). The ECB paid particular attention to monetary developments, also with a view to better understanding the shorter-term response of financial institutions, households and firms to the financial market turmoil in the second half 2007. At the time there was little evidence that the financial market turmoil had strongly influenced the overall dynamics of money and credit expansion, also thanks to the effectiveness of ECB liquidity injections in containing volatility in money market rates. Accordingly, the ECB decided to raise the MRO by 25 bps in July 2008 to avert the risk of second-round effects on wages.

October 2008 – April 2010: The global financial crisis and the great recession

This increase in the policy rate was quickly reversed when the financial turmoil escalated in a deep financial crisis after the collapse of Lehman Brothers on 15 September 2008, once it became clear that even prominent and systemically important institutions could fail. At that point financial markets froze, economic activity was disrupted, and the global economy was on the verge of collapse. Tensions spilled over from the financial sector into the real economy, leading to the Great Recession. The collapse of the financial system hit trade financing, and global trade plummeted by one-third in the fourth quarter of 2008. The US economy, which had slowed considerably when the

financial turmoil first began, entered a severe recession in the last quarter of 2007 and exited it in the first quarter of 2009. Owing to strong economic and financial ties, the crisis spread to the main trade and financial partners of the United States, including the euro area. Within a few months, the euro area had entered its own severe recession, which lasted from the second quarter of 2008 until the second quarter of 2009. During this period year-on-year GDP growth fell below -5% (Figure 6), headline HICP inflation was briefly negative in the summer of 2009 also on the back of falling oil prices (Figure 5) and money and credit growth dropped to 0% in the beginning of 2010 (Figure 7).

While the separation principle was maintained, in this period standard and non-standard measures taken by the ECB worked in tandem. Following the internationally coordinated interest rate cut of 8 October 2008 by 50 bps and in response to the collapse in output and inflation, the ECB decreased its key policy rates further in six steps by 275 bps, reaching a level of 1% for its main policy rate in May 2009, a new historical low (Figure 11). At the same time, the ECB took a number of non-standard measures to satisfy the high demand for liquidity, foster an even transmission of monetary policy impulses across countries and banks and help fend off risks of a financial meltdown. From 15 October onwards the main refinancing operations were carried out through a fixed rate tender procedure with full allotment at the interest rate on the main refinancing operation. At the same time, the corridor of standing facilities was temporarily reduced from 200 bps to 100 bps from October 2008 to January 2009. In addition, the ECB expanded the list of marketable assets eligible as collateral in Eurosystem credit operations from A- to BBB-; enhanced the provision of longer-term refinancing; and provided US dollar liquidity through foreign exchange swaps. Additional non-standard measures were adopted in May 2009 – when the MRO rate reached the 1% level – to support the flow of credit to households and corporations. These included the lengthening of the maximum maturity of refinancing operations to one year, a further extension of the list of assets accepted as collateral, and a Covered Bonds Purchase Programme (CBPP), the first outright purchase programme carried out by the ECB with the aim of reviving the funding channel for banks and support their credit intermediation. Together with those adopted in October 2008, these measures configured the ECB's policy of "enhanced credit support" in response to the financial crisis (Trichet, 2009).

The combination of these standard and non-standard monetary policy responses had a beneficial impact on interbank market spreads (Figure 13) and financing conditions more generally (Figures 14 and 15), and contributed, together with expansionary fiscal policies (Figure 9), to the initial economic and financial recovery from the Great Recession.¹⁸ By the end of 2009, year-on-year real GDP growth turned again positive and continued to pick up in 2010 (Figure 6). The fall in underlying inflation stopped at around 1% and headline inflation rose above 2% as energy prices again soared (Figure 5). In addition there was a modest recovery in money and credit growth (Figure 7). This led to an initial discussion about "phasing out" some of the exceptional monetary policies, which ex post proved to be premature.

May 2010 – June 2013: The sovereign debt crisis and the doom loop

¹⁸ In November 2008, the European Commission formulated a 200bn concerted European Economic Recovery Plan to boost demand and stimulate confidence in the EU (Commission, 2008). For an analysis of the effects of this fiscal stimulus, see Coenen et al (2012).

The financial crisis and the great recession had left its mark on public finances. Government bond yield spreads increased significantly in the euro area, in particular in those countries where deficits rose substantially owing to the impact of automatic stabilisers in the face of a deep recession, discretionary expansionary fiscal policy (Figure 13), and, importantly, interventions to shore up the banking sector (ECB, 2018). At least to some extent risk was transferred from the financial sector onto the public sector balance sheets leading to a deterioration of the fiscal position. When in April 2010 the Greek sovereign debt market seized up following a large revision of the reported government deficit for 2009 and a loss of market confidence in the authorities' ability and willingness to address the large rise in Greek government debt, this shock soon spilt over to other "peripheral" countries (at first Ireland and Portugal and later Spain and Italy).

In order to ensure depth and liquidity in malfunctioning segments of the debt securities markets and to restore an appropriate functioning of the monetary policy transmission mechanism, in May 2010, the ECB expanded its monetary outright portfolio through secondary market purchases of sovereign bonds under a new Securities Markets Programme (SMP). To signal that the SMP was not designed to alter the stance of monetary policy, the SMP purchases of debt securities were sterilised.

Indeed, as both GDP growth and headline inflation picked up, the ECB raised its key policy rates by 25 basis points in April 2011 and again in July 2011, following almost two years of no change. The euro area economy had grown at a quarterly rate of 0.8% in the first quarter of 2011, and the economic analysis revealed some upside risks to price stability. In fact, inflation had risen to 2.6% in March 2011 (and actually reached 3% towards the end of 2011). There were concerns about second-round effects in the setting of prices and wages, and a risk of inflation expectations becoming dis-anchored from the ECB's definition of price stability.

While the SMP interventions were effective in countering upward pressures and lowering the volatility of sovereign yields for most countries (Section 2.3), they did not stop the rise in sovereign spreads. By mid-July 2011 financial tensions intensified again due to the worsening of public finances in several euro area countries and contagion from the restructuring of the Greek sovereign debt. The sovereign debt crisis increasingly turned into a twin sovereign debt and banking crisis, as many banks were affected by considerable mark-to-market losses in their holdings of sovereign bonds. Negative feedback loops between vulnerable banks, indebted sovereigns and weak economies took hold in several countries and led to acute financial fragmentation along country borders (Shambaugh, 2013). The most affected countries lost market access and entered adjustment programmes (Ireland in November 2010, Portugal in May 2011), contributing to a period of fiscal consolidation (Figure 9).

As the financial tensions intensified and fiscal consolidation took hold, economic confidence fell, the economy slowed down rapidly and the euro area entered a double-dip recession in the last quarter of 2011 (Figure 6). An important contributing factor was banks' deleveraging needs and the associated tightening of bank lending standards and further reduction in money and credit growth (Figures 14, 15 and 7).

On 7 August 2011, ECB President Trichet made a statement on Italy and Spain and announced that the ECB would reactivate its Securities Market Programme. Towards the end of 2011, the ECB introduced several new non-standard measures. Two Long Term Refinancing Operations (LTROs) of twelve and thirteen months were announced on 6 October 2011, as well as a second covered bond purchase programme (CBPP2) for an intended amount of 40bn euro. Then, under the new President,

Mario Draghi, the ECB reversed the interest rate hikes of April and July 2011, by cutting key policy rates in November and December 2011 by a total of 50 bps. Moreover, in December 2011 and February 2012, two 36-month very long-term refinancing operations (VLTROs), with the option of early repayment after one year, were conducted with a combined gross amount of more than 1tr euros (Figure 12). These VLTROs gave banks funding certainty, eased redemption of maturing bonds and helped them sustain credit lines with private customers. Finally, on 8 December 2011, the ECB also decided to enlarge again the collateral list via a reduction of the rating threshold for certain asset-backed securities and reduce the reserve ratio from 2% to 1%.

These measures brought much needed relief for banks' funding, but did not directly address the need for balance sheet repair. Also the need for fiscal consolidation lingered on. In early 2012, weak growth and news of fiscal slippages in several countries strained financial markets once more, and financial tensions rose again. A rise in redenomination risk premia of sovereign bond yields led again to a widening in the cost of funding for several stressed euro area countries, seriously hampering the transmission of the ECB's policy stance to the real economy in those countries. Preserving the unity of the euro area became the defining challenge of the crisis. On 11 July 2012, the ECB lowered rates by 25 basis points, bringing the Deposit Facility Rate (DFR) to 0%, which was then left unchanged for almost two years (Figure 11). More importantly, on 26 July 2012, ECB President Draghi delivered a speech in London in which he gave the assurance that: "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough." Several days later, on 2 August 2012, the ECB's Governing Council announced it would undertake outright monetary transactions (OMTs). The OMT programme consists of purchasing sovereign bonds in secondary markets under strict conditions with the aim of "... safeguarding an appropriate monetary policy transmission and the singleness of monetary policy". The technical framework of OMTs was announced on 6 September 2012 and, on the same day, the SMP was terminated. A necessary requirement for OMTs was strict and effective conditionality attached to an appropriate EFSF/ESM programme.

The OMT back-stop was seen as credible and led to an immediate contraction of sovereign bond spreads, which rapidly declined to more sustainable levels. An important contributing factor was the European Council agreement on 29 June 2012 to create a European banking supervision mechanism and a resolution mechanism, a first step towards building a banking union. This was followed in September 2012 by the European Commission's proposal for a Single Supervisory Mechanism (SSM) for banks in the euro area and the publication of the Four Presidents roadmap towards a genuine Economic and Monetary Union in December 2012.

On 8 May 2013 the ECB lowered the MRO and LFR and further narrowed the interest rate corridor, meaning that the room for further cuts in interest rates was increasingly limited. In response to the partial normalisation of financial tensions, growth slowly picked up in the course of 2013.

Overall, in this episode the ECB entered the uncharted territory of non-standard monetary policy measures as the financial and sovereign debt crisis takes hold in an incomplete monetary union where both fiscal and supervisory policies are still national and are grappling to come to terms with the crisis. The ECB's operational framework was well-suited to address impairments in the interbank market by providing ample liquidity to its wide set of counterparts and against a wide set of collateral (Holthausen et al, 2010). In this context, the ECB relied on a separation principle to

distinguish very generous liquidity provision from setting the monetary policy stance. One question in this regard is whether the ECB was too optimistic about its ability to contain those impairments and their macro-economic effects, in particular in 2008 and 2011 when it tightened standard monetary policy while continuing to maintain easy liquidity provision.

The outbreak of the sovereign debt crisis and the negative loop between sovereign and banking risks was more problematic for the ECB's response, as monetary policy cannot address solvency issues of either governments or banks. In fact, the prohibition of monetary financing laid down in the Treaty forbids the ECB to directly finance governments or government tasks such as the recapitalisation of banks. Instead, those solvency issues required prompt action by national governments and supervisory authorities, which only happened slowly. Against this background the ECB's actions had to balance the need to address impairments in the transmission of monetary policy due to malfunctioning financial markets and self-fulfilling market dynamics with the obligation to maintain monetary dominance. This partly explains the initial timid interventions based on implicit conditionality in the government bond market through the SMP, which only turned into a more forceful programme (OMT) based on explicit conditionality of an EFSF/ESM programme after actions were taken by European and national authorities to start completing EMU. The question remains whether an earlier more forceful response in government bond markets would have been more effective in the absence of such decisive actions to address the underlying solvency issues (Martin and Philippon, 2017).

As monetary policy entered crisis management mode, the two-pillar approach took a backseat in communication. While the Introductory Statements at the regular monetary policy press conferences remained structured along the two pillars including a cross-checking section, few speeches of EB members dealt with the two-pillar structure of the ECB's monetary policy strategy (Figure 3). Instead the focus turned to, first, how to identify and address the impairments in the transmission mechanism of monetary policy following the financial crisis. This had a big impact on the ECB's monetary analysis. The financial crisis necessitated a comprehensive broadening of the monetary analysis towards a detailed macro and micro-economic analysis of the financial system and the bank lending channel in particular. For example, the Bank Lending Survey became a prominent tool to understand supply side restrictions in bank credit markets. More generally, a deep analysis of the capital, leverage and liquidity positions of banks became important, as well as a comprehensive look at both bank and non-bank financing conditions in the economy. This led to a thorough revamping of the Quarterly Monetary Assessment. At the same time, given the intimate interaction between financial and real factors, it also blurred the distinction between the economic and monetary analysis.

2.4. The low-inflation recovery and addressing the zero-lower-bound constraint (June 2013 – June 2018)

The sovereign debt crisis abated and the recovery started to take hold, as some of its underlying causes were addressed by the various country programmes, the creation of a banking union with common supervision and resolution and the establishment of a back-stop for governments via the European Stabilisation Mechanism (ESM) and the ECB's OMT programme. The damage of high unemployment and negative output gaps in 2012 and 2013 was however done (Figure 4). Towards

the second half of 2013 both headline and core inflation dropped below 1%, with headline inflation becoming negative in the course of 2015 (minimum of -0.7% in January 2015) largely on account of falling energy prices (Figure 5). Inflation expectations, which up until then had remained well anchored, started to decline (Section 3.1). Concerns of deflation risks and a prolonged period of low inflation grew. Moreover, it became increasingly clear that the transmission of the easing of ECB key policy rates had remained impaired and uneven. In particular, the cumulative 125 bps reduction from September 2011 to June 2014 had not yet been transmitted to households and firms in the stressed euro area countries. At the same time, as the medium-term outlook for inflation continued worsening, the ECB's balance sheet shrank, credit growth was negative reflecting ongoing deleveraging and the exchange rate of the euro strengthened.

To stave off emerging deflation risks and address the impairment of the bank lending channel, the ECB embarked on a three-pronged comprehensive monetary policy easing strategy as of June 2014.¹⁹ A first measure was to go into negative interest rate territory. On June 2014, and again on September 2014, the ECB lowered the DFR by 10 bps respectively to -0.2%. Second, in order to revive the provision of credit and address the fragmented policy transmission a renewed round of credit easing measures with a series of targeted longer-term refinancing operations fixed at the MRO rate plus 10 basis points were announced. The surcharge was abolished in January 2015. The maximum maturity for the TLTROs was set to September 2018, and the initial allowance amounted to 7% of outstanding loans to the euro area non-financial private sector. These credit easing measures were complemented by an asset-backed securities purchase programme (ABSPP) and a third covered bond purchase programme (CBPP3) in September 2014. Thirdly, in order to provide additional stimulus in an environment where further cuts in short-term rates were constrained, in January 2015 the ECB announced an expanded Asset Purchase Programme, with average monthly purchases of public and private sector securities of 60bn euro (Draghi, 2014b). Through the portfolio rebalancing and signalling channels this put further downward pressure on long-term interest rates and flattened the slope of the yield curve (Figure 8). The combined impact of these measures was to lower market- and bank-based financing costs and ease financial conditions more broadly. Figure 15 shows that the composite indicator of the cost of borrowing for NFCs and households fell from 3% to close to 2% at the end of 2015 and bank lending rates started to converge following the earlier fragmentation. At the same time, banks started easing lending standards and credit growth to the private sector gradually started recovering (Figures 7 and 15). By the summer of 2015 GDP growth had picked up to close to 2% and both headline and underlying inflation had stabilised, but at relatively low levels of 0 and 1%.

Against this background of still uneven and fragile growth and low inflation, the growth in global demand faltered in the summer of 2015 as a stock market collapse and unexpected depreciation of the renminbi in China caused financial turbulence in emerging market economies. In order to avoid a renewed increase in deflation risk and to continue to support the gradual recovery in the euro area economy, the three-pronged package of measures was recalibrated again in December 2015 and March 2016 with a view of adding further monetary policy stimulus. On 9 December 2015, the ECB lowered interest rates further by 10bps and announced a recalibration of the APP, prolonging the programme until March 2017, or beyond if necessary to ensure a sustained adjustment of inflation towards the aim of below, but close to 2%. At the same time, the ECB announced that it would

¹⁹ This strategy was foreshadowed in a speech by President Draghi in May 2004. See Draghi (2004).

reinvest the principal repayments, keeping the stock of the APP portfolio constant after the end of the net purchases for as long as necessary, and extended the list of APP-eligible assets to include securities issued by regional and local governments. On 10 March 2016, the ECB lowered rates again, bringing the interest rate corridor down to 65 basis points and lowering the DFR by 10 bps to -0.4%. At the same time, a considerable expansion of the APP was announced, with average monthly purchases being increased to 80bn euros. The ECB also launched a corporate sector purchase programme (CSPP) as integral part of the APP. Finally, four new targeted longer-term refinancing operations (TLTRO-II), each with a maturity of four years, were announced, starting in June 2016 and running until March 2017. The rates on these operations could be as low as the negative DFR rate, if banks exceeded certain lending benchmarks. The combined effect of these additional easing measures was to further reduce financing conditions. This stimulated domestic demand and turned a fragile and uneven recovery into a solid and broad-based expansion in spite of the temporary weakness of the international economy.

As the economy strengthened, but underlying inflation remained subdued, further monetary stimulus was deemed appropriate, but the intensity of the monetary stimulus was gradually adjusted. On 8 December 2016, the Governing Council decided to extend the net APP till the end of 2017, while at the same time reducing its monthly pace as of April 2017 to 60bn euros. On 26 October 2017 a further recalibration of the APP was decided as the programme was extended until September 2018 with a reduced monthly pace of purchases of 30bn euros starting from January 2018. Finally, on 14 June 2018, the Governing Council announced an anticipated extension of the net APP till the end of 2018 at a reduced pace of 15bn euros followed by ending the net APP. At the same time, it enhanced its forward guidance on policy rates by stating that it expects policy rates to remain at their present levels at least through the summer of 2019 and, in any case, for as long as necessary to ensure the sustained convergence of inflation to levels that are below, but close to 2%.

Overall, the fourth and most recent episode was characterised by the ECB's actions to overcome the zero-lower bound on interest rates in its attempt to address deflation risks and bring inflation back to levels close to 2%. In doing so, the ECB turned to policies such as quantitative easing, funding for lending and explicit forward guidance that had been used before by other central banks such as the Fed and the Bank of England. The ECB was, however, the first major central bank to also go into negative interest rate territory. We review existing evidence on the effectiveness of these programmes in Section 3.3.

As monetary policy became much more complex, there was an increased need for communication. As part of the efforts of enhanced communication in a more complex environment, in January 2015 the Governing Council decided to release the accounts of the monetary policy Governing Council meetings, approximately four weeks after each meeting (Draghi, 2014a). At the same time, the frequency of these meetings was changed from monthly to eight times a year.

Also the ECB's forward guidance evolved in this period (Table 2). Following the taper tantrum in the US, the ECB introduced explicit forward guidance about the future path of key interest rates in July 2013, announcing that the policy rates were expected "to remain at present or lower levels for an extended period of time" and that this expectation was "based on the overall subdued outlook for inflation extending into the medium term, given the broad-based weakness in the real economy and subdued monetary dynamics." The aim was to anchor policy expectations and maintain an

accommodative level of long-term interest rates in the face of rising bond yields in the global market and a still very subdued and fragile euro area recovery. As explained by Praet (2013), the forward guidance on interest rates was meant to clarify the ECB's reaction function.

As in other central banks, the ECB's forward guidance framework subsequently evolved. It took on a more complex and time and state-dependent form when the expanded APP was announced in January 2015. On this occasion, the ECB also gave forward guidance on the net asset purchases and announced that they "are intended to be carried out until end-September 2016 and in any case until it sees a sustained adjustment in the path of inflation which is consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term." This forward guidance therefore had both date and state-dependent conditioning elements. The former underscored the commitment made by the Governing Council, whereas the latter made the state dependent nature of the forward guidance clear. A direct link with the ultimate objective was seen as more appropriate than alternative intermediate targets, also in the light of the mixed experience with conditioning variables such as unemployment in the United States and the United Kingdom. The APP was subsequently extended in December 2015, in December 2016 and in October 2017 maintaining a similar formulation.

In March 2015, when the APP monthly purchases were increased from 60 to 80bn per month, the ECB also for the first time linked the forward guidance on interest rates to that on the APP by stating that the "key interest rates would remain at present or lower levels for an extended period of time and well past the end of the net asset purchases". This helped to secure the credibility of the interest rate forward guidance (Ehrmann et al, 2017), thereby reinforcing both parts of the easing programme, and it also provided clarity on the sequencing in the normalisation of the various elements of the easing measures (Praet, 2018). In June 2017, the reference to lower interest rates was dropped. And, in June 2018, when the anticipation of the end of the net asset purchases by the end of 2018 was announced, the forward guidance on interest rates was delinked from the APP programme and now states that "The Governing Council expects key interest rates to remain at the present level through the summer of 2019 and, in any case, as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term". A date and state-based element is now attached to the lift-off of policy rates.

3. Assessing the ECB's monetary policy

3.1. The objective of price stability: Performance, credibility and challenges

In this section we analyse the performance and credibility regarding the ECB's primary mandate of medium-term price stability for the euro area. The key question is to what extent the ECB managed to anchor medium-term inflation expectations consistent with its mandate after 1999 and in the aftermath of the financial crisis.

How well anchored are inflation expectations in the euro area?

Figure 17 shows that over the past two decades average euro area inflation has been approximately 1.7 percent. This average outcome is consistent with, but on the low side of Issing's indication of an inflation aim between 1.7 and 1.9%. Over this period annual HICP inflation has roughly fluctuated

between 0 and 4%, mostly reflecting the impact of volatile energy and food price inflation. The range for core inflation (i.e. HICP inflation excluding energy and food) is smaller and lies between 0.7 and 2.5% reflecting its more sluggish nature. Figure 17 also depicts a five-year centred moving average of HICP inflation which may capture a more appropriate medium-term horizon for assessing the ECB's performance. This moving average has fluctuated closely around 2 percent till the start of the sovereign debt crisis, fell to a historic low of approximately 0.7% at the beginning of 2016 and is expected to slowly recover since then.

Given the imperfect short-term control of inflation by the central bank, it is also useful to examine the stability of medium to long-term inflation expectations. The anchoring of longer-term inflation expectations to the ECB's inflation aim is a good measure of the ECB's credibility for maintaining price stability over the medium term. The empirical literature has shown that the degree to which inflation expectations are anchored has been dispersed across countries and time and appears to co-move with the degree of credibility of monetary policy. The tendency towards better anchored expectations was typically stronger in countries with official inflation targets, suggesting that agents use inflation targets as focal points when forming long-term inflation expectations (See, for example, Demertzis et al. (2009), Dräger and Lamla (2013), Gürkaynak et al. (2010), Demertzis et al. (2012) and Mehrotra and Yetman (2014)).

A study focusing on the earlier part of the EMU period (Beechey et al, 2011) showed that on average euro area long-run inflation expectations were more firmly anchored than those in the US. In this section we follow Dovern and Kenny (2017) and use using the ECB's Survey of Professional Forecasters (SPF) to examine how the various moments of long-term inflation expectations in the euro area have evolved over the past two decades. Figure 18 shows the evolution of two measures of average 5-year ahead inflation expectations taken from the SPF. The average point forecast stayed close to 2.0% over the full EMU period, roughly fluctuating between 1.8 and 2.0%. The average mean of the individual forecasters' distributions has fluctuated a bit more and reached a minimum of 1.65% at the beginning of 2016. As shown in Lyziac and Palovitta (2016), there is some dependence of those average forecasts on a moving average of actual inflation, but overall these movements have been very contained. Using more formal tests for breaks in mean long-term inflation expectations, Dovern and Kenny (2017) find two significant breaks in 2005Q2 and then again in 2013Q2. In 2005Q2 the mean expectation shifted upward from an estimated 1.85% to 1.92%. Arguably this corresponds to the clarification of the definition of price stability of below, but close to 2% in 2003. This upward movement in expectations was however more than reversed in 2013Q2 when the mean inflation expectation dropped back to 1.8%, partly in response to the persistently low level of inflation following the sovereign debt crisis in the euro area.

It is also instructive to look at the second moment of the longer-term forecast distribution. Figure 19 shows three measures of longer-term inflation uncertainty based on the SPF. First, it shows a measure of disagreement amongst professional forecasters, i.e. the standard deviation of individual forecasters' point forecasts. Disagreement fell significantly in the first decade of EMU from 0.4pp to 0.1pp suggesting that the ECB's extensive communication about its stability-oriented monetary policy strategy and the quantitative definition was effective in aligning longer-term expectations across forecasters. While disagreement rose significantly after the start of the great recession, it has fallen back reaching levels close to 0.15pp since then. The other two measures take into account the individual forecast uncertainty. Following the financial crisis longer-term inflation forecast

uncertainty has clearly increased, reflecting also the higher variance of actual HICP inflation after 2007 (Dovern and Kenny, 2017). There is no evidence that this measure of uncertainty has significantly reverted to its pre-crisis level.

Finally, one can also analyse the balance of longer-term inflation risks as captured by the professional forecasters expected distributions. Figure 20 gives the evolution of three such measures. It shows that before the financial crisis the risks around the longer term inflation forecast were roughly balanced. Interestingly, a slight negative skew emerged around 2003-2004, when as discussed before there was a debate about the impact of the zero-lower bound on optimal inflation targets and the ECB's inflation aim was clarified. However, the skew became persistently negative following the outbreak of the financial crisis and in particular after the sovereign debt crisis. Most recently there has been a return towards more balanced risks as suggested by the two quantile measures (in grey). This is consistent with recent evidence in Grishchenko, O., S. Mouabbi and J.P. Renne (2017).

Figure 20 also shows that the negative skew is highly correlated with model-based estimates of the inflation risk premium in inflation indexed bonds and can explain why market-based 5-year ahead 5-year forward inflation rates have been more responsive to actual headline inflation than the average survey expectations. As the probability of getting trapped in a low inflation or deflation regime increases, the demand for deflation protection rises affecting inflation risk premia.

A second approach for analysing the anchoring of inflation expectations is to investigate the sensitivity of longer-term inflation expectations to short-term macro-economic news and inflation developments, as reviewed in Ciccarelli and Osbat (2017). While the reviewed studies differ in the details of their respective methodologies, there are some common findings which are consistent with the findings above. Before the crisis no significant pass-through effects were recorded. The overall picture is less clear after the start of the financial crisis.²⁰ However, after the negative oil price shock of mid-2014, three out of four pass-through measures identified increasing risks of a de-anchoring of longer-term inflation expectations. In 2015, the announcement and subsequent implementation of the APP seems to have softened these risks and some studies suggest that the pass-through signal has become insignificant.

Overall, this review of the evidence suggests that in contrast to some early fears the ECB was effective in anchoring medium to long-term inflation expectations to its inflation aim early on (Smets, 2010). Moreover, modal expectations remained anchored below, but close to 2% throughout the financial and sovereign debt crisis. However, the higher uncertainty around the expected longer-term inflation forecast and the emergence of a significant negative skew in the balance of risks after the beginning of the sovereign debt crisis in particular suggests that the ECB was not able to fully dispel the probability of ending up in a low inflation/deflation regime (as had happened in Japan). This may not necessarily be related to the credibility of the ECB's commitment to maintain price stability, but it may be due to doubts that the ECB had the necessary tools to fight deflation in a low interest rate environment. Not the willingness of the central bank, but its ability may have been put in doubt. This explanation is also borne out by some evidence of asymmetry

²⁰ For the US a number of studies have shown that long-term mean inflation expectations started to react more strongly to macroeconomic news after the financial turmoil of 2008 (e.g., Galati et al., 2011; Nautz and Strohsal, 2014; Autrup and Grothe, 2014).

between the response of long-term market inflation compensation measures to inflationary and deflationary shocks (Natoli and Sigalotti, 2017a/b). While this may have been more important for the European Central Bank where a discussion on the use of QE was more intense and may explain its delayed implementation, the fact that this feature has also been observed in other jurisdictions with a single fiscal authority suggests that it may be a more general phenomenon related to the risk that one can get trapped in a deflation regime once inflation expectations adjust (Benhabib, Evans and Honkapohja, 2018). As discussed above, the emergence of medium-term deflation risks eventually led the ECB to embark on a comprehensive unconventional easing programme which helped to remove the deflation risks (Andrade et al (2015) and Karadi et al (2016)).

Possible implications for the definition of price stability

The review of the ECB's credibility highlights that over the past two decades the initial concerns that the ECB may not have had the same anti-inflation credibility as some of its predecessors such as the Bundesbank turned into the opposite concern that it may not be sufficiently equipped to avoid a low inflation or deflation equilibrium. In this light, it is worthwhile to review some of the elements of the ECB's definition of price stability.

One issue is whether the excess sensitivity of longer-term inflation expectations to low inflation is partly due to a persistent perception of a lack of *symmetry* in the ECB's inflation objective. Due to the formulation of the inflation aim ("below, but close to"), many observers continue to think that the ECB's tolerance for lower inflation is higher than its tolerance for higher inflation (e.g. Martin Wolf, 2017), although ECB policy makers have continuously stressed the importance of symmetry.²¹ The question of symmetry can be addressed within the policy reaction function literature. A recent Bank of Finland paper finds no evidence of asymmetry if the inflation target is assumed to be 1.7%, but some evidence of asymmetry if the target is assumed to be 2%.²² In Section 3.2 we test for asymmetry in a simple policy reaction function set-up and find little evidence of a stronger response to positive deviations of inflation than to negative deviations from the ECB's inflation aim.

A related question is whether the *precision* of the medium-term inflation objective matters. As mentioned above, empirical evidence suggests that a point target helps agents to focus when forming inflation expectations and contributes to the anchoring of those expectations. This is why many academics were originally in favour of a point target (e.g. Bernanke, Laubach, Mishkin and Posen, 1999). It also explains why most inflation targeting central banks have a clear focal point.²³ To underline that a central bank cannot precisely pin down inflation at all times, this focal point is often embedded within a target range. In the ECB's strategy the medium-term orientation serves this purpose.

²¹ For example, in a recent speech President Draghi (2016) emphasised the importance of pursuing the price stability objective symmetrically particularly in a zero-lower-bound and high debt environment. This criticism was around from day one, as discussed before.

²² Other earlier studies of possible asymmetries of the ECB's monetary policy include Aguiar and Martins (2008), who find a "precautionary demand for price stability", and Surico (2003, 2007) and Ikeda (2010).

²³ A precise numerical target also helps in communication. In the words of Stephen Nickel, former Bank of England MPC member, in 2006: "In my own experience, I find being provided with a precise numerical inflation target enormously helpful, since I can then explain my own policy decisions very simply in terms of avoiding an undershoot or overshoot of this target".

But what is the optimal focal point for inflation? In the advanced economies there has been a convergence of inflation targets to 2% since the start of inflation targeting regimes in New Zealand in 1989. Recent examples are the Federal Reserve Board in 2012, the Bank of Japan in 2013 and the Norges Bank in 2018. One argument against being very precise is that there is uncertainty surrounding *the optimal medium-run inflation objective* and that it may change over time. In the academic literature estimates of the optimal inflation target vary from mild deflation to 4% and higher. The recent experience of a higher macroeconomic volatility and a lower equilibrium real interest rate lead some macroeconomists to argue for higher inflation targets of 4% (e.g. Blanchard et al, 2010 and Ball, 2014).²⁴ At the same time, central banks, including the ECB, have gained a lot of positive experience with the use of unconventional policy measures to circumvent the effective lower bound on short-term interest rates, as discussed in the next section. Recent empirical research suggests that these tools may have been equally effective as the more standard short-term interest rate tools in steering the economy, although they may come with some additional side effects (Debortoli and Gali, 2017). And changing inflation objectives always runs the risk of undermining the central bank's credibility.

A suggested compromise has therefore been to keep the 2% focal point, but strengthen the role of inflation expectations as an automatic stabilisation mechanism to further alleviate the zero lower bound on interest rates. This can, for example, be done by average inflation targeting (e.g. Nessen and Vestin (2002) and Smets (2003)). Gaspar et al (2010) show that those benefits continue to exist even in the absence of rational expectations, as long as the agents learn and adapt their expectation formation to changes in the regime.²⁵

3.2. The conduct of monetary policy: The ECB's interest rate decisions

This section analyses the ECB's interest rate decisions through the lens of an empirical interest rate reaction function. This is particularly appropriate until the ECB hit the zero-lower bound in 2013. Figure 11 shows the developments of the main policy-controlled interest rates since the start of EMU. During the first decade of EMU, the overnight interest rate (EONIA) has fluctuated within a 200 basis point corridor given by the marginal lending rate and the deposit facility rate (DFR) (with the exception of the initial weeks in 1999). Until October 2008, the main objective of the ECB's operational framework was to steer very short-term interest rates in line with the decisions of the Governing Council. During that time, the main policy rate was the minimum bid rate (MBR) in the ECB's weekly main refinancing operations (MROs). These are liquidity-providing repo operations conducted as variable rate tenders, subject to the minimum bid rate, in which the ECB determines the total amount that is allotted to counterparties, while banks submit bid schedules expressing the price they are willing to pay for liquidity in these operations. As can be seen from Figure 11, over this period the EONIA, the overnight money market rate, stayed relatively close to the MBR, i.e. the midpoint of the corridor, with exceptions at the end of the maintenance period when unexpected

²⁴ Early on, Wyplosz (2000) argued for a higher inflation target of 4% for the euro area on the basis of the presence of more significant downward nominal wage rigidities.

²⁵ An argument against average inflation targeting is that it may require short periods of deflation following periods of inflation. This is addressed in the proposal by Bernanke (2017) of installing a price level target only after periods in which the lower bound has been binding.

liquidity shortages or surpluses can lead to sharp deviations within the corridor. Over this decade a number of refinements were made to the ECB's operational framework, but the big changes came with the outbreak of the financial crisis in October 2008 (ECB, 2011).

As discussed above, following Lehman's failure the interbank market seized up both internationally and within the euro area, giving rise to large spreads between secured and unsecured money market rates and falling interbank transaction volumes.²⁶ The ECB responded by adopting a fixed-rate/full-allotment (FRFA) tender procedure in all its regular monetary policy operations, expanded its list of eligible collateral (BBB or higher) and lengthened the average maturity of its outstanding operations. These measures led to a significant expansion of the ECB balance sheet as the ECB became the market maker in the money market and in this way avoided a more dramatic and costly financial collapse and promoted effective monetary policy transmission. As shown in Figure 12, excess liquidity increased and as a result the EONIA dropped below the MRO rate towards the bottom of the corridor given by the DFR, which became the main policy rate. The distance of the EONIA rate from the DFR is a function of the amount of excess liquidity in the banking system as illustrated in Figure 21. Two periods are characterised by a rising EONIA relative to the deposit rate. The first one is in 2011 when the macro-economic picture improved, the ECB raised rates twice and excess liquidity dropped to very low levels. The second period is towards the end of 2013 and 2014 when excess liquidity again fell to low levels as banks started repaying the VLTRO operations.

In the rest of this section we analyse the setting of the main policy rate through the lens of a simple, but robust first-difference policy rule originally proposed by Orphanides (2003). This rule links the change in the main policy rate of the ECB (the MBR before October 2008 and the DFR after October 2008) to deviations of the one-year ahead inflation forecast from the ECB's inflation aim and deviations of the one-year ahead real GDP growth forecast from potential output growth:

$$(1) \quad \Delta i = 0.5(E\pi_{t+1} - \bar{\pi}) + 0.5(E\Delta y_{t+1} - \Delta \bar{y})$$

Orphanides (2003) showed that this rule describes quite well the behaviour of US policy rates during the Volcker/Greenspan period. As discussed in Orphanides (2006), one of the advantages of this simple rule is that it avoids having to rely on unobservable concepts such as the output gap and the natural real interest rate, which are subject to considerable uncertainty. Moreover, the first-difference rule has been shown to be robust in a variety of models, reflecting a wide range of data, parameter and model uncertainty (Orphanides and Williams, 2008). Finally, because the rule can be implemented on the basis of short-term forecasts for growth and inflation that were available at the time of the policy decision, it is an easy way of constructing a real-time policy benchmark that is not contaminated by ex-post information. It is also a rule that is easy to use in communication given its direct reliance on the outlook for inflation and GDP growth. Smets (2010), Orphanides and Wieland (2013) and Bletzinger and Wieland (2017), amongst others, have applied this rule to the euro area.

Figure 22 replicates and extends the rule shown in Orphanides and Wieland (2013). The solid black line depicts the changes in the relevant policy-controlled interest rate.²⁷ The shaded area shows the

²⁶ See Heider et al (2009) for a description and theoretical analysis. Pill and Reichlin (2014) describe the financial crisis response by the ECB in detail.

²⁷ Note that the changes in the policy rate are quarterly changes to align it with the quarterly frequency of the SPF forecasts, whereas the policy decisions are monthly through most of the period. We take the policy rate

predictions of the Orphanides rule where we use the one-year ahead forecasts for inflation and growth from the ECB's Survey of Professional Forecasters (SPF) and the European Commission's real-time estimate of the potential GDP growth as input variables. The upper and lower limits of the shaded area correspond to a range for the inflation aim between 1.5 and 2.0%. As also shown by Smets (2010) and Orphanides and Wieland (2013), it is remarkable how well this simple rule captures the changes in the ECB's policy rate. If we impose the condition that the average error between the actual and predicted interest rate changes is zero (as in a regression analysis), then we can use this rule to calculate the ECB's implied inflation aim which is 1.76%, very close to the midpoint between 1.5 and 2.0% and consistent with the range highlighted by Issing in 2003.

In the rest of this section we go beyond the previous papers by using the ECB's own growth and inflation projections to derive the rule. From the start in 1998, the ECB and the Eurosystem have produced quarterly macroeconomic projections, which typically are presented to the Governing Council in the first meeting of March, June, September and December of each year as part of the economic analysis.²⁸ Figure 23 shows the evolution of the one-year ahead SPF and ECB/Eurosystem projections for HICP inflation and real GDP growth respectively, as well as the actual developments. The growth forecasts are generally very closely aligned.²⁹ The HICP inflation forecasts also move together, but the ECB/Eurosystem forecasts are a bit more volatile, reflecting the Eurosystem's detailed knowledge of the disaggregated inflation components.

Kontogeorgios and Lambrias (2018) recently investigated some of the properties of the (B)MPE projections for GDP growth and HICP inflation and they find that they satisfy the properties of optimal forecasts. They are generally unbiased; errors are not correlated beyond what one theoretically could expect; and the uncertainty in the forecast increases with the horizon. They outperform simple benchmarks such as the Random Walk and an AR(1) model, and, in the case of inflation, are rational (See also Alessi et al, 2007). Unfortunately, a direct comparison with the SPF forecasts is difficult because they use different information sets and different technical assumptions. Paloviita et al (2017) focus on the properties of the BMPE forecasts over the projection horizon. They find that the BMPE projections exhibit stronger and faster mean reversion than implied by the persistence in the actual data. After about six quarters the median inflation projections are already in the proximity of their levels at the end of the forecast horizon. They also find that inflation forecasts are too often close to the mean and that 3 to 4 quarters out the inflation and growth forecasts are not correlated with the actual outcomes. Figures 24 shows the mean, max/min, and 25/75 percentile of the (B)MPE projections of year-on-year inflation and GDP growth over the projections horizon.

set in the middle of the quarter to align it with the time when the SPF forecasts are first available to the Governing Council.

²⁸ The June and December projections are called the Broad Macroeconomic Projection Exercise (BMPE) because it is a Eurosystem exercise involving the contributions of all the national central banks of the euro area, whereas the March and September Macroeconomic Projection Exercise (MPE) is an intermediate update of the December and June BMPE produced by ECB staff.

²⁹ Note that the ECB/Eurosystem's projections were at first based on a constant interest rate assumption, but since the June 2006 projection exercise are based on market expectations of short and long term interest rates. Differences in technical assumptions for the oil prices or the exchange rate may explain part of the differences between SPF and ECB/Eurosystem projections.

Figure 25 shows the outcome of applying the Orphanides rule to the (B)MPE projections. In order to align the interest rate decisions with the ECB/Eurosystem projections, we take the policy rate set when the projections are presented (i.e. in the last month of the quarter). This explains the slightly different pattern of interest rate changes. The conclusions remain, however, roughly the same. The simple policy rule captures the ECB's policy decisions quite well. The increase in rates in 1999 and 2000 and the subsequent fall, the pause in 2000 and the subsequent fall, the rise starting in 2006, the sharp fall in 2008 and 2009 and the slight increase in 2011, as well as the fall in 2012 are all captured fairly well by a simple response to deviations of the one-year ahead inflation projection from the inflation aim and the deviations of the one-year ahead growth projection from estimated potential output growth. Not surprisingly, the correspondence is less striking as of 2013 when the deposit rate is constraint by the zero lower bound and only small further changes into negative territory were feasible.

Table 1 shows the results from estimating this rule.³⁰ The estimated coefficients are somewhat smaller than, but not significantly different from 0.5. The ECB's implicit inflation aim which can be deducted from the estimated constant is 1.81%. The R2 is higher than 0.5, which is quite high given that the variable we are trying to explain is in first differences. Shortening the sample till the second quarter of 2013 (second column of Table 1) does not significantly change these results. In these regressions we chose the horizon for year-on-year GDP growth to be $t+3Q$, reflecting the fact that at the time of the interest rate decisions in the last month of the quarter, the current quarter is not yet known while the previous quarter is known, whereas for inflation we have $t+11M$, reflecting that previous month inflation is known. We tested for different forecast horizons and found that for both GDP growth and inflation the one-year ahead projections are the most informative for policy decisions (highest R2).

Figure 26 shows the cumulated errors of both the calibrated and estimated rules. Using this set of benchmarks suggests that interest rate policy may have been somewhat too loose in 2002 and too tight in 2009 and 2013.³¹ This finding is consistent with more elaborate thick-modelling exercises by ECB staff, which identify both 2009 and 2012/2013 as periods in which the actual interest rate is above what a range of Taylor rules estimated before 2008 would have suggested. Of course, the latter periods are also when the ECB implemented a range of unconventional measures as we will discuss below. The interest rate increase in July 2008 does not appear to be justified by the ECB's own outlook for growth and inflation, but was quickly reversed. The interest rate increases in 2011 do not show up as a major policy mistake as both the inflation and growth projection suggested a tightening move. Of course, this does not exclude the possibility that the ECB underestimated the

³⁰ Other studies that have estimated policy reaction functions for the ECB include Gerdesmeier and Roffia (2003), Gorter et al (2008), Sturm and De Haan (2011), Gerlach and Lewis (2014), Paloviita et al (2017). Paloviita et al (2017) find support for monetary policy reaction functions with i) very short run (one quarter ahead) GDP growth projections; ii) somewhat longer (one-year ahead) inflation projections; and iii) including a proxy for the natural rate of interest.

³¹ The finding of too tight policy in 2009 is somewhat at odds with the findings of Giannone et al (2012 and 2014) and Pill and Smets (2013), which show that by the end of 2009 and until 2012 the actual path of 3-month Euribor was below the counterfactual one based on the historical ECB monetary policy rule. Pill and Reichlin (2014) argue that the euro area experience contrasts with evidence from the US, where the zero lower bound appears to have been a binding constraint on rate setting throughout the crisis period.

impact of the financial and sovereign debt crisis on economic activity and inflation. Similarly, these benchmarks do not suggest that monetary policy was too loose during the run-up to the crisis, as suggested by Taylor (2007) for the United States.

In Table 1 we also test a number of alternative specifications. First, the second column shows that the BMPE projections outperform the SPF forecasts in explaining the ECB's interest rate decisions. This is not surprising as the SPF forecasts are collected one to two months earlier than the BMPE projections and therefore do not incorporate the latest data available at the time of the interest rate decision. Second, we test whether the projection for HICP inflation excluding food and energy adds additional value in explaining the interest rate decisions (the third column). The estimated coefficient on the projection for core inflation is actually negative, but insignificant. This is consistent with empirical findings for the euro area that headline inflation leads core inflation and not the other way around and the descriptive analysis in section 2 which points to the fact that on a number of occasions the ECB was worried about second-round effects of changes in headline inflation driven by rising oil prices on wages and underlying inflation. This was, for example, the case for the interest rate increases in 2008 and 2011.

Next we test whether the ECB responded more aggressively to positive deviations of projected inflation from its inflation aim than to negative deviations. The fourth column of Table 1 shows that the relevant coefficient is not significantly different from zero. However, when we interact both inflation and output terms with a dummy when positive, we get the interesting finding that the coefficient is large, positive and significant when inflation is above target, but insignificant otherwise, whereas we have the opposite for growth: It is large and significant when growth is below potential and insignificant when growth is above potential. So, over the sample period the ECB seems to ease policy mainly in response to expected growth slowdowns and tighten policy mainly in response to inflation boosts.

Finally, we also tested whether indicators coming from the ECB's *monetary analysis* provide additional information determining the ECB's interest rate decisions. Fischer et al (2008) do not find additional explanatory power coming from the monetary analysis that is not already captured in the growth and inflation forecasts (See also Smets, 2010). This would be consistent with the idea of monetary analysis being a cross-check. It is also consistent with the argument by Orphanides (2006) that the simple policy rule can also be derived from the combination of the quantity theory of money and a money demand function and therefore already embeds an implicit role for money. The last column of Table 1 includes changes in annual credit growth as an additional explanatory variable in the interest rate rule and finds that the related coefficient is not significant and, if anything, negative. Similar results are obtained with M3 growth or other money and credit growth indicators. Of course, this does not exclude the usefulness of monetary analysis as a cross-checking device (see Beck and Wieland, 2008,2010).

3.3. Reviewing the ECB's non-standard monetary policy measures

Classifying the ECB's non-standard policy measures

Table 2 (to be done) gives an overview of the non-standard monetary policy measures the ECB has taken since 2007.³² These measures can be divided into four categories: i) reverse lending operations with the ECB's counterparties, i.e. euro area monetary and financial institutions; ii) outright asset purchases of both private and public sector securities; iii) negative interest rates; and iv) forward guidance, i.e. enhanced communication about future policy actions.³³

Broadly speaking the use of the non-standard measures served two purposes. First, some of the measures complemented standard reductions in policy-controlled interest rates in the presence of impairments in the monetary policy transmission. In a financial crisis it may be optimal to address the rise in funding and financing costs arising from malfunctioning financial markets through direct market interventions or lending operations, rather than try to offset them through a reduction in policy-controlled interest rates. Second, other measures were substitutes for standard policy: they provided additional stimulus in the presence of limited room for further standard interest rate easing close to the zero lower bound.

A number of observations are worth making regarding these two purposes. First, in the early stages of the financial crisis when short-term interest rates were not yet constrained by the zero lower bound, the ECB in its communication made a clear distinction - through the so-called separation principle - between standard policy which was geared at maintaining price stability and non-standard measures that were focused on addressing malfunctioning financial markets and impairments in policy transmission. In practice the two policies of course interact and together determine the monetary policy stance, but arguably highlighting this distinction allowed the ECB to more easily take different directions in its standard and non-standard monetary policy. This was, for example, the case in 2008 and 2011, when the ECB tightened standard monetary policy while non-standard measures were still in place. One signal of the separation principle during the sovereign debt crisis was the decision to sterilise the SMP and OMT interventions.³⁴

Second, the nature of the non-standard measures will depend on which impairments are being addressed. As discussed in section 2, three stages can be distinguished. In the early stages of the financial crisis, the focus was primarily on banks' funding markets, in particular the money market and the covered bond market. In the second stage, the financial crisis turned into a sovereign debt crisis with repercussions for bank funding markets (the so-called sovereign-bank nexus) and the emergence of self-fulfilling redenomination risk. The last stage focused on the heterogeneous transmission in bank lending markets and involved funding for lending operations. An evaluation of those different non-standard measures therefore involves an assessment of whether the specific impairments were addressed.

³² See Eser et al (2012) and Alvarez et al (2017) for a detailed and comprehensive description of the Eurosystem's operational framework and its monetary policy instruments since the start of the financial crisis.

³³ The extent to which these measures can be classified as non-standard is of course debatable. For example, in the early part of the financial crisis the ECB primarily adjusted the conditions and features of its lending operations which are standard instruments of the ECB's monetary policy operational framework. Similarly, negative interest rates and forward guidance can be seen as variants of the standard setting of policy-controlled interest rates and their communication.

³⁴ The ECB conducted regular one-week Fine Tuning Operations (FTO) between May 2010 and June 2014 to absorb the liquidity effect of the SMO initiated on 10 May 2010.

Third, the non-standard measures geared at addressing impairments in the monetary transmission process are akin to classical lender of last resort policies whereby the central bank steps in to provide liquidity and avoid that market runs and self-fulfilling speculative attacks turn into solvency issues. One issue with those policies is that it is often not easy to distinguish between liquidity and solvency problems. In lending operations to MFIs this is solved by requiring collateral, often government bonds. However, in a monetary union with national fiscal policies sovereign risks may undermine the safety of such collateral and may make direct interventions in sovereign bond markets more problematic. This explains why non-standard measures to address illiquidity and self-fulfilling redenomination risks in sovereign bond markets (SMP and OMT) required conditionality ensuring the soundness of the underlying fiscal policies.

Finally, from the Table it is also clear that over time, as the euro area economy fell in a double-dip recession, more of the measures, in particular the negative DFR, the large-scale asset purchase programme (APP) and the enhanced forward guidance, served the second purpose of easing policy close to the zero lower bound.

In line with this distinction, next we review the evidence on the effectiveness of the non-standard measures.

Addressing impairments in the monetary policy transmission process

During the early stages following the outbreak of the financial crisis the non-standard measures have mostly focused on bank funding markets. Due to the fixed rate full allotment procedure, liquidity provision was primarily demand-determined during that period. The “Enhanced Credit Support” helped ease tensions in the money market as indicated by the reduction in the Euribor-OIS spreads at various maturities (Figure 13). Reichlin (2014) and Pill and Reichlin (2014) describe this period as the ECB taking a “market operation approach” to its role as lender of last resort and conclude that it contributed to the recovery of economic activity which started in the third quarter of 2009. Lenza et al (2010), Giannone et al (2012) and Peersman (2011) use a variety of counterfactual exercises to conclude that in this period the effectiveness of the ECB’s actions was not constrained by the zero lower bound and that these measures were supportive of economic activity, largely by preventing a more discontinuous and dramatic curtailment of credit provision to the real economy. A model-based analysis is done in Cahn, Matheron and Sahuc (2017). Using an estimated DSGE model with a frictional banking sector, they find that liquidity injections have played a key role in averting a major credit crunch. A counterfactual analysis suggests that, absent these non-conventional measures, output, consumption, investment and the GDP deflator would have been 2.5%, 0.5%, 9.7% and 0.5% lower on average over 2009 respectively. See also Quint and Tristani (2007).

Part of the “Enhanced Credit Support” policy was the first Covered Bond Purchases Programme (CBPP1). Purchases of 60 bn were made from July 2009 till June 2010, distributed across the euro area in both primary and secondary markets. Beirne et al (2012) discuss the modalities and the impact of the first CBPP and find that it has contributed to i) a decline in money market term rates, ii) an easing of funding conditions for credit institutions and enterprises, iii) encouraging credit institutions to maintain and expand their lending to clients, and iv) improving market liquidity. A second and a third instalment of the CBPP were decided respectively in October 2011 in the context of the intensification of the sovereign debt crisis which again impacted bank’s funding conditions

and in September 2014 as part of the comprehensive easing package to fight risks of deflation starting in June 2014.

The Security Markets Programme (SMP) was introduced to address malfunctioning sovereign bond markets following the outbreak of the sovereign debt crisis, in particular in Greece, Portugal and Ireland, which suffered from illiquidity and which was deemed to threaten monetary policy transmission. Interventions faded out in the relatively stable first half of 2011, but as the sovereign debt crisis negatively affected Italy and Spain in July 2011 a reactivation of the SMP was announced on 7 August 2011. The SMP ran until the end of December 2012 and reached an outstanding nominal amount of around 218bn, although the volumes were not announced ex ante. Various authors have assessed the impact of the SMP on sovereign bond yields. The SMP interventions succeeded in reducing yields and volatility of government bond segments of the countries under the programme. Using a counterfactual exercise, Ghysels et al (2017) find that purchases of Italian and Spanish bonds lowered two-year yields by 320 and 180 bps respectively, and ten-year yields by 230 bps for both countries. Similarly, Eser and Schwaab (2016) find a significant impact of the SMP on the yields of those securities purchased. Their baseline model suggests that, on average, a daily SMP intervention of EUR 100 million lowered yields by 0.1 to 2 bps. This impact is stronger in markets which are smaller, less liquid, and where risk premia are higher. See also Trebesch and Zettelmeyer (2016) and De Pooter et al (2018).

Nevertheless, the SMP was not able to stem the rising redenomination risk. Pill and Reichlin (2014) point to three reasons why the SMP did not succeed in stemming the rise in sovereign spreads. First, the SMP actions were characterised as limited and temporary, which undermined market confidence that the ECB was prepared to offer a full backstop. Second, the ECB had conditioned its provision to Italy and Spain on certain policy commitments which threatened the political feasibility of the support. Third, there were concerns about the subordination of private sector bond holders. Bolder ECB action became possible after European governments had started to strengthen fiscal governance, provided a back-stop for governments in the form of the ESM and decided to create a banking union with common supervision and resolution. Following the famous “whatever it takes” speech of President Draghi, the ECB announced its readiness to undertake ex-ante unlimited Outright Monetary Transactions (OMTs) in euro area secondary sovereign bond markets, subject to countries complying with conditionality.³⁵ Although so far OMTs have not been activated, the announcement was instrumental in addressing excessive risk premia and improving financial market confidence as shown in Figure 13. The success of the OMT was dependent on a number of features: a strict and effective conditionality attached to an appropriate EFSF/ESM programme, a focus on the shorter segment of the yield curve, no ex-ante quantitative limits on size and pari-passu treatment. The conditionality was key for preserving the appropriate incentives for fiscal discipline and monetary dominance as well as to ensure proper risk management by the central bank. Using high-frequency data, Altavilla et al (2016) find that OMT announcements decreased the Italian and Spanish two-year government bond yields by about 2 pp, while leaving the bond yields in Germany and France unchanged. Using a multi-country VAR model, they also find that the reduction in bond yields due to the OMT was associated with a significant increase in real activity, credit and prices in Italy and Spain, with some positive spillovers in France and Germany. See also Krishnamurthy et al (2017) and Szczerbowicz, U. et al (2015) for additional evidence on the financial market effects.

³⁵ The technical features of the OMTs are in ECB (2012).

Using evidence from SAFE, Ferrando et al (2015) find that the ECB's OMT announcement was followed by an immediate decline in the share of credit rationed firms and firms discouraged from applying. Firms with improved outlook and credit history were particularly likely to benefit from easier credit access. Acharya et al (2018) also find positive effects of the revaluation of sovereign bond portfolios due to OMT on bank lending. They argue though that a significant fraction of this lending went to zombie firms.

As part of the attempt to stop the doom loop, the ECB also conducted two 3-year Very Long Term Refinancing Operations (VLTROs) in December 2011 and February 2012. A combined gross amount of more than a trillion euros was allotted, giving banks funding uncertainty, easing redemption of maturing bonds and helping to sustain credit lines with households and firms. Darracq-Paries and De Santis (2015) show that the VLTROs increased real output and lending to NFCs over a two to three-year horizon (See also Garcia-Posada and Marchetti (2016) for evidence in Spain and Szczerbowicz (2015)). Sjasova, Mendicino and Supera (2018) use micro-economic bank-firm level data for Portugal to show that the lengthening of bank debt maturity had a positive and economically sizable impact on bank lending. A one standard deviation increase in bank exposure to the reduction in roll-over risk is associated with a 5.3 percent increase in both existing and new lending. The effects are stronger on the supply of credit to smaller, younger and riskier firms. However, they also show that unrestricted liquidity provision provided incentives to banks to purchase more government securities, partly offsetting the positive effects on lending. Crosignani et al (2017) find that the VLTROs induced Portuguese banks to purchase short-term domestic government bonds and pledge them to obtain central bank liquidity (See also Acharya and Steffen, 2015 and Van Bakkum et al, 2018)

Turning to the funding for lending policies, it is difficult to disentangle the effects of the TLTROs from the other measures that were part of the comprehensive easing package that started in June 2014 and which also included negative rates and asset purchases.³⁶ ECB (2015) shows that the rates on loans to NFCs declined markedly immediately after the announcement of the first series of TLTROs. The declines were sharper in countries where the composite lending rates to NFCs had been more elevated. Moreover, in vulnerable countries, banks that borrowed under TLTRO-I reduced their rates by more than banks that abstained from bidding. Altavilla et al (2016) explicitly analyse developments over time in the pass-through of monetary policy measures on bank lending rates and find that after 2014 the non-standard policy measures (including the TLTROs) significantly normalised the capacity of banks to grant loans and reduced the cross-sectional dispersion of interest rate pass-through.

Providing additional stimulus at the effective lower bound

As the policy controlled interest rates were increasingly constrained by the effective lower bound in 2013, the ECB took a number of additional non-standard measures such as the expanded Asset Purchase Program (APP) and forward guidance with the aim of further lowering medium to long-term interest rates through portfolio rebalancing and signalling channels (Table 2). One way of capturing the impact of these unconventional measures is to calculate a shadow short-term interest rate as proposed by Krippner and others. A shadow rate is the shortest maturity rate extracted from

³⁶ ECB (2017) explains the features of the two TLTRO programmes as well as their impact on bank lending. See also ECB (2017a).

a term structure model that would generate the observed yield curve in the absence of a lower bound. It coincides with the policy rate in normal times and is free to go into negative territory when the policy rate is stuck at the lower bound.

Various authors have shown that the shadow rate captures the stance of monetary policy during lower bound periods in the same way the policy rate does in normal times (Claus, Claus and Krippner, 2014, Francis, Jackson and Owyang, 2014 and Van Zandweghe, 2015). They show that i) the shadow rate captures the impact of both conventional and non-conventional policy measures such as asset purchase programmes, forward guidance on interest rates and long-term refinancing operations; and ii) that the dynamic interactions between macro-economic activity and the short term rate is preserved through the shadow rate. The latter is consistent with the results in Debortoli and Gali (2017) that there has been no structural break in the macro-economic relations since the use of non-conventional measures. These authors conclude that the non-conventional tools must have had a similar impact on the macro-economy than conventional interest rate policy. Similarly, a number of VAR exercises, where unconventional monetary policy are identified through the term structure changes during a narrow window around monetary policy decisions, have shown that QE has very similar effects on the economy.³⁷ Finally, Wu and Zhang (2017) show that in a New Keynesian model for the United States the negative shadow rates are a useful summary statistic to capture the impact of unconventional policies, especially quantitative easing and lending facilities.

At the same time, it is well-known that estimates of shadow rates are quite sensitive to differences in term structure models and in particular to the assumptions made about where the effective lower bound on interest rates lies. This may in particular be an issue for the euro area where the perceived effective lower bound has changed over time as interest rates went into negative territory. Figure 27 plots several shadow rate estimates for the euro area together with the EONIA. It shows generally speaking that the shadow rates are close to the EONIA before 2012 and that unconventional measures have had an easing impact on the yield curve after 2012. While there is considerable comovement, the levels of the shadow rates are however very diverse. We therefore follow Mouabbi and Sahuc (2017) and use a common factor of the five alternative shadow rate models for the euro area as a summary statistic for the stance of monetary policy in the euro area after the second quarter of 2013. The results of this exercise are shown in Figure 28, which after 2013 compares changes in the shadow rate with the outcome of the Orphanides rule also shown in Figure 22. Broadly speaking, changes in the shadow rate capture the two periods which correspond to a slowdown in expected growth and inflation and the resulting intensification of non-standard measures taken by the ECB as discussed in Section 2 and also reflected in Table 2. In contrast, as of the end of 2017 increases in the shadow rate reflect a relative tightening of monetary policy. However, movements in the shadow rate do not capture the need for additional easing in 2013. Mouabbi and Sahuc (2017) use the shadow rates to capture monetary policy after 2013 in an estimated DSGE model for the euro area and find that without the implemented non-conventional measures year-on-year inflation and GDP growth would have been lower by 0.66% and 0.99% respectively over the period 2014Q1 to 2017Q2.

³⁷ See Bundick and Smith (2016), Swanson (2016), Rossi and Inoue (2018).

Overall, these estimates are in the same ball park of estimates by the ECB that are based on a variety of methods (Draghi, 2017; Praet, 2017 and Hutchinson and Smets, 2017).³⁸ ECB staff estimates that the monetary policy contribution of the easing package since 2014 to euro area GDP is around 1.9%, cumulatively over the period 2016-2019. In terms of inflation, absent the ECB's policy package, inflation on average, would be almost half a percentage point lower than currently projected in each year over the 2016-2019 period.

Counterfactual simulations by ECB staff estimate that the 2014 policy package has had a considerable impact on euro area financing conditions. Figure 29 shows some of the results. For example, without the ECB's measures the 10-year sovereign yield for a euro area GDP-weighted aggregate would be about 150 basis points higher and lending rates to euro area non-financial corporations (NFCs) approximately 70bps higher. The ECB's measures have also had a sizeable impact on nominal euro effective exchange rate, which would have been about 13% higher than without the measures (Altavilla, Carboni and Motto, 2015; Ambler and Rumler, 2017; De Santis, 2016). There is also emerging evidence of the portfolio rebalancing effects of the APP (Paludkiewicz, 2018).

To put this in perspective, we show the estimates from a selection of studies for the US and UK in a standardised format. A comparison is also made with the median ECB staff euro area estimates (red horizontal dashed line), which are based on a suite of models that adopt both direct and two-step approaches. While the euro area estimates are in the lower mid-range of the US estimates, they are below the estimates for UK GDP and are in the lower part of the range for inflation. See also Andrade et al (2016) and ECB (2017).

Finally, as part of the comprehensive easing programme the ECB also lowered the deposit facility rate into negative territory. Eisenschmidt and Smets (2018) review the euro area experience with negative rates and the related literature. They document the pass-through of negative policy rates on bank deposit and lending rates as well as on loan volumes in the euro area. They show that the zero lower bound constraint is binding for interest rates on household deposits held at banks. Nevertheless, the pass-through on loan rates is broadly unchanged, even at banks with high reliance on household deposit funding. The negative effect on the interest rate margin and profitability is generally offset by the positive impact of lower market rates on asset values and loan loss provisions (See Altavilla et al, 2018).

4. Conclusions

In this paper we have reviewed the ECB's monetary policy during its first 20 years of existence. Overall, the ECB has delivered on its price stability mandate despite the very challenging crisis times of the last decade. Average inflation over this period has been 1.7 percent, which is below, but close

³⁸ The approaches can be categorised into two groups: a "direct" and an indirect or "two-step" approach. In the "direct approach", models tend to be fully specified structural models such as DSGE models which incorporate mechanisms to directly allow for asset purchases to affect economic activity and inflation. Typically, these models extend the workhorse New-Keynesian model by including financial frictions so that central bank asset purchases impact on the economy. In the "two-step" approach, the first-step involves estimating off-model the impact of asset purchases on long-term yields and other financial prices. In the second-step, this is fed into a macro model which then estimates the impact on activity and inflation.

to 2 percent, although on the low side of the inflation aim of between 1.7 and 1.9 percent. This average number masks quite stable inflation around 2 percent before the outbreak of the financial turmoil and a much more volatile and on average lower inflation rate around 1.5 percent thereafter. Five-year ahead inflation expectations as captured by the Survey of Professional Forecasters (SPF) have remained close to 2 percent (between 1.8 and 2.0 percent) throughout the period, underlining the ECB's credibility. But following the sovereign debt crisis perceived deflation risks emerged and only disappeared after the ECB initiated a comprehensive easing package in June 2014 and thereby dispelled doubts about whether it had an effective tool kit to address risks of deflation in a low interest rate environment. Headline inflation is currently 2 percent (August 2018), and underlying inflation, while still subdued, is slowly converging back to close to 2 percent.

The important building blocks of the ECB's original monetary policy strategy, its quantitative definition of price stability, the two pillars of economic and monetary analysis, the communication and accountability framework and the broad-based and flexible operational framework have served the ECB well and are still in place. But, as described in this paper, they have evolved in response to the challenges of the time. As initial doubts by some observers about the ECB's anti-inflation credibility turned early on into fears of deflation, the quantitative inflation aim was clarified as being close to 2 percent, providing a buffer against the zero-lower bound. As indicated by the analysis of the ECB's interest rate reaction function in section 2.2, the economic analysis and the quarterly macro-economic projections in particular formed the basis for the monthly monetary policy decisions throughout this period. The monetary analysis provided a cross-check and evolved from a narrow focus on a reference value for M3 growth based on the quantity theory of money, which was useful in the transition period to borrow the Bundesbank's medium-term stability-oriented credibility, to a broad-based assessment of financial intermediation and bank lending in the euro area economy. This broad-based analysis was useful to detect the building up of financial imbalances before the crisis and thereafter helped assessing the impairments in the transmission mechanism of monetary policy and the effectiveness of some of the non-standard measures.

Also the communication and accountability framework adjusted as the need for additional communication in a complex policy environment rose and forward guidance became an essential tool for easing policy in a low interest rate environment. Finally, the ECB's operational framework – which we do not fully review in this paper – was very well suited to provide ample liquidity to its wide set of counterparts and against a wide set of collateral when the money market froze, thereby addressing financial market fragmentation and contributing to financial stability. But when the zero-lower bound became more and more a constraint after the sovereign debt crisis, the ECB needed to expand its tool set with other unconventional measures such as quantitative easing, funding for lending policies, negative interest rates and forward guidance to provide additional monetary stimulus and ensure the maintenance of medium-term price stability.

Overall, the ECB adjusted its framework to the changing and challenging circumstances over time, while maintaining a clear focus on its primary mandate of price stability in the medium term. As a consequence it moved from a “narrow central bank” to one that now incorporates a broad set of tools. The ECB was also assigned new supervisory responsibilities and a greater contributing role to financial stability matters, confirming the historical regularity that as soon as significant financial instability strikes, central banks are crucial players in restoring the stability of the financial system. As a result, the ECB now resembles more closely many of its peers.

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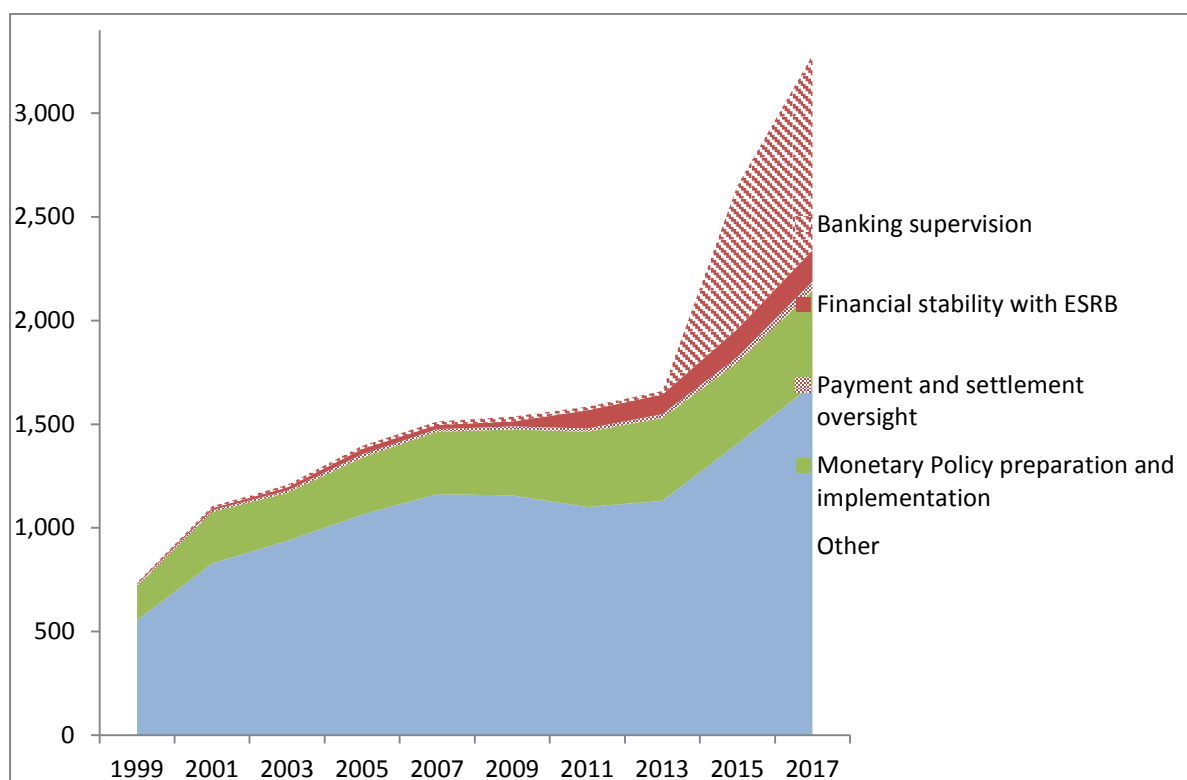
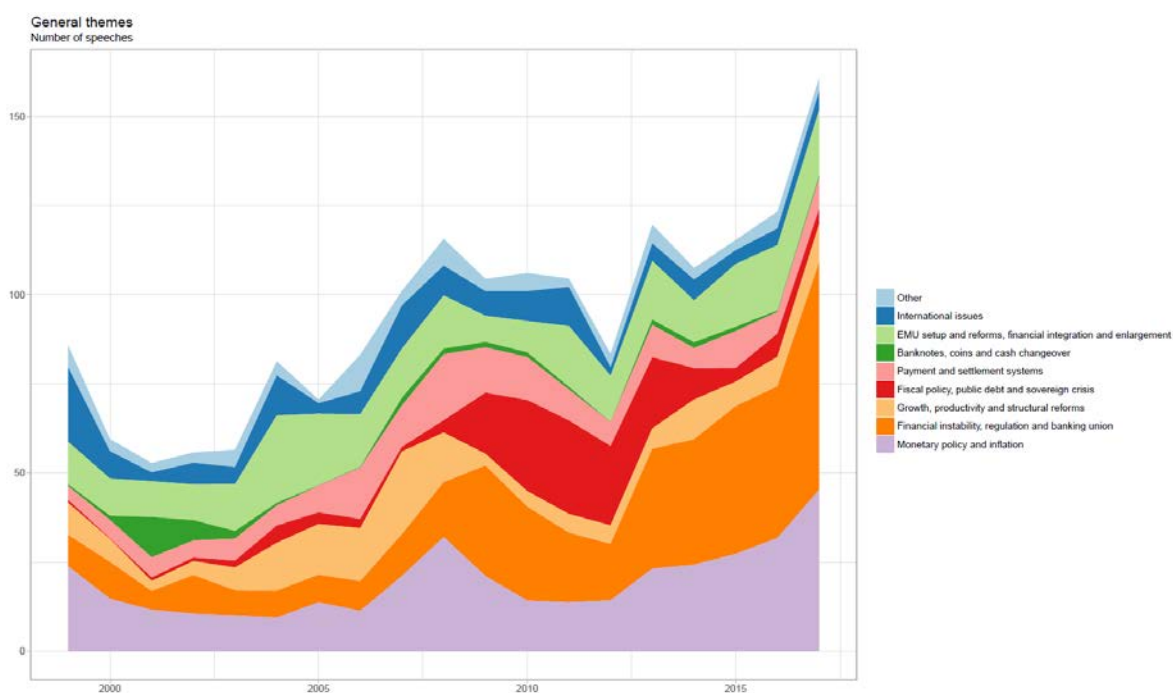
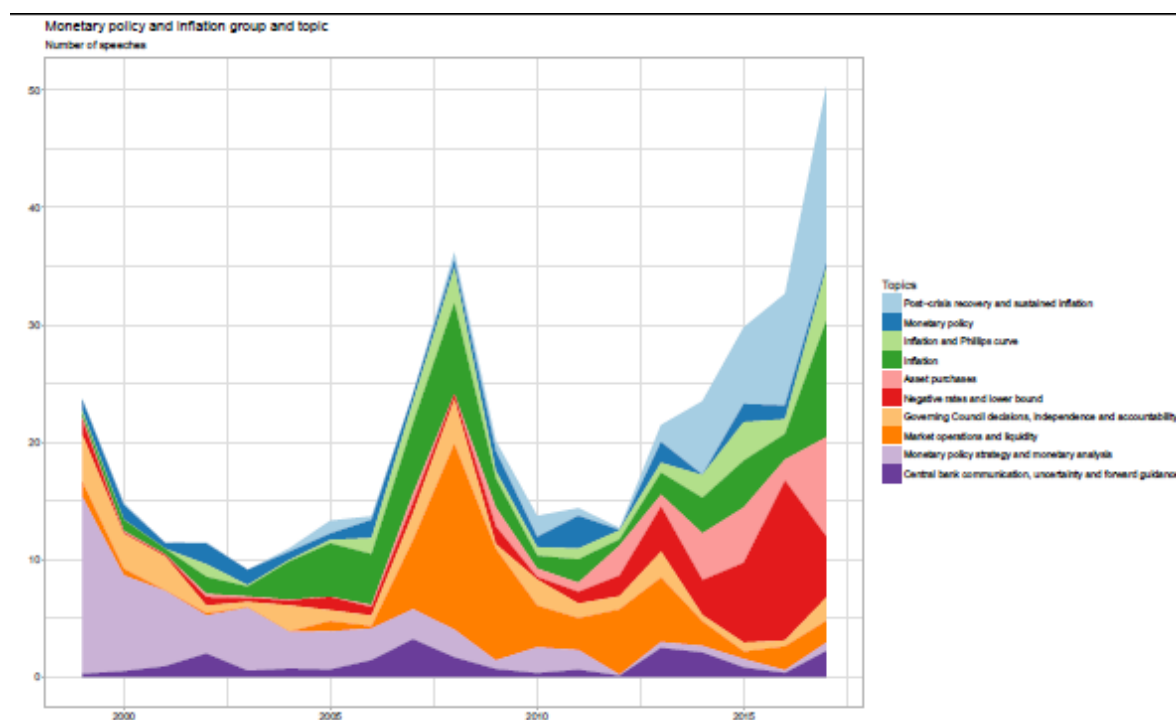
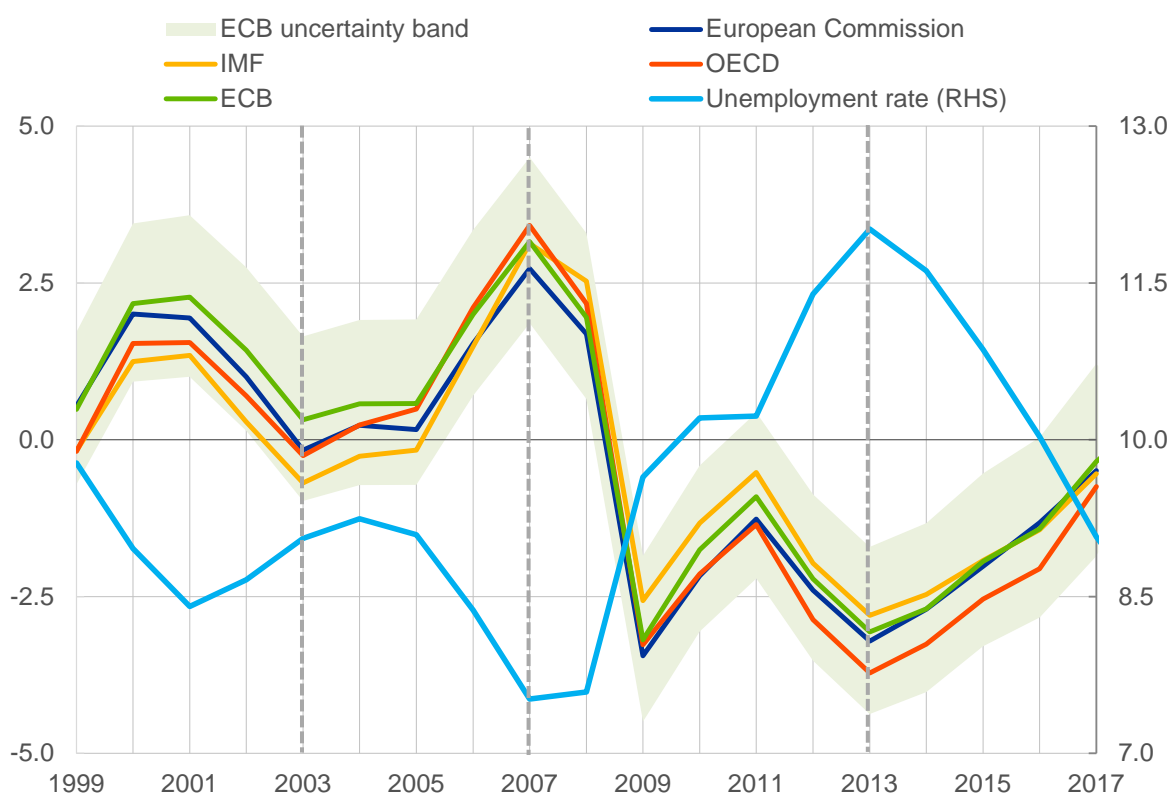
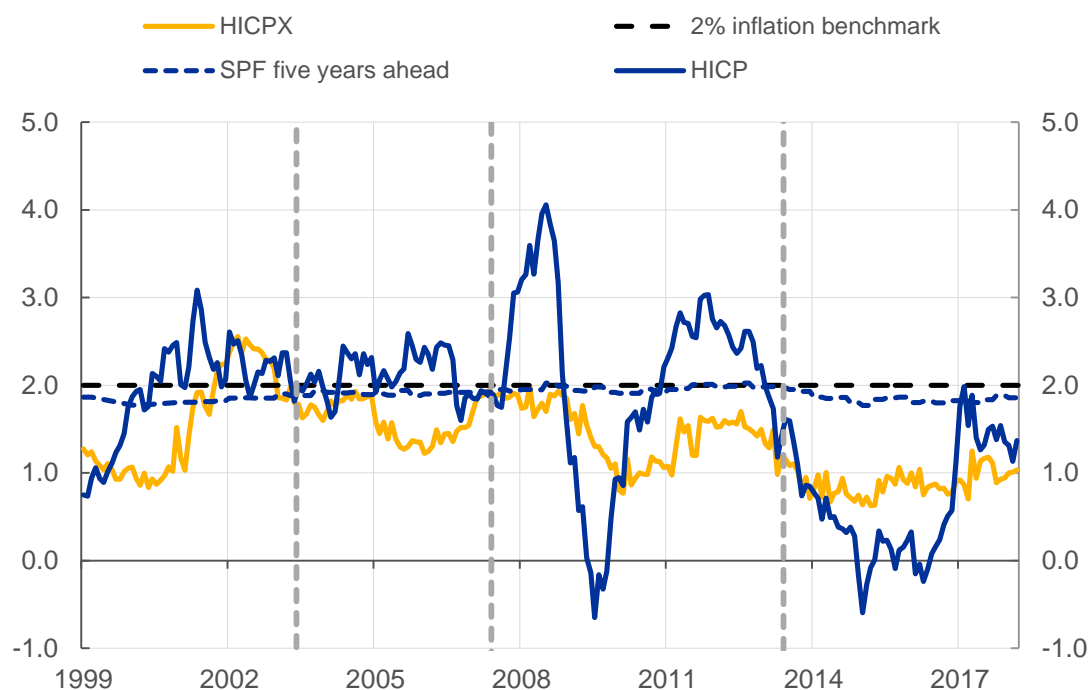
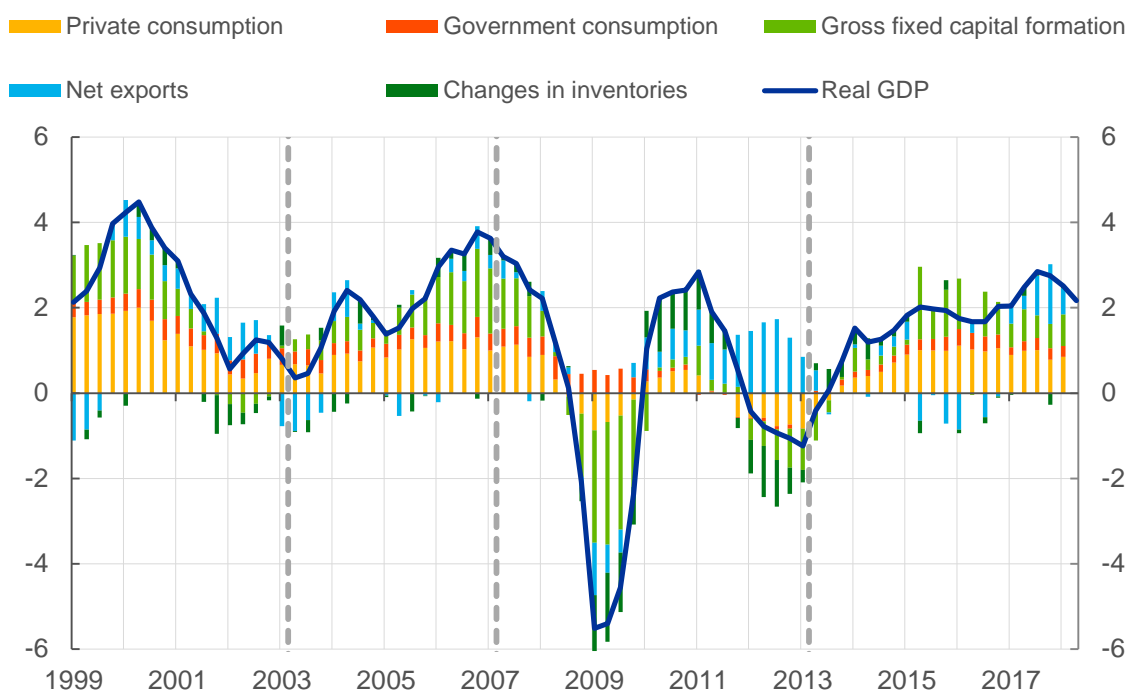
Figure 1: Composition of ECB human resources (number of employees)**Figure 2: Speeches by ECB Executive Board members (Decomposition in general themes)**

Figure 3: Monetary policy related speeches by EB members (textual analysis)**Figure 4: Output gap estimates and unemployment rate**

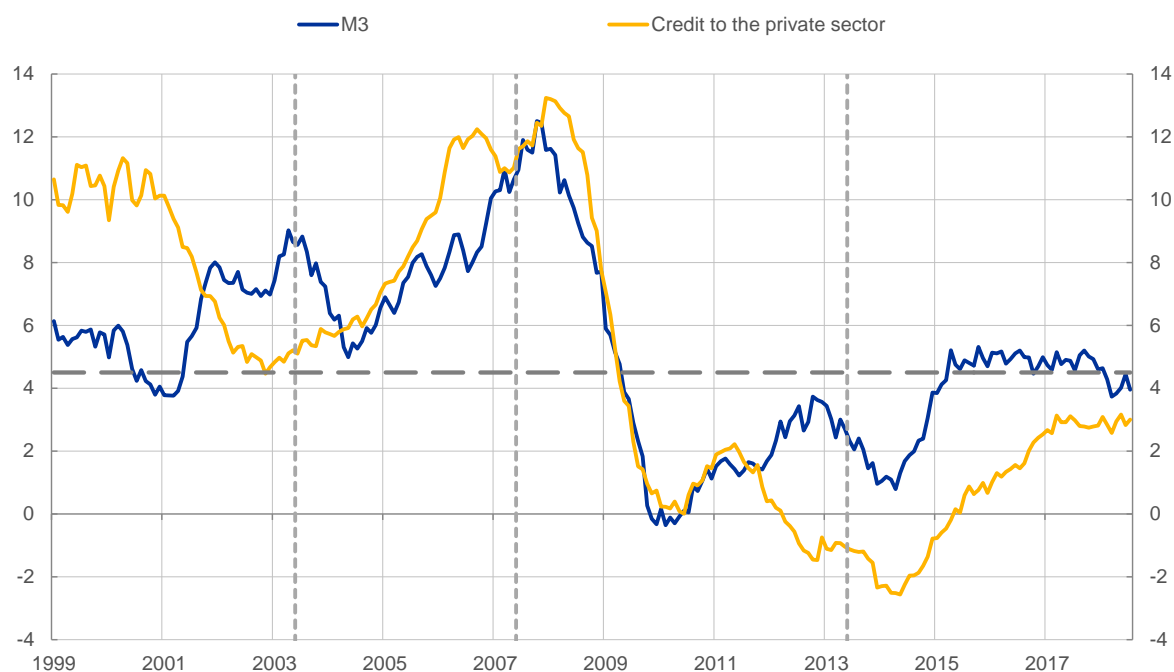
Sources: European Commission 2018 Spring forecast; IMF WEO 2018 April; OECD Economic Outlook 2018 May; ECB output gap follows Szörfi, B. and Tóth, M. (2018): Measures of slack in the euro area, Economic Bulletin, Issue 3, ECB. The uncertainty band refers only to the ECB output gap.

Figure 5: Headline and core inflation and longer-term inflation expectations

Source: ECB and survey of professional forecasters (SPF).
 Latest observation: 31 March 2017

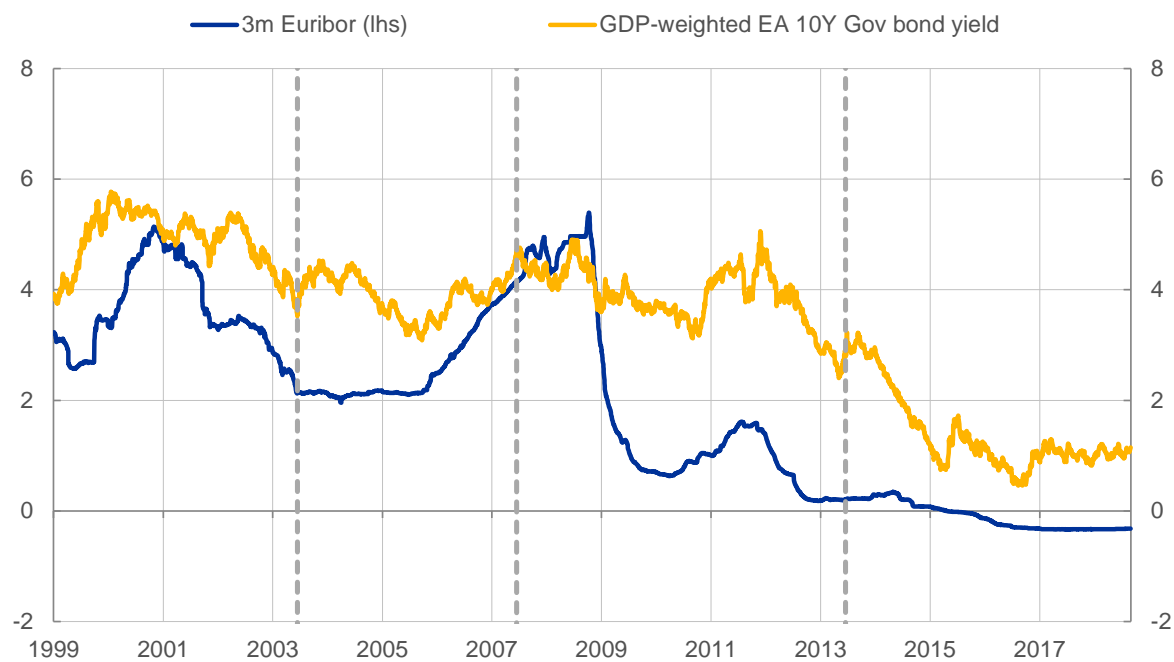
Figure 6: Real GDP growth and its components

Source: ECB
 Note: Euro Area 19 (fixed composition)
 Latest observation: 30 June 2018

Figure 7: Growth of M3 and MFI credit to the private sector

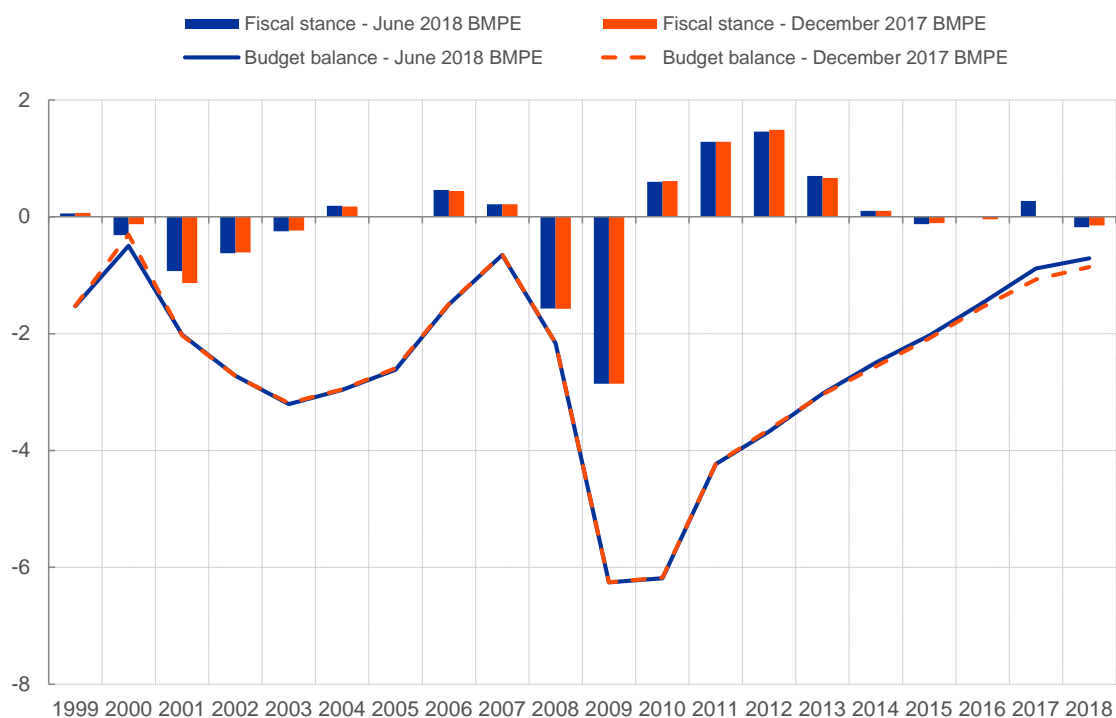
Source: ECB

Latest observation: July 2018

Figure 8: Short-term (3-months) and long-term (10-years) interest rates (1999-2018)

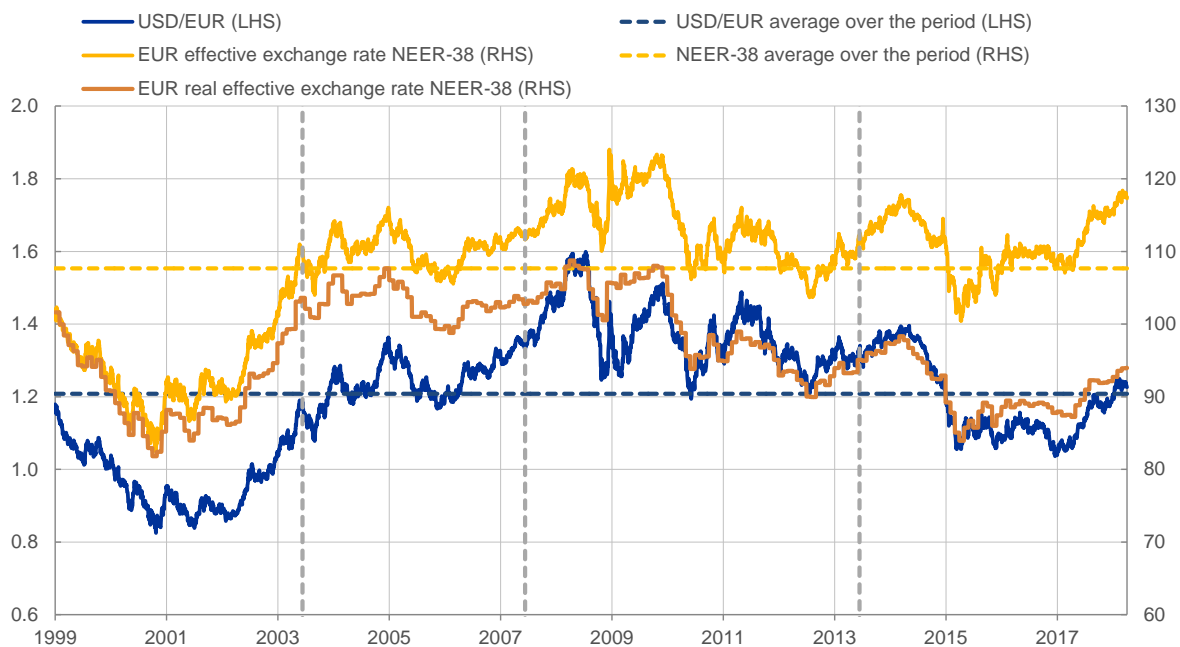
Source: ECB

Latest observation: 30 August 2018

Figure 9: Fiscal policy in the euro area (1999-2018)

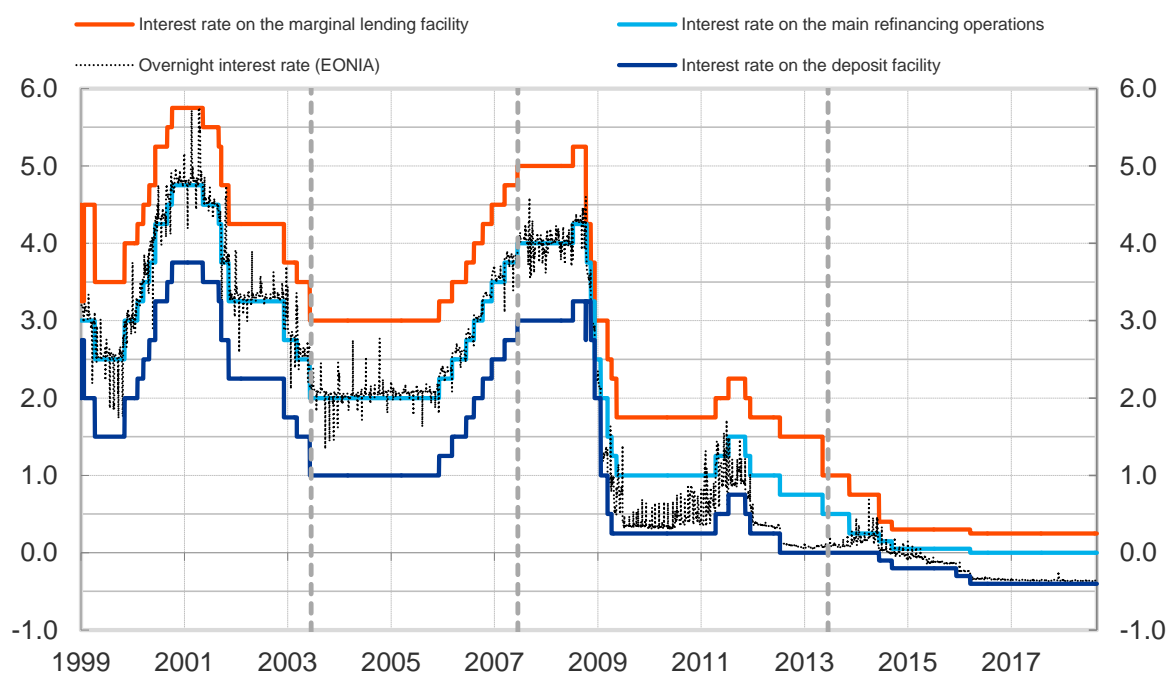
Source: ECB

Latest observation: 2018

Figure 10: Euro exchange rate against US dollar and in effective terms

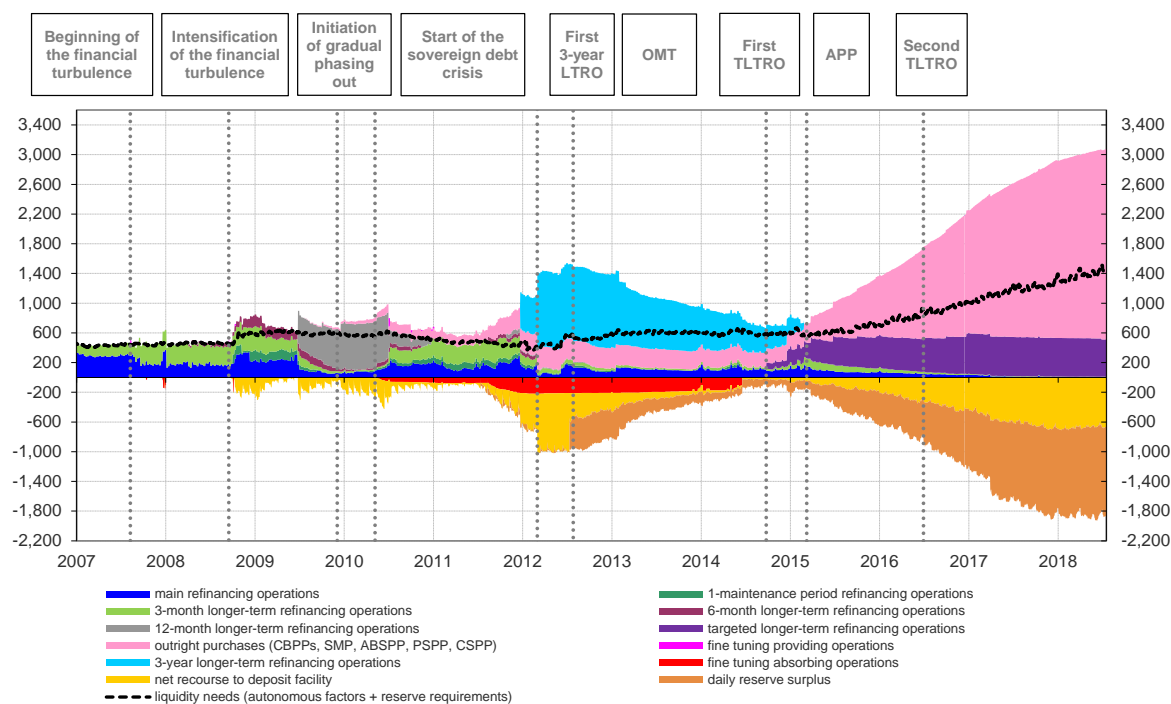
Source: ECB

Latest observation: 5 April 2018

Figure 11: Policy-controlled interest rates and the EONIA

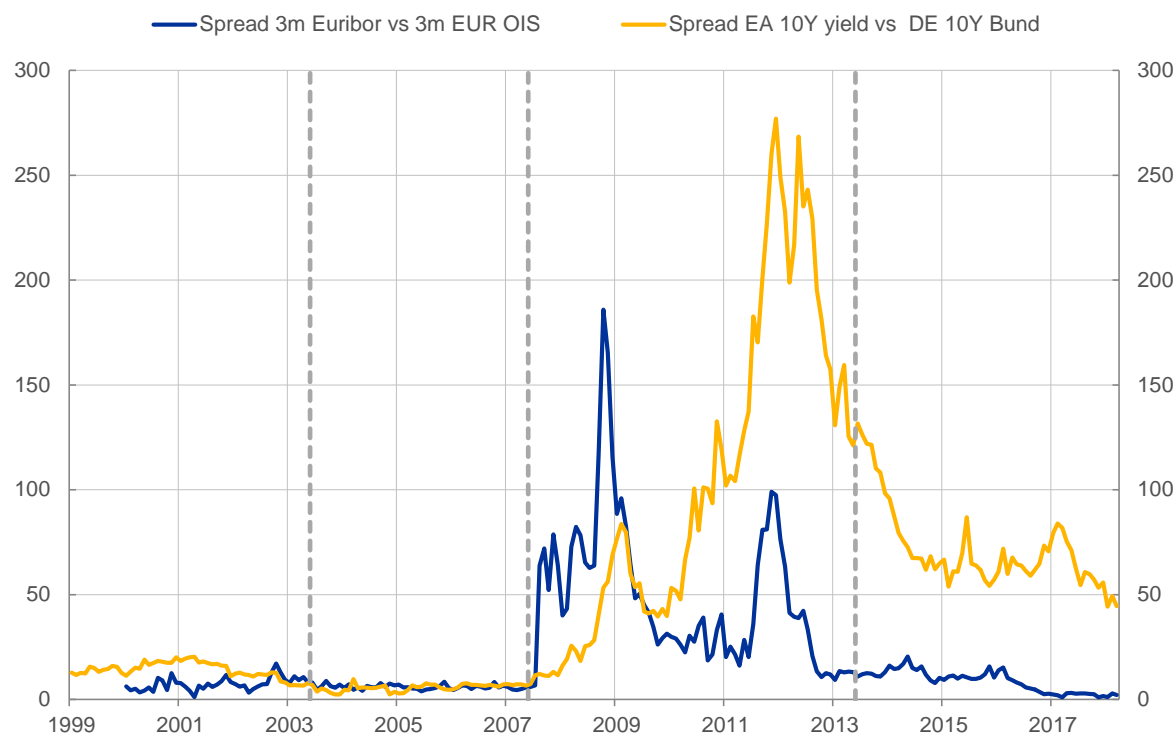
Source: ECB

Latest observation: 28 August 2018

Figure 12: Detailed balance sheet developments

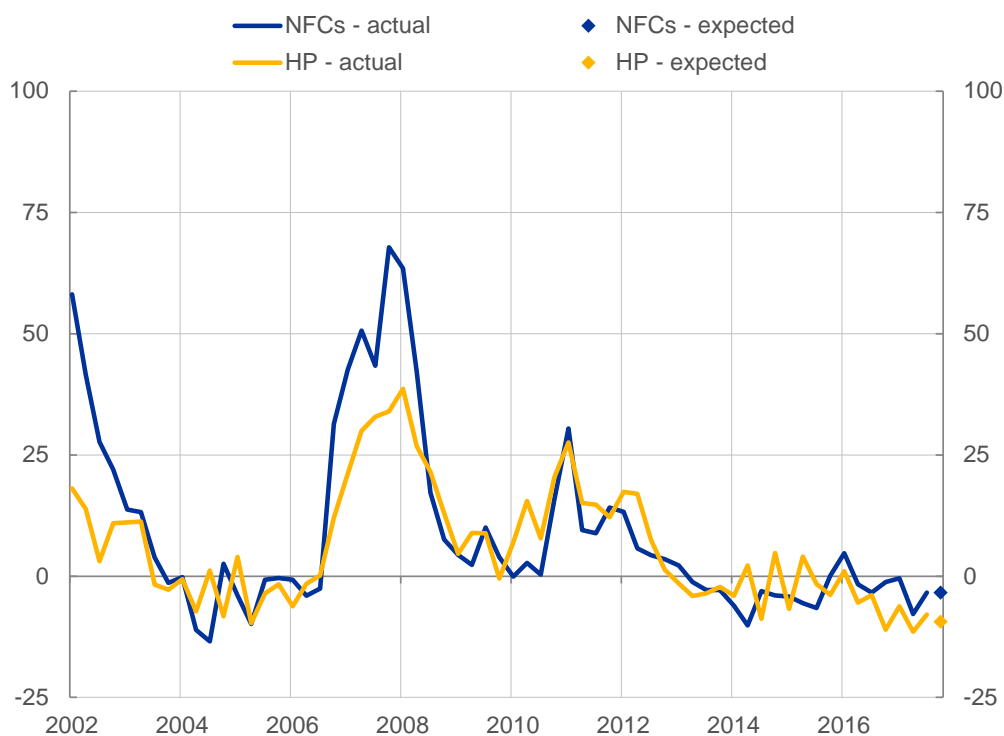
Source: ECB

Latest observation: 17 July 2018

Figure 13: Three-month OIS-Euribor and 10-year Euro-area/Bund spread

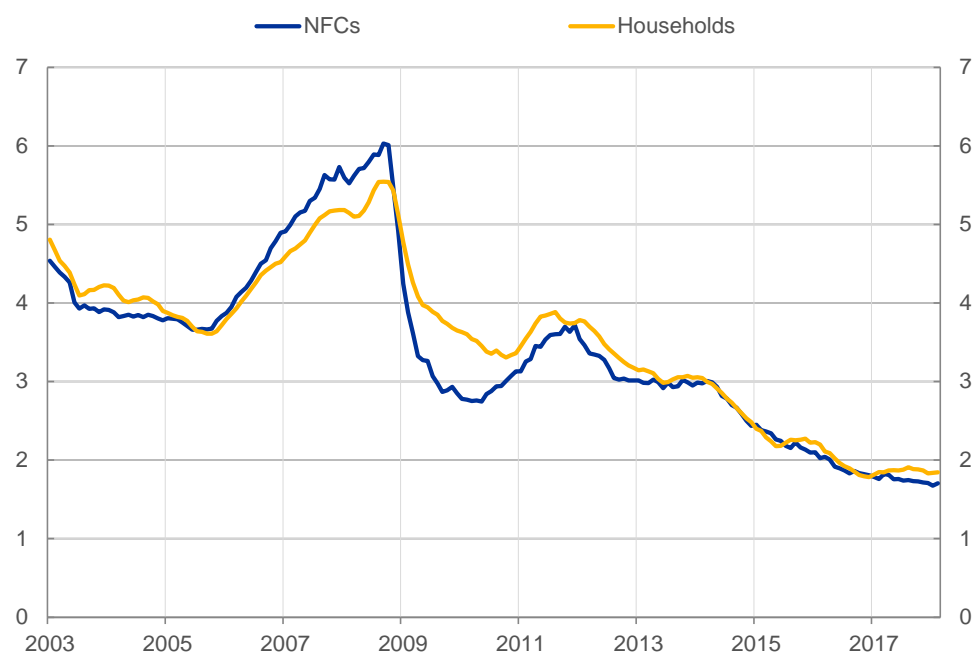
Source: ECB

Latest observation: 1 March 2018

Figure 14: Net tightening of credit standards for loans to NFCs and households for house purchase

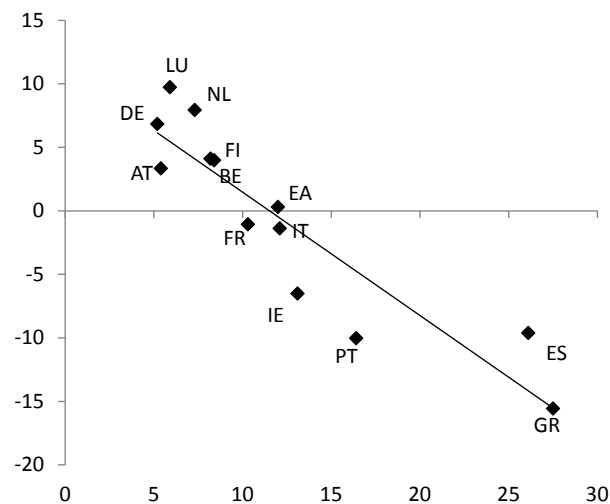
Source: ECB

Latest observation: 30 June 2018

Figure 15: Composite bank lending rates for NFCs and households in the euro area (%)

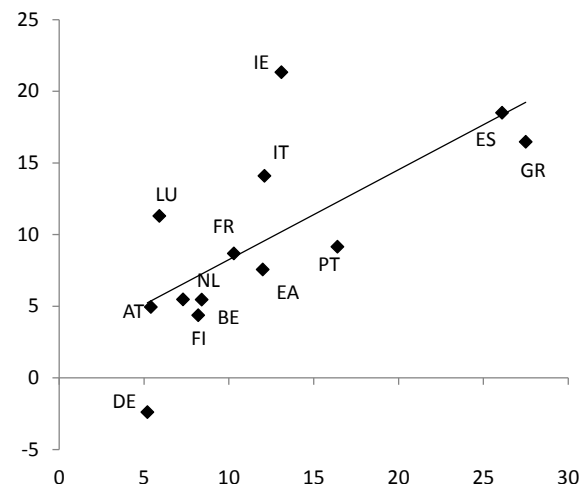
Source: ECB

Figure 16a – Current account balance (2007, in % of GDP, y-axis) and **unemployment rate** (2013, in % of labour force, x-axis)



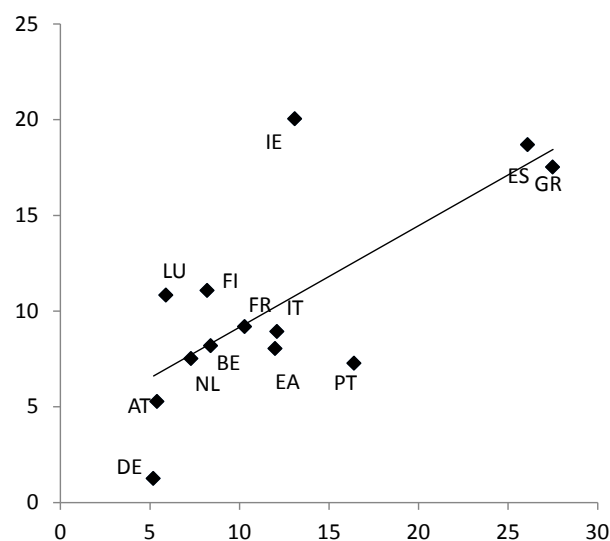
Source: Eurostat and authors' calculations

Figure 16b – Unit labour cost (cumulated growth 2002-2007, y-axis) and **unemployment rate** (2013, in % of labour force, x-axis)



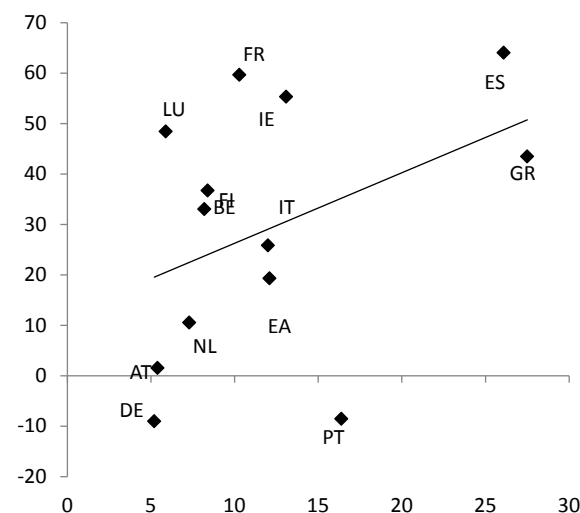
Source: Eurostat and authors' calculations

Figure 16c – Credit growth (2002-2007, in % of GDP, y-axis) and **unemployment rate** (2013, in % of labour force, x-axis)



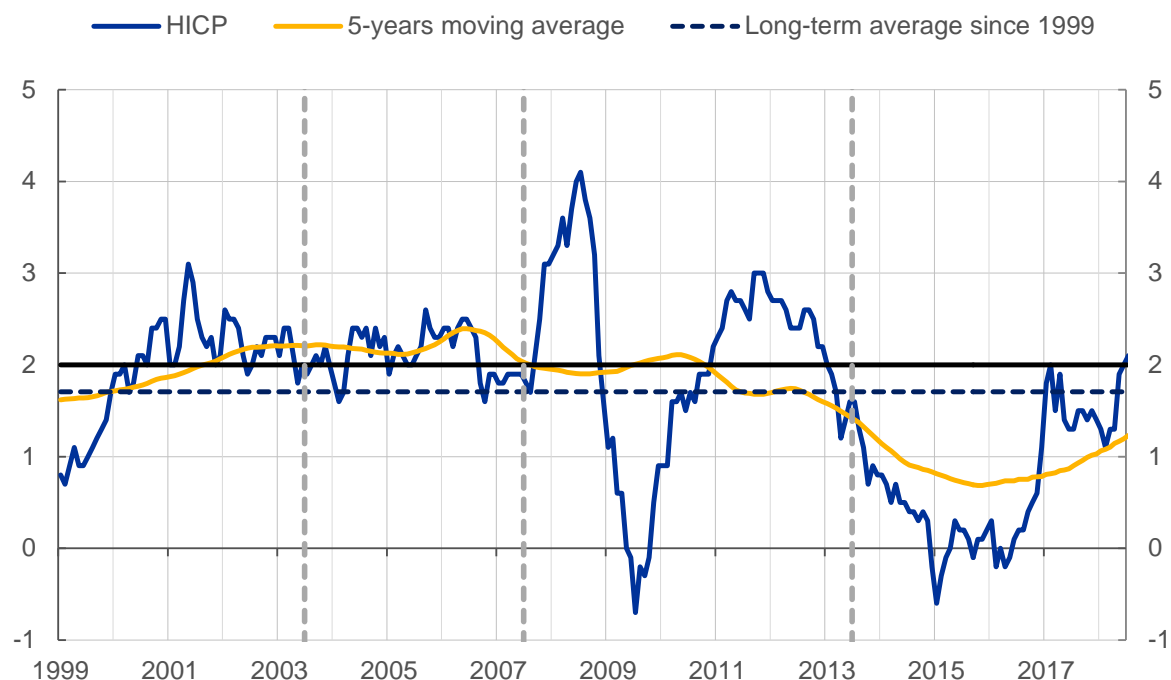
Source: Eurostat and authors' calculations

Figure 16d – House prices (cumulated growth 2002-2007, y-axis) and **unemployment rate** (2013, in % of labour force, x-axis)



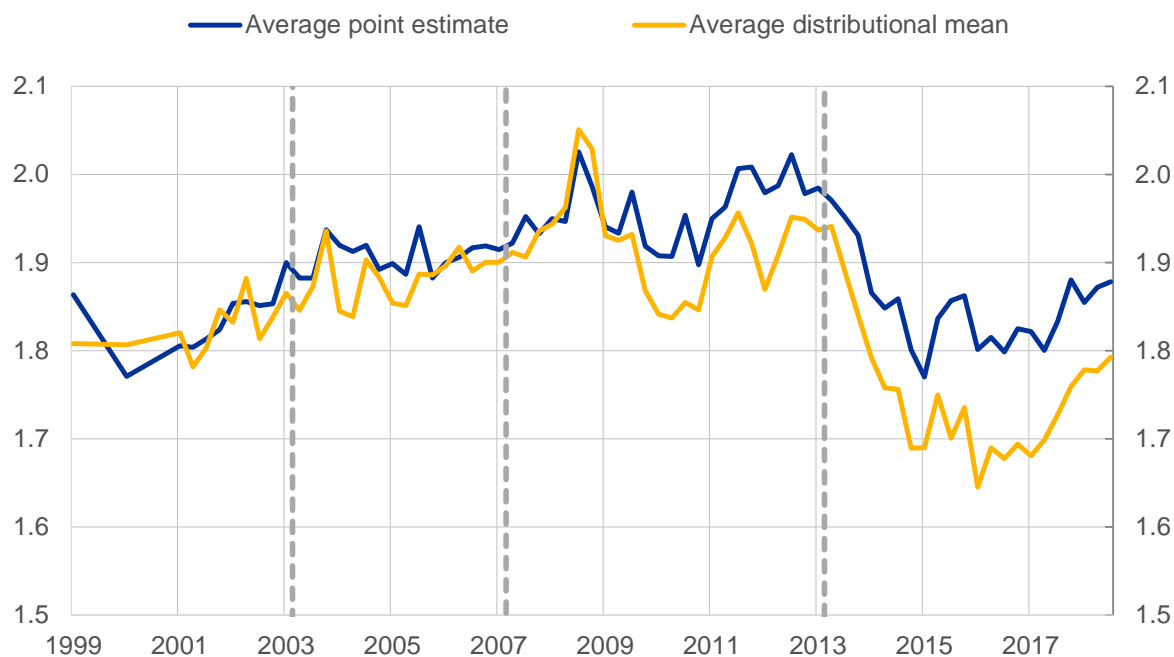
Source: Eurostat and authors' calculations

Latest observation: 1 February 2018

Figure 17: Headline inflation and a 5-year moving average

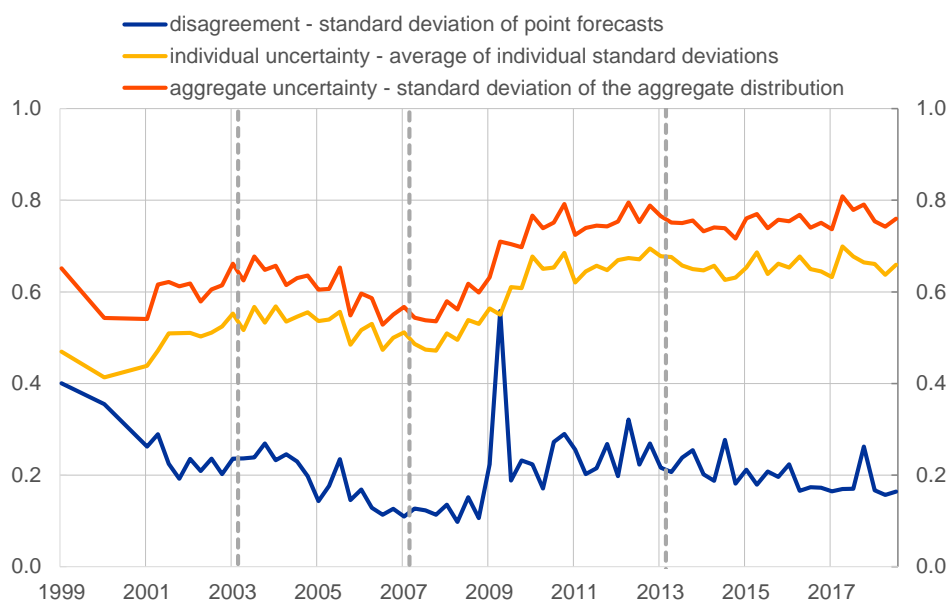
Source: ECB

Latest observation: 1 June 2018

Figure 18: Average five-year head inflation expectations in the euro area (SPF)

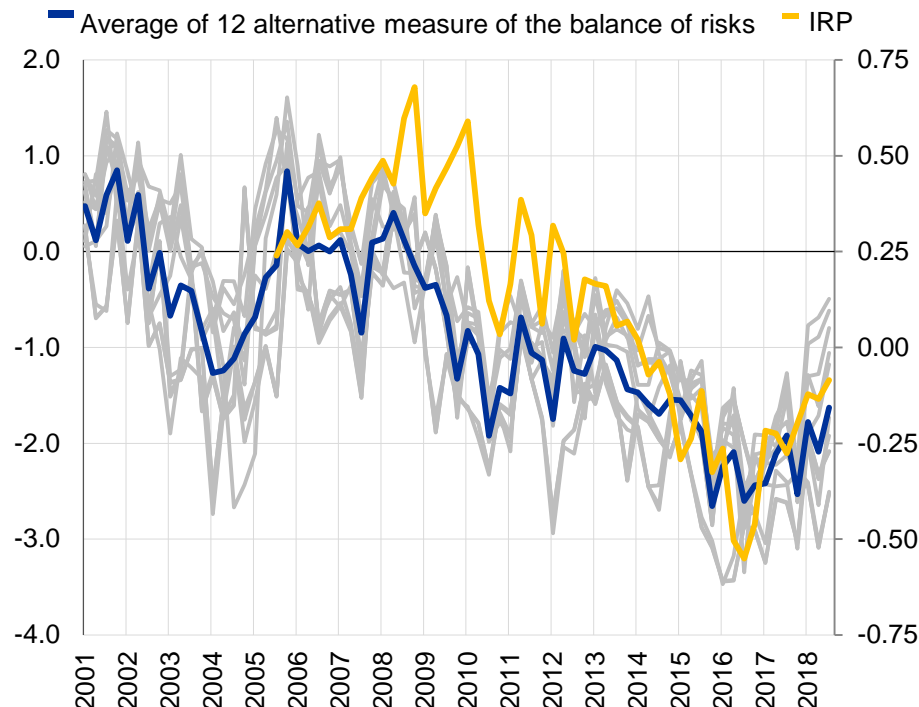
Sources: ECB and survey of professional forecasters (SPF).

Notes: 1st moment – inflation expectations. Further explanations in Box 4 of ECB Economic Bulletin, Issue 5 / 2017 “How do professional forecasters assess the risks to inflation?” Latest observation: 1 July 2018

Figure 19: Longer-term inflation uncertainty

Sources: ECB

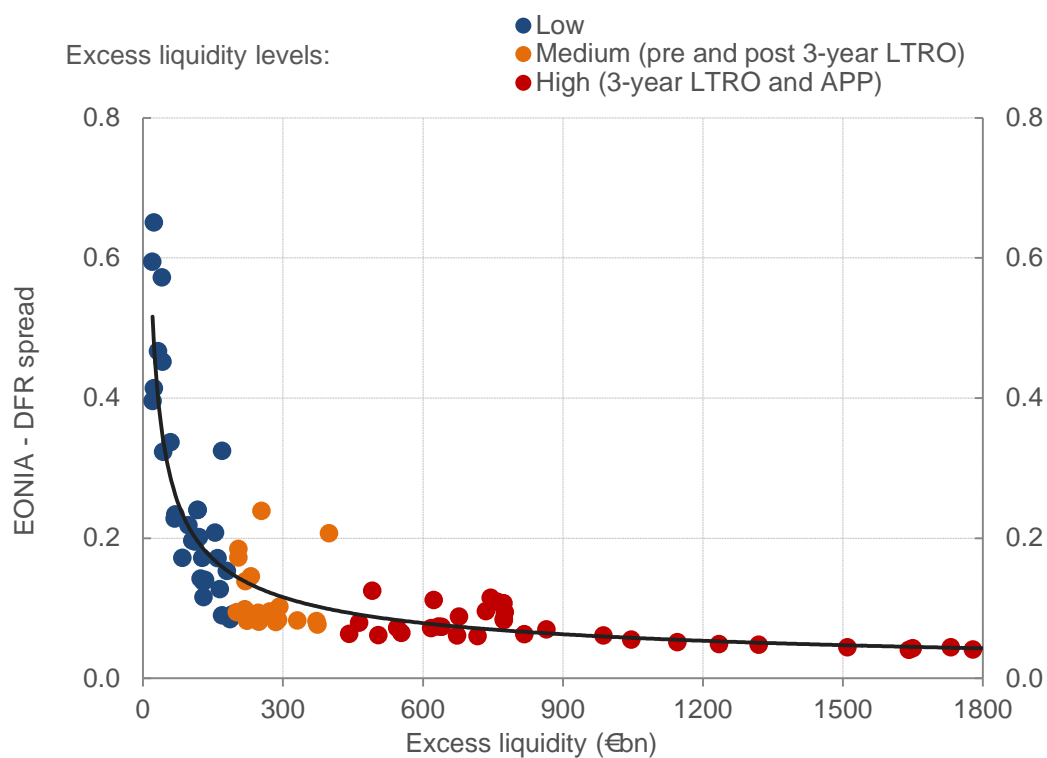
Notes: 2nd moment – inflation uncertainty. Further explanations in Box 4 of ECB Economic Bulletin, Issue 5 / 2017 “How do professional forecasters assess the risks to inflation?”. Latest observation: 1 July 2018

Figure 20: Balance of longer-term inflation risks (SPF) and inflation risk premium

Source: ECB

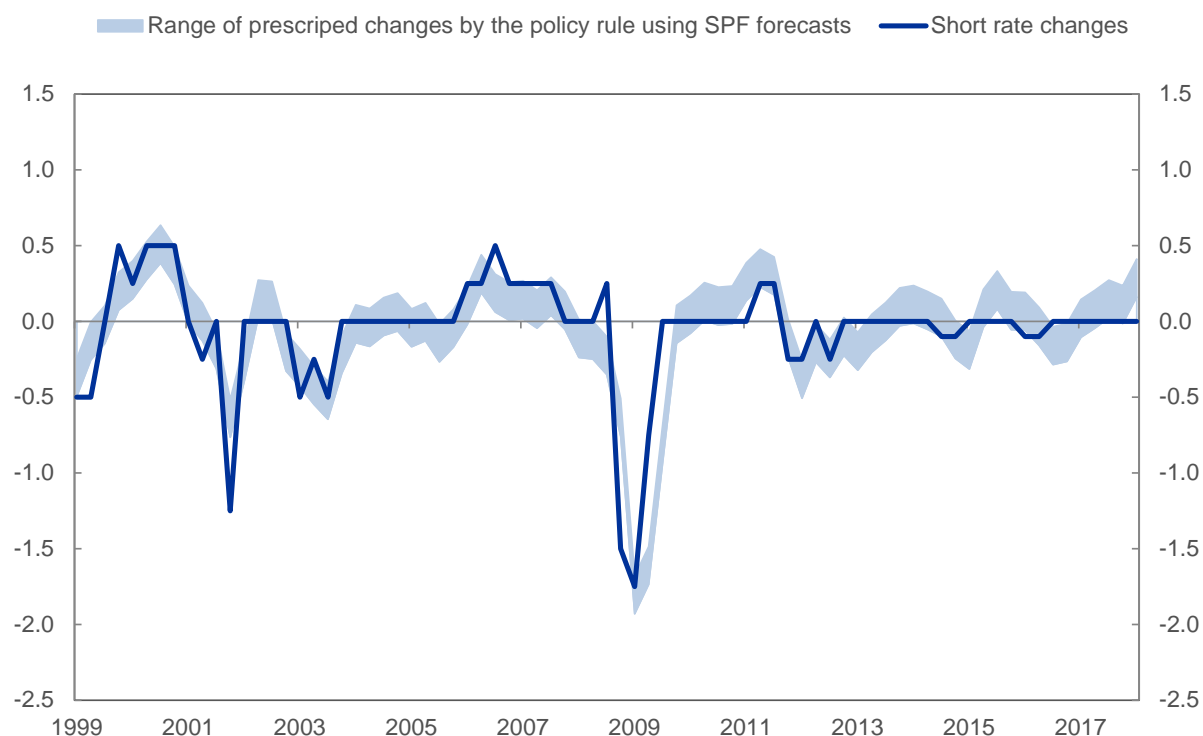
Notes: IRP refers to inflation risk premium. The IRP decomposition is based on an affine term structure model and fitted to the euro area zero-coupon inflation-linked swap curve. The estimation method follows Joslin, Singleton and Zhu (2011). For details see Camba-Méndez, G. and T. Werner, ECB Working Paper 2033 (2017). Further information in Box 4 of ECB Economic Bulletin, Issue 5 / 2017 “How do professional forecasters assess the risks to inflation?”.

Latest observation: 1 August 2018

Figure 21: Excess liquidity and EONIA-DFR differential

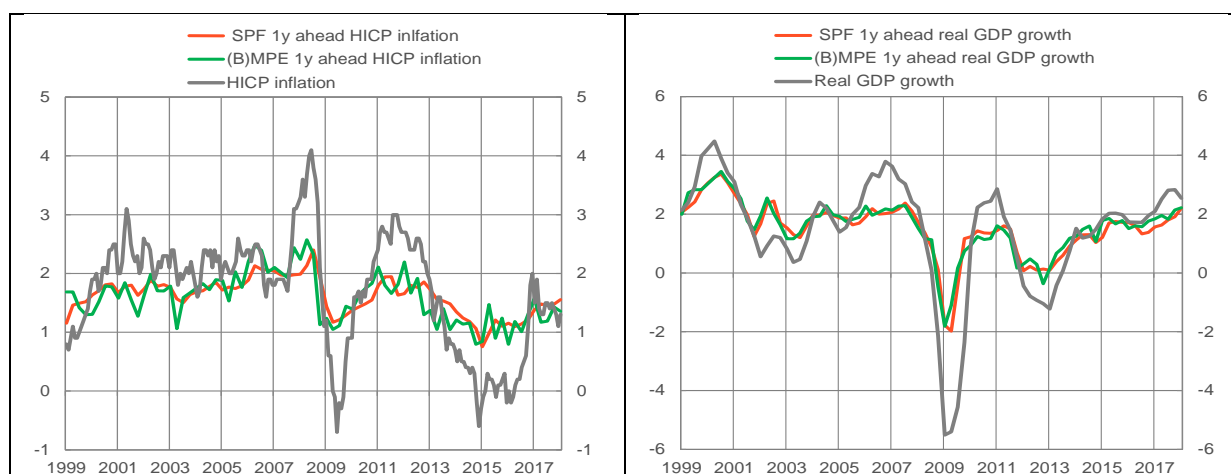
Source: ECB

Notes: each dot corresponds to the average spread between the EONIA and the DFR over each maintenance period. Low excess liquidity levels refer to excess liquidity below €bn 200 and correspond to the period before December 2011 and between the end of 3-year LTRO and the start of APP. Medium levels refer to excess liquidity between €bn 200 and €bn 400 and high levels refer to excess liquidity above €bn 400. Last observation: May 2018.

Figure 22: Orphanides rule for the euro area (with SPF as in Orphanides and Wieland, 2013)

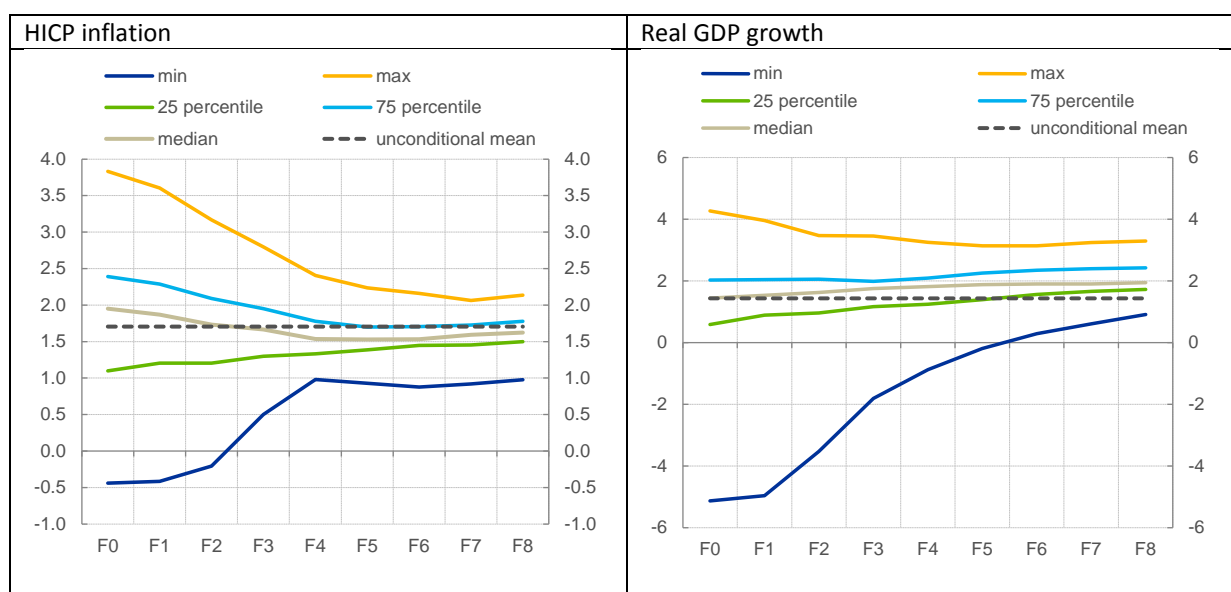
Sources: ECB, survey of professional forecasters and European Commission.

Notes: The short rate combines the time series of the change in the MRO up to 2008Q3 with the time series of the change in the DFR from 2008Q4 onwards. Latest observation: 2018Q1

Figure 23: One-year ahead forecasts for HICP inflation and real GDP growth in the euro area

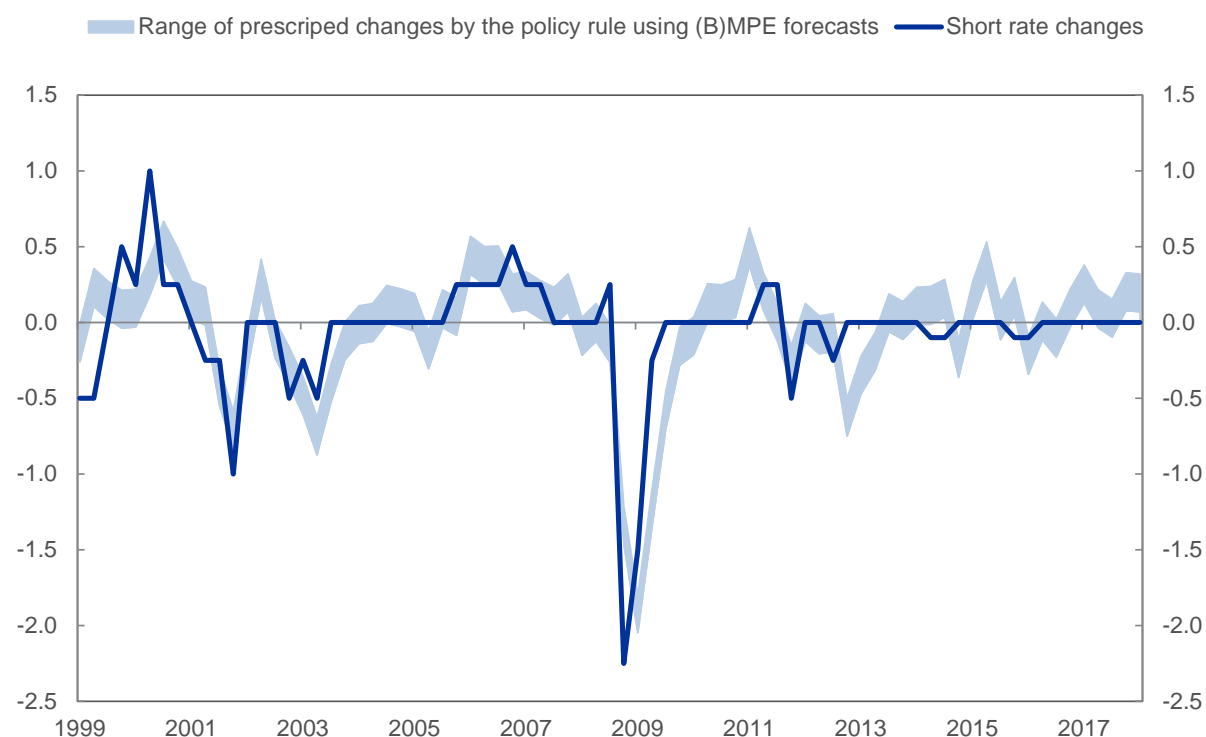
Sources: ECB, survey of professional forecasters and ECB staff projections.

Latest observation: 2018Q1

Figure 24: (B)MPE projections for year-on-year HICP inflation and real GDP growth - horizons 0 to 8

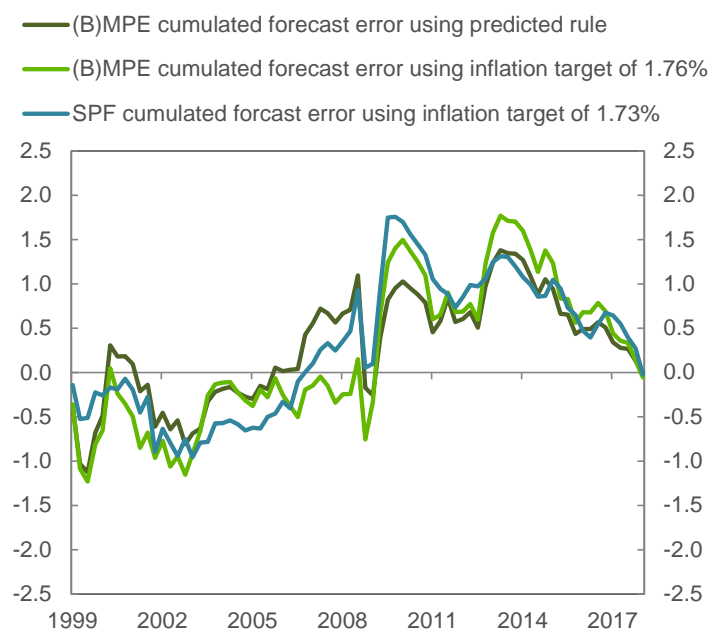
Sources: ECB, ECB staff projections.

Notes: Range of data included goes from 1999Q1 to 2018Q1 for HICP inflation and from 2000Q1 to 2018Q1 for real GDP growth

Figure 25: Orphanides rule for the euro area with (B)MPE forecasts

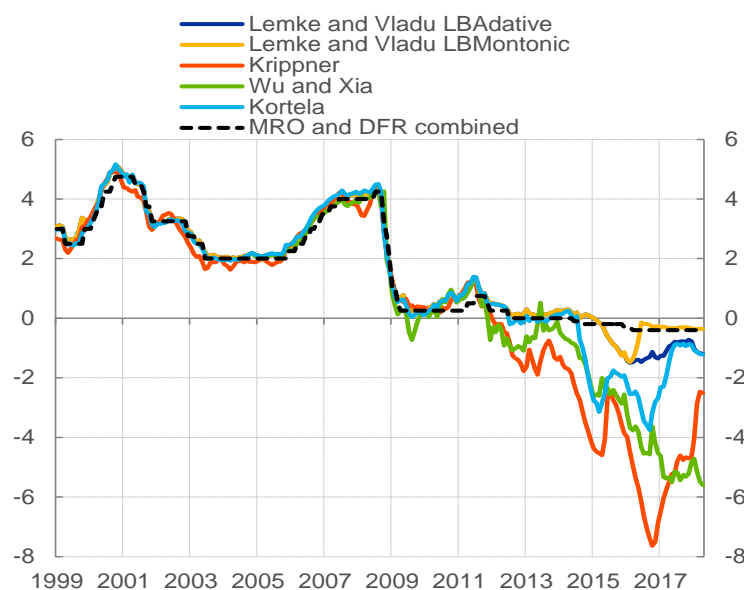
Sources: ECB, ECB staff projections and European Commission.

Notes: The short rate combines the time series of the change in the MRO up to 2008Q3 with the time series of the change in the DFR from 2008Q4 onwards. Latest observation: 2018Q1

Figure 26: Cumulative errors from the Orphanides rule for the euro area

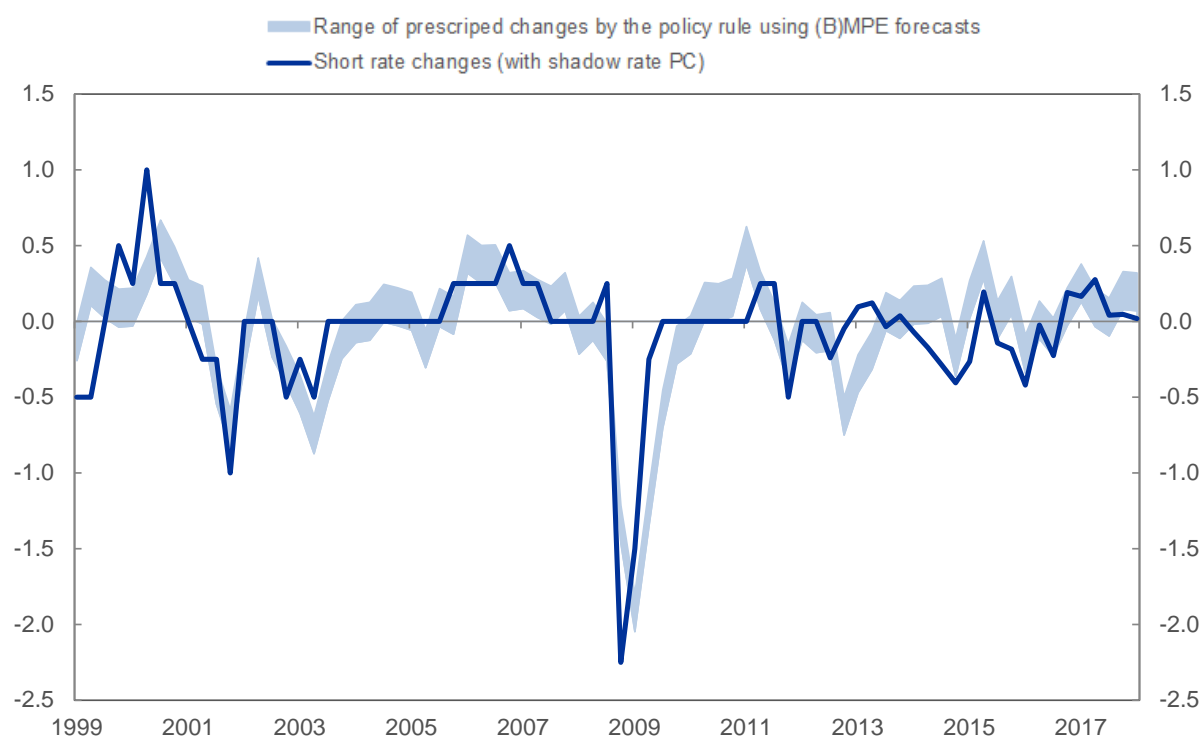
Sources: ECB, ECB staff projections and European Commission.

Latest observation: 2018Q1

Figure 27: Estimated shadow rates for the euro area

Sources: ECB; Kortela, T. (2016). "A shadow rate model with time-varying lower bound of interest rates". *Research Discussion Papers* 19/2016; Bank of Finland; Krippner, L. (2013), "Measuring the stance of monetary policy in zero lower bound environments". *Economics Letters* 118: 135–138; Lemke, W. and A. Vladu (2017), "Below the zero lower bound: a shadow-rate term structure model for the euro area", ECB Working Paper No 1991; Wu JC, Xia FD. (2017), "Time-Varying Lower Bound of Interests in Europe." *Chicago Booth Research Paper* 17-06, Chicago Booth.

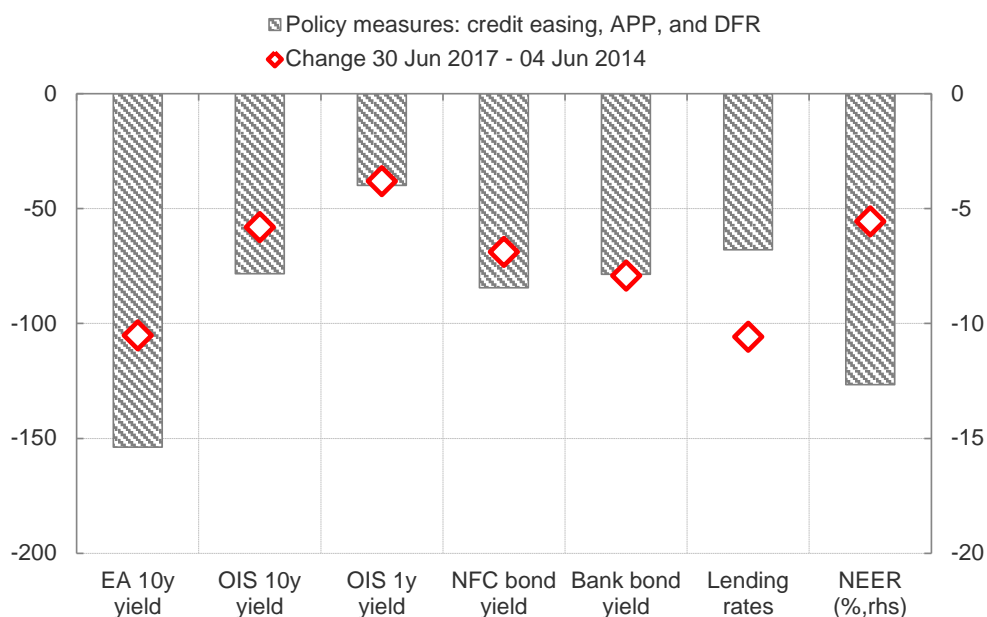
Notes: The short rate combines the time series of the change in the MRO up to 2008Q3 with the time series of the change in the DFR from 2008Q4 onwards. Last observation: March 2018

Figure 28: Orphanides rule with change in estimated shadow rate since 2013

Sources: ECB, ECB staff projections and European Commission. Krippner (2013), Kortela (2016), Lemke and Vladu (2017) and Wu and Xia (2017).

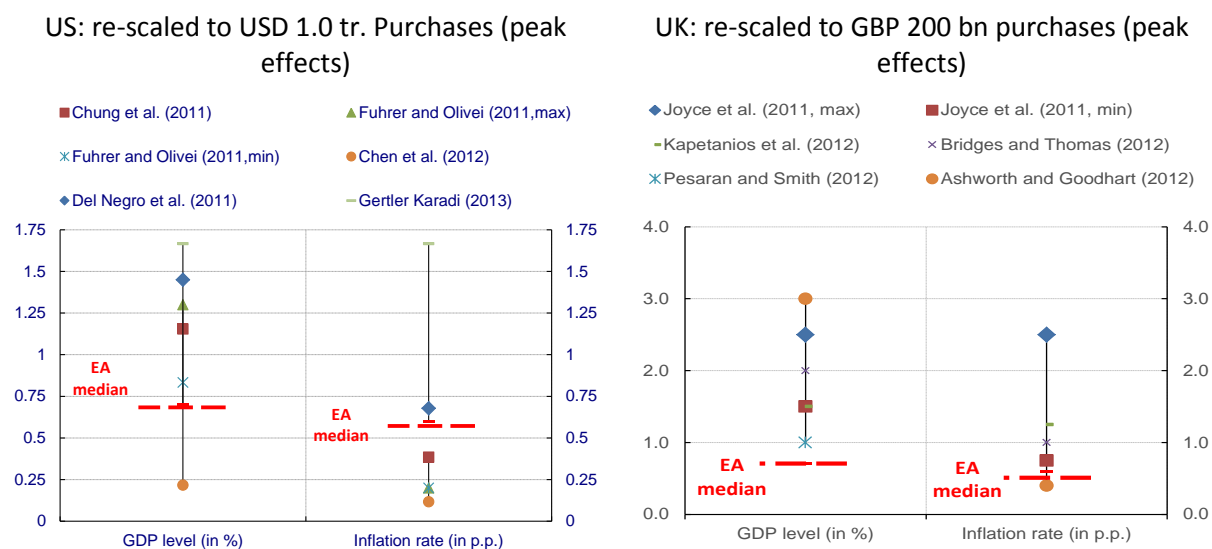
Notes: The short rate combines the time series of the change in the MRO up to 2008Q3 with the time series of the change in the DFR from 2008Q4 and the time series of the principal component of five shadow rates. Latest observation: 2018Q1

Figure 29: Key financial indicators since June 2014 and impact of policy measures
(basis points unless indicated)



Source: Bloomberg, ECB, ECB calculations.

Note: The impact of credit easing is estimated on the basis of an event-study methodology which focuses on the announcement effects of the June-September package; see the EB article "The transmission of the ECB's recent non-standard monetary policy measures" (Issue 7 / 2015). The impact of the DFR cut rests on the announcement effects of the September 2014 DFR cut. APP encompasses the effects of January 2015, December 2015, March 2016, and December 2016 measures. The January 2015 APP impact is estimated on the basis of two event-studies exercises by considering a broad set of events that, starting from September 2014, have affected market expectations about the programme; see Altavilla, Carboni, and Motto (2015) "Asset purchase programmes and financial markets: lessons from the euro area" ECB WP No 1864, and De Santis (2015), "Impact of the asset purchase programme on euro area government bond yields using market news", ECB WP No. 1939. The quantification of the impact of the December 2015 policy package on asset prices rests on a broad-based assessment comprising event studies and model-based counterfactual exercises. The impact of the March 2016 measures and the impact of the December 2016 measures are assessed via model-based counterfactual exercises. *Changes in lending rates are based on monthly data, the reference period for which is June 2014 to April 2017. Last observation: 30 June 2017.

Figure 30: Asset purchases comparison with the US and UK

Source: See studies quoted in the charts and ECB calculations.

Note: For the US, the macroeconomic impact is scaled to USD 1 tr. of asset purchases to allow for comparison across studies. Some of the studies provide the impact only for real GDP.

Table 1: Regression results Orphanides Rule

<i>Y = Short rate</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inf_BMPE	0.34*** (0.09)	0.30** (0.13)	0.20 (0.19)	0.37*** (0.14)	0.33** (0.14)	0.17 (0.13)	0.36*** (0.09)
GDP_BMPE	0.37*** (0.08)	0.43*** (0.09)	0.54*** (0.20)	0.36*** (0.08)	0.37*** (0.08)	0.52*** (0.14)	0.40*** (0.09)
Inf_SPF			0.27 (0.22)				
GDP_SPF			-0.17 (0.19)				
Core_Inf_BMPE				-0.073 (0.16)			
Pos_Inf_Dev					0.27 (0.17)	0.50*** (0.18)	
Pos_GDP_Dev						-0.46*** (0.17)	
Change_in_cred it_to_HH&NFC							-0.07 (0.07)
Inf_dev_dum					-0.10 (0.08)	-0.15** (0.07)	
GDP_dev_dum						0.02 (0.08)	
Constant	-0.62*** (0.164)	-0.52** (0.26)	-0.85*** (0.14)	-0.56*** (0.16)	-0.60** (0.22)	-0.22 (0.20)	-0.65*** (0.16)
Inf_target	1.81	1.75	1.78	1.85			1.82
Observations	77	54	77	77	77	77	77
Adjusted R-squared	0.52	0.58	0.54	0.52	0.53	0.57	0.53

Notes: Robust standard errors in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels. Coefficients are rounded to the second decimal. The dependent variable, short rate, combines the time series of the change in the MRO up to 2012Q2 with the time series of the change in the DFR from 2012Q3 onwards. Changes are end of quarter. Inf_target is equal to minus the constant over the estimated inflation coefficient(s).

Table 2: To be done.