

## **The Non-Standard Monetary Policy Measures of the ECB: Motivations, Effectiveness and Risks\***

Stefano Neri\*\* and Stefano Siviero\*\*\*

### **Abstract**

This paper examines the challenges faced by the European Central Bank since the outbreak of the global financial crisis. From 2008 to 2014, the need to preserve the correct functioning of the monetary policy transmission mechanism and ensure the supply of credit to the private sector stretched the limits of conventional monetary policy. In 2015, the risk of deflation led the ECB to start a large scale asset purchase programme. The analysis is largely based on a review of the many studies that Banca d'Italia staff has produced on the factors that have brought inflation to unprecedented low levels in 2014 and on the effects of the asset purchase programme.

### **Die nicht-standardisierten geldpolitischen Maßnahmen der EZB: Motivationen, Effektivität und Risiken**

### **Zusammenfassung**

Dieser Beitrag untersucht die Herausforderungen, vor denen die Europäische Zentralbank seit dem Ausbruch der globalen Finanzkrise steht. Von 2008 bis 2014 hat die Notwendigkeit, das ordnungsgemäße Funktionieren des geldpolitischen Transmissionsmechanismus zu wahren und die Kreditversorgung des privaten Sektors sicherzustellen, die

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Grenzen der konventionellen Geldpolitik überschritten. Im Jahr 2015 führte das Deflationsrisiko dazu, dass die EZB ein groß angelegtes Anleihenkaufprogramm aufnahm. Die vorliegende Analyse basiert im Wesentlichen auf einer Überprüfung der zahlreichen Studien, welche die Mitarbeiter der Banca d'Italia zu den Faktoren erstellt haben. Diese Faktoren haben einerseits die Inflation 2014 auf ein beispiellos niedriges Niveau gebracht und andererseits Auswirkungen auf das Programm zum Ankauf von Vermögenswerten zur Folge gehabt.

*Keywords:* monetary policy; global financial crisis; sovereign debt crisis; deflation; asset purchases.

*JEL classification:* E31; E43; E52.

*No axiom is more clearly established in law, or in reason, than that [...] wherever a general power to do a thing is given, every particular power necessary for doing it is included.*

Publius [Alexander Hamilton, John Jay, James Madison],  
"The Federalist Papers," 1788, No. 44.

## I. Introduction

One cannot start a paper on macroeconomic developments and monetary policy in the last decade without remarking that those were extraordinary times, in which unprecedented shocks brought havoc all around the globe and led central banks to adopt new and bold countermeasures in massive doses.

After decades in which the world economy had quietly sailed in untroubled waters, effortlessly and quickly fending off a number of threats and shocks, in 2008 the subprime crisis resulted in a dramatic worldwide recession. Imbalances that had slowly built up over several years came violently to the fore; only later were they identified as the deep causes of the crisis. Monetary policy was quick to react. Following the bankruptcy of Lehman Brothers in September 2008, a number of central banks joined hand in an unprecedented cut to policy rates. Extraordinary monetary policy measures were adopted, including, in many economies, forms of quantitative easing (QE), i.e., non-standard measures consisting of purchases of financial assets by a central bank to lower medium and long-term yields in order to stimulate economic activity and raise inflation.

In some countries, in an effort to contrast the dramatic contraction in aggregate demand induced by the global financial crisis, governments resorted to expansionary fiscal policies. Partly as a result of this, pre-existing imbalances and structural weaknesses were exacerbated. Doubts on the sustainability of public finances in some euro area countries emerged. The ensuing violent financial tensions resulted in a contraction of credit supply in the economies directly hit by those tensions; the transmission of the single monetary policy was hampered. Eventually, fears of a breakup of the European monetary union emerged. In the

opinion of many observers, a political response to those worries was late in materialising. Those fears were effectively extinguished by the famous “Whatever it takes” speech in London by the President of the European Central Bank (ECB), Mario Draghi, in the summer of 2012. This, however, was not enough to prevent the sovereign crisis from taking its toll on the real economy. Euro-area economic activity experienced a double dip and unemployment surged again. The impact was felt especially, but not only, in the economies that had been directly hit by the tensions in the sovereign debt markets.

Following the renewed weakness of the euro area economy, inflation started declining in the first half of 2012. That decline became an almost free fall toward the end of 2013, despite oil prices in euro hovering around 83 euros per barrel, on average, between mid-2011 and mid-2014. By the end of the following year, inflation had turned negative in almost all euro area countries. The risk of deflation became material and was further magnified by emerging signs of a possible loss of confidence in the willingness and/or ability of the ECB to restore price stability.<sup>1</sup>

The ECB reacted to those developments with a variety of measures. During the global financial and sovereign debt crises, they were mostly aimed at restoring the proper functioning of specific segments of the monetary policy transmission mechanism. Later on, to counter the risk of deflation, an active management of the balance sheet of the Eurosystem through quantitative measures was adopted with the aim of boosting economic activity and raise inflation.

Were those measures justified? Did they produce the intended effects, and if so, how did they do it? Did they have unintended side-effects too? What risks may be in stock for the future? These are the questions we address in this paper. We provide the answers mostly drawing from research produced at the Bank of Italy and in other national central banks of the Eurosystem.

The remainder of the paper is organized as follows. Section 2 briefly recalls how the two crises erupted and what effects they had on the euro area economy; it then examines the causes of the decline in inflation in 2013–14 and the risks it entailed. Section 3 sketchily describes the monetary policy of the ECB between 2008 and today. Section 4 focuses on the effectiveness of the monetary policy measures, with a particular focus on asset purchases, and their possible unintended consequences. Section 5 reviews the guiding principles that the ECB has followed in recalibrating its monetary policy and touches upon some long-term challenges. Section 6 concludes.

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<sup>1</sup> Price stability is defined by the Governing Council as year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below, but close to 2% over the medium term.

## II. A Challenging Environment: The Two Crises and the Disinflation

In this Section we briefly review the unfolding and the macroeconomic impact of the global financial and sovereign debt crises; we then move on to examine the causes of the 2013–14 disinflation and the risks it raised.

### 1. *The Lull Before the Storm*

Storms are preceded by calm weather and the gradual accumulation of pressure and energy. The global financial crisis was no exception. After the burst of the stock market bubble in early 2001, monetary policies in advanced economies turned very accommodative and policy rates reached historically low levels. The Federal Reserve lowered the target for the Federal funds rate to 1 per cent in June; in the same month, the ECB lowered the rate on the main refinancing operations (MRO) to 2 per cent and kept it at this level until the first increase in December 2005. During this period, macroeconomic imbalances continued to build up, arguably also supported by regulatory gaps and excessive optimism about growth prospects and the resilience of the global economy. Financial engineering, originating in the United States, contributed to creating new, complex and opaque assets, which spread all over the world. In the euro area, credit to the private sector boomed, leading to M3 growing in excess of its reference value, although with varying strength across the monetary union, and credit risk premiums became very compressed (Lane, 2012).<sup>2</sup>

### 2. *The Storm: the Global Financial and Sovereign Debt Crises*

In the summer of 2007 an unprecedented storm hit the financial systems of advanced economies, quickly causing disruptions and then a freeze of financial and credit markets (Figure 1, panel a). Central banks were quick to respond with a first set of extraordinary measures.<sup>3</sup>

After the bankruptcy of Lehman Brothers in September 2008, the ECB aggressively cut policy rates; the flexibility of the operational framework of the Eurosystem was key in preserving the proper functioning of the monetary policy transmission mechanism (Cecioni / Ferrero / Secchi, 2011; Eser et al., 2012). However, the damage was done: it could be attenuated, but not avoided. Economic activity collapsed in 2009 (Figure 2, panel a), as world trade and confidence fell

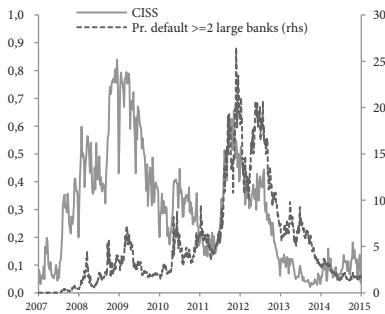
<sup>2</sup> Galí (2012) discusses the role of the ECB's monetary pillar in the run-up and during the global financial crisis.

<sup>3</sup> Mishkin (2011), among many others, offers an overview of the global financial crisis and the policy response in the United States.

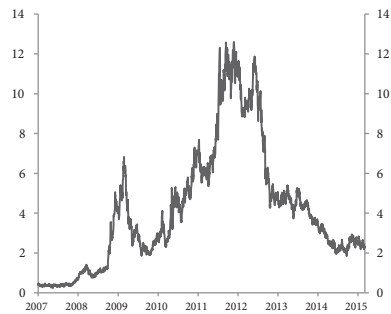
sharply and banks tightened credit conditions.<sup>4</sup> *Kollman et al.* (2016) assess the role of various shocks, including fiscal and monetary policy ones, in explaining the 2008–09 recession and the post-crisis slump in the euro area.<sup>5</sup> Both the level and the rate of growth of potential output declined too, as hysteresis kicked in (the output gap eventually reached –3 per cent in 2013, just after the most acute phase of the sovereign debt crisis; Figure 2, panel b).

In a number of countries, the response to the financial crisis involved expansionary fiscal policy measures, which entailed a deterioration in public balances. Financial conditions worsened rapidly, particularly in Greece, where the situation of public finances was found to be much worse than previously stated by the Greek government and assessed by analysts; in addition, Greece was also running a sizeable external imbalance.<sup>6</sup>

Prob. of default of two or more large banks and CISS (a)



Prob. of default of two or more EU sovereign (b)



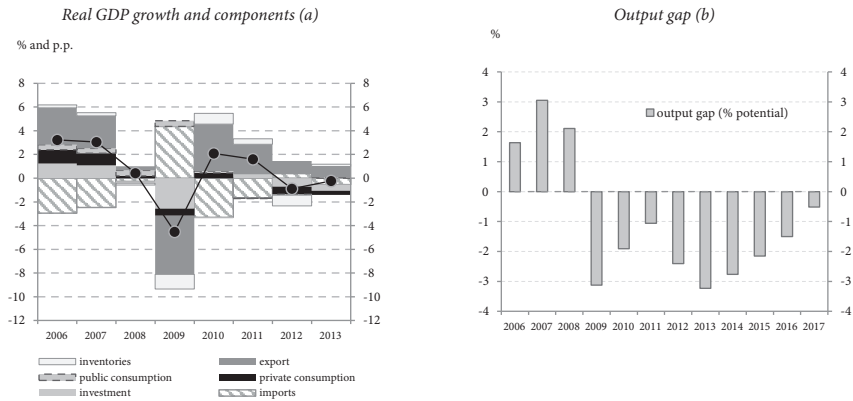
Source: ECB. Note: CISS = Coincident Indicator of Systemic Stress. The CISS captures several symptoms of stress in different segments of the financial system. It is an aggregation of indicators of stress in these markets, based on their time-varying cross-correlations. The CISS increases when stress prevails in several markets at the same time, capturing the idea that financial stress is more systemic the wider financial instability spreads across the financial system. The probabilities of default of two or more large banks or sovereigns are based on CDS prices with maturity of one year.

Figure 1: Indicators of Systemic Stress in the Euro Area

<sup>4</sup> *Albertazzi/Bottero* (2014), using disaggregate bank-firm data for the Italian economy, show that foreign lenders restricted credit supply more sharply than their domestic counterparts. Using the same data, *Bonaccorsi/Sette* (2016) quantify the adverse effects of the freeze of the securitization market on bank lending during the global financial crisis. *Del Giovane/Eramo/Nobili* (2011) find that both demand and supply factors have played a relevant role in shaping the dynamics of lending to non-financial corporations in Italy during the global financial crisis.

<sup>5</sup> In a similar vein, *Caivano/Rodano/Siviero* (2011) assess the impact of the global financial crisis on the Italian economy, highlighting the contribution of the different channels of transmission.

<sup>6</sup> For a detailed review of the handling of the Greek situation in the early stage of the sovereign debt crisis, see, e.g., European Economic Advisory Group (2011).



Source: Eurostat, IMF, OECD and European Commission. The output gap is the average of the estimates of the IMF, the European Commission and the OECD.

Figure 2: Economic Activity in the Euro Area During the Two Crises

In the spring of 2010, contagion from the Greek crisis started spreading to other economies (Ireland, Portugal, Spain; Figure 1, panel b). A first rescue package was jointly set up in early May by the European Union, the ECB and the IMF, to be accompanied by severe fiscal consolidation measures by the Greek governments; *Orphanides* (2015) argues that this first rescue package was designed to protect specific political and financial interests in other member states. This, however, was not enough to rein in Greek sovereign spreads, which kept rising. In October 2010, the decisions taken in Deauville by the German Chancellor and the French President led the so-called PSI, i.e., the involvement of the private sector in sharing losses on Greek government bonds. Following that decision, the worsening of financial conditions accelerated and became disorderly, quickly affecting other countries. The economies that had been hit the hardest by the sovereign crisis adopted contractionary fiscal policies to support confidence in public finances; these policies had a large and negative additional impact on the real economy.<sup>7</sup> Over subsequent years, further rescue packages for Greece, and other euro area countries, needed to be set up; Greece was the last country to exit all programmes, in the summer of 2018.

<sup>7</sup> *In't Veld* (2013) quantifies the impact of the fiscal consolidation measures adopted in 2011–13 in the largest euro area economies. *Busetti / Cova* (2013) study the macroeconomic impact of the sovereign crisis on the Italian economy. The volume “The sovereign debt crisis and the euro area” (Banca d’Italia, 2013) collects the papers presented at the workshop held at the Banca d’Italia on 15 February 2013 on the impact of the sovereign crisis on the financial system and the economy in Italy and other euro-area countries.

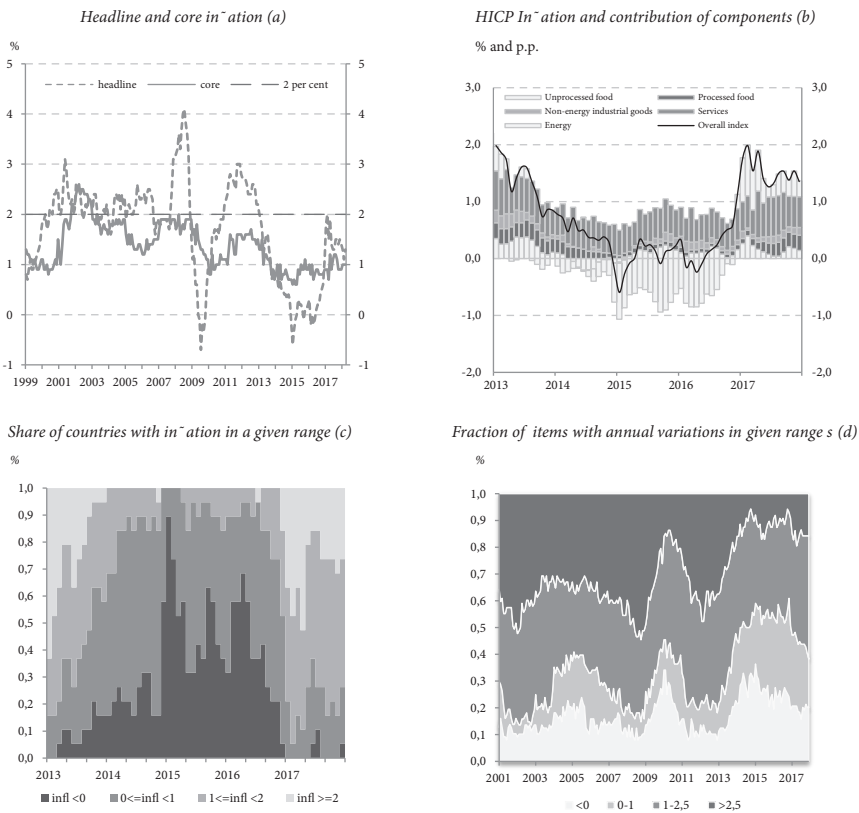
The sovereign debt tensions had a significant impact on the functioning of financial and credit markets and on the real economy. *Neri* (2014) and *Neri/Ropele* (2015) document the impact of the increase in sovereign spreads on bank lending rates, credit and the real economy in the euro area as a whole and its main economies. *Del Giovane et al.* (2017) find that the sovereign crisis had larger effects on the supply of credit than the global financial crisis. The economic and financial strains in some euro-area countries turned into a full-blown sovereign crisis, spreading to the whole euro area and hitting hard a number of economies, including Italy and Spain.

### 3. *The Disinflation and the Risk of Deflation*

The sovereign debt crisis had a strong impact on aggregate demand in the euro area; these effects were much larger in the economies directly hit by the tensions in sovereign debt markets, where credit conditions were severely tightened; but the remaining economies were not unaffected. For the euro area as a whole, this second crisis and the consequent recession were mostly determined by domestic factors, contrary to the 2008 crisis and the recession of 2009, which had a global nature and, from the area's viewpoint, was mostly "imported." More specifically, the Spanish and Irish crises were caused by the burst of the real estate bubble, which impacted negatively on public finances and the banking sector, whereas in Greece, Italy and Portugal the tensions were sparked by concerns over public debt sustainability.

Eventually, the prolonged weakness in aggregate demand provoked by financial tensions and contractionary fiscal policies exerted a generalized downward pressure on consumer prices. *Corsetti et al.* (2014) show, using a New Keynesian model of a two-region monetary union, that a combination of sovereign risk in one region and strongly pro-cyclical fiscal policy at the aggregate level exacerbates the risk of belief-driven deflationary downturns.

Inflation started declining in the first half of 2012 and reached negative values at the end of 2014 (Figure 3, panel a). Part of the decline of headline inflation in the second half of 2014 and in 2015 was due to the decline in oil prices (Figure 3, panel b), which fell from 100 US dollars in August 2014 to slightly below 45 in January 2015, close to the levels reached at the end of 2008; in the same period, oil prices in euros nearly halved. Core inflation also hit a historical low at 0.6 per cent in January 2015, as service and non-energy industrial goods inflation fell sharply. An increasingly large fraction of goods and services was recording rate of changes below one per cent (Figure 3, panel d). Given the global nature of oil price developments, the disinflation occurred also in other advanced economies, such as the US; nowhere, however, was it as deep and long lasting as in the euro area.



Source: Eurostat and Banca d'Italia calculations.

Figure 3: The 2013–14 Disinflation in the Euro Area

Initially, inflation fell particularly in countries where the brunt of the sovereign debt crisis was more severely borne; for some of those countries, it could be argued that prices actually had to decline, in order to recoup previous competitiveness losses (European Economic Advisory Group, 2013). However, inflation soon collapsed virtually everywhere in the euro area, affecting also the countries that had not been hit by the crisis. In January 2015, in no country of the euro area inflation was above 1 per cent; in 17 countries out of 19, year-on-year consumer price changes were negative (Figure 3, panel c).

The increased sensitivity of core inflation to the output gap may have contributed to exerting further downward pressures to consumer prices; this possibility is supported by the findings of *Riggi/Venditti* (2015). Compared with the 2009 disinflation, surprises in the more recent period were more persistent, with no



signs of reversion in forecast errors, and were not related to oil prices. Indeed, analysts were particularly surprised by the fall of core inflation, which is more sensitive to the business cycle. *Jarocinski/Lenza* (2016) estimate a small dynamic factor model of the euro area to compute the implicit output gap that would be consistent with core inflation developments. According to their best forecasting model of inflation, the output gap in the euro area was about -6 per cent in 2014 and 2015, compared with official estimates between -2 and -3 per cent. *Riggi/Venditti* (2015) show that a larger output gap can rationalize the observed fall in inflation between 2012 and 2014. *Conti/Neri/Nobili* (2015) find that the joint contribution of (conventional) monetary policy and aggregate demand shocks to the decline in inflation in 2014 was at least as large as that of oil price shocks. *Bobeica/Jarocinski* (2018) use a medium-scale VAR to show that domestic factors were the main drivers of price dynamics after the sovereign debt crisis.

The disinflation prompted research in several areas variously relating to the modelling of inflation. *Auer/Borio/Filardo* (2017) expand the set of explanatory variables of price dynamics in individual countries by including global variables, which are argued to be an important determinant of national inflation rates, because of the rising importance of global value chains; this finding is confirmed by *Forbes* (2018). By contrast, a number of other studies, including, recently, *Mikolajun/Lodge* (2016), ECB (2017) and *Bereau/Faubert/Schmidt* (2018), fail to confirm that global economic slack significantly affects domestic inflation. *Bianchi/Civelli* (2015) find that global slack affects inflation in many countries, but its role has not become stronger over time. *Carriero/Corsello/Marcellino* (2018) find that, while global factors are important drivers of domestic headline inflation in a number of countries, their role is much less relevant when it comes to core inflation. *Coibion/Gorodnichenko* (2015) question the reliability of the available measures of economic slack. *Ball/Mazumder* (2011) had already pointed out that, in the course of the Great Recession, the Phillips curve would have implied a more pronounced fall of inflation than actually observed; this finding raised doubts as to the usefulness and ability of existing models to account for inflation developments following the global financial crisis.

In real-time, the assessment of the drivers of the deflationary drift and the choice of the appropriate policy response were far from obvious. A view put forward by some observers was that the decline in consumer price dynamics had been mostly induced by the dynamics of oil prices. However, the available evidence does not seem to support that interpretation. First, inflation started falling in the first half of 2012, well before the decline in oil prices, which mostly occurred about 2½ years later, in the summer of 2014. Second, the fact that disinflation was broad-based across individual goods and services, including low-energy-intensive sectors, as well as across countries, suggests that a com-

mon factor other than oil, such as a generalized weakness of aggregate demand (*Constâncio*, 2014), must have been responsible for those developments (*Delle Monache / Petrella / Venditti*, 2016). Third, oil price developments cannot account for the forecast errors during the disinflation.

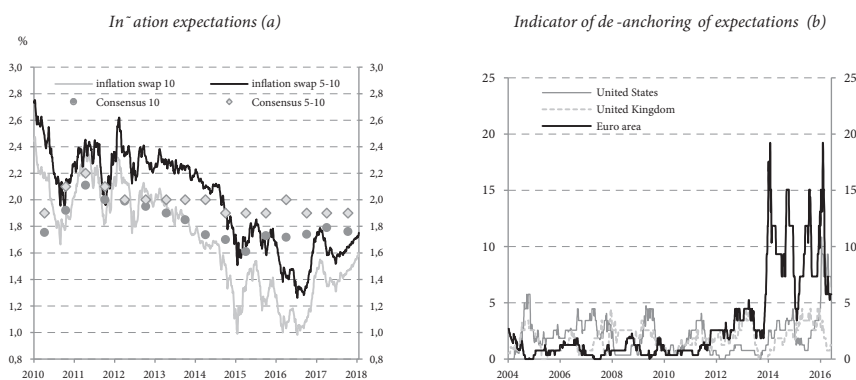
Quantile regression models show that inflation is more persistent in the lowest quantiles of the distribution of inflation (*Busetti / Caivano / Rodano*, 2015). Moreover, inflation is less sensitive to cyclical conditions in the left tail of the distribution, where inflation is low and the output gap is typically large and negative. These findings imply that inflation is comparatively more resilient and harder for monetary policy to dislodge once it reaches “too” low levels.

Among the reason for this more pronounced resiliency of low inflation, the effective lower bound to policy rates prevents the central bank from providing the necessary monetary accommodation in the context of weakening prospects for economic activity and consumer price dynamics. In the case of the euro area, falling inflation expectations thus resulted in an unwarranted tightening of monetary conditions, as real rates arose when aggregate demand was weak, and inflation was already falling to low levels. *Conti / Neri / Nobili* (2015) show that the real short-term rate increased markedly in 2013 and 2014; the lower bound to the policy rates hence resulted in an unintended and unwarranted tightening of monetary conditions. High levels of private debt can amplify the effects of disinflationary shocks, together with nominal wage rigidities (*Neri / Notarpietro*, 2015). Negative shocks to inflation, even when favourable in principle, as is the case of oil price declines, may have contractionary effects once the interplay of the zero lower bound (ZLB)<sup>8</sup> and the debt-deflation mechanism is considered. These effects are larger, the larger is the degree of nominal wage rigidity and the more households are indebted. Under those conditions (which closely resemble those of the euro area at the time), even supply-driven price disinflation can have contractionary effects and turn into “bad” disinflation/deflation. Relatedly, *Casiraghi / Ferrero* (2015) argue that the macroeconomic effects of shocks to inflation of the same size but opposite sign are not symmetric. The costs of deflation and disinflation tend to exceed those of inflation, once again because of the presence of constraints in the economy: the ZLB on nominal interest rates, borrowing limits, and downward nominal wage rigidities. These constraints, when binding, may prevent monetary policy from achieving the degree of accommodation required to close the inflation gap.

Predictions by professional forecasters also proved continuously overoptimistic as regards consumer price dynamics and economic activity: the fall in infla-

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<sup>8</sup> As shown by the events that followed the fall in inflation, the lower bound for policy rates is not necessarily zero, but, rather, some small negative number. For this reason, the label “Effective Lower Bound (ELB)” is now often used.



Source: Bloomberg and Banca d'Italia calculations. Note: inflation expectations in panel (a) are measured with the rates on inflation swap contracts. The indicator of de-anchoring measures the degree of tail co-movement between short- and long-term distributions of inflation expectations, estimated from daily quotes of inflation derivatives. See Natoli and Sigalotti (2018).

Figure 4: Inflation Expectations and Risk of De-anchoring

tion was systematically sharper than implied by the historical correlation between inflation and the output gap (Riggi/Venditti, 2015). The projections by the Eurosystem were also repeatedly revised downward during this period; those for inflation in 2015 produced by the staff of the Eurosystem in December 2013 was 1.3 per cent; by December 2014 the projection for the same year was roughly halved, to 0.7.

Inflation expectations, as measured by inflation swaps, also fell sharply, particularly when the disinflation process strengthened after the collapse of oil prices. Expectations declined across the whole maturity spectrum, including, and most importantly, longer-term maturities. The five-year forward five-year ahead inflation swap, which had stood above 2 per cent since the beginning of this market in 2004, reached its historical minimum of 1.5 per cent in January 2015.<sup>9</sup> Similar indications were given by survey-based measures of inflation expectations. The mean of the aggregate probability distribution of the five-year ahead expectations of one-year inflation in the ECB's Survey of Professional Forecasters (SPF) fell from 1.9 in the 2012 to 1.65 in the first quarter of 2016. Market-based measures of inflation expectations were increasingly affected by those persistent negative surprises (Miccoli/Neri, 2018). Casiraghi/Miccoli (2015) show that part of the ex-post excess return on inflation swap contracts at short-to-medium maturities can be predicted with macroeconomic variables. Risk-adjusted inflation swap rates show that the decline observed in 2014 was

<sup>9</sup> In July 2016 the five-year forward five-year ahead inflation swap fell to just below 1.3 per cent.

driven mainly by changes in inflation expectations and not by changes in risk premiums.

The persistent decline of inflation expectations gradually raised concerns about the possibility of their de-anchoring from the definition of price stability. In an early phase, the ECB tended to downplay the risk of de-anchoring (see, e.g., ECB, 2014, which, as late as May, claimed that “[e]uro area medium to long-term inflation expectations have remained firmly anchored in the midst of these probably transitory cost-push and demand-pull forces”). The attitude towards de-anchoring changed later in 2014. Starting in September, any reference to firmly anchored expectations was removed from the Introductory Statement. Rather, in that month the further accommodation of the monetary stance was motivated with the following words: “Today’s decisions, together with the other measures in place, have been taken with a view to underpinning the firm anchoring of medium to long-term inflation expectations”. In the course of the year, the risk of de-anchoring of long-term inflation expectations was repeatedly pointed out by several members of the Governing Council of the ECB (*Draghi*, 2014; *Praet*, 2014; *Visco*, 2014).

Starting in mid-2014, negative tail events affecting short-term inflation expectations were increasingly channelled onto long-term ones (*Natoli / Sigalotti*, 2018). By contrast, positive short-term tail events left long-term moments mostly unaffected. This asymmetric behaviour suggests that in the second-half of 2014 the risk of de-anchoring of long-term inflation expectations became material. *Nautz / Pagenhardt / Strohsal* (2017) and *Lyziak / Palovita* (2017) also document a de-anchoring of long-term inflation expectations in the euro area.<sup>10</sup> By contrast, *Speck* (2017) finds no evidence of de-anchoring of inflation expectations or loss of credibility by the ECB. *Ciccarelli / Osbat* (2017) summarize and compare a number of studies on the issue of de-anchoring (including some of the studies mentioned above); they argue that, while results for the period 2012–2014 are inconclusive, most studies identify increasing risks of de-anchoring after mid-2014. A de-anchoring of long-term inflation expectations from the target of the central bank can be particularly serious in a context in which agents have incomplete information about the working of the economy and form expectations through an adaptive learning process, and monetary policy is constrained by the lower bound to the policy rates. *Busetti et al.* (2017) investigate the effects of a sequence of deflationary shocks on expected and realized inflation in a new Keynesian model in which agents have incomplete information about the economy and form expectations through an adaptive learning process. Compared with the case of fully rational expectations, the assumption of learning implies a 0.6 percentage point lower inflation in the average of 2015–16, as

<sup>10</sup> *Nautz / Pagenhardt / Strohsal* (2017) focus their analysis on inflation swap rates, while *Lyziak / Palovita* (2017) rely on the SPF of the ECB.

agents revise their assessment of the inflation objective downwards in response to repeated disinflationary surprises.

### III. The Response of the ECB

A full description of the wide range of extraordinary measures adopted by the ECB between the start of the global financial crisis and today is beyond the scope of this paper: it would fill several pages and most likely make poor and boring reading.<sup>11</sup> In this Section, we focus on the main measures, with the following objectives: (i) show the diversity and richness of the overall monetary policy package that the ECB has adopted over the years;<sup>12</sup> (ii) document how the pre-crisis operational framework has proved flexible enough to adapt to the unfolding of events; (iii) relate the measures to the specific impairment or issue they were meant to address. To this end, it is convenient to separate the narrative in three parts, corresponding to three distinct phases: (i) the global financial crisis (2007–09); (ii) the euro-area sovereign debt crisis (2010–12); (iii) the disinflation (2013–16). Our focus will mostly be on the last period.

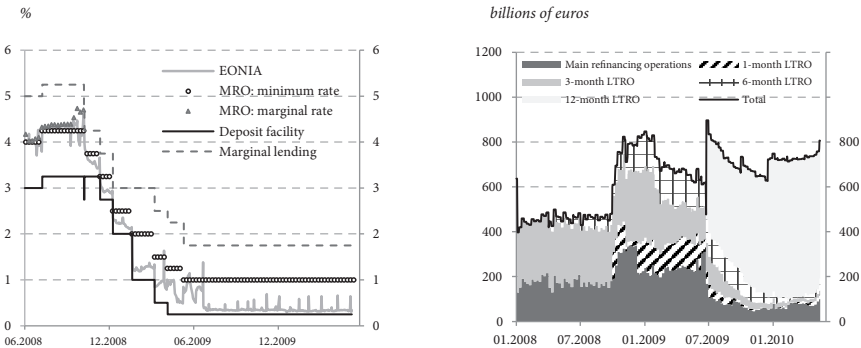
#### 1. *The Global Financial Crisis and its Immediate Aftermath*

When money market tensions suddenly burst on 9 August 2007, the ECB was quick to react to an unprecedented situation and provided ample liquidity to banks, effectively replacing the money market, as the latter had come to a complete standstill. As pointed out by *Trichet* (2009), the ECB was “the first central bank to take non-standard measures”, since the provision of unlimited liquidity (a policy adopted by the ECB very early on during the crisis) was not “normal” central bank policy back then. The ECB accommodated bank’s preference for longer-term liquidity and provided liquidity in US dollars too, following an agreement with the Federal Reserve. Despite the tensions in the money market and the increasing likelihood that the financial turmoil would negatively affect the real economy, the ECB kept the policy rates unchanged between mid-2007 and the summer of 2008, when “overreacting to a reading of 4 % in headline inflation related to oil price developments [the Governing Council] took the controversial decision to increase the [MRO] policy rate to 4.25 %” (*Constâncio*, 2018).

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<sup>11</sup> Several chronologies are available on the ECB website and in its publications (see, among others, ECB, 2010; ECB, 2011); similar chronologies from other sources may be easily found on the internet.

<sup>12</sup> An overview of euro area monetary policy from 1999 to 2018 can be found in *Constâncio* (2018); *Hartmann / Smets* (2018).



Sources: ECB and Thomson Reuters Datastream. Note: the length of the 1-month operations is equal to the duration of the reserve maintenance period.

Figure 5: ECB Policy Rates and Open Market Operations

As remarked by *Constâncio* (2018), the ECB's guiding principle in its response to the crisis at this relatively early stage was to resort to an array of measures and to calibrate each of them “to address the specific market impairment prevailing at that point”. For instance, the provision of liquidity at long maturity was meant to alleviate tensions due to rising uncertainty as to banks' liquidity position beyond the very short-term.

Prior to the financial crisis, the conduct of monetary policy by the ECB had abided by the so-called separation principle, according to which policy rates were set in order to achieve price stability and refinancing operations were used to ensure the smooth functioning of the money market and implementing the desired level of short-term interest rates. Starting in October 2008, when the need to ensure an orderly functioning of the interbank market became an essential component of monetary policy itself, the principle was progressively discarded and eventually fell into oblivion.

The financial turmoil became a fully-blown-up crisis in early September 2008, with the bankruptcy of Lehman Brothers. That event brought about a virtual standstill of interbank trading. A number of major central banks, including the Federal Reserve and the ECB, simultaneously cut their policy rates in early October, in a swift and unprecedented move. In the euro area, the easing of monetary policy conditions continued at a fast pace in late 2008: by December, the MRO had been lowered to 2.5 %. The easing cycle continued in 2009, when the ECB brought the MRO to the (then) historical low of 1 % in May. At the same time, the ECB enlarged the palette of facilities available to provide liquidity to the banking sector, increasing the length of the refinancing operations. As a result of those decisions, the balance sheet of the Eurosystem increased substantially, reaching 2 trillion euro in early 2009.

## 2. The Euro-area Sovereign Debt Crisis

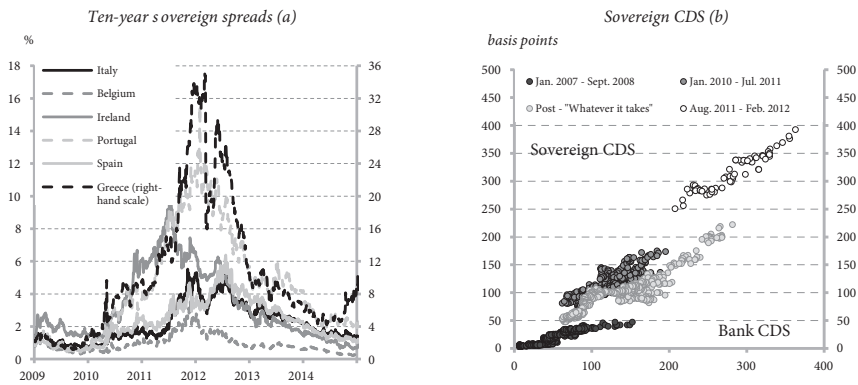
Following the havoc in the global and euro-area economies brought about by the global financial crisis and its macroeconomic repercussions, a recovery of most euro area economies started emerging in the course of 2009; it gained further strength in 2010. However, already by the end of 2009 tensions emerged in the government bond market as the newly established government in Greece revealed that the public deficit was much higher than previously stated.

The ECB took action to address specific market impairments that were affecting the functioning of the monetary policy transmission mechanism. To this end, the ECB adopted in May 2010, after the first bail-out of Greece, the Securities Markets Programme (SMP), whereby bonds issued by countries in distress could be purchased by the ECB in the secondary market. The purchases initially targeted Greek, Portuguese and Irish government bonds. The programme aimed at ensuring depth and liquidity in those markets that were dysfunctional. Some members of the Governing Council were concerned that the SMP would end up blurring the boundary between the responsibilities of monetary and fiscal policies and would be ineffective in addressing the malfunctioning in the monetary transmission channel. Weber (2010) argued that the risks associated with the programme outweighed the benefits and argued that “securities purchases should [...] be phased out permanently [...]”

The sovereign debt crisis was initially confined to a few small countries. For the area as a whole, the economy seemed to be on the way to recovering; growth prospects became increasingly brighter and inflation started rising, reaching 2.8% in April 2011; it was projected by the staff of the Eurosystem to remain above 2.0% during 2011. The Governing Council was concerned with the risk of a spiralling interaction of prices and wages. As a result, the ECB increased the policy rates in April and July 2011, bringing the MRO rate to 1.5%. With the benefit of hindsight, those decisions now look too hasty (*Constâncio*, 2018). The projections of real GDP growth and inflation formulated by the ECB staff in March 2011 and by the Eurosystem staff in the following June, while in line with those of other institutions and analysts, turned out to be overly optimistic. The burst of the sovereign debt crisis, however, could not have been easily predicted at that time.

In the summer of 2011, following the spreading of the sovereign crisis to Italy and Spain (Figure 6, panel a), bonds issued by those countries were included in the SMP. A new loosening cycle of the policy rates started at the end of 2011. To appease banks' concerns about the availability of sufficient funding in a situation in which interbank trading remained impaired, starting in December 2011 the ECB launched two three-years refinancing operations, which succeeded in averting a more severe impact of the financial tensions on banks' funding and





Source: Bloomberg. Note: the sovereign spreads are computed as differences between the 10-year government bond yield of a given country and the yield on the German Bund of the same maturity.

Figure 6: Sovereign Spreads and Bank vs. Sovereign CDS

liquidity and, ultimately, on the availability and cost of bank credit to non-financial corporations and households.<sup>13</sup>

At the same time as monetary policy was quickly becoming more expansionary, fiscal policy turned increasingly restrictive. Fiscal consolidation efforts were carried out in several euro area countries. The consequences of such coordinated fiscal tightening were initially underestimated. As it turned out, fiscal multipliers, in the specific circumstances that the euro area was facing, and given the simultaneity of the fiscal adjustment, were much larger than expected (*Cugnasca / Rother, 2015; Lalik, 2017*). The euro area as a whole slipped into a recession in 2012.

In mid-2012 the tensions in the euro area government bond markets reached a new peak and spread to the banking sector (Figure 6, panel b).<sup>14</sup> Fears of a break-up of the monetary union came to the fore. Due to the unique nature of

<sup>13</sup> For a comprehensive overview of the use of the Eurosystem's monetary policy instruments and the operational framework after 2012, see *Alvarez et al. (2017)*. A quantification of the impact on the Italian economy of the unconventional monetary policy measures adopted by the ECB in 2011–2012 is provided by *Casiraghi et al. (2016)*.

<sup>14</sup> There are various reasons why tensions in government bond market can spread onto the banking sector (Committee on the Global Financial System, 2011). Banks typically own non negligible amounts of domestic bonds; changes in their prices directly impact banks' balance sheets. To the extent that governments are perceived as either explicitly or implicitly guaranteeing national banks, turmoil that affect the market for government bonds also affect the perceived health of the banking sector. Finally, to the extent that financial tensions are expected to result in deteriorating macroeconomic conditions, banks would be negatively affected by the worsening of borrowers' credit quality.



that danger, the analytical challenges that one faced in estimating it were daunting.<sup>15</sup> Some estimates first pointed out that the euro break-up risk, or redenomination risk, as it came to be called, was responsible for most of the increase in the spreads between peripheral and core countries.<sup>16</sup>

Tensions eased rapidly after the by now famous “Whatever it takes” speech by the ECB President, Mario Draghi.<sup>17</sup> The speech was followed in September by the announcement of a new programme, the Outright Monetary Transactions (OMT), whereby the Eurosystem would stand ready to buy bonds with maturity below three years issued by euro-area member states, should severe market impairments emerge, conditionally on those states agreeing to carry out macroeconomic adjustment programmes. The OMT never needed to be used: simply announcing that the ECB was ready to activate it was enough to calm the markets and remove the redenomination risk, which was at the time severely impairing the transmission mechanism of monetary policy. Between the London speech and mid-September, the spread of Italian and Spanish ten-year government bond yields with respect to the Bund yield declined by 100 basis points, the Portuguese spread by 180. CDS premiums on sovereigns and banks also declined sharply.

### 3. *The Disinflation and the Monetary Policy Measures Taken in 2014 and Beyond*

In the most acute phase of the sovereign debt crisis, inflation was still above 2.5 %. However, after the peak (3 %) reached in late 2011, inflation started to decline. The trend accelerated in the second half of 2013 and by early 2014 it became the ECB’s main concern. Against the background of falling inflation, the ECB reduced the policy rates twice in 2013, bringing the MRO rate to 0.25 per cent in November.<sup>18</sup> In July 2013, the ECB started to provide forward guidance on its policy rates, in order to maintain price stability in the context of a sub-

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<sup>15</sup> Researchers resorted to financial market variables (Favero, 2013) and to web-based keywords diffusion indexes and anecdotal evidence on industry hedging practices (Di Cesare et al., 2012). Subsequent research (Li/Zinna, 2018) confirmed the systemic nature of the euro-area break-up risk.

<sup>16</sup> Di Cesare et al. (2012) show that in the first half of 2012 the Italian and Spanish sovereign spreads vis-à-vis the German Bund were well above the values consistent with country-specific fiscal and macroeconomic fundamentals; for the Italian spread, most estimates of the 10-year spread were around 200 basis points, as opposed to a market value of almost 450 at end-August 2012.

<sup>17</sup> On 26 July 2012, in his speech in London, President Draghi said: “Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough” (Draghi, 2012).

<sup>18</sup> The rate on the deposit facility was lowered to 0.0 per cent in July 2012.

dued outlook for inflation and growth. However, the reimbursement of the three-year refinancing operations, which began in the Spring of 2013, caused a reduction of excess liquidity. *Orphanides* (2017) argues that that reduction in the size of the Eurosystem balance sheet resulted in a tightening of the ECB monetary policy. Indeed, the decline in excess liquidity pushed the overnight rate up, away from the rate on the deposit facility and close to the MRO rate.

In his speech on 24 April 2014, President Draghi outlined the contingencies that would require adopting quantitative measures. In particular, he emphasised that a worsening of the medium-term outlook for inflation, in the context of policy rates close to their effective lower bound, would demand a broad-based asset purchase programme. President Draghi also announced the commitment of the Governing Council to using both non-standard and standard measures in order to avoid a prolonged period of too low inflation.

In June 2014, a series of targeted long-term refinancing operations (TLTROs) was announced, together with the decision to bring the rate on the deposit facility into negative territory ( $-0.10$  per cent) for the first time. These measures were introduced to stimulate aggregate demand by providing incentives to banks to lend to non-financial corporations and households. Contrary to the measures taken in the previous phases of the long crisis, the new non-standard monetary policy measures were not meant to address impairments in this specific markets or to avert a break-up of the monetary union, but were, instead, directly aimed at providing more stimulus to aggregate demand and raise inflation.

In light of the worsening of the outlook for inflation during the summer, the Governing Council of the ECB felt that it had to switch to an active management of the balance sheet of the Eurosystem, given that the TLTROs take-up was perceived as being insufficient to achieve a substantial increase in the size of the balance sheet. To this end, in September 2014 the Governing Council decided to purchase asset-backed securities and covered bonds. This decision aimed at increasing the balance sheet of the Eurosystem and lowering the funding costs of banks. Later in 2014, after the collapse of oil prices, the risk of de-anchoring of inflation expectations was perceived as having increased sharply (Section 2). It became clear that, unless additional asset classes were included in the perimeter of eligible securities, a substantial expansion of the balance sheet of the Eurosystem could not be achieved.

The credibility of the ECB, its main asset and the necessary condition for preserving price stability, was at serious risk; the Governing Council could not afford a “benign neglect” attitude. Investors started speculating on the possibility that ECB would soon start purchasing sovereign bonds. As the expectations of such move strengthened, in particular after the meeting of the Governing Council in November 2014, the euro depreciated and long-term government bond yields declined (see next Section).

In early 2015, the ECB launched a much more sizeable purchase programme (the Expanded Asset Purchase Programme, APP), which included the purchase of public securities (Public Sector Purchase Programme, PSPP). The Governing Council unanimously viewed the programme as a legitimate tool of monetary policy and voted by a large majority to deploy it immediately. The initial amount of the monthly purchases was set at €60 billion and the duration until September 2016. The purchase of sovereign debt was the only instrument through which the necessary increase of the size of the balance sheet of the Eurosystem could be reached. Purchases of corporate bonds would not have been sufficient, since the markets for these securities are much thinner and are concentrated in a few countries, where mainly large corporates issue bonds.

The Governing Council decided that national central banks would bear the risks associated with the government securities purchased, since some members feared that the APP could lead to transfers of resources between countries. This feature was not seen as limiting the effectiveness of the programme, since this would mostly be determined by its duration and size.

In March 2016, the Governing Council decided to expand the APP by including investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area (Corporate Sector Purchase Programme, CSPP) in the set of eligible assets; the purchases aimed at further easing the financing conditions of non-financial corporations. At the same meeting, the Governing Council decided to launch a new series of targeted longer-term refinancing operations (TLTRO II) with a maturity of four years, to reinforce the accommodative monetary policy stance and provide additional incentives to banks to lend.

Some commentators argued that the ECB waited too much before launching the APP. Ubide (2014) argues that the worry about the costs of the programme was a major impediment to its adoption. According to *Kang/Ligthart/Mody* (2016), the ECB should have acted earlier and with more determination; in their words, “[t]he ECB was reacting to news – building its shelter amidst a raging storm”; this attitude resulted in too slow a reduction of the policy rates in the first part of the long crisis and too late a launch of the large-scale asset purchase programme. This opinion is shared by both *Orphanides* (2017) and *Honohan* (2018), both former members of the ECB Governing Council; the latter argues that the ECB’s capacity to respond to economic developments has been limited by self-imposed constraints that are more imagined than real, in that they stem from an over-interpretation of the limitations imposed by the ECB Statute.

#### IV. Effectiveness and Risks of the APP

In this Section we answer the following questions. Was the APP successful in contrasting the fall of inflation and its expectations? How large were the costs, actual or potential, entailed by the programme?

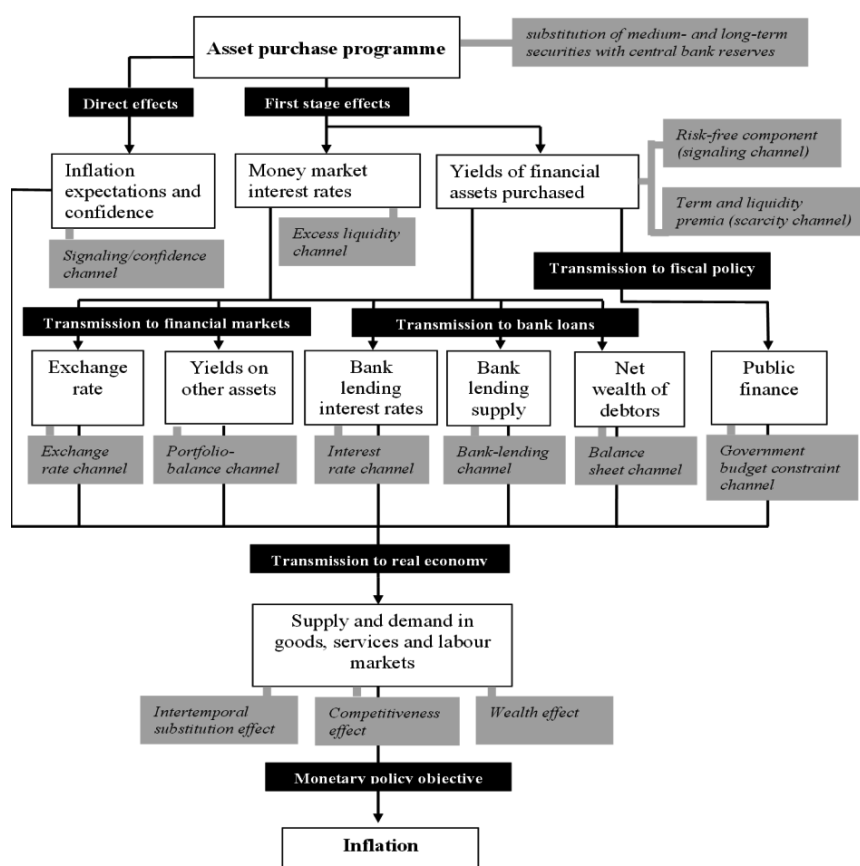
In a nutshell, the available empirical evidence by and large supports the conclusion that the APP was very successful in averting what was seen by many policymakers, commentators and economists as the greatest danger that the euro area economy was facing at the end of 2014, i.e., a deflationary spiral; at the same time, the available evidence does not suggest that the APP has had, as of today, significant undesirable side effects. Indeed, to the extent that the US experience (where similar programmes were launched just after reaching the lower bound to the policy rates, i.e., several years before they were adopted in the euro area) can teach us anything in this respect, the absence of significant episodes of financial instability in that economy, several years after the conclusion of net purchases and well into the phase of normalization of monetary policy, is per se a reassuring development. This said, brave actions are never without risks: for this reason, the Eurosystem has repeatedly stated that it will keep monitoring financial and economic developments, to spot possible signs of undesired developments at the earliest possible stage.

To better articulate these conclusions, we first briefly review the transmission mechanism of asset purchases, distinguishing between direct and indirect effects; we then consider the available empirical evidence of the impact of the APP on financial and credit markets (i.e. on yields, exchange rates, lending rates and credit conditions) and macroeconomic variables (inflation, inflation expectations and economic activity); finally, we investigate whether signs of undesirable consequences of the APP, along different dimensions, are visible in the data.

##### 1. Brief Review of Transmission Mechanisms

The main channels through which purchases of assets by a central bank are transmitted onto economic activity and inflation are depicted in Figure 7, adapted from Cova/Ferrero (2015).

When a central bank buys a financial asset, the first impact of that action is, of course, an increase in the price, and a corresponding decline in the yield, of that specific asset. This is in fact the compounded outcome of two effects. First, by buying financial assets the central bank signals that it considers it appropriate for the monetary policy stance to remain accommodative for some time into the future. Therefore, the risk-free component of the yield of the specific asset should fall. This is the channel labelled ‘signalling channel’. Second, the term premium component of the yield of the purchased asset also declines, because



Source: Adapted from Cova / Ferrero (2015).

Figure 7: Channels of Transmission of Asset Purchases

of the working of the scarcity channel: if investors have a preference for holding the class of assets that are purchased by the central banks, the lower quantity of assets that are available in the market as the result of central bank purchases induces those investors to accept a lower yield from those assets; of course, the lower the elasticity of investors' demand with respect to prices, the stronger the impact through the scarcity channel. A further downward pressure on the risk premium component is exerted much more indirectly by the overall working of a quantitative easing programme, as the improvement in macroeconomic and financial conditions ultimately induced by the programme lowers the probability of default of issuers, and this in turn results in a further fall of risk premiums.

The purchase of assets by the central bank also results in an increase of excess liquidity in interbank markets. In a corridor system, this naturally pushes interbank rates towards the lower bound of the corridor, so that interbank rates also decline; this, in turn, affects banks' lending rates. This effect is labelled 'excess liquidity channel'.

Firms' and households' confidence and inflation expectations may also be directly affected by asset purchases ('confidence channel'), to the extent that, by taking quantitative easing measures, the central bank signals its determination to attain its inflation objective and hence strengthens its credibility and affects agents' expectations.

While the latter channel directly impinges on real economic activity and inflation, most of the channels mentioned above exert their impact indirectly, through the working of other mechanisms down the road. The most relevant of these is arguably the 'portfolio rebalancing channel', consisting of the increase in price, and decline in yields, of a large number of financial and real assets, well beyond those that are the direct target of the purchases. As the price of the purchased assets rises, and their yield declines, investors will search for yield elsewhere, raising their demand for other assets, whose prices will therefore themselves be subject to upward pressure. There is ample evidence, for all the economies in which quantitative easing measures were adopted, that the portfolio-rebalancing channel was significant and relevant. Of course, when a purchase programme is enlarged to include other asset classes, such as bonds issued by private sector companies (as was the case when the APP was enhanced with the inclusion of the CSPP in March 2016), this channel is further strengthened.

Foreign denominated assets are no exception: as the yield of domestic assets declines, comparatively higher yields may be obtained by purchasing assets denominated in other currencies. The 'exchange rate channel' may therefore be viewed as a special case of the more general portfolio-rebalancing channel. The ensuing depreciation of the exchange rate, in turn, tends to boost exports while making imports relatively less appealing.

Another special case is the 'bank interest rate channel': as the yield on assets that are part of QE falls, bank lending activity becomes comparatively more profitable, and thus banks will be more willing to extend credit to the real economy. This mechanism is further reinforced by the fact that the improvement in macroeconomic and financial conditions induced by such a programme lowers the probability of default of borrowers, thus enhancing the quality of bank credit. This leads to an improvement in the overall credit conditions ('bank lending channel').

The decline in yields may make additional resources available to support the real economy and hence consumer prices, by lowering the cost of servicing the

public debt, and hence relaxing the budget constraint of the public sector ('government budget constraint channel').

The final links in the chain of transmission of asset purchases to the real economy are the same that are activated by changes in the policy rates, with the important difference that, in the case of an asset purchase programme, the whole spectrum of interest rates is affected. In short, the 'intertemporal substitution channel', the 'competitiveness channel' and the 'wealth channel' are the last links in the overall transmission mechanism.

## 2. *The Effects on Asset Prices and Financing Conditions*

As the expectations that the ECB would eventually adopt a quantitative easing programme gradually gained strength, the euro depreciated and long-term government bond yields declined (Figure 8).<sup>19</sup> Much of the effect was achieved even before the actual implementation of the programme. Between mid-2014 and April 2015 (one month after the actual start of purchases), the euro area yield curve shifted downward by a sizeable amount (around 50 basis points up to 2 years, as much as around 200 from about 15 years onwards). As shown by *Bulligan / Delle Monache* (2018), APP-related announcements had a significant impact on yields.<sup>20</sup>

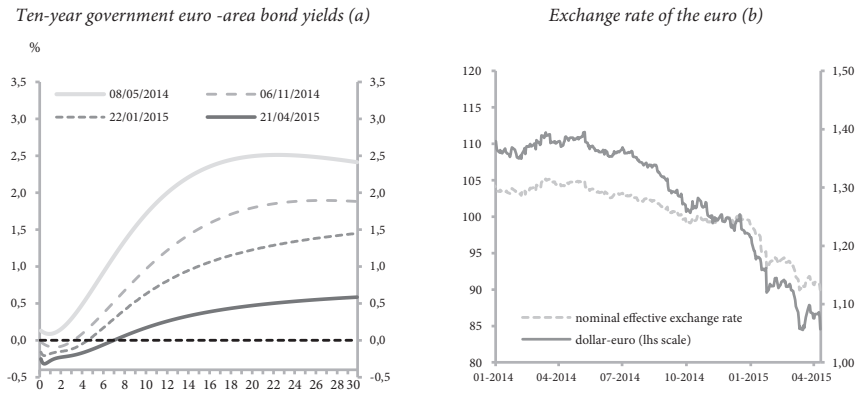
The yield of corporate bonds that were not initially included in the perimeter of purchasable assets started gradually falling as the portfolio rebalancing channel was set in motion by the PSPP. *Altavilla / Carboni / Motto* (2015) evaluate the impact of the ECB asset purchase programme on asset prices, using a term structure model extended to include bond supply effects to account for assets with different types of risk premiums and relying on an event study analysis. The authors find that the APP significantly lowered the yields in various market segments, with larger effects at longer maturities and for riskier assets.<sup>21</sup> *De Santis* (2016) assesses the impact of the APP on euro area sovereign bond yields

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<sup>19</sup> *Belke / Gros / Osowski* (2017) argue that, without controlling for the common downward trend in interest rates across the major advanced economies, the impact of QE is bound to be over-estimated.

<sup>20</sup> The so called shadow rate may also be used to assess the degree of monetary policy accommodation associated with unconventional measures when the policy rates are at their effective lower bound (*Wu / Xia*, 2016). *Pericoli / Taboga* (2015) find that the shadow rate in the euro area fell deeply into negative territory ahead of the launch of the APP.

<sup>21</sup> Event studies may deliver biased estimates of the impact of policy announcements (*Greenlaw et al.*, 2018), as initial market over-reactions (based on expectations about the policy moves) are often corrected later on, once the decisions are actually taken. Moreover, the results of these analyses may be sensitive to the choice of the events.



Source: ECB. Note: the euro-area yield curve is based only on AAA government bonds. The nominal effective exchange rate is based on the 18 most important trading partners of the euro area.

Figure 8: The Exchange Rate and Ten-year Government Yields

by using Bloomberg news dealing with the programme. The econometric analysis shows that the impact of the APP on euro area long-term sovereign yields was sizeable, even considering that the programme was announced at a time of low financial distress. *Albertazzi / Becker / Boucinha* (2018) examine the portfolio rebalancing channel of the APP by exploiting the cross-sectional heterogeneity in the impact of purchases on the valuation of the portfolios held by different sectors of the euro area economy. The authors find that the programme induced a rebalancing towards riskier securities in the more vulnerable countries, while in the less vulnerable ones the rebalancing occurred mainly towards bank lending.

Between mid-2014 and April 2015, the euro depreciated by 14 per cent in nominal effective terms and by around 25 per cent against the US dollar. *Cecioni* (2018) finds that both conventional and non-standard monetary policies contributed to these developments. Bundesbank (2017a) shows that market reactions to the decisions taken by the ECB Governing Council on the APP had a significant impact on the exchange rate of the euro.

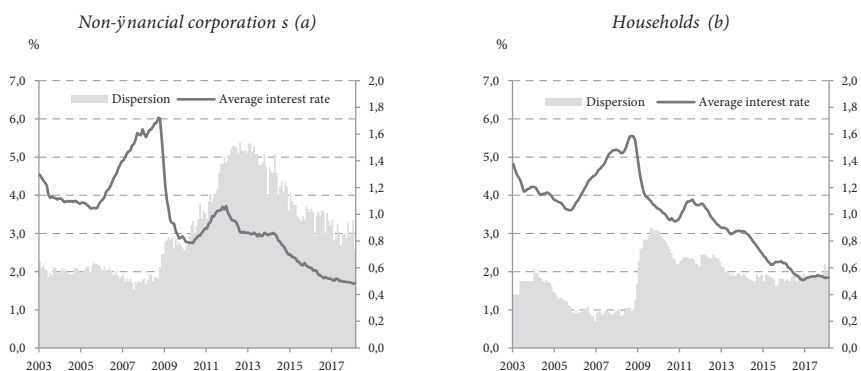
Regarding the CSPP, according to ECB (2016a), “the announcement of the CSPP on 10 March 2016 was followed by a significant contraction in the spread between yields on bonds issued by non-financial corporations and a risk-free rate”. This assessment is confirmed by the results in *Cecchetti* (2017), who finds that the fall in credit default swaps on the day of the announcement of the CSPP can be mostly attributed to the decline in the risk premium. *Zaghini* (2017) and *Li et al.* (2018), using very different empirical approaches, conclude that the impact of the CSPP was sizeable and that the programme significantly lowered the



spread of euro area bonds over the risk-free rate. Interestingly, *Zaghini* (2017) also finds that the decline in the yields on non-eligible bonds, while much less intense, was not negligible, thus providing further confirmation of the portfolio-rebalancing channel.

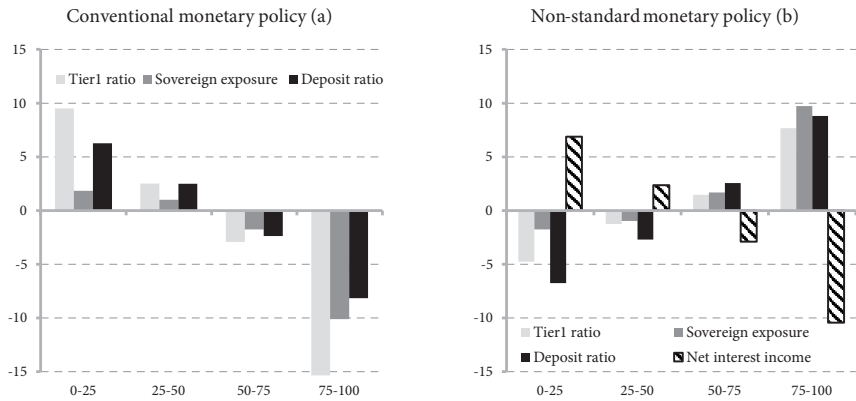
Against the background of the generalized decline in yields, the cost of bank loans to households and firms fell too (Figure 9). Between early 2014 and early 2018, the average cost of loans to non-financial corporations and to households for house purchase declined by 130 and 120 basis points, respectively. Not only did lending rates fall across the area, but the dispersion of the cost of borrowing for firms, which had risen quickly after 2008 and had reached the historical high in 2012, almost halved over the following five years. The spread between the lending rates charged by Spanish and German banks, which amounted to nearly 200 basis points at the end of 2013, narrowed to 50 in late 2017; the difference between lending rates of Italian and German banks, close to 150 basis points in late 2013, virtually vanished starting in late 2016. *Gambetti/Musso* (2017) estimate a time-varying parameter VAR model with stochastic volatility to assess the macroeconomic impact of the APP. They find that the programme activated the credit channel and was effective in lowering bank lending rates and increasing loan volumes.

The expansionary stance of the ECB monetary policy, to which both the policy rates and the non-standard measures contributes, was essential in lowering the financing costs of the private sector. *Albertazzi/Nobili/Signoretti* (2016) find that, similarly to what happens following a conventional monetary policy shock, also in the case of non-standard monetary policy shocks the transmission to the macroeconomy also involves the working of the bank lending channel. However, they find that the characteristics of banks that are more responsi-



Source: ECB. Note: the dispersion is computed as the standard deviation across the euro-area economies.

Figure 9: Cost of Bank Loans in the Euro Area



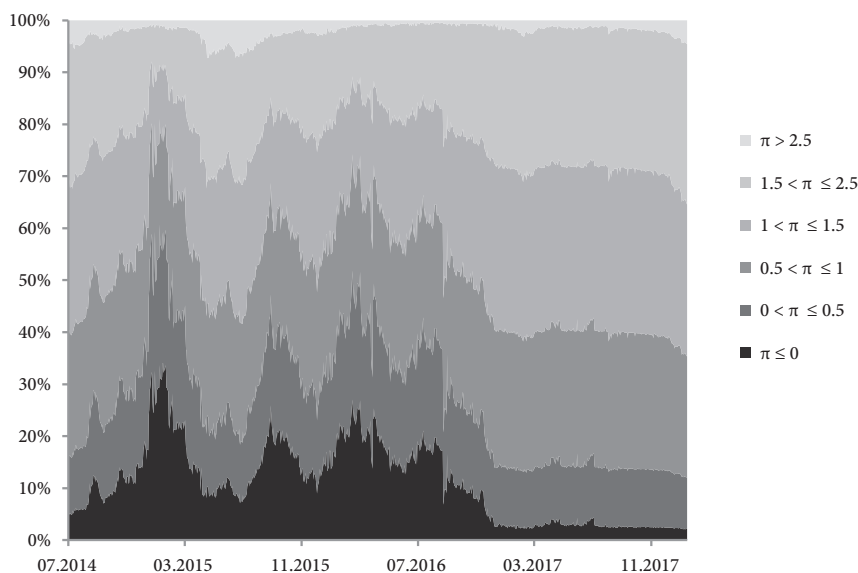
Source: Albertazzi, Nobili and Signoretti (2016). Note: conventional monetary policy is measured with the MRO; non-standard monetary policy is measured with the difference between the shadow rate and the MRO. Deviation from the median bank, basis points, by quartiles of bank characteristics.

Figure 10: Difference in Long-run Pass-through on Lending Rates

ble for the transmission of the monetary policy impulse is very different in the two cases. Specifically, in the case of conventional monetary policy measures, the transmission is stronger for weaker banks, i.e., banks that are comparatively less capitalized, are more exposed to sovereigns and have a weaker funding structure. By contrast, non-standard monetary policies exert a stronger impact through banks that have a more solid capital position and a healthier funding structure and are less exposed to sovereign (Figure 10). The asymmetry documented by in *Albertazzi / Nobili / Signoretti* (2016) is very relevant, as it implies that a potential source of risk associated with conventional measures (i.e., the fact that the expansion in credit is more pronounced for overall less solid banks) is not at work in the case of non-standard ones.

### 3. The Macroeconomic Impact of the APP

The APP has been undoubtedly successful in averting what most observers viewed as the most dangerous risk faced by the euro area at the end of 2014, i.e., that of falling into a deflationary spiral. While it may be estimated that, between late 2014 and early 2015, financial markets put the probability of deflation at as high as one third, such probability declined thereafter (although not in a monotonic fashion) and had all but disappeared by late 2016 (Figure 11). *Bulligan* (2018) shows, using data for a panel of professional forecasters, that the first APP announcement had a sizeable and statistically significant direct impact on inflation expectations. This estimate does not include the indirect effects stemming from the later improvement in macroeconomic conditions.



Source: based on Taboga (2016) and Cecchetti, Natoli and Sigalotti (2015).  
Last observation: 15 January 2018.

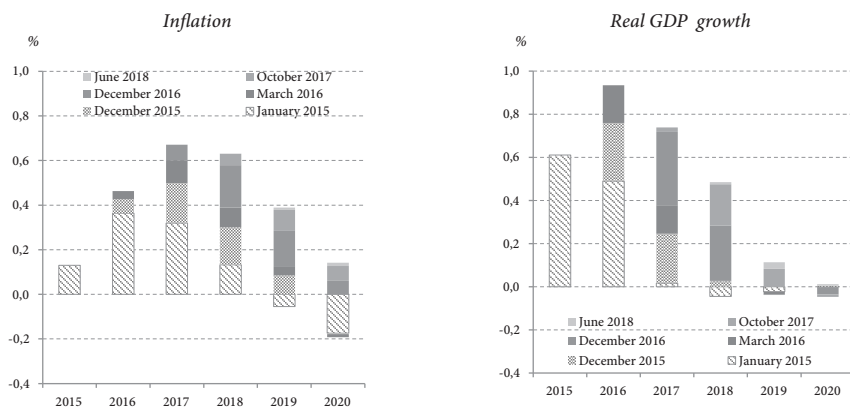
*Figure 11: Probability Distribution of Average Inflation over a 5-year Horizon in the Euro Area*

The complete vanishing of risks of deflation is a sign of success of the programme, and a reason for being confident of its effectiveness. However, the recovery of inflation has been slow and, to date, is far from complete. While the option-implied probability of deflation has disappeared (Figure 11), the probability of inflation in the 1.5–2.5 per cent range is still comparatively low (about 1/3, vs. almost 2/3 probability of inflation being lower than 1.5).

Counterfactual simulations conducted by a number of institutions, including Banca d'Italia (Burlon et al., 2015), confirm both that the APP provided a powerful stimulus to the recovery of euro area real GDP and inflation, and that the monetary expansion, while remaining essential and relevant, is gradually becoming less needed, in that economic activity and consumer price dynamics now need less support than they did until not too long ago.<sup>22</sup> Figure 12 reports the results of simulations carried out at Banca d'Italia, where the impact of successive “waves” of the APP is separately depicted.<sup>23</sup>

<sup>22</sup> As phrased by Visco (2018) with reference to Italy, “[m]acroeconomic policies were still the main driver [of growth in 2017,] but growth is increasingly self-sustained.”

<sup>23</sup> Cova et al. (2015) provide estimates for both the domestic and the international impact of the APP.



Source: Burlon et al. (2015). Note: the charts report the contributions of the initial APP programme (announced in January 2015) and subsequent extensions and re-calibrations.

Figure 12: Macroeconomic Impact of the APP

Qualitatively similar conclusions on the macroeconomic impact of the APP have been reached by *Andrade et al.* (2016), *Gambetti/Musso* (2017); see also *Draghi* (2015, 2016, 2018) and *Praet* (2016). Regarding the CSPP, *Bartocci et al.* (2017) estimate that the macroeconomic impact of the programme has been significant. Bundesbank (2016a) presents the results of simulations that evaluate the impact of the APP on macroeconomic developments and inflation; while the results are surrounded by substantial uncertainty, they suggest that the APP has exerted positive effects on aggregate demand and inflation.

The most recent estimates were provided by *Draghi/de Guindos* (2018), in the Press Conference following the June 2018 meeting of the Governing Council of the ECB: “Considering all the measures taken since mid-2014, the overall impact on euro area real GDP growth and euro area inflation is estimated by the ECB to be – in both cases – around 1.9 percentage points cumulatively in the period between 2016 and 2020.” This is indeed close to the assessment by *Burlon et al.* (2015) shown in Figure 12, which considers only the APP.

Summing up, both the estimates by Banca d’Italia researchers and those by researchers of other national central banks and the ECB unanimously estimate a sizeable overall effect of the APP on both real GDP and inflation over the period 2015–20. However, an earlier adoption of the APP would arguably have prevented the sharp decline in long-term inflation expectations and the rise in the risk of their de-anchoring from the definition of price stability observed until 2015.

#### 4. *Risks and Unintended Consequences*

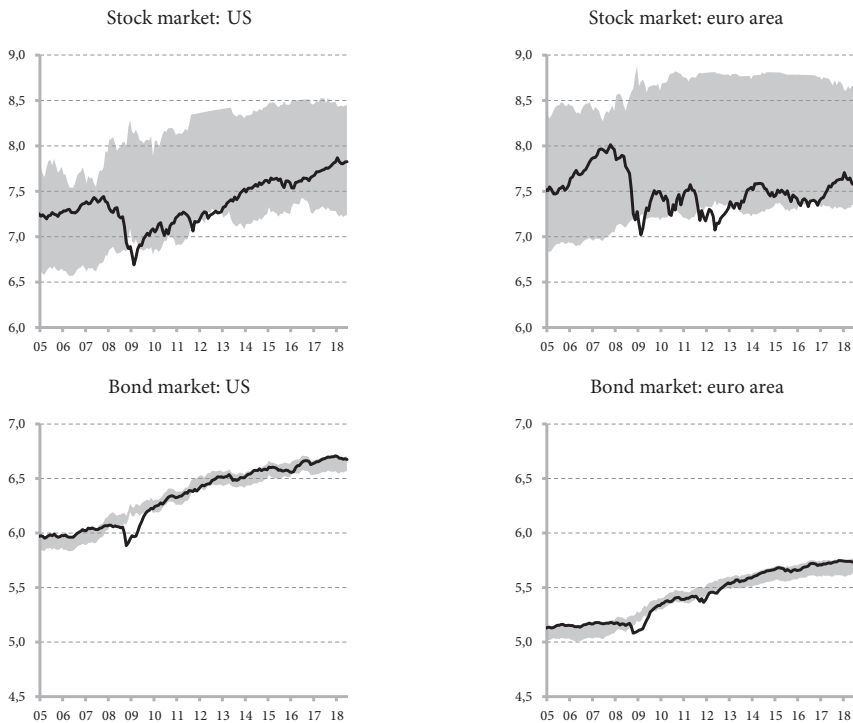
When sailing in uncharted waters, as the ECB monetary policy did in the last decade, it is common-sense to be extra-cautious and continuously on the lookout for possible unknown problems and obstacles. Following a new and unknown course of action without wondering about the possibility of undesirable occurrences would be foolish.

There is no question that many, if not most, of the measures adopted by the Eurosystem since 2008 qualify as extraordinary and previously unexplored. Concerns about the possibility of unfavourable collateral effects are therefore fully warranted. While the issue of possible unintended consequences of the APP and other non-standard measures has understandably attracted a lot of attention (see, among others, Bundesbank, 2016a), a fair conclusion to date is, in our opinion, that the available evidence is on the whole reassuring. Even in economies where quantitative measures were adopted long before they were in the euro area (in the US, for instance, QE started six years earlier than the APP), so far signs of financial imbalances, or worse, have not clearly emerged.

In this section we briefly present empirical evidence addressing the following questions: Did the APP result in overvaluation of financial assets, which could imply the risk of a bubble bursting in the future? Were the non-standard policies adopted by the Eurosystem detrimental to bank profitability? Did the asset purchases favor asset holders, thus resulting in undesirable income and wealth redistribution effects? And finally, do asset purchases encourage moral hazard and delay the adoption of much-needed structural reforms?

As regards the first question, *Cecchetti / Taboga* (2017) compute confidence intervals for the value of stocks and corporate bonds, taking into account uncertainty about future cash flows (when applicable) and the discount factors used to compute their net present value (the resulting confidence intervals are obviously much wider for stocks than for bonds). Their results, reported in Figure 13, suggest that for both the US and the euro area the risk of stocks overvaluation is very low, while it is higher, though within the confidence intervals, for bonds.

*Droes / Lamoen / Mattheuassens* (2017) find that, just before the implementation of the APP, government bond prices in euro area rose to such an extent that they were no longer aligned with their underlying fundamental value. However, their analysis shows no evidence of exuberant government bond prices after January 2015, i.e., the actual start of the programme. Price-earnings ratios provide another way of assessing the degree of overvaluation of stock market prices. ECB (2018) presents several indicators, among which the price-earnings ratio, for both the US and the euro area stock markets; equity valuations are argued to be high by historical standards in the US, while they are in line with past developments in the euro area.



Source: Cecchetti / Taboga (2017). The charts show, on a log scale, the actual asset prices (black solid lines) and the estimated confidence bands for the fundamental value (grey shaded area). The methodology to compute the intervals for the fundamental values of stocks and corporate bonds takes into account uncertainty about future cash flows and the discount factors; both sets of variables are estimates resorting to different approaches and parameter calibrations. The confidence bands span the area comprised between the 10<sup>th</sup> and 90<sup>th</sup> percentiles of the distribution of fundamental values. Sample period: December 1980 to February 2017.

Figure 13: Bond and Stock Prices in the Euro Area and the US

Burlon et al. (2016) argue that, even in case asset overvaluation does emerge in specific regions of the area, financial tensions may and should be dealt with by means of region-specific macroprudential measures, with no need to depart from the appropriate monetary policy stance. Specifically, they show that macroprudential measures can stabilize private sector borrowing with limited negative effects on economic activity.

Another risk often mentioned in relation to the non-standard measures of the ECB is that their net effect on banks' profitability is negative. While the direct impact on banks' maturity transformation is likely to be negative, a fair and comprehensive assessment should take into account the indirect impact of the measures, including those on the quality of bank credit and the volumes of credit. For the euro area as a whole, ECB (2016b) shows the impact of monetary pol-

icy measures on bank profitability does not appear to be particularly strong compared with other cyclical and structural factors affecting bank profitability.<sup>24</sup> *Altavilla / Boucinha / Peydró* (2017) analyse the impact of standard and non-standard monetary policy measures on bank profitability, focusing on the euro area and exploiting bank and country heterogeneity within the monetary union. The analysis shows that a decrease in short-term interest rates or a flattening of the yield curve is not associated with lower profits. The positive impact of a monetary easing on loan loss provisions and non-interest income largely offsets the negative effect on the net interest income.<sup>25</sup>

As far as the impact of non-standard monetary policy on inequality is concerned, some authors (including economic journalists and commentators writing in mainstream media<sup>26</sup>) have argued that the non-standard monetary policy measures adopted by the Eurosystem and by other central banks, by supporting the price of assets, necessarily benefitted asset-holders, i.e., the wealthiest portion of the population, thus acting as a “reverse Robin Hood”. This conclusion stems from considering only part of the overall impact of the non-standard monetary policy measures. By combining macro and micro evidence, *Casiraghi et al.* (2018) conclude that non-standard monetary did not act as a “reverse Robin Hood”. Larger, if less direct, benefits accrued to households at the bottom of the income scale, as the effects via the stimulus to economic activity and employment outweigh those via financial variables. The response of both income and wealth, as a function of income and wealth deciles, is actually U-shaped; overall, the effects on inequality are negligible. A study by the Bundesbank (2016b) reaches similar conclusions: the monetary policy measures of the last few years may have reduced the inequality of income distribution, while the impact on wealth distribution is less clear.

Finally, it has been argued that the APP may have blurred the distinction between monetary and fiscal policies, thus encouraging moral hazard, slowing down fiscal consolidation, and delaying the adoption of structural reforms. Empirical evidence on this issue is still scant. If anything, available evidence (*Dias Da Silva / Givone / Sondemann*, 2017; *Draghi*, 2017a) suggests that “low interest rates, if at all, tend to promote rather than discourage structural reforms,” while there is no clear link between fiscal policy and reforms. Furthermore, there are good reasons to believe that monetary policy may support, rather than discourage, the adoption of structural reforms and efforts aimed at consolidating fiscal balances. As argued by *Visco* (2015), “the adoption of an asset purchase pro-

<sup>24</sup> Internal simulations by the Bank of Italy confirm, for Italy, the results of the ECB.

<sup>25</sup> Bank profitability is affected negatively by bank provisions against high non-performing loan ratios. *Altavilla, Boucinha and Peydró* (2017) find that the higher the NPL, the more positive the impact of monetary policy easing on profitability.

<sup>26</sup> See, e.g., *Giles* (2014); *Claeys et al.* (2015).

gramme – which stimulates aggregate demand, reduces uncertainty and sustains confidence – can help the economy absorb these possible costs and maintain the necessary political drive and consensus on the need for reforming, thus making it more feasible [...] Similar considerations hold for fiscal sustainability.”

## V. The Recalibration of the ECB Monetary Policy

In this Section we describe the recalibration of the ECB monetary policy since December 2016 and provide some thoughts on the way forward, also touching upon the role of the natural rate of interest and the operational framework in the “new normal”. We start by briefly reviewing the experience of the Federal Reserve with its gradual exit from a very accommodative stance.

### 1. *The Experience of the Federal Reserve*

The accumulation of positive economic news in the spring of 2013 led Federal Reserve Chairman Ben Bernanke to announce at its testimony to the US Congress on 22 May 2013 that the Federal Reserve would likely consider slowing – tapering – the pace of asset purchases over the course of the next few meetings. On that occasion, Chairman Bernanke made no reference to the possibility of raising the target for the Federal funds rate. On the contrary, he stated that the FOMC intended to maintain a highly accommodative monetary policy. The “taper-tantrum” episode, which was characterized by a sharp correction in asset valuations in global financial markets (and especially in emerging market economies, where asset prices had increased substantially in previous years, following a period of exceptionally strong growth and asset inflows), shows that market participants could not clearly distinguish between changes in asset holdings and the broader stance of monetary policy. Despite the “Exit Strategy Principles” outlined by the FOMC in June 2011,<sup>27</sup> in spring 2013, investors misread the intentions of the Federal Reserve and erroneously extrapolated the desire to reduce the net purchases of securities as implying that the central bank was ready to adjust its monetary policy stance sooner than previously thought.

In September 2014, a new set of normalization principles was agreed upon by the FOMC;<sup>28</sup> the normalization would begin with the adjustment of the target range for the Federal funds rate and would be followed, depending on the evolution of economic and financial conditions and of the economic outlook, by phasing out the reinvestment of maturing securities on the Federal Reserve’s balance sheet. At its December 2015 meeting, the FOMC decided to begin the

<sup>27</sup> See Board of Governors of the Federal Reserve System (2011).

<sup>28</sup> See Board of Governors of the Federal Reserve System (2014).



normalization process by modestly raising its target range for the Federal funds rate. In June 2017, the FOMC announced that the Federal Reserve would decrease (but not discontinue) its reinvestment of the principal payments from maturing securities, thus gradually reducing securities holdings.

All in all, the experience of the Federal Reserve clearly shows the importance of a careful and unambiguous communication about the expected changes to the monetary policy stance, so as to avoid an unwarranted tightening of monetary and financial conditions.

## 2. A Risk Management Approach to Recalibration

When the policy rate is at its lower bound, recalibration of the monetary stance arguably calls for a risk-management approach, which requires that, in assessing policy options, the dispersion of shocks is duly taken into account. *Evans et al. (2015)* show that such an approach has two implications. First, the possibility of a binding effective lower bound to the policy rates tomorrow leads to lower expected inflation and output today, calling for policy easing. Second, if inflation or output are intrinsically persistent, building up output and inflation today reduces the likelihood and severity of hitting the lower bound in the future.

Even abstracting from the implications highlighted by *Evans et al. (2015)*, it is intuitively the case that the optimal monetary policy should be looser in order to raise inflation and strengthen economic activity if there is sufficiently high probability of hitting again the lower bound in the future during the process of recalibrating monetary policy. A longer delay in raising policy rates is advisable, so as to avoid the reputational costs of having hastily to revert to the ZLB. The public may lose confidence in the central bank's ability to understand the functioning of the economy and delivering on its mandate. At the lower bound, this concern would call for a delay in the lift-off of the policy rates. Moreover, if there is uncertainty over the strength of the economy, an early lift-off might be interpreted as a weaker commitment to the policy objectives.

*Greenspan (2004)* in his speech on "Risk and uncertainty in monetary policy" underlines that uncertainty is the defining characteristic of the monetary policy landscape and acknowledges that "the conduct of monetary policy in the United States has come to involve, at its core, crucial elements of risk management", building upon the construction of risk scenarios and assessing the corresponding costs. Therefore, not only the central projections are important, but also the distribution of the possible outcomes around it. A risk-management approach to monetary policy calls for a joint assessment of the probabilities, the costs, and the benefits of the different scenarios, conditional on alternative policy measures. *Greenspan* cites as an example the 1998 crisis. Following the Russian debt

default in the autumn of 1998, the Federal Reserve lowered the target for the Federal funds rate, even though the US economy was performing well at the time, because the FOMC was concerned that about the low-probability risk that the default might trigger events that would severely disrupt domestic and international financial markets, feeding back to the US economy.

The decisions taken since mid-2014 by the Governing Council of the ECB are arguably another instance of a risk-management approach to monetary policy (Cœuré, 2017). Following the disinflation that started in late 2012, the balance of risks gradually shifted downwards; the probability of falling into a deflationary spiral increased substantially, also due to the increasing risk of de-anchoring of long-term inflation expectations. If extreme shocks had materialized, even in the context of low but positive central projections for inflation, the ability of the ECB to preserve price stability in the medium-term would have been seriously compromised. Faced with a serious threat to its credibility, the ECB adopted a set of policy measures, including the purchases of government securities, to avoid the materialization of deflation. The Governing Council announced that it was ready to introduce additional measures to make the stance of monetary policy more accommodative, if needed. Bold steps were needed in order to preserve the most important assets of a central bank: its credibility. These policy interventions contributed to shifting upwards, and narrowing, the distribution of risks to the inflation outlook.

The boldness of these decisions contrasts with the more cautious approach to the recalibration of the monetary stimulus. Indeed, *Ferrero / Pietrunti / Tiseno* (2018) show that resorting alternatively to boldness and gradualism in different cyclical phases can be rationalized once it is acknowledged that the central banks has imperfect information on the transmission mechanism of monetary policy.<sup>29</sup> In this sense, the Brainard principle of gradualism (*Brainard*, 1967) is not a doctrine but “a pragmatic approach that is generally suitable to situations characterised by significant uncertainty about the impact of available policy instruments” (*Praet*, 2018).

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<sup>29</sup> The mechanism underlying this conclusion is that, if a risk-averse policymaker is uncertain about the slope of the Phillips curve and if a shock is transitory, the policy response should be gradual, thus abiding by the Brainard principle. However, if a shock is very persistent, the effects of inaction today would imply long-lasting undesired deviations of output and inflation from the target in the future; this being the case, an aggressive response is warranted. As the negative shocks to inflation in 2013–15 were arguably very persistent (as documented, e.g., by the systematically negative projection errors in that periods), an aggressive response was warranted. In the current circumstances, by contrast, shocks are arguably back to being transitory and the Brainard principle applies.

### 3. *Patience, Prudence and Persistence*

Extreme circumstances require exceptional measures. Had the ECB not adopted the APP, and in particular had it not included public securities in the set of eligible assets, a deflationary spiral could have materialized, with serious consequences for the credibility of the central bank.

Since 2017, the ECB has been confronting a more benign environment.<sup>30</sup> The set of tools used between mid-2014 and early 2015 have contributed to stabilizing inflation and its expectations by supporting the recovery. Economic developments have allowed the Governing Council of the ECB to gradually recalibrate the policy tools. The recovery in economic activity gradually evolved into a robust expansion, with real GDP growth reaching 2.5 per cent in 2017. This contributed to closing the output and employments gaps, exerting upward pressures on nominal wages and inflation and further reducing the perceived risk of deflation (Figure 11), which had instead been material between late 2014 and mid-2016.

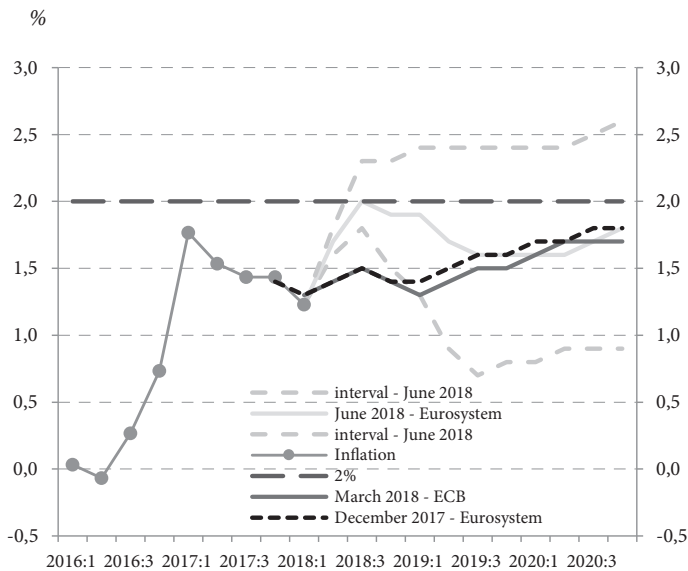
Inflation has recovered from the lows reached in 2015 and 2016 and is gradually returning to levels consistent with the definition of price stability. Economic developments have allowed the Governing Council of the ECB to gradually recalibrate the policy tools. Projections by the Eurosystem staff released in December 2017 confirmed that a significant progress towards a sustained adjustment in the path of inflation had been achieved. The projections by the ECB staff in March 2018 and those by the staff of the Eurosystem in June 2018 provided additional support to the view that inflation was expected to converge to levels consistent with price stability (Figure 14). Confidence in the prospects for inflation also gradually strengthened; the risks around the projections became more balanced. Persistence in expansionary monetary policy was still required, given that the upward trend in inflation was assessed to be still dependent on a very accommodative policy stance.

The various recalibrations of the monetary instruments since late 2016, when deflation risks were perceived to have by and large vanished, are summarised in Table 1.

Supported by an increasingly positive assessment of the inflation outlook, in December 2016 the Governing Council decided to reduce the pace of monthly purchases from €80 to €60 billion from April 2017 until the end of 2017, or beyond, if necessary, and in any case until a sustained adjustment in the path of

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<sup>30</sup> The reference to the use of all instruments to fulfil the mandate of price stability, which was introduced in the communication by the Governing Council in April 2016, was removed in March 2017, when it was felt that the risks of deflation had disappeared.



Source: ECB. Note: the December 2017 and June 2018 projections are computed by the Eurosystem staff, the March 2018 ones by the ECB staff.

Figure 14: Eurosystem Inflation Projections

Table 1  
Recalibration of the Monetary Tools by the ECB

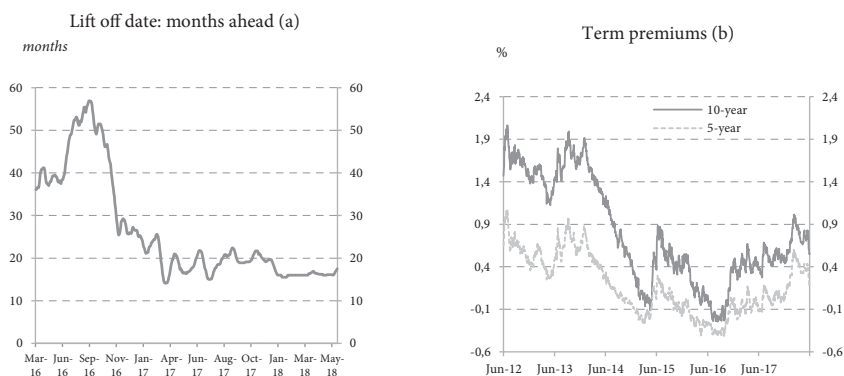
Date	Tool	Adjustment
8 December 2016	Asset purchase programme	Reduction of purchases from € 80 billion to € 60 billion from April 2017 until December 2017
8 June 2017	Forward guidance on policy rates	Removal of “easing bias” from forward guidance
26 October 2017	Asset purchase programme	Reduction of purchases from € 60 billion to € 30 billion from January 2018 until September 2018
8 March 2018	Asset purchase programme	Removal of “easing bias” from forward guidance
14 June 2018	Asset purchase programme and forward guidance on policy rates	Reduction of purchases from € 30 to € 15 billion from October 2018 until December 2018 and expected to end afterwards. Policy rates expected to remain at current levels at least through the summer of 2019

Source: ECB.

inflation consistent with the definition of price stability has been achieved. At the same time, the Governing Council introduced a “negative (easing) bias” in the communication on the future path of APP net purchases, highlighting its willingness to increase the asset purchase programme in terms of size and/or duration, if warranted. The sequencing of the changes to the monetary policy stance along the path of normalisation was outlined by the ECB president in *Draghi (2017c)*.

In June 2017, the Governing Council removed the “easing bias” (i.e. the reference to the possibility of further reduction of the policy rates) embedded in the forward guidance on the policy rates. The pace of monthly net asset purchases was again reduced in October 2017, from €60 to €30 billion from January 2018 until the end of September 2018, or beyond, if necessary, and in any case until a sustained adjustment in the path of inflation consistent with the definition of price stability had been achieved. The easing bias on the APP was left in the forward guidance.

A further recalibration was decided in March 2018, when the easing bias on the APP (“If the outlook becomes less favourable, or if financial conditions become inconsistent with further progress towards a sustained adjustment in the path of inflation, we stand ready to increase the asset purchase programme (APP) in terms of size and/or duration”) was removed. The removal of the two easing biases in the forward guidance did not result in unwarranted adjustments in expected short-term rates and in long-term yields (Figure 15, panel a), confirming that the decisions were clearly perceived as being justified by the improvement in the outlook for growth and inflation.



Source: Bloomberg and Banca d'Italia calculations. Note: the lift-off date is computed on the basis of overnight index swap rates. The lift-off date is defined as the date at which the OIS forward rate goes permanently above a given threshold ( $-0.25$  basis points).

Figure 15: Expected Date of Lift-off and Term Premiums in the Euro Area

*Praet* (2018) conveyed the message that the Governing Council was confident in the continuation of the strong and broad-based expansion, which will eventually support the return of inflation to levels consistent with the definition of price stability. As this confidence increased further, the Governing Council decided in June 2018 to reduce the pace of net monthly purchases to €15 billion for the last quarter of the year, conditional on incoming data confirming its medium-term inflation outlook. The forward guidance on the policy rates was modified by attaching both a calendar-based (“[...] at least through the summer of 2019 [...]”) and an outcome-based (“[...] to ensure that the evolution of inflation remains aligned with our current expectations of a sustained adjustment [...]”) conditionality.

Even after the adjustment to the forward guidance and the scaling down of the net asset purchases, the monetary policy stance continues to be very accommodative. The policy stance is now made up of three elements: the flow of net asset purchases, the stock of outstanding bonds and principal reinvestments and the forward guidance on the future path of the policy rates. To the extent that the evolution of inflation will be consistent with a sustained adjustment of inflation, the policy instruments that define the monetary policy stance will be further adjusted.

This bird’s eye view of the adjustments made by the Governing Council of the ECB to the (non-standard) monetary policy stance over the last two years highlights an important message: normalization of monetary policy should not be thought of as a binary event, with two outcomes corresponding to an “extraordinary” and a “normal” stance. Rather, normalization is a process, which has started as far back as late 2016, and has been quietly proceeding since, without producing any major shock waves. Indeed, the gradual rescaling of the net asset purchases did not result in a significant increase in term premiums on highly-rated government securities (Figure 15, panel b). The term premiums on the five and ten-year maturities were still below the levels that prevailed before the beginning of the disinflation in the second half of 2012, in particular for the longer maturity. Changes to the forward guidance on the policy rates did not substantially modify market-based expectations on the lift-off. Even the announcement, in June 2018, of the termination of the program by the end of the year was quietly received by the markets.

#### *4. Challenges Ahead: the Natural Rate of Interest and the Long-run Operational Framework*

Looking ahead, once the recalibration of monetary policy has been completed and more “normal” conditions have been restored, two challenges, which have first order implications for policymaking, will need to be addressed: the low level of the natural rate and the operational framework in the “new normal”.

On the first issue, *Ferrero / Neri* (2017) present a review of the literature on the factors that may have brought nominal interest rates to historically low levels in the recent years. The decline of the natural rate of interest, on which extensive evidence may be found in the literature, is the main factor behind the low interest rate environment. *Gerali / Neri* (2018) estimate a closed-economy model for the United States and the euro-area to assess the current level of the natural rate of interest and shed light on its drivers. The analysis shows that the natural rate has declined over the past decades, contributing to lowering nominal and real rates. Bundesbank (2017b) considers different methods to estimate the natural interest in the euro area and also finds evidence of a downward trend in the natural interest rate, although the estimates are surrounded by large uncertainty. Indications of a declining trend in the natural rate in both the US and the euro area are also presented in Bank for International Settlements (2018); also in this case the range spanned by the estimates is large.

A lower natural rate increases the likelihood of hitting the lower bound to policy rates (*Kiley and Roberts*, 2017). Many of the theories proposed to explain long-term interest rate trends emphasize the role of structural, economic and demographic changes, which have given rise to a persistent imbalance between investment demand and savings supply and to a phase of secular economic stagnation (*Summers*, 2014). Among these factors, *Ferrero / Gross / Neri* (2017) focus on the impact of ageing on interest rates in the euro area. *Busetti / Caivano* (2017) show that the evolution of total factor productivity (with a specific role for human capital accumulation) and demographic trends are important drivers of the long-term movements of real rates. A second group of hypotheses underlines the role of financial factors (*Borio*, 2014; *Rogoff*, 2016). While the two sets of hypotheses may have different implications for monetary policy the long-term, their short- and medium-term implications are similar.

Concerning the operational framework, changes in regulation requiring banks to hold more liquid assets, the developments of the shadow banking sector, the deepening and broadening of financial markets in Europe will have to be carefully assessed in order to understand the implications for counterparty eligibility, the choice of money market rates to target to ensure an effective monetary policy transmission and the size of the balance sheet of the Eurosystem. Asset purchases may be adopted more frequently, to the extent that the policy rates hit their effective lower bound more often. Further research is needed on both the strategy and implementation of monetary policy in order for central banks to be ready for future challenges (*Williams*, 2017).

## VI. Concluding Remarks

The ECB has faced extreme circumstances since the outbreak of the global financial crisis. The need to preserve the correct functioning of the monetary policy transmission mechanism and the supply of credit to the private sector, and to avoid the materialization of deflationary risks, have stretched the limits of monetary policy. The operational framework has proved flexible enough to allow the ECB to sail in uncharted waters. During the 2013 and 2014 disinflation the ECB has faced the most serious risk for a central bank, that is, the risk of losing its credibility, arguably its most important asset. The APP was essential in avoiding the materialization of such risk and preserving the reputation of the ECB.

This paper has reviewed a large body of studies that have been conducted in recent years in order to help address those challenges. As a by-product, the review of the literature suggests that the research conducted in a number of central banks (including Banca d'Italia) has provided an important input to Eurosystem monetary policymaking in very difficult and challenging circumstances. Indeed, policy and research continuously interact in a two-way relationship. On the one hand, policy provides researchers with important questions to be addressed. On the other, high-quality research is essential for a central bank to be able effectively to contribute to policy debates and policymaking. The contribution of research to policymaking in the recent past was particularly important, as acknowledged by the ECB President in a recent speech (*Draghi, 2017b*): “[...] the past ten years show how indebted the former [policymakers] are to the latter [researchers]”. As remarked by *Visco (2016)*, the support that economic research provides to policy analysis is indeed particularly relevant, and challenging, when economic conditions are unusual and extreme – as was the case in the last decade – and, as a result of this, past evidence is unlikely to be very helpful. In those conditions, given that “monetary policy cannot wait until sufficient information accumulate that may cast full light on the new mechanisms at work,” central bank researchers must ‘rush against time’ and strive to “develop in a very short span of time [new] indicators and models that make the best out of whatever information is available.” The evidence presented in this paper shows that the output of euro area central banks’ research was heavily made use of by the monetary policymaker, and suggests that it proved to be, by and large, useful.



## References

- Albertazzi, U./Becker, B./Boucinha, M.* (2018): Portfolio rebalancing and the transmission of large-scale asset programmes: evidence from the euro area, ECB Working Paper No. 2125.
- Albertazzi, U./Bottero, M.* (2014): Foreign bank lending: evidence from the global financial crisis, *Journal of International Economics*, Vol. 92, pp. S22-S35.
- Albertazzi, U./Nobili, A./Signoretti, F. M.* (2016): The bank lending channel of conventional and unconventional monetary policy”, Banca d’Italia Working Paper No. 1094.
- Altavilla, C./Boucinha, M./Peydro, J. L.* (2017): Monetary policy and bank profitability in a low interest rate environment, ECB Working Paper No. 2105.
- Altavilla, R./Carboni, C./Motto, R.* (2015): Asset purchase programmes and financial markets: lessons from the euro area, ECB Working Paper No. 1864.
- Alvarez, I./Casavecchia, F./De Luca, M./Duering, A./Eser, F./Helmus, C./Hemous, C./Herrala, N./Jakovick, J./Lo Russo, M./Pasqualone, F./Rubens, M./Soares, R./Zennaro, F.* (2017): The use of the Eurosystem’s monetary policy instruments and operational framework since 2012, ECB Occasional Paper No. 188.
- Andrade, P./Breckenfelder, J./De Fiore, F./Karadi, P./Tristani, O.* (2016): The ECB’s asset purchase programme: An early assessment, ECB Working Paper No. 1956.
- Auer, R./Borio, C./Filardo, A.* (2017): The globalization of inflation: the growing importance of global value chains, BIS Working paper No. 602.
- Ball, L./Mazumder, S.* (2011): Inflation dynamics and the Great Recession, *Brookings Papers on Economic Activity*, Vol. 42, pp. 337–405.
- Banca d’Italia* (2013): The sovereign debt crisis and the euro area, Papers presented at the workshop held at the Bank of Italy on 15 February.
- (2018): 2017 Annual Report, 29 May.
- Bank for International Settlements* (2018): Annual economic report, June.
- Bartocci, A./Burlon, L./Notarpietro, A./Pisani, M.* (2017): Macroeconomic effects of non-standard monetary policy measures in the euro area: the role of corporate bond purchases, Banca d’Italia Working Paper No. 1136.
- Belke, A./Gros, D./Oswski, T.* (2017): The effectiveness of the Fed’s quantitative easing policy: New evidence based on international interest rate differentials, *Journal of International Money and Finance*, Vol. 73, pp. 335–349.
- Bereau, S./Faubert, V./Schmidt, K.* (2018): Explaining and forecasting euro area inflation: the role of domestic and global factors, Banque de France Working Paper No. 663.
- Bianchi, F./Civelli, A.* (2015): Globalization and Inflation: Evidence from a Time-Varying VAR, *Review of Economic Dynamics*, Vol. 18, 2, pp. 406–33.
- Board of Governors of the Federal Reserve System* (2011): FOMC Minutes, June 21–22 (<https://www.federalreserve.gov/monetarypolicy/fomcminutes20110622.htm>).
- (2014): Policy Normalization Principles and Plans ([https://www.federalreserve.gov/monetarypolicy/files/FOMC\\_PolicyNormalization.pdf](https://www.federalreserve.gov/monetarypolicy/files/FOMC_PolicyNormalization.pdf)).

- Bobeica, E./Jarociński, M.* (2018): Missing disinflation and missing inflation: a VAR perspective, *International Journal of Central Banking*, forthcoming.
- Bonaccorsi di Patti, E./Sette, E.* (2016): Did the securitization market freeze affect bank lending during the financial crisis? Evidence from a credit register, *Journal of Financial Intermediation*, Vol. 25, pp. 54–76.
- Borio, C.* (2014): The financial cycle and macroeconomics: What have we learnt?, *Journal of Banking and Finance*, Vol. 45, pp. 182–198.
- Brainard, W. C.* (1967): Uncertainty and the Effectiveness of Policy, *American Economic Review Papers and Proceedings*, Vol. 57, pp. 411–425.
- Bulligan, G.* (2018): The effect of the Eurosystem's expanded Asset Purchase Programme on inflation expectations: evidence from the ECB Survey of Professional Forecasters., Banca d'Italia Occasional paper, forthcoming.
- Bulligan, G./Delle Monache, D.* (2018): Financial markets effects of ECB unconventional monetary policy announcements, Banca d'Italia Occasional Paper No. 424.
- Bundesbank* (2016a): The macroeconomic impact of quantitative easing in the euro area, *Monthly Bulletin*, June, pp. 29–54.
- (2016b): Distributional effects of monetary policy, *Monthly Bulletin*, September, pp. 15–38.
  - (2017a): The Eurosystem's bond purchases and the exchange rate of the euro, *Monthly Bulletin*, January, pp. 13–40.
  - (2017b): The natural rate of interest, *Monthly Bulletin*, October, pp. 35–38.
- Burlon, L./Gerali, A./Notarpietro, A./Pisani, M.* (2015): Inflation, financial conditions and non-standard monetary policy in a monetary union. A model-based evaluation, Banca d'Italia Working Paper No. 1015.
- (2016): Non-Standard Monetary Policy, Asset Prices and Macroprudential Policy in a Monetary Union, Banca d'Italia Working Paper No. 1089.
- Busetti, F./Caivano, M.* (2017): Low frequency drivers of the real interest rate: A band spectrum regression approach, Banca d'Italia Working Paper No. 1132.
- Busetti, F./Caivano, M./Rodano, L.* (2015): On the Conditional Distribution of Euro Area Inflation Forecast, Banca d'Italia Working Paper No. 1027.
- Busetti, F./Cova, P.* (2013): The macroeconomic impact of the sovereign debt crisis: A counterfactual analysis for the Italian economy, Banca d'Italia Occasional Paper No. 201.
- Busetti, F./Delle Monache, D./Gerali, A./Locarno, A.* (2017): Trust, but verify. De-anchoring of inflation expectations under learning and heterogeneity, ECB Working Paper No. 1994.
- Caivano, M./Rodano, L./Siviero, S.* (2011): La trasmissione della crisi finanziaria globale all'economia italiana. Un'indagine controfattuale, 2008–2010, *Giornale degli Economisti e Annali di Economia*, Vol. 70, pp. 1–32.
- Carriero, A./Corsello, F./Marcellino, M.* (2018): The global component of inflation volatility, Banca d'Italia Working Paper No. 1170.

- Casiraghi, M./Ferrero, G.* (2015): Is deflation good or bad? Just mind the inflation gap, Banca d'Italia Occasional Paper No. 268.
- Casiraghi, M./Gaiotti, E./Rodano, L./Secchi, S.* (2016): ECB unconventional monetary policy and the Italian economy during the sovereign debt crisis", *International Journal of Central Banking*, Vol. 12, pp. 269–315.
- (2018): A “reverse Robin Hood”? The distributional implications of non-standard monetary policy for Italian households, *Journal of International Money and Finance*, Vol. 85, pp. 215–235.
- Casiraghi, M./Miccoli, M.* (2015): Risk-adjusted forecasts of inflation, Banca d'Italia Occasional Paper No. 286.
- Cecchetti, S.* (2017): A quantitative analysis of the risk premia in the corporate bond market, Banca d'Italia Working Paper No. 1141.
- Cecchetti, S./Natoli, F./Sigalotti, L.* (2015): Tail comovement in option-implied inflation expectations as an indicator of anchoring, Banca d'Italia Working Paper No. 1025.
- Cecchetti, S./Taboga, M.* (2017): Assessing the risks of asset overvaluation: models and challenges, Banca d'Italia Working Paper No. 1114.
- Cecioni, M.* (2018) ECB monetary policy and the euro exchange rate, Banca d'Italia Working Paper No. 1172.
- Cecioni, M./Ferrero, G./Secchi, A.* (2010): Unconventional monetary policy in theory and in practice?, Banca d'Italia Occasional Paper No. 102.
- Ciccarelli, M./Osbat, C.*, eds. (2017): Low inflation in the euro area: Causes and consequences, ECB Occasional Paper No. 181.
- Claeys, G./Darvas, Z./Leandro, A./Walsh, T.* (2015): The effects of ultra-loose monetary policy on inequality, Bruegel policy contribution, June.
- Cœuré, B.* (2017): Central banks as risk managers, speech at the 53<sup>rd</sup> SEACEN Governors' Conference/High-Level Seminar and the 37<sup>th</sup> Meeting of the SEACEN Board of Governors, Bangkok, 16 December.
- Coibion, O./Gorodnichenko, Y.* (2015): Is the Phillips curve alive and well after all? Inflation expectations and the missing disinflation, *American Economic Journal: Macroeconomics*, Vol. 7, pp. 197–232.
- Committee on the Global Financial System* (2011): The impact of sovereign credit risk on bank funding conditions, CGFS papers, No. 43.
- Constâncio, V.* (2014): Speech at the 18<sup>th</sup> Annual Central Bank and Investment Authority Seminar organised by Commerzbank, Berlin, 16 October.
- (2018): Past and future of the ECB monetary policy, speech at the Conference on “Central Banks in Historical Perspective: What Changed After the Financial Crisis?”, Central Bank of Malta, Valletta, 4 May.
- Conti, A./Neri, S./Nobili, A.* (2015): Why inflation is so low in the euro area ?, Banca d'Italia Working Paper No. 1019.
- Corsetti, G./Kuester, K./Meier, A./Müller, G.* (2014): Sovereign risk and belief-driven fluctuations in the euro area, *Journal of Monetary Economics*, Vol. 61, pp. 53–73.

- Cova, P./Ferrero, G. (2015): Il programma di acquisto di attività finanziarie per fini di politica monetaria dell'Eurosistema, Banca d'Italia Occasional Paper No. 270.
- Cova, P./Pagano, P./Pisani, M. (2015): Domestic and international macroeconomic effects of the Eurosystem expanded asset purchase programme, Banca d'Italia Working Paper No. 1036.
- Cuñasca, A./Rother, P. (2015): Fiscal multipliers during consolidation: evidence from the European Union, ECB Working Paper No. 1863.
- De Santis, R. A. (2016): Impact of the asset purchase programme on euro area government bond yields using market news, ECB Working Paper No. 1939.
- Del Giovane, P./Eramo, G./Nobili, A. (2011): Disentangling demand and supply in credit developments: A survey-based analysis for Italy, *Journal of Banking and Finance*, Vol. 35, pp. 2719–2732.
- Del Giovane, P./Nobili, A./Signoretti, F. M. (2017): Assessing the Sources of Credit Supply Tightening: Was the Sovereign Debt Crisis Different from Lehman?, *International Journal of Central Banking*, Vol. 13, pp. 197–234.
- Delle Monache, D./Venditti, F. (2016): Common faith or parting ways? A time varying parameters factor analysis of euro-area inflation, in: E. Hillebrand and S. J. Koopman (eds.) *Advances in Econometrics*, Vol. 35, pp. 539–565, Emerald Group Publishing Limited.
- Di Cesare, A./Grande, G./Manna, M./Taboga, M. (2012): Recent estimates of sovereign risk premia for euro-area countries, Banca d'Italia Occasional Paper No. 128.
- Dias Da Silva, A./Givone, A./Sondemann, D. (2017): When do countries implement structural reforms?, ECB Working Paper No. 2078.
- Draghi, M. (2012): Speech at the Global Investment Conference in London, 26 July.
- (2014): Monetary policy in the euro area, speech at the Frankfurt European Banking Congress, Frankfurt am Main, 21 November.
  - (2015): Global and domestic inflation, speech at the Economic Club of New York, 4 December.
  - (2016): Delivering a symmetric mandate with asymmetric tools: monetary policy in a context of low interest rates, speech at the ceremony to mark the 200<sup>th</sup> anniversary of the Oesterreichische Nationalbank, Vienna, 2 June.
  - (2017a): Structural reforms in the euro area, Introductory remarks at the ECB conference Structural reforms in the euro area, Frankfurt am Main, 18 October.
  - (2017b): The interdependence of research and policymaking, speech at the Lindau Nobel Laureate Meeting, Lindau, Germany, 23 August.
  - (2017c): Monetary policy and the economic recovery in the euro area, speech at The ECB and Its Watchers XVIII Conference, Frankfurt am Main, 6 April 2017.
  - (2018): Monetary policy and the economic recovery in the euro area, speech at The ECB and Its Watchers XVIII Conference, Frankfurt am Main, 6 April 2017.
- Draghi, M./de Guindos, L. (2018): Introductory Statement, press conference, 14 June.

*Droes, M./van Lamoen, R./Mattheuissens, S. (2017):* Quantitative Easing and exuberance in government bond markets, evidence from the ECB's Expanded Asset Purchase Program, Tinbergen Institute Discussion Paper No. 17–080/IV.

*ECB (2010):* Chronology of monetary policy measures of the Eurosystem, Monthly Bulletin, June.

- (2014): Financial Stability Review, May.
- (2011): Chronology of monetary policy measures of the Eurosystem, Monthly Bulletin, November.
- (2016a): The corporate bond market and the ECB's corporate sector purchase programme, Economic Bulletin, August.
- (2016b): Financial Stability Review, November.
- (2017): Economic Bulletin, April.
- (2018): Financial Stability Review, May.

*Eser, F./Carmona Amaro, M./Iacobelli, S./Rubens, M. (2012):* The use of the Eurosystem's monetary policy instruments and its monetary policy implementation framework since 2009, ECB Occasional Paper No. 135.

*European Economic Advisory Group (2011):* The EEAG Report on the European Economy. Governing Europe, CESifo, Munich.

- (2013): The EEAG Report on the European Economy. Rebalancing Europe, CESifo, Munich.

*Evans, C./Gourio, F./Fisher, J./Krane, S. (2015):* Risk management for monetary policy near the Zero Lower Bound, Brookings Papers on Economic Activity, Spring.

*Favero, C. (2013):* Modelling and forecasting government bond spreads in the euro area: a GVAR model, *Journal of Econometrics*, Vol. 177, pp. 343–356.

*Ferrero, G./Gross, M./Neri, S. (2017):* Secular stagnation, demographic developments and interest rates: an empirical investigation, Banca d'Italia Working Paper No. 1137.

*Ferrero, G./Neri, S. (2017):* Monetary policy in a low interest rate environment, Banca d'Italia Occasional Paper No. 392.

*Ferrero, G./Pietrunti, M./Tiseno, A. (2018):* Benefits of gradualism or costs of inaction? Monetary policy in times of uncertainty, Banca d'Italia, mimeo.

*Forbes, K. (2018):* Has globalization changed the inflation process? Paper presented at the 17<sup>th</sup> BIS Annual Research Conference, Zurich, 22 June.

*Gali, J. (2012):* The monetary pillar and the great financial crisis, in *The great financial crisis – Lessons for financial stability and monetary policy*, an ECB colloquium held in honor of Lucas Papademos, 20–21 May 2010.

*Gambetti, L./Musso, A. (2017):* The macroeconomic impact of the ECB's expanded asset purchase programme (APP), ECB Working Paper No. 2075.

*Gerali, A./Neri, S. (2018):* Natural rates across the Atlantic, *Journal of Macroeconomics*, forthcoming.

- Giles, C. (2014): Debate rages on quantitative easing's effect on inequality, *Financial Times*, 21 October.
- Greenlaw, D./Hamilton, J. D./Harris, E./West, K. D. (2018): A Skeptical View of the Impact of the Fed's Balance Sheet, NBER Working paper No. 24687.
- Greenspan, A. (2004): Risk and uncertainty in monetary policy, *American Economic Review*, Vol. 94, pp. 33–40.
- Hartmann, P./Smets, F. (2018): The first 20 years of the European Central Bank: Monetary policy, *Brookings Papers on Economic Activity Conference*, 13–14 September.
- Honohan, P. (2018): Real and Imagined Constraints on Euro Area Monetary Policy, *Peterson Institute for International Economics Working paper* 18–8.
- In't Veld, J. (2013): Fiscal consolidations and spillovers in the Euro area periphery and core, *Economic Papers*, Vol. 506.
- Jarociński, M./Lenza, M. (2016): An inflation-predicting measure of the output gap in the euro area, *ECB Working Paper* No. 1966.
- Kang, D. W./Ligthart, N./Mody, A. (2016): The ECB and the Fed: A comparative narrative, *Voxeu*, 16 January.
- Kiley, M. T./Roberts, J. M. (2017): Monetary policy in a low interest rate world, *Board of Governors of the Federal Reserve System Finance and Economics Discussion Series*, No. 80.
- Kollman, R./Pataracchia, B./Raciborski, R./Ratto, M./Roeger, W./Vogel, L. (2016): The post-crisis slump in the euro area and the US: evidence from an estimated three-region DSGE model, *European Economic Review*, Vol. 88, pp. 21–41.
- Lalik, M. (2017): Interactions between fiscal multipliers and sovereign risk premium during fiscal consolidation: model based assessment for the euro area, *ECB Working Paper* No. 2016.
- Lane, P. R. (2012): The European sovereign debt crisis, *Journal of Economic Perspectives*, Vol. 26, pp. 49–68.
- Li, F./Mäkinen, T./Mercatanti, A./Silvestrini, A. (2018): Evaluating central bank purchases of corporate bonds using a regression discontinuity design, *Banca d'Italia*, mimeo.
- Li, J./Zinna, G. (2018): How much of bank credit risk is sovereign risk? Evidence from Europe, *Journal of Money, Credit and Banking*, forthcoming.
- Łyziak, T./Paloviita, M. (2017): Anchoring of inflation expectations in the euro area: recent evidence based on survey data, *European Journal of Political Economy*, Vol. 46, pp. 52–73.
- Miccoli, M./Neri, S. (2018): Inflation surprises and inflation expectations in the euro area, *Applied Economics*, forthcoming.
- Mikolajun, I./Lodge, D. (2016): Advanced economy inflation: the role of global factors, *ECB Working Paper* No. 1948.
- Mishkin, F. (2011): Monetary policy strategy: lessons from the Crisis, *NBER Working Paper* No. 16755.

- Natoli, F./Sigalotti, L. (2018): Tail co-movement in inflation expectations as an indicator of anchoring, *International Journal of Central Banking*, Vol. 14, pp. 35–71.
- Nautz, D./Pagenhardt, L./Strohsal, T. (2017): The (de-)anchoring of inflation expectations: new evidence from the euro area, *North American Journal of Economics and Finance*, Vol. 40, pp. 103–115.
- Neri, S. (2014): The impact of the sovereign debt crisis on bank lending rates in the euro area, *Rivista Bancaria*, No. 5–6, pp. 41–72.
- Neri, S./Notarpietro, A. (2015): The macroeconomic effects of low and falling inflation at the zero lower bound, *Banca d'Italia Working Paper No. 1040*.
- Neri, S./Ropele, T. (2015): The macroeconomic effects of the sovereign debt crisis in the euro area, *Banca d'Italia Working Paper No. 1007*.
- Orphanides, A. (2015): The euro area crisis five years after the original sin, *Credit and Capital Markets*, Vol. 48, pp. 535–565.
- (2017): The fiscal-monetary policy mix in the euro area: challenges at the zero lower bound, *European Economy, European Commission Discussion Paper No. 60*.
- Pericoli, M./Taboga, M. (2015): Understanding policy rates at the zero lower bound: insights from a Bayesian shadow rate model, *Banca d'Italia Working Paper No. 1023*.
- Praet, P. (2014): Current issues in monetary policy. Speech at the Peterson Institute for International Economics, Washington, 9 December.
- (2016): The ECB's monetary policy response to disinflationary pressures, speech at ECB and Its Watchers XVII conference organised by Center for Financial Studies, Frankfurt, 7 April.
  - (2018): Assessment of quantitative easing and challenges of policy normalization, speech at The ECB and Its Watchers XIX Conference, Frankfurt am Main, 14 March.
- Riggi, M./Venditti, F. (2015): Failing to forecast low inflation and Phillips curve instability: a euro-area perspective, *International Finance*, Vol. 18, pp. 47–67.
- Rogoff, K. (2016): Debt supercycle, not secular stagnation, in: O. Blanchard, R. G. Rajan, K. Rogoff and L. H. Summers (eds.), *Progress and Confusion: The State of Macroeconomic Policy*, Cambridge, MA, MIT Press, pp. 19–28.
- Speck, C. (2017): Inflation anchoring in the euro area, *ECB Working Paper No. 1998*.
- Summers, L. H. (2014): "U.S. economic prospects: secular stagnation, hysteresis, and the zero lower bound" *Business Economics*, Vol. 49, pp. 65–73.
- Taboga, M. (2016): Option-implied probability distributions: How reliable? How jagged?, *International Review of Economics and Finance*, 45, pp. 453–469.
- Trichet, J. C. (2009): The financial crisis and the response of the ECB, speech at the Ceremony conferring the honorary title of Doctor Honoris Causa at the University of National and World Economy, Sofia, 12 June.
- Ubide, A. (2014): Is the European Central Bank failing its price stability mandate?, *Policy Brief, Peterson Institute for International Economics*, No. 14–5.
- Visco, I. (2014): "The Governor's Concluding Remarks", *Annual Report*, 30 May.

- (2015): Eurozone central bank policy challenges and risks, *Central Banking*, July (<https://www.centralbanking.com/central-banking/feature/2416104/eurozone-central-bank-policy-challenges-and-risks>).
  - (2016): Modelli e metodi quantitativi per le decisioni di politica monetaria: limiti e nuove prospettive, *Lectio magistralis* in occasione del conferimento della Laurea honoris causa in Scienze Statistiche per le Decisioni, Università degli Studi di Napoli Federico II, 19 December.
  - (2018): The Governor's Concluding Remarks, *Annual Report*, 29 May.
- Weber, A. A.* (2010). Monetary policy after the crisis – a European perspective, speech at the Shadow Open Market Committee (SOMC) symposium, New York City, 12 October.
- Williams, J. C.* (2017): Preparing for the next storm: reassessing frameworks and strategies in a low R-star world, *Federal Reserve Bank of San Francisco Economic Letter*, No. 3.
- Wu, J. C./Xia, F. D.* (2016): Measuring the macroeconomic impact of monetary policy at the Zero Lower Bound, *Journal of Money, Credit and Banking*, Vol., 48 pp. 253–291.
- Zaghini, A.* (2017): The CSPP at work: yield heterogeneity and the portfolio rebalancing channel, *Banca d'Italia Working Paper* No. 1157.