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The role of ECB communication in guiding markets

Marc Anderes[1] · **Alexander Rathke**[1,2] · **Sina Streicher**[1] · **Jan-Egbert Sturm**[1,2]

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Abstract
Economists and central bankers nowadays believe that forward guidance has become more important in a world in which key interest rates have hit their effective lower bounds (ELB). In the case of the European Central Bank (ECB), forward guidance should have increased the informational content of the introductory statements at the press conferences following ECB policy meetings. We examine whether such ECB communication adds information to a shadow interest rate that summarizes the overall policy stance as interpreted by financial markets. To measure communication, we use information based on ECB press releases distinguishing between topics like inflation, the real economy and monetary developments. We also look at the effect of communication on consensus expectations about key macroeconomic variables. The ECB's assessment of the economy, i.e., communication related to economic growth, triggers movements in financial markets and thereby the shadow rate. Communication of the ECB through its press releases also causes professional forecasters to change their outlooks. Not only are their growth forecasts affected, but so are their expectations for M3 growth and inflation.

Keywords Central bank communication · Shadow rates · Consensus expectations · ECB · Euro area · Money growth

JEL Classification E3 · E43 · E51 · E52 · E58

1 Introduction

In a remarkable 180-degree turn from their long-standing traditions of secrecy, many central banks today regard their external communication as an important tool for achieving their policy goals. Today's view is that communication can make monetary policy more effective by influencing expectations about monetary policy objectives and strategies, the

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✉ Jan-Egbert Sturm
sturm@kof.ethz.ch

[1] KOF Swiss Economic Institute, ETH Zurich, Leonhardstrasse 21, 8092 Zurich, Switzerland

[2] CESifo Munich, Munich, Germany

economic outlook, and the (outlook for future) policy decisions (Blinder et al. 2008, 2017). Especially in a world in which key interest rates can hardly be lowered any further and new instruments to stimulate the economy are introduced, communication is seen as an important tool for influencing longer-term interest rates and yield curves. Hence, economists and central bankers nowadays agree that public perceptions about the stance of monetary policy is crucial for its effectiveness (de Haan and Sturm 2019).[1]

Since its existence, the European Central Bank (ECB) has used its main refinancing rate as the primary instrument of monetary policy. The Great Financial Crisis of 2008/2009 and the subsequent euro area debt crisis have caused the ECB to move this rate to such low levels that lowering it further became more and more difficult. Consequently, the ECB has started to deploy unconventional policy tools like asset purchase programs (APP) and targeted funding of bank lending to businesses and households. The tools were accompanied by forward guidance and intended to address the risks of a too prolonged period of low inflation. Accordingly, the ECB had to change its monetary policy communication strategy (Praet 2013).[2]

The introduction of unconventional policy instruments has been highly controversial, especially among German economists, exemplified by presidents of the Bundesbank. They have been notorious for their opposition to any program involving the purchase of government debt.[3] According to the fundamental monetarist dictum, "inflation is always and everywhere a monetary phenomenon" caused by an increase in the money supply in excess of real output (Friedman 1970). Ample evidence has identified a monetary overhang, especially when caused by financing governmental debts, as the cause of (hyper-) inflations (e.g., Bernholz 2015, ch. 5). On the other hand, a collapsing money supply still is considered as the main cause of the Great Depression, which led to deflation (Friedman and Schwartz 1963). Hence, the policies that lead to a huge increase in the money supply are still hotly debated. Bernholz (2015, p. 10) states that "during the crisis such a dramatic increase of the monetary base … took place as had formerly only been observed before high or hyperinflations. However, this time it happened without leading to inflation. On the other hand, broader money … saw no unusual increase during the financial crisis. This leads to problems, namely which type of money could be responsible for later inflation". That controversy begs the question of how far markets perceived the actions of the ECB to be de- or inflationary.

Assessing the impact of those changes or summarizing the overall stance of monetary policy in such a different environment is challenging. To start with the latter, conventional monetary policy commonly is approximated by short-term policy interest rates (e.g., Mumtaz and Theophilopoulou 2017; Coibion et al. 2017). In unconventional times, the primary instrument is constrained by the effective lower bound, making the assessment of

[1] In a survey conducted by Blinder et al. (2017), more than half of the responding central bank governors say that new communication measures have been adopted at their institution since the crisis. Moreover, the overwhelming majority (more than 80%) of central bankers and academic economists (more than 90%) stated that the role of central bank communication has intensified. Both the majority of central bankers (60%) and academic economists (75%) expect communication policy changes to remain in place, or to go even further (Blinder et al. 2017).

[2] As stated by Hartmann and Smets (2018, p. 4), "the need for additional communication in a complex (non-standard) policy environment rose and forward guidance became an essential tool for easing policy in a low interest rate context".

[3] See, for instance, Jones (2014). For a critical view on unconventional policies, see Borio and Gambacorta (2017).

the stance of monetary policy infeasible. A common way of circumventing that problem is the use of so-called shadow rates (Krippner 2015; Wu and Xia 2016; Inui et al. 2017). The shadow rate is derived from yield curve data and has no binding lower bound. In normal times, it approximately equals the policy rate, whereas in effective lower bound environments, it may turn negative reflecting movements at the far end of the yield curve. Considering longer maturity interest rates is essential for assessing the monetary policy stance; the ECB's unconventional tools like APP and forward guidance aim to influence exactly those rates. We follow Krippner (2013a, b, 2015) and measure the stance of monetary policy as interpreted by financial markets by using the Krippner shadow rate.

We want to gain insights into the extent to which financial markets react to the communication of the ECB. Further, we are interested in the relationship between communication and the expectations of professional forecasters.

Communication plays an extremely important role in the introduction and implementation of unconventional policy measures such as the quantitative easing (QE) programs. According to various studies, the strongest effects on asset prices can be felt precisely when such programs are announced. The expected consequences of the programs are therefore immediately reflected in asset prices. How the programs initially are "sold" could be a key factor in their success. Substantive evidence exists that ECB communication is able to reduce financial market variability (see, for instance, Coenen et al. 2017; Filardo and Hofmann 2014). Moreover, financial markets are able to predict monetary policy decisions better when communication is collegial, i.e., by conveying the majority view of the committee instead of members' individualistic opinions (Ehrmann and Fratzscher 2013). A broad consensus also exists that forward guidance moves financial markets in the intended direction (Brand et al. 2010; Ehrmann and Fratzscher 2007; Galardo and Guerrieri 2017; Swanson 2017). That is also the case for the announcement of an APP, especially in the presence of forward guidance (Coenen et al. 2017). In line with the view that central banks manage expectations by using communication (Woodford 2001), a second strand of literature has investigated the influence of communication on inflation expectations and, eventually, inflation outcomes. Empirical results suggest that transparency reduces the volatility of expectations and inflation (van der Cruijsen and Demertzis 2007; Ullrich 2008).

Studies that quantify central bank communication differ in terms of the methodology applied. Some scholars measure communication by interpreting the tone of inter-meeting speeches (Ehrmann and Fratzscher 2007); others quantify the frequency of future-tense verbs in the first section of the introductory statement (Galardo and Guerrieri 2017). Coenen et al. (2017) consider the length of the introductory statement, compute a language complexity index and classify different types of forward guidance and APP announcements to estimate their individual effects. Other strategies include the use of money market data to build communication indicators (Brand et al. 2010).

Our empirical analysis uses a unique dataset encompassing almost 43,000 classified statements that stem from the introductory statements after each ECB Governing Council meeting in which monetary policy decisions were made. We rely on human coding to accurately distil the information conveyed. In contrast to other studies that quantify communication, that method allows us to build more thorough and reliable communication measures that are consistent across time. Each press release is dissected into statements that subsequently are classified according to their topical association, time reference and qualitative content. The last reflects the tone ("increase", "stay the same", or "decrease"), allowing for an economic interpretation of the impact on various variables. From the statement-level data, we construct indicators that reflect key subjects in the introductory statement: price stability aspects, the economy and monetary developments. To measure the change in the

market's interpretation of the stance of monetary policy, we compare the shadow rate the day after the Governing Council meeting to its value the day before. By concentrating on that short time window and furthermore controlling for, e.g., the previous shadow rate, the actual interest rate decision and its surprise component, the changes in expected and realized inflation, GDP and money (M3) growth, we intend to isolate the effects of the ECB's communicated actions and outlook on the market interpretation of monetary policy. Additionally, we want to assess the impact of ECB communication on the market's perspectives on exchange rates and inflation expectations. For that purpose, we consider the change in the nominal euro effective exchange rate and the change in inflation-indexed swap rates around ECB Governing Council meetings. In a second model, we analyze whether changes in professional forecasts, as measured by the consensus forecasts published by Consensus Economics, are related to the communicated assessments of the ECB Governing Council. We distinguish between expectations in inflation, GDP growth and M3 growth.

We find that ECB communication on the economy has been important in driving the shadow rate. This relationship appears stable over time, i.e., does not change across the different monetary policy phases we distinguish. When focusing on changes in the shadow rate, we therefore do not find evidence that communication has become more important. Communication on money is not immediately picked up by financial agents and thus not reflected in the shadow rate. Communication on money does appear to matter for inflation expectations as extracted from swap data. In our setup, exchange rates do not appear to be affected by ECB communication through its press releases. Its communication on price and in particular economic developments, however, does matter for the shadow rate. We find a significant, quantitatively important and stable impact of both on the assessment of financial market participants of the ECB's monetary policy stance, as measured by the shadow rate.

Not only financial market participants, but also professional forecasters appear to be influenced by the messages conveyed in the ECB's press releases. Messages related to the economy and price stability both impact changes in growth and inflation forecasts; those on money are related only to money growth forecasts. We thereby confirm the results already reported in Berger et al. (2011) that monetary developments in general appear to play only a minor role. The clear exception occurs during the period that covers both the Great Financial Crisis and the euro area crisis. During that period, actual increases in asset and security holdings related to monetary policy were associated with downward adjustments of growth forecasts; communication suggesting expansionary developments in the monetary sector coincided with downward forecasts in money growth rates. Hence, particularly during that crisis period these relationships appear to have been distorted.

The rest of the paper is structured as follows. We describe the different phases of monetary policy since the existence of the ECB in the next section. The data are introduced subsequently in Sect. 3. Section 4 presents the empirical results and Sect. 5 concludes.

2 Different phases of monetary policy

Since the start of its activities in 1999, the ECB has gone through various stages in its monetary policy operations. Clearly, policy was conducted in a different way before the onset of the Great Financial Crisis than it was afterwards. Those changes are documented

in Fig. 1, which depicts the evolution of the asset side of the ECB's balance sheet, the main refinancing rate and the shadow rate as a measure of the overall policy stance.[4]

Until the Great Financial Crisis, the shadow rate, in line with short-term money market rates, followed the path of the main refinancing rate closely. During that period, monetary policy was conducted almost exclusively by setting the three key ECB interest rates, which determined the path of money market rates. When the financial crisis hit, central banks around the world reacted in a consolidated fashion by providing an ample and stable supply of emergency liquidity to avoid a financial meltdown. They also cut policy rates decisively. Those efforts were most pronounced after the Lehman Brothers shock in September 2008. The ECB started to provide unlimited credit to banks at a fixed interest rate, an approach known as fixed-rate full allotment. Moreover, the maturity of refinancing operations was extended considerably and the range of eligible assets that could be used as collateral was expanded.

In 2010, the European Sovereign Debt crisis emerged, when the Greek fiscal situation deteriorated significantly and several other euro area countries subsequently became distressed. During the first stage of the crisis (until September 2012), the ECB bought a limited amount of troubled bonds under the Security Markets Program, but sterilized the effect on the monetary base using the Term Deposit facility. A policy of quantitative easing was not yet politically feasible. In contrast to other major central banks, the ECB started to raise rates in 2011, citing upside risks to price stability, which with the benefit of hindsight exacerbated the debt crisis unnecessarily. The shadow rate increased even before the official rate hikes, already indicating a more restrictive policy stance. When President Mario Draghi took over duties as ECB president in late 2011, policy reversed course. Monetary conditions were eased by two additional large liquidity-providing operations (VLTROs - very long-term refinancing operations[5]) and a later reversing of the interest rate hikes. Mario Draghi finally ended the debt crisis by giving his famous "Whatever it takes" speech on July 26, 2012, which was followed by the official announcement of the Outright Monetary Transactions (OMT) program that in principle allows the ECB to buy government bonds in unlimited quantity to avoid a self-reinforcing vicious feedback loop in sovereign bond markets. In fact, that particular program never was activated. Nevertheless, all of the foregoing measures led to a considerable easing of monetary conditions.

However, in 2013, the stance of monetary policy started to become more restrictive when banks repaid large fractions of money taken up under the VLTROs; the monetary base contracted significantly. The ECB began using explicit forward guidance in July 2013 when the ECB Governing Council said that it expected interest rates to remain low for an extended period of time. Significant worries about a continued downward trend in underlying inflation saw the ECB entering a new phase of monetary easing in June 2014. The Governing Council decided to introduce a negative rate on its deposit facility to overcome the zero lower bound problem, start new asset purchase programs for asset-backed securities (ABS) and covered bonds (CBPP) and to stop sterilizing asset purchases. In addition, the ECB introduced a facility to provide longer-term funding to banks for new loans,

[4] For a comprehensive treatment see, Hartmann and Smets (2018).

[5] Regular longer-term refinancing operations (LTRO) have maturities of three months. The VLTROS had a maturity of 36 months and were conducted as fixed rate full allotment procedures. They were accompanied by a reduction in the required reserve ratio from 2 to 1% and an increase collateral availability by broadening the definition of eligible assets.

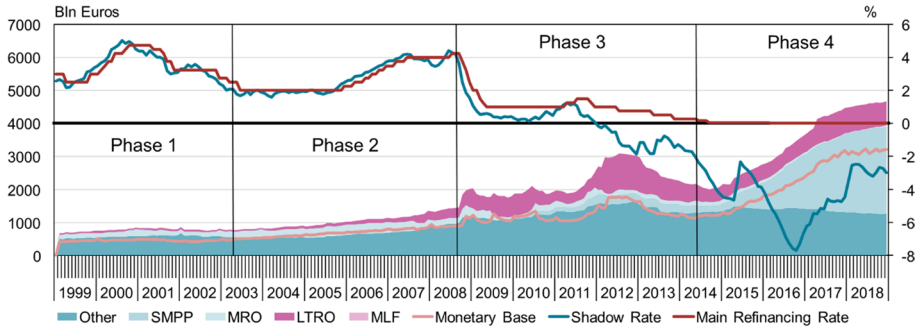

Fig. 1 ECB's balance sheet. *Notes*: *SMPP* Securities held for monetary policy purposes, *MRO* main refinancing operations, *LTRO* longer term refinancing operations, *MLF* Marginal lending facility. *Source*: ECB, Krippner

contingent on bank credit supply behavior, referred to as targeted longer-term refinancing operations (TLTRO).

Finally, in January 2015, as the last of the world's major central banks, the ECB embarked on a large-scale asset purchase program (APP), which included sizable purchases of sovereign bonds. It was announced that the ECB would each month buy euro-area bonds from central governments, agencies and European institutions worth 60 billion euros. That program started in March 2015, and initially was supposed to last until September 2016. It was later extended in size and duration. Net purchases under the APP program finally ended in December 2018 and the ECB's balance sheet then contained assets held for monetary policy purposes worth 2.6 trillion euros.

Hence, we can summarize that, until the financial crisis monetary policy was conducted primarily through changes in policy rates, while in recent years the effect of unconventional measures dominated. Broadly in line with the ECB (Constâncio 2018), we classify the monetary policy for the euro area into four phases. The first phase starts with the launch of the single currency and lasts until the revision of the monetary policy strategy in May 2003, when the weight of the monetary pillar and the "dominant role of money" were demoted, bringing the framework closer to the flexible inflation-targeting regime adopted by many other central banks around the world. Also, for purely technical reasons—we do not have expected inflation and growth rates for the euro area at large of a similar quality beforehand as we do afterward—we will ignore that period altogether in the rest of this paper.

The second phase spans from the revision of the monetary strategy to the outbreak of the Great Financial Crisis, i.e., the bankruptcy of Lehman Brothers in September 2008. The third phase then marks an abrupt change in euro area monetary policy. The fourth and final phase of monetary policy, the quantitative easing phase, starts in June 2014 with the announcement of the comprehensive package of expansionary measures described above.

3 Data

To summarize the overall stance of monetary policy, we use the shadow rate (SR) as developed by Krippner (2013a, b, 2015). Prior to the financial crisis in 2008, yield curve dynamics were often modelled using Gaussian affine term structure models (GATSM). One

prominent downside of GATSMs is that they assign positive probabilities to negative interest rates. In other words, they do not account for the effective lower bound (ELB). Shadow models have become a popular tool to circumvent that problem. The shadow rate represents the short rate in a hypothetical cashless world. The difference between that hypothetical world and the real world is the opportunity to withdraw and store cash if interest rates turn negative. The feature is modelled by a put option, i.e., the right to exchange the shadow rate against the fixed ELB rate.[6] Hence, the short rate (R) is the sum of the shadow rate and the payoff from the put option: $R = SR + max\{\text{ELB} - SR, 0\}$. Consequently, whenever the shadow rate is (far) above the ELB, the option value becomes close to zero and the short rate coincides with the shadow rate. In contrast, in ELB environments, the SR may turn negative, reflecting movements at the long end of the yield curve.

In essence, Krippner's shadow model estimates the observed yield curve and the shadow yield curve simultaneously. To obtain the shadow rate, one essentially slides along the shadow yield curve to the point at which the term to maturity is zero.

Figure 2 depicts changes in the estimated euro yield curve and the corresponding shadow yield curve between two specific dates. The top panel illustrates the change between September 2008 and March 2009. During that period, the main refinancing rate (MRR) was reduced from 4.25 to 1.5% in five steps. While the shadow rate on September 19, 2008, is almost identical to the MRR, it is substantially lower on March 19, 2009, reflecting the rising value of the put option in near-ELB environments. At the beginning of 2018 (bottom panel), when shorter maturity rates hit the ELB, the increase at the long end of the yield curve from January 19, 2018, until February 19, 2018, affects the entire shadow yield curve, including the shadow rate. Thus, the SR offers a comprehensive indicator of monetary policy's stance across conventional and unconventional phases.

Krippner provides the shadow rate for the euro area on a daily basis, enabling us to assess the effect of policy decisions communicated by the ECB Governing Council on its meeting days.[7]

Figure 1 shows the SR and the MRR as determined by the ECB Governing Council. Unsurprisingly, the SR and the MRR move closely together until the beginning of the European debt crisis. Both rates diverge sharply once the MRR enters the ELB environment. The contemporaneous correlation coefficient is 0.91.

We use real-time consensus forecasts as provided by Consensus Economics, Inc., to construct expected inflation, output growth and M3 growth series. The monthly survey includes estimates of prominent banks and forecast organizations on a range of variables

[6] The idea dates back to Black (1995), who argued that when interest rates reach the zero lower bound, people would prefer to hold cash rather than financial instruments generating negative interest.

[7] The data produced by Leo Krippner can be accessed through the website of the Reserve Bank of New Zealand: https://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures. In order to cope with the non-linearity introduced by the option effect, Krippner applies an Iterated Extended Kalman Filter for the estimation. He uses German and French zero government bond rates and overnight indexed swap rates (once they become available for the euro area in 2008) with maturities of 0.25, 0.5, 1, 2, 3, 5, 10 and 30 years to approximate the euro yield curve. For comparison, Krippner sets the ELB to 12.5 basis points across all estimated currencies. McCoy and Clemens (2017) analyze the effect of the choice of the effective lower bound in Krippner's shadow rate model estimation and give an illustrative example. They point out that, the higher the ELB is set, the more pronounced is the option effect, implying that the shadow yield curve (and, thus, the shadow rate) is shifted downwards. Hence, a trade-off exists between a meaningful monetary policy stance indicator and an economically relevant policy rate estimate. In our analysis, we use the shadow rate as a proxy for the stance of monetary policy and, therefore, are not concerned with the relatively high lower bound of 12.5 basis points.

such as future growth, inflation, interest rates and exchange rates. Each forecast is made for the current and the following year, enabling the construction of 12-month forecasts as a weighted average of both rates.[8] Since Consensus Economics did not publish forecasts for the euro area prior to January 2003, we restrict our estimation window to the 2003–2018 period.[9]

To reflect the latest economic information available, we collect real-time observations on actual inflation, GDP growth and M3 growth from the Real Time Database published by the ECB in its Statistical Data Warehouse.[10] For all three variables, we must realize that the "euro area" is a moving concept in the sense that the introduction of that currency in Greece, Slovenia, Cyprus, Malta, Slovakia, Estonia, Latvia and Lithuania redefines the area that is covered by our data, thereby implying benchmark revisions. Regarding inflation, we use the different vintages that are available for monthly year-over-year growth rates in the overall Harmonised Index of Consumer Prices (HICP). As to be expected, those inflation statistics hardly ever are revised. The small revisions that do occur take place within the first couple of releases or are required by other smaller benchmark revisions.[11] GDP growth is calculated from the chain-linked volumes of quarterly Gross Domestic Product. In general, revisions to that variable tend to be larger and more frequent than those to the inflation variable. Revisions in monthly year-over-year growth in the monetary aggregate M3 are, on the other hand, more comparable to those in inflation.

The ECB's most important channel of communication is the ECB president's Introductory Statement following the Governing Council meeting (de Haan 2008). Roughly once a month, the ECB Governing Council meets to discuss and take monetary policy decisions, which are announced publicly at 13:45 (CET). The subsequent press conference held by the ECB's president and vice president consists of two parts: a prepared Introductory Statement agreed upon on a word-by-word basis by all council members and a Questions & Answers session allowing journalists to address remaining questions. Beside the monetary policy decisions, the different sections of the Introductory Statement provide the ECB's assessment of developments in areas such as the real economy, prices and monetary aggregates.

In order to quantify ECB communication, we use indicators that capture the key subjects of the Introductory Statement for monetary policy, i.e., the development of the real economy, prices and monetary aggregates. The statements by the ECB president are analyzed by the media research institute Media Tenor. A media analyst codes each statement (several statements can be found within one sentence) by assigning a broad as well as a specific topic association, a time reference and its qualitative content. The latter is classified numerically into "increase", "stay the same", or "decrease". For instance, in the introductory statement from March 17, 2019, Mario Draghi said

[8] The weight for the forecast of the current year is $m/12$ and the weight for the forecast of the following year is $(12-m)/12$, where m denotes the number of remaining months in the current year. As the survey usually is published in the first half of the month, we assign the current month to the remaining months of the year.

[9] Using nominal GDP weighted averages from the euro area member states to construct expectations that go back to January 1999 does not change the conclusions. However, as money growth expectations are not available at the member state level, we would lose information by going back that far.

[10] The database can be accessed through https://sdw.ecb.europa.eu/browse.do?node=9689716. The first vintages of the for-us relevant variables published in that real-time database date from January 2001.

[11] The benchmark revisions took place early March 2002, June 2002, March 2003, May 2005, March 2011 and March 2016.

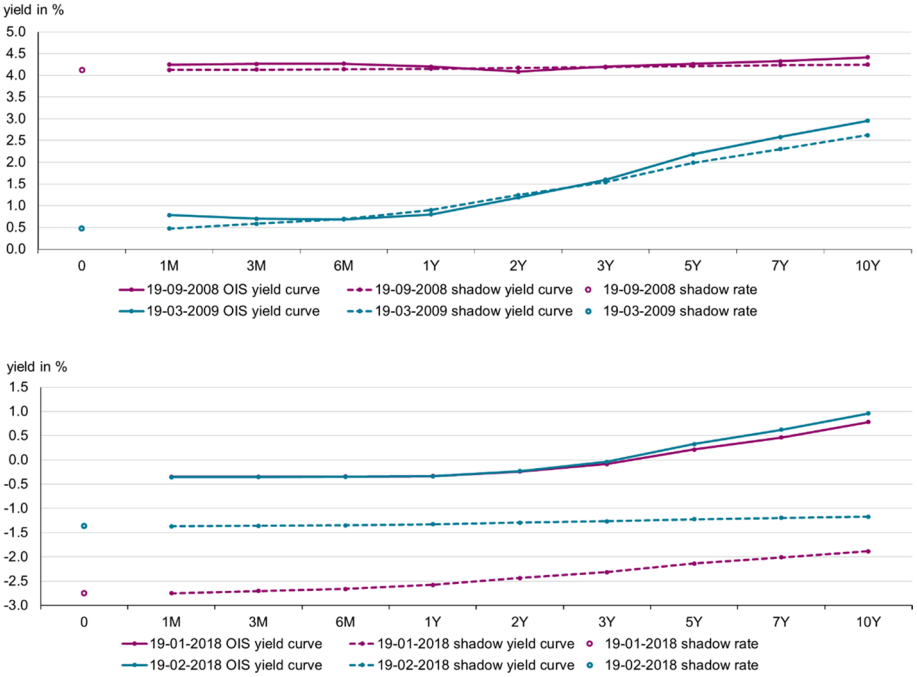

Fig. 2 Euro Overnight Indexed Swaps (OIS) yield curve, estimated shadow yield curve, and shadow rate for specific dates prior to QE (top) and afterwards (bottom). *Notes*: The euro OIS rates are taken from Datastream. The shadow yield curve is estimated from 3- and 6-month, and 1, 2, …, 10 year euro OIS rates.

> Compared with the December 2016 Eurosystem staff macroeconomic projections, the outlook for real GDP growth has been revised upwards slightly in 2017 and 2018.

That sentence has been assigned to the broad topic "economy" and assessed to be an "increase". Overall, we use 42,827 statements contained in 168 Introductory Statements, each of which contains, on average, 255 coded statements. Our three ECB communication indicators (price stability, economy and money) are, on average, constructed from 37.9, 19.2 and 24.3 coded statements, respectively. The constructed indicators are the normalized balances of up- and downward assessments (including the neutral ones) regarding the specific topic. Formally,

$$indicator_{i,t} = \frac{\#positive_{i,t} - \#negative_{i,t}}{\#positive_{i,t} + \#negative_{i,t} + \#neutral_{i,t}},$$

where $i \in \{\text{price stability, economy, money}\}$. Accordingly, all indicators range theoretically from minus one to plus one.,[12][13] Each of the panels in Fig. 3 plots the evolutions

[12] The way in which our indicators are constructed very much follows the procedure underlying the so-called KOF Monetary Policy Communicator (MPC), as published by the KOF Swiss Economic Institute and used, e.g., by Sturm and de Haan (2011), Conrad and Lamla (2010), Lamla and Sturm (2013), Bulíř et al. (2013) and Neuenkirch (2013). The key difference is that the MPC is a leading indicator for monetary policy and therefore considers only forward-looking statements regarding prices.

[13] While most of the data we use are proprietary and cannot be shared publicly, we are happy to provide our communication data upon request.

of the statements' realized and expected counterparts, together with the respective communication indicator. Each data point reflects the information available at that particular moment in time. The resemblance between the communication indicators and their respective reference series clearly is visible.

In line with Bredin et al. (2010) and Fausch and Sigonius (2018), we use three-month Euribor future rates to construct the market's surprise reaction to the change in the main refinancing rate. Bernoth and von Hagen (2004) show that Euribor future rates are unbiased and informationally efficient predictors of future spot rates. Consequently, we define the surprise component of the monetary policy decision by the change in the Euribor future rate from the end of the ECB Governing Council meeting day and the end of the previous day.[14]

In order to control for the market's reaction to the US jobless claims published each Thursday, we use the difference between actual unemployment compensation claims and the median expected claims polled by Reuters on the previous Monday as a surprise indicator (Coenen et al. 2017). Hence, a positive surprise means that more claims were filed than expected previously.

As a robustness check, we also want to examine the effect of ECB communication on other measures that reflect financial market expectations. For that purpose, we examine both exchange rates and a financial market measure of inflation expectations. We use the euro's nominal effective exchange rate as published by the ECB to measure the foreign exchange market's perception of the value of euro relative to foreign currencies.[15] Regarding inflation expectations, we use one-year euro inflation-linked swaps provided by Bloomberg on a daily basis, which have been available since 2004 (e.g., Grothe and Meyler 2015). An inflation swap is a derivative contract that entitles the buyer to earn a fixed interest rate in exchange for a floating rate. The floating rate is linked to an inflation index. The fixed inflation swap rate therefore represents the market's inflationary expectation over a specific investment period. As in the case of the shadow rate, its daily frequency allows us to infer the immediate impacts of ECB communication on the change in market-based inflation expectations.

Table 1 reports summary statistics and contemporaneous correlation coefficients for all variables used. The largest contemporaneous correlations are found between the shadow rate and the main refinancing rate, between the expected and realized inflation rates and between expected and realized M3 growth rates.[16] The three different communication variables hardly are correlated with each other and, hence, appear to reflect substantially different informational contents of the ECB's press releases.

In the empirical analyses below, we either move to the frequency at which press releases after ECB Governing Council meetings are issued, or to the monthly frequency at which

[14] The Euribor 3-month futures contracts have expiry dates on the 3rd Wednesdays of each of the following six months and at quarterly frequencies for longer horizons. Each contract can be traded until two days before the expiry date, meaning we do not have a natural series of future prices. We use an end-of-day series that represents the future contract that expires next and can still be traded. That series may contain price jumps once a month, exactly two days prior to the expiry dates. Owing to the timing of the ECB Governing Council meeting days, those jumps do not affect our market surprise measure.

[15] We have also experimented with the US dollar-euro exchange rate. The conclusions are not affected by that alternative.

[16] The change in the shadow rate and the change in the main refinancing rate are not correlated in this table because it takes up to 6 days for the main refinancing rate effectively to be changed after having been announced publicly by the ECB. By that time, the shadow rate already has adapted.

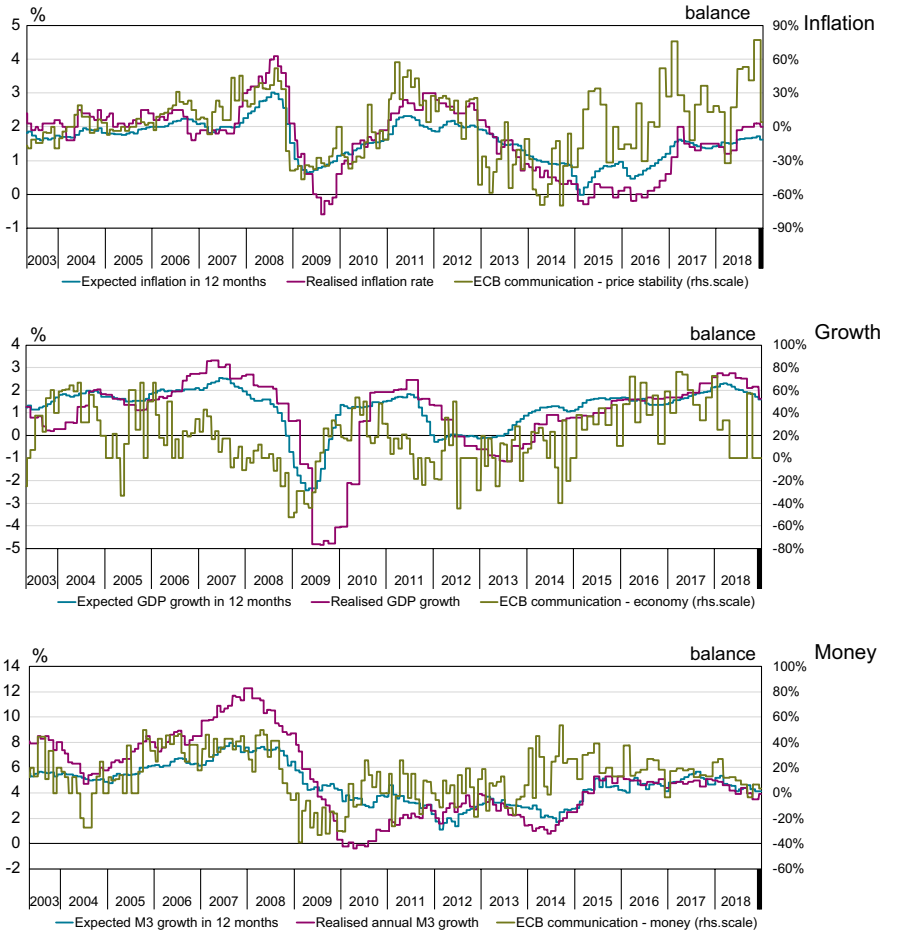

Fig. 3 Forecast, realized and communicated information on inflation, economic growth and money growth, 2003m5-2018m12. *Notes*: The forecast information is taken from Consensus Economics, Inc. The realized data are taken from the real-time database of the ECB's Statistical Data Warehouse. The ECB communication data are extracted from ECB press releases.

consensus forecasts are published. In the first case, we will concentrate on the change in the shadow rate around the Governing Council meetings, i.e., the difference in the shadow rate between the day before and the day after the ECB Governing Council's press conference. The analysis will be repeated for the change in the euro's nominal effective exchange rate and the change in inflation expectations based on swaps.

Table 1 Summary statistics and contemporaneous correlation coefficients

						Correlation coefficients													
		Mean	SD	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)	Shadow rate (%)	−0.50	3.11	−7.69	4.44	1													
(2)	Nominal effective exchange rate (index)	101.59	5.42	88.16	114.44	0.76	1												
(3)	Inflation expectations based on swaps (%)	1.45	0.68	−0.76	3.49	0.71	0.47	1											
(4)	Main refinancing rate (MRR) (%)	1.36	1.31	0.00	4.25	0.91	0.70	0.65	1										
(5)	3-month Euribor future (%)	1.29	1.61	−0.34	5.26	0.89	0.66	0.66	0.99	1									
(6)	Surprise in US jobless claims (%)	0.10	4.53	−14.29	23.65	0.12	0.09	0.08	0.12	0.12	1								
(7)	Expected inflation in 12 months (%)	1.57	0.60	−0.02	3.02	0.68	0.42	0.81	0.69	0.68	0.10	1							
(8)	Realised inflation rate (%)	1.61	1.03	−0.60	4.10	0.64	0.38	0.75	0.62	0.62	0.09	0.94	1						
(9)	Expected GDP growth in 12 months (%)	1.21	1.00	−2.44	2.54	0.05	−0.21	0.28	0.15	0.21	0.02	0.25	0.16	1					
(10)	Realised GDP growth (%)	1.03	1.73	−4.85	3.33	0.08	−0.24	0.28	0.23	0.31	−0.01	0.40	0.41	0.72	1				
(11)	Expected M3 growth in 12 months (%)	4.60	1.59	1.11	7.98	0.49	0.37	0.40	0.70	0.73	0.06	0.40	0.31	0.40	0.41	1			
(12)	Realised annual M3 growth (%)	4.92	3.11	−0.40	12.30	0.50	0.29	0.41	0.73	0.77	0.04	0.46	0.39	0.29	0.49	0.90	1		
(13)	ECB communication—price stability (balance)	0.03	0.30	−0.70	0.77	0.08	−0.11	0.45	0.18	0.24	0.05	0.48	0.46	0.43	0.52	0.33	0.32	1	
(14)	ECB communication—economy (balance)	0.18	0.27	−0.53	0.76	−0.33	−0.39	−0.05	−0.26	−0.23	−0.05	−0.17	−0.24	0.48	0.18	0.08	−0.06	0.11	1
(15)	ECB communication—money (balance)	0.13	0.20	−0.39	0.53	0.12	−0.15	0.19	0.29	0.36	0.02	0.20	0.14	0.56	0.58	0.45	0.53	0.24	0.15

The data cover the period May 1st, 2003, until December 31st, 2018

Given the different monetary policy phases summarized in Sect. 2, we are interested not only in analyzing the impact of ECB communication during the full sample period, but also whether we can observe structural changes across those phases. In a first step, Table 2 reports the correlation coefficients between the change in the shadow rate, on the one hand, and the actual decided change in the main refinancing rate as well as the three communication indicators based on the ECB press releases, on the other hand.[17]

What catches the eye is that the largest correlation is between the ECB communication indicator reflecting price stability and the change in the shadow rate. However, that holds only for the last monetary policy phase we distinguish. Whereas Fig. 1 suggests a close link between the main refinancing rate and the shadow rate until the financial crisis. The correlation between the change in each of them is quite stable across the different phases. Overall, the ECB's communicated assessment of the economic situation and outlook is most strongly correlated with changes in the shadow rate.

Another way in which we can split our sample is by comparing each interest rate decision with what would have been implied by a rule-based approach. Debate continues about the benefits of rule-based versus discretionary monetary policy. Following Cochrane et al. (2019), we construct a measure indicating whether the actual decision aligns with a (Taylor) rule-based policy and check whether the effect of communication on expectations depends on it. When the interest rate decision is in line with a Taylor rule, the correlation between the change in the MRR and the change in the SR is almost non-existent. The same conclusion, albeit to a much lesser extent, also applies to our surprise measure and the shadow rate. Apparently, market participants are more likely to have anticipated policy decisions that are consistent with a Taylor rule. Communication regarding the economy appears to be especially relevant when the ECB deviates from what a Taylor rule would have implied.

4 Results

4.1 Explaining the immediate impact on the shadow rate

In our first model, we want to explain the reactions of financial market participants as measured by changes in the shadow rate on both the decisions made by the ECB Governing Council and its communication. We use the change in the shadow rate between the day before and the day after the ECB Governing Council meetings that are followed by a press conference. By concentrating around those meeting days, we reduce the probability that developments other than the ECB's explicit decisions and communication are driving the movements in the shadow rate.

The most general version of our model is summarized by

$$\tilde{\Delta} s_{t_i} = \alpha s_{t_i-1} + \beta ECB\ communciation_{t_i} + \gamma z_{t_i}^{market} + \delta z_{t_i}^{economy} + \varepsilon_{t_i},$$

where t_i is the day of the i-th ECB Governing Council meeting in our sample, the dependent variable $\tilde{\Delta} s_{t_i} = s_{t_i+1} - s_{t_i-1}$ denotes the change in the shadow rate the day before and the

[17] The effective change in the MRR usually takes place six days after it was announced publicly. Since financial markets incorporate the announced change in the MRR immediately, we use the decided change in MRR in the subsequent analyses.

Table 2 Correlation of the change in the shadow rate with the change in the ECB main refinancing rate and all three communication indicators

Observations	Full period	Phase 2 2003:5–2008:8	Phase 3 2008:9–2014:5	Phase 4 2014:6–2018:12	Not rule-based	Rule-based
	168	60	69	39	73	95
Decided change in main refinancing rate	0.20	0.15	0.21	0.17	0.31	0.08
Surprise in MRR (based on euribor futures)	0.56	0.77	0.65	0.13	0.65	0.49
Surprise in US Jobless Claims	−0.15	−0.17	−0.21	−0.08	−0.13	−0.16
ECB communication—price stability	0.11	−0.07	−0.05	0.38	0.11	0.13
ECB communication—economy	0.28	0.27	0.28	0.22	0.45	0.12
ECB communication—money	0.11	−0.01	0.12	0.01	0.05	0.18

The frequency has been reduced to the frequency at which press releases after Governing Council meetings took place. The May 2003–December 2018 period is covered, leaving 168 observations. Each cell shows the correlation coefficient with the change in the shadow rate

day after the i-th meeting, and $z_{t_i}^{market}$ includes financial market control variables such as the decided and surprise change in the main refinancing rate as well as the surprise in US jobless claims. The economic control variable $z_{t_i}^{economy}$ includes realized and expected twelve-month inflation rates, GDP growth and M3 growth. The variable $ECB\ communication_{t_i}$ includes our three ECB communication measures on price stability, the economy and money, respectively. The exact timing of the model is illustrated in Figure A.1 in the online appendix.

The first column in Table 3 indeed reveals a positive and significant correlation between the decided change in the main refinancing rate and the movement of the shadow rate. Despite its significance, the size of the coefficient is at first glance small. Only 7% of the change in the main refinancing rate is reflected immediately in the shadow rate. That result is, however, not that surprising, given that most of the time markets are well prepared regarding upcoming interest rate decisions and, hence, most likely already have incorporated them in the shadow rate the day before the Governing Council meeting. The same conclusion also is supported by the next column showing that the shadow rate reacts much more strongly to the surprise component of the interest rate decision. When we use our three different communication measures to explain movements in the shadow rate, the results in column (3) show that, although all three have the expected positive signs, only that part of the press release that indicates the views of the ECB regarding the direction in which the real economy is evolving has a significant impact on the change of the shadow rate.[18] Comparing columns (1) and (3) highlights that the information revealed in the press release is more salient to the financial markets than the mere interest rate decision itself: albeit still small, the adjusted R^2 more than doubles in size. Including the initial value of the shadow rate does not change things (column (4)). When we enter the decision and the surprise variable next to our communication measures, we still find an improvement in the adjusted R^2 and, again, in our communication variables; only the one on the economy has a significant impact on the change in the shadow rate (column (5)).

In column (6), we add several other variables that might be related to the monetary policy decision and thereby perhaps to the change in the shadow rate. They include changes in professional forecasts, but also in releases of "hard" data regarding inflation, GDP growth and M3 growth since the previous Governing Council meeting. The only variable that helps to explain changes in the shadow rate further is the change in the expected GDP growth rate. When expected GDP growth picks up, the shadow rate tends to pick up as well. Entering expected GDP growth, however, does not change the significance of the coefficient capturing the impact of ECB communication on the economy. As to be expected, the size of the coefficient, however, is modestly reduced further. Once we incorporate the additional control variables, the actual interest rate decision no longer has a significant impact on the shadow rate.[19]

[18] Including each of these communication variables separately does not change the conclusion: only communication on the economy is significant in explaining the change in the shadow rate. Given the low correlation between those indicators, that was to be expected (see Table 2).

[19] All results in Table 3 are based upon those days in which a Governing Council meeting has taken place and a monetary policy press release has been published. If we move to a daily frequency, increasing the size of the sample to 5724 observations, the significance of the variables increases, while no significant changes in signs are recorded.

In a next step and based upon the model's full specification in column (6), we apply a general-to-specific methodology while keeping all communication variables on board.[20] The results are shown in column (7). The change in the consensus forecast of GDP growth and the interest rate surprise remain significant. In addition to the ECB's communication on the economic situation and the outlook, communication on inflation now also has a positive and significant impact on the change in the shadow rate. That does not change if we no longer restrict the general-to-specific approach by including all communication variables (column (8)).[21]

How important is the impact of ECB communication on the real economy?[22] A one standard deviation change in overall ECB communication leads roughly to a one-quarter standard deviation movement in the shadow rate. An effect of comparable magnitude is found for changes in expected GDP growth. A similar variation in the interest rate surprise leads to more than half of a standard deviation change in the shadow rate. Hence, only the interest surprise variable appears quantitatively more important than, in particular, the messages regarding price stability and the economy as contained in the ECB's press releases.

How stable are the detected relationships across the different monetary policy phases identified in Sect. 2? To answer that question, we allow all variables identified in column (7) of Table 3 to differ in phases 3 and 4.[23] For that purpose, we introduce dummy variables reflecting each of those phases and interact them with all included variables. The regression results are displayed in Table 4. As the individual dummy and interaction coefficients for the communication variable suggest, and as is formally shown by *p*-values of joint F-tests on them, no statistical differences across the phases are found regarding any of the variables. In addition, when computing an overall Chow test, of which the *p*-value is shown in the last row in the left panel of Table 4, that conclusion does not change. Therefore, the shadow rate response seems remarkably stable over such different periods.

Complementary to our policy phases, we classify each ECB Governing Council meeting day into rule-based or not rule-based phases and then estimate a similar regression model with dummy interaction terms according to those classifications. We follow Cochrane et al. (2019) and Nikolsko-Rzhevskyy et al. (2014) and apply an adjusted Taylor rule that accounts for the zero lower bound on interest rates in order to allocate each policy decision to the two phases. Whenever the difference between the policy rate and the Taylor-rule-implied rate declines, a meeting is classified as rule-based; if the difference increases, it is classified as not rule-based. The results are presented in the right panel of Table 4. Looking at the individual coefficients across the two phases, we again do not find evidence of structural breaks. In addition, an overall Chow test (as reported in the last row of the right panel in Table 4) cannot reject the null hypothesis of no significant differences across them.

By focusing on the immediate impacts of the press release and monetary policy decision on the shadow rate, we have so far found significant, strong, stable and robust relationships

[20] A general-to-specific methodology means dropping insignificant variables one at a time until all variables remaining in the model are significant.

[21] We have furthermore carried out a placebo test in which the dependent variable has been moved to another arbitrary date and find that in general all variables become insignificant.

[22] Standardized beta coefficients are shown in Table A.1 in the online appendix.

[23] Hence, we use phase 2 as our baseline. As noted, phase 1, owing to data limitations, is not included in our sample. Similar analyses have been carried out for the other columns in Table 3. The conclusions are not affected.

Table 3 Explaining the change in the shadow rate around Governing Council meetings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Shadow rate at day before meeting				−0.000586	−0.000534	−0.000150		
				(−0.436)	(−0.431)	(−0.133)		
ECB communication—price stability			0.0117	0.0123	0.0126	0.0126	0.0195**	0.0221**
			(0.919)	(0.957)	(1.201)	(1.225)	(2.149)	(2.353)
ECB communication—economy			0.0439***	0.0423***	0.0301***	0.0251**	0.0232**	0.0252**
			(3.077)	(3.118)	(3.035)	(2.373)	(2.146)	(2.362)
ECB communication—money			0.0125	0.0139	0.00715	0.00390	0.0169	
			(0.817)	(0.846)	(0.476)	(0.285)	(1.238)	
Decided change in main refinancing rate (change since day before meeting)	0.0634***				0.0500***	0.0256		
	(3.472)				(3.179)	(1.526)		
Surprise in MRR (based on euribor futures) (change since day before meeting)		0.721***			0.725***	0.704***	0.745***	0.745***
		(7.152)			(7.932)	(8.027)	(8.534)	(8.419)
Surprise in US Jobless Claims						−0.000770		
						(−1.604)		
Expected inflation in 12 months						0.00360		
(change since previous meeting)						(0.187)		
Expected GDP growth in 12 months						0.0350**	0.0464***	0.0445***
(change since previous meeting)						(2.420)	(4.281)	(4.060)
Expected M3 growth in 12 months						−0.0128		
(change since previous meeting)						(−1.499)		
Realised inflation rate						0.0134		
(change since previous meeting)						(1.173)		
Realised annual GDP growth						0.000145		
(change since previous meeting)						(0.0188)		
Realised annual M3 growth						0.0121		
(change since previous meeting)						(1.553)		

Table 3 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−0.00231	−0.00327	−0.0129**	−0.0128**	−0.00901**	−0.00780**	−0.00997***	−0.00813**
	(−0.655)	(−1.103)	(−2.426)	(−2.415)	(−2.435)	(−2.003)	(−2.744)	(−2.548)
Observations	168	168	168	168	168	168	168	168
Adjusted R-squared	0.034	0.312	0.070	0.066	0.392	0.425	0.415	0.414

The sample covers the May 2003–December 2018 period. Robust t-statistics in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

between those aspects of the press release that interpret the real economy and price stability through the ECB's eyes.

4.2 Do other financial market variables react to ECB Communication?

In an additional exercise, we swap the change in the shadow rate for the change in the nominal effective exchange rate and the change in market-based inflation expectations, respectively. The results are presented in Table 5. In a first regression, we include all ECB communication indicators and all control variables; we then use the same general-to-specific procedure as before. Regarding the change in the nominal effective exchange rate, we observe that none of the communication indicators has a significant impact. The only variables that affect the change in the nominal effective exchange rate significantly around ECB Governing Council meeting days turn out to be the decided change as well as the surprise in the MRR, along with expected M3 growth.

However, ECB communication regarding money does have a positive and significant effect on the change in inflation expectations. In a quantitative sense, it has the strongest impact of all of the variables we consider. According to Table A.1 in the online appendix, which reports the standardized results of the general-to-specific approach, a one standard deviation change in the communication variable regarding money leads to approximately more than a fifth of a standard deviation change in inflation expectations. The surprise in US jobless claims as well as in expected M3 growth have negative and significant effects, albeit they are quantitatively less strong than that of our money-communication variable. Unsurprisingly, the expected twelve-month ahead inflation rate has a significant and positive impact on inflation expectations, although it also is quantitatively less strong than that of ECB communication regarding money.

We can conclude that while we do not find evidence that ECB communication affects exchange rates, ECB communication on monetary phenomena does affect inflation expectations based on swaps. At least in that market, participants consider ECB communication related to its monetary pillar to be indicative for future inflation. That exchange rates are unrelated to ECB communication is consistent with the claim of ECB officials that exchange rates are not an ECB policy target and are in general not commented on.

4.3 The impact on the expectations of professional forecasters

The above subsection provided evidence that financial market participants listen and react to what the ECB communicates. The shadow rate and inflation expectations react within a day to messages conveyed in the ECB's press releases. In a next step, we investigate the extent to which professional forecasters are affected by both monetary policy decisions and the information contained in the associated press releases of the ECB. For that purpose, we look at changes in the twelve-month ahead consensus forecasts constructed from monthly forecast surveys published by Consensus Economics, Inc. In line with our communication indices, we concentrate on inflation, GDP growth and M3 growth projections for the euro area. As before, the sample starts in May 2003 and ends in December 2018.[24]

[24] This time, however, we are working with what boils down to a monthly frequency that did not change over time.

Table 4 Differences across phases or decision type

	Phase 2	ΔPhase 3	ΔPhase 4	Not rule-based	ΔRule-based
ECB communication—price stability	0.00552	−0.00544	0.0571	0.0334***	−0.0201
	(0.241)	(−0.205)	(1.551)	(2.611)	(−1.096)
ECB communication—economy	0.0192	0.00272	0.00645	0.0363**	−0.0276
	(1.476)	(0.0992)	(0.267)	(2.220)	(−1.299)
ECB communication—money	0.0186	−0.00560	0.0545	−0.00439	0.0364
	(1.253)	(−0.197)	(0.414)	(−0.206)	(1.253)
Surprise in MRR (based on euribor futures) (change since day before meeting)	0.721***	0.0514	−0.229	0.858***	−0.216
	(9.666)	(0.320)	(−0.979)	(7.404)	(−1.344)
Expected GDP growth in 12 months (change since previous meeting)	0.0457	−0.00356	0.0367	0.0491***	−0.0104
	(1.636)	(−0.112)	(0.470)	(3.730)	(−0.484)
Constant	−0.00863	−0.00305	−0.0154	−0.0111*	0.00495
	(−1.529)	(−0.411)	(−0.621)	(−1.678)	(0.637)
Observations	168			168	
Adjusted R-squared	0.408			0.417	
F-test phases com. prices equal (*p*-value)	0.145				
F-test phases com. economy equal (*p*-value)	0.965				
F-test phases com. money equal (*p*-value)	0.895				
F-test phases communication equal (*p*-value)	0.358				
F-test phases MRR equal (*p*-value)	0.556				
F-test phases exp. GDP gr. equal (*p*-value)	0.863				
Chow test (*p*-value)	0.339			0.209	

The sample covers the May 2003–December 2018 period. Robust t-statistics in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

A general version of our second model is given by[25]

$$\Delta\hat{x}_{k,t_j} = \alpha\hat{x}_{t_{j-1}} + \beta ECB\ communciation_{t_j} + \gamma z_{t_j}^{ECB} + \delta z_{t_j}^{economy} + \varepsilon_{t_j},$$

where t_j is the day of the j-th consensus forecast release date in our sample and the dependent variable $\Delta\hat{x}_{k,t_j} = \hat{x}_{k,t_j} - \hat{x}_{k,t_{j-1}}$ denotes the change of the twelve-month ahead consensus forecast of variable k between t_j and its previous release t_{j-1}.

We distinguish four sets of explanatory variables. The first set contains the consensus forecasts at the beginning of the period ($\hat{x}_{t_{j-1}}$). We expect to see some mean reversion in our data, i.e., strong (weak) forecasts are likely subsequently to be reduced (increased).

[25] An illustration of the timing of the model can be found in Figure A.2 in the online appendix.

The second set represent our communication variables. $ECB\ communciation_{t_j}$ denotes the latest available version of our three communication variables prior to the j-th release of the consensus forecast. Our expectation is that statements suggesting improvements or deteriorations in the to-be-forecasted economic variable will lead forecasters to adjust their expectations for that particular variable in the same direction.

The third set includes variables associated with ECB actions ($z_{t_j}^{ECB}$). As in the previous section, we enter the change in the main refinancing rate and the interest rate surprise derived from money market futures at decision days. In addition, we include the realized change in total assets and securities on the ECB's balance sheet that reflect monetary policy actions.[26,27]

The last variable group measures changes in our variables of interest as reported officially and available at the time of the consensus forecast ($z_{t_j}^{economy}$). It includes the latest version of realized inflation rates, GDP growth and M3 growth published prior to t_j. We expect that official information released regarding the forecasted variables will influence the expectations of the professional forecasters.

Table 6 reports summary statistics for all variables just described. It reveals that the average inflation, economic growth and money growth forecasts in our sample hover around 1.6%, 1.2% and 4.7%, respectively. The changes in those forecasts are, on average, close to zero.

Table 7 reports the results for three alternative specifications. The first column for each outcome variable includes all variables described and available. The second column contains the results from a simplified model where variable reduction is based on the same general-to-specific methodology as before. Finally, the three third columns are estimated jointly using the seemingly unrelated regression method. That method allows for a potential gain in efficiency, as the residuals across these three equations are likely to be correlated.[28]

The results of the first set of variables reveal that, in general, forecasts revert to the mean. Such reversion is most pronounced for GDP growth forecasts. For money growth, however, we hardly can reject the hypothesis that we are observing a random walk process. Furthermore, money growth forecasts appear unrelated to previous forecasts in inflation and GDP growth. According to the general-to-specific results, the same holds for inflation expectations. Previous GDP or money growth expectations are not associated with subsequent changes in inflation expectations. Changes in growth expectations are, on the other hand, also affected negatively by high inflation expectations at the previous consensus survey release.

The impact of the communication variables mostly is significant and qualitatively at least as important as that of the first set of variables. Whereas ECB communication related to money is helpful only in explaining changes in money growth forecasts, communication on price stability and the economy is significant in explaining both changes in inflation and growth expectations. As expected, communication regarding the course of the economy is more important in explaining growth than inflation forecasts. The same holds true for the

[26] Note that it did not make much sense to include this variable in our first model when we looked at the changes between the day before and the day after the Governing Council meeting. In such a short time frame, including it always resulted in insignificant coefficient estimates.

[27] Since the Great Financial Crisis, the variable takes on non-zero values. Hence, it covers only the last two monetary policy phases of our sample, i.e., 2008m9-2014m5 and 2014m6-2018m12.

[28] The correlation between the residuals of the inflation and GDP growth equations is the highest and equals 0.27.

Table 5 Explaining changes in the exchange rate and market-based inflation expectations

	Nominal effective exchange rate			Inflation expectations (swaps)		
	Full	Gen-to-Spec	Gen-to-Spec	Full	Gen-to-Spec	Gen-to-Spec
Shadow rate at day before meeting	0.000236			−0.0108		
	(0.0228)			(−1.080)		
ECB communication—price stability	−0.187	−0.00470		0.0103	0.00569	
	(−1.054)	(−0.0324)		(0.472)	(0.282)	
ECB communication—economy	0.116	0.119		0.00881	0.0313	
	(0.703)	(0.863)		(0.363)	(1.269)	
ECB communication—money	0.225	0.231		0.0921***	0.0832***	0.0844***
	(1.014)	(1.264)		(2.782)	(3.049)	(3.172)
Decided change in main refinancing rate (change since day before meeting)	−0.705**	−0.598***	−0.479**	0.0426		
	(−2.458)	(−2.723)	(−2.364)	(0.924)		
Surprise in MRR (based on euribor futures) (change since day before meeting)	6.804***	7.056***	7.150***	0.437*		0.397*
	(5.850)	(6.151)	(6.392)	(1.778)		(1.721)
Surprise in US jobless claims	−0.00769			−0.00265*	−0.00355**	−0.00289*
	(−0.708)			(−1.756)	(−2.042)	(−1.857)
Expected inflation in 12 months (change since previous meeting)	0.773			0.0835		0.0875*
	(1.191)			(1.594)		(1.833)
Expected GDP growth in 12 months (change since previous meeting)	−0.280			0.0138		
	(−0.921)			(0.465)		
Expected M3 growth in 12 months (change since previous meeting)	0.314**	0.298**	0.337**	−0.0346**	−0.0325**	−0.0309**
	(2.352)	(2.206)	(2.590)	(−2.480)	(−2.275)	(−2.227)
Realised inflation rate (change since previous meeting)	0.196			−0.0248		
	(1.293)			(−0.856)		
Realised annual GDP growth (change since previous meeting)	−0.0471			0.00257		
	(−0.644)			(0.230)		

Table 5 (continued)

	Nominal effective exchange rate			Inflation expectations (swaps)		
	Full	Gen-to-Spec	Gen-to-Spec	Full	Gen-to-Spec	Gen-to-Spec
Realised annual M3 growth (change since previous meeting)	−0.0182			−0.00516		
	(−0.180)			(−0.387)		
Constant	−0.113	−0.0926*	−0.0389	0.00824	−0.0110	−0.00572
	(−0.104)	(−1.727)	(−0.974)	(0.501)	(−1.326)	(−0.914)
Observations	168	168	168	155	155	155
Adjusted R-squared	0.231	0.227	0.232	0.099	0.082	0.128

The sample covers the May 2003–December 2018 period. Robust t-statistics in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

importance of price-stability communication on inflation versus growth forecasts. As the standard deviations of both communication variables are of about the same magnitude, the relative sizes of the coefficient estimates can be compared directly.[29] Accordingly, when explaining inflation forecasts, the impact of communication on price stability is almost twice as large as that of communication on the economy, and vice versa.

The changes in the main refinancing rate and in the assets and securities linked directly to monetary policy are both robust in explaining forecast revisions of GDP growth and inflation. Neither of those two measures of actual policy implementation helps in explaining changes in money growth forecasts. Looking at the estimated signs of those variables reveals that a loosening of monetary policy is associated with both lower growth and inflation forecasts for the upcoming 12 months. Instead of boosting these outlooks, we find that professional forecasters rather interpret expansive policies as signs of deteriorating economic conditions. Note that the foregoing effects are conditional on the communicated assessment of the ECB and recently published hard data. Hence, even if we hold official data and ECB communication constant, actions that loosen monetary policy are associated with downward revisions of growth and inflation forecasts using a forecast horizon of 12 months.

Finally, it comes as no surprise that the release of official data drives forecast revisions in the same direction. The estimation results suggest, however, that only the data directly related to the variable forecasted has an impact on those forecasts, i.e., the realized inflation rate helps explain inflation forecasts, the GDP growth rate the GDP growth forecast and M3 growth the growth forecast for M3.

Taken together, the communication variable measuring price stability has the quantitatively largest impact on inflation forecasts. A one standard deviation change in that communication variable translates into more than a third of a standard deviation change in the inflation forecast. Although the impact of communication regarding the economy on the GDP growth forecast is even larger, at 0.4 standard deviations, both the initial forecasts and the change in the main refinancing rate are at least as important quantitatively. Our model can explain approximately half of the variation in changes in growth forecasts. Changes in money growth forecasts are much more difficult to model. The only three significant variables each have a quantitative impact of about 20% of a standard deviation triggered by a one standard deviation change (see Table A.2 in the online appendix). The resulting R^2 merely is around 0.1.

How robust are those results across the three different monetary policy phases that we distinguish? In Table 8, we first report results that allow all ECB variables to differ across the phases. Subsequently, we apply the same general-to-specific methodology as before. At the bottom of the table, we report *p*-values of F-statistics testing the null hypothesis that the respective interaction terms are zero, implying no statistically significant differences across the monetary policy phases.

In contrast to our first model in which we explained changes in the shadow rate and did not find any notable differences across these monetary policy phases, we now find that the ECB communication variables do have statistically different impacts across the phases when it comes to adjustments in consensus forecasts. In particular, communication related to the economy has a much stronger impact on both inflation and growth forecasts during the period starting with the Great Financial Crisis and ending before the quantitative easing

[29] Table A.2 in the online appendix reports standardized coefficients of the results presented in Table 7, allowing for a direct comparison of the quantitative importances of each of the explanatory variables.

Table 6 Summary statistics of variables used in explaining changes in forecasts

	Obs.	Average	SD	Min	Max
Change in 12-months ahead inflation forecast (in %-points)	188	−0.0011	0.1126	−0.5539	0.2480
Change in 12-months ahead GDP growth forecast (in %-points)	188	0.0018	0.1810	−0.7173	0.8379
Change in 12-months ahead M3 growth forecast (in %-points)	188	−0.0074	0.3421	−0.9344	0.9530
Previous 12-months ahead inflation forecast (in %)	188	1.5834	0.5773	−0.0233	3.0235
Previous 12-months ahead GDP growth forecast (in %)	188	1.2283	0.9724	−2.4352	2.5372
Previous 12-months ahead M3 growth forecast (in %)	188	4.6699	1.5562	1.1092	7.9767
ECB Communication—price stability	188	0.0204	0.2966	−0.7000	0.7714
ECB Communication—economy	188	0.2002	0.2755	−0.5263	0.7647
ECB Communication—money	188	0.1344	0.1972	−0.3913	0.5333
Change in the main refinancing rate (in %-points)	188	−0.0133	0.1421	−1.0000	0.2500
Surprise in MRR based on 3 m Euribor futures (in %-points)	188	0.0010	0.0359	−0.1250	0.1550
Change in Assets & Securities for monetary policy purposes (in bln €)	188	14.0998	25.5838	−8.0810	102.6400
Change in the realised inflation rate (in %-points)	188	−0.0016	0.2593	−1.1000	0.9000
Change in the realised GDP growth rate (in %-points)	188	0.0047	0.4470	−3.3701	2.7583
Change in the realised M3 growth rate (in %-points)	188	−0.0245	0.4905	−1.5000	1.3000

All variables cover the period May 2003–December 2018

phase in June 2014. After the ECB started to deploy its asset purchase program, money growth forecast revisions were associated strongly with the bank's communicated assessments of the course of the economy. Whereas communication on money overall has a positive impact on money growth forecasts (see Table 7), the relationship was reversed during the Great Financial Crisis and the euro crisis period. In the same period, the actual increase in assets and securities for monetary policy purposes led to a decline in money growth forecasts. Both effects appear to have been temporary, as the counterintuitive relationships have disappeared with the onset of quantitative easing.

5 Conclusions

In this paper, we have studied one particular channel through which the European Central Bank (ECB) communicates with the external world: the press releases following ECB Governing Council meetings at which monetary policy decisions are made. Those press releases have been coded at the statement level and allow us to analyze the tones the ECB adopts on topics related to price stability, the real economy and monetary phenomena. Arguably, those three topics capture the monetary policy mandate of the ECB.

We have first looked into the impact those messages have on the financial market. For that we use the shadow rate as developed and published by Krippner (2013a, b), which reflects the assessment of financial market participants of the ECB's overall monetary policy stance. By comparing the shadow rate the day before and the day after the ECB's

Table 7 Monetary policy and communication impact on professional forecasters' expectations

	Change in inflation expectations			Change in GDP growth expectations			Change in M3 growth expectations		
	Full	Gen-to-spec.	SUR est.	Full	Gen-to-spec.	SUR est.	Full	Gen-to-spec.	SUR est.
Expected inflation in 12 months (at previous consensus release)	−0.0676***	−0.0689***	−0.0675***	−0.144***	−0.141***	−0.140***	−0.0611		
	(−3.108)	(−3.038)	(−4.298)	(−5.085)	(−4.986)	(−6.001)	(−0.852)		
Expected GDP growth in 12 months (at previous consensus release)	−0.0173*			−0.0693***	−0.0660***	−0.0604***	−0.0110		
	(−1.838)			(−3.554)	(−3.670)	(−4.987)	(−0.308)		
Expected M3 growth in 12 months (at previous consensus release)	0.00510			0.00785			−0.0371*	−0.0382*	−0.0408**
	(0.810)			(0.772)			(−1.663)	(−1.950)	(−2.441)
ECB Communication—price stability (available at forecast release)	0.155***	0.144***	0.144***	0.108**	0.121***	0.114***	0.0700		
	(4.559)	(4.291)	(5.029)	(2.449)	(2.835)	(2.783)	(0.573)		
ECB Communication—economy (available at forecast release)	0.0837***	0.0734***	0.0702***	0.268***	0.271***	0.256***	0.181*		
	(2.681)	(2.793)	(2.651)	(6.273)	(6.590)	(6.207)	(1.840)		
ECB Communication—money (available at forecast release)	−0.00216			−0.0347			0.347*	0.343**	0.364**
	(−0.0450)			(−0.523)			(1.824)	(1.993)	(2.570)
Main refinancing rate (change between professional forecasts)	0.221***	0.188**	0.188***	0.508***	0.525***	0.512***	0.0939		
	(3.056)	(2.582)	(3.808)	(5.094)	(6.005)	(7.226)	(0.428)		
Surprise in MRR (based on 3 m Euribor futures) (change since day before meeting)	0.231			−0.254			−1.205*		
	(1.157)			(−0.670)			(−1.662)		
Assets & Securities for monetary policy purposes (change between professional forecasts)	−0.000700*	−0.000754**	−0.000697**	−0.00266***	−0.00267***	−0.00258***	−0.00188		
	(−1.826)	(−1.996)	(−2.043)	(−4.750)	(−4.741)	(−5.173)	(−1.574)		
Realised inflation rate (change between professional forecasts)	0.105***	0.107***	0.101***	0.0462			−0.0648		
	(3.483)	(3.625)	(3.840)	(0.876)			(−0.649)		
Realised annual GDP growth (change between professional forecasts)	0.0152			0.0732**	0.0753**	0.0737***	−0.0568		
	(0.851)			(2.177)	(2.362)	(3.507)	(−1.011)		
Realised annual M3 growth (change between professional forecasts)	0.00778			0.0114			0.169***	0.145**	0.141***
	(0.505)			(0.452)			(2.718)	(2.482)	(2.695)

Table 7 (continued)

	Change in inflation expectations			Change in GDP growth expectations			Change in M3 growth expectations		
	Full	Gen-to-spec.	SUR est.	Full	Gen-to-spec.	SUR est.	Full	Gen-to-spec.	SUR est.
Constant	0.0966**	0.104**	0.101***	0.272***	0.294***	0.287***	0.225*	0.128	0.137*
	(2.055)	(2.552)	(3.545)	(5.157)	(5.540)	(6.907)	(1.729)	(1.487)	(1.834)
Observations	188	188	188	188	188	188	188	188	188
Adjusted R-squared	0.370	0.375	0.394	0.478	0.483	0.502	0.107	0.108	0.122

The sample covers the May 2003–December 2018 period. The OLS results (in the columns labelled "Full" and "Gen-to-spec.") report robust t-statistics in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 8 Impact across different policy phases

	Change inflation exp.		Change growth exp.		Change gr.M3 exp.	
	Full	Gen-to-spec.	Full	Gen-to-spec.	Full	Gen-to-spec.
Expected inflation in 12 months (at previous release)	−0.0875***	−0.0906***	−0.105***	−0.0825***	−0.00227	
	(−3.112)	(−4.055)	(−3.072)	(−3.075)	(−0.0277)	
Expected GDP growth in 12 months (at previous release)	−0.0147	−0.0184*	−0.0784***	−0.0748***	0.0142	
	(−1.359)	(−1.813)	(−3.191)	(−3.592)	(0.257)	
Expected M3 growth in 12 months (at previous release)	−0.0110		−0.00873		−0.127***	−0.104***
	(−1.119)		(−0.469)		(−3.320)	(−3.591)
ECB Communication—price stability (available at forecast release)	0.321***	0.175***	0.0312		0.197	
	(3.689)	(5.093)	(0.324)		(0.693)	
Dummy ECB phase 2008:9–2014:5	−0.170**		0.0342		−0.325	
*ECB communication—price stability	(−2.162)		(0.371)		(−1.088)	
Dummy ECB phase 2014:6–2018:12	−0.187**		0.0428		0.00276	
*ECB communication—price stability	(−2.119)		(0.469)		(0.00941)	
ECB Communication—economy (available at forecast release)	−0.0394		0.0823*	0.0791***	−0.0601	
	(−1.090)		(1.706)	(2.825)	(−0.530)	
Dummy ECB phase 2008:9–2014:5	0.188***	0.192***	0.384***	0.382***	−0.00671	
*ECB communication—economy	(3.024)	(3.541)	(3.331)	(3.526)	(−0.0270)	
Dummy ECB phase 2014:6–2018:12	0.0622		0.0208		0.656***	0.609***
*ECB communication—economy	(0.833)		(0.283)		(2.713)	(3.371)
ECB Communication—money (available at forecast release)	−0.00206		0.0840		0.391***	0.497***
	(−0.0420)		(1.059)		(2.657)	(2.876)
Dummy ECB phase 2008:9–2014:5	−0.112		−0.402***	−0.314***	−0.657*	−0.754**
* ECB communication—money	(−1.418)		(−3.034)	(−2.725)	(−1.656)	(−2.168)
Dummy ECB phase 2014:6–2018:12	−0.200		−0.285*	−0.185**	0.363	
*ECB communication—money	(−1.162)		(−1.854)	(−2.030)	(0.500)	

Table 8 (continued)

	Change inflation exp.		Change growth exp.		Change gr.M3 exp.	
	Full	Gen-to-spec.	Full	Gen-to-spec.	Full	Gen-to-spec.
Main refinancing rate (change between professional forecasts)	0.0930	0.186***	0.196**	0.161*	0.132	
	(1.371)	(3.015)	(2.258)	(1.929)	(0.510)	
Dummy ECB phase 2008:9–2014:5	0.162		0.347**	0.443***	−0.207	
*change main refinancing rate	(1.492)		(1.988)	(3.202)	(−0.485)	
Dummy ECB phase 2014:6–2018:12	−0.225*	−0.240***	−0.119		0.760**	0.992***
*change main refinancing rate	(−1.888)	(−3.315)	(−1.032)		(2.095)	(4.804)
Surprise in MRR (based on 3 m Euribor futures) (change since day before meeting)	0.164		0.369		−0.187	
	(0.949)		(1.280)		(−0.277)	
Dummy ECB phase 2008:9–2014:5	0.230		−0.761		−1.043	
*change implied future MRR	(0.798)		(−1.388)		(−0.832)	
Dummy ECB phase 2014:6–2018:12	−1.036		−0.108		−2.191	
*change implied future MRR	(−1.079)		(−0.201)		(−0.814)	
Assets & Securities for monetary policy purposes, 2014:6–2018:12	0.00130*		−9.81e−05		−0.00265	−0.00361**
(change between professional forecasts)	(1.818)		(−0.162)		(−1.153)	(−2.448)
Dummy ECB phase 2008:9–2014:5	−0.00183		−0.00566***	−0.00583***	−0.00225	
*change monetary policy assets	(−1.500)		(−3.876)	(−3.958)	(−0.750)	
Realised inflation rate	0.0655**	0.0819***	−0.00130		−0.0295	
(change between professional forecasts)	(2.379)	(3.050)	(−0.0269)		(−0.275)	
Realised annual GDP growth	0.0161		0.0822***	0.0852***	−0.0346	
(change between professional forecasts)	(0.974)		(2.733)	(2.887)	(−0.601)	
Realised annual M3 growth	0.0157		0.0214		0.163**	0.157**
(change between professional forecasts)	(0.982)		(0.896)		(2.605)	(2.518)
Constant	0.263***	0.208***	0.355***	0.275***	0.692***	0.549***
	(3.117)	(5.232)	(2.790)	(4.710)	(2.842)	(3.429)

Table 8 (continued)

	Change inflation exp.		Change growth exp.		Change gr.M3 exp.	
	Full	Gen-to-spec.	Full	Gen-to-spec.	Full	Gen-to-spec.
Dummy ECB phase 3	−0.0836**	−0.0660***	−0.0985*	−0.0935**	−0.294**	−0.228***
	(−2.237)	(−3.109)	(−1.797)	(−2.513)	(−2.223)	(−2.806)
Dummy ECB phase 4	−0.127***	−0.0857***	−0.0687	−0.0485**	−0.353**	−0.187*
	(−2.728)	(−3.429)	(−1.226)	(−2.108)	(−2.223)	(−1.715)
Observations	188	188	188	188	188	188
Adjusted R-squared	0.463	0.447	0.572	0.585	0.151	0.188
F-test interaction terms price stability zero	0.082		0.896		0.259	
F-test interaction terms economy zero	0.012		0.004		0.026	
F-test interaction terms money zero	0.239		0.007	0.003	0.210	
F-test interaction terms main ref.rate zero	0.023		0.041		0.041	
F-test interaction terms future MRR zero	0.381		0.378		0.556	
F-test interaction terms mon.pol. assets zero	0.136		0.000		0.454	

The sample covers the May 2003–December 2018 period. The OLS results (in the columns labelled "Full" and "Gen-to-spec.") report robust t-statistics in parentheses
***$p<0.01$, **$p<0.05$, *$p<0.1$

council meeting, we are confident that our results are driven by the actions of the ECB. Of the three topics identified and analyzed, we find a strong and robust impact of communication regarding the real economy and price stability on the shadow rate. Inflation expectations as measured by interest-rate swaps also appear to be affected by ECB communication on monetary developments. None of the established relationships appears to have changed significantly over time. Hence, the short-run reactions of financial market participants in setting interest rates or forming inflation expectations after a monetary policy decision and its communication by the ECB has remained remarkably stable over time.

In a next step, we have analyzed how professional forecasters, on average, change their inflation, GDP and money growth outlooks for the upcoming twelve months using data from Consensus Economics, Inc. We use the change in those consensus monthly forecasts, i.e., between consensus forecast releases. Given that longer time window, we can be less certain that we are indeed estimating a truly causal impact. We do, however, find that soft(er) information revealed by the press releases generally are related to consensus forecast adjustments. Overall, the information contained in that communication device appears to outperform actual monetary policy adjustments as measured by the change in the main refinancing rate and the assets and securities on the ECB's balance sheet that are used for monetary policy purposes. Hence, again words seem to matter more than deeds.

In contrast to what we found for the shadow rate, professional forecasters did appear to have changed the ways in which they have interpreted the communication and decisions of the ECB. In particular, during the Great Financial Crisis and the euro area crisis, their behavior was different. To quite some extent, the relationship appears to have normalized again during the quantitative easing phase that started June 2014.

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