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The Role of ECB Communication in Guiding Markets*

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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 case of the European Central Bank (ECB), this should have increased the informational content of the introductory statements at the press conference following ECB policy meetings. We examine whether this form of ECB communication adds information to a shadow interest rate that summarises 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. Especially ECB's assessment of the economy, i.e. communication related to economic growth, triggers movement in financial markets and thereby the shadow rate. Communication of the ECB through its press releases also causes professional forecasters to change their outlook. Not only their growth forecasts are affected, also their expectations for M3 growth and inflation are.

JEL classification: E3, E43, E51, E52, E58

Keywords: Central bank communication, shadow rates, consensus expectations, ECB, euro area, money growth

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1. Introduction

In a remarkable 180-degree turn from their long-standing tradition of secrecy, many central banks today regard their external communication as an important tool to achieve their goals. Today's view is that communication can make monetary policy more effective by influencing expectations about the monetary policy objectives and strategy, the 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 to influence longer-term interest rates and yield curves. Hence, economists and central bankers nowadays agree that public perception of the stance of monetary policy is crucial for its effectiveness (de Haan and Sturm, 2019).[1]

Since its existence, the ECB has used its main refinancing rate as primary instrument of monetary policy. The Great Financial Crisis and the subsequent euro area debt crisis have caused the ECB to move this rate to such low levels that lowering it further did become more and more difficult. Consequently, the ECB has started to deploy unconventional policy tools like asset purchase programmes (APP) and targeted funding of bank lending to businesses and households. These 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. These have been notorious for their opposition to any programme 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 governments debts, as the cause of (hyper-)inflations (e.g. Bernholz, 2015, ch. 5). On the other hand, a collapsing money supply is still considered as the main cause of the Great Depression, which led to deflation (Friedman and Schwarz, 1963). Hence, the policies that lead to a huge increase in the money supply are still hotly debated. Bernholz (2015, p. x) states that "during the crisis such a dramatic increase of the monetary base … took place

[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 percent) of central bankers and academic economists (more than 90 percent) stated that the role of central bank communication has intensified. Both the majority of central bankers (60%) and academic economists (75%) expect communicational changes to remain, 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).

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". This controversy begs the question of how far markets perceived the actions of the ECB to be de- or inflationary.

Assessing the impact of these changes or summarising the overall stance of monetary policy in such a different environment is challenging. To start with the latter, conventional monetary policy is commonly approximated by short-term policy interest rates (e.g. Mumtaz and Theophilopolou, 2017; Coibion et al., 2017). In unconventional times, the primary instrument is constrained by the effective lower bound, making the assessment of the stance of monetary policy infeasible. A common way to circumvent this problem is the use of so-called shadow rates (Krippner, 2015; Wu, 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 long end of the yield curve. Considering longer maturity interest rates is essential for assessing the monetary policy stance, as the ECB's unconventional tools like APP and forward guidance aim to influence exactly these rates. We follow Krippner (2013a, 2013b, 2015) and measure the stance of monetary policy as interpreted by financial markets by using the Krippner shadow rate.

We want to gain insights to which extent 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 quantitative easing programmes. According to various studies, the strongest effects on asset prices can be felt precisely when such programmes are announced. The expected consequences of these programmes are therefore immediately reflected in asset prices. How these programs are initially "sold" could be a key factor in their success. There is substantive evidence that the ECB's communication is able to reduce financial market variability (see, for instance, Coenen et al., 2017; Filardo and Hofmann 2014). Moreover, financial markets are better able to predict monetary policy decisions when communication is collegial, i.e. by conveying the majority view of the committee instead of members' individualistic opinions (Ehrmann and Fratzscher, 2013). There is also a broad consensus that forward guidance moves financial markets in the intended direction (Brand et al., 2010; Ehrmann and Fratzscher, 2007; Galardo and Guerrieri, 2017; Swanson, 2017). This is 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 applied methodology. Some measure communication by interpreting the tone of inter-meeting speeches (Ehrmann and Fratzscher, 2007), others quantify the frequency of future verbs in the first section of the introductory statement (Galardo and Guerrieri, 2017). Coenen et al. (2017) consider the length of the introductory statement and 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, this allows us to build more thorough and reliable communication measures that are consistent across time. Each press release is dissected into statements that are subsequently classified regarding their topic affiliation, time reference and qualitative content. The latter reflects the tone ("increase", "stay the same", or "decrease") allowing for an economic interpretation of the impact on various variables. From this statement level data, we construct indicators that reflect key subjects of the introductory statement: price stability aspects, the economy and monetary developments. To measure the change in the market 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 this 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 realised inflation, GDP and M3 growth, we intend to isolate the effects of the communicated actions and outlook of the ECB on the market interpretation of monetary policy. Additionally, we want to assess the impact of ECB communication on the market's perspective of exchange rates and inflation expectations. For this purpose, we consider the change in the Euro nominal effective exchange rate and the change in inflation-indexed swap rates around ECB governing council meetings. In a second model, we analyse whether changes in professional forecasts, as measured by the consensus forecasts published by Consensus Economics, are related to the communicated assessment of the ECB governing council. We distinguish between expectations in inflation, GDP growth and M3 growth.

We find that 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 set-up, 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, do matter for the shadow rate. We find a significant, quantitatively important and stable impact of both on the assessment of financial market participant of ECB's

monetary policy stance, as measured by the shadow rate.

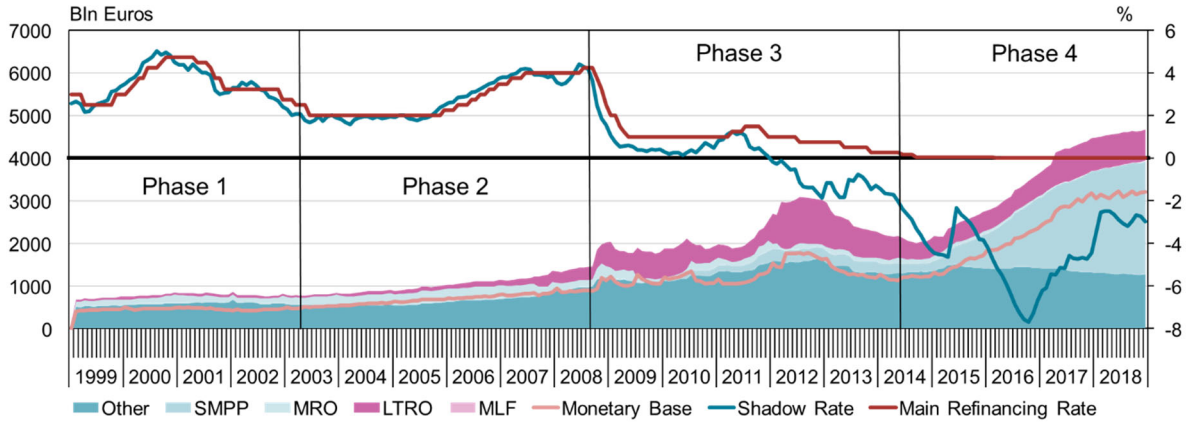
Not only financial market participants, but also professional forecasters appear influenced by the messages conveyed in the ECB press releases. Messages related to the economy and price stability both impact changes in growth and inflation forecasts; those on money are only related to money growth forecasts. We thereby confirm the results already reported in Berger et al. (2011) that monetary developments in general only appear to play a minor role. The clear exception occurs during the period that covers both the Great Financial Crisis and the euro area crisis. During this period, actual increases in assets and securities related to monetary policy were associated with downward adjustments of growth forecasts and communication suggesting expansionary developments in the monetary sector coincided with downward forecasts in money growth rates. Hence, particularly during this crises 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 is subsequently introduced in Section 3. Section 4 presents the empirical results and Section 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. These changes are documented in Figure 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]

Figure 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.

Until the Great Financial Crisis, the shadow rate, in line with short-term money market rates, closely followed the path of the main refinancing rate. During this period, monetary policy was

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

conducted almost exclusively by setting the three key ECB interest rates that 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. These 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 subsequently several other euro area countries 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 Programme, but sterilised 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 unnecessarily exacerbated the debt crisis. The shadow rate increased even before the official rate hikes already indicating a more restrictive policy stance. When President Mario Draghi took over duties 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 subsequent 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) programme that in principle allows the ECB to buy government bonds in unlimited quantity to avoid a self-reinforcing fear loop in sovereign bond markets. In fact, that particular programme was never activated. Nevertheless, all of these 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 parts of money taken up under the VLTROs and the monetary base contracted significantly. The ECB began using explicit forward guidance in July 2013 when the ECB's 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 the deposit facility to overcome the zero lower bound problem, start new asset purchase programmes for asset-backed securities (ABS) and covered bonds (CBPP) and to stop sterilising asset purchases. In addition, the ECB introduced a facility to provide longer-term funding to banks for new loans, contingent on bank credit supply

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

behaviour, referred to as targeted longer-term refinancing operations (TLTRO).

Finally, in January 2015, as the last of the major central banks, the ECB embarked on a large-scale asset purchase programme (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. This programme started in March 2015 and was initially supposed to last until September 2016. It was later extended in size and duration. Net purchases under the APP programme 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 sum up that up to 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 and the framework got 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 as afterward –, we will ignore this 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 thereby 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 summarise the overall stance of monetary policy, we use the shadow rate (*SR*) as developed by Krippner (2013a, 2013b, 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 probability to negative interest rates. In other words, they do not account for the ELB. Shadow models have become a popular tool to circumvent this problem. The shadow rate represents the short rate in a hypothetical world where cash does not exist. The difference between this hypothetical world and the real world is the opportunity to withdraw and store cash in the case that interest rates turn negative. This 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 of the put option: $R = SR + max\{\text{ELB} - SR, 0\}$. Consequently, whenever the shadow rate is (far) above

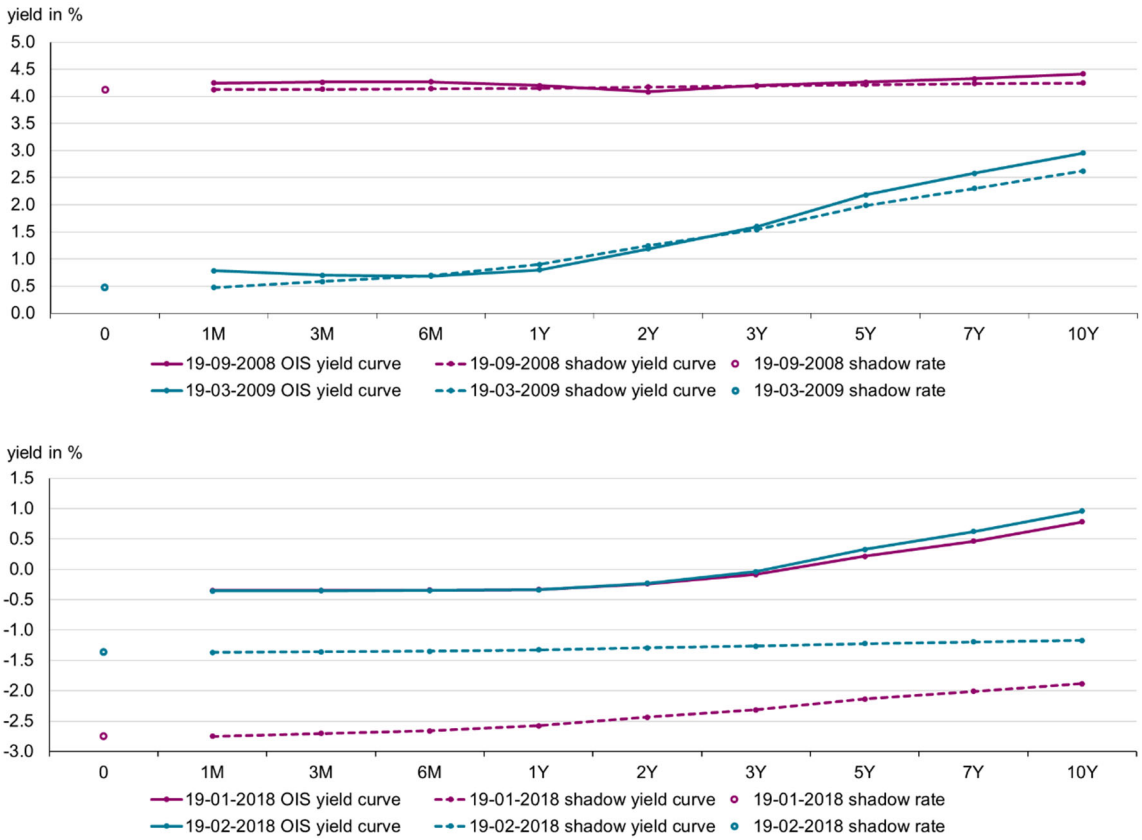
[6] This idea dates back to Black (1995) who argued that when interest rates reach the zero-lower bound, people would prefer to hold cash rather than financial instruments generating negative interest.

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, the Krippner shadow model estimates the observed yield curve and the shadow yield curve simultaneously. To obtain the shadow rate, one can essentially slide along the shadow yield curve to the point where the time 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. In that period, the 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 increasing value of the put option in near ELB environments. In 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 reflection of the stance of monetary policy across conventional and unconventional phases.

Figure 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, 6 month, and 1, 2 … 10 year Euro OIS rates.

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 heavily once the MRR reaches the ELB environment. The contemporaneous correlation coefficient is 0.91.

We use the real-time consensus forecasts as provided by Consensus Economics to construct expected inflation, output growth and M3 growth series. The monthly survey includes estimates of prominent banks and forecast institutes on a range of variables 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 by a weighted average of both rates.[8] Since Consensus Economics did not collect forecasts for the euro area prior to January 2003, we restrict our estimation window to 2003 until 2018.[9]

To reflect the latest economic information available, we take real-time vintages of 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 have to realise that the euro area is a moving concept in the sense that the introduction of the euro in Greece, Slovenia, Cyprus, Malta, Slovakia, Estonia, Latvia and Lithuania redefines the area that is covered by our data and therefore imply 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

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[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 (once they become available for the Euro area in 2008) rates with maturities 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) analyse the effect of the choice of the effective lower bound in the Krippner shadow rate model estimation and give an illustrative example. They point out that, the larger 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, there exists a trade-off 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 are therefore not concerned with the relatively high lower bound of 12.5 basis points.

[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 remaining months of the current year. As the survey is usually published in the first half of the month, we assign the current month to belong 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 on that.

[10] This 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 this real-time database date January, 2001.

Consumer Prices (HICP). As to be expected, there are generally hardly any revisions in these inflation statistics. The small revisions that occur take place within the first couple of releases, or are caused by smaller benchmark revisions.[11] GDP growth is calculated from the chain-linked volumes of quarterly Gross Domestic Product. In general, revisions in this variable tend to be larger and more frequent. 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 has a meeting regarding monetary policy decisions, which are publicly announced at 13:45 (CET). The subsequent press conference held by the ECB 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 analysed by the media research institute Media Tenor. A media analyst codes each statement (there can be several statements within a sentence) by assigning a broad as well as a specific topic affiliation, a time reference and its qualitative content. The latter is numerically classified into "increase", "stay the same", or "decrease". For instance, in the introductory statement from March 17, 2019, Mario Draghi stated

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

This 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 has 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 normalised balance of up- and downward assessments (including the neutral ones) regarding the specific topic. Formally,

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

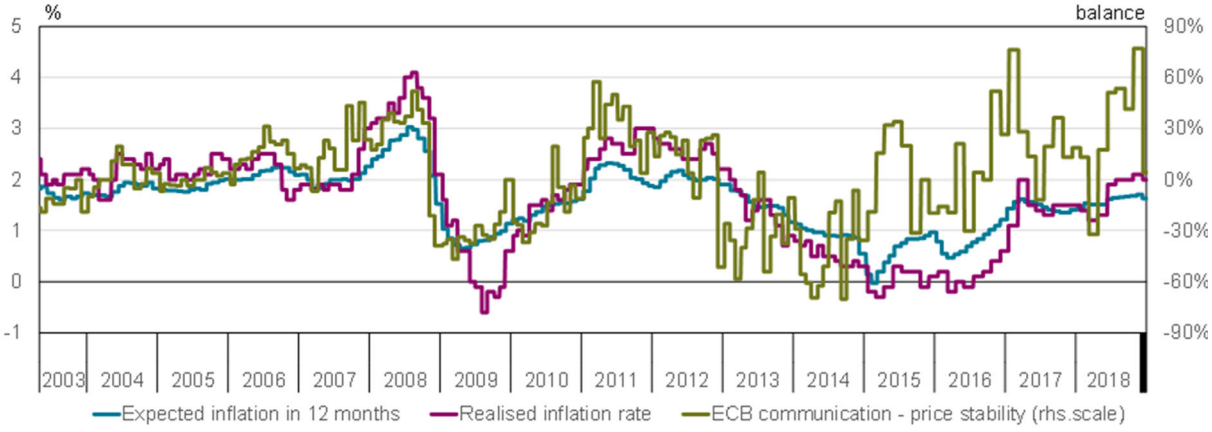
where $i \in$ {price stability, economy, money}. Accordingly, all indicators theoretically range

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

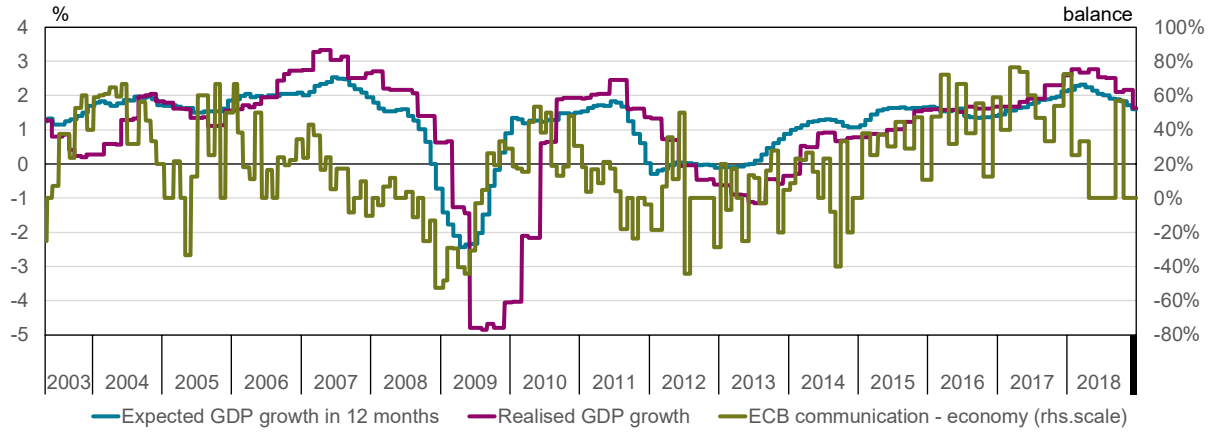
from minus one to one.[12,13] Each of the panels in Figure 3 plots the development of realised and expected counterpart together with the respective communication indicator. Each data point reflects the information available at that particular moment in time. The resemblance between the communication indicators and their respective reference series is clearly visible.

Figure 3: Forecast, realised and communicated information on inflation, economic growth and money growth, 2003m5-2018m12.

Inflation



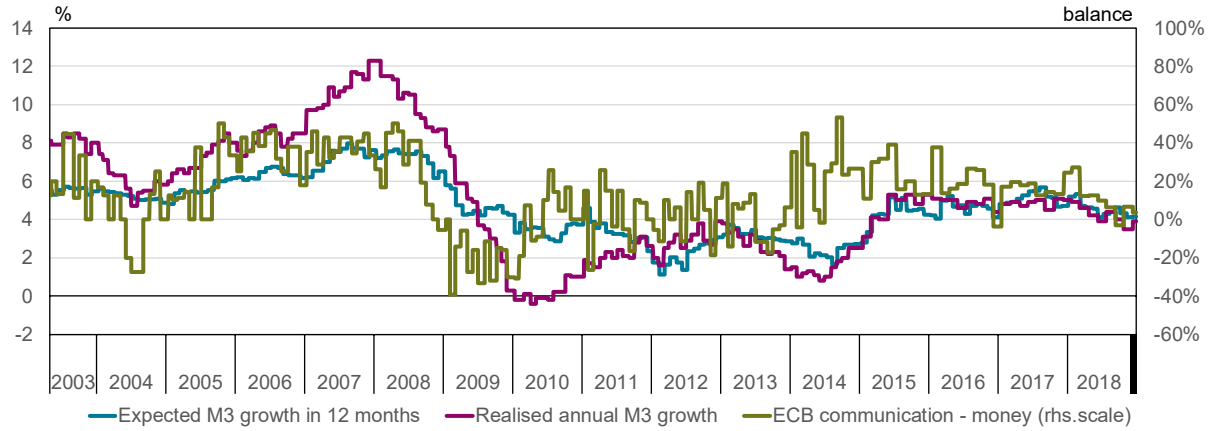
Economic Growth



M3 Growth

[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) and Neuenkirch (2013). The key difference is that the MPC is a leading indicator for monetary policy and therefore only considers forward-looking statements regarding prices.

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



Notes: The forecast information is taken from Consensus Economics Inc. The realised data is taken from the Real-Time database of the ECB Statistical Data Warehouse. The ECB communication data are extracted from ECB press releases.

In line with Bredin et al. (2010) and Fausch and Sigonius (2018), we use 3-month Euribor future rates to construct the market 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 between the end of the ECB governing council meeting day and the end of the previous day.[14]

In order to control for the market reaction to the US jobless claims published each Thursday, we use the relative difference between the actual 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 there were more claims than previously expected.

As robustness check, we also want to examine the effect of ECB communication on other measures that reflect financial market expectations. For that, we take both exchange rates and a financial market measure of inflation expectations. We use the nominal effective exchange rate of the Euro as published by the ECB to measure the financial exchange market's perception of the Euro compared to foreign currencies.[15] Regarding inflation expectations, we use 1-year Euro inflation-linked swaps provided by Bloomberg on a daily basis that is available since 2004 (e.g. Grothe and Meyler, 2015). An inflation swap is a derivative contract that entitles the buyer to receive a fixed interest rate instead of the realised inflation rate over a specific investment period. The fixed inflation swap rate therefore represents the market's inflation

[14] The 3-month Euribor future contracts have expiry dates on the 3rd Wednesday of each of the following six months and at a quarterly frequency for longer horizons. Each future can be traded until two days before the expiry date. This means that there does not exist 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. This series may contain price jumps once a month, exactly two days prior to the expiry dates. Due to the timing of the ECB governing council meeting days, these 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 this.

expectation over the same period. As in the case of the shadow rate, its daily frequency allows us to infer about the immediate impact 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 highest contemporaneous correlations are found between the shadow rate and the main refinancing rate, between the expected and realised inflation and between expected and realised M3 growth rates.[16] The three different communication variables are hardly correlated with each other and hence appear to reflect substantially different information contained in the press releases of the ECB.

Table 1: Summary statistics and contemporaneous correlation coefficients.

	Mean	Std.D.	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

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

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

Given the different monetary policy phases described in Section 2, we are not only interested in analysing the impact of ECB communication during the entire period, but also whether we can observe structural changes across these 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 that are based on the ECB press releases on the other hand.[17]

[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 six days for the main refinancing rate to be effectively changed after having been publicly announced by the ECB. By that time, the shadow rate has already adapted.

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

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, this only holds for the last monetary policy phase we distinguish. Whereas Figure 1 suggests that there is a close link between the main refinancing rate and the shadow rate up until the financial crisis. The correlation between the change in each of these is quite stable across the different phases. Overall, in particular the communicated assessment of the ECB regarding the economic situation and outlook is most strongly correlated with changes in the shadow rate.

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

	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
Observations	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

Notes: The frequency has been reduced to the frequency at which press releases after governing council meetings took place. The period May 2003 – December 2018 is covered. This leaves 168 observations. Each cell shows the correlation coefficient with the change in the shadow rate.

Another way in which we can split up our sample is by comparing each interest rate decision with what would have been implied by a rule-based approach. There is some debate about the benefits of rule-based over discretionary policy. Following Cochrane et al. (2019), we construct a measure that indicates whether the actual decision made has been in line with a (Taylor) rule-based policy and check whether the effect of communication on expectations depends on it. In case 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. This, albeit to a much lesser extent, also applies to our surprise measure and the dependent variable. Apparently, market participants are more likely to have incorporated policy decisions that are in line with a Taylor rule. Especially the communication regarding the economy appears relevant when the ECB deviates from what a Taylor rule would have implied.

subsequent analyses.

4. Results

Explaining the immediate impact on the shadow rate

In our first model, we want to explain the reaction 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 after the ECB governing council meetings that are followed by a press conference. By concentrating around these meeting days, we reduce the probability that other developments besides the explicit decisions and communication of the ECB are driving the movements in the shadow rate.

The most general version of our model is summarised by

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

where t_i is the day of the i-th ECB governing council meeting in our sample, the dependent variable $\widetilde{\Delta}s_{t_i} = s_{t_i+1} - s_{t_i-1}$ denotes the change in the shadow rate the day before and after the i-th meeting, $z_{t_i}^{market}$ 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 realised and expected 12-month inflation rates, GDP growth, and M3 growth. The variable $ECBcommunication_{t_i}$ includes our three ECB communication measures on price stability, the economy and money, respectively. The exact timing of the model is illustrated in

Figure 4 in the appendix.

The first column in Table 3 reveals that there is indeed 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 percent of the change in the main refinance rate is immediately reflected in the shadow rate. This is, however, not that surprising, given that most of the time markets are well prepared regarding upcoming interest rate decisions and therefore most likely already incorporated these in the shadow rate the day before the Governing Council meeting. This is also supported by the next column that shows that the shadow rate reacts much stronger 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 sign, 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) already highlights that the information revealed in the press release is more informative to the financial markets than the mere interest rate decision: albeit still low, the adjusted R^2 is more than double the size. Including the initial value of the shadow rate is not changing this (column (4)). When we include the decision and the surprise variable next to our communication measures, we still find an improvement in the adjusted R^2 and again, of 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. These 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 further explain changes in the shadow rate is the change in the expected GDP growth rate. In case expected GDP growth picks up, the shadow rate tends to pick up as well. This, 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 slightly 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]

In a next step and based upon the full specification in column (6), we apply a general-to-specific

[18] Including each of these communication variables separately does not change this conclusion: only communication on the economy is significant in explaining the change in the shadow rate. Given the low correlation between these indicators, this 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.

methodology while keeping all communication variables on board.[20] The results are shown in column (7). The change in the consensus forecast on GDP growth and the interest rate surprise remain significant controls. In addition to 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. This does not change if we no longer restrict the general-to-specific approach to include 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 size movement in the shadow rate. An effect of comparable size 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 these ECB press releases.

[20] General-to-specific methodology means dropping insignificant variables one at a time until all remaining variables are significant.

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

[22] Standardised beta coefficients are shown in Table 9 of the appendix.

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	0.0634***				0.0500***	0.0256		
(change since day before meeting)	(3.472)				(3.179)	(1.526)		
Surprise in MRR (based on euribor futures)		0.721***			0.725***	0.704***	0.745***	0.745***
(change since day before meeting)		(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)		
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

Notes: The sample covers the period May 2003 – December 2018. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

How stable are the detected relationships across the different monetary policy phases identified in Section 2? For that, we allow all variables identified in column (7) of Table 3 to differ in phases 3 and 4.[23] For this purpose, we introduce dummy variables reflecting each of these phases and interact them with all included variables. The results of these regressions 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 these, there is no statistical difference across these phases regarding any of the variables. In addition, when using an overall Chow test, of which the p-value is shown in the last row in the left panel of Table 4, this 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 and not rule-based phases and run a similar regression with dummy interaction terms according to those. We follow Cochrane et al. (2019) and Nikolsko-Rzhevskyy et al.

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

(2014) and use an adjusted Taylor-rule that accounts for the zero lower bound in order to allocate each policy decision into the two phases. Whenever the difference between the policy rate and the Taylor-rule-implied rate decreases, a meeting is classified as rule-based and 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 these 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 that there are no significant differences across these two phases.

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)	0.721***	0.0514	-0.229	0.858***	-0.216
(change since day before meeting)	(9.666)	(0.320)	(-0.979)	(7.404)	(-1.344)
Expected GDP growth in 12 months	0.0457	-0.00356	0.0367	0.0491***	-0.0104
(change since previous meeting)	(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	

Notes: The sample covers the period May 2003 – December 2018. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

By focusing on the immediate impact the press release and monetary policy decision have on the shadow rate, we have so far found significant, strong, stable and robust relationships between those aspects of the press release that interpret the real economy and price stability through the eyes of the ECB.

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 and 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 significantly affect the change in the nominal effective exchange rate around ECB governing council meeting days turn out to be the decided change as well as the surprise in the MRR and the expected M3 growth.

However, ECB communication regarding money does have a significant positive effect on the change in inflation expectations. In a quantitative sense, it has the strongest impact of all variables we consider. According to Table 9 in the appendix, which reports the standardised 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 the expected M3 growth have significant negative effects, albeit quantitatively less strong than that of our money-communication variable. Unsurprisingly, the expected 12-month ahead inflation rate has a significant and positive impact on inflation expectations, though it is also 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 these market participants consider ECB communication related to its monetary pillar to still 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 is in general not communicated upon.

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

	Nom.Eff.Exch.Rate			Inflation exp. (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	-0.705**	-0.598***	-0.479**	0.0426		
(change since day before meeting)	(-2.458)	(-2.723)	(-2.364)	(0.924)		
Surprise in MRR (based on euribor futures)	6.804***	7.056***	7.150***	0.437*		0.397*
(change since day before meeting)	(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	0.773			0.0835		0.0875*
(change since previous meeting)	(1.191)			(1.594)		(1.833)
Expected GDP growth in 12 months	-0.280			0.0138		
(change since previous meeting)	(-0.921)			(0.465)		
Expected M3 growth in 12 months	0.314**	0.298**	0.337**	-0.0346**	-0.0325**	-0.0309**
(change since previous meeting)	(2.352)	(2.206)	(2.590)	(-2.480)	(-2.275)	(-2.227)
Realised inflation rate	0.196			-0.0248		
(change since previous meeting)	(1.293)			(-0.856)		
Realised annual GDP growth	-0.0471			0.00257		
(change since previous meeting)	(-0.644)			(0.230)		
Realised annual M3 growth	-0.0182			-0.00516		
(change since previous meeting)	(-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

Notes: The sample covers the period May 2003 – December 2018. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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 press release. In a next step, we investigate to what extent professional forecasters are affected by both monetary policy decisions and the information contained in the associated press releases of the ECB. For that, we look at changes in the 12-months 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.

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

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

where t_j is the day of the j-th consensus forecast release date in our sample, 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 12-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 to be subsequently reduced (increased).

The second set represent our communication variables. $ECBcommunciation_{t_j}$ denotes the latest available version of our three communication variables prior to the j-th release of the consensus forecast. Our expectation is, that in particular 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 use 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 realised change in total assets and securities on the ECB balance sheet that reflect monetary policy actions.[26,27]

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

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

[25] An illustration of the timing of the model can be found in Figure 5 in the appendix.

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

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

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

	Obs.	Average	St.dev.	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 at GC meetings based on 3m 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

Note: All variables cover the period May 2003 – December 2018.

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 jointly estimated using the seemingly unrelated regression method. This 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 there is mean reversion in these forecasts. This is most pronounced for GDP growth forecasts. For money growth, however, we can hardly 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 negatively affected by high inflation expectations at the previous consensus survey release.

The impact of the communication variables is mostly significant and qualitatively at least as important as that of the first set of variables. Whereas, ECB communication related to money is only helpful in explaining changes in money growth forecasts, communication on price stability and the economy are 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 for the importance of communication on price stability on inflation versus growth forecasts. As the standard deviations for both communication variables are about the same magnitude, the relative size of

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

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 directly linked to monetary policy are both robust in explaining forecast revisions of GDP growth and inflation. Neither of these two measures of actual policy implementation helps in explaining changes in money growth forecasts. Looking at the estimated signs of these 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 these effects are conditional on the communicated assessment of the ECB and recently published hard data. Hence, even if we keep official data and ECB communication constant, actions that loosen the stance of 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. Estimation results suggest, however, that only the data directly related to the variable forecasted has an impact on these forecasts, i.e. the realised 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 the inflation forecasts. A one standard deviation change in this communication variable is translated 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 with 0.4 standard deviations, both the initial forecasts and the change in the main refinancing rate are quantitatively at least as important. 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 percent of a standard deviation triggered by a one standard deviation change (see

29

Table 10 reports standardised coefficients of the results presented in Table 7 allowing for a direct comparison of the quantitative importance of each of the explanatory variables.

Table 10 in the appendix). The resulting R-squared is merely around 0.1.

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

Notes: The sample covers the period May 2003 – December 2018. 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.

How robust are these 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 these 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 for testing the null hypothesis that the respective interaction terms are zero implying that there are no statistically significant differences across these 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 these phases when it comes to adjustments in consensus forecasts. In particular, communication related to the economy has had 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 phase in June 2014. After the ECB started to deploy the asset purchase program, money growth forecast revisions were strongly associated with the communicated assessment of the course of the economy. Whereas communication on money overall has a positive impact on money growth forecasts (see Table 7), this 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 these counterintuitive relationships have disappeared with the onset of quantitative easing.

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	-0.0875***	-0.0906***	-0.105***	-0.0825***	-0.00227	
(at previous release)	(-3.112)	(-4.055)	(-3.072)	(-3.075)	(-0.0277)	
Expected GDP growth in 12 months	-0.0147	-0.0184*	-0.0784***	-0.0748***	0.0142	
(at previous release)	(-1.359)	(-1.813)	(-3.191)	(-3.592)	(0.257)	
Expected M3 growth in 12 months	-0.0110		-0.00873		-0.127***	-0.104***
(at previous release)	(-1.119)		(-0.469)		(-3.320)	(-3.591)
ECB Communication - price stability	0.321***	0.175***	0.0312		0.197	
(available at forecast release)	(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	-0.0394		0.0823*	0.0791***	-0.0601	
(available at forecast release)	(-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	-0.00206		0.0840		0.391***	0.497***
(available at forecast release)	(-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)	
Main Refinancing Rate	0.0930	0.186***	0.196**	0.161*	0.132	
(change between professional forecasts)	(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 3m Euribor futures)	0.164		0.369		-0.187	
(change since day before meeting)	(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)
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	

Notes: The sample covers the period May 2003 – December 2018. 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.

5. Conclusions

In this paper, we have analysed one particular channel through which the ECB communicates with the external world: the press releases following ECB Governing Council meetings at which monetary policy decisions are made. These press releases have been coded at the statement level and allow us to analyse the tone the ECB sets regarding topics related to price stability, the real economy, and monetary phenomena. Arguably, these topics relate to the monetary policy mandate of the ECB.

We have first looked into the impact these messages have on the financial market. For that we use the shadow rate as developed and published by Krippner (2013a, 2013b), which reflects the assessment of financial market participants of the overall monetary policy stance of the ECB. By comparing the shadow rate the day before and after the ECB council meeting, we are confident that our results are driven by the actions of the ECB. Of the three topics identified and analysed, we find a strong and robust impact of communication regarding the real economy and price stability on the shadow rate. Inflation expectations as measured through swaps appear to be affected by ECB communication on monetary developments. None of these established relationships appear to have changed significantly over time. Hence, the short-run reaction of financial market participants 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 analysed how professional forecasters on average change their inflation, GDP and money growth outlook for the upcoming twelve months using data from Consensus Economics. We use the change in these consensus forecasts during a month, i.e. between consensus forecast releases. Given this 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 release are generally related to these forecast adjustments. Overall, the information contained in this communication device appears to outperform actual monetary policy adjustments as measured by the change in the main refinancing rate and the assets and securities 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, these professional forecasters did appear to have changed the way they have interpreted the communication and decisions of the ECB. In particular during the Great Financial Crisis and the euro area crisis, their behaviour was different. To quite some extent, this appears to have normalised again during the quantitative easing phase that started June 2014.

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Appendix

Table 9: Standardised coefficients of selected results presented in Table 3 and Table 5

	Shadow Rate		Nom.Eff.Exch.Rate		Inflation exp. (swaps)	
	Gen-to-Spec	Gen-to-Spec	Gen-to-Spec	Gen-to-Spec	Gen-to-Spec	Gen-to-Spec
ECB communication - price stability	0.123**	0.139**	-0.00234		0.0221	
	(2.155)	(2.361)	(-0.0325)		(0.283)	
ECB communication - economy	0.139**	0.151**	0.0562		0.108	
	(2.153)	(2.369)	(0.865)		(1.273)	
ECB communication - money	0.0732		0.0791		0.219***	0.222***
	(1.242)		(1.268)		(3.059)	(3.183)
Decided change in main refinancing rate			-0.148***	-0.119**		
(change since day before meeting)			(-2.732)	(-2.371)		
Surprise in MRR (based on euribor futures)	0.581***	0.580***	0.435***	0.440***		0.186*
(change since day before meeting)	(8.560)	(8.445)	(6.170)	(6.412)		(1.727)
Surprise in US Jobless Claims					-0.202**	-0.164*
					(-2.049)	(-1.864)
Expected inflation in 12 months						0.166*
(change since previous meeting)						(1.839)
Expected GDP growth in 12 months	0.221***	0.212***				
(change since previous meeting)	(4.294)	(4.072)				
Expected M3 growth in 12 months			0.181**	0.205**	-0.154**	-0.147**
(change since previous meeting)			(2.213)	(2.598)	(-2.283)	(-2.234)
Observations	168	168	168	168	155	155
Adjusted R-squared	0.415	0.414	0.227	0.232	0.082	0.128

Notes: The sample covers the period May 2003 – December 2018. Standardised (or beta) coefficients are shown. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Standardised coefficients of results presented in Table 7.

	Change in inflation expect.			Change in GDP growth expect.			Change in M3 growth expect.		
	Full	Gen-to-spec.	SUR est.	Full	Gen-to-spec.	SUR est.	Full	Gen-to-spec.	SUR est.
Expected inflation in 12 months	-0.346***	-0.353***	-0.346***	-0.460***	-0.450***	-0.446***	-0.103		
(at previous consensus release)	(-3.108)	(-3.038)	(-4.298)	(-5.085)	(-4.986)	(-6.001)	(-0.852)		
Expected GDP growth in 12 months	-0.149*			-0.372***	-0.355***	-0.324***	-0.0312		
(at previous consensus release)	(-1.838)			(-3.554)	(-3.670)	(-4.987)	(-0.308)		
Expected M3 growth in 12 months	0.0705			0.0675			-0.169*	-0.174*	-0.185**
(at previous consensus release)	(0.810)			(0.772)			(-1.663)	(-1.950)	(-2.441)
ECB Communication - price stability	0.407***	0.379***	0.380***	0.176**	0.199***	0.187***	0.0607		
(available at forecast release)	(4.559)	(4.291)	(5.029)	(2.449)	(2.835)	(2.783)	(0.573)		
ECB Communication - economy	0.205***	0.180***	0.172***	0.408***	0.412***	0.390***	0.146*		
(available at forecast release)	(2.681)	(2.793)	(2.651)	(6.273)	(6.590)	(6.207)	(1.840)		
ECB Communication - money	-0.00378			-0.0378			0.200*	0.197**	0.210**
(available at forecast release)	(-0.0450)			(-0.523)			(1.824)	(1.993)	(2.570)
Main Refinancing Rate	0.279***	0.238**	0.237***	0.398***	0.412***	0.402***	0.0390		
(change between professional forecasts)	(3.056)	(2.582)	(3.808)	(5.094)	(6.005)	(7.226)	(0.428)		
Surprise in MRR (based on euribor futures)	0.0737			-0.0503			-0.126*		
(change since day before meeting)	(1.157)			(-0.670)			(-1.662)		
Assets & Securities for monetary policy purposes	-0.159*	-0.171**	-0.158**	-0.375***	-0.377***	-0.365***	-0.141		
(change between professional forecasts)	(-1.826)	(-1.996)	(-2.043)	(-4.750)	(-4.741)	(-5.173)	(-1.574)		
Realised inflation rate	0.241***	0.247***	0.232***	0.0662			-0.0491		
(change between professional forecasts)	(3.483)	(3.625)	(3.840)	(0.876)			(-0.649)		
Realised annual GDP growth	0.0602			0.181**	0.186**	0.182***	-0.0743		
(change between professional forecasts)	(0.851)			(2.177)	(2.362)	(3.507)	(-1.011)		
Realised annual M3 growth	0.0339			0.0309			0.242***	0.208**	0.203***
(change between professional forecasts)	(0.505)			(0.452)			(2.718)	(2.482)	(2.695)
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

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

Figure 4: Data Timeline for Results in Tables 1-5 and 9.

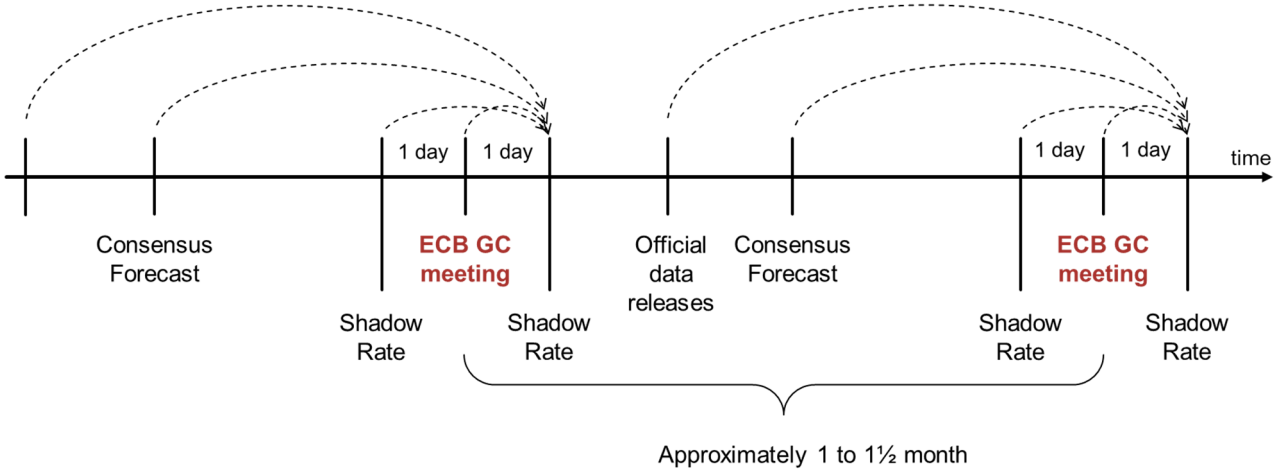

Figure 5: Data Timeline for Results in Tables 6-8 and 10.