Delphic and odyssean monetary policy shocks: Evidence from the euro area

Published Version:
Andrade, P., Ferroni, F. (2021). Delphic and odyssean monetary policy shocks: Evidence from the euro area. JOURNAL OF MONETARY ECONOMICS, 117, 816-832 [10.1016/j.jmoneco.2020.06.002].

Availability:
This version is available at: https://hdl.handle.net/11585/996134 since: 2024-11-10

Published:
DOI: http://doi.org/10.1016/j.jmoneco.2020.06.002

Delphic and Odyssean monetary policy shocks: Evidence from the euro area*

Philippe Andrade[a,*], Filippo Ferroni[b]

[a] *Federal Reserve Bank of Boston*
[b] *Federal Reserve Bank of Chicago*

Abstract

What drives the reaction of financial markets to central bank communication on the days of policy decisions? We highlight the role of two factors that we identify from high-frequency monetary surprises: news on future macroeconomic conditions (Delphic shocks) and news on future monetary policy shocks (Odyssean shocks). These two shocks move the yield curve in the same direction but have opposite effects on financial conditions and macroeconomic expectations. They also have a different impact on macroeconomic outcomes so that central bankers cannot infer the degree of stimulus they provide by looking at the mere reaction of the yield curve.

Keywords: Central bank communication, Yield curve, Monetary policy surprises, Signaling, Forward guidance
JEL: E52, E32, C10

*Philippe Andrade is a senior economist and policy advisor in the research department at the Federal Reserve Bank of Boston. Filippo Ferroni is a senior policy economist in the economic research department at the Federal Reserve Bank of Chicago. We are grateful to the editor (Urban Jerman), the associate editor (Jonathan Wright), an anonymous referee, our discussants (Marco Del Negro, Refet Gürkaynak, and Andrea Vedolin), as well as Jeff Campbell, Jonas Fisher, Caroline Jardet, Alejandro Justiniano, Aeimit Lakdawala, Julien Matheron, Leonardo Melosi, Benoit Mojon, Ali Ozdagli, Francesco Ravazzolo, Eric Swanson, Jenny Tang, and participants at various conferences and seminars for very helpful comments. The views expressed herein are those of the authors and do not indicate concurrence by the Federal Reserve Bank of Boston, the Federal Reserve Bank of Chicago, the principals of the Board of Governors, or the Federal Reserve System.

*Corresponding author. Address: 600 Atlantic Ave, Boston, MA 02110 (USA). Phone number: +1 617-973-3847.
Email address: philippe.andrade@bos.frb.org (Philippe Andrade)

1. Introduction

For many academics and central bankers, the potency of monetary policy does not stem from its direct impact on *current* short-term rates but from its influence on expectations about *future* interest rates and, hence, on the whole yield curve. Long-term rates are indeed deemed to have a greater impact than short-term rates on firms' and households' decisions. This view has led central bankers to increasingly rely on communication in order to improve the transmission of their policy rate decisions (Woodford, 2005; Bernanke, 2013). It is also central to forward guidance policies by which a commitment to future expansionary monetary policy can provide extra accommodation even when the nominal interest rate is constrained by its lower bond (Krugman, 1998; Eggertsson and Woodford, 2003; Werning, 2011).

Consistent with this view, (Gürkaynak, Sack and Swanson, 2005b) show that the yield curve reacts strongly and far ahead to central bank communication on the days of policy decisions. However, it is not clear how markets understand these announcements about future monetary policy: Gürkaynak, Sack and Swanson (2005a) show that surprises about future short-term interest rates have no impact on stock prices and Nakamura and Steinsson (2018) show they have little impact on market-based inflation expectations.

In this paper, we show that central bank communication on *future* interest rates—forward guidance—sends two types of signals: news about the future state and news about the central bank's future stance. We develop a methodology that allows us to separately identify two shocks from a single monetary policy surprise observed on the day of a policy decision: a "Delphic" shock—that is, news about the macroeconomic state to which the central bank will react given its usual policy rule—and an "Odyssean" shock—that is, news about future deviations from the central bank policy rule given a future macroeconomic state.[1]

We show that the coexistence of these two components in central bank communication can explain why announcements about future interest rates lead to a strong reaction by the yield curve together with a weak reaction by inflation expectations and stock prices. The intuition is that the two shocks move the yield curve in the same direction but have offsetting effects on these asset prices. Take expected inflation for instance: A communication that signals lower future interest rates can reveal, *at the same time*, bad news about future macroeconomic outcomes—which will lower the expected price pressures—and the good news of a more accommodative monetary policy, as the central bank signals it will deviate from its usual reaction function in the future—which will increase expected inflation.

We also document that these two shocks have different impacts on not only financial conditions but also macroeconomic expectations and outcomes. A negative Odyssean shock implies a decrease in future interest rates together with an increase in stock prices, an increase in the private sector's forecasts for GDP and inflation, and an increase in activity and prices. A negative Delphic shock also brings a decrease in future expected interest rates. But, by contrast, it goes with a decrease in stock prices, in the private sector's forecasts for GDP and inflation, as well as a decline in prices.

Our results imply that a central bank cannot infer the degree of stimulus/contraction it provides by looking at the mere reaction of the yield curve to its communication about future rates. In this regard, our methodology is helpful because it allows us to isolate what, in the reaction of the yield curve, is understood as future stimulus/contraction. A related issue is whether and how a central bank can control its communication in order to deliver the degree of accommodation it desires. We find that Delphic and Odyssean shocks are not predictable based on information available before the policy announcement. In particular, Delphic shocks are not driven by the release of central bank staff forecasts. However, we also show that changes in central bank communication policy—such as the move to explicit forward guidance—modifies what markets predominantly infer from these announcements.

We work with euro-area data. This is an interesting case study, as the communication of the European Central Bank (ECB) on the days of a Governing Council meeting explicitly brings more information than the mere policy decision. Indeed, a policy statement is released first, followed by a press conference of about one hour. We identify surprises in expected future interest rates that result only from ECB communication by looking at the intraday variations in interest rate swap contracts observed in a tight window around the press release and press conference. We consider the reaction of swap contracts of maturities between one month and two years. As in Gürkaynak et al. (2005a), we show that the bulk of the variations in these contracts can be summarized by two factors: a "Target" factor that reflects

[1] The "Delphic" versus "Odyssean" terminology was introduced by Campbell, Evans, Fisher and Justiniano (2012). Delphic shocks correspond to the central bank's oracles on the macroeconomic outlook. Odyssean shocks correspond to the central bank tying its hands to the mast to commit to future deviations from its usual reaction function.

surprises about the current policy rate and a "Path" factor that conveys news on the path of future interest rates that are independent of the news affecting the current rate.

The reaction of asset prices to the Target factor is broadly consistent with the typical effects expected from a monetary policy shock. In particular, an unexpected drop in the current target rates lowers future interest rates for as long as three years, increases inflation expectations for as long as three years, and increases stock prices. The reaction to the Path factor, however, is much more puzzling. An unexpected lower path of future interest rates lowers expected future interest rates, even for horizons as far ahead as 10 years. However, it also leads to lower expected inflation and has no significant impact on stock market prices. In sum, this is inconsistent with expectations of future monetary policy shocks.

We then identify Delphic and Odyssean shocks in the Path factor. More specifically, we combine interest rate swaps with market-based measures of inflation expectations derived from Inflation Linked Swaps contracts (ILS). We impose sign restrictions so that a Delphic (Odyssean) shock generates a positive (negative) correlation between the reaction of future interest rates and the reaction of medium-term inflation expectations. The shocks we obtain are broadly consistent with a narrative description of the latest ECB monetary policy decisions. Moreover, the three factors—Target, Delphic, and Odyssean—together account for the bulk of the variations in both interest rates and inflation swaps.

These two shocks have very different impacts on financial conditions. Delphic shocks have roughly the same effect on the path of future interest rates and on inflation expectations, such that the path of expected real rates remains almost constant. By contrast, Odyssean shocks that move the path of future interest rates downward have a negative impact on expected nominal interest rates and a positive impact on inflation expectations. These impacts are roughly the same for maturities of interest rates and inflation swaps ranging from one to ten years. Stock market prices decrease in response to a negative Delphic shock, and they increase in response to a negative Odyssean shock. Moreover, after a negative Delphic shock, corporate borrowing rates decrease by less than the average reaction of risk-free rates, signaling an increase in credit risk. By contrast, they decrease on average more than risk-free rates after a negative Odyssean shock, implying a decrease in credit risk. Overall, these reactions are consistent with Delphic shocks conveying news about the macroeconomic outlook and Odyssean shocks conveying news about future monetary policy shocks.

We also assess how the two types of shocks affect macroeconomic expectations and realizations. First, we document that market reaction to these shocks persists beyond the business days immediately following the monetary policy press conference. Second, we show that they affect the private sector's forecasts of GDP growth and inflation as measured in the Consensus Forecasts survey. Delphic shocks are positively correlated with private forecasts of output and inflation, and Odyssean shocks are negatively correlated with both. These results are again consistent with the structural interpretation of the two shocks. Third, we estimate the dynamic propagation of Delphic and Odyssean shocks on realized output and prices by using high-frequency monetary policy surprises as exogenous shocks in a VAR, as in Gertler and Karadi (2015). Our estimation strategy relies on instrumenting the reduced-form VAR residuals with our high-frequency observable measures of exogenous monetary policy shocks as in Mertens and Ravn (2013) and Stock and Watson (2012). An unexpected decline in the path of future interest rates generates a drop in prices, which suggests a strong signaling effect of central bank communication. By contrast, consistent with expectations of future accommodation, a negative Odyssean shock generates a drop in the slope of the yield curve and an increase in realized output and prices.

Finally, we explore how a central bank can affect Delphic and Odyssean shocks. We find that surprises about the *current* interest rate (the Target factor) partly reveals macroeconomic information that is incorporated in staff forecasts. However, this is not the case for surprises specific to *future* rates (the Path factor). Delphic shocks are thus not redudant with central bank private information released with such staff forecasts. This does not necessarily imply that markets' reaction to forward guidance on future rates is driven by uninformative signals as the monetary autority can disclose private information through other medium. A typical example is the balance of risk assessment, which is frequently revised even when staff forecasts are not (in particular at meetings where no staff forecasts are released).

We also document that surprises to the path of future rates were predominantly associated with perceived Delphic shocks during the pre-2012 period. Conversely, Odyssean shocks became prevalent in the post-2012 period, during which policy rates went to zero (in July 2012) and the Governing Council started giving explicit guidance on future rates (in July 2013). This period corresponds to a time when the ECB dropped its practice of making no pre-commitment to future rates. We provide some evidence that the relative importance of Delphic shocks declines when ECB presidents use less "no pre-commit" type of wording during their press conferences. So, changes in communication policy affect the way markets understand communication about future interest rates.

The rest of this paper is organized as follows. Section 2 reviews the related literature. Section 3 presents some basic properties of monetary policy surprises in the euro area, in particular some puzzling impacts on financial markets. Section 4 details how we separately identify Delphic and Odyssean shocks from news on the expected path of future interest rates, and it discusses their impact on financial conditions. Section 5 investigates the transmission of the two different shocks to macroeconomic variables. Section 6 investigates what drives Delphic shocks. Section 7 documents how communication regimes change the way markets predominantly understand what central bankers say. Section 8 provides concluding remarks.

2. Related Literature

Our paper is linked to the literature which identifies exogenous monetary policy surprises using high-frequency data on future interest rates observed in a narrow window around monetary policy announcements.[2] This approach was pioneered by Kuttner (2001) and Cochrane and Piazzesi (2002). Bernanke and Kuttner (2005) show that the stock market reaction to surprises on the *current* policy rate is consistent with what is expected from a monetary policy shock.[3] Gürkaynak et al. (2005a) emphasize that surprises specific to expected *future* policy rates account for an important share of the yield curve reaction to monetary policy decisions but that US stock prices barely reacted to these Path surprises. Nakamura and Steinsson (2018) emphasize that US monetary surprises have no impact on expected inflation. These latter two results are inconsistent with what is expected from monetary shocks.[4] We obtain similar results for the euro area and show they can be explained by the offsetting effects of Delphic and Odyssean shocks in surprises on future policy rates.

Our results confirm earlier studies (Romer and Romer, 2000; Campbell et al., 2012; Andrade, Gaballo, Mengus and Mojon, 2015) reporting survey data evidence that central bank communication conveys information on macroeconomic conditions, consistent with the "signaling" or "information" channel of monetary policy (Ellingsen and Söderstom, 2001; Melosi, 2017; Nakamura and Steinsson, 2018; Tang, 2015). We emphasize that the information channel is particularly important in central bank communication about *future* rates.[5]

Several recent papers (Miranda-Agrippino and Ricco, Forthcoming; Cieslak and Schrimpf, 2018; Jarociński and Karadi, 2020; Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa, 2019)—developed independently of us— also stress the importance of the information channel in the transmission of high frequency monetary surprises to financial conditions and macroeconomic outcomes. Our paper complements these studies in several dimensions. First, unlike these first three references, we focus on news about *future* interest rates and thus the transmission of forward guidance (FG). Second, we tease out information shocks from pure monetary policy ones differently. Cieslak and Schrimpf (2018) and Jarociński and Karadi (2020) use sign restrictions on the joint reaction of interest rates and stock market prices. Their identifying scheme does not *a priori* exclude supply side information shocks to which the central bank would respond.[6] Our sign restriction on the joint reaction of interest rates and inflation expectations is not prone to this potential limit under standard monetary policy rules. Unlike Miranda-Agrippino and Ricco (Forthcoming), our identification does not rely on projecting high frequency surprises on observable measures of central bank information, typically staff forecasts available at the time of the decision.[7] We show that, while surprises about current interest rates are predicted by ECB staff forecasts, surprises about future interest rates are not so that their projection would not purge FG shocks from their signalling component. Third, while Altavilla et al. (2019) also analyze the impact of FG together with quantitative easing (QE) in the euro area, they do not separately look at the impact of information

[2] This is just one out of several dimensions in which central bank communication matters. See Blinder, Ehrmann, de Haan, Fratzscher and Jansen (2008) for a general survey.

[3] Paul (forthcoming) shows this remains valid for the more recent period. The cross-section reaction of stocks to surprises on the current policy rate is also consistent with what is expected from a monetary policy shocks for firms with different price (Weber, 2015) or information (Ozdagli, 2018) rigidities.

[4] See also Brand, Buncic and Turunen (2010), Jardet and Monks (2014), and Leombroni, Vendolin, Venter and Whelan (2017) for similar results in the euro area.

[5] Our results are also consistent with Gürkaynak, Kısacıkoğlu and Wright (2018) who show that markets extract several dimensions from macroeconomic news such as monetary policy announcements.

[6] Positive news about future supply shocks lift the stock market and depress inflation and inflation expectations inducing the central bank to lower the nominal rates (see e.g Barsky and Sims, 2011). An identification scheme based on stock prices movements would classify this shock as a monetary policy one.

[7] See also Campbell, Fisher, Justiniano and Melosi (2017) and Lakdawala (2019) for comparable approaches on US data and Hubert and Labondance (2018) on euro area data.

(Delphic) and policy (Odyssean) shocks.[8]

Our work also contributes to the literature assessing the effectiveness of FG policies implemented to overcome the zero lower bound (ZLB) constraint. Swanson and Williams (2014) show that non-conventional policies allowed the FOMC to gear the yield curve despite the ZLB constraint. Andrade et al. (2015) emphasize that news about future low rates can be counterproductive if predominantly understood as Delphic shocks. We find evidence that the ECB announcements became predominantly understood as Odyssean when explicit FG policy was implemented. This is consistent with Swanson (2018) who shows that both FG and QE have been effective at easing US financial conditions during the ZLB period.[9]

Del Negro, Giannoni and Patterson (2012) show that standard New Keynesian dynamic stochastic general equilibrium (DSGE) models predict incredibly strong positive impacts of FG on macroeconomic outcomes, a result that has been dubbed the "forward guidance puzzle". Their exercise implicitly assumes that the yield curve reaction to FG announcements results only from future monetary policy—Odyssean—shocks. We emphasize that it is important to control for the Delphic component of FG in that exercise. Our work also shows that the empirical impact of purely Odyssean shocks on output and prices is not excessively strong. This is consistent with recent models in which the impact of FG is mitigated compared with its impact in the basic New Keynesian setup due to incomplete markets (McKay, Nakamura and Steinsson, 2016), imperfect information and higher-order beliefs (Angeletos and Lian, 2018), bounded rationality (Gabaix, Forthcoming; García-Schmidt and Woodford, 2019), or bounded rationality combined with incomplete markets (Farhi and Werning, 2019).

3. Financial market reaction to monetary policy surprises

We use intraday data to identify surprises about current and future short-term interest rates generated by central bank communication on the days of a policy decision. We split these surprises into two dimensions: a component related to the surprise in the current interest rate decision and a component related to surprises about future actions on interest rates. These two components account for the vast majority of movements in the interest rates with maturity between one month and two years. Surprises about the current decision dominate maturities of less than six months, and their impact on asset prices is broadly consistent with the effect associated with a monetary policy shock. By contrast, surprises about expected future actions account for most of the variations in maturities of between six months and two years, and their impact is inconsistent with the one of a monetary policy shock.

3.1. Surprises in current and future monetary policy decisions

We rely on intraday data to identify the reaction of future short-term rates to the ECB Governing Council's decisions. More specifically, we use minute-by-minute mid-quote observations of euro-area overnight indexed swap (OIS) contracts from the Thomson-Reuters Tick History database to compute changes in forward rates when such decisions are announced.

The ECB communicates its decisions in the following way. A monetary policy decision statement is released at 1:45pm Central European Time (CET). The statement release is followed by a press conference with the ECB's president that begins at about 2:30pm CET and lasts for about one hour.[10] We assume that the change in forward rates observed during this period identifies the effect of news released by ECB communication on current and future interest rates. Accordingly, we compute the difference in OIS forward rates using five-minute averages before the start and after the end of an identification window around the ECB interest rate announcement and press conference that starts at 1:35pm and ends at 3:50pm CET. Our sample covers 169 scheduled Governing Council meetings from January 2002 through January 2016.[11] We consider nine forward rates associated with horizons of between one month and two

[8] Altavilla et al. (2019) distinguish between a statement window which identifies surprises about the current rate, and a press conference window which identifies surprises about future interest rates. As we show, we get very similar Delphic and Odyssean shocks when using their press conference window.

[9] See also Lunsford (Forthcoming) for related US evidence during the 2003-2006 period, a time when the FOMC first gave forward guidance on interest rates.

[10] The conference opens with the ECB president reading an introductory statement that lasts about 15 minutes and contains the reasons for the monetary policy decisions, including staff forecasts. This is followed by a Q&A session with the press.

[11] We exclude the 1999-2002 period to avoid outliers due to liquidity issues on OIS contracts at the time.

years.[12]

The range of horizons considered provides information on how markets update their beliefs about future short-term interest rates both in the short and medium run. We summarize this rich set of information as in Gürkaynak et al. (2005a). We standardize the variations of the selected forward OIS rates and extract their first two principal components.[13] We then apply some identifying constraints to give these factors a structural interpretation. Namely, we rotate them so that the first factor affects every forward rate considered, whereas the second factor contributes to the variation in every forward rate but the current-month one. As in Gürkaynak et al. (2005a), we label the first a "Target" factor. It corresponds to the conventional monetary surprise in the current policy rate. Because monetary policy decisions are persistent, this surprise also affects expected future rates. As we document below, it looks like an innovation in the level of the yield curve. We label the second factor a "Path" factor. It conveys surprises about future short-term rates that are independent of current policy action, typically communication, or forward guidance, about future policy intentions.

As Table 1 illustrates, these two factors account for almost the whole of the variation in forward rates during ECB communication on the days of Governing Council meetings. While the Target factor accounts for more than half of the variation in short-term maturities, the Path factor contributes to the bulk of the variance for maturities beyond six months.[14] These results are not specific to the euro area. As a matter of fact they are strikingly similar to the ones reported by Gürkaynak et al. (2005a) for the US. So, except for maturities shorter than six months, central bank communication about future interest rates is the main driver of the yield curve on the days of the monetary policy decisions.[15]

3.2. Market reaction to central bank communication

We assess how markets react to ECB communication on Governing Council meeting days by running the following regression:

$$\Delta x = \alpha + \beta \text{Target} + \gamma \text{Path} + \epsilon,$$

where Δx is the change in various asset prices, Target and Path are the two factors describing the intraday reaction of the short- to medium-term yield curve to monetary policy decisions described in the previous section, and ϵ is an error term.

As emphasized in Gürkaynak et al. (2005a), an interesting feature of this specification is that it allows us to separately identify the impact of the surprise on current policy rate decisions from the independent effect of future policy decisions that markets extract from central bank communication. As previous work does, we investigate the reaction of the yield curve and of the stock price index. We also consider the reaction of market-based measures of expected inflation to these two factors which has not been documented so far.

More precisely, we consider the following set of financial data: daily measures of nominal OIS spot rates with maturities of 1 month to 10 years;[16] daily marked-based inflation expectations using the Inflation Linked Swaps (ILS) with horizons of 1 year to 10 years;[17] daily variations in real interest rates that are derived by taking the difference between OIS rates and ILS rates of corresponding maturity; daily and intraday observations of the reference log stock price index for the euro area, Eurostoxx50; and daily bond yields for euro-area non-financial corporations and banks from Gilchrist and Mojon (2017). These rates correspond to the effective yields on the zero-coupon euro-denominated bonds issued by banks and by non-financial corporations in the euro area. The Target (Path) factor is normalized so that it generates a 1% increase in the one-month (one-year) OIS. Table 2 shows the results.[18]

[12] In section 4.4, we show that our results are robust to allowing for a larger spectrum of maturities (up to ten year) and considering an identification window restricted to the time of the press conference.

[13] This is consistent with the result of a Cragg and Donald (1997) test which identifies two significant factors in the interest rate variations around the monetary policy event; see table A.1 in the appendix.

[14] As reported in table A.2, these two factors based on intraday surprises also account for a substantial fraction of monthly variations in the yield curve.

[15] A third factor is important to describe the long end of the yield curve, typically between 3 and 10 years. This factor can be associated with large asset purchases as in Swanson (2018) for the US and Altavilla et al. (2019) for the euro area.

[16] We obtain comparable results when using euro-area average sovereign yields instead.

[17] An alternative is to use the break-even inflation rate, the yield spread between nominal and inflation-linked bonds. However, these contracts are country-specific, which makes them unsuitable for computing expected inflation for the whole euro area. Moreover, the euro ILS market is much more liquid than the market for inflation-linked bonds. A drawback is that these ILS rates are available only from 2004 onward.

[18] We consider the variation in a 2-day window around the ECB monetary policy press conference as a baseline. Tables B.3 and B.4 in the Online Appendix B report the results obtained when regressing the 1-day or the 2-day variations in

The response of financial markets to the Target factor is broadly consistent with what is expected from a standard monetary policy shock. Monetary policy decisions are persistent, and so a higher-than-expected interest rate today implies higher nominal rates tomorrow and hence transmits to rates of longer maturities. This impact is not significant for maturities of more than three years. An unexpected tightening lowers expected inflation two to three years ahead, which is consistent with the estimated reaction to monetary shocks obtained from typical VAR studies. As a consequence, this unexpected tightening implies a hump-shaped and persistent increase in real rates. Lower rates have a negative impact on the intraday reaction of stock prices, even though this impact is not statistically significant. This is consistent with the evidence in Bernanke and Kuttner (2005) and with higher expected real rates being associated with lower expected dividends and higher discount rates. Finally, corporate yields do not significantly increase in reaction to an unexpected tightening such that the difference with the risk-free rate declines. This is inconsistent with the intended effects of a monetary policy shock, which should increase credit spreads.

By contrast, markets' reaction to the Path factor is much more puzzling. Its impact on the yield curve is stronger and more persistent than the impact of the Target factor. This is consistent with the fact that monetary policy communication sends signals about future interest rates even far ahead.[19] It is possible that markets extract signals about the long-term inflation objective from the communication of the central bank (Ellingsen and Söderstom, 2001; Gürkaynak et al., 2005b). In that case, a higher interest rate would be associated with lower expected inflation. However, the reaction of inflation is positively correlated with the Path factor. As a consequence, unexpected signals of future tightenings lead to persistent increases in real rates. Yet, the reaction of stock prices is very small (about 2.5 times smaller than their reaction to the Target factor). Finally, corporate yields increase with the Path factor, but less than the average reaction of nominal rates, so that credit spreads decline after a positive surprise on future short-term rates.

4. Delphic and Odyssean components in central bank communication

The previous section provides evidence that the major driver of the yield curve reaction to central bank communication is related to signals about future short-term rates and that these are inconsistent with signals about future monetary policy shocks. So what are markets reacting to? In this section we identify two different dimensions in the Path factor: information about the future state of the economy and information about the future monetary policy stance given the expected future state. Using the terminology of Campbell et al. (2012), we assume that the Path factor can be decomposed into:

$$\text{Path} = \sigma\text{Delphic} + \varsigma\text{Odyssean} + \varepsilon,$$

where Delphic and Odyssean are two orthogonal shocks affecting future interest rates but not the current one, and ε is a noise that affects future interest rates. We show that these two components have very different impacts on financial conditions, such that identifying each is crucial to assessing the impact of central bank communication on financial markets.

4.1. Identification

In a narrow window around monetary policy announcements, it is reasonable to assume that there is no extrinsic variation in economic fundamentals (other than monetary policy shocks). So, in a model with perfect information, all the variation in the slope of the term structure of nominal interest rates is attributable to future policy decisions given the outlook, hence to an Odyssean shock. A positive (negative) intraday monetary policy surprise would mean more tightening (accommodation) given the outlook. This should thus lead markets to revise their inflation expectations downward (upward). In other words, Odyssean shocks generate a *negative* correlation between the Path factor and market-based inflation expectations.

With imperfect information, the private sector might revise its estimates of the fundamentals based on the monetary authority's communication during the press conference. We can even think of an extreme

Spot ILS rates on the Target and Path factors. Coefficient estimates are comparable in the two specifications. Yet, adjusted R^2's are larger with 2-day variations.

[19] The Path factor peaks at the 2-year maturity as the FG factor identified in Altavilla et al. (2019). See Section 3.4 for a further comparison.

case where the variation in the slope of the term structure of nominal interest rates is solely attributable to private central bank information about the future outlook, hence to a Delphic shock. A positive (negative) intraday monetary policy surprise would correspond to a better (worse) economic outlook, to which the central bank is expected to adjust given its reaction function. This should thus lead markets to revise their inflation expectations upward (downward). In other words, Delphic shocks generate a *positive* correlation between the Path factor and market-based inflation expectations.

We use these sign restrictions on inflation and interest rate expectations to separately identify the Delphic and Odyssean shocks in the Path factor. More precisely, we postulate that the intraday variations in the OIS forward rates and ILS spot rates can be described by a three-factor model structure:[20]

$$Y = F\Lambda' + e,$$

where Y is a $T \times k$ matrix pooling together the high-frequency variations in the OIS forward rates and ILS spot rates for the k maturities observed around the T Governing Council meetings in our sample, F is a $T \times 3$ matrix of factors, Λ is a $k \times 3$ matrix of loadings, and e is an error term. We then rotate the factors to get a structural factor model

$$Y = (FH)(\Lambda H)' + e,$$

where (ΛH) satisfies identifying assumptions. Specifically, let us assume, without loss of generality, that the first three columns in the Y matrix are made of the intraday variations in the current-month OIS, the intraday variations in the one-year OIS, and the two-day variations in the five-year ILS, followed by the remaining OIS and ILS rates. Our identification is achieved assuming that ΛH has the following structure:

$$\begin{pmatrix} \Delta OIS_{1M,t} \\ \Delta OIS_{1Y,t} \\ \Delta ILS_{5Y,t} \\ \vdots \\ * \end{pmatrix} = \begin{pmatrix} * & 0 & 0 \\ * & + & + \\ * & + & - \\ \vdots & \vdots & \vdots \\ * & * & * \end{pmatrix} \begin{pmatrix} \text{Target}_t \\ \text{Delphic}_t \\ \text{Odyssean}_t \end{pmatrix} + e_t.$$

This set of restrictions implies that the second and the third factors do not influence the current-month OIS, while the first one has an impact. This is akin to the split between a Target and a Path factor. To distinguish between the Delphic and Odyssean components, we further assume that the second factor has a positive impact on the one-year OIS forward rate and on the five-year ILS rate, and that the third factor has a positive impact on the one-year OIS forward rate and a negative impact on the five-year ILS rate.[21]

4.2. Estimated shocks and illustrating examples

Figure 1 depicts the Target (black line in the top panel) and Path (black line in the central panel) factors obtained when using only information on OIS as well as the Delphic and Odyssean factors obtained using both OIS and ILS. The Target (Path, Delphic, and Odyssean) factor is normalized so that it generates a 1% increase in the one-month (one-year) OIS spot rate. The top panel shows the Target factor obtained when using only OIS or both OIS and ILS: That factor stays relatively similar under the two identifications. The central panel compares the Path factor with the Delphic shocks in monetary policy communication. Although there are clear co-movements between the two (i.e. the correlation between the Path factor and the Delphic factor is 0.70), the differences are also substantial. Finally the bottom panel reports the estimated Odyssean shocks. The correlation with the Path factor is only 0.46. Recent episodes in which realized shocks were larger than the standard deviations (in absolute values) are:

07/2013 *Odyssean factor* -4.8 *basis points.* President Draghi announced for the first time forward guidance. According to his introductory statement, "[The Governing Council] expects the key ECB interest rate to remain at present or lower levels for an extended period of time."

[20] Consistent with this, a Cragg and Donald (1997) test identifies three factors in the interest rates and inflation linked swaps variations around the monetary policy event; see table A.1 in the appendix.

[21] Further details can be found in the online Appendix C.

01/2015 *Odyssean factor* −4.9 *basis points.* President Draghi announced the QE package with some guidance on the horizon of purchases:“First, [the Governing Council] decided to launch an expanded asset purchase programme, encompassing the existing purchase programmes for asset-backed securities and covered bonds. Under this expanded programme, the combined monthly purchases of public and private sector securities will amount to Euro 60 billion. They are intended to be carried out until end-September 2016 and will in any case be conducted until we see a sustained adjustment in the path of inflation which is consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term.”

10/2015 *Odyssean factor* −6.3 *basis points.* President Draghi signals that the QE package could be expanded. “In this context, the degree of monetary policy accommodation will need to be re-examined at our December monetary policy meeting, when the new Eurosystem staff macroeconomic projections will be available. The Governing Council is willing and able to act by using all the instruments available within its mandate if warranted in order to maintain an appropriate degree of monetary accommodation. In particular, the Governing Council recalls that the asset purchase programme provides sufficient flexibility in terms of adjusting its size, composition and duration.”

12/2015 *Odyssean factor* +10 *basis points.* President Draghi announced two monetary measures: (1) a 10 basis point cut in the deposit facility rate (from −0.2% to −0.3%) and (2) an extension of the horizon of the asset purchase program until at least March 2017 (instead of September 2016). The positive Odyssean shock is inconsistent with the announcement of additional accommodation. However, market participants were expecting a more aggressive move as can be seen in the transcript of the monetary policy press conference. For example, one participant said, “And my second question is, it seems like what you’ve done is a little bit on the low end of the range of what the financial markets had expected, in terms of your stimulus package today. It seems like the initial reaction in the financial markets bears this point. Why didn’t you do more, given how much you’ve warned about the risks of low inflation? Why didn’t you raise the monthly purchase amount? Why didn’t you cut the deposit rate more?”[22]

Our measure of Odyssean shocks is thus able to identify a number of recent key events that appear relevant from a narrative viewpoint. Interestingly, these shocks do not show up as (relative) outliers if one only looks at the Path factor. It also seems that Delphic shocks are more important in the central part of our sample and less so in the recent episodes. Section 7 provides further evidence that this decline coincides with a change in ECB communication when the Governing Council started to give explicit forward guidance on future policy.

4.3. Impact on financial markets

We assess how markets react to the information released via ECB communication on the days of a Governing Council meeting by running the following regression:

$$\Delta x = \alpha + \beta \text{Target} + \delta \text{Delphic} + \kappa \text{Odyssean} + \upsilon,$$

where Δx is the change in various asset prices (we consider the same four class of asset prices than in the previous section); Target, Delphic, and Odyssean are the three factors describing the intraday reaction of the short- to medium-term yield curve to monetary policy decisions described in the previous section; and υ is an error term. Columns four to seven of Table 2 reports the results. There are several things worth highlighting.

First, the Target, Delphic, and Odyssean factors provide a better fit for the variations in different segments of the yield curve compared with the one obtained using only the Target and Path factors. The R^2 adjusted for the larger number of explanatory variables increases by about 10 percentage points (with some heterogeneity across maturities). Noticeably, these three factors account for the bulk of the variations in the spot ILS rates observed right after Governing Council meetings with figures above 85% for maturities of 2 to 10 years.

[22] Similarly another participant said, “You’ve just explained your reasoning, but nevertheless, financial markets appear to be disappointed. So what is the reason there? Do you think that something went wrong in your communication in the run-up to the decision? Did you perhaps overestimate your ability to convince fellow policy-makers to decide something even more aggressive? Or do financial markets not understand yet how powerful these measures actually are?”

Second, real rates react differently to Delphic and Odyssean shocks. As expected, a Delphic (Odyssean) shock driving up future interest rates is associated with higher (lower) price expectations for a wide range of maturities. Note that this result is not fully obtained by construction, as the identifying sign restrictions apply only to the five-year maturity spot ILS rate. A positive Delphic shock is associated with first a drop in real rates and then an increase in real rates, consistent with gradualism in the central bank reaction function. By contrast, a positive Odyssean shock is associated with an increase in real rates of every maturity, consistent with an expected future tightening given the outlook due to, for example, a change in the preference of the Governing Council regarding the long-term inflation target (Ellingsen and Söderstom, 2001).

Third, both Delphic and Odyssean shocks affect stock prices with opposite signs. The lack of reaction of stock prices to the Path factor is thus due to the fact that the two effects offset each other. These different effects are also consistent with the different natures of the two shocks. A positive Delphic shock signals a better macroeconomic outlook, to which stock markets react positively. A positive Odyssean shock signals tighter future monetary policy given the outlook, to which stock market react negatively.

Fourth, positive Delphic and Odyssean shocks exert upward pressures on the cost of marketable debt for non-financial corporations and banks. However, the reaction of corporate bond yields to a positive Delphic shock is lower than the average reaction of the riskless (OIS) yield curve to the same shock. Conversely, the reaction of corporate bond yields to a positive Delphic shock is lower than the average reaction of the riskless (OIS) yield curve to the same shock. In other words, corporate spreads decline (increase) after a positive Delphic (Odyssean) shock. A positive Delphic shock conveys looser financing conditions due to good news about the macroeconomic outlook. A positive Odyssean shock signals tighter financing conditions stemming from more restrictive monetary policy.[23]

4.4. Alternative event-window and maturity spectrum

In their recent related study of euro area monetary policy surprises, Altavilla et al. (2019) distinguish between the reaction of the yield curve observed around the public release of the statement and during the press conference. They show that the reaction observed in the statement window is related to surprises about the *current* policy rate, while the reaction observed in the press conference window is related to surprises about *future* policy rates. Another difference is that they look at the reaction of the yield curve for maturities as far away as ten years which allows them to capture surprises related to FG and also QE policies. Results reported in the online Appendix D show that our results are robust to using these alternative identification window and maturity spectrum.

First, we applied our identification scheme to surprises identified during the mere press conference window. As Figure D.1 shows, Odyssean and Delphic shocks are almost unaffected. In the euro-area, both the factor rotation identification of Gürkaynak et al. (2005a) applied to the full monetary policy event window and the identification using the press conference window used in Altavilla et al. (2019) capture the bulk of news about future interest rates. Second, we applied our identification scheme to variations over the whole monetary policy window but extended our previous maturity structure to include the 3-year OIS rate, and the 5-year and 10-year German bund yields, all obtained from Altavilla et al. (2019). As Figure D.2 reveals, Odyssean and Delphic shocks are again barely affected. As Table 2 illustrates, the Gürkaynak et al. (2005a) Path factor identified with maturities up to two years features properties that ressemble those of the FG factor identified using maturities up to ten years in Altavilla et al. (2019): these surprises affect the whole yield curve, with a peak effect at two or three years. The online Appendix D provides further evidence that the results which follows are robust to these alternative event-window and maturity spectrum.

5. Impact of delphic and odyssean shocks beyond the initial reaction

In this section, we document that the impact of Delphic and Odyssean shocks on financial conditions lasts beyond the days right after central bank announcements. We then analyze the reaction of macroeconomic expectations and outcomes to these shocks.

[23] In unreported results, we find evidence that Delphic shocks correlate negatively with sovereign spreads of euro-area countries that were under stress during the sovereign crisis, while Odyssean shocks correlate positively with these spreads. This impact on euro-area fragmentation is reminiscent of the evidence in Leombroni et al. (2017).

5.1. Persistence after initial impact

To get a sense of the persistence of the effects of Delphic and Odyssean shocks, we follow Jordà (2005) and estimate the following daily local projection regressions:

$$x_{t+h} = a_h + b_h(L)x_t + c_h\text{Factor}_t + \epsilon_{t+h},$$

for horizons h in between 1 and 30 days. x denotes the daily financial variable of interest; t indexes business days; Factor = {Target, Delphic, Odyssean} denotes the factors underlying the intraday monetary policy surprises as estimated earlier in the paper (and is set equal to zero on non-ECB announcement days); ϵ is a forecast error term; and $a_h, b_h(L)$, and c_h are parameters that may vary across regressions h.[24]

Figure 2 plots the results of these regressions for the two-year, the two-year in two-year, and the five-year in five-year ILS; the non-financial corporation borrowing rates; and the (log of) stock market prices. The effects of Target shocks are transitory and disappear after a few days, whereas Delphic and Odyssean shocks have effects that last for at least a month, that is well beyond the business days immediately following the policy decision.[25] Interestingly, while we impose signs restrictions on only the contemporaneous correlation between nominal and inflation rates, we find that the signs of the impact of Delphic and Odyssean shocks associated with the two-day variations also hold at longer horizons.

5.2. Impact on macroeconomic expectations

We investigate the effects of Target, Delphic and Odyssean shocks on macroeconomic survey forecasts by looking at the following regressions:

$$\Delta\overline{E} = \alpha + \beta\text{Target} + \gamma\text{Path} + \varepsilon$$

and

$$\Delta\overline{E} = \alpha + \beta\text{Target} + \delta\text{Delphic} + \kappa\text{Odyssean} + \nu,$$

where $\Delta\overline{E}$ is the change in the median expectation of euro-area GDP growth and HICP inflation observed in the Consensus Economics surveys conducted before and after the Governing Council meeting.[26] Consensus Economics surveys forecasts for the end of the current year and the end of the next year horizon. A drawback of these "fixed-date" forecasts is that their horizon varies with time so the above regressions pool observations with different horizons which might bias the results. We thus also look at the impact on "fixed-horizon" forecasts using the transformation used in Jarociński and Karadi (2020).[27]

Table 3 reports the results. Although they are small components of the total change, Delphic and Odyssean shocks contribute to the revision in macroeconomic forecasts with the expected signs. The effects are not always statistically significant which might be due to our sample size: when looking at individual responses and panel regressions with fixed or random effects, point estimates are similar to those obtained with the median respondes, and coefficients are all statistically significant (see Table E.6 in Appendix E).

5.3. Impact on macroeconomic outcomes

We also assess the dynamic propagation of shocks on expected future interest rates on macroeconomic outcomes by conducting a structural VAR exercise. Following Mertens and Ravn (2013) and Stock

---

[24] Altavilla, Giannone and Modugno (2017) and Hanson, Lucca and Wright (2017) provide thorough assessments of the persistence of the impact monetary policy decisions have on the yield curve.

[25] Extending the horizon further shows that Delphic shocks have effects that do not disappear within a quarter. Odyssean shocks' effects are less persistent, their dynamic transmission is found to last for one to two months. We also find that a_h and b_h are essentially always close to zero and one, respectively. Of course, for longer horizons, there will also be a greater amount of non-monetary-policy news that impacts swaps, so the residuals and standard errors surrounding the coefficient estimates will tend to be larger.

[26] The Survey of Consensus Economics is mostly collected over the days following a monetary policy decision. So variations in expectations between t and $t-1$ can be influenced by the various dimension of a the monetary policy surprises. However, this is not the case for fourteen dates for which the monthly revision in the Consensus Forecasts preceded the Governing Council meeting. We thus decided to drop these dates from our sample. See table E.7 for further details.

[27] Following footnote 15 in Jarociński and Karadi (2020), we define the one-year fixed horizon forecast as follows $E^{fh}X_t = \frac{12-j}{12}E^{cy}X_t + \frac{j}{12}E^{ny}X_t$ where cy stands for current calendar year and ny stands for next calendar year, X stands for either real GDP growth or CPI inflation and t a specific point in time and j corresponds to the month when the survey is collected.

and Watson (2012), we deal with the issue of structural identification by *instrumenting* the observable reduced-form VAR residuals with a measurable proxy for the unobservable structural shocks.

We show that the reaction of macroeconomic realizations to shocks on the expected future interest rates obtained when instrumenting the VAR residuals with the Path factor, is close to the reaction to shocks to the expected future macroeconomic state obtained when instrumenting the VAR residuals with the Delphic shock. So, over our sample, information effects on average prevail in the ECB communication about future interest rates. By contrast, when instrumenting the VAR residuals with the Odyssean shocks, we obtain a reaction of macroeconomic outcomes that is consistent with expected future monetary policy shocks.

The VAR includes six monthly variables. The first one is associated to the policy instrument, that is communication on future interest rates. We capture it by a measure of the slope of the EONIA swap rates, namely the difference between the 1-year and the 3-month OIS spot rates.[28] We then include standard macroeconomic variables which should react to the policy instrument. Namely, the seasonally adjusted (log) industrial production index (excluding construction), as a monthly indicator of economic activity, and the (log) HICP index excluding energy and food prices, as a measure of inflation. Using core instead of headline inflation sharpens the estimation as it mitigates the volatility introduced by shocks that are not related to monetary policy. We also include variables that are important for the transmission of monetary policy to aggregate outcomes. First, a measure of macroeconomic expectations, namely the Consensus Forecasts survey for next year's GDP growth and next year's inflation rate. Second, a measure of credit risk, namely the Gilchrist and Mojon (2017) euro area credit spread index. The sample period goes from January 2002 to January 2016.

The structural identification methodology works as follows. We first estimate the VAR by OLS to obtain reduced-form residuals. We then project the reduced-form residual in the policy variable equation on the various intraday data instruments. We finally regress the remaining reduced-form residuals on the fitted value of this first-stage regression. This two-stage IV regression approach allows to recover the rotation matrix mapping the reduced-form residuals into structural shocks, and hence impulse responses to the structural monetary policy shocks. Confidence intervals are obtained from a multi-block bootstrap of the VAR residuals as advocated in Jentsch and Lunsford (2019).[29]

Figure 3 reports the estimated responses to an impulse in the Path (upper panel) of future interest rates, with no distinction between Delphic and Odyssean shocks, and the responses to a Delphic (central panel) and Odyssean (bottom panel) shocks. The initial impulses are normalized to generate a one standard-deviation increase in expected future short-term rates for a given current short-term rate, that is a steepening in the slope of the yield curve. A positive shock to the Path increases prices and the private sector's output and inflation forecasts, and reduces credit spreads; a positive Delphic shock has similar effects. This shows that the information effect dominates in surprises about the path of future short term rates. By contrast, a positive Odyssean shock lowers output and prices and the private sector's output and inflation forecasts, and increases credit spreads. This is consistent with the effects of future monetary policy shocks. After two years, the cumulated impact of an Odyssean shock that increases forward rates in one year by 25 basis points is of about 1.5% on industrial production and 15 basis points on core inflation. At odds with what standard DSGE models imply (Del Negro et al., 2012), our methodology shows that the effects of a pure Odyssean FG shock are comparable to the ones of a standard monetary policy shock.

6. The information content of monetary surprises

Recent studies (Ramey, 2016; Miranda-Agrippino and Ricco, Forthcoming) emphasize that even high-frequency US monetary policy surprises are predictable based on information available at the time of monetary policy decisions. This is again evidence consistent with the signalling channel of monetary policy. In this Section, we confirm this predictability for intraday euro-area monetary surprises. We

[28] This is comparable to the approach of Eberly, Stock and Wright (2020) who associate unconventional (resp. conventional) monetary policy to changes in the slope (resp. level) of the yield curve.

[29] Appendix F shows that our baseline results are robust to several alternative exercices: (i) a Bayesian VAR estimation method using uninformative priors on the VAR reduced form parameters along the lines discussed in Miranda-Agrippino and Ricco (Forthcoming); (ii) the same set of variables using fixed-horizon Consensus forecasts instead of the fixed date ones; (iii) a different set of variables in the VAR including the HICP price level and a measure of the level of the short term interest rate (3M OIS rate), and substituting the Consensus expectations with market based inflation expectations; and (iv) IRFs based on local projections (LP) instead of a VAR. Some of these exercises are performed using the empirical macro toolbox described in Ferroni and Canova (2020).

also go one step further and show that only surprises about the current rate (the Target factor) are predictable. In contrast, surprises specific to future rates (the Path factor) are not. In particular, they do not correlate with staff forecasts.

6.1. Are euro-area intraday monetary policy surprises predictable?

We test for such predictability by projecting the Path and Target factors onto the factors summarizing the information content of a rich set of variables observables on the day before the announcement. We consider a set of about 40 macroeconomic, survey and financial variables.[30] We extract their principal components which account for about 70 percent of their total variance. Factors are extracted on a rolling basis in order to avoid including the information available after the announcement. We then regress either the Path or the Target factor on these factors and look at their statistical significance.

Results are reported in Appendix H. Overall, the publicly available information seems to explain very little of the interest rate variations in a narrow window around the monetary policy press conference. Only a single macro-factor, which correlates with core and headline inflation, significantly predicts surprises about the *current policy* rate (the Target factor). By constrast, no macro-factor has predictive power for surprises about the expected *future* policy rates (the Path factor).

6.2. Do delphic shocks correlate with staff forecasts?

According to the signalling channel of monetary policy, central banks can process more information than private agents who revise their expectations as this superior information is disclosed. Is there a simple measure of such information central banks reveal to the public with their policy announcement? Miranda-Agrippino and Ricco (Forthcoming) propose an obvious candidate: central bank staff forecasts. They show that indeed these predict US monetary policy surprises. They consequently advocate to use residuals from a projection of monetary surprises on the Fed staff forecasts as a proxy for pure monetary policy shocks.

Along the lines of their analysis, we regress the Target, Path, Odyssean and Delphic components of our euro area intra-day monetary surprises on ECB staff projections of GDP growth and CPI inflation for the current and next calendar years, as well as on their revisions compared with the previous quarter.[31] Table 6 shows the results. Monetary policy Target surprises are explained by the Eurosystem projections of inflation for the current year and next year. By contrast, the Path, the Odyssean, or the Delphic factor do not correlate with ECB's staff forecasts.[32] A consequence is that projecting intraday monetary surprises on staff forecasts to get a pure monetary policy shock as Miranda-Agrippino and Ricco (Forthcoming) advocate is appropriate if one is interested in a conventional monetary policy shock that affect the current policy rate. It is not if the focus is on future monetary policy shocks.[33]

7. Changing communication near the effective lower bound

We document that the ECB's communication changed when the euro area entered a regime in which interest rates were very close to the effective lower bound (ELB). Starting in July 2012, excess liquidity combined with a rate on the deposit facility of the Eurosystem set at zero drove the interbank market rates close to zero. These rates even entered negative territory starting in June 2014, when the deposit facility rate was set to $-.10\%$. We label this a "near-ELB" regime.

As we document in this section, during that period, the ECB managed to have a larger impact on the risk-free yield curve through its communication on future interest rates. Moreover, while the ECB's communication was mostly understood as Delphic before the near-ELB regime, it became predominantly interpreted as Odyssean afterward. Still, the Delphic component remained present. This change in

[30] The selection of variables is pretty standard and mimics the choices in Banbura and Modugno (2014). More details are reported in Appendix H.

[31] Such projections are conducted quarterly and released during the press conferences of the March, June, September, and December Governing Council meetings. This thus reduces our sample size from 135 to 46 for Delphic and Odyssean factors and from 169 to 55 for Target and Path factors. Note that since we are removing two-thirds of the observations, the new series for the estimated factors might not be centered at zero and with zero autocorrelation.

[32] We also run regression along the lines of Campbell et al. (2017) and provide evidence that the asymmetry between staff and private sector forecasts does not correlate with the Path factor. See Table H.10 for details.

[33] Interestingly, that the Target responds to the Eurosystem forecasts of inflation is consistent with the evidence of the previous subsection: the Target factor can also be predicted by one macro-factor which correlates with measures of inflation.

communication can be related to explicit policy decisions, such as offering explicit forward guidance about future rates, which was adopted in July 2013.

7.1. ECB gave more forward guidance

The first striking difference between the two regimes is the relative contribution of each identified factor in explaining the volatility of the OIS futures at various maturities. This is illustrated in Table 4. For convenience, the first two columns report the fractions of the variance of each interest rate futures contract rate that are due to the Target and the Path factors over the whole sample period of January 2002 through January 2016. The next columns report the same for the 2002-2012 and 2012-2016 subsamples. The Path factor explains 55% of the variance in the three-month Euribor 1.5 years ahead in the pre-ELB regime. This contribution jumps to 75% in the near-ELB period.[34]

7.2. ECB communication became predominantly interpreted as Odyssean

We run the regression used in previous sections, namely

$$\Delta x = \alpha + \beta \text{Target} + \gamma \text{Path} + \epsilon,$$

over the pre-ELB and near-ELB sub-samples.

Table 5 provides the results. Over the pre-ELB regime, the Path factor had a positive impact on both market-based inflation expectations derived from ILS contracts and stock prices (although non-significant for stock prices). In comparison, the Path factor had a negative impact on both market-based inflation expectations derived from ILS contracts and stock prices over the near-ELB regime. This is consistent with ECB communication being predominantly interpreted as Delphic before the euro area reached very low levels of interest rates and then Odyssean when interest rates were at or below zero and forward guidance policies were more actively used to promise future accommodation. These time variations in the response of inflation expectations to the Path factor are also observed with rolling estimates or local kernel estimators instead of considering arbitrary subsamples (see Appendix G).

We offer further evidence that the relative share of Delphic to Odyssean shocks evolves with ECB communication. The ECB communication put a strong emphasis on the absence of pre-commitment until it started to give forward guidance on interest rates. We therefore count the number of times ECB presidents used the following terms during press conferences: "never pre-commit," "no pre-commit*," "not pre-commit*." We then average that number for each year in the sample and compare it with the average of the ratio between the squared Delphic and Odyssean shocks for the same year. Figure 4 below illustrates that there is a strong positive correlation between the two series (the correlation is 0.85): Delphic shocks became relatively less important when the ECB used much less of this type of wording in its communication.

8. Conclusion

Distinguishing between Delphic and Odyssean shocks is crucial for understanding how central bank communication about *future* interest rates affects financial and economic conditions. We develop an approach to separately identify these shocks from intraday monetary policy surprises and measure their dynamic impact on financial conditions as well as on macroeconomic expectations and realizations in the euro area. We show that there is a substantial information effect in financial markets' reaction to central bank communication on the days of Governing Council meetings. However, that information is not redundant with new central bank assessments revealed in the release of macro staff forecasts. Markets also partly interpret news on future interest rates as a signal that the central bank will deviate from its normal-time reaction function in the future. These results stress that monetary authorities should not look at just the reaction of the yield curve to assess the degree of accommodation/tightening they provide. Our methodology offers a way to extract the pure expected monetary policy shocks in the reaction of the yield curve to forward guidance. We also provide evidence that Odyssean shocks became prevalent during the time when the ECB implemented explicit forward guidance policies and dropped the term "never pre-commit" from its communication. So central banks can have some control over how markets understand those communications. A better understanding of how they can shape

[34] Carvalho, Hsu and Nechio (2016) obtain comparable results for US yields including for longer maturities.

that understanding—either via their language (Hansen and McMahon, 2016) or by stating conditions for future actions (Ehrmann, Gaballo, Hoffmann and Strasser, 2019)—is left for further research.

References

Altavilla, C., Brugnolini, L., Gürkaynak, R.S., Motto, R., Ragusa, G., 2019. Measuring Euro Area Monetary Policy. Journal of Monetary Economics 108, 162–179.

Altavilla, C., Giannone, D., Modugno, M., 2017. Low Frequency Effects of Macroeconomic News on Government Bond Yields. Journal of Monetary Economics 92, 31–46.

Andrade, P., Gaballo, G., Mengus, E., Mojon, B., 2015. Forward Guidance and Heterogenous Beliefs. American Economic Journal: Macroeconomics 11, 1–29.

Angeletos, G.M., Lian, C., 2018. Forward Guidance without Common Knowledge. American Economic Review 108, 2477–2512.

Banbura, M., Modugno, M., 2014. Maximum Likelihood Estimation Of Factor Models On Datasets With Arbitrary Pattern Of Missing Data. Journal of Applied Econometrics 29, 133–160.

Barsky, R.B., Sims, E.R., 2011. News shocks and business cycles. Journal of Monetary Economics 58, 273–289.

Bernanke, B.S., 2013. Communication and Monetary Policy. Herbert Stein Memorial Lecture at the National Economists Club Annual Dinner – November 19 2013 – Washington DC.

Bernanke, B.S., Kuttner, K.N., 2005. What Explains the Stock Market's Reaction to Federal Reserve Policy? Journal of Finance 60, 1221–1257.

Blinder, A.S., Ehrmann, M., de Haan, J., Fratzscher, M., Jansen, D.J., 2008. Central Bank Communication and Monetary Policy. Journal of Economic Literature 46, 910–945.

Brand, C., Buncic, D., Turunen, J., 2010. The Impact of ECB Monetary Policy Decisions on the Yield Curve. Journal of European Economic Association 8, 1266–1298.

Campbell, J.R., Evans, C.L., Fisher, J.D., Justiniano, A., 2012. Macroeconomic Effects of Federal Reserve Forward Guidance. Brookings Papers on Economic Activity , 1–80.

Campbell, J.R., Fisher, J.D., Justiniano, A., Melosi, L., 2017. Forward Guidance and Macroeconomic Outcomes Since the Financial Crisis. NBER Macroeconomics Annual 31, 283–357.

Carvalho, C., Hsu, E., Nechio, F., 2016. Measuring the Effect of the Zero Lower Bound on Monetary Policy. Working Paper 2016-06. Federal Reserve Bank of San Francisco.

Cieslak, A., Schrimpf, A., 2018. Non Monetary News in Central Bank Communication. Journal of International Economics 118, 293–315.

Cochrane, J.M., Piazzesi, M., 2002. The Fed and Interest Rates: A High Frequency Identification. American Economic Review 92, 90–95.

Cragg, J.G., Donald, S.G., 1997. Inferring the rank of a matrix. Journal of Econometrics 76, 223–250.

Del Negro, M., Giannoni, M., Patterson, C., 2012. The Forward Guidance Puzzle. Staff Reports 574 (revised 2015). Federal Reserve Bank of New York.

Eberly, J.C., Stock, J.H., Wright, J.H., 2020. The Federal Reserve's Current Framework for Monetary Policy: A Review and Assessment. International Journal of Central Banking 16, 5–71.

Eggertsson, G.B., Woodford, M., 2003. The Zero Bound on Interest Rates and Optimal Monetary Policy. Brookings Papers on Economic Activity , 139–235.

Ehrmann, M., Gaballo, G., Hoffmann, P., Strasser, G., 2019. Can More Public Information Raise Uncertainty? The International Evidence on Forward Guidance. Journal of Monetary Economics 108, 93–112.

Ellingsen, T., Söderstom, U., 2001. Monetary Policy and Interest Rates. American Economic Review 91, 1594–1607.

Farhi, E., Werning, I., 2019. Monetary Policy, Bounded Rationality, and Incomplete Markets. American Economic Review 109, 3887–3928.

Ferroni, F., Canova, F., 2020. A hitchhiker guide to empirical macro models. Working Paper. MIMEO. URL: `https://github.com/naffe15/BVAR_`.

Gabaix, X., Forthcoming. A Behavioral New Keynesian Model. American Economic Review .

García-Schmidt, M., Woodford, M., 2019. Are Low Interest Rates Deflationary? A Paradox of Perfect-Foresight Analysis. American Economic Review 109, 86–120.

Gertler, M., Karadi, P., 2015. Monetary Policy Surprises, Credit Costs, and Economic Activity. American Economic Journal: Macroeconomics 7, 44–76.

Gilchrist, S., Mojon, B., 2017. Credit Risk in the Euro Area. Economic Journal 128, 118–158.

Gürkaynak, R.S., Kısacıkoğlu, B., Wright, J., 2018. Missing Events in Events Studies: Identifying the Effects of Partially-Measured News Surprises. Working Paper 25016. NBER.

Gürkaynak, R.S., Sack, B., Swanson, E., 2005a. Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. International Journal of Central Banking 1, 55–93.

Gürkaynak, R.S., Sack, B., Swanson, E., 2005b. The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models. American Economic Review 95, 425–36.

Hansen, S., McMahon, M., 2016. Shocking Language: Understanding the Macroeconomic Effects of Central Bank Communication. Journal of International Economics 99, 114–133.

Hanson, S.G., Lucca, D., Wright, J., 2017. The Excess Sensitivity of Long-Term Rates: A Tale of Two Frequencies. Staff Report 810 (revised 2018). Federal Reserve Bank of New York.

Hubert, P., Labondance, F., 2018. The Effect of ECB Forward Guidance on the Term Structure of Interest Rates. International Journal of Central Banking 14, 193–222.

Jardet, C., Monks, A., 2014. Euro Area Monetary Policy Shocks: Impact on Financial Asset Prices During the Crisis? Working papers 512. Banque de France.

Jarociński, M., Karadi, P., 2020. Deconstructing Monetary Policy Surprises -The Role of Information Shocks. American Economic Journal: Macroeconomics 12, 1–43.

Jentsch, C., Lunsford, K.G., 2019. The dynamic effects of personal and corporate income tax changes in the united states: Comment. American Economic Review 109, 2655–78.

Jordà, O., 2005. Estimation and Inference of Impulse Responses by Local Projections. American Economic Review 95, 161–182.
Krugman, P.R., 1998. It's Baaack: Japan's Slump and the Return of the Liquidity Trap. Brookings Papers on Economic Activity 29, 137–206.
Kuttner, K.N., 2001. Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market. Journal of Monetary Economics 47, 523–544.
Lakdawala, A., 2019. Decomposing the Effects of Monetary Policy Using an External Instruments SVAR. Journal of Applied Econometrics 34, 934–950.
Leombroni, M., Vendolin, A., Venter, G., Whelan, P., 2017. Central Bank Communication and the Yield Curve.
Lunsford, K., Forthcoming. Policy Language and Information Effects in the Early Days of Federal Reserve Forward Guidance. American Economic Review .
McKay, A., Nakamura, E., Steinsson, J., 2016. The Power of Forward Guidance Revisited. American Economic Review 106, 3133–3158.
Melosi, L., 2017. Signaling Effects of Monetary Policy. Review of Economic Studies 84, 853–884.
Mertens, K., Ravn, M.O., 2013. The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States. American Economic Review 103, 1212–47.
Miranda-Agrippino, S., Ricco, G., Forthcoming. The Transmission of Monetary Policy Shocks. American Economic Journal: Macroeconomics .
Nakamura, E., Steinsson, J., 2018. High Frequency Identification of Monetary Non-Neutrality. Quarterly Journal of Economics 133, 1283–1330.
Ozdagli, A., 2018. Financial Frictions and the Stock Price Reaction to Monetary Policy. The Review of Financial Studies 31, 3895–3936.
Paul, P., forthcoming. The Time Varying Effect of Monetary Policy on Asset Prices. Review of Economics and Statistics .
Ramey, V.A., 2016. Macroeconomic Shocks and Their Propagation, in: Taylor, J.B., Uhlig, H. (Eds.), Handbook of Macroeconomics. North Holland. volume 2A. chapter 3, pp. 71–162.
Romer, D.H., Romer, C.D., 2000. Federal Reserve Information and the Behavior of Interest Rates. American Economic Review 90, 429–457.
Stock, J.H., Watson, M.W., 2012. Disentangling the Channels of the 2007-09 Recession. Brookings Papers on Economic Activity , 81–156.
Swanson, E., 2018. Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets. Brookings Papers on Economic Activity .
Swanson, E.T., Williams, J.C., 2014. Measuring the Effect of the Zero Lower Bound on Medium- and Long-Term Interest Rates. American Economic Review 104, 3155–85.
Tang, J., 2015. Uncertainty and the Signaling Channel of Monetary Policy. Working Papers 15-8. Federal Reserve Bank of Boston.
Weber, M., 2015. Nominal Rigidities and Asset Pricing.
Werning, I., 2011. Managing a Liquidity Trap: Monetary and Fiscal Policy. NBER Working Papers 17344. National Bureau of Economic Research, Inc.
Woodford, M., 2005. Central Bank Communication and Policy Effectiveness, in: Economic Policy Symposium Proceedings, Federal Reserve Bank of Kansas City.

Table 1: Contributions of the Path and Target factors to intraday changes in the yield curve

Forward rates	Target	Path
EONIA current	85	0
EONIA next	66	17
Euribor 3M in 3M	42	49
Euribor 3M in 6M	25	67
Euribor 3M in 9M	16	76
Euribor 3M in 12M	15	78
Euribor 3M in 15M	8	80
Euribor 3M in 18M	11	57
Euribor 3M in 21M	2	64

This table reports the share of the total variance of interest rate forward rates derived from OIS contracts observed during ECB communication on the days of Governing Council meetings that is explained by the Target and Path factors. "EONIA current" corresponds to the unexpected change in the EONIA rate that will prevail until the next Governing Council meeting. "EONIA next" corresponds to the unexpected change in the EONIA rate that will prevail between the following two Governing Council meetings. The sample includes the scheduled Governing Council meetings that took place from January 2002 through January 2016. The variance is computed as the R^2 of the regression of the change in each swap contract on either the Target factor or the Path factor.

Table 2: Regression Estimating Responses of the (daily) revision of Financial Instruments to Target, Path, Delphic and Odyssean factors.

	Target	Path	Adj R^2	Target	Delphic	Odyss	Adj R^2
Interest Rates							
OIS 1m	0.78*** (0.22)	-0.03 (0.05)	0.34	0.58*** (0.36)	0.10 (0.10)	-0.08 (0.12)	0.13
OIS 1y	0.89*** (0.32)	0.84*** (0.08)	0.46	1.22*** (0.45)	1.22*** (0.18)	0.37** (0.21)	0.58
OIS 2y	0.87*** (0.34)	1.16*** (0.12)	0.44	1.56*** (0.45)	1.59*** (0.16)	0.48** (0.25)	0.59
OIS 3y	0.58** (0.39)	1.13*** (0.11)	0.48	1.44*** (0.46)	1.53*** (0.17)	0.50** (0.25)	0.54
OIS 5y	0.37 (0.38)	0.93*** (0.09)	0.38	0.89*** (0.43)	1.40*** (0.15)	0.48** (0.28)	0.46
OIS 10y	-0.09 (0.37)	0.50*** (0.11)	0.11	0.18 (0.37)	0.88*** (0.18)	-0.00 (0.36)	0.17
Inflation							
ILS 1y	0.23 (0.27)	0.43*** (0.13)	0.07	-0.34 (0.31)	1.55*** (0.17)	-0.35 (0.17)	0.46
ILS 2y	-0.36 (0.46)	0.37*** (0.10)	0.08	-1.09*** (0.25)	1.51*** (0.12)	-0.65*** (0.11)	0.85
ILS 3y	-0.53*** (0.34)	0.33*** (0.08)	0.12	-0.99*** (0.12)	1.31*** (0.06)	-0.62*** (0.06)	0.92
ILS 5y	-0.08 (0.15)	0.24*** (0.06)	0.09	-0.09 (0.12)	0.86*** (0.05)	-0.83*** (0.08)	0.87
ILS 10y	0.12 (0.13)	0.17*** (0.06)	0.06	0.33*** (0.09)	0.61*** (0.03)	-0.96*** (0.06)	0.88
Real Rates							
OIS Real 1y	0.58* (0.26)	0.37** (0.15)	0.07	1.56*** (0.69)	-0.33* (0.28)	0.72** (0.28)	0.18
OIS Real 2y	1.15*** (0.36)	0.77*** (0.11)	0.35	2.65*** (0.38)	0.08 (0.17)	1.14*** (0.24)	0.52
OIS Real 3y	1.08*** (0.34)	0.78*** (0.13)	0.35	2.43*** (0.45)	0.22 (0.19)	1.13*** (0.27)	0.45
OIS Real 5y	0.42* (0.33)	0.69*** (0.11)	0.27	0.96*** (0.50)	0.55*** (0.17)	1.31*** (0.31)	0.31
OIS Real 10y	-0.23 (0.35)	0.33*** (0.13)	0.05	-0.17 (0.42)	0.28* (0.18)	0.96*** (0.37)	0.11
Stock Prices							
Eurostoxx50	-0.02 (0.10)	0.05 (0.04)	0.00	0.01 (0.12)	0.14*** (0.07)	-0.28*** (0.08)	0.15
Eurostoxx50 (intraday)	-5.06 (3.04)	-0.19 (1.31)	0.02	4.01 (3.26)	1.62 (1.50)	-13.95*** (3.12)	0.24
Corporate bonds							
NFC	0.22 (0.36)	0.77*** (0.12)	0.25	0.50** (0.51)	0.84*** (0.15)	0.75*** (0.26)	0.31
Banks	0.13 (0.25)	0.70*** (0.09)	0.30	0.54** (0.38)	0.67*** (0.13)	0.93*** (0.20)	0.31

Regression estimating the impact of intraday Target and Path surprises on 2-day variations of various assets observed after Governing Council's decisions, except stock prices for which the variation is intraday. Real rates are computed as the difference between the nominal interest rates and the inflation rates of equivalent maturity. *, ** and *** indicate statistical significance at 10%, 5%, and 1% respectively and robust SE are reported in parenthesis. The "Target" ("Path","Delphic" and "Odyss") factor is normalized so that it generates a 1% increase in the one-month (one-year) OIS rates.

Table 3: Central bank communication and macroeconomic expectations

	Target	Path	Adj R^2	Target	Delphic	Odyss.	Adj R^2
Δ GDP growth forecasts							
Current year	-0.47 (0.53)	0.12 (0.30)	-0.01	-0.40 (0.55)	0.75* (0.37)	-0.25 (0.77)	-0.00
Next year	-1.37* (0.77)	0.38 (0.24)	0.04	-1.52** (0.71)	0.73 (0.52)	-0.60 (0.55)	0.05
Fixed Horizon	-1.86** (0.90)	0.40 (0.25)	0.07	-1.96** (0.90)	0.75 (0.53)	-0.54 (0.58)	0.07
Δ CPI inflation forecasts							
Current year	0.28 (0.28)	-0.07 (0.14)	-0.01	0.27 (0.28)	0.13 (0.25)	-0.75** (0.31)	0.00
Next year	-0.71 (0.44)	-0.13 (0.14)	0.03	-0.83 (0.52)	0.10 (0.29)	-0.57* (0.34)	0.04
Fixed Horizon	-0.64 (0.54)	0.01 (0.13)	0.01	-0.79 (0.58)	0.23 (0.37)	-0.72* (0.39)	0.04

Regression Estimating the monthly variation of Consensus forecasts on factors. The Target (Odyssean or Delphic) factor is normalized so that it generates a 1% increase in the 1 month (year) OIS rates. One, two, and three asterisks indicate statistical significance at 10%, 5%, and 1%, respectively. Robust Standard Error in parenthesis.

Table 4: Contribution of the Path and Target factors to intraday changes in the yield curve

	Whole sample		**Pre-ELB**		**Near-ELB**	
Forward rates	Target	Path	Target	Path	Target	Path
EONIA current	85	0	84	0	93	0
EONIA next	66	17	66	17	67	19
Euribor 3M in 3M	42	49	44	49	28	58
Euribor 3M in 6M	25	67	26	67	15	73
Euribor 3M in 9M	16	76	16	76	9	80
Euribor 3M in 12M	15	78	15	78	8	81
Euribor 3M in 15M	8	80	8	79	5	88
Euribor 3M in 18M	11	57	12	55	7	75
Euribor 3M in 21M	2	64	2	62	0	83

This table reports the variance of interest rate forward rates derived from OIS contracts observed during ECB communication on the days of Governing Council meetings that are explained by the Target and Path factors. "EONIA current" corresponds to the unexpected change in the EONIA rate that will prevail until the next Governing Council meeting. "EONIA next" corresponds to the unexpected change in the EONIA rate that will prevail between the following two Governing Council meetings. The sample includes the unscheduled Governing Council meetings that took place from January 2002 through January 2016. The "pre-ELB" sample runs from January 2002 through January 2012. The "near-ELB" sample runs from February 2012 through January 2016. The variance is computed as the R^2 of the regression of each futures contract on the Target or Path factor.

Table 5: Changes in markets interpretation of ECB communication

	ILS 2y	ILS 5y	ILS 10y	ILS 15y	Stoxx50
Whole sample					
Target	-0.41 (0.46)	-0.08 (0.15)	0.12 (0.13)	0.05 (0.15)	-5.06 (3.04)
Path	0.34^{***} (0.10)	0.24^{***} (0.06)	0.17^{***} (0.06)	0.13^{**} (0.06)	-0.19 (1.31)
Adj R^2	0.07	0.09	0.06	0.04	0.02
Pre-ELB					
Target	-0.37 (0.49)	-0.02 (0.15)	0.18 (0.13)	0.11 (0.15)	-5.07^{*} (2.73)
Path	0.38^{***} (0.10)	0.28^{***} (0.06)	0.20^{***} (0.05)	0.17^{***} (0.05)	1.06 (1.46)
Adj R^2	0.09	0.14	0.12	0.09	0.05
Near-ELB					
Target	-0.64 (0.39)	-0.73^{**} (0.27)	-0.83^{***} (0.17)	-0.58^{**} (0.22)	-7.39 (13.17)
Path	-0.64^{***} (0.12)	-0.69^{***} (0.19)	-0.63^{***} (0.19)	-0.81^{***} (0.18)	-11.21^{**} (4.53)
Adj R^2	0.24	0.27	0.51	0.55	0.15

Response of the two-day change in ILS spot rates of various maturities and in the intraday change in EuroStoxx50 to the Target and Path factor extracted from OIS reaction to ECB communication on the days of Governing Council meetings. Estimates are provided for the entire July 2004-January 2012 sample, the pre-ELB July 2004-June 2012 sample and the near-ELB July 2012-January 2016 sample. The Target (Path) factor is normalized so that it generates a 1% increase in the one-month (year) OIS futures. One, two, and three asterisks indicate statistical significance at 10%, 5%, and 1%, respectively. Robust SE in parenthesis.

Table 6: Monetary policy surprises and Eurosystem staff projections and forecast revisions.

	Target	Path	Delphic	Odyssean
Projections				
INF current year	0.01** (0.01)	-0.02 (0.02)	0.01 (0.01)	-0.00 (0.01)
INF next year	-0.02** (0.01)	0.04 (0.03)	-0.01 (0.03)	-0.01 (0.01)
GDP current year	0.00 (0.00)	0.00 (0.01)	0.01 (0.01)	0.00 (0.00)
GDP next year	-0.00 (0.00)	-0.02 (0.02)	-0.01 (0.02)	0.00 (0.01)
const	0.02 (0.02)	0.00 (0.03)	0.04 (0.03)	0.02 (0.02)
Adj R2	0.06	-0.03	-0.04	-0.07
F test	1.91	0.55	0.59	0.31
Revisions of projections				
INF current year	0.01 (0.01)	0.03 (0.02)	0.01 (0.01)	0.00 (0.01)
INF next year	-0.02 (0.01)	-0.01 (0.03)	-0.02 (0.03)	-0.00 (0.01)
GDP current year	-0.00 (0.00)	-0.01 (0.01)	0.00 (0.01)	-0.00 (0.00)
GDP next year	0.00 (0.01)	0.01 (0.02)	-0.01 (0.02)	0.00 (0.01)
const	0.00 (0.00)	0.02* (0.01)	0.01** (0.01)	0.01 (0.00)
Adj R2	-0.04	-0.05	-0.03	-0.09
F test	0.48	0.36	0.63	0.09
Sample size	56	56	46	46

This table provides estimates for various regressions of the different factors in the intraday monetary policy surprises on the Eurosystem staff projections and revisions released with the monetary policy decisions. OLS estimates and statistical significance, 1 (5 and 10)% indicated with $***$ ($**$ and $*$) with robust SE in parenthesis. Top panel ECB forecasts, bottom panel ECB forecast revisions.

Figure 1: Target, Path, and Delphic and Odyssean forward guidance (FG) shocks in percentage units.

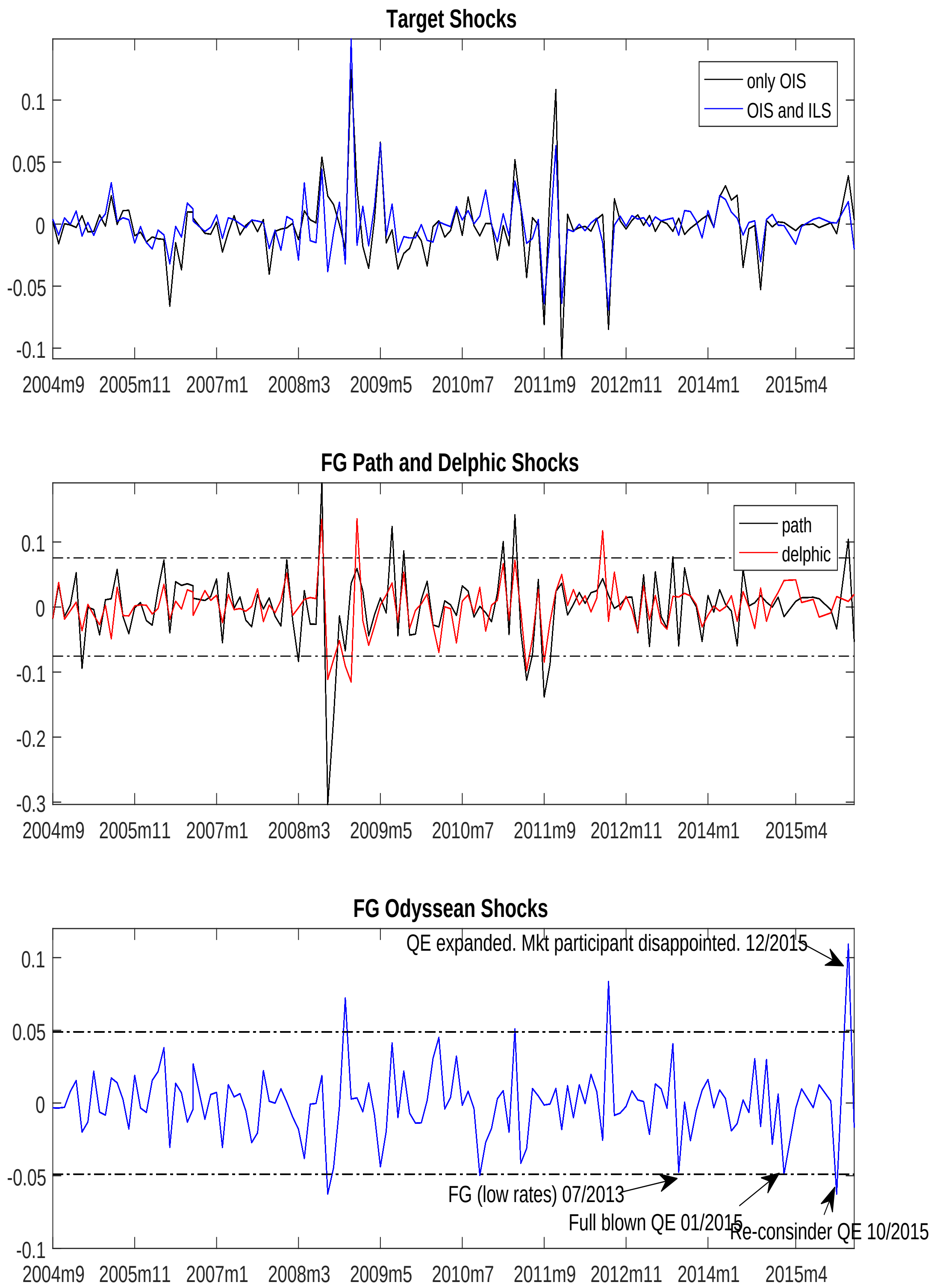

Figure 2: Persistence of monetary policy surprises. Impact of monetary policy surprises on two years, the two years in two years, and the five years in five years ILS; the non-financial corporation borrowing rates; and the (log of) stock market prices x days after the monetary policy announcement.

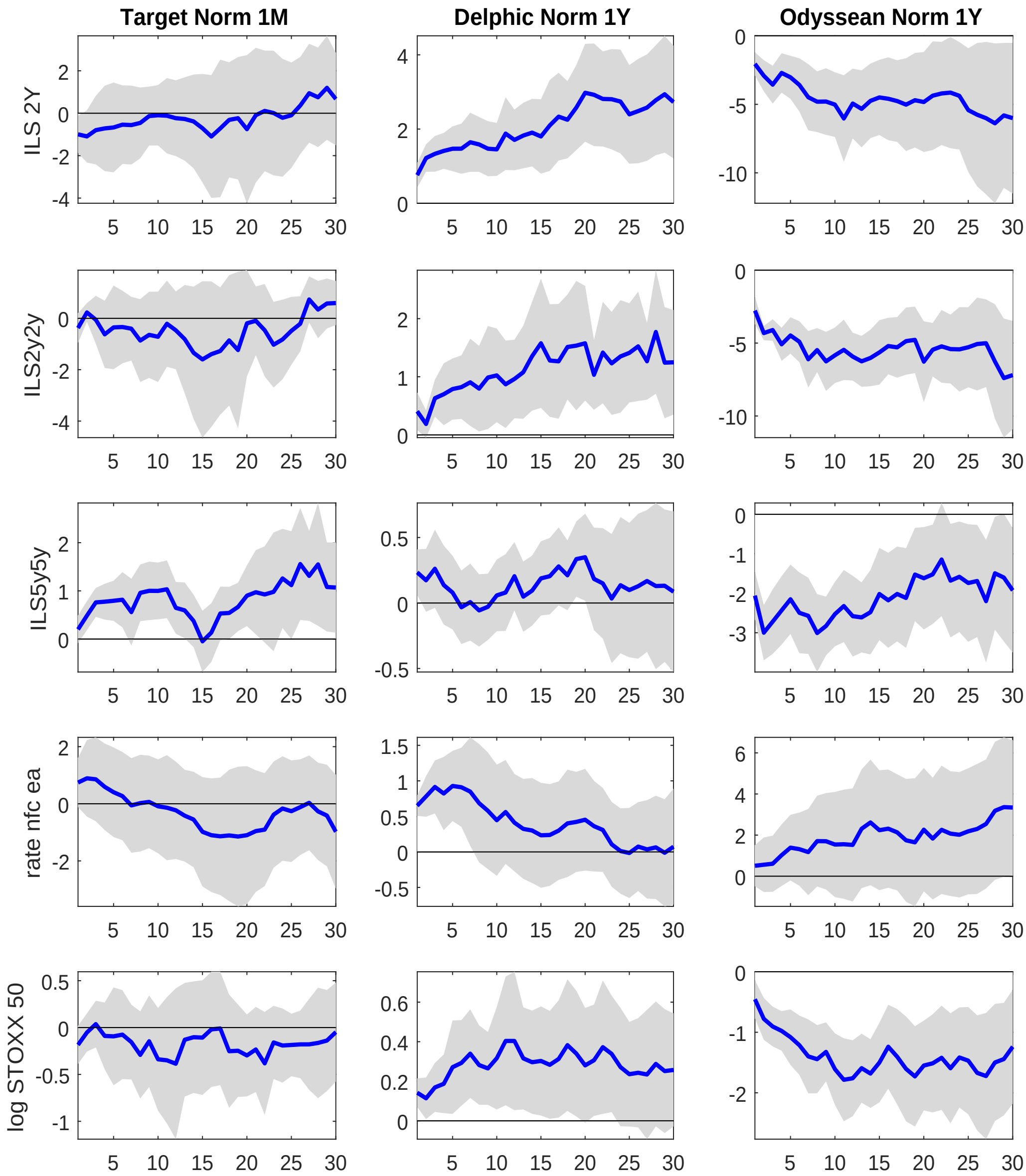

Figure 3: Responses of expectations, prices and output to an impulse in Path (upper panel), Delphic (center panel), and Odyssean factors. From left to right: EONIA swapa slope (difference between one year and three month OIS rates), log of industrial production, log of HICP price index excluding food and energy, Gilchrist and Mojon euro area credit spread, end of next yeareuro area inflation average forecast from Consensus, and end of next year euro area output growth average forecast from Consensus. The gray bands 68% confidence sets; bands constructed using multi block bootstrap as in Jentsch and Lunsford (2019).

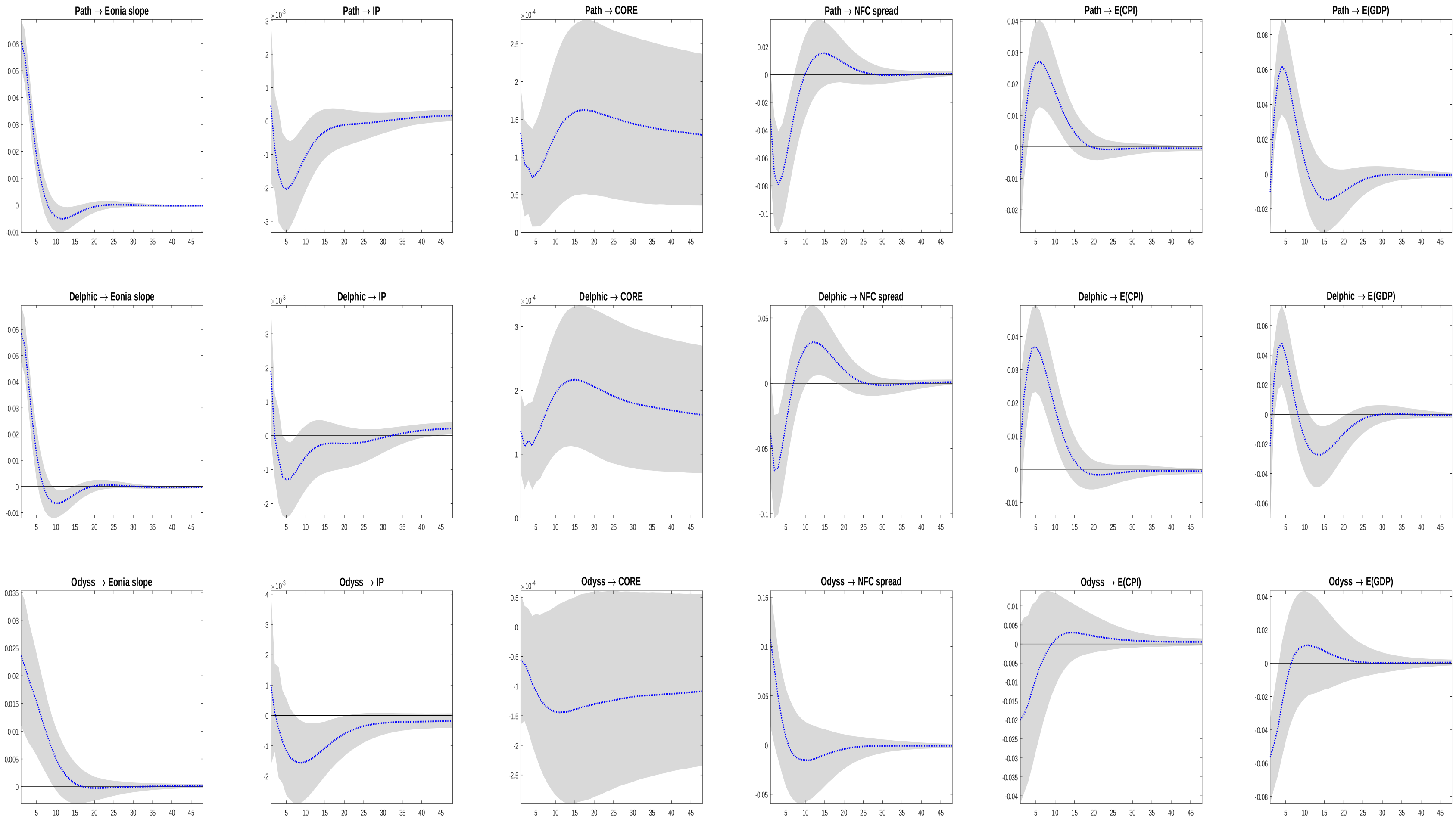

Figure 4: Number of times that the negation of the term “pre-commit*” is used during the monetary policy press conference and ratio of squared Delphic and Odyssean shocks, yearly average.