Authors:
SAMI OINONEN
Monetary Policy and Research Department, Bank of Finland
MATTI VIREN
Monetary Policy and Research Department, Bank of Finland
School of Economics, University of Turku, Finland

EFFECTS OF MONETARY POLICY DECISIONS ON PROFESSIONAL FORECASTERS' EXPECTATIONS AND EXPECTATION UNCERTAINTY*

ABSTRACT

In this paper, we examine how professional forecasters' expectations and expectation uncertainty have reacted to the ECB's interest rate and non-conventional monetary policy decisions during the period 1999-2017. The analysis makes use of a conventional intervention dummy -type set up. The results indicate that expectations have been sensitive to policy actions, but forecasters' reactions are quite different and, as a rule, do not seem to follow the predictions of a standard New Keynesian model. Also the relationship between inflation and output forecasts does not seem to follow a Phillips curve relationship. Rather, the forecasters interpret policy actions as signals of ECB's inside information. Thus, for instance, cuts in policy rates are interpreted as the CB's information of worse than generally assumed cyclical situation rather than the eventual positive effects of lower interest rates. The magnitude of expectation effects depends much of the way in which other macro variables are controlled. Even so the basic feature of these effects remain the same.

Keywords: Expectations; ECB; Uncertainty; Monetary Policy
JEL Classification: D84; G02

* Useful comments from Jarmo Kontulainen, Mika Kortelainen, Maritta Paloviita, Tuomas Välimäki and Xuguang S. Sheng and two anonymous referees are gratefully acknowledged. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Bank of Finland or the Eurosystem.

RIASSUNTO

Effetti delle decisioni di politica monetaria sulle aspettative dei previsori professionali e incertezza delle aspettative

In questo articolo esaminiamo come le aspettative dei previsori professionali e l'incertezza delle aspettative hanno reagito ai tassi di interesse della Banca Centrale Europea ed alle decisioni non-convenzionali di politica monetaria nel periodo 1999-2017. L'analisi utilizza un modello dummy di intervento convenzionale. I risultati indicano che le aspettative sono state sensibili alle decisioni politiche, ma le reazioni dei previsori sono molto differenti e, di regola, non sembrano seguire le predizioni di un modello neo-keynesiano standard. Inoltre, la relazione tra inflazione e produzione prevista non sembra seguire la curva di Phillips. Piuttosto, i previsori interpretano le azioni politiche come un segnale interno della Banca Centrale Europea. Cioè, per esempio, i tagli ai tassi di interesse sono interpretati come un segnale della Banca Centrale che la situazione è peggiore di quanto si poteva prevedere piuttosto che come eventuali effetti positivi portati da tassi di interesse inferiori. La portata degli effetti delle aspettative dipende molto dal modo in cui le altre macro-variabili sono controllate. Anche così la caratteristica di base di questi effetti non cambia.

1. INTRODUCTION

It is generally agreed that current and future macroeconomic developments are largely determined by expectations. For macroeconomists, it is crucial to know how expectations are formed and how they depend on macroeconomic news. From the monetary policy point of view, a deep understanding how monetary policy decisions affect expectations is even more important, as monetary policy transmission mechanism is crucial for expectations management and monetary policy credibility. *A priori*, there is no reason why expectations should react to policy decisions, if policies are pursued according to a rule which is fully understood and anticipated by the general public. Thus, only apparent deviations from the rule should show up in expectations. At least they should show up in perceived uncertainty on future developments; unanticipated policy actions should obviously increase uncertainty. The financial crisis and recent low inflation regime emphasized the need to analyze reactions of expectations to monetary policy decisions, as the standard interest rate policy approached its effective lower bound and new unconventional monetary policy measures were introduced.

In interpreting the reactions of expectations to monetary policy decisions we face a big problem due to the possibility that information sets of the central bank and the general public are different. Therefore, an announcement of policy action can be interpreted not only to reflect (future) policy objectives but also the central bank's new macroeconomic forecast. Thus, an interest rate cut can be thought to reflect a worsening economic outlook and lower inflation, which may lead to decreasing inflation expectations. By contrast, an interest rate cut might be interpreted to reflect more accommodative monetary policy in the future and inflation expectations may increase.

In addition to conventional monetary policy measures, we need to analyze how unconventional monetary policy measures and particularly forward guidance are related to expectations formation. Following literature (see e.g. Campbell, 2013; Andrade *et al.*, 2015; and Coenen *et al.,* 2017), forward guidance can be characterized in two alternative ways. Odyssean forward guidance represents a strong pre-commitment to future monetary policy, while the Delphic forward guidance, which is determined by forecasted policy instruments, is subject to revisions as a response to new information. Incomplete information whether forward guidance is Odyssean or Delphic complicates expectation formation of the private sector. In fact, Andrade and Ferroni (2019) show that the offsetting effects of Delphic and Odyssean policy shocks can explain why central bank communication can lead to a weak reaction by inflation expectations (or asset prices). This result is interesting also in interpreting the subsequent results in this paper.

One simple way to assess how monetary policy actions are related to expectations is to compare the mean interest rate for refinancing operations (MRO) rate with the interest rate swap rates. Clearly, these two variables are highly correlated and they generally precede the policy rate, which indicates that in general interest rate decisions are anticipated by financial market participants[1]. Ideally, we should use the unexpected policy rate change but it is not easy to derive it with the ECB's Survey of Professional Forecasts data (to be abbreviated as ECB SPF). First of all, quarterly data is not very suitable to evaluation of effects of policy announcements. With the data we could, of course, compare policy rates with the Taylor rule predictions (and thereby derive an unexpected component of policy rates). The problem is that specification and estimation of the Taylor rule requires data that are usually available with relatively long lags and

[1] The correlation coefficient between the (one-year rate) time series is 0.981.

not at high frequency, and moreover, it requires fixing/estimating a set of parameters (the interest rate smoothing parameter, the inflation target rate, the output gap specification, the respective coefficients and selecting the sample period) which would create a lot of extra uncertainty to the derived policy measures. That is why we just use the first differences of the policy rate (and the non-standard policy measures as such) as the independent variable.

Reactions of expectations and expectations uncertainty to monetary policy decision are likely to vary over time and across forecasters. Using micro level survey data, we are able to assess whether and how monetary policy decisions affect individual expectations both in terms of inflation output growth. We can also see whether the impact of individual decisions is state-dependent. These are indeed the major research questions in the paper. Moreover we will analyze whether forecast uncertainty is affected by policy decisions. We do consider both short-term and long-term expectations and both short-term and long-term uncertainty measures. As said above, the data for expectations are quarterly and does not exactly match with the data on policy decisions. We try solve the problem by controlling Euro area stock price movements (at daily level) between different forecast rounds and the governing council meetings. Besides interest rate decisions we focus on unconventional monetary policy measures which have been analyzed only in a few studies.

Micro level survey data of ECB SPF also facilitate a comparison between forecasters' disagreement and average forecast uncertainty. Forecast disagreement reflects dispersion of individual views (in the sense of different point forecasts), while subjective forecast uncertainty variables measure how confident individual forecasters are in forming their expectations (this in the sense of standard deviation of probability distributions at the individual level). Very dispersed point forecasts do not necessarily mean that individual forecasters are very puzzled about future economic developments (for the interpretation of these two measures, see e.g. Conflitti, 2012; Engelberg *et al.*, 2009; and Rich *et al.*, 2012). All these analyses will be done both for short- and long-term forecasts.

The impact of monetary policy decision on long term inflation expectations is closely related to monetary policy credibility and management of inflation expectations. Under credible monetary policy, long-term inflation expectations are firmly anchored to the price stability objective of the central bank and therefore, the impact of regular monetary policy announcements should be

expected to fade away in the long term. This fact provides a simple way testing policy credibility just by scrutinizing how long-term inflation expectations depend on macro shocks (see e.g. Demertzis *et al.*, 2012) in general and on monetary policy action in particular. This issue is not the main research question in our analysis but because we do also examine the behavior long-term inflation expectations we cannot avoid focusing on the credibility issue.

Obviously, our study is also related to the research on the impact of macro news on expectations (Beechey *et al.*, 2011; Galati *et al.*, 2011; Gürkaynak *et al.*, 2010). Papers examining anchoring of inflation expectations are also closely linked to our study (e.g. Nautz and Strohsal, 2015; Pagenhardt *et al.*, 2017; Lyziak and Paloviita, 2017; Grishchenko *et al.*, 2017; and Kumar *et al.*, 2015)[2].

The impact of monetary policy decision on expectations may differ in different time episodes. Especially, the financial crisis may have changed the way private sector expectations react to monetary policy actions. Within our framework of empirical analysis, we can also consider this issue. Hence, our analysis is closely linked to the study by Scharnagl and Stapf (2015), who use a time-varying event study framework to examine how monetary policy announcements affect medium and long run inflation expectations in the euro area. By examining full distribution of option implied expectations, they find that in the middle of the sovereign debt crisis the effects of monetary policy announcements on inflation expectations decreased across all horizons. They also report that euro area inflation expectations are firmly anchored even though market participants have become more concerned about future price developments.

Some other relevant studies have been published recently. Jarocinski and Karadi (2018) use a structural VAR framework to analyze monetary policy shocks in the US and euro area. They separate monetary policy shocks from central bank information shocks by analyzing the co-movements of stock prices and future interest rates using high-frequency data and narrow windows around policy announcements. Consistent with our findings, they show that the

[2] There are also some studies dealing with the question of how investor sentiment responds to monetary policy decisions. Kurov (2010) finds that unexpected US monetary policy decisions have an effect on investor sentiment, and this effect depends on equity market conditions. Also Lutz (2015) reports substantial changes in US investor sentiment due to unanticipated conventional or unconventional monetary policy decisions. In their study of nine euro area countries, Galariotis *et al.* (2018) find a positive effect on investor sentiment with conventional policy measures and negative effect with unconventional policy measures. They show that these effects are different in core and peripheral countries. As a rule, these studies focus only on investor sentiment without paying any attention to sentiment uncertainty.

impacts of monetary policy announcements vary a lot and they do no follow a standard theoretical model (for example, higher interest rates do not necessarily lead to lower stock prices). The decomposition of news about monetary policy from that of news about the economic outlook would be useful also from the point of view of our results but our low-frequency data effectively prevents making such distinction. We try, however, to control economic developments between forecast rounds by using stock prices in order to isolate the policy effect on expectations.

The ECB Survey of Professional Forecasters has been analyzed quite extensively on both the aggregated level (e.g. Tsenova, 2012; Andrade and Le Bihan, 2013) and on the micro level (Dovern and Kenny, 2017; Lopez-Peres, 2016a, 2016b; Abel *et al.*, 2016; Oinonen and Paloviita, 2017). Individual responses of other surveys have also been examined by some authors. For example, Boneva *et al.* (2016) report that quantitative easing in the UK has a significantly positive impact on price and wage inflation expectations of manufacturing firms. The impact of forward guidance is insignificantly positive. The study of Andrade *et al.* (2016) also showed that the first asset purchase program led to an increase in inflation expectations. The result may not, however, apply to all programs. The recent study on the effect of ECB's asset purchase program on expectations by Bulligan (2018) shows that the expectation effects varied over time; the first announcement created a positive effect but the subsequent announcements did not.

Although the ECB SPF survey respondents are "professionals" in economics that does not mean, of course, that they are good forecasters and their forecasts are the same as other forecasters'. Coibion and Gorodnichenko (2015) pointed out that professional forecasters' expectations are largely different from business and consumers expectations. As the consequence, they found consumer expectations more explanatory e.g. for "missing disinflation" puzzle in the US in the post-crisis eruption period. Later Coibion *et al.* (2020) found that the recent FED's policy change in terms of inflation targeting (August 27, 2020) does not show in any way in household expectations. Needless to say, this result is puzzling and suggests that the way in which policy changes affect expectations can be quite opaque. Similar features are also found in our study, especially in the case of unconventional monetary policy measures. Otherwise, we find statistically significant effects but (with a few exceptions) only in the short-run. Finally, the policy effects on (subjective) uncertainty measures turn out to be very weak.

As for the contents of the paper, our study is organized as follows. The data and empirical framework are described in section 2 and empirical results are reported in section 3. Concluding remarks are provided in section 4.

2. DATA AND EMPIRICAL FRAMEWORK

2.1 Data

We analyze micro level survey responses in the ECB SPF in the period 1999Q1 – 2017Q4. In addition to one year ahead and 5 years ahead point forecasts for the HICP inflation rate and real GDP growth, we examine corresponding forecast disagreement measures (standard deviation of point forecasts) and subjective forecast uncertainty series based on individual probability distributions (histograms).

The quarterly ECB SPF survey was launched in 1999Q1[3]. Forecasters are asked in each forecast round to report their expectations for the euro area inflation rate, growth rate of gross domestic production (gdp) and unemployment. The ECB SPF also collects information on forecast uncertainty by asking respondents to report their assessment that their forecasted outcome will fall within a pre-determined probability ranges (bins)[4]. Using individual probability histograms, we compute a subjective uncertainty series at the micro level. The subjective individual uncertainty (i.e., the standard deviation derived from the individual probability distribution) is the main measure of the confidence of a survey respondent. It is denoted by π_u for inflation and g_u for gdp growth. In addition we compute a simpler dispersion measure that is the standard deviation of respondents' point forecasts (denoted by π_{disp} and g_{disp}).

While the ECB SPF surveys have six forecast horizons, we focus here on the short-term rolling forecast horizon and the long-term forecast horizon. The short-term rolling forecast horizon refers to 1 year ahead (denoted by π_1 and g_1), and the long-term forecast five years ahead from the current calendar year (denoted by π_L and g_L).

[3] Overviews of the ECB SPF survey are provided in Bowles *et al.* (2007), see particularly Table 1 there, and the January 2014 ECB Monthly Bulletin article "Fifteen years of the ECB Survey of Professional Forecasters." Detailed information about the survey, as well as the complete microdata set can be downloaded from http://www.ecb.europa.eu/stats/prices/indic/forecast/html/index.en.html.

[4] We assume that all the probability for a certain range relates to the mid-point of that range. Both side ranges are open-ended. In the case of the lowest (highest) open-ended range, we fix all the probability at one percentage point below (above) the left (right) end-point of that range. After the onset of the financial crisis, negative ranges were added to the inflation histograms. These new extreme values were rarely used. When they were used, the probability of a forecasted inflation outcome was typically small.

As said earlier, our aim is to assess whether and how forecasters' expectations and expectations uncertainty respond to the ECB's decisions of conventional and unconventional monetary policy measures listed in Appendix 2. Since 1999Q1, 41 policy rates changes[5] and starting from 2009Q3, 13 unconventional monetary policy measures (for example, forward guidance, asset purchase programs and changes in full allotment fixed-rate tender procedure) have been announced. Regarding conventional monetary policy actions, our focus is on policy changes: policy rates increase or decrease. Of course a "no change in policy rates" is also a policy decision, and we try to account for that in the empirical analysis by comparing the "change" and "no-change" periods. The problem arises because of different sampling frequencies: policy decisions are made once a month (and from 2015 onwards once in every six week) while the ECB SPF is conducted quarterly. Thus, we might have a quarter with two "no change" decisions and one "change" decision. Moreover, it could well be that something, say an output shock, happens between governing council meetings and we cannot really pinpoint the sources of the change in expectations. We have tried to solve the problem using the change rates of the Euro Stoxx 50 prices between different forecast rounds (or alternatively between the forecast round's last date and the GC meeting date) as control variables in the way that is illustrated with the time line (below).

The timeline of events: 1= survey period "n" ends, 2 = GC meeting, 3 = survey period "n+1" starts, 4 = survey period n+1 ends. The stock price variables reflect the rate of change between the values of day after "1" and day before "3" (sp1) or values between a day after "1" and day before "2" (sp2) or values between a day after "2" and day before "3" (sp3).

Even so, we have to rely on rather weak tests where we in the first place compare the mean values of changes in expectations for cases where policy rates are changed (or so-called unconventional policy measures are made) and cases where there is no change in policy. Then we try to identify the expectation effects from some simple estimating equations where different

[5] Since some of the monetary policy decisions have been made during the same quarter, our analysis contains 32 policy rate changes.

sort of decisions are modelled with a set of dummy variables. These equations also include the stock price variables as controls.

It is hard to see how to take into account the effect of all possible ("size") variations of the Governing Council's decisions on expectations. The relatively small number of policy decisions does not make the task easier. What we can do is to present a detailed list of the dates of all interest rate (and unconventional policy) decisions and the deadline dates of ECB SPF survey (see Appendix 2). Given these data we can try to scrutinize if the menu of decisions does make any difference e.g. by looking only at the decisions that are made just prior to the ECB SPF deadline. We can also scrutinize the correspondence between the actual interest rate change and the corresponding change in expectations.

The scrutiny of data suggests that from the point of view of changes in expectations, interest rate (cum the unconventional policy measure) decisions make a difference. Thus, we see that expectations and expectation uncertainty change much less in quarters with no policy changes. Thus, for instance, with short-term inflation expectations, the standard deviation of the change in mean point forecasts is 0.175 % in quarters with interest rates changes and 0.125 % in quarters with no change in policy rates. The behavior of forecast uncertainty is scrutinized more thoroughly in the end of next section.

As said, our focus is only on those survey rounds, which have been conducted soon after policy-change-monetary policy decisions, which all are listed in the Appendix (see also Oinonen *et al.*, 2018). In order to make reasonable analysis, we need to pay special attention to the timing of the Governing Council meetings and the dates when the ECB SPF is conducted. Monetary policy decisions are announced in press conferences right after the Governing Council meetings. Until 2014, the press conferences were held in the last week of every month and thereafter once in every six week, whereas the ECB SPF survey is conducted in the first month of every quarter and published in the mid-month of the same quarter[6]. On average, there is a time lag of 17 days between a governing council meeting and the deadline of the SPF questionnaire that follows the latest monetary policy meeting. The median lag is 10 days. The time window for answering to the

[6] More precisely, until 2002Q1 the survey was conducted during the second month of the quarter and published on the third month and during 2002Q2-2014Q4 the survey was conducted in the end of first month and published in the middle of second month. Since 2014Q4 the survey has been conducted in the beginning of the first month and published in the end of the same month.

survey is one week (7 days). There is a couple of cases when the governing council meeting has taken place when the window has still been open (so that somebody might have already answered) but, of course, never right after the deadline.

In this paper we mainly pay attention to short-term expectations although all analyses are also carried out with long-term expectations. The emphasis is due to the fact that long-term expectations, particularly the long-term inflation expectations, are used for different purposes (say, evaluation of policy credibility). Moreover, they are very persistent and thus it is hard identify the policy effects.

2.2 Empirical Framework

In the first instance, we just compare the average values of differences of various forecasts over the whole sample period. The sample is divided to subsamples according to outcome of the preceding governing council decision: whether the rate is increased, decreases, allowed to constant, or whether some unconventional monetary policy measure is announced. These values are reported in Table 1. To get some idea of the results, we also show Figure 1 where we report the values for possible outcomes: all changes in policy measures (irrespectively of the direction) and no change in policy measures. To see, whether the changes are indeed statistically different we run a simply dummy regression where the dependent variable is the change in expectations and the independent variables are indicators (dummies) of different outcomes of the governing council decisions. In the first place, we analyze the mean values for each period for different forecast variable and relate the values to different outcomes of the governing council. These analyses are reported in Table 1 which shows the sample mean values for each outcome of the governing council meeting and in Table 2 which displays estimates of the following simple equation for these sample mean values:

$$\Delta x^{f}_{jt} = \alpha_{0j} + \sum_j \alpha_{1i} D_{jt} + \mu_{jt,} \qquad (1)$$

where Δx^{f}_{jt} refers to the changes in inflation (π_t) or real GDP expectations (g_t), or changes in corresponding forecast uncertainties (π_{ut} or g_{ut}), μ the error term and t indicates the time period (quarter). The subscript j denotes the type of the monetary policy decision and the D_j's denote the corresponding series for dummy variables. After that we move to the individual forecasters' micro data and estimate the following panel data equation:

$$\Delta x^{f}_{ijt} = \beta_{0j} + \sum_j \beta_{1i} D^{j}_{t} + \mu_{ijt} \quad (2)$$

where Δx^{f}_{ijt} now refers to the changes in individual (i) forecaster's inflation or real GDP expectations (π_{it} or g_{it}), or changes in corresponding forecast uncertainties ($u\pi_{it}$ or ug_{it}). That equation is estimated by having all policy dummies on the right-hand side at the same time or by having just one sort of policy dummies as explanatory variables at time. We allow the individual (decision) dummies to have their own coefficients which are reported in Table 3 or we constrain the dummies to have identical coefficients (Table 4). In this case, we had only three variables in panel regression: one indicating an increase in policy rates, the second a decrease in policy rates and the third an unconventional monetary policy decision.

As a final check, we estimated the regression between the changes of expectations and the change of the policy rate to see whether the size of the change in the policy rate makes a difference. Thus, the estimating equation is:

$$\Delta x^{f}_{it} = \gamma_0 + \gamma_1 \Delta r_t + \mu_{it,} \quad (3)$$

where r is the policy rate. The results are reported in Table 5.

Our focus is on the estimated β_i parameters, which reveal whether and how professionals change their expectations as a response to individual policy actions of the ECB. Estimation was carried out by using either a fixed effects specification and a random effects specification but it turned out neither ingredient was needed and hence the reported equations are just least squares estimates of equation (2)[7].

As said earlier, we mainly consider short term expectations, which seem more informative, but we do also examine long term forecasts in order to evaluate the above-mentioned credibility issues. The useful feature of the ECB SPF is that micro panel data are also available for long term expectations although a scrutiny of the data tells that the long-term data are probably not as informative as the short-term data. The time series are highly persistent and most of the forecast

[7] In order to assess whether the estimation results based on all survey responses are "representative" for all forecasters, we also run quantile regressions with 10 % and 90 % tails for short term forecasts and forecast uncertainties to assess whether the panel least squares results based on all survey responses are dominated by certain segments of forecasters but that turned out not to provide much additional information. We also carried out the analysis by estimating the dummy regressions for each individual subsample (of the length of 12 quarters) but we found it difficult to disentangle the policy effects in periods when many policy changes were made in a row. Anyway, the results were consistent with those reported in the paper.

values are just some "popular" numbers like "1.5" or "2". Moreover, the number of respondents is rather small (roughly 35)[8].

To get some idea of the basic relationships in the data we show a set of scatter diagrams of the relevant times series. In Figure 3, we relate interest rate changes to changes in short-term point forecasts. The relationship between the level of policy interest rate and the (micro level) point forecasts are shown in Figure 4.

Our focus is not only on "reaction" or "no reaction" of expectations to policy actions, but also on the signs and magnitudes of these reactions. In order to infer whether the estimated β_i parameters are reasonable, we try interpret the sings of the coefficients from the point of view of economic theory. Although the Neo-Fisherians may disagree, we expect a decrease in inflation and output growth forecasts when interest rates are increased, and vice versa when the rates are decreased. Unconventional policy measures are assumed to stimulate economic activity and hence the signs are interpreted accordingly. As for uncertainty, we cannot really assume any *a priori* sign for the parameter β_1.

3. Evaluation of the results for the point forecasts

So, do the policy changes show up in expectations? Some idea of the effect can be seen from Figure 1 which illustrates the sample means of "change" and "no change" periods. Quite clearly, there is a difference indicating that policy changes are associated with increased values of both inflation and output growth expectations while no change decisions are associated with decreased values. To understand the logic of this, we have to look at the policy change more carefully focusing on the sign of the change of the policy instrument. The corresponding values can be detected from Tables 1 and 2. The message is somewhat surprising suggesting that expected inflation and output growth increase when interest rates increase and decrease when rates are cut. It looks like a Neo-Fisherian result but the interpretation could be more straightforward: the policy moves could be interpreted as signals for the Central Bank's assessment of the future development of the economy. Thus, an increase in rates will be

[8] Although the "professional forecasters" are supposed to be experts in economics they are not active traders and thus they may not perform better in term of forecasting accuracy or they are not more forward-looking. For instance, Gerberding (2001) found French professionals less forward-looking than consumers.

interpreted as signals of "better than expected" cyclical development while the interest rate cuts are interpreted as "worse than expected" development of the economy.

A similar result is obtained when expectations are related to changes in ECB's policy rate (Table 5). Thus, the coefficients are all positive and can be estimated rather precisely. This results even carried over to long-run expectations even though the statistical power is much smaller. It is of some interest to compare the explanatory power of equation (3) to equation (2) where all interest rate changes are indicated by a set of dummies. If the right-hand side variable is just the difference in the policy rate, the R^2 for $\triangle p_1$ ($\triangle g_1$) is 0.049 (0.090) but if we use 32 dummies for each interest rate change the respective values are much higher being 0.098 and 0.321. In other words, the impact of interest rate is not constant but depends very much on the timing of the policy change and obviously on the economic environment at the moment of the policy decision. This feature is also shown by the results in Table 4, where we use dummies for positive and negative values of interest rate changes (plus unconventional policy actions). Thus the magnitude and precision of the respective coefficients are rather different. The effect of an increase in policy rates is not a mirror-image of a decrease in rates. As for the signs of the dummies, they follow the same pattern as in other tables suggesting that the respondents see an interest rate cut as a sign of deteriorating economic situation rather than anticipating that lower rates would stimulate the economy and improve prospects. Similar logic seems to apply to an interest rate increase.

As for the control variables, change in stock prices between forecasting rounds, sp1, sp2 and sp3, we find that they help very much in predicting changes in expectations. It seems that there is not much benefit in disaggregating sp1 to sub-sample variables sp2 and sp3 (see Table 5). Hence, we concentrate here on the full-sample specification sp1. In fact, this control variable outperforms the effects of policy decisions. Even so, we cannot say that nothing is left of the policy effects but the effects are more marginal when the control variable(s) are introduced into the estimating specifications.

As for the unconventional policy measures, our estimation results are somewhat harder to interpret than the interest rate changes (see the uc rows/columns in Tables 1-4). While the aim of the unconventional monetary policy actions is to maintain an accommodative stance of monetary policy which would imply positive values for the dummy coefficients, the problem is

that there is no clear patterns of signs in the estimates of β_1. Moreover, only half of the coefficients are statistically significant. When the control (stock price) variables(s) are introduced, statistical significance deteriorates even more. The reason is probably that different policy actions have been interpreted differently. This can be seen from Table 3. Most of the coefficients are negative (especially with output growth expectations) which is consistent with the findings of interest rate effects. Thus, unconventional monetary policy actions are seen rather as indications of worse (from the point of view of the CB) economic prospects than significant stimuli to the economy. Against this background it is a bit difficult to consider/differentiate our findings from the point of Delphic or Odyssean approach to monetary policy.

But these are not the only puzzling features of the results. Also Figures 2 and 3 show a positive relationship between interest rate changes and changes in both inflation and output growth forecasts, although the outcome partly reflects some outliers. It is even more difficult to interpret the level form results in Figure 4. In the case of short term inflation expectations, one may interpret the relationship as a Fisher equation but in this context the interpretation could equally well be a Taylor rule type relationship. The scatter for long term inflation expectations and the level of policy rate (upper panel in Figure 4), is perhaps best interpreted as an existence of no relationship between these variables. In the case of output growth we do find a positive relationship, i.e. when the policy rate is high, forecasters expect higher growth rate. This sounds again like a Taylor rule, but it is difficult to figure out how forecasters end up with this kind of outcome. Notice, however, the large heterogeneity of observations. The relationship between long run output growth expectations and the policy rate makes perhaps more sense: forecasters assume that in the long run monetary policy has no effect of growth. Thus, forecasters do not seem to think that higher (nominal) rates are an obstacle for long-term growth[9].

Even though the long-term inflation expectations have been less sensitive to ECB monetary policy actions in quantitative terms, changes of expectations, however small, are statistically significant. Thus, in accordance with e.g. Pagenhardt *et al.* (2017) it is justified to conclude that long-term expectations are no more anchored to the ECB's inflation target. Also long term

[9] Finally, a brief comment on the quantile regression coefficients merits note (which we for space reasons do not report here). With inflation, we find rather small differences between upper and lower tails but with output growth it seems that certain differences exist. Overall, in all cases there is clearly more significant and correct sign coefficients in lower than upper tail.

growth expectations have responded only marginally (again in quantitative terms) to monetary policy decisions. Reactions of short and long-term expectations to policy rate changes are positively correlated, but correlation is far from perfect. With inflation, the coefficient of correlation is 0.54 and with output growth 0.60. It also turns out that short and long-term inflation forecasts are positively correlated, not much, but still significantly. The same is true with output growth forecasts, but that is a different matter from the point of view of inflation anchoring proposition[10].

What makes us suspect the idea that long-term inflation expectations are firmly anchored is the fact that the average subjective forecast uncertainty increased permanently after the onset of the financial crisis (although the dispersion of point forecasts increased only temporarily). One may think that if the long-term inflation forecasts become more uncertain, it is difficult to argue that the inflation target is then equally unanimously accepted as before.

4. THE IMPACT OF MONETARY POLICY DECISIONS ON FORECAST UNCERTAINTY

Next, we turn to forecast uncertainties, see Figures 5 and 6. Again, we find some interesting responses of expectations to both directions. The biggest increase in short term inflation uncertainty shows up after interest rate decrease in 2009Q1. At the same time, however, there was a clear decrease of short term inflation expectations. After the next interest rate decrease in 2009Q2, these two variables moved to the same direction, as both short term inflation expectations and short term inflation uncertainty decreased clearly. In 2010Q3, after the SMP announcement, short term inflation uncertainty decreased substantially, but the opposite is true for long term inflation uncertainty after the Draghi's "whatever it takes" speech and the announcement of the OMT program in 2012Q4. The biggest decrease in short term output growth uncertainty took place in 2016Q2 after interest rate decrease and the announcement to increase EAPP asset purchases. Responses of long term output growth uncertainties to interest rate decreases in 2009 were large to both directions.

[10] One might interpret the results as evidence for adaptive expectations (or learning). It is only that the long-term expectations do not really "move": the probability that the long terms inflation point forecast falls inside the range of 1.5 - 2.0 per cent is above 90 %. See Grishchenko *et al.* (2017) who try evaluate the anchoring by not only paying attention to mean values of expectations but also the forecast uncertainty.

These outcomes may be related to the special features of the financial crisis. In the onset of the crisis, in 2008, inflation and output forecasts were drastically reduced, but at the same time forecast uncertainty – for obvious reasons – increased. After the acute crisis (and also during the sovereign debt crisis in 2009-2010), inflation and output growth forecasts were revised upwards but economic uncertainty did not vanish. Even so, the estimated dummy coefficients for changes in forecast uncertainties are typically not significant. Results for non-standard monetary policy measures follow the same lines as the interest rate decisions indicating that there is no systematic pattern in uncertainty effects[11].

While the changes in uncertainty cannot be predicted by information of the policy changes it seems that the level of uncertainty is related to changes in policy parameters. How to interpret this? The most obvious interpretation is that the different forecasters interpret policy decisions quite differently. Some expect an increase in rates, some no change and some a decrease. Those who have expected a "different" decision are obviously more or less puzzled with the outcome. Some may disagree with the policy outcome and some may not understand ("see through it") the outcome. Even though the effect on forecast values (point estimates) could be small, the policy measures still have behavioral consequences that have thus far not recognized.

4. Concluding remarks

Our analysis with the ECB SPF panel data indicates that expectations – even long term expectations – are sensitive to both policy rate changes and unconventional monetary policy measures. Not only this applies to point forecasts but some traces can be detected in forecast uncertainty measures too. The sensitiveness does, however, deteriorate a lot when we introduce data on stock price movements between different forecast rounds as control variables.

More importantly, the impact of monetary policy decisions on professional forecasters' expectations and expectations uncertainty does not seem to follow a pattern of a text-book

[11] These comments apply to the average of subjective uncertainty measures which are derived from the SPF survey. The outcome is bit different if we focus on the dispersion (standard deviation) of point forecasts. In particular, there is big difference for output growth forecasts in 2008-2009 so that in the dispersion measure there is sharp peak while the subjective uncertainty measure increases only modestly. The dispersion measure seems to be more sensitive to policy shocks than the subjective uncertainty measure. In particular, the dispersion of point forecasts is positively related in changes in the policy rate. Because we cannot exploit panel data properties in estimating this dependence, the results should be considered with due care. See Lahiri and Sheng (2010) for possible explanation for the difference between these measures.

macroeconomic theory in the sense that tighter (looser) monetary policy would show up in lower (higher) inflation and output growth expectations. It seems that the policy changes are mainly interpreted as signals of the views of the Central Bank of the future development of the economy. Lower rates are seen as signals of the Central Bank's pessimistic assessment of economic prospects and, accordingly higher rates signals of better prospects of the economy. Effects of unconventional monetary policy measures follow the same lines but there is more ambiguity in the signs and significance of the effects. Thus, we come close to the conclusion that the expectation effect on these measures is so small that is cannot be disentangled.

REFERENCES

Abel, J., R. Rich, J. Song And J. Tracy (2016), "The Measurement And Behavior Of uncertainty: Evidence from the ECB Survey of Professional Forecasters", *Journal of Applied Econometrics*, 31(3), 553-550.

Andrade, P., J. Breckenfelder, F. De Fiore, P. Karadi and O. Tristani (2016), "The ECB's Asset Purchase Programme: An Early Assessment", ECB Discussion Paper 1956. <https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1956.en.pdf>.

Andrade, P., Gaballo, G., Mengus, E. and Mojon, B. (2015), "Forward Guidance and Heterogeneous Beliefs", Bank of France, Document de travail n° 573, <https://www.banque-france.fr/sites/default/files/medias/documents/document-de-travail_573_2015.pdf>.

Andrade, P. and F. Ferroni (2019), "Delphic and Odyssean Monetary Policy Shocks: Evidence from the Euro Area", Federal Reserve Bank of Boston, Research Department Working Paper 19-17, <https://www.bostonfed.org/publications/research-department-working-paper/2019/delphic-and-odyssean-monetary-policy-shocks-evidence-from-the-euro-area.aspx>.

Andrade, P. and H. Le Bihan (2013), "Inattentive Professional Forecasters", *Journal of Monetary Economics*, 60(8), 967-982.

Beechey, M.J., B.K. Johannsen and A.T. Levin (2011), "Are Long-Run Inflation Expectations Anchored more Firmly in the Euro Area than in the United States?", *American Economic Journal: Macroecnomics,* 3(2), 104-129.

Boneva, L., J. Cloyne, M. and T. Wieladek (2016), "The Effect of Unconventional Monetary Policy on Inflation Expectations: Evidence from Firms in the United Kingdom", *International Journal of Central Banking,* 12(3), 161-195.

Bowles, C., R. Friz, V. Genre, G. Kenny, A. Meyler and T. Rautanen (2007), "The ECB Survey Of Professional Forecasters (SPF). A Review after Eight Years' Experience", ECB Occasional Paper No. 59, <https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp59.pdf>.

Bulligan, G. (2018), "The Effect of the Eurosystem's Expanded Asset Purchase Programme on Inflation Expectations: Evidence from the ECB Survey of Professional Forecasters", Banca D'Italia, Occasional Paper No. 455.

Campell, J. (2013), "Odyssean Forward Guidance in Monetary Policy: A Primer", *Economic Perspectives,* 37(Q IV), 130-138.

Coibion, O. and Y. Gorodnichenko (2015), "Is the Phillips Curve Alive and Well After All? Inflation Expectations and the Missing Disinflation", *American Economic Journal: Macroeconomics*, 7(1), 197-232.

Coibion, O., Y. Gorodnichenko, E. Knotek and R. Schoenle (2020), "Average Inflation Targeting and Household Expectations", NBER Working Paper No. 27836.

Coenen, G., M. Ehrmann, G. Gaballo, P. Hoffmann, A. Nakov, St Nardelli, E. Persson and G. Strasser (2017), "Communication of Monetary Policy in Unconventional Times", ECB Working Paper No. 2080.

Conflitti, C. (2012), "Measuring Uncertainty and Disagreement in the European Survey and Professional Forecaster", *OECD Journal: Journal of Business Cycle Measurement and Analysis*, 2011(2), 69-103.

Demertzis, M., M. Marcellino and N. Viegi (201, "A Credibility Proxy: Tracking US Monetary Developments", *The B.E. Journal of Macroeconomics*, 12(1), 1-36.

Dovern, J. and G. Kenny (2017), "The Long-Terms Distribution of Expected Inflation in the Euro Area: What Has Changed since the Great Recession", ECB Working Paper Series 1999.

ECB (2018), "Results on Third Special Questionnaire for Participants in the ECB survey of Professional Forecasters", <https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/ecb.spf201902_specialsurvey~7275f9e7e6.en.html#toc4>.

Engelberg, J., C.F. Manski and J. Williams (2009), "Comparing the Point Predictions and Subjective Probability Distributions of Professional Forecasters", *Journal of Business &*

Economic Statistics, 27(1), 30-41.

Galariotis, E., P. Makrichorit and S. Spyrous (2018), "The Impact of Conventional and Unconventional Monetary Policy on Expectations and Sentiment", *Journal of Banking and Finance* 86, 1-20.

Galati, G., S. Poelhekke and C. Zhou (2011), "Did the Crisis Affect Inflation Expectations?", *International Journal of Central Banking,* 7(1), 167-207.

Geberding, C. (2001), "The Information Content of Survey Data on Expected Price Development for Monetary Policy", Deutsche Bundesbank Discussion Paper 9/01.

Grishchenko, O., S. Mouabbi and J-P. Renne (2017), "Measuring Inflation Anchoring and Uncertainty: A US and Euro Area Comparison, Finance and Economics Discussion Series 2017-102", Washington: Board of Governors of the Federal Reserve System, <https://doi.org/10.17016/FEDS.2017.102>.

Gürkaynak, S., E. Swanson and A. Levin (2010, "Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence from the U.S., UK and Sweden", *Journal of European Economic Association,* 8(6), 1208-1242.

Jarocinski, M. and P. Karadi (2018), "Deconstructing Monetary Policy Surprises: The Role of Information Shocks", ECB Working Paper No. 2133.

Kumar, S., H. Afrouzi, O. Coibion and Y. Gorodnichenko (2015), "Inflation Targeting does not Anchor Inflation Expectations: Evidence from Firms in New Zealand", *Brookings Papers on Economic Activity*, 51(2), 151-225.

Kurov, A. (2010), "Investor Sentiment and the Stock Market's Reaction to Monetary Policy", *Journal of Banking and Finance*, 34(1), 139-143.

Lahiri, K. and X. Sheng (2010), "Measuring Forecast Uncertainty by Disagreement: The Missing Link", *Journal of Applied Econometrics*, 25(4), 514-538.

López-Pérez, V. (2016a), "Macroeconomic Forecast Uncertainty in the Euro Area", *Equilibrium – Quarterly Journal of Economics and Economic Policy*, 11(1), 9-41.

López-Pérez, V. (2016b), Does uncertainty affect non-response to the European Central Bank's Survey of Professional Forecasters? *Economics – The Open-Access, Open-Assessment E-Journal,* 10(25), 1-46.

Lutz, C. (2015), "The Impact of Conventional and Unconventional Monetary Policy on Investor Sentiment", *Journal of Banking and Finance* 61, 89-105.

Łyziak, T. and M. Paloviita (2017), "Anchoring of Inflation Expectations in the Euro Area: Recent

Evidence Based on Survey Data", *European Journal Political Economy*, 46, 52-73.

Nautz, D. and T. Strohsal (2015), "Are US Inflation Expectations Re-Anchored?", *Economics Letters*, 127, 6-9.

Oinonen, S. and M. Paloviita (2017), "How Informative are Aggregated Inflation Expectations? Evidence from the ECB Survey of Professional Forecasters?", *Journal of Business Cycle Research*, 13(2), 139-163.

Oinonen, S., M. Paloviita and M. Viren (2018), "Effects of Monetary Policy Decisions on Professional Forecasters' Expectations and Expectation Uncertainty", Bank of Finland Research Discussion Papers 24/2018.

Pagenhardt, P., D. Nautz and T. Strohsal (2017), "The (De-)Anchoring of Inflation Expectations: New Evidence from the Euro Area", *The North American Journal of Economics and Finance*, 40(C), 103-115.

Rich, R., J. Song and J. Tracy (2012), "The Measurement and Behavior of Uncertainty: Evidence from the ECB Survey of Professional Forecasters", Staff Report 588, Federal Reserve Bank of New York.

Scharnagl, M. and J. Stapf (2015), "Inflation, Deflation, and Uncertainty: What Drives Euro-Area Option-Implied Inflation Expectations, and are they still Anchored in the Sovereign Debt Crisis?", *Economic Modelling,* 48, 248-269.

Tsenova, T. (2012), "Are Long-Term Inflation Expectations Well-Anchored? Evidence from the Euro Area and the United States", *Bulletin of Economic Research*, 67(1), 65-82.

TABLE 1 - *Mean Values of Changes in Expectations in Response to Policy Changes*

	Δg_1	g_L	Δg_{1u}	Δg_{Lu}	$\Delta \pi_1$	$\Delta \pi_L$	$\Delta \pi_{1u}$	$\Delta \pi_{Lu}$
All changes:	-0.076	-0.015	0.010	0.000	-0.016	0.005	0.007	0.012
ir changes	-0.101	-0.016	0.009	-0.002	-0.032	0.005	0.006	0,008
ir up	0.035	0.000	0.005	-0.004	0.064	0.021	0.004	0.006
ir down	-0.167	-0.024	0.010	-0.004	-0.091	-0.005	0.007	0.010
uc	0.049	-0.023	0.007	0.004	-0.003	0.001	0.015	0.019
No change:	0.070	0.058	-0.006	0.023	0.024	0.047	-0.002	-0.010

ir up (ir down) indicates an increase (decrease) of the policy rate and uc an unconventional monetary policy decision. No change corresponds to periods when the governing council does not make any change in policy parameters. π denotes inflation expectations and g output growth expectations. "1" stands for one year horizon and "L" for long-term.

TABLE 2 - *Estimation Results for Indicators of Policy Changes*

	$\Delta\pi_1$	$\Delta\pi_1$	$\Delta\pi_L$	$\Delta\pi_L$	Δg_1	Δg_1	Δg_L	Δg_L
no change	.024 (1.22)	.020 (1.12)	-.003 (0.68)	-.003 (064)	.070 (1.06)	.052 (0.98)	-.018 (2.84)	-019 (2.97)
ir up	.063 (2.07)	.057 (1.45)	.021 (2.30)	.021 (2.44)	.035 (0.65)	-.002 (0.45)	.004 (0.03)	-.001 (0.47)
ir down	-.110 (1.61)	-.096 (1.59)	-.006 (0.58)	-.007 (0.62)	-.224 (1.54)	-.150 (1.41)	-.020 (1.72)	-.016 (1.61)
uc	.056 (0.97)	.042 (0.82)	.004 (0.35)	.005 (0.38)	.171 (0.72)	.092 (0.48)	-.012 (1.03)	-.016 (1.48)
stock prices[1)]		.002 (2.96)		-.001 (0.42)		.009 (4.45)		.001 (2.40)
R^2	0.156	0.238	0.071	0.074	0.065	0.331	0.037	0.094
SEE	0.139	0.133	0.032	0.032	0.445	0.379	0.041	0.040
DW	1.59	1.53	2.35	2.35	1.15	1.58	2.24	2.36

Newey-West t-ratios are inside parentheses. The dependent variable is the average quarterly change in expectations. The RHS variables are indicators (dummies) of changes in policy rates or unconventional policy measures. The results of the uncertainty measures are not reported because the hypothesis that the coefficients in each equation are equal to zero could not be rejected with the Wald test. 1) Here we use definition sp1 of stock price increase.

TABLE 3 - *Coefficients of Individual Dummy Variables in Explaining Changes in Expectations*

inflation expectations									output growth expectations								
up			down			uc			up			down			uc		
dummy	coef.	t-value	dummy	coef.	t-value	dummy	coef.	t-value	dummy	coef.	t-value	dummy	coef.	t-value	dummy	coef.	t-value
D00Q1	0,11	3,11	D01Q3	0,01	0,25	D09Q3	0,03	0,30	D00Q1	0,22	4,32	D01Q3	-0,45	-5,57	D09Q3	1,60	9,89
D00Q2	0,07	1,74	D01Q4	-0,25	-5,07	D11Q4	-0,26	-6,02	D00Q2	0,24	3,64	D01Q4	-0,79	-9,23	D11Q4	-0,81	-10,78
D00Q3	0,08	2,00	D02Q1	0,13	2,76	D12Q1	0,00	-0,11	D00Q3	0,12	1,90	D02Q1	0,34	4,23	D12Q1	-0,63	-6,27
D00Q4	0,04	1,20	D03Q1	-0,10	-2,22	D12Q4	0,06	1,57	D00Q4	-0,19	-4,45	D03Q1	-0,22	-3,01	D12Q4	0,09	1,13
D06Q1	0,10	2,53	D03Q2	-0,24	-5,35	D13Q3	-0,07	-2,17	D06Q1	0,27	6,54	D03Q2	-0,29	-3,74	D13Q3	0,24	4,56
D06Q2	0,25	6,74	D03Q3	-0,07	-1,49	D14Q1	-0,16	-4,83	D06Q2	0,33	8,12	D03Q3	-0,21	-2,61	D14Q1	0,23	3,47
D06Q3	-0,07	-2,08	D08Q4	-0,50	-10,94	D14Q3	-0,10	-2,75	D06Q3	-0,10	-1,97	D08Q4	-0,86	-10,89	D14Q3	-0,01	-0,19
D06Q4	0,01	0,20	D09Q1	-0,42	-8,92	D14Q4	-0,11	-2,96	D06Q4	0,02	0,42	D09Q1	-2,07	-26,87	D14Q4	-0,25	-4,40
D07Q1	0,00	0,14	D09Q2	-0,27	-5,70	D15Q2	0,20	2,61	D07Q1	0,09	2,22	D09Q2	-0,18	-2,38	D15Q2	0,52	8,67
D07Q2	-0,08	-2,15	D09Q3	0,01	0,11	D16Q2	-0,07	-1,07	D07Q2	0,18	4,15	D09Q3	1,53	18,39	D16Q2	-0,10	-2,61
D07Q3	0,01	0,27	D12Q1	-0,03	-0,59	D17Q2	0,07	2,01	D07Q3	0,29	5,36	D12Q1	-0,70	-8,99	D17Q2	0,11	4,99
D08Q3	0,28	4,75	D12Q3	-0,07	-1,46				D08Q3	-0,43	-7,44	D12Q3	-0,18	-2,04			
D11Q2	0,19	3,79	D13Q3	-0,09	-1,69				D11Q2	0,17	3,33	D13Q3	0,16	1,87			
D11Q3	0,03	0,75	D14Q1	-0,18	-3,74				D11Q3	-0,06	-1,17	D14Q1	0,16	1,91			
			D14Q3	-0,12	-2,44							D14Q3	-0,08	-0,93			
			D14Q4	-0,13	-2,68							D14Q4	-0,32	-3,83			
			D16Q2	-0,09	-1,96							D16Q2	-0,17	-2,13			
			D99Q2	0,28	6,80							D99Q2	0,13	1,80			

The values are coefficient estimates for different monetary policy decision dummies on short-term point expectations estimated from individual micro data (3124 observations).

TABLE 4 - *Impact of Policy Rate Changes on Expectations and Expectations' Uncertainty*

	$\Delta\pi_1$	$\Delta\pi_L$	$\Delta\pi_{1u}$	Δg_1	Δg_L	Δg_{1u}
c	.017	.003	.000	.032	-.015	-.012
	(2.61	(0.02)	(0.15)	(2.49)	(3.14)	(1.25)
ir up	.050	.009	-.002	.017	.018	.033
	(3.89)	(1.43)	(0.37)	(0.87)	(1.91)	(1.08)
ir down	-.106	-.019	.003	-.235	-.014	.018
	(6.39)	(2.25)	(0.59)	(7.81)	(1.53)	(0.67)
uc	.032	.001	.002	.140	.003	-.000
	(1.65)	(011)	(0.28)	(3.30)	(0.33)	(0.17)
R^2	0.027	0.046	0.000	0.036	0.003	0.001
SEE	0.313	0.149	0.114	0.596	0.175	0.502
DW	2.48	2.23	2.67	1.86	2.43	3.05

	$\Delta\pi_1$	$\Delta\pi_L$	$\Delta\pi_{1u}$	Δg_1	Δg_L	Δg_{1u}
c	.015	.003	-.001	.016	-.016	-.012
	(2.15)	(0.83)	(0.21)	(1.32)	(3.35)	(1.31)
ir up	.045	.008	-.001	-.015	.018	.031
	(3.41)	(1.43)	(0.025)	(0.79)	(1.85)	(1.00)
ir down	.-.093	-.020	.002	-.019	-.008	.022
	(5.78)	(2.20)	(0.35)	(6.11)	(0.89)	(0.84)
uc	.021	.010	.003	.075	.000	-.000
	(1.14)	(0.09)	(0.45)	(1.97)	(0.03)	(0.01)
stock prices sp1	.001	.000	-.001	.010	.001	.002
	(5.64)	(0.20)	(1.66)	(21.61)	(3.28)	(1.47)
R^2	0.041	0.004	0.002	0.181	0.007	0.002
SEE	0.306	0.149	0.114	0.549	0.175	0.502
DW	2.48	2.14	2.67	2.20	2.43	3.05

Corrected t-values are inside parentheses. The right-hand side variables are dummies that correspond to different policy decisions. The models are estimated from the panel data without fixed and random effects because those alternatives were rejected in testing. The data are individual micro data with 3124 observations.

TABLE 5 - *Response of Expectations to Changes in the Policy Rate*

	$\Delta\pi_1$	$\Delta\pi_1$	$\Delta\pi_1$	$\Delta\pi_L$	$\Delta\pi_L$	$\Delta\pi_L$	Δg_1	Δg_1	Δg_1	Δg_L	Δg_L	Δg_L
constant	.017 (3.28)	.014 (1.03)	.016 (1.23)	.002 (0.63)	.002 (0.67)	.001 (0.18)	.019 (1.93)	-.001 (0.03)	-.017 (0.34)	-.013 (3.49)	-.014 (3.48)	-.016 (3.21)
Δr	.219 (9.48)	.218 (3.40)	.280 (6.56)	.029 (2.50)	.032 (2.83)	.024 (2.27)	.572 (12.65	.395 (1.96)	.339 (1.97)	.035 (2.64)	.024 (1.22)	.023 (1.26)
sp1		0.01 (1.11)			.000 (0.54)			.008 (4.54)			.004 (2.94)	
sp2			-.000 (0.60)			.000 (0.80)			.007 (3.39)			.002 (1.36)
sp3			-.001 (0.75)			-.000 (0.88)			.002 (0.30)			-.000 (0.57)
R^2	0.049	0.052	0.072	0.003	0.003	0.004	0.090	0.205	0.160	0.003	0.007	0.004
SEE	0.305	0.305	0.300	0.149	0.149	0.149	0.578	0.541	0.559	0.175	0.174	0.175
DW	2.49	2.49	2.55	2.13	2.13	2.13	1.91	2.19	2.10	2.43	2.43	2.43

Corrected t-values are inside parentheses. r denotes the ECB main policy rate. The coefficients of the uncertainty measures are not reported because they are not significant. The data are individual micro data with 3124 observations.

FIGURE 1 - *Sample Mean Values in Changes in Expectations in Response to All Policy Changes*

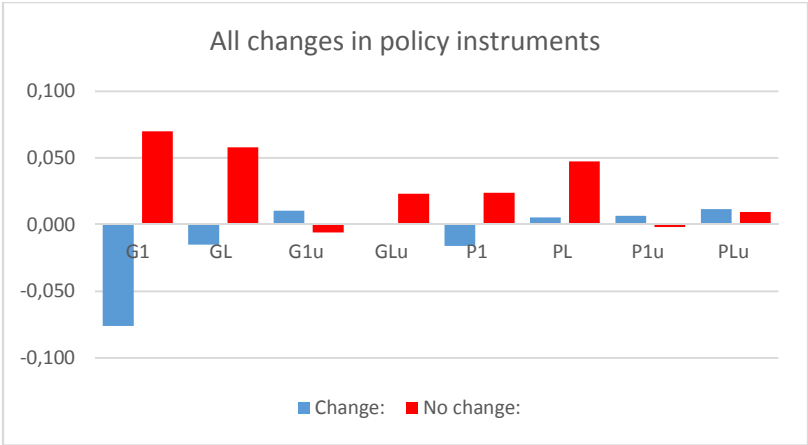


FIGURE 2 - *Policy Dummy Coefficients for the Short-Term Expectations' Equations*

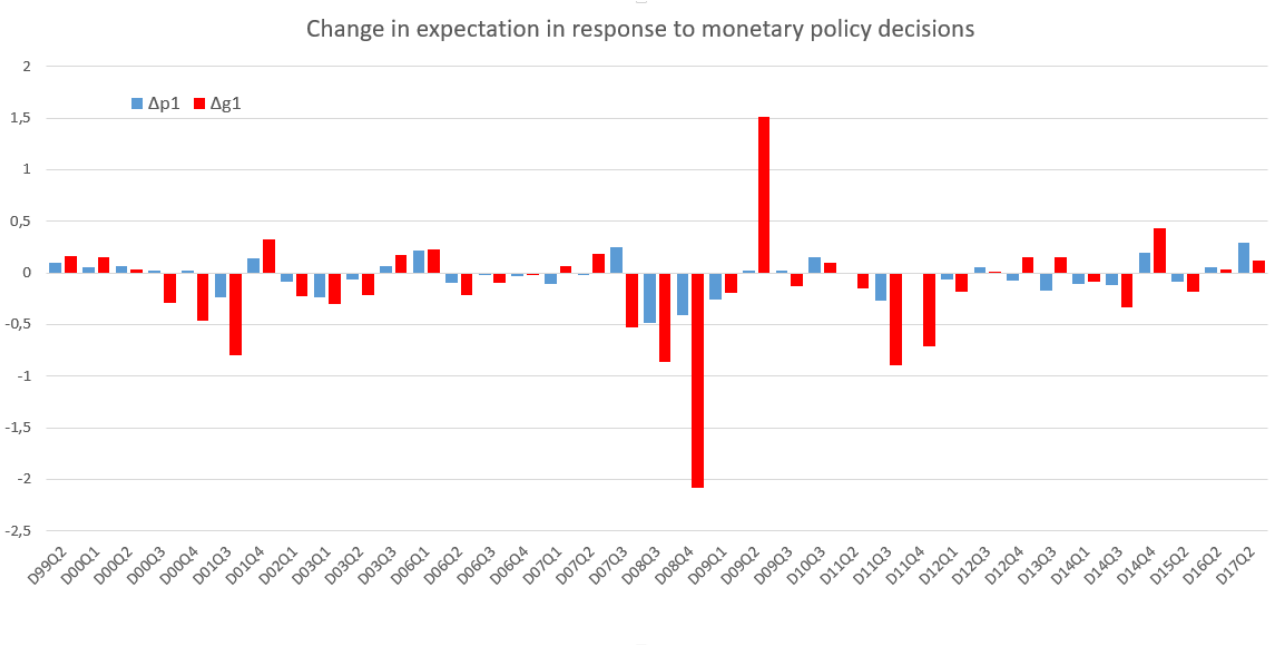
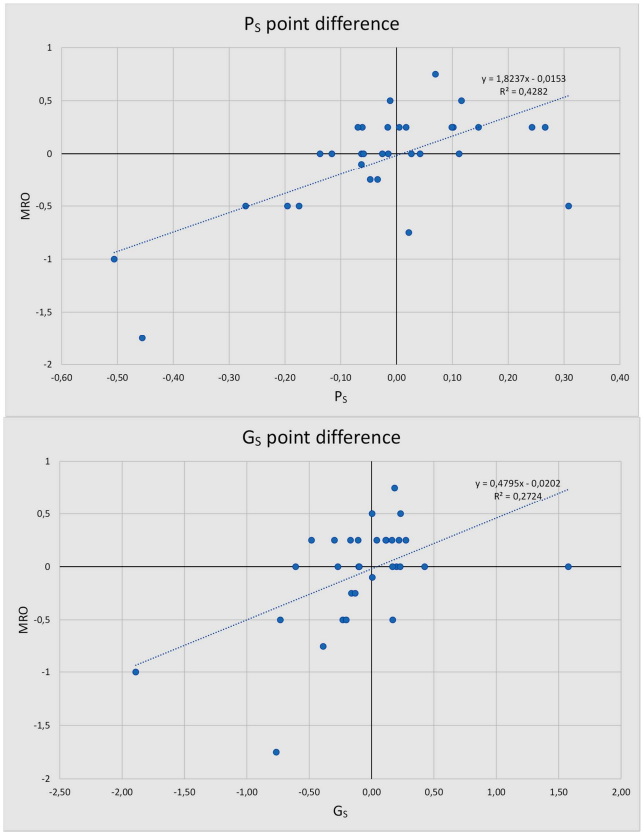
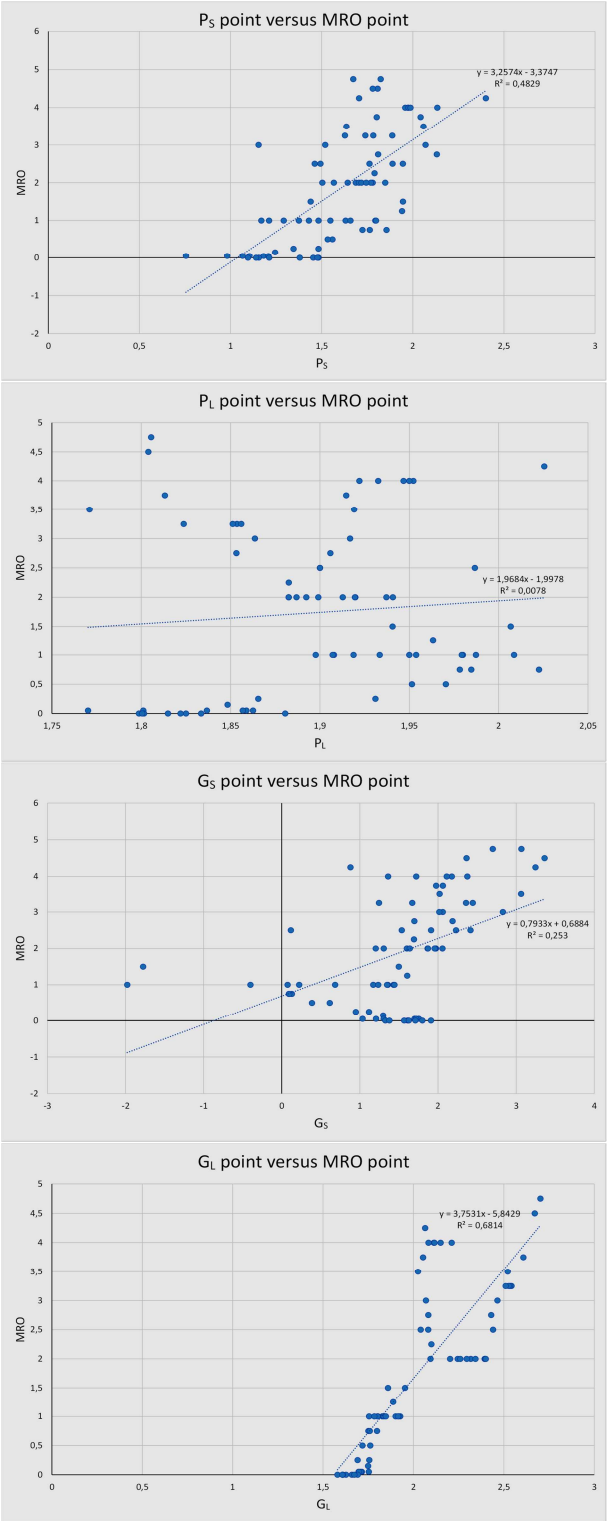


FIGURE 3 - *Relationship between Interest Rate Changes and Short-Term Expectations*



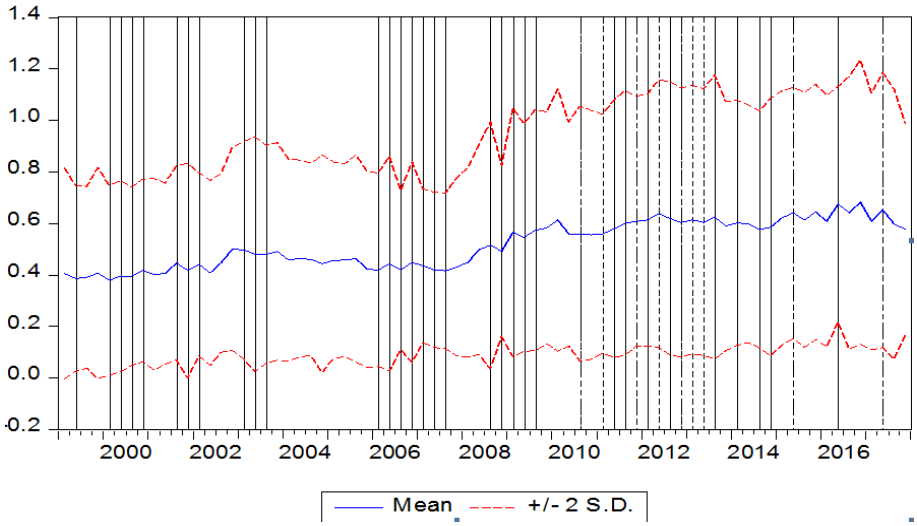
Note: P_s (G_s) denotes first differences in short-term inflation (output growth) forecasts, MRO a change in the main ECB policy rate. "The point difference" denotes an average of first differences in forecast values.

FIGURE 4 - *Relationship between the Level of Interest Rate and Inflation/Output Growth Expectations*



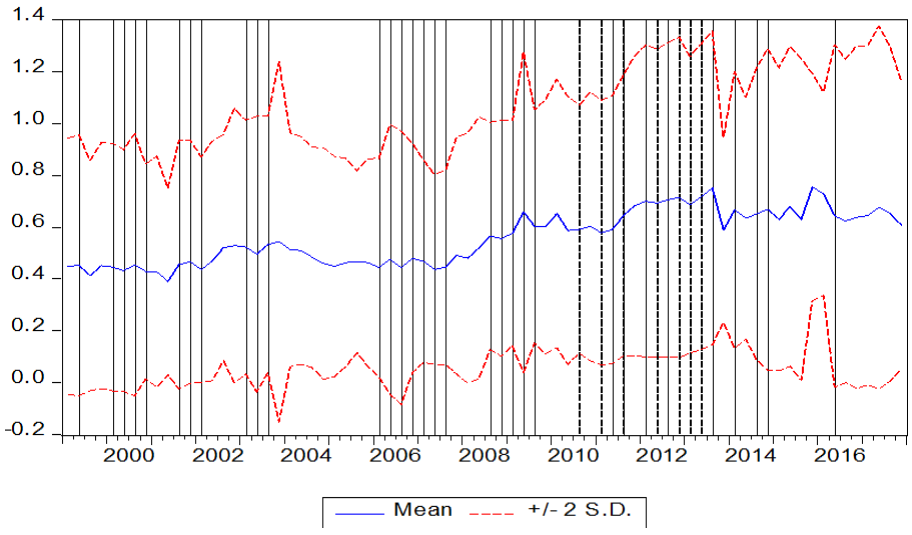
In this figure both the policy rate and the forecast values are in levels. Otherwise, notation is the same as in Figure 3.

FIGURE 5 - *Policy Measures and Short-Term Inflation Uncertainty*



Solid line indicates the mean of individual standard deviations (computed from their subjective assessments of uncertainty) for short-term inflation forecasts and the dotted lines the respective confidence interval (dispersion).

FIGURE 6 - *Policy Measures and Short-Term Output Growth Uncertainty*



The notation is the same as figure 5 but deals with for short-term output growth forecasts.

APPENDIXES

A1 - *Details of the Data*

r Interest rate of ECB's main refinance operations.

g_S, π_S short term real GDP growth and inflation expectations (one year ahead), that are obtained from the responses to the ECB questionnaire.

g_{SU}, π_{SU} corresponding individual uncertainties measured by computing the standard deviation from distribution (histogram) that the respondents provide for each to forecast in the questionnaire.

g_L, π_L long-term real GDP growth and inflation expectations (4-5 years ahead)

g_{LU}, π_{LU} corresponding long-terms individual uncertainties (computed in the same way as the short-term counterparts).

The sample period is 1999Q1 – 2017Q4 (76 observations). Our panel data include 119 forecasters altogether, but the composition of the panel changes over time. On average, there are roughly 45 participants in one quarter. All data come from the ECB. In figures, symbol "π" is replaced by "P".

A2 - *Policy (Change) Decision Dates and Deadlines for Submitting the Survey Answers*

GC Meeting date	deadlines to reply	Policy rate	Deposit rate	Lending rate	Unconventional MP
7.1.1999	12.2.				
4.3.1999					
8.4.1999		3 -> 2,5	2 -> 1,5	4,5 -> 3,5	
22.4.1999	3.5.				
6.5.1999					
20.5.1999					
2.6.1999					
17.6.1999					
15.7.1999					
29.7.1999	7.8.				
26.8.1999					
9.9.1999					
23.9.1999					
7.10.1999					
21.10.1999	3.11.				
4.11.1999		3	2	4	
18.11.1999					
2.12.1999					
15.12.1999					
5.1.2000					
20.1.2000					
3.2.2000	9.2.	3,25	2,25	4,25	
17.2.2000					
2.3.2000					
16.3.2000		3,5	2,5	4,5	
30.3.2000					
13.4.2000					
27.4.2000	5.5.	3,75	2,75	4,75	
11.5.2000					
25.5.2000					
8.6.2000		4,25	3,25	5,25	
21.6.2000					
6.7.2000					
20.7.2000					
3.8.2000	4.8.				
31.8.2000		4,5	3,5	5,5	
14.9.2000					
5.10.2000		4,75	3,75	5,75	
19.10.2000					
2.11.2000	2.11.				
16.11.2000					
30.11.2000					
14.12.2000					
4.1.2001					
18.1.2001					
1.2.2001	1.2.				

A2 - *continued*

GC Meeting date	deadlines to reply	Policy rate	Deposit rate	Lending rate	Unconventional MP
15.2.2001					
1.3.2001					
15.3.2001					
29.3.2001					
11.4.2001					
26.4.2001	3.5.				
10.5.2001		4,5	3,5	5,5	
23.5.2001					
7.6.2001					
21.6.2001					
5.7.2001					
19.7.2001					
2.8.2001	3.8.				
30.8.2001		4,25	3,25	5,25	
13.9.2001					
17.9.2001		3,75	2,75	4,75	
27.9.2001					
11.10.2001					
25.10.2001	29.10.				
8.11.2001		3,25	2,25	4,25	
6.12.2001					
3.1.2002	4.2.				
7.2.2002					
7.3.2002					
4.4.2002	22.4.				
2.5.2002					
6.6.2002					
4.7.2002	22.7.				
1.8.2002					
12.9.2002					
10.10.2002	23.10.				
7.11.2002					
5.12.2002		2,75	1,75	3,75	
9.1.2003	27.1.				
6.2.2003					
6.3.2003		2,5	1,5	3,5	
3.4.2003	24.4.				
8.5.2003					
5.6.2003		2	1	3	
10.7.2003	23.7.				
31.7.2003					
4.9.2003					
2.10.2003	28.10.				
6.11.2003					
4.12.2003					
8.1.2004	28.1.				
5.2.2004					
4.3.2004					

A2 - *continued*

GC Meeting date	deadlines to reply	Policy rate	Deposit rate	Lending rate	Unconventional MP
1.4.2004	26.4.				
6.5.2004					
3.6.2004					
1.7.2004	26.7.				
5.8.2004					
2.9.2004					
7.10.2004	21.10.				
4.11.2004					
2.12.2004					
13.1.2005	26.1.				
3.2.2005					
3.3.2005					
7.4.2005	22.4.				
4.5.2005					
2.6.2005					
7.7.2005	22.7.				
4.8.2005					
1.9.2005					
6.10.2005	24.10.				
3.11.2005					
1.12.2005		2,25	1,25	3,25	
12.1.2006	23.1.				
2.2.2006					
2.3.2006		2,5	1,5	3,5	
6.4.2006	26.4.				
4.5.2006					
8.6.2006		2,75	1,75	3,75	
6.7.2006	22.7.				
3.8.2006		3	2	4	
31.8.2006					
5.10.2006	20.10.	3,25	2,25	4,25	
2.11.2006					
7.12.2006		3,5	2,5	4,5	
11.1.2007	24.1.				
8.2.2007					
8.3.2007		3,75	2,75	4,75	
12.4.2007	23.4.				
10.5.2007					
6.6.2007		4	3	5	
5.7.2007	18.7.				
2.8.2007					
6.9.2007					
4.10.2007	18.10.				
8.11.2007					
6.12.2007					
10.1.2008	18.1.				
7.2.2008					
6.3.2008					

A2 - *continued*

GC Meeting date	deadlines to reply	Policy rate	Deposit rate	Lending rate	Unconventional MP
10.4.2008	18.4.				
8.5.2008					
5.6.2008					
3.7.2008	18.7.	4,25	3,75	5,25	
7.8.2008					
4.9.2008					
2.10.2008					
8.10.2008	17.10.	3,75	3,25	4,25	
6.11.2008		3,25	2,75	3,75	
4.12.2008		2,5	2	3	
15.1.2009	20.1.	2	1	3	
5.2.2009					
5.3.2009		1,5	0,5	2,5	
2.4.2009	20.4.	1,25	0,25	2,25	
7.5.2009		1	0,25	1,75	CBPP+ 1y LTRO
4.6.2009					
2.7.2009	17.7.				
6.8.2009					
3.9.2009					
8.10.2009	19.10.				
5.11.2009					
3.12.2009					
14.1.2010	19.1.				
4.2.2010					
4.3.2010					
8.4.2010	20.4.				
6.5.2010					
9.5.2010					SMP
10.6.2010					
8.7.2010	19.7.				
5.8.2010					
2.9.2010					
7.10.2010	19.10.				
4.11.2010					
2.12.2010					
13.1.2011	18.1.				
3.2.2011					
3.3.2011					
7.4.2011	19.4.	1,25	0,5	2	
5.5.2011					
9.6.2011					
7.7.2011	19.7.	1,5	0,75	2,25	
4.8.2011					
8.9.2011					
6.10.2011	18.10.				CBPP2
3.11.2011		1,25	0,5	2	
8.12.2011		1	0,25	1,75	3 year LTRO
12.1.2012	20.1.				

A2 - continued

GC Meeting date	deadlines to reply	Policy rate	Deposit rate	Lending rate	Unconventional MP
9.2.2012					
8.3.2012					
4.4.2012	19.4.				
3.5.2012					
6.6.2012					
5.7.2012	19.7.	0,75	0	1,5	
26.7.2012					Draghi ”Whatever it takes”
2.8.2012					
6.9.2012					OMT program
4.10.2012	22.10.				
8.11.2012					
6.12.2012					
10.1.2013	22.1.				
7.2.2013					
7.3.2013					
4.4.2013	19.4.				
2.5.2013		0,5	0	1	
6.6.2013					
4.7.2013	19.7.				Forward guidance
1.8.2013					
5.9.2013					
2.10.2013	22.10.				
7.11.2013		0,25	0	0,75	
5.12.2013					
9.1.2014	24.1.				
6.2.2014					
6.3.2014					
3.4.2014	25.4.				
8.5.2014					
5.6.2014		0,15	-0,1	0,4	TLTRO
3.7.2014	24.7.				
7.8.2014					
4.9.2014		0,05	-0,2	0,3	CBPP3 + ABSPP
2.10.2014	23.10.				
6.11.2014					
4.12.2014	13.1.				
22.1.2015					EAPP: PSPP
5.3.2015	7.4.				
15.4.2015					
3.6.2015	6.7.				
16.7.2015					
3.9.2015	6.10.				
22.10.2015					
3.12.2015	11.1.				
21.1.2016					
10.3.2016	6.4.	0	-0,4	0,25	EAPP: asset purchase 60→ 80 Bill €
21.4.2016					

A2 - continued

GC Meeting date	deadlines to reply	Policy rate	Deposit rate	Lending rate	Unconventional MP
2.6.2016	6.7.				
21.7.2016					
8.9.2016	6.10.				
20.10.2016					
8.12.2016	10.1.				
19.1.2017					EAPP: asset purchase 80→ 60 Bill €
9.3.2017	7.4.				
10.3.2017					EAPP: CSPP program
27.4.2017					
8.6.2017	7.7.				
20.7.2017					
7.9.2017	6.10.				

*Acronyms refers to ECB unconventional monetary policy packages:
CBPP: Covered bond purchase programme
(1y)LTRO: 12-months longer-term refinancing operations
SMP: Securities Markets Programme
CBPP2: Second covered bond purchase programme
(3y)LTRO: 3years longer-term refinancing operations
OMT: Outright Monetary Transactions
TLTRO: Targeted longer-term refinancing operations
CBPP3: Third covered bond purchase programme
ABSPP: Asset-backed securities purchase programme
EAPP: Expanded asset purchase programme
PSPP: Public sector purchase programme
CSPP: Corporate sector purchase programme