Central Bank Communication with the General Public: Survey Evidence from Germany

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Abstract

This paper studies the effect of different types of monetary policy announcements on household inflation expectations based on micro data from a survey of German households. As a key feature, survey interviews were conducted both shortly before and after monetary policy events. This timing provides a natural experiment to identify the immediate effects of policy announcements on household inflation expectations. The availability of the survey over a period of 15 years further allows me to exploit the time-series dimension to estimate the medium-term effects of policy announcements. Policy rate announcements lead to quick and significant adjustments in household inflation expectations. Announcements about forward guidance and quantitative easing, by contrast, have no or only smaller and delayed effects.

Keywords: Central bank communication, unconventional monetary policy, household inflation expectations, high-frequency identification, survey data

JEL classification: E31, E52, E58, D12, D84

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1 Introduction

Managing inflation expectations is generally considered to be paramount for successful monetary policy. Nonetheless, the evidence on how well central banks can steer inflation expectations is mixed. Household and firm expectations seem to respond much less to monetary policy than financial markets or experts (Coibion et al. (2020)). In the context of household survey expectations, the literature has primarily relied on microeconometric approaches such as randomised control trials (e.g. Armantier et al. (2016) and Coibion et al. (2022b)) or difference-in-differences estimation around a given event (e.g. D'Acunto et al. (2021)). This paper exploits a natural experiment resulting from weekly interview windows before and after monetary policy events to provide novel evidence on the effectiveness of monetary policy on household inflation expectations. It distinguishes between different types of monetary policy announcements over a sample of 15 years and estimates the short- and medium-term effects of monetary policy announcements. I find that announcements about conventional policy rate changes are (most) effective, whereas announcements about unconventional measures have no or only smaller and delayed effects.

Why is it important to distinguish different types of monetary policy announcements? First, unconventional monetary policy, such as QE, is a relatively new and complex tool for households to understand.[1] Therefore, it is relevant to investigate how responsive households' expectations are to these newer and fairly sophisticated tools. Second, households might care more about the current interest rates than guidance about (expected) changes in the future path of these rates (see McKay et al. (2016) or Gabaix (2020) for theoretical formulations of this idea).

Against this background, this paper studies the effect of different types of monetary policy announcements by the European Central Bank (ECB) on household inflation expectations in Germany over the period from 2004 to 2019. I use micro data on household expectations from a survey conducted by the Gesellschaft für Konsumforschung (GfK). In order to identify the unexpected component of monetary policy announcements, I

[1] See D'Acunto et al. (2022) on the role of cognitive abilities in the transmission of economic policies.

apply the methodology developed by Altavilla et al. (2019). Policy surprises are based on high-frequency interest rate changes around monetary policy events and are decomposed into (i) Target, (ii) Timing, (iii) Forward Guidance and (iv) Quantitative Easing (QE) surprises. Target announcements refer to changes in the short-term policy rate.[2] Timing and Forward Guidance announcements provide guidance about the (expected) future path of policy rates over the next few months and the next few years, respectively. Lastly, QE announcements primarily affect the interest rates at the long end of the yield curve. Altavilla et al. (2019) show that these announcements correspond to asset purchases such as the ECB's Asset Purchase Programme (APP) initiated in mid-2014.[3]

To identify the effect of monetary policy announcements on household expectations I follow two approaches. First, I use the combined timing of interview dates and policy announcements which provides a natural experiment framework. The interviews in the GfK survey are always conducted in two independent weekly waves and in many cases the ECB Governing Council meetings take place at the end of the first wave and before the start of the second wave. This unique feature allows me to estimate the immediate effect of policy announcements by comparing responses of households from the waves before and after Governing Council meetings of the ECB. By contrast, most of the existing literature on household or firm expectations relies on lower-frequency data that makes identification more difficult. Moreover, I exploit the rich information on demographic characteristics entailed in the GfK dataset to study potentially heterogeneous effects. Second, I aggregate the cross-sectional survey data at the monthly level and use local projections to estimate the dynamic effects of policy announcements over a 12-month horizon.

My main finding is that Target announcements significantly affect household inflation expectations. A 25 basis point positive Target surprise reduces the probability of people expecting an increase in inflation by around 2.6 percentage points. Timing, Forward Guidance and QE, on the other hand, have no significant effect in the short run. This result highlights that the type of policy announcement matters for the reaction of household

[2]Unlike the US Fed, the ECB's policy rate has been reduced below zero and generally Target surprises also exhibit important variations in the post Great Recession period.

[3]QE announcements target interest rates at long maturities since the average maturity of the QE programme by the ECB is around eight years.

inflation expectations.

I further look at specific household subgroups who are likely to pay more attention to inflation based on demographic characteristics such as income, education or age. Middle-aged households - who are typically those getting a mortgage or saving for retirement - respond more strongly to Target announcements but also do not respond to the other types of announcements. Similarly, more educated households exhibit a significant response to Target announcements but no clear response to other announcements. Only in the case of income, is there some evidence that high-income households do not respond only to Target announcements but also to QE and partly Forward Guidance. This suggests that demographic characteristics are relevant for the transmission of monetary policy announcements to household expectations but the effectiveness of Target announcements relative to other types of announcements is generally confirmed.

When I estimate the dynamic effects on household inflation expectations over a 12-month horizon, I find that the effect of Target announcements increases over the medium term with a maximum effect reached after five months. Timing and QE announcements also affect inflation expectations negatively but only after around seven and four months, respectively. The effects of Forward Guidance announcements remain quantitatively small and mostly insignificant for the entire forecast horizon. While these dynamic results point to some delayed effects of unconventional policies on household inflation expectations the effects are smaller and conventional interest rate changes seem to be most effective overall.

To provide a natural benchmark and comparison to my main results, I then use the same series of ECB monetary policy announcements and estimate their effect on inflation expectations of financial markets and professional forecasters. In contrast to households, professional forecasters and especially financial markets also react strongly to unconventional tools such as forward guidance. Moreover, compared to households their responses are more similar in magnitude across types of announcements. This suggests that unconventional tools are powerful because they affect financial markets and thereby also influence household choices through borrowing and saving rates, but household inflation expectations themselves do not (yet) seem to be an important transmission channel of

unconventional monetary policy.

Consistent with the responses of household inflation expectations, I document that public interest in the ECB and its policies also shows a differential response by type of monetary policy announcement. More specifically, I use the search interest based on Google trends data as a proxy for public interest and the likely degree of media coverage. While Target and partly QE announcements are associated with an increase in public interest with respect to the ECB and its monetary policy, other announcements such as forward guidance do not have the same effect. This can be seen as complementary evidence of how different types of monetary policy announcements reach the general public and is consistent with (though not a proof of) the role of media as a key transmission channel.

Finally, I investigate the wider implications by looking at how other household expectations - including spending attitudes - respond to inflation expectations. I find that inflation expectations are negatively related to various other household expectations, suggesting that households relate higher inflation expectations to worse economic outcomes. This reduced-form relationship also partly appears when estimating the effect of different types of monetary policy announcements on proxies of consumer spending attitudes. Positive Target surprises that reduce household inflation expectations have no significant or even a positive effect on consumer spending attitudes. This positive effect goes in the opposite direction than one would expect from theoretical macroeconomic models with a representative agent where the intertemporal Euler equation intuition is at the core. Instead, it suggests that other channels such as income and wealth effects might be more important. This is consistent with Coibion et al. (2022a), who reach similar conclusions based on Dutch household data.

Related literature This paper contributes to two strands of the literature. First, there is a growing literature studying the effects of monetary policy measures and communication strategies on the broader public. Most of the currently existing literature finds that neither households' nor firms' expectations respond much to monetary policy as reviewed by Coibion et al. (2020). Related papers that use survey data to assess the effects of monetary policy on household inflation expectations are Lamla and Vinogradov (2019), De Fiore

et al. (2021) and Binder et al. (2022). Lamla and Vinogradov (2019) focus on a sample between 2015 and 2018 and run surveys shortly before and after US FOMC announcements to estimate the effect of communication on household beliefs. While the identification strategy is similar to this paper, my focus is on distinguishing between different types of announcements over a sample of 15 years covering both conventional and unconventional times. De Fiore et al. (2021) follow a similar approach for US FOMC meetings between 2013 and 2019, but they use high-frequency monetary policy surprises that are more similar to this paper. Similar to De Fiore et al. (2021), Binder et al. (2022) also use the NY Fed's Survey of Consumer Expectations but they focus on a narrower window around announcements and also study the effects of non-monetary events such as macroeconomic data releases and news related to the Covid-19 pandemic. My paper contributes to this literature by using household level inflation expectations data from Germany and focusing on a longer sample. In particular, my sample covers both conventional and unconventional policy times and is therefore well suited to distinguishing between different types of monetary policy tools. D'Acunto et al. (2021) also use German household survey data to analyse the effect of an unexpected announcement of a value-added tax increase in November 2005 in comparison with the ECB's forward guidance announcement in July 2013. They show that while the former has a significant effect on household consumption by influencing household inflation expectations, the latter announcement has no significant effect in line with my findings. Claus and Nguyen (2020) follow a different methodology and identify monetary policy shocks from a consumer perspective, studying their effects on Australian household survey expectations. Enders et al. (2019), Bottone and Rosolia (2019) and Di Pace et al. (2023) study the response of firm expectations to monetary policy.

Unlike the approach in my paper, some papers have used randomised control trials to measure the effect of policy treatments on household expectations. Coibion et al. (2023) use a randomised control trial to study how information about current and future interest rates affects households' expectations. They find that information about current and next year's interest rates moves inflation expectations but providing also information

beyond one or two years in the future has no additional effect. Brouwer and de Haan (2022) implement a randomized control trial among Dutch households and show that the information treatment effect varies depending on the type of monetary policy instrument, with information on (conventional) interest rate policies having stronger treatment effects than information on more unconventional instruments.

One paper closely related to my analysis is Lewis et al. (2020). They study the response of consumer confidence in the US to different types of monetary policy announcements between 2008 and 2017. Using daily data, they find that in contrast to most of the existing literature households respond very quickly to some news. In particular, they show that surprises in the federal funds rate lead to quick adjustments of consumer confidence, but forward guidance and asset purchase surprises yield no significant effect. These differential findings by type of monetary policy announcement are complementary to the results obtained in my paper based on a different identification approach and focusing on German households' inflation expectations as a variable of interest.

The second strand of literature deals with the effectiveness of unconventional monetary policies and to what extent they can help to circumvent the constraint of the zero/effective lower bound on the short-term nominal interest rate. Swanson (2021) argues with regard to the US that unconventional policies such as forward guidance and QE have been effective substitutes for conventional monetary policy. Similarly, Debortoli et al. (2020) find that there is little evidence against the ZLB irrelevance hypothesis, i.e. that the economy's performance was not affected by the binding ZLB constraint in the US between 2009 and 2015. They further argue that this is consistent with unconventional monetary policies being (at least partially) successful at circumventing the lower bound constraint on conventional monetary policy. By contrast, Campbell et al. (2019) show that the Fed has a limited ability to influence expectations, especially at longer horizons, and highlight the role of imperfect communication. The main focus of this literature has been on financial markets and professional forecasters or the macro effects in general.[4] While my identification approach for monetary policy announcements builds on this literature, I

[4]See also Andrade and Ferroni (2021), Inoue and Rossi (2021), Del Negro et al. (2023), Altavilla et al. (2019), Lewis (2023) and Campbell et al. (2012).

use household level data and focus on one specific part of the transmission channel: the role of the general public and household inflation expectations.

Outline The rest of this paper is organised as follows. Section 2 describes the household survey data and the construction of monetary policy surprises. In Section 3, I present the identification approach and the main results for the effects of different types of monetary policy announcements on household inflation expectations. I also contrast the findings for households with those of financial markets and professional forecasters. Section 4 discusses the role of media coverage and public interest as potential transmission channels. Section 5 provides some evidence on the relationship of household inflation expectations with other household expectations and the effects of policy announcements on consumer spending attitudes. Section 6 concludes.

2 Data and descriptive evidence

2.1 Household survey data

Most of the analysis is based on household survey data from the Gesellschaft für Konsumforschung (GfK). As part of a harmonised EU consumer survey programme, the GfK interviews repeated cross-sections of around 2000 consumers in Germany at the beginning of every month. The survey is conducted by means of face-to-face interviews that take place in two independent waves of around 1000 consumers each. The first wave starts on a Friday and continues for one week and the second wave starts on the following Friday. This timing is important and will be exploited in the empirical approach described in Section 3. The GfK first asks consumers a qualitative questions on expected inflation over the next twelve months:

> How do you think consumer prices will develop over the next 12 months, in comparison to the last 12 months? They will...
>
> 1. Increase more rapidly
> 2. Increase by approximately the same rate

3. Increase less strongly
4. Stay about the same
5. Fall
6. Don't know

Figure 1 shows the distribution of qualitative inflation expectations. It highlights that there is substantial variation both over time and across individuals. More than 80% of households expect inflation either to be around zero or to be positive, with most households expecting either around zero (light green) or approximately constant inflation (yellow).

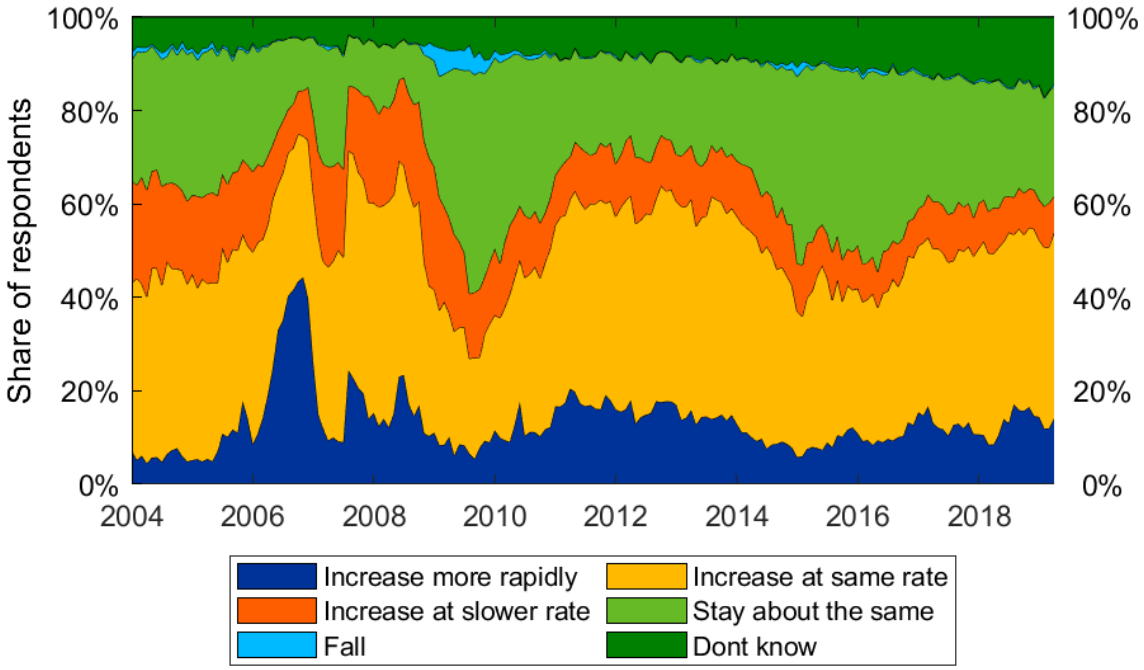

Figure 1: Distribution of qualitative inflation expectations over time

In order to estimate the dynamic effects of announcements on expectations (see section 3.3), I use an aggregate measure of qualitative inflation expectations. This is constructed following Arioli et al. (2017) and published by the European Commission for all euro area countries.[5] They propose a balanced statistic that is computed as the difference between

[5]Link to EU consumer survey: https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/business-and-consumer-surveys_en. The underlying micro data for all European countries is confidential and the European Commission only publishes some aggregated time series data.

the relative frequencies of responses falling in different categories:

$$P[1] + 0.5P[2] - 0.5P[4] - P[5] \tag{1}$$

where P[i] is the frequency of response with P[1]: increase more rapidly, P[2]: increase approximately at the same rate, P[4]: stay about the same and P[5]: fall. This balanced statistic can take values between -100 and 100. A value of 100 would imply that everybody expects higher inflation and a value of -100 that everybody expects deflation.

In my analysis I follow D'Acunto et al. (2021) and focus on the qualitative inflation expectations question but the survey also includes a second question on quantitative inflation expectations. The question is as follows

> By how many percent do you think consumer prices in the next 12 months will increase (if 1, 2 or 3) / decrease (if 5)?
> Answer options: enter number or don't know

This quantitative expectations question has several shortcomings. First, only households that do not answer 4. or 6. in response to the qualitative question are asked about their quantitative expectations. Figure 1 demonstrates that the share of households answering that they expect prices to stay about the same is significant and this survey design implies that their quantitative inflation expectations are imputed to be zero. It is not possible to distinguish whether these households really mean a point estimate of zero or values of very low inflation as observed during parts of the sample period. Second, the share of households that do not respond to this quantitative question is around 20%. Together, this implies that only around 55% of households provide quantitative inflation expectations and sometimes these are unbalanced across waves.

Properties of qualitative inflation expectations By definition, qualitative inflation expectations do not provide a point forecast for the level of inflation, but they can still be a useful measure to capture households' expectations about future inflation dynamics. In fact, in the GfK survey average qualitative inflation expectations as measured by the balanced statistic capture meaningful variation in future realised inflation. Figure 2 illustrates this

point and plots inflation expectations from one year before as measured by the balanced statistic together with current HICP core inflation (see also D'Acunto et al. (2021), who make a similar point). For most of the sample period, the dynamics of the two series are very similar[6]. In the appendix, I also look in more detail at the cross-correlation of inflation expectations with different inflation components. Similar to the US evidence presented by Cavallo et al. (2017) and Coibion and Gorodnichenko (2015b), amongst others, inflation expectations exhibit a strong contemporaneous co-movement with non-core items such as food and energy prices to which consumers are more regularly exposed. The correlation of inflation expectations with core inflation is strongest one-year ahead, which underscores the predictive power of expectations for realised inflation. In contrast to this, quantitative inflation expectations are not only very noisy and on average biased upwards but their predictive power is also significantly lower than that of qualitative inflation expectations (see Figure A.2). Based on these properties and aforementioned survey design aspects, I focus on qualitative inflation expectations in this paper.

Finally, the survey contains other questions about perceived current personal and economic conditions and expected future conditions together with rich information on demographic characteristics (see summary statistics in the appendix, Table A.1). My sample goes from January 2004 to April 2019. In May 2019 there was a structural change in the way the consumer data is collected. Appendix A provides more details on the survey.

2.2 Monetary policy surprises

I use monetary policy surprises based on the high-frequency identification approach first introduced by Kuttner (2001). Policy surprises are captured by high-frequency interest rate changes in a narrow window around the announcement on the day of ECB Governing Council meetings. The narrow window ensures that surprises measure the unanticipated component of ECB policy announcements, since during this narrow window asset prices respond to monetary policy, but there is no reverse causality from asset prices to monetary

[6]The structural break in core inflation in 2015 is due to a change in the way the price index for package holidays is calculated in the HICP for Germany that was implemented from 2015 onwards.

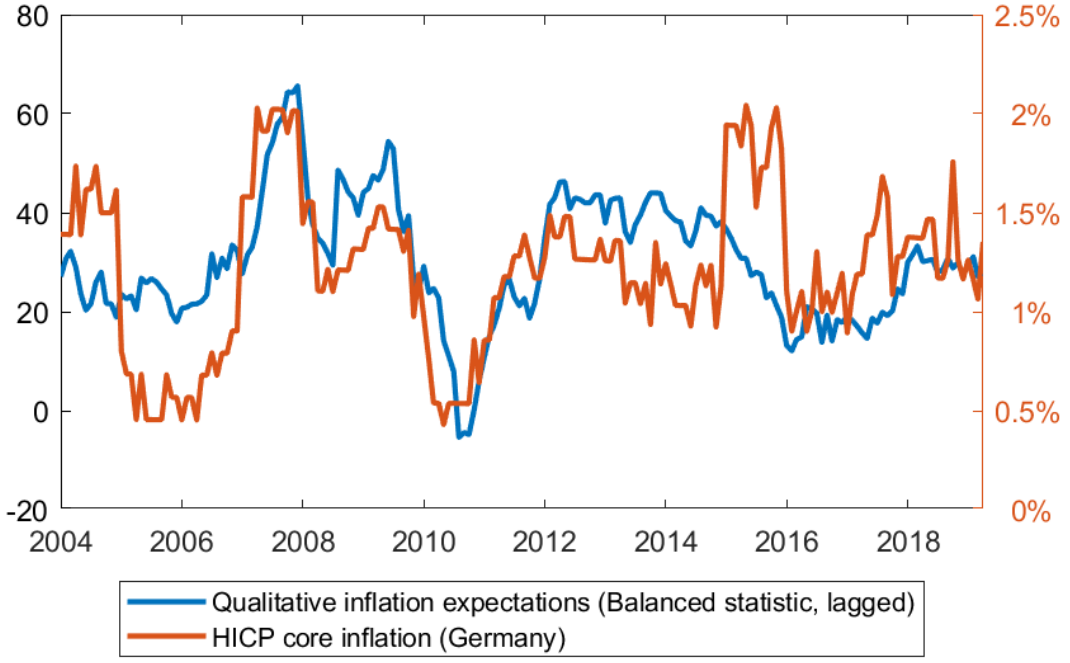

Figure 2: Inflation expectations and actual realised inflation

Notes: HICP core inflation (rhs) is inflation excluding food and energy and is calculated as the year-on-year growth rate. Inflation expectations are lagged by one year and calculated as balanced statistics following Arioli et al. (2017).

policy. I follow this high-frequency identification approach based on asset prices, as it is very widely used to identify monetary policy shocks in the presence of the lower bound on the short-term nominal interest rate (see for example Rossi (2020) for an overview of identification approaches). Additionally, and more importantly for the question of this paper, it allows me to disentangle different types of announcements in one consistent framework.

In order to identify different types of ECB monetary policy announcements, I rely on the decomposition of policy surprises by Altavilla et al. (2019). Their approach builds on a large literature of high-frequency identification of monetary policy announcements, in particular Gürkaynak et al. (2005) and Swanson (2021). The detailed approach is described in Appendix B. The main idea is to summarise yield changes across different maturities during the ECB's press release and press conference window in a factor model. Factors are uniquely identified by imposing restrictions on the rotation matrix, so that the estimated factors can be related to different dimensions of monetary policy announcements.

Altavilla et al. (2019) estimate four different factors labelled as Target, Timing, Forward Guidance (FG) and QE. The Target factor is primarily about changes in the current policy rate. The Timing factor captures near-term expected policy actions. The FG factor has the strongest effects on the medium-term horizon of the yield curve thus capturing more medium-term policy expectations. Finally, the QE factor affects primarily longer-term yields and can be related to asset purchase announcements. The series of Target, Timing, Forward Guidance and QE surprises are plotted in Appendix B (see Figure B.1). The four factors are normalised to have a one-unit effect on the 1-month, 6-month, 2-year and 10-year OIS, respectively. It is important to highlight that unlike the US Fed, ECB policy rates have reached levels below zero and the series of Target surprises also exhibits relevant variation in the post Great-Recession period.

3 Effects of announcements on inflation expectations

I use two empirical approaches to estimate the effects of monetary policy announcements on household inflation expectations. First, I exploit the survey design together with the timing of monetary policy announcements to identify the short-term effects of monetary policy announcements. Second, I use a local projections approach to estimate the dynamic effects of policy announcements over the medium term.

3.1 Short-term effects of announcements on expectations

As mentioned in section 2.1, the GfK interviews take place at the beginning of every month in two independent waves of around 1000 consumers each. The first survey wave starts on a Friday and continues for a week, when the second survey wave starts for a week (see Figure 3 for illustration). Interviews are face-to-face and relatively evenly distributed over the whole week.

Until 2014, the ECB Governing Council meeting usually took place at the beginning of every month. From 2015, the ECB Governing Council met only every six weeks. The press release and press conference happen on Thursday afternoon. Due to this timing of

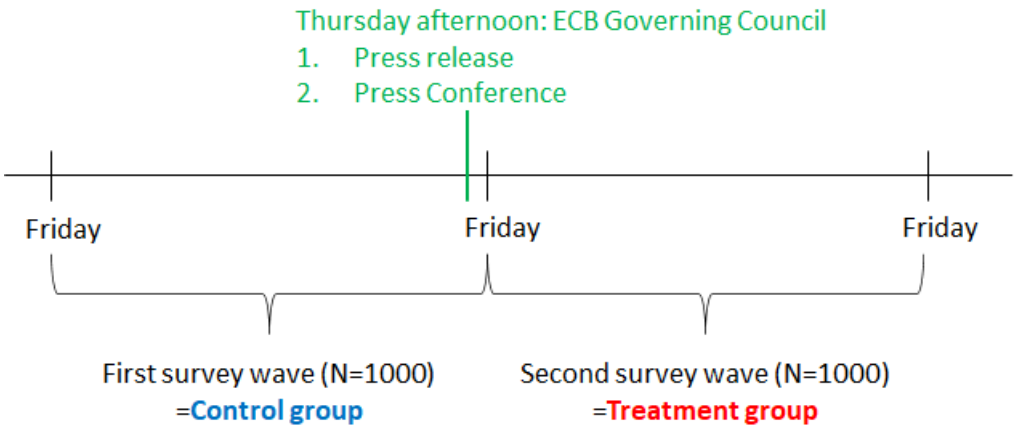

Figure 3: Survey timeline

events, there are a considerable number of ECB Governing Council meetings that take place exactly between the two survey waves, so that I observe some households answering the survey just before the ECB policy announcements and some households answering the survey directly afterwards. This provides a natural experiment to identify the immediate effects of policy announcements. More specifically, for the period from January 2004 to April 2019 around 65% of ECB Governing Council meetings took place between the two survey waves (see the blue bars in Figure B.1 for the ECB Governing Councils that are included).[7]

To identify the effects of different types of policy announcements, I estimate the following model:

$$Y_{i,t} = \alpha + \beta_1 D_{i,t} Target_t + \beta_2 D_{i,t} Timing_t + \beta_3 D_{i,t} FG_t + \beta_4 D_{i,t} QE_t + \gamma X_{i,t} + u_{i,t} \quad (2)$$

where $Y_{i,t}$ refers to the inflation expectation over the next twelve months of consumer i in month t. $D_{i,t}$ is a dummy variable equal to one if respondent i in month t is in the second survey wave and zero if she is in the first wave. $Target_t$, $Timing_t$, FG_t and QE_t are equal to the different policy announcement surprises described in the previous section. $X_{i,t}$ includes month fixed effects, a dummy for consumer i belonging to wave 1 or 2 and various household controls such as age, household income, occupation, education, gender,

[7]Due to the change from a monthly to six weeks schedule in 2015 the share of meetings covered after 2015 is much lower than before 2015.

city size, state, marital status, housing status and household size (see also Table A.1 for an overview and summary statistics). Additionally, I include the average value of expectations in the previous four survey waves as a control variable. I use robust standard errors that are clustered at the monthly level. As the baseline, I use qualitative inflation expectations as depicted in Figure 1. This means that the dependent variable is an ordered categorical variable and estimating a linear model is likely to yield biased estimates. Therefore, I estimate the model as an ordered logit model.

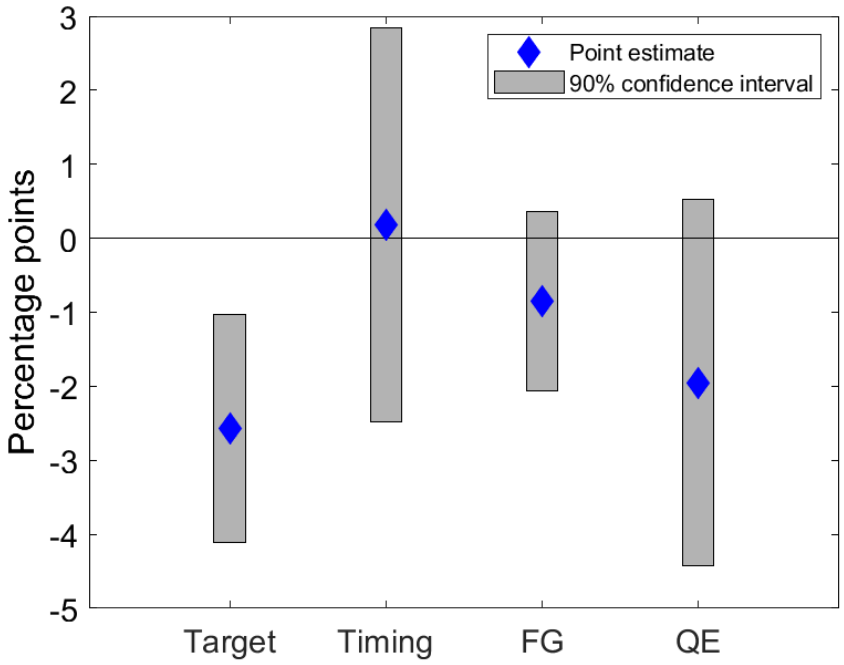

Figure 4: The immediate effect on inflation expectations

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on the probability of prices increasing more rapidly (=inflation rises).

Figure 4 shows the results of the ordered logit model based on equation (2). More specifically, the figure shows the average marginal effect on the probability of households expecting prices to increase more rapidly, i.e. inflation to rise. A 25 basis points Target surprise makes it 2.6% less likely that households expect inflation to rise. The effect of Timing, FG and QE are imprecisely estimated and, especially for Timing and FG, the magnitude is very small compared to the effect of Target. The detailed marginal effects are reported in Table D.2, while Table D.1 shows the estimates when successively adding

the different types of controls. In particular, it highlights that the wave dummy is not statistically different from zero, which confirms that the two waves are quite similar and comparable.

The scaling of surprises can be done in various ways and to some extent this is arbitrary. In the description above and also in the rest of the paper, I use a scaling of a 25 basis points change in the reference rate. I follow this approach because 25 basis points is a conventional size considered in the literature and makes the comparison with alternative monetary policy surprises easier. However, there are some caveats. First, a 25 basis point change in the short rate might have different economic effects than a 25 basis point change in the long rate. Second, for the given surprises and sample period, surprises of this size basically do not exist. The average surprises are of the order of 1 basis point in absolute terms and the largest surprises are usually between 10 and 15 basis points in absolute terms. Therefore, the effect whereby households are 2.6% less likely to expect higher inflation as shown above for the Target surprise is rather small in economic terms.

Table 1: Results for different demographic characteristics

	(1)	(2)		(3)		(4)	
	Baseline	High income	Low income	Age (30-60)	Age (not 30-60)	High education	Low education
Target	-0.026***	-0.043***	-0.021**	-0.045***	-0.003	-0.039***	-0.002
	(0.009)	(0.011)	(0.010)	(0.011)	(0.012)	(0.014)	(0.014)
Timing	0.002	-0.008	0.004	0.008	-0.004	0.001	0.003
	(0.016)	(0.028)	(0.015)	(0.016)	(0.018)	(0.019)	(0.017)
FG	-0.008	-0.027**	-0.004	-0.011	-0.006	-0.004	-0.016
	(0.007)	(0.013)	(0.007)	(0.008)	(0.009)	(0.008)	(0.010)
QE	-0.020	-0.094***	-0.004	-0.035	-0.004	-0.009	-0.038
	(0.015)	(0.030)	(0.018)	(0.025)	(0.023)	(0.029)	(0.032)

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability of prices increasing more rapidly (=inflation rises). High income refers to households in the top 25% of the monthly net income distribution, high education to households with high school or higher degree. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

While the baseline results show that only Target announcements lead to a significant effect on household expectations, it might be that certain household groups react more to monetary policy announcements that also include forward-looking communication. Table 1 shows that the evidence from Figure 4 is supported by looking at different demographic groups that are likely to be more responsive to monetary policy announcements. These

are in column (2) households in the top quartile of the net income distribution[8], in column (3) middle-aged households that are typically those that take out a mortgage or need to save for retirement and in column (4) households with a high school degree or above. For all these three groups the response of inflation expectations to Target surprises is significant. By contrast, with the exception of low-income households, the other household subgroups exhibit no significant response to any type of announcement. The difference in coefficients for the Target announcement is only partly statistically significant, however (see Table 2). For the other types of policy announcements, the effects are again very imprecisely estimated, with the signs of the coefficients sometimes changing across the columns. There is only a significant effect of QE surprises - and partly for FG - in the case of high-income households. Besides looking at different demographic groups, I also exploit the question on quantitative inflation expectations to exclude households that do not provide consistent answers between the qualitative and quantitative question or that provide unreasonably large inflation expectations. Excluding these types of households leads to a slightly stronger effect of Target announcements (see Table D.3). Overall, this suggests that there is some relevance for household heterogeneity, but the conclusion from the baseline estimates on the relative effectiveness of Target announcements in comparison to other announcements is broadly confirmed.

Table 2: Testing difference in coefficients across demographic groups

	(1) High-low income	(2) Age (30-60) vs (not 30-60)	(3) Higher-lower education
Target	3.98**	9.66***	3.40*
Timing	0.37	1.06	0.02
FG	3.54*	0.39	1.07
QE	6.17**	0.68	0.30

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability of prices increasing more rapidly (=inflation rises). High income refers to households in the top 25% of the monthly net income distribution, higher education to households with high school or higher degree. Values correspond to Chi2 test-statistic, * p<0.10, ** p<0.05, *** p<0.01.

[8]The income data and results based on it should be treated with some caution since a significant share of households (more than 20%) have a missing answer to this question.

3.2 Robustness and extensions

Placebo tests I run two "Placebo tests" to validate the previous results. On the one hand, I use the same framework as in my baseline estimation, but I randomly assign households to the two waves that correspond to the treatment and control group. On the other hand, I replace the monetary policy surprises by random draws from a standard normal distribution. For both cases I repeat this 500 times and perform independent estimations. Table 3 reports the average coefficient and p-value.[9] Unlike the baseline model, the average coefficient is close to zero in all cases and the p-value indicates no significance.

Table 3: Results for placebo tests

	(1)	(2)			(3)		
	Baseline	Average coefficient	Average p-value	P-value<0.01	Average coefficient	Average p-value	P-value<0.01
Target	0.211	-0.002	0.435	4.6%	-0.007	0.475	2.0%
Timing	-0.015	0.002	0.448	3.0%	-0.001	0.483	1.2%
FG	0.069	-0.001	0.452	4.0%	-0.010	0.481	2.4%
QE	0.160	-0.007	0.416	5.4%	-0.074	0.468	3.8%

Notes: Column (2) shows placebo test when randomly assigning households to the two survey waves and column (3) shows placebo test when drawing monetary policy surprises from standard normal distribution. All results are based on 500 estimations with an ordered logit model.

Model specification The baseline results are robust to using model specifications other than an ordered logit model. In particular, the effects are similar when using (i) a logit model where the dependent variable is a dummy variable that is one if households expect prices to increase more rapidly and zero otherwise or (ii) a linear regression model (see Table D.4). In addition, Table D.5 highlights that the policy announcements have no significant effect on the proportion of households answering "Don't know", which would be problematic for the use of the ordered logit model.

Inflation perceptions In Table D.6, I analyse the role of perceptions of past inflation which are likely correlated with inflation expectations. In order to make sure that my results are not driven by an effect on inflation perceptions, I control for inflation perceptions in equation (2) and show that the effects of monetary policy announcements on inflation

[9]For computational reasons, I only compute the coefficients from the ordered logit model and not marginal effects as shown in Figure 4.

expectations are similar to the baseline in that case. Moreover, the different types of policy announcements do not significantly affect households' perceptions of past inflation.

Role of specific monetary policy surprises by Altavilla et al. (2019) In my baseline analysis, I follow Altavilla et al. (2019) and assume that the QE factor is only active from 2014. However, Figure B.1 shows that there are also larger surprises in this factor before 2014. In Table D.7, I show that controlling for these surprises does not really affect the coefficients of the other types of monetary policy announcements and the pre-2014 surprises themselves have no significant effect on household inflation expectations. When looking at the role of large surprises, I find that dropping the three largest Target surprises yields effects that are similar to the baseline results presented before (see Table D.8). Moreover, I add the November 2008 Governing Council meeting that was excluded by Altavilla et al. (2019) on the grounds that it represents an outlier.

Subsamples Table D.9 shows the results for some subsamples. First, results are robust to excluding the Great Recession period between March 2008 and June 2009. Second, I present results for the sample from 2008 onwards given that before 2008 unconventional monetary policy tools were arguably less relevant. Third, focusing just on the sample before the zero lower bound - which can be defined either as pre-July 2012 or pre-June 2014 - yields similar results.

(Potential) shortcomings of monetary policy surprises The literature has emphasised that high-frequency identified monetary policy surprises are often predictable by current economic conditions and correlated with central banks' private macroeconomic forecasts (see Ramey (2016) and Miranda-Agrippino and Ricco (2021)). In order to check whether these issues drive some of my results I follow Miranda-Agrippino and Ricco (2021) and orthogonalise the monetary policy surprises with respect to (i) current economic conditions and (ii) the central banks' private macroeconomic forecasts. For (i), I take the residuals from a regression of the surprises on a set of macro-financial factors extracted from a broad collection of real-time monthly variables.[10] For (ii), I take the residuals from a regression of the surprises on the ECB's one-year ahead GDP and inflation forecasts and forecast

[10]I use the Euro Area Real-Time Database which has been constructed by Giannone et al. (2012) and can be found here: https://sdw.ecb.europa.eu/browseExplanation.do?node=9689716.

revisions. This second regression should control for the signalling channel as described in Melosi (2016), where there is some information asymmetry between private agents and the central bank and therefore central bank announcements also have some effect via signalling the central bank's view about the macroeconomic development. Columns (1) and (2) in Table 4 show the results for the two orthogonalised monetary policy surprises and the results are very similar to the baseline.

Table 4: Results for alternative monetary policy surprises

	(1)	(2)	(3)	(4)	(5)
Target	-0.022***	-0.025***			
	(0.008)	(0.008)			
Timing	-0.002	0.001			
	(0.016)	(0.016)			
FG	-0.004	-0.007			
	(0.009)	(0.008)			
QE	-0.024	-0.010			
	(0.016)	(0.018)			
1Y OIS			-0.010		
			(0.008)		
1Y OIS (release)				-0.028**	
				(0.011)	
1Y OIS (conference)				-0.005	
				(0.009)	
Policy					-0.020***
					(0.008)
Info					0.001
					(0.012)
N	205,784	205,784	205,784	200,238	205,784

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability of prices increasing more rapidly (=inflation rises). Column (1) shows the responses using monetary policy surprises orthogonalised with respect to current economic conditions. Column (2) shows the responses using monetary policy surprises orthogonalised with respect to the ECB's macroeconomic forecasts and forecast revisions. Column (3) shows the response to the change of the 1-year OIS during the full monetary event window including both press release and press conference. Column (4) shows the response to the change of the 1-year OIS during press release and press conference, respectively. Column (5) shows the response to policy and information shock series by Jarociński and Karadi (2020). Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Alternative monetary policy surprises I consider two alternative monetary policy surprises. In column (3), I do not use a factor model as Altavilla et al. (2019) do but simply take the 1-year OIS change for the full monetary event window. The 1-year OIS rate is commonly used as a summary indicator of monetary policy, especially since it was not or only little constrained at the lower bound. The insignificant response highlights that

it is important to consider the multi-dimensionality of monetary policy announcements as I do in this paper. In column (4), I use the 1-year OIS change separately for the press release window and the press conference window. The press release window is just a short statement about policy actions taken by the Governing Council and until 2014 this only included interest rate changes. The press conference is more about communication. It explains the underlying reasons for the policy decisions and also provides a further outlook. In column (5), I take the monetary policy surprise series by Jarociński and Karadi (2020), who decompose monetary policy news into a policy and an information component. These last two columns of Table 4 indicate that surprises relating to policy actions yield a stronger response compared to surprises that are more about communication and providing information on potential future actions. One potential reason for this could be that (current) policy actions are covered more by media and therefore reach households more easily.

3.3 Dynamic effects of announcements on expectations

The previous section focused on the immediate response of household inflation expectations to policy announcements. The literature on information rigidities (see for example Coibion and Gorodnichenko (2015a)) highlights that households often need time to process new information or do not pay attention all the time and hence only react to news after a time lag. Therefore, in this section I estimate the medium-term dynamic effects of policy announcements on inflation expectations. Since the survey consists of repeated cross-sections of consumers, it is not possible to directly follow individual respondents over time. I use aggregated household expectations at monthly frequency and then estimate the dynamic effects of policy announcements by local projections building on Jordà (2005).[11]

I estimate the following specification for $0 \leq h \leq 12$ months:

$$y_{t+h} - y_{t-1} = \beta_h^{Ta} Target_t + \beta_h^{Ti} Timing_t + \beta_h^{FG} FG_t + \beta_h^{QE} QE_t + \gamma_h X_{t-1} + u_{t+h} \quad (3)$$

[11] This approach also allows me to exploit the full sample of Governing Council meetings since 2004 and to compare the responses to professional forecasters for which the empirical approach described in the previous section is not feasible due to the data frequency.

where y_t is the inflation expectations in month t and $Target_t$, $Timing_t$, FG_t and QE_t correspond to the policy surprises[12] in month t. X_{t-1} includes three lags of the policy surprises and two lags[13] of y_t, the short-term interest rate, the long-term interest rate, the HICP index, the industrial production index and a credit spread. The HICP index and industrial production are transformed into log-first differences. Inflation expectations are aggregated at the monthly frequency to a balanced statistic as described in section 2 (see time series in Figure 2). The contemporaneous values of the control variables are not included, so that I implicitly allow for contemporaneous (within the month) effects of announcements on all control variables. 68% and 90% confidence bands are computed using Newey-West standard errors to control for heteroscedasticity and serial correlation.

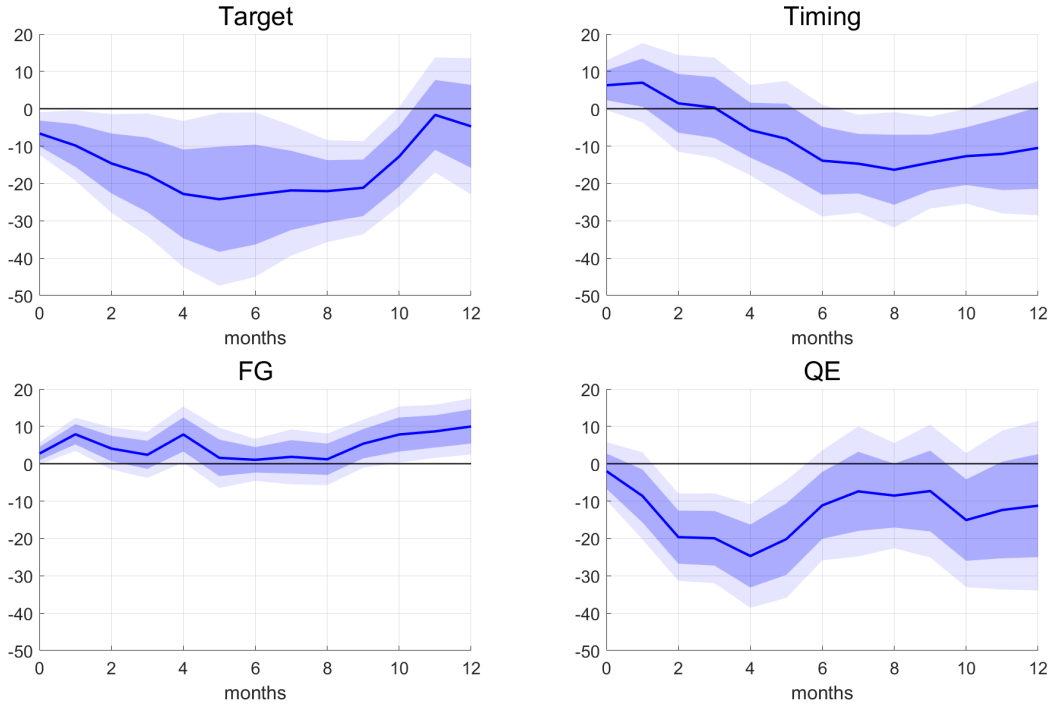

Figure 5: Response of qualitative inflation expectations (balanced statistic)

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in Equation 3. Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled in such a way that a surprise increases the respective reference rate by 25 basis points.

[12] An alternative to including the raw surprises would be to use LP-IV. I do not follow this approach for the following reasons. First, by construction the methodology by Altavilla et al. (2019) provides a scaling of the surprise measures to the relevant references rates that would be the endogenous variables in the first stage IV regression. Second, the surprises jointly affect the relevant reference rates but to different degrees which makes a standard IV regression challenging.

[13] The number of lags is set on the basis of the Akaike information criteria. Results are robust to using alternative lag specifications.

Figure 5 shows the response of qualitative inflation expectations to the different types of monetary policy announcements. The responses are again scaled in such a way that the respective reference rates - 1-month, 6-month, 2-year and 10-year OIS, respectively - increase by 25 basis points on impact. The units are changes in the balanced statistic. A positive Target surprise significantly reduces household inflation expectations on impact and with a through effect of around -24 reached after five months. While a 25 basis point surprise is very large, this effect implies even for smaller scaled surprises that Target announcements have an economically meaningful and sizeable effect. For the other types of announcements, the effect is not significant at the 90% level on impact. Positive Timing surprises lead to a reduction of inflation expectations as measured by the balanced statistic by around 15 after six to eight months. For FG surprises, the effects are generally small and mostly insignificant. Positive QE surprises decrease inflation expectations but the effect is only significant after a few months with a through effect of -25 after four months.

In the appendix, I provide several robustness checks including alternative lag lengths, controlling for surprises in the QE factor before 2014 and the role of potential cross-correlation of policy surprises (see Appendix E).

Overall, the above evidence is broadly in line with the results from the event study approach in the previous section. While Target announcements lead to a significant and sizeable reduction in inflation expectations, the other announcements have no or only smaller delayed effects.

3.4 Financial markets and professional forecasters as benchmark

In order to provide a benchmark, this section compares the response of household inflation expectations with the response of inflation expectations of financial markets and professional forecasters. Especially professional forecasters who are well informed economic agents can be regarded as a natural benchmark for comparison to households.

Financial markets In order to measure the response of inflation expectations of financial markets, I use German inflation linked bonds at 1-4 years maturity (see time series of inflation linked bonds in the appendix Figure F.4). I estimate the effects of policy

announcements based on an event study framework. More specifically, I regress one-day changes from the day before the Governing Council meeting to the end of the day of the Governing Council meeting on the different types of monetary policy surprises. Table 5 shows the results for 25 basis points policy surprises. Positive Target and QE announcements lead to a reduction in inflation expectations, while Timing and FG announcements increase inflation expectations.[14] In particular, for FG announcements the effects are highly significant, which is different from the household responses.

Table 5: The response of financial markets: German inflation linked bonds

	1Y	2Y	3Y	4Y
Target	-0.24*	-0.25*	-0.10	-0.08
	(0.13)	(0.13)	(0.19)	(0.17)
Timing	0.20**	0.03	0.10	0.04
	(0.10)	(0.06)	(0.08)	(0.06)
FG	0.19**	0.20***	0.20***	0.21***
	(0.08)	(0.05)	(0.06)	(0.05)
QE	-0.13**	-0.08*	-0.12**	-0.12**
	(0.05)	(0.04)	(0.05)	(0.06)
N	132	137	137	136

Notes: Regression of one-day changes in German inflation linked bonds for the four different surprise series (included simultaneously). Responses are scaled to a surprise that increases the respective reference rate by 25 basis points. Due to data availability, the sample starts only at the Governing Council in May 2006. Robust standard errors are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

In the appendix, I also show the dynamic effects over the next 120 days using local projections (see Figure F.5). The magnitude of the effects is fairly similar across types of announcements, which is also in contrast to the responses of household inflation expectations. These results are qualitatively similar to Andrade and Ferroni (2021), who distinguish between a target and a path factor and find that especially the path factor has strong positive effects on market-based inflation expectations.

Professional forecasters In order to measure the response of inflation expectations of professional forecasters, I use survey data from a monthly survey by Consensus Economics that asks professional forecasters about their inflation expectations for the current and next year. I construct one-year ahead inflation expectations as a weighted average and

[14]The positive response to FG and Timing announcements is in line with the signalling/information channel of monetary policy that has been documented in the literature (see Melosi (2016) and Nakamura and Steinsson (2018)).

then use the same local projections framework as defined in equation (3). Figure 6 plots the impulse response functions to 25 basis points policy surprises. A 25 basis points Target surprise leads to a reduction in inflation expectations of up to 0.5 percentage points, but the effects are very imprecisely estimated. In response to an FG surprise, there is a significant albeit delayed increase in inflation expectations, with the peak magnitude similar to the decline of the point estimate in response to a Target surprise. The responses to Timing and QE surprises exhibit some qualitative similarity to those of households.

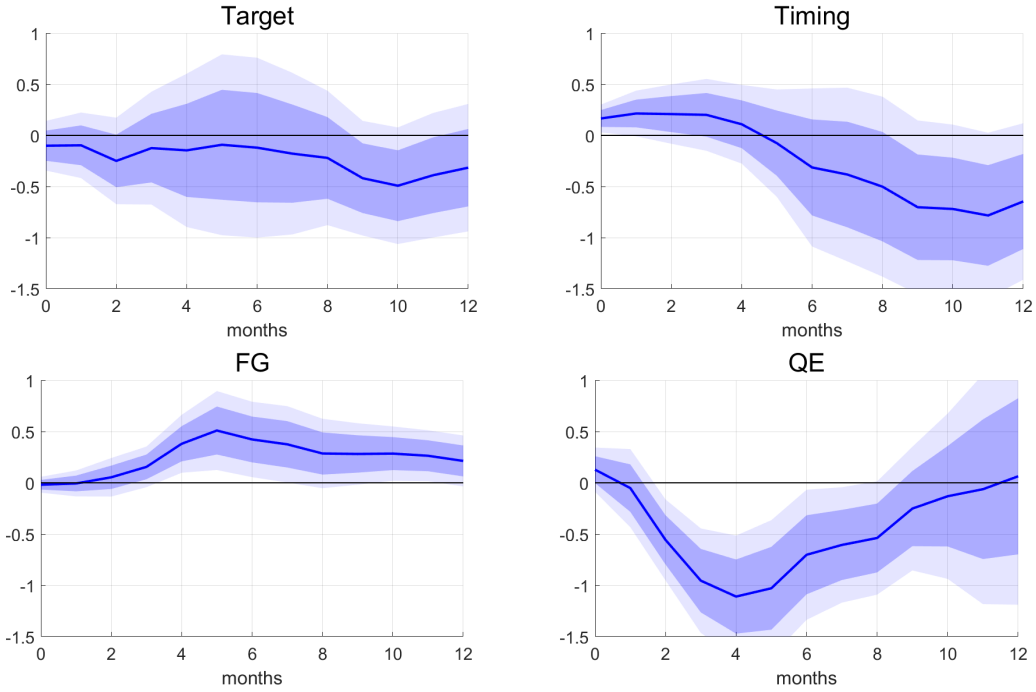

Figure 6: Response of inflation expectations of professional forecasters, Germany

Notes: Estimates based on local projections of one year ahead inflation expectations on monetary policy surprises and control variables as in Equation 3. Inflation expectations come from a monthly survey of professional forecasters conducted by Consensus Economics. Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled in such a way that a surprise increases the corresponding interest rate by 25 basis points.

The results described above show that while household expectations react most strongly to Target announcements, professional forecasters and especially financial markets also react to the other types of policy announcements. Moreover, the magnitude of the responses is more similar across types of announcements. In particular, communication such as forward guidance has powerful effects on financial markets in line with a large existing literature also mentioned earlier in the related literature.

4 The role of media as a transmission channel

The literature on household expectations often uses designed experiments in which researchers provide participants with specific pieces of information and then estimate the effect of this information. By contrast, in this framework I do not control or know the information that households receive. It is likely that almost no household follows the ECB's press conference or directly obtains information from the ECB via its website. Instead, it is more likely that information on ECB monetary policies reaches households via "classical" media or social media such as Twitter and that they react to this information. Consequently, media coverage might play an important role in explaining the previous results. If some types of policy announcements lead to more/different media coverage than others, that could explain the differences across types of announcement presented previously.

In the following, I use Google trends data to establish to what extent different policies reach the general public. Google trends data measures the search interest for certain topics/keywords and can reflect the general public's interest in a topic, how much people pay attention and whether people search for information on a topic. Therefore, I would argue that it is related to media coverage and can be considered as a proxy for the media transmission channel.

Figure 7 shows the search interest for different keywords related to the ECB and its policies in Germany over time since 2004. The largest search interest for the keyword ECB is at the beginning of 2015, when the ECB announced the asset purchase programme (APP). Looking at the figure on the right side, the spikes in the keywords "ECB asset purchase" and "ECB government bonds" also relate to events concerning asset purchases such as the introduction of APP and the announcement of the pandemic purchase programme in March 2020. For the term "ECB policy rate", there are also other events that generate high search interest: in late 2008 and early 2009, the ECB changed the key interest rates several times; in June 2014 the ECB first lowered the deposit facility rate below zero; and in March 2016, the rate on main refinancing operations was lowered to zero.

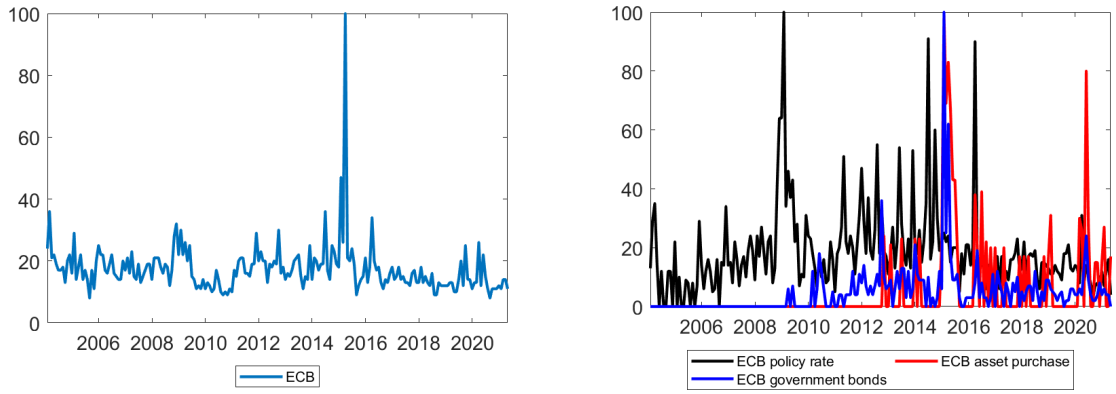

Figure 7: Search interest for different keywords on Google Search in Germany

Notes: The four keywords used in German are "EZB", "EZB Leitzins", "EZB Anleihenkauf" and "EZB Staatsanleihen", respectively. Series show how frequently a given search term is entered into Google's search engine relative to the site's total search volume over a given period of time. Series are scaled in such a way that 100 indicates the point with the maximum search interest over time. Monthly data from January 2004 to April 2021.

In order to measure the effects of different types of policy announcements on search interest I regress the different series of search interest on the absolute values of the monetary policy surprises.[15] Column (1) in Table 6 indicates that Target and partly QE announcements are significantly related to increases in the search interest for the keyword ECB. For Timing and FG announcements, the effects are smaller and not statistically significant. Looking at the other keywords, this result is broadly confirmed. For the keyword "ECB policy rate", Timing announcements are also weakly related to Google search interest, but the magnitude is smaller than for Target announcements. Columns (3)-(5) indicate that for the last years since 2014 QE announcements are the only announcements that are at least partly significantly related to Google search interest. Overall, this illustrates that announcements about changes in the policy rate and asset purchases might be more likely to reach the public and generate more public interest compared to Timing and especially FG announcements. In that sense, these results are complementary to the effects of announcements on household inflation expectations. They at least suggest a consistency with (though not proof of) the idea that public attention and media play an important role as a transmission channel and for explaining the differential responses of households' inflation expectations.

[15]Using the absolute value allows me to take into account the size of monetary policy surprises, but I abstract for simplicity from potential differences depending on the direction of policy change.

Table 6: Effect of policy announcements on Google search interest

	(1) ECB	(2) ECB policy rate	(3) ECB	(4) ECB asset purchase	(5) ECB government bonds
Target	0.620***	2.692***	0.028	-2.807	-2.585
	(0.226)	(0.940)	(1.242)	(2.544)	(1.872)
Timing	0.325	1.033*	1.517	-6.330	2.512
	(0.205)	(0.592)	(2.783)	(5.787)	(3.873)
FG	0.130	-0.035	1.700	3.513	-2.141
	(0.140)	(0.320)	(2.162)	(4.772)	(3.468)
QE	2.326**	0.834	2.377*	6.438**	5.048
	(1.088)	(0.730)	(1.215)	(3.097)	(3.376)
Sample	2004-2019	2004-2019	2014-2019	2014-2019	2014-2019

Notes: Results based on regression of Google search interest on **absolute** value of announcement surprises. The keywords used in German and for Google in Germany are "EZB", "EZB Leitzins", "EZB Anleihenkauf" and "EZB Staatsanleihen", respectively. The sample period goes from January 2004 until April 2019. Robust standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.010.

5 Inflation expectations and consumer spending

In standard macroeconomic models, expectations play an important role for the determination of households' consumption and saving choices and this ultimately also affects aggregate inflation and output. Inflation expectations could influence household consumption via different channels and I describe some possible channels below. First, the traditional Euler equation mechanism would suggest that higher inflation expectations should reduce real interest rates and create incentives for households to bring forward consumption, in particular durable consumption that is more interest rate sensitive. Second, higher inflation expectations might lead households to expect lower real incomes if they do not expect nominal wages to rise as well and therefore reduce consumption. Third, there might be additional effects in so far as higher inflation expectations also influence uncertainty. There are potentially additional relevant channels and overall the effect of household inflation expectations on consumption is not clear. Furthermore, the existing empirical literature has not reached a consensus yet.[16]

While the given dataset does not contain actual consumption data, it does contain sev-

[16]See for example Bachmann et al. (2015), who find no or only a small negative relationship, while Coibion et al. (2022a) find a negative relationship for durable consumption and Duca-Radu et al. (2021) and Armantier et al. (2015) find a positive relationship. Andrade et al. (2023) find that the extensive margin of households' expectations, i.e. whether households expect prices to remain stable or to increase, matters most for durable consumer spending.

eral questions on other expectations and in particular questions about consumer spending attitudes. Looking at the reduced-form relationship, Table 7 shows that higher inflation expectations are significantly negatively related to a broad set of household expectations, i.e. households that expect higher inflation are more pessimistic about personal and general economic conditions (see Appendix A for the detailed survey questions). More specifically, the probability of the general economic situation getting a lot better, of there being much less unemployment and of households answering that they expect their personal financial situation to get a lot better decreases. The probability of households answering that it is a good time to spend or that they plan to spend much more is lower. The probability of households answering that it is a good time to save increases, which might be driven by precautionary reasons given that households seem to associate higher inflation with worse times. When asked about their actual plans to save, the probability of households answering that they plan to save much more decreases. This likely reflects households' expectation of a worse financial/income situation. Finally, higher inflation expectations are significantly related to a reduction in consumer confidence. Overall, these results highlight that households expect the general and their own economic situation to get worse when inflation increases.

Table 7: Inflation expectations and personal and economic expectations

	(1)	(2)	(3)	(4)
	Economic situation	Unemployment	Personal financial situation	Time to spend
	A lot better	Much less	A lot better	Good
Inflation	-0.002***	-0.003***	-0.002***	-0.007***
expectations	(0.000)	(0.000)	(0.000)	(0.002)
	(5)	(6)	(7)	(8)
	Plan to spend	Time to save	Plan to save	Confidence
	Much more	Good	Much more	
Inflation	-0.001***	0.005***	-0.007***	-0.051***
expectations	(0.000)	(0.001)	(0.001)	(0.003)

Notes: Results based on ordered logit model for columns (1)-(7) and linear regression for column (8). Household controls and month-fixed effects included. Marginal effect of a one unit change in (qualitative) inflation expectations on various measures of consumer expectations. Note that qualitative inflation expectations have been rescaled in such a way that an increase corresponds to an increase in inflation expectations. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

One reason behind this seemingly counter-intuitive relationship of inflation expectations

and other expectations could be that households associate lower inflation with good times and high inflation with bad times. Especially for Germany, with the hyperinflation in the 1920s, this historical episode might still influence the way many households perceive inflation today. Moreover, there is some evidence in the literature that many households have a supply-side interpretation of inflation, i.e. they relate inflation to negative income effects and depressed economic activity (see for example Kamdar (2019) and Candia et al. (2020)).

My framework makes it possible to test whether the reduced-form relationships between inflation expectations and consumer spending attitudes shown above also hold in response to monetary policy announcements that affect inflation expectations. I estimate the ordered logit specification from equation (2) and use three different dependent variables as proxies for consumer spending attitudes. The first proxy is the readiness to spend. Readiness to spend is the measure most commonly used in the literature when testing the effects of changes in inflation expectations on consumer spending attitudes (see for example Bachmann et al. (2015)). The distribution of readiness to spend on durables over time is plotted in Figure A.3. Alternatively, I also consider the spending plans and a composite confidence indicator as proxies for consumer spending attitudes (see questions 8 and 9 in Appendix A for details). Consumer confidence is often mentioned in the literature as a good predictor of consumption growth.[17] Consumer confidence is constructed as a weighted statistic of four different questions in the survey concerning households' past and expected financial situation, general economic expectations and spending plans (see Appendix A for details).

Table 8 shows the response of the three proxies for consumer spending attitudes. The coefficients show the effect of a 25 basis points surprise, i.e. one that in the case of the Target announcement reduces inflation expectations significantly. Column(1) shows the effect on the probability of it being a good time to make major purchases now. None of the coefficients is statistically significant. Columns (2) and (3) show that contractionary Target surprises that reduce inflation expectations have a positive - albeit only weakly

[17] See for example https://ec.europa.eu/info/sites/info/files/new_cci.pdf.

Table 8: Effect of policy announcements on proxies for consumer spending attitudes

	(1) Time to spend Good	(2) Plan to spend Much more	(3) Confidence
Target	-0.007	0.002*	0.042*
	(0.017)	(0.001)	(0.023)
Timing	-0.009	-0.001	0.020
	(0.013)	(0.001)	(0.028)
FG	0.010	0.001	0.005
	(0.010)	(0.001)	(0.019)
QE	0.014	0.001	0.003
	(0.032)	(0.003)	(0.078)
N	195,560	191,159	177,668

Notes: Column (1) and (2) are based on an ordered logit model and show the marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on the probability of it being the right moment to make major purchases and planning to spend much more on major purchases, respectively. Column (3) shows results from a linear regression on the consumer confidence indicator where a higher value indicates higher consumer confidence. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

significant - effect on spending plans and confidence. However, the magnitude of the effect is very small if one considers that a 25 basis points Target surprise has a positive effect of 0.047 and the standard deviation of consumer confidence is 0.42. Taken together, all three proxies of consumer spending attitudes respond only very weakly to the Target surprises that are shown to reduce household inflation expectations.

6 Conclusion

This paper analyses the effect of different types of monetary policy announcements on household inflation expectations. While there has been a lot of research on the reaction of professional forecasters and financial markets to monetary policy, households and firms have been studied less. Studying the role of household expectations is relevant for several reasons. First, household survey data can provide a representative view of inflation expectations in the wider economy. Their expectations are also likely to be a good proxy of firms' expectations, since many firms in countries like Germany are small or medium-sized companies, which makes it reasonable to assume that their knowledge and expectation

formation is similar to that of households. Second, household expectations matter for economic activity. Many households participate in some form of wage bargaining processes and they take consumption and saving decisions that are influenced not only by financial market prices but also by their expectations (see Armantier et al. (2015) or Malmendier and Nagel (2016), amongst others). One issue is that household inflation expectations data are usually not available at high frequency, such that a clean identification and estimation of the causal effect of monetary policy is challenging. My analysis exploits within-month variation of interview dates that provides a natural experiment to identify the immediate effects of monetary policy announcements on household inflation expectations. Moreover, I use local projections to study the dynamic effects of policy announcements over the medium term.

In contrast to most of the existing literature on household inflation expectations, I find that households do adjust their expectations in response to some policy announcements. More specifically, policy rate announcements lead to a quick and significant adjustment in inflation expectations. An announcement that increases the policy rate leads to a reduction in household inflation expectations. Forward guidance and quantitative easing, on the other hand, have no or only a smaller and delayed effect on households' inflation expectations. Consistent with these responses of inflation expectations, I document that public interest in the ECB and its policies also exhibits the same differential response by type of monetary policy announcement.

Household inflation expectations are linked to other expectations, in particular consumer spending attitudes. I find that households associate higher inflation expectations with bad times and there is no significant evidence that policy announcements that lead to higher household inflation expectations also have a positive effect on consumer spending attitudes. This contradicts the prediction of many conventional monetary/macroeconomic models with standard intertemporal Euler equation mechanics at their core.

My findings contribute to the discussion about central bank communication with the general public and highlight that there exist significant communication challenges. In particular, in the last two decades central banks have relied heavily on unconventional

measures other than policy rate changes, but these measures seem to have no effect (or less of an effect) on household inflation expectations.

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A GfK household survey

A.1 Survey questions

The full set of survey questions used in this paper beyond inflation expectations are

Q1: How has the financial situation of your household changed over the last 12 months? It has...

1. Got a lot better
2. Got a little better
3. Stayed the same
4. Got a little worse
5. Got a lot worse
6. Don't know

Q2: How do you expect the financial position of your household to change over the next 12 months? It will...

1. Get a lot better
2. Get a little better
3. Stay the same
4. Get a little worse
5. Get a lot worse
6. Don't know

Q4: How do you expect the general economic situation in this country to develop over the next 12 months? It will...

1. Get a lot better
2. Get a little better
3. Stay the same
4. Get a little worse
5. Get a lot worse
6. Don't know

Q7: How do you expect the number of people unemployed in this country to change over the next 12 months? The number will...

1. Increase sharply
2. Increase slightly
3. Remain the same
4. Fall slightly
5. Fall sharply
6. Don't know

Q8: In view of the general economic situation, do you think that now it is the right moment for people to make major purchases such as furniture, electrical/electronic devices, etc.?

1. Yes, it is the right moment now
2. It is neither the right moment nor the wrong moment
3. No, it is not the right moment now 4. Don't know

Q9: Compared to the past 12 months, do you expect to spend more or less money on major purchases (furniture, electrical/electronic devices, etc.) over the next 12 months? I will spend...

1. Much more
2. A little more
3. About the same
4. A little less
5. Much less
6. Don't know

Q10: In view of the general economic situation, do you think that now is...?

1. A very good moment to save
2. A fairly good moment to save
3. Not a good moment to save
4. A very bad moment to save
5. Don't know

Q11: Over the next 12 months, how likely is it that you save any money?

1. Very likely
2. Fairly likely
3. Not likely
4. Not at all likely
5. Don't know

Q12: Which of these statements best describes the current financial situation of your household?

1. We are saving a lot
2. We are saving a little
3. We are just managing to make ends meet on our income
4. We are having to draw on our savings
5. We are running into debt
6. Don't know

The confidence indicator used in section 4.2 is constructed as weighted some of questions 1, 2, 4 and 9.

A.2 Descriptive statistics

Table A.1: Summary statistics of demographic characteristics

		Mean
Age		47.86
Gender	female	54.66%
	male	45.44%
Household net income (Euro per month)	<500	1.21%
	(500,749)	1.70%
	(750,999)	5.00%
	(1.000,1.249)	4.57%
	(1.250,1.499)	9.21%
	(1.500,1.999)	10.71%
	(2.000,2.499)	14.00%
	(2.500,2.999)	9.50%
	(3.000,3.499)	8.59%
	(3.500,3.999)	4.46%
	>=4.000	7.69%
	No answer	23.34%
Education	Volks-/Hauptschule	38.82%
	Höhere Schule ohne Abitur	40.06%
	Abitur/Hochschulreife	10.73%
	Universität	8.92%
	No answer	1.47%
Household size	1 person	22.83%
	2 person	38.39%
	3 person	18.50%
	4 person	14.98%
	5 person or more	5.30%
City size	<2000	7.13%
	(2.000,2.999)	3.46%
	(3.000,4.999)	8.10%
	(5.000,9.999)	9.69%
	(10.000,19.999)	14.78%
	(20.000,49.999)	19.77%
	(50.000,99.999)	7.91%
	(100.000,199.999)	7.02%
	(200.000,499.999)	7.12%
	>=500.000	15.04%
Occupation	farmer	1.44%
	liberal profession	0.26%
	self-employed	5.69%
	civil servant	2.09%
	white-collar worker	30.59%
	blue-collar worker	15.02%
	student	6.37%
	trainee	2.39%
	housewife	5.89%
	retiree	24.25%
	unemployed	5.99%
	No answer	0.02%
Housing situation	own house	44.11%
	own apartment	6.47%
	rented house/apartment	49.42%
Marital status	single	22.41%
	living together	10.77%
	married	49.75%
	divorced/widowed	17.03%
	No answer	0.04%
Household head	yes	59.94%
State	16 German states	

Notes: Sample from January 2004 until April 2019. Total number of observations is 338.778.

The cross-correlation of qualitative inflation expectations with core inflation 12 months ahead is 0.53 for the full sample and 0.72 for the sample until December 2014. Note that this is not just driven by some predictive power of food and energy inflation for core inflation. The 12-month ahead correlation of food and energy inflation with core inflation is 0.28 and 0.12 for the full sample and 0.42 and 0.34 for the sample until December 2014.

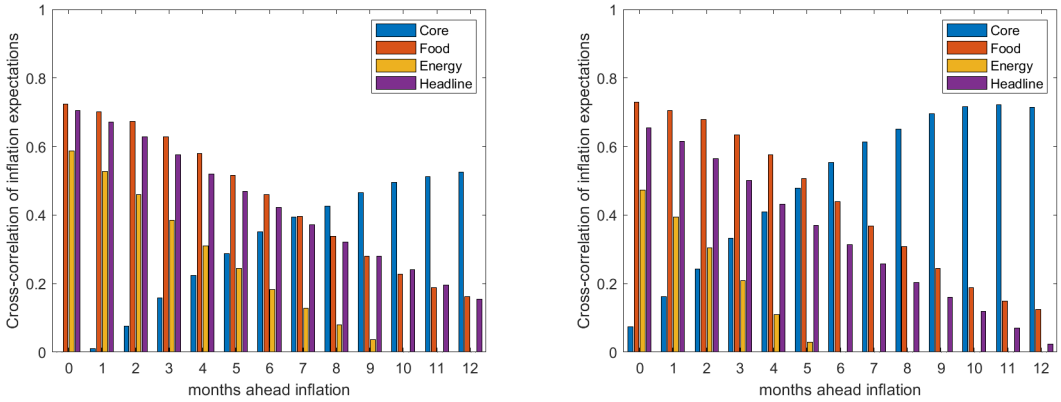


Figure A.1: Predictive power of qualitative inflation expectations for realized inflation

Notes: Cross-correlations of **qualitative** inflation expectations (balanced statistic) with realized inflation at different future horizons. Sample: January 2004 until April 2019 (lhs) and December 2014 (rhs), respectively.

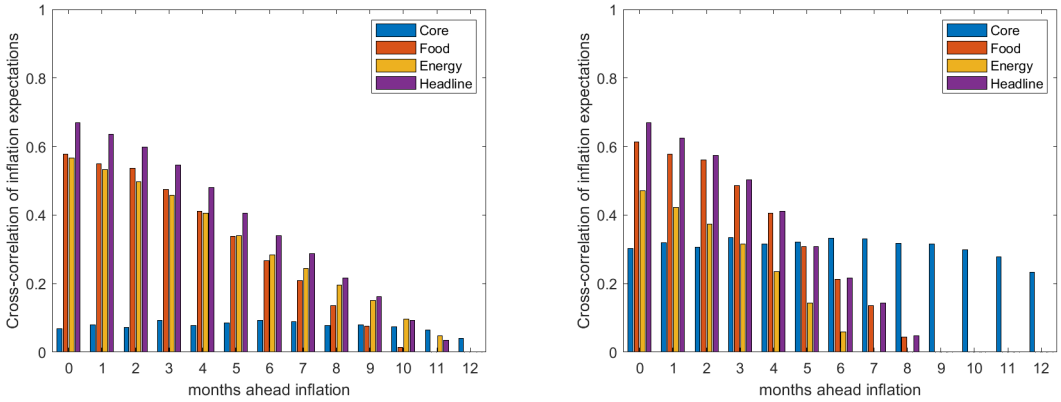


Figure A.2: Predictive power of quantitative inflation expectations for realized inflation

Notes: Cross-correlations of **quantitative** inflation expectations (trimmed mean) with realized inflation at different future horizons. Sample: January 2004 until April 2019 (lhs) and December 2014 (rhs), respectively.

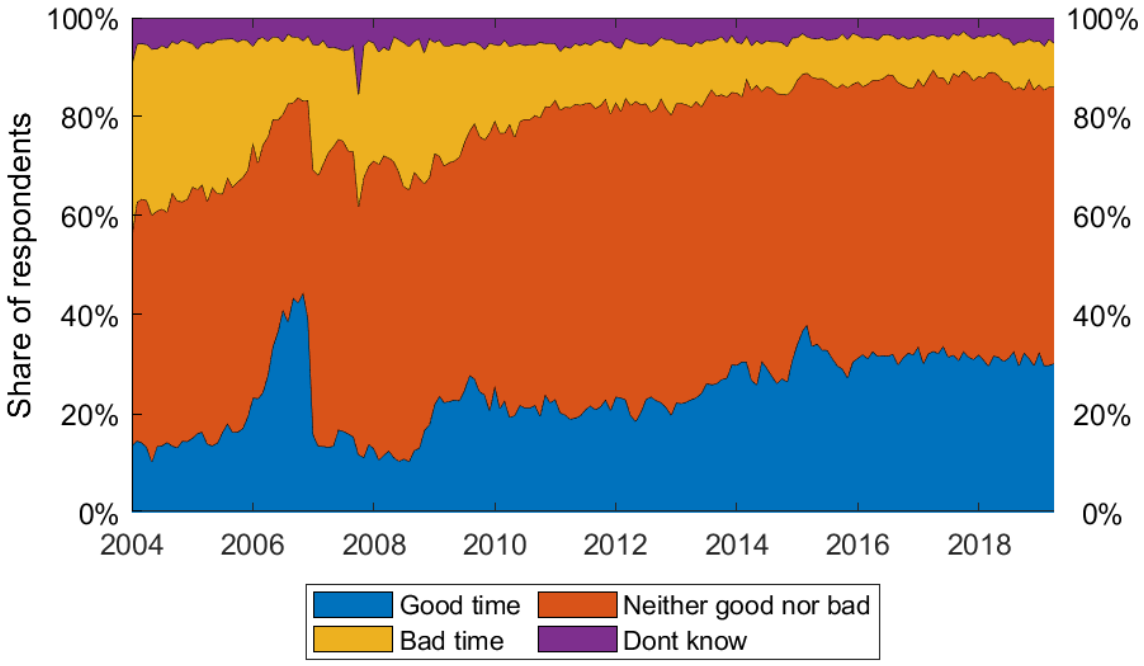


Figure A.3: Distribution of readiness to spend on durables over time

B Monetary policy surprises

Monetary policy surprises are based on the Euro Area Monetary Policy Event-Study Database (EA-MPD) compiled by Altavilla et al. (2019).[18] This database provides data on changes of various interest rates around ECB Governing Council meetings. More specifically, the events of interest are the press release and the press conference that follow each Governing Council meeting. The press release is just a short statement on the policy decisions taken. Until March 2016 this only contained decisions on policy rates and since March 2016 also decisions on unconventional measures have been included. The press conference starts with the ECB President reading a prepared Introductory Statement on the rationale behind the decisions followed by a question-and-answer session with journalists. Therefore, for each ECB Governing Council meeting there are three event windows: the press release window, the press conference window and the monetary event window which contains both press release and press conference. The changes in interest rates are based on high-frequency tick-data and defined as follows for the three windows:

[18] https://www.ecb.europa.eu/pub/pdf/annex/Dataset_EA-MPD.xlsx

1. The press release window captures the change in the median quote from the window 13:25-13:35 before the press release to the median quote in the window 14:00-14:10 after it.

2. The press conference window captures the change in the median quote from the window 14:15-14:25 before the press conference to the median quote in the window 15:40-15:50 after it.

3. The monetary event window captures the change around both events, i.e. the change in the median quote from the window 13:25-13:35 before the press release to the median quote in the window 15:40-15:50 after the press conference.

The database contains interest rate changes for each window spanning the full term structure from 1 week to 20 years maturity.

In order to identify different types of policy announcements, I rely on the decomposition of policy surprises by Altavilla et al. (2019). Since their series of surprises end in September 2018, I extend their analysis to obtain a series of surprises for my sample period until April 2019. Over the common sample period until September 2018 the original series of surprises and my estimated series of surprises have a correlation of more than 0.99. For each of the two windows (press release and press conference), they estimate latent factors from changes in yields of risk-free rates at different maturities, spanning 1 month to 10 years.[19]

$$X^j = F^j \Lambda^j + \epsilon^j \qquad \text{with j=\{press release, press conference\}} \tag{4}$$

where X is a matrix of yield changes, F are unobserved factors, Λ the loadings matrix and ϵ white noise residuals. They test for the number of statistically significant factors in each of the two factor models. For the press release window they estimate a single significant factor which they label Target as it primarily loads on the short end of the yield curve. This factor is primarily about changes in the current policy target rate. For the press conference window they estimate two significant factors for the period before QE (until

[19]When available they use overnight-index-swap (OIS) interest rates to proxy the risk-free rate curve. Before August 2011 OIS data on maturities longer than 2 years is not available and they use yields on German sovereign yields instead.

December 2013) and three factors for the full sample. This suggests that there is a third factor that is only active from 2014 onwards.

Figure B.1: Monetary policy surprises (in basis points)

Notes: Estimation based on methodology and data by Altavilla et al. (2019). Surprises are normalized to have unit effect on 1-month, 6-month, 2-year and 10-year OIS, respectively. Blue bars indicate events that are included in the event study approach, i.e. there is one survey wave before the Governing Council meeting and one survey wave directly after.

The three factors in the press conference window are only unique up to an orthonormal transformation and do not have an economic interpretation.[20] To allow for an economic interpretation, the orthogonal factors are identified by imposing restrictions on the rotation matrix similar to Gürkaynak et al. (2005) and Swanson (2021): (i) the second and third factor do not load on the 1-month OIS and (ii) the third factor has the smallest variance in the pre-crisis period. Then, they label the first factor that loads on the 1-month OIS as Timing that captures near-term expected policy actions. The second factor that is also active for the full sample is labelled Forward Guidance (FG) as it has the strongest effects on the medium-term horizon of the yield curve. Finally, the third factor is labelled QE and is shown to load only on longer-term yields with the effect being greater the longer the

[20]To see that F and Λ are not uniquely identified, take orthonormal matrix U satisfying UU'=I. Then, $\tilde{F} \equiv FU$ and $\tilde{\Lambda} \equiv U'\Lambda$ and $\tilde{F}\tilde{\Lambda} = F\Lambda$. Unique identification requires putting restrictions on U. See Appendix F of Altavilla et al. (2019) for more details on identification and factor rotation.

maturity. This is consistent with the assets purchased by the ECB which had an average maturity of about eight years. The series of Target, Timing, Forward Guidance and QE surprises are plotted in Figure B.1. The four factors are normalized to have a one unit effect on 1-month, 6-month, 2-year and 10-year OIS, respectively.

Note that the last factor (QE) is only active from 2014 onwards but the series of surprises shown in Figure B.1 also exhibits some larger surprises in the years between the Great Recession and 2014. These are likely related to other monetary policy announcements that moved primarily long-term interest rates for example around the sovereign debt crisis. These types of announcements are different from the asset purchase announcements from 2014 and not the focus of this paper. In the robustness analysis I check that controlling explicitly for these surprises before 2014 does not meaningfully affect my results.

In some analysis, I use two alternative monetary policy surprise measures. On the one hand, I directly use the change of the 1-year OIS interest rates from the monetary event window of the EA-MPD as this maturity has been commonly used in the literature as (summary) policy indicator for monetary policy including the effective lower bound period (see for example Gertler and Karadi (2015)). On the other hand, I use the monetary policy surprises by Jarociński and Karadi (2020). They use the principle component of OIS changes from maturities 1-month until 1-year and then disentangles the information component from the policy component using a VAR model with sign-restrictions on interest rate and stock prices.

C Other data

There are three other types of data that I use in the rest of this paper. First, this is data on macroeconomic variables such as HICP, Industrial Production, short-term and long-term interest rates and credit spreads. This data is downloaded from the ECB Statistical Data Warehouse and the OECD library and the credit spreads from the paper by Gilchrist and Mojon (2018). Second, I use daily data on German inflation-linked bonds downloaded from Bloomberg. Third, I obtained inflation forecasts from a survey of professional forecasters by Consensus Economics that is conducted monthly.

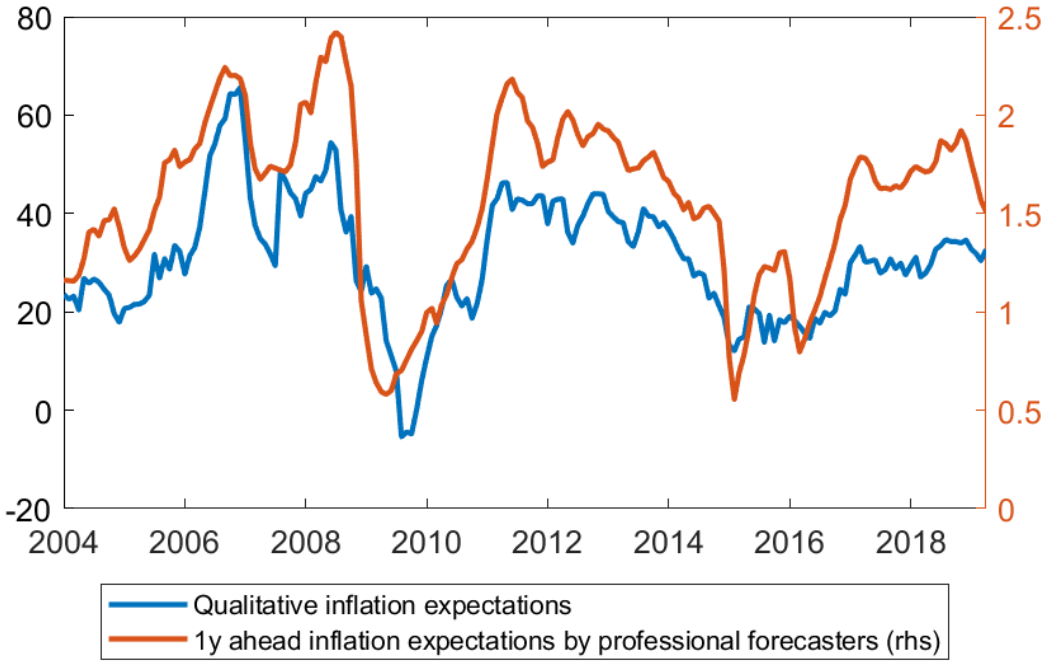


Figure C.2: Inflation expectations and actual realized inflation

Notes: Qualitative inflation expectations by households are calculated as balanced statistic following Arioli et al. (2017): (P[1]+0.5 P[2]-0.5 P[4]-P[5])*100 where P[i] is the frequency of response. Inflation expectations by professional forecasters are Consensus and show the mean forecast.

D Additional event study results

Table D.1: Main results for effect of different types of policy announcements

	(1)	(2)	(3)
Target	-0.021*	-0.024**	-0.026***
	(0.011)	(0.011)	(0.009)
Timing	-0.000	-0.002	0.002
	(0.016)	(0.016)	(0.016)
FG	-0.009	-0.010	-0.008
	(0.007)	(0.007)	(0.007)
QE	-0.011	-0.007	-0.020
	(0.014)	(0.015)	(0.015)
N	203.778	203.778	203.778
Month FE	Yes	Yes	Yes
Wave dummy	No	Yes	Yes
HH controls	No	Yes	Yes
Past expectations	No	No	Yes
Sample	2004-2019	2004-2019	2004-2019

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability that prices increase more rapidly (=inflation goes up). Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.2: Detailed marginal effects from Table D.1 based on ordered logit model

	(1)	(2)	(3)	(4)	(5)
	Increase more rapidly	Increase by approximately same rate	Increase less strongly	Stay about the same	Fall
Target	-0.026***	-0.023***	0.008***	0.038***	0.002**
	(0.009)	(0.008)	(0.003)	(0.014)	(0.001)
Timing	0.002	0.002	-0.001	-0.003	-0.000
	(0.016)	(0.014)	(0.005)	(0.024)	(0.001)
FG	-0.008	-0.008	0.003	0.013	0.001
	(0.007)	(0.007)	(0.002)	(0.011)	(0.001)
QE	-0.020	-0.017	0.006	0.029	0.001
	(0.015)	(0.013)	(0.005)	(0.022)	(0.001)

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.3: Results for "informed" households

	(1)	(2)	
	Baseline	Informed	Uninformed
Target	-0.026***	-0.035**	0.036
	(0.009)	(0.014)	(0.038)
Timing	0.002	0.008	-0.036
	(0.016)	(0.021)	(0.025)
FG	-0.008	-0.010	0.000
	(0.007)	(0.008)	(0.014)
QE	-0.020	-0.031*	0.046
	(0.015)	(0.018)	(0.063)

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability that prices increase more rapidly (=inflation goes up). Informed households refers to households who do not provide an inconsistent answer between the qualitative and quantitative inflation expectations questions and who provide quantitative expectations smaller than 20% in absolute terms. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.4: Main results from Table D.1 based on alternative model specification

	(1)	(2)
	Logit model	Linear regression model
Target	-0.022***	-0.107**
	(0.007)	(0.046)
Timing	0.005	-0.002
	(0.017)	(0.070)
FG	-0.002	-0.031
	(0.007)	(0.032)
QE	-0.015	-0.082
	(0.034)	(0.067)
N	220.414	203.778
Month FE	Yes	Yes
Wave dummy	Yes	Yes
HH controls	Yes	Yes
Past expectations	Yes	Yes
Sample	2004-2019	2004-2019

Notes: Results in column (1) based on logit model with dependent variable being 1 if consumers say prices increase more rapidly and 0 otherwise. Results in column (2) based on linear regression model with qualitative inflation expectations as dependent variable. Note that qualitative inflation expectations have been rescaled such that an increase corresponds to an increase in inflation expectations. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.5: Effect of announcements on proportion of "Don't know" answers

	(1)
Target	-0.002
	(0.008)
Timing	-0.004
	(0.010)
FG	-0.005
	(0.006)
QE	-0.004
	(0.014)
N	220.414
Month FE	Yes
Wave dummy	Yes
HH controls	Yes
Past expectations	Yes
Sample	2004-2019

Notes: Results based on logit model with dependent variable being 1 if consumers say they don't know and 0 otherwise. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability that households answer "Don't know". Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.6: The role of inflation perceptions

	(1)	(2)
	Controlling for inflation perception	Inflation perceptions as dependent variable
Target	-0.021**	-0.014
	(0.010)	(0.020)
Timing	0.004	-0.008
	(0.014)	(0.021)
FG	-0.005	-0.008
	(0.006)	(0.013)
QE	-0.016	-0.004
	(0.011)	(0.026)
N	203.778	215.122
Month FE	Yes	Yes
Wave dummy	Yes	Yes
HH controls	Yes	Yes
Past expectations	Yes	Yes
Sample	2004-2019	2004-2019

Notes: Results based on ordered logit model. Column (1) shows the effect of different types of announcements on inflation expectations when controlling for inflation perceptions. Column (2) shows the effect of different types of announcements on inflation perceptions. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.7: Main results from Table D.1 controlling for QE factor before 2014

	(1)
Target	-0.026***
	(0.010)
Timing	0.001
	(0.016)
FG	-0.009
	(0.008)
QE	-0.019
	(0.015)
QE (pre-2014)	-0.001
	(0.001)
N	203.778
Month FE	Yes
Wave dummy	Yes
HH controls	Yes
Past expectations	Yes
Sample	2004-2019

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.8: Robustness of main results to dropping large Target surprises

	Baseline	Drop Oct 2011	Drop Nov 2011	Drop July 2012	Add Nov 2008
	(1)	(2)	(3)	(4)	(5)
Target	-0.026***	-0.029**	-0.033***	-0.020**	-0.025***
	(0.009)	(0.012)	(0.011)	(0.009)	(0.008)
Timing	0.002	0.002	0.002	0.001	0.002
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
FG	-0.008	-0.009	-0.007	-0.008	-0.008
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)
QE	-0.020	-0.019	-0.019	-0.020	-0.020
	(0.015)	(0.016)	(0.016)	(0.015)	(0.015)
N	203.778	201.913	201.964	201.909	205784
Month FE	Yes	Yes	Yes	Yes	Yes
Wave dummy	Yes	Yes	Yes	Yes	Yes
HH controls	Yes	Yes	Yes	Yes	Yes
Past expectations	No	Yes	Yes	Yes	Yes
Sample	2004-2019	2004-2019	2004-2019	2004-2019	2004-2019

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability that prices increase more rapidly (=inflation goes up). Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table D.9: Robustness of main results to subsamples

	Excluding Great Recession	post 2008	pre July 2012	pre June 2014
Target	-0.027**	-0.018***	-0.026**	-0.027**
	(0.011)	(0.007)	(0.011)	(0.011)
Timing	-0.019	0.010	0.001	0.001
	(0.016)	(0.015)	(0.018)	(0.017)
FG	-0.009	-0.009	-0.008	-0.008
	(0.014)	(0.007)	(0.008)	(0.008)
QE	-0.010	-0.032*		-0.022
	(0.016)	(0.017)		(0.031)
N	182.520	135.642	144.068	178.027

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points on probability that prices increase more rapidly (=inflation goes up). Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

E Additional local projection results

The specification in equation (3) already includes lags of the surprises to control for potential correlations with past surprises. However, their can be also cross-correlation with future surprises. This can be problematic when estimating the dynamic effects. Therefore, as robustness I follow Alloza et al. (2019) who suggest to include h leads of the shock in the regression to control for persistence. The results are shown in Figure E.1. The magnitude of the inflation expectations response to a Target announcement gets slightly larger but overall the qualitative conclusions remain broadly unchanged.

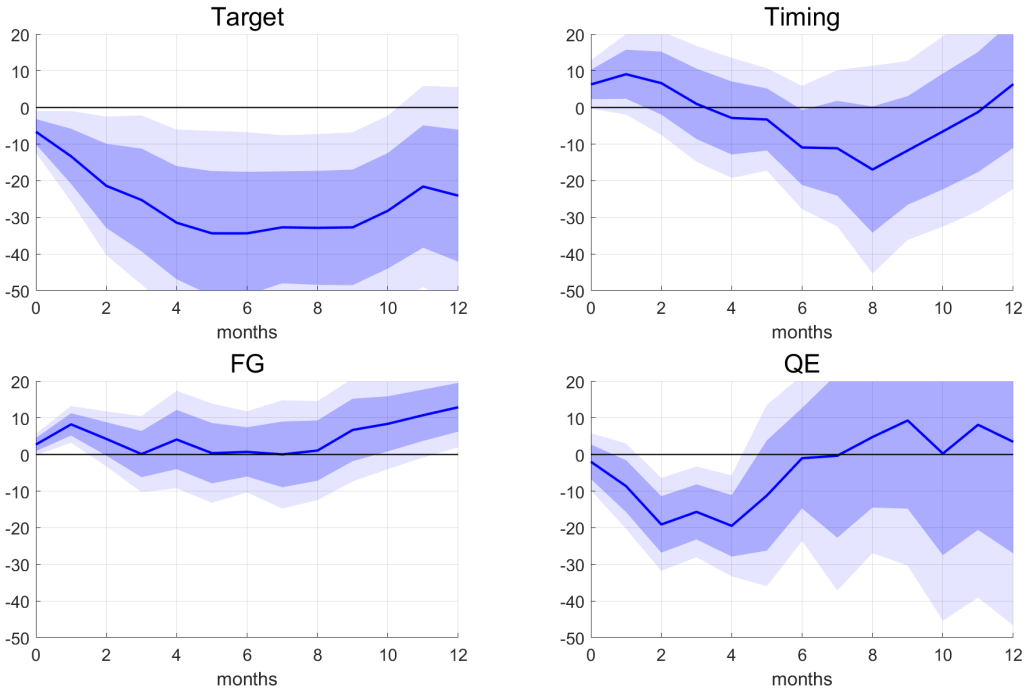


Figure E.1: Robustness to controlling for cross-correlations

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in equation (3). Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled such that a surprise increases the corresponding interest rate by 25 basis points.

Figure E.2 and Figure E.3 shows the robustness to choosing different number of lags and to controlling for the surprises in the QE factor before 2014.

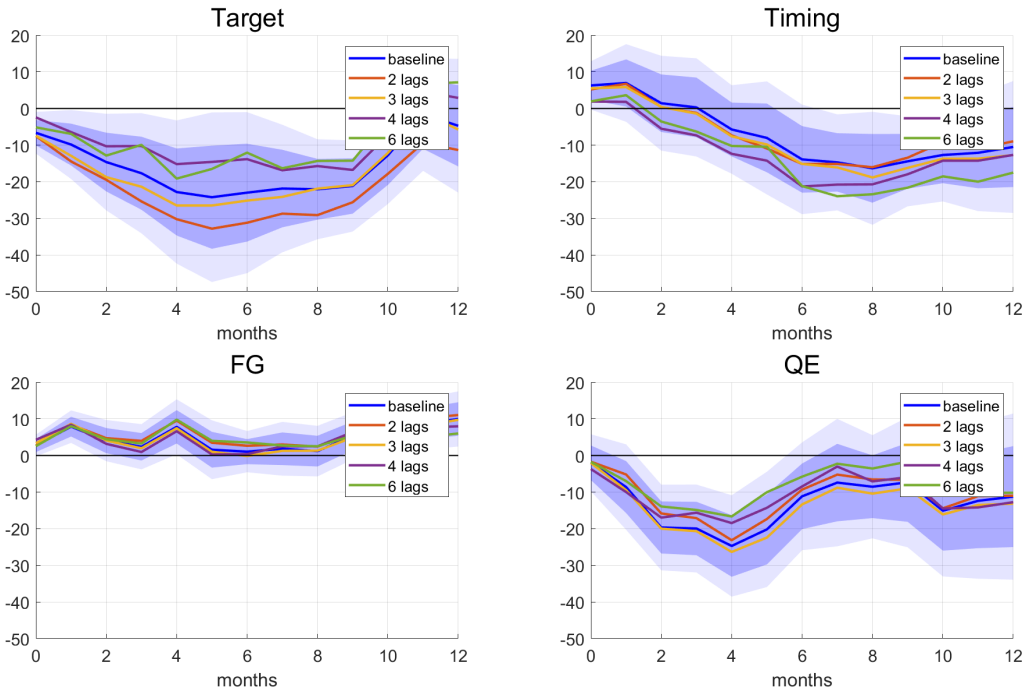


Figure E.2: Robustness to different lag lengths

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in equation (3). Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled such that a surprise increases the corresponding interest rate by 25 basis points.

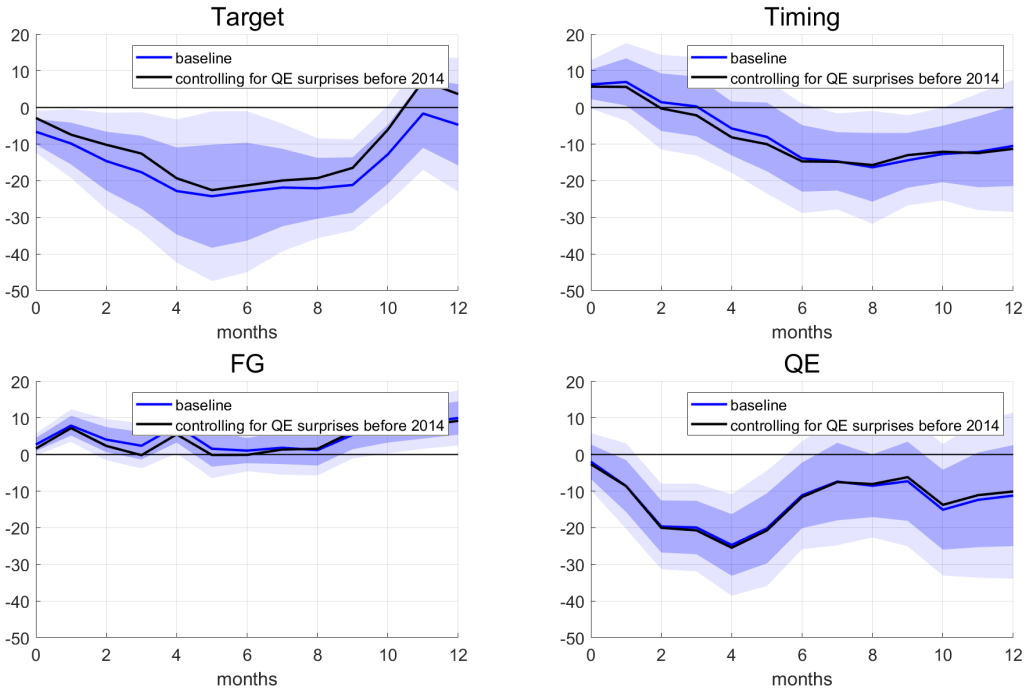


Figure E.3: Robustness to controlling for pre 2014 QE surprises

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in equation (3). Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled such that a surprise increases the corresponding interest rate by 25 basis points.

F Financial market responses

Figure F.4 shows the daily time series of German inflation linked bonds for maturities 1, 2, 3 and 4 years. Figure F.5 shows the dynamic effects of the different types of monetary policy announcements on German inflation linked bonds. The impulse response functions are estimated based on daily local projections.

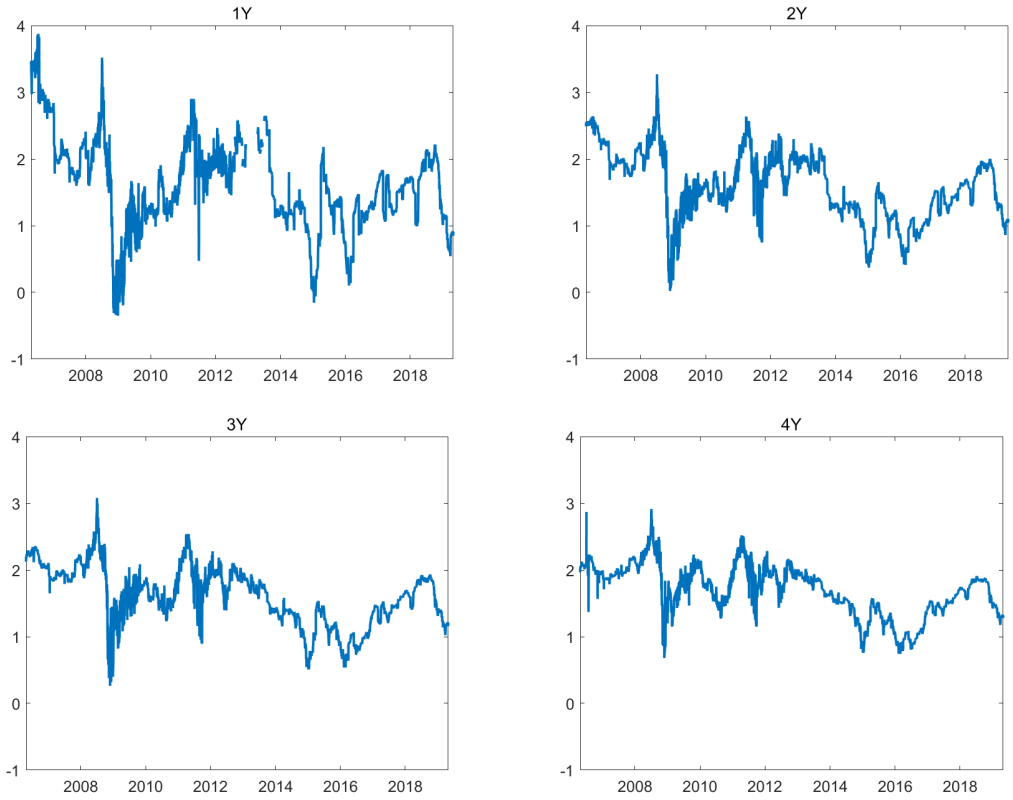
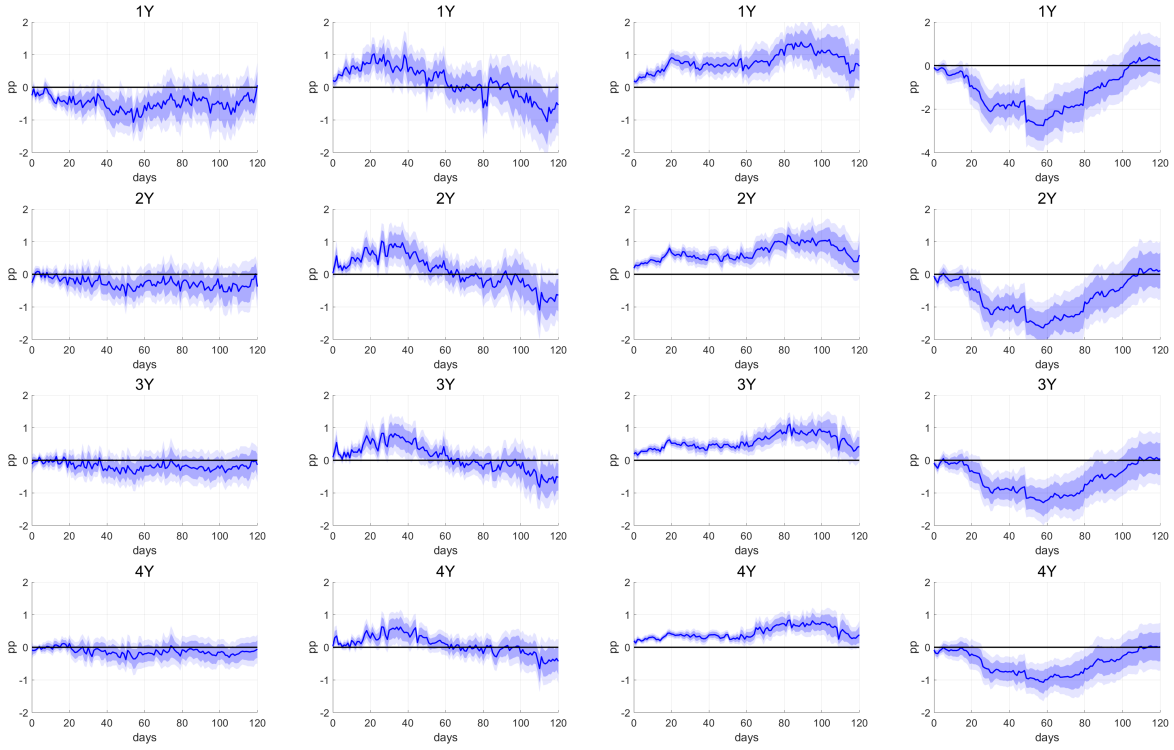


Figure F.4: Time series of German inflation linked bonds



(a) Target **(b)** Timing **(c)** FG **(d)** QE

Figure F.5: Response of German inflation linked bonds

Notes: Estimates based on daily local projections. Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled to a policy surprise that increases the respective reference rate by 25 basis.