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 unique feature, interviews of the survey 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. In contrast to most existing studies, the availability of the survey over a period of 15 years also allows me to exploit the time-series dimension to estimate how policy announcements affect household inflation expectations over the medium-term. I find that policy rate announcements lead to quick and significant adjustments in household inflation expectations with the effect peaking after half a year. Announcements about forward guidance and quantitative easing, on the other hand, have only small and delayed effects. My results suggest that monetary policy announcements can influence household expectations but further improvements in communication seem to be necessary to reach the general public more effectively. In particular, in an environment where policy rates are constrained by the effective lower bound, it may be very hard for central banks to influence household expectations.

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

JEL classification: E52, E58, D12

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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. A large literature has shown that expectations of financial markets respond strongly to monetary policy (see e.g. Andrade and Ferroni (2021), Del Negro et al. (2015) and Swanson (2021)). Instead, household and firm expectations seem to respond much less to monetary policy (Coibion et al. (2020b)). While the literature on financial markets is primarily using time series methods, the literature on household and firm expectations has relied more on microeconometric approaches. This paper provides novel evidence on the effectiveness of monetary policy on household inflation expectations. It distinguishes between different types of monetary policy announcements and exploits both microeconometric and time series methods to estimate the short- and medium-term effects of policy announcements on household inflation expectations. I find that announcements about conventional policy rate changes are (most) effective, whereas announcements about unconventional measures have only small and delayed effects.

Understanding the effects of monetary policy on household expectations is particularly relevant in current times. First, interest rates have been low for several years and in many advanced economies central banks have been frequently constrained by the lower bound on nominal interest rates. In such an environment, managing public expectations is crucial and optimal monetary policy prescribes that central banks should promise lower future interest rates to raise inflation expectations (Woodford (2003)). Second, several policymakers and some scholars have recently advocated that central banks need to reach out to the broader public more.[1] For effective and targeted central bank communication, understanding how inflation expectations are formed and to what extent monetary policy influences them is important.

In this paper, I study 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 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 Target, Timing, Forward Guidance and Quantitative Easing (QE) surprises. Target announcements refer to changes in the short-term policy rate. Timing and Forward Guidance announcements

[1] See for example the speech by ECB president Lagarde (2020): "There is one issue, however, on which I can be decisive today: we must explain much better to the general public what we are doing and why, and we must talk to people that we do not normally reach." In terms of scholars see for example the 2020 Jackson Hole presentation by Yuriy Gorodnichenko (Candia et al. (2020)) or Haldane and McMahon (2018).

provide guidance about the (expected) future path of policy rates over the next few months and 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.[2]

This distinction between different types of monetary policy announcements is largely unexplored in the literature on household inflation expectations. In the context of household expectations, the distinction is relevant for several reasons. First, unconventional monetary policy, such as QE, is a relatively new and complex tool for households to understand.[3] Therefore, it is interesting to investigate how responsive households' expectations are to these new 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), and hence also here it is of high importance to shed light on different effects.

To identify the effect of monetary policy announcements on household expectations I follow two approaches. First, I use the timing of interview dates within the month which, together with the timing of policy announcements, provides a natural experiment framework. The interviews in the GfK survey are always conducted in two independent 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. In contrast, most of the existing literature on household or firm expectations relies on monthly or quarterly 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. These medium-term effects might be different from the short-term effects due to informational rigidities.

My main finding is that Target announcements significantly affect household inflation expectations. A 25 basis point positive Target surprise reduces the probability that people expect an increase in inflation by around 2.7 percentage points. Timing, Forward Guidance and QE instead have no significant effect in the short run. This result highlights that the type of policy announcement matters for the reaction of household inflation expectations. These different effects depending on the type of policy announcement are also confirmed when looking at different subgroups of households. Households who are likely to pay more

[2]QE announcements target interest rates at long maturities since the average maturity of the QE program by the ECB is around 8 years.

[3]See D'Acunto et al. (2019) on the role of cognitive abilities in the transmission of economic policies.

attention to inflation based on demographic characteristics such as income, education, age or their financial situation respond to Target announcements. However, they also do not respond significantly to the other type of announcements. Moreover, households who are well-informed about inflation in the sense that their inflation expectations are reasonable or their inflation expectations are ex-post accurate also only respond significantly to Target announcements.

When I estimate the dynamic effects on household inflation expectations over a 12-month horizon, I find that the effect of Target rate announcements increases over the medium term with a maximum effect reached after 4-6 months. Timing and QE announcements also affect inflation expectations negatively but only after around 8 and 3 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.

In order to provide an additional validation to how I interpret my results, I analyse the relationship of policy announcements and public interest in the ECB and its policies. 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 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 could explain why households react less to the latter type of announcements.

When I apply the different types of policy announcements on inflation expectations by financial markets and professional forecasters the picture is different. In contrast to households, financial market expectations react strongly to unconventional tools such as forward guidance. The response of professional forecasters is qualitatively more similar to households but their response is overall more immediate and significant compared to households. 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.

Finally, I test the predictions of standard macroeconomic models according to which higher inflation expectations stimulate current household spending. I investigate the validity of this prediction looking at how expectations including spending attitudes of each individual household responds to its inflation expectations in my data set. I find that inflation expectations are negatively related with various other household expectations, suggesting that households relate higher inflation expectations to worse economic outcomes. This reduced-form relationship also 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 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 last result highlights that an additional challenge for effective central bank communication beyond reaching the broader public and influencing its expectations is to influence in the desired direction.

My results show that households adjust their expectations more to some policy announcement and less to others. These findings suggest that monetary policy communications are heard by households but further improvements in communication is needed to influence their expectations with newer and more sophisticated tools of modern monetary policy. This is all the more important in a low interest rate environment in which the effective lower bound is recurrently constraining the manoeuvring of the conventional policy rate.

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. (2020b). In particular, Lamla and Vinogradov (2019) run surveys shortly before and after each FOMC press conference between 2015 and 2018 to estimate the effect of announcements on consumers' inflation perceptions and expectations. They find that announcements have no significant effect on inflation perceptions and expectations, but they make people more likely to receive news about the central bank announcements. However, Lamla and Vinogradov (2019) use an announcement dummy which does not distinguish between different types of measures announced at the same time and also does not measure the size and direction of the unexpected component in the monetary policy announcement as I do in this paper. Fiore et al. (2021) follow a similar approach for US FOMC meetings between 2013 and 2019 but use high-frequency monetary policy surprises more similar to this paper. They find that Fed announcements affect household expectations about interest rates of saving accounts but other expectations are not really influenced. D'Acunto et al. (2021) analyze the effect of an unexpected value-added tax increase on German consumers and compare it with the more complex policy measure of the forward guidance announcement by the ECB in July 2013. They show that while the former has a significant effect on household consumption via influencing household inflation expectations, the latter announcement has no significant effect. Brouwer and de Haan (2021) study the impact of communication about monetary policy instruments on inflation expectations and trust in the ECB based on a randomized control trial among Dutch

households. They show that providing households not only with information about the ECB's goal but also about the policy instruments leads to inflation expectations being closer aligned with the ECB's target. Their findings also suggest that the information treatment effect varies depending on the type of monetary policy instrument with information about (conventional) interest rate policies having stronger treatment effects than information about more unconventional instruments. Coibion et al. (2020a) use a randomized control trial to study how information about current and future interest rates affect households' expectations. They find that information about current and next year's interest rates move inflation expectations but providing also information beyond one or two years in the future has no additional effect.

To the best of my knowledge, my paper is the first one to use household level inflation expectations data and to distinguish between different types of monetary policy tools covering both conventional and unconventional policy times. This long sample has the advantage that it allows me not only to study the immediate announcement effects but also the dynamic effects over the medium term.

One closely related paper to my analysis is Lewis et al. (2019). 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 to the federal funds rate lead to quick adjustments of consumer confidence but forward guidance and asset purchase surprises yield no significant effect. While this paper also distinguishes different types of monetary policy announcements, my focus on inflation expectations as variable of interest and the identification approach is different.

Additionally, my paper is related to Enders et al. (2019) and Bottone and Rosolia (2019), who study the response of firm expectations to monetary policy in an event study approach similar to this paper. Apart from studying expectations of firms, their papers are different in the sense that they do not distinguish between different types of monetary policy announcements and they only focus on the immediate policy effects.

The second strand of literature deals with the effectiveness of unconventional monetary policies and to which extent they can help to circumvent the constraint of the zero/effective lower bound on the short-term nominal interest rate. Swanson (2021) argues for 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 the zero lower bound in the US between 2009 and 2015 was irrelevant likely because of the use of unconventional monetary policies during that time. In 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] In contrast, my paper focuses 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 organized 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 on the effects of different types of monetary policy announcements on household inflation expectations. Section 4 discusses the role of media coverage and public interest as potential transmission channels and contrasts the findings for households with those of financial markets and professional forecasters. 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 by the Gesellschaft für Konsumforschung (GfK). As part of a harmonized EU consumer survey program, the GfK interviews repeated cross-sections of around 2000 consumers in Germany at the beginning of every month. The survey is conducted via face-to-face interviews that take place in two independent waves of around 1000 consumers each. The first wave starts on a Friday and goes 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 asks consumers both qualitative and quantitative questions on expected inflation over the next twelve months. The questions on inflation expectations used in this paper are:

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

[4] See also Inoue and Rossi (forthcoming), Del Negro et al. (2015) Altavilla et al. (2019) and Campbell et al. (2012)

In addition, the survey contains other questions about perceived current personal and economic conditions and expected future conditions. Finally, the GfK survey collects rich information on demographic characteristics (see summary statistics in the Appendix, Table A.1). The questions on quantitative inflation expectations are only available starting in January 2004 and in May 2019 there was a structural change in the way the consumer data is collected. Therefore, I use the sample from January 2004 until April 2019. Appendix A provides more details on the survey.

Figure 1 shows the distribution of qualitative inflation expectations which are the main focus of this paper. It highlights that there is substantial variation both over time and across individuals. More than 80% of households expect inflation to be either around zero or to be positive with most households expecting either around zero or approximately constant inflation.

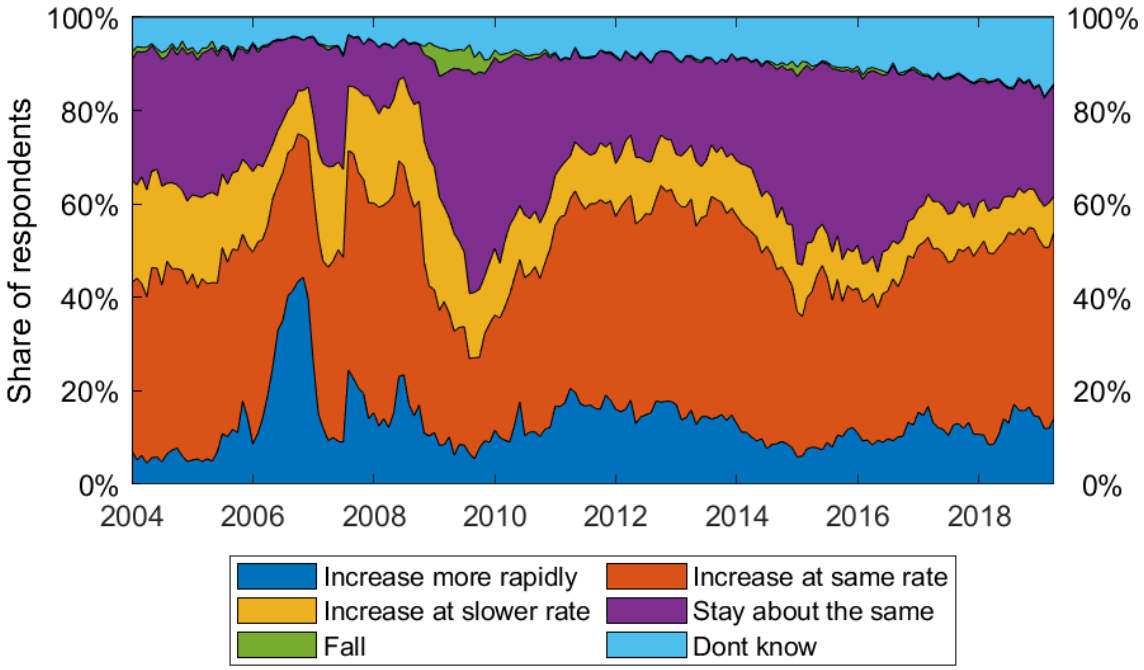

Figure 1: Distribution of qualitative inflation expectations over time

For some of my analysis I construct an aggregate measure of qualitative inflation expectations following Arioli et al. (2017). They propose a balanced statistic which is computed as the difference between the relative frequencies of responses falling in different categories. More specifically, the balanced statistic is defined as

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

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.

Besides the micro data for German consumers, I also use more aggregated data from the harmonized EU consumer survey program. This allows me to compare the results for Germany with the euro area as a whole.[5]

Properties of 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 following I am describing some properties and argue why qualitative inflation expectations are the focus of this paper and preferable towards quantitative inflation expectations in the given survey. First, there is some co-movement between the dynamics of headline inflation and qualitative inflation expectations as measured by the balanced statistic. Similar to the US evidence presented by Cavallo et al. (2017) and Coibion and Gorodnichenko (2015b) among others, this co-movement is mainly driven by non-core items such as food and energy prices to which consumers are more regularly exposed (see the cross-correlations in Figure A.3). Second, qualitative inflation expectations capture meaningful variation in future realized core inflation which is more relevant for consumers durable consumption. Since I am also interested in studying potential effects of higher inflation expectations on durable consumption this is a relevant property. 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. For most of the sample period the dynamics of the two series are very similar (see also Figure A.3 for the cross-correlations at different horizons).

While average quantitative inflation expectations also exhibit some co-movement with inflation their predictive power for future realized inflation is very limited and much smaller than for qualitative inflation expectations (see the cross-correlations in Figure A.4). In addition, it has been well documented in the literature that the average level of quantitative inflation expectations by households is much higher than actual inflation and many households provide extreme point forecasts. This is also the case in the given survey where the average level of expected inflation over my sample period is 4.6% while the actual realized level of inflation was only 1.6% (see also Figure A.1 in the Appendix). Based on these properties, I focus on qualitative inflation expectations in this paper. I will discuss the findings for quantitative inflation expectations and the comparison with qualitative expectations more detailed in Appendix F.

[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.

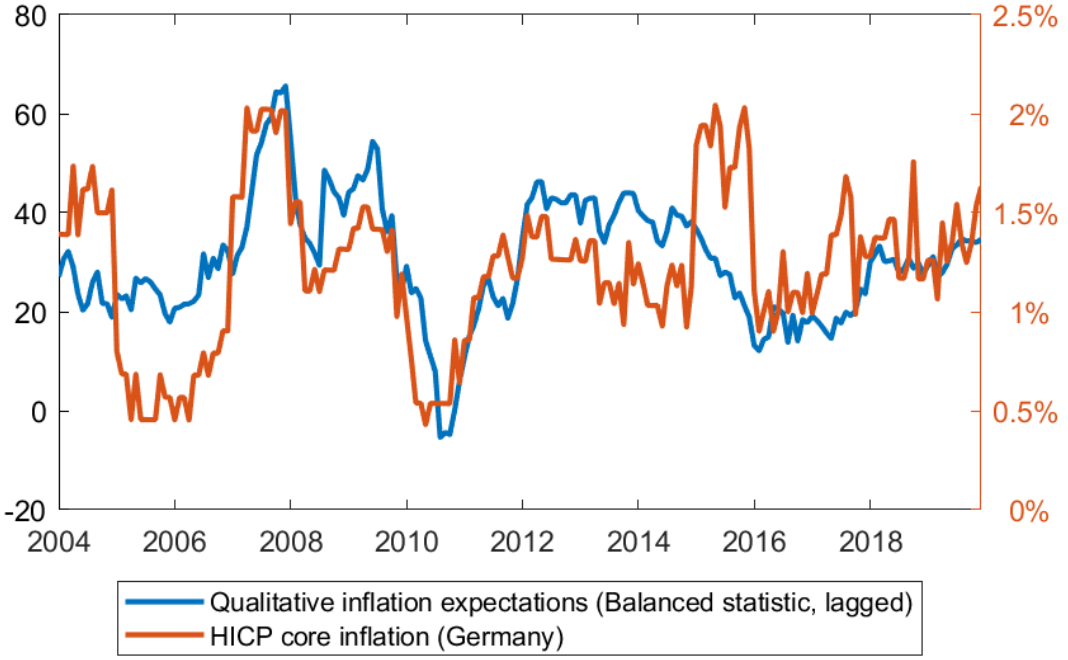

Figure 2: Inflation expectations and actual realized inflation

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

2.2 Monetary policy surprises

I use monetary policy surprises based on the high-frequency identification approach introduced first 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 policy.[6]

For most of my analysis, I build on the Euro Area Monetary Policy Event-Study Database (EA-MPD) compiled by Altavilla et al. (2019).[7] 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

[6] 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.

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

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:

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).[8] Their approach builds on a large literature of high-frequency identification of monetary policy announcements, in particular Gürkaynak et al. (2005) and Swanson (2021). In the following, I describe their approach more detailed. 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.[9]

$$X^j = F^j \Lambda^j + \epsilon^j \qquad \text{with j=\{press release, press conference\}} \tag{2}$$

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 (see factor

[8]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.

[9]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.

loadings in Appendix B, Figure B.1). For the press conference window they estimate two significant factors for the period before QE (until December 2013) and three factors for the full sample. This suggests that there is a third factor that is only active from 2014 onwards.

The three factors in the press conference window are only unique up to an orthonormal transformation and do not have an economic interpretation.[10] 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 maturity. This is consistent with the assets purchased by the ECB which had an average maturity of about eight years. All the factor loadings and the series of Target, Timing, Forward Guidance and QE surprises are plotted in Appendix B (see Figure B.1 and Figure B.2). 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.2 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.[11]

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 Kerssenfischer (2019) who follows a similar approach as Jarociński and Karadi (2020). He uses 2-year Bund futures and then disentangles the information component from the policy component using a VAR model with sign-restrictions on interest rate and stock prices.

[10] 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.

[11] In the robustness analysis I check that controlling explicitly for these surprises before 2014 does not meaningfully affect my results.

2.3 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 Bloomberg survey of professional forecasters that is conducted monthly.

3 Identification approach and main results

I use two empirical approaches to estimate the effects of monetary policy announcements on household 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 Event study approach

In the following, I describe how I exploit the timing of the ECB Governing Councils and the survey timing design for identification. As shortly 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 goes 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 during the whole week.

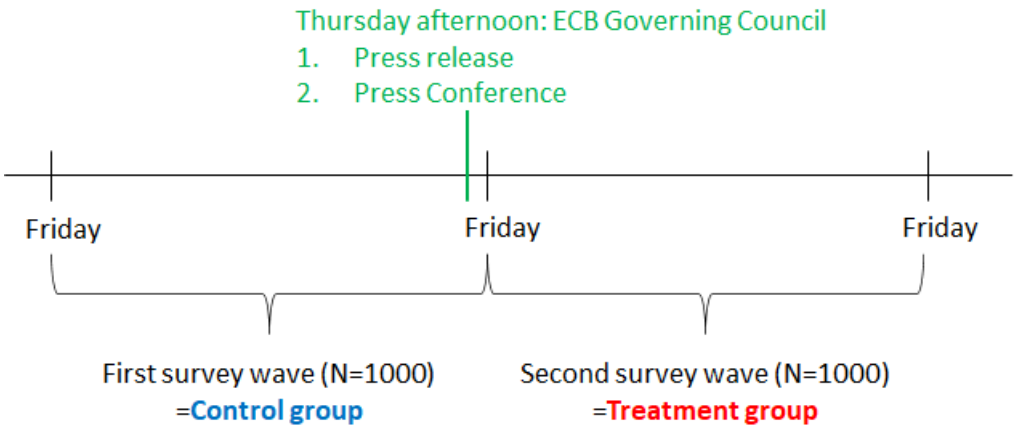

Figure 3: Survey timeline

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 is usually on Thursday afternoon. Due to this timing of events there is a considerable amount of ECB Governing Council meetings that take place exactly between the two survey waves such that I observe some households that answer the survey right before the ECB policy announcements and some households that answer the survey directly afterwards. This provides a natural experiment to identify the immediate effects of policy announcements. More specifically, for the period January 2004 until April 2019 around 65% of ECB Governing Council meetings take place between the two survey waves (see the blue bars in Figure B.2 for the ECB Governing councils that are included).[12]

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

$$Y_{i,t} = \alpha + \beta_1 D_{i,t} Target_t + \beta_2 D_{i,t} Timing_t + \beta_3 D_{i,t} FG_t + \beta_4 D_{i,t} QE_t + \gamma X_{i,t} + u_{i,t} \quad (3)$$

where $Y_{i,t}$ refers to inflation expectation over the next twelve months of consumer i at 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 it 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, city size, state, marital status, housing status, household size (see also Table A.1 for an overview and summary statistics). Additionally, I include the average value of expectations in the previous 4 survey waves as control variable. I use robust standard errors that are clustered at the monthly level. As 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 ordered logit model.

Table 1 shows the results of the ordered logit model based on Equation 3. For reasons of simplicity the table only focuses on one outcome category. More specifically, the table shows the average marginal effect on the probability that households expect prices to increase more rapidly, i.e. inflation to go up. The marginal effects for the other outcome categories are reported in Table C.1. The effects are scaled to a shock corresponding to a 25 basis point increase in the respective reference rate.[13] This implies the coefficients show by how much percent households are more/less likely to expect inflation to go up if there is an announcement that increases the corresponding reference rate by 25 basis points.

In columns (1)-(3), I successively add the different types of control variables. Column

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

[13]As mentioned in the previous section, the reference rates are the 1-month, 6-month, 2-year and 10-year OIS rate for the Target, Timing, FG and QE announcements, respectively.

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

	(1)	(2)	(3)	(4)
Target	-0.022*	-0.026**	-0.027***	
	(0.012)	(0.013)	(0.010)	
Timing	0.000	-0.003	0.002	
	(0.016)	(0.015)	(0.016)	
FG	-0.009	-0.010	-0.008	
	(0.007)	(0.008)	(0.007)	
QE	-0.009	-0.004	-0.017	
	(0.014)	(0.015)	(0.015)	
1Y OIS				-0.009
				(0.009)
N	203.778	203.778	203.778	203.778
Month FE	Yes	Yes	Yes	Yes
Wave dummy	No	Yes	Yes	Yes
HH controls	No	Yes	Yes	Yes
Past expectations	No	No	Yes	Yes
Sample	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.

(1) only includes month fixed effects as control variables. Column (2) also includes a wave dummy and household controls. Generally, the differences in coefficients between the first two columns are small. Moreover, the coefficient on the wave dummy is not statistically different from zero. This is important as it confirms that the two waves are quite similar and comparable. Column (3) includes all control variables including average expectations during the past 4 survey waves. This is my baseline specification. I find that a 25 basis points Target surprise makes it 2.7% less likely that households expect inflation to go up. The effect of Timing, FG and QE are imprecisely estimated and especially for Timing and FG the magnitude is very small. In column (4), I show the response when using the high-frequency change in the 1-year OIS which is commonly used as a summary indicator of monetary policy. The insignificant response highlights that it is important to consider the multi-dimensionality of monetary policy announcements.

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 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, note that for the given surprises and sample period surprises of this size basically do not not exist. The standard deviation of Target, Timing, FG and QE surprises are 1.9, 2.3, 3.4 and 1.9 basis points, respectively. 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, I would argue that households being 2.7% less likely to expect higher inflation as shown in the table above for the Target surprise is a rather small effect in economic terms.

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 including also forward looking communication. In the following, I will analyse this for (i) demographic characteristics and (ii) how well households are informed about inflation.

Table 2 shows that the evidence from Table 1 is supported by looking at different demographic groups who 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, in column (3) households with a high school degree or more, in column (4) middle-aged households who are typically the ones who get a mortgage or who need to save for retirement and in column (5) households who say that they can save a bit or a lot. The last household group can be considered as a proxy for households with little financial constraints. For all these four groups the response of inflation expectations to Target surprises is significant. The magnitude of coefficients is larger but the difference to the baseline is not in all cases statistically significant. For the other types of policy announcements, the effects are again very imprecisely estimated with the signs of the coefficients often changing across the four columns. There is only a significant effect of QE surprises in the case of high-income households, hence suggesting that overall the conclusion from the baseline analysis also holds for different household subgroups.

Table 2: Results for different demographic characteristics

	(1)	(2)	(3)	(4)	(5)
	Baseline	High income	Higher education	Age (30-60)	Saver
Target	-0.027***	-0.046**	-0.031***	-0.048***	-0.030***
	(0.010)	(0.018)	(0.009)	(0.010)	(0.009)
Timing	0.002	-0.020	0.000	0.003	-0.009
	(0.016)	(0.028)	(0.020)	(0.017)	(0.018)
FG	-0.008	-0.015	0.001	-0.006	0.005
	(0.007)	(0.014)	(0.009)	(0.009)	(0.009)
QE	-0.018	-0.100**	-0.017	-0.041	0.003
	(0.015)	(0.043)	(0.024)	(0.030)	(0.020)
N	203.778	42.020	122.340	108.549	112.268

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). 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, saver to households who save a bit or a lot. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Table 3 shows the results for households who are better informed about inflation and should therefore be more likely to pay attention and adjust their expectations. I use the

answers to the quantitative questions on inflation expectations and perceptions. In column (2), these are households who expect inflation to be between 0 and 3 percent in line with the range of realized inflation in the period between 2004 and 2019. In column (3) and (4), I show the responses for households who are better forecasters of ex-post realized inflation. Finally, column (5) reports the response of households who provide consistent answers to the questions on quantitative and qualitative inflation expectations. These households are likely to understand the survey questions well. Again for all four household groups there is a significant effect of Target surprises on inflation expectations but for the other three types of announcements there is generally no consistent evidence for significant effects.

Table 3: Results for "informed" households

	(1) Baseline	(2) Reasonable	(3) Top 10% accurate	(4) 1pp accurate band	(5) Consistent
Target	-0.027***	-0.058***	-0.032***	-0.020***	-0.043***
	(0.010)	(0.014)	(0.010)	(0.007)	(0.008)
Timing	0.002	-0.036**	0.022	-0.005	0.018
	(0.016)	(0.016)	(0.032)	(0.019)	(0.025)
FG	-0.008	0.018	0.013	-0.002	-0.017
	(0.007)	(0.013)	(0.024)	(0.017)	(0.013)
QE	-0.017	0.044	0.018	0.008	-0.094*
	(0.015)	(0.043)	(0.069)	(0.039)	(0.051)
N	203.778	37.064	31.860	41.585	100.023

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). Reasonable refers to households that expect inflation between 0 and 3 percent, top 10% accurate refers to the households that are among the 10% households that were most accurate in terms of one year ahead realized inflation, 1 percentage point accurate band refers to households that have inflation expectations that are within a 1 percentage point band of actual one year ahead realized inflation. Consistent refers to households who give quantitative inflation expectations that are consistent with their qualitative inflation expectations. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Overall, these results suggests that qualitative inflation expectations respond to Target surprises but for the other types of announcement the evidence points to households not responding to them in line with a large degree of inattention/unresponsiveness to monetary policy that is highlighted in the previous literature. Moreover, this result also holds when looking at various subgroups of households that are likely to be more attentive to inflation and monetary policy.

Robustness and extensions I perform several robustness checks and extensions for which most of the results can be found in Appendix C. The results are robust to using other model specifications 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 C.2). Besides, Table C.3 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.

In Table C.4, I analyse the role of perceptions about 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 3 and show that the effects of monetary policy announcements on inflation expectations are similar to the baseline in that case. Moreover, the different type of policy announcements do not significantly affect the perception of households about past inflation.

In my baseline analysis I follow Altavilla et al. (2019) and assume that the third factor (QE) is only active from 2014. However, Figure B.2 shows that there are also larger surprises in this factor before 2014. In Table C.5, 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 itself 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 C.6). Table C.7 shows that results are also robust to excluding the Great Recession period between March 2008 and June 2009.

The literature has emphasized 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 (2020)). In order to address these issues I follow Miranda-Agrippino and Ricco (2020) and orthogonalize the monetary policy surprises with respect to (i) current economic conditions and (ii) the central banks' private macroeconomic forecasts. First, 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.[14] Second, I take the residuals from a regression of the surprises on the ECB's one-year ahead GDP and inflation forecasts and forecast 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.

Column (1) and (2) in Table 4 show the results for the two orthogonalized monetary policy surprises and results are very similar to the baseline. Moreover, in column (3) I show that results are robust to using the monetary policy surprises orthogonalized with respect to 3 lags and leads of each of the surprises to control for potential serial and

[14] 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.

Table 4: Results for alternative monetary policy surprises

	(1)	(2)	(3)	(4)	(5)
Target	-0.024**	-0.028**	-0.031**		
	(0.009)	(0.011)	(0.016)		
Timing	0.004	0.002	0.007		
	(0.017)	(0.016)	(0.021)		
FG	-0.009	-0.007	-0.011		
	(0.008)	(0.008)	(0.012)		
QE	-0.019	-0.013	-0.017		
	(0.015)	(0.017)	(0.016)		
1Y OIS (release)				-0.033**	
				(0.013)	
1Y OIS (conference)				-0.005	
				(0.009)	
Policy					-0.016**
					(0.008)
Info					0.009
					(0.013)
N	203.778	203.778	203.778	203.778	201.946

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). Column (1) shows the responses using monetary policy surprises orthogonalized with respect to current economic conditions. Column (2) shows the responses using monetary policy surprises orthogonalized with respect to the ECB's macroeconomic forecasts and forecast revisions. Column(3) shows the responses using the monetary policy surprises orthogonalized with respect to three lags and leads of the surprises to control for serial and cross-correlation. 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 Kerssenfischer (2019) which go only until December 2018. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

cross-correlation of the surprises.[15] As a further robustness check, I consider two alternative monetary policy surprises. First, I do not use a factor model as Altavilla et al. (2019) but simply take the 1-year OIS change 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 just included interest rate changes. The press conference is more about communication and explains the underlying reasons for the policy decisions and also provides a further outlook. Second, I take the monetary policy surprise series by Kerssenfischer (2019) who decomposes monetary policy news into a policy and an information component similar to Jarociński and Karadi (2020). Results are shown in Column (4) and (5) of Table 4 and in both cases the surprises that are about policy actions yield a stronger response compared to the surprises that are more about communication and providing information about 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.

[15] According to the Akaike information criteria, 3 is the optimal number of lags.

3.2 Local projections approach

The previous section has focused on the immediate response of household expectations to policy announcements. The literature on information rigidities (see for example Coibion and Gorodnichenko (2015a)) highlights that households often need some time to process new information or do not pay attention all the time and therefore only react with some time lag to news. 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 aggregate household expectations at monthly frequency and then estimate the dynamic effects of policy announcements by local projections building on Jordà (2005).[16] Alternatively, I construct a pseudo panel as introduced by Deaton (1985). The results for the pseudo panel approach are presented in Appendix E and lead to qualitatively similar conclusions.

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

$$y_{t+h} = \beta_h^{Ta} Target_t + \beta_h^{Ti} Timing_t + \beta_h^{FG} FG_t + \beta_h^{QE} QE_t + \gamma_h X_t + u_{t+h} \tag{4}$$

where y_t are inflation expectations in month t and $Target_t$, $Timing_t$, FG_t and QE_t correspond to the policy surprises in month t. X_t includes three lags of the policy surprises and two lags of y_t, the short-term interest rate, the long-term interest rate, the HICP index, the industrial production index and a credit spread.[17] 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 such 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 4 shows the response of qualitative inflation expectations to the different types of monetary policy announcements. The response of the macro variables and interest rates are shown in the Appendix (see subsection D.1). The responses are scaled such that 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 peak effect of around -30 reached after around 5 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

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

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

announcements there is no significant effect on impact. Positive Timing surprises slightly increase expectations during the first months but then lead to a reduction of inflation expectations as measured by the balanced statistic by around 10 after 6-8 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 maximum effect of slightly more than -10.

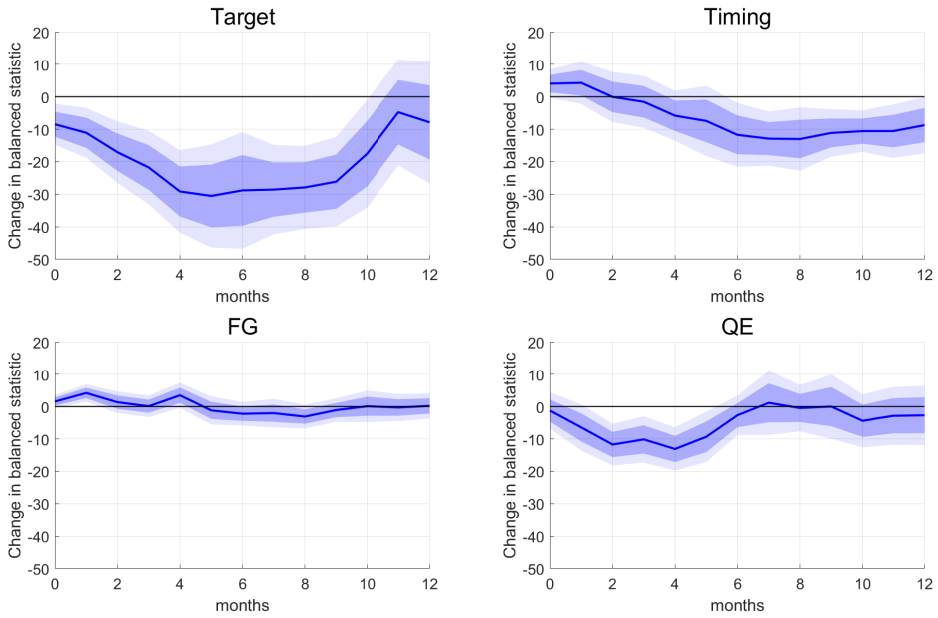

Figure 4: Response of qualitative inflation expectations (balanced statistic)

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in Equation 4. Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled such that a surprise increases the respective reference rate by 25 basis points.

In subsection D.2, 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.

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. Besides, the results for Germany are qualitatively similar to the euro area as a whole (see Figure D.6 in the Appendix). Comparing these results to the existing literature on monetary policy and household inflation expectations might look contradictory. However, most existing studies focus on quantitative inflation expectations. In Appendix F, I provide some results and discussion about quantitative inflation expectations.

4 Discussion

In this section I provide further analysis to explain and put the previous results into context. First, I analyse the role of media as potential transmission channel. Second, I compare the response of households to financial markets and professional forecasters.

4.1 The role of media as 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. In contrast, in this framework I do not control or know the news or signals that households receive. It is likely that almost no household follows the ECB's press conference or directly obtains information from the ECB via their website. Instead, it is more likely that information on ECB monetary policies reaches households via "classical" media or social media such as Twitter and they react to this information. Therefore, media coverage might play an important role in explaining the previous results. If some type of policy announcements lead to more/different media coverage than others that could explain the differences across types of announcement presented in the previous section. Even though a detailed analysis is beyond the scope of this paper, I am using Google trends data to establish to what extent different policies reach people. Google trends data measures the search interest for certain topics/keywords and can reflect the general public interest in a topic, how much people pay attention and if people search for information on a topic. Therefore, I would argue it is related to media coverage and can be considered as a proxy for the media transmission channel.

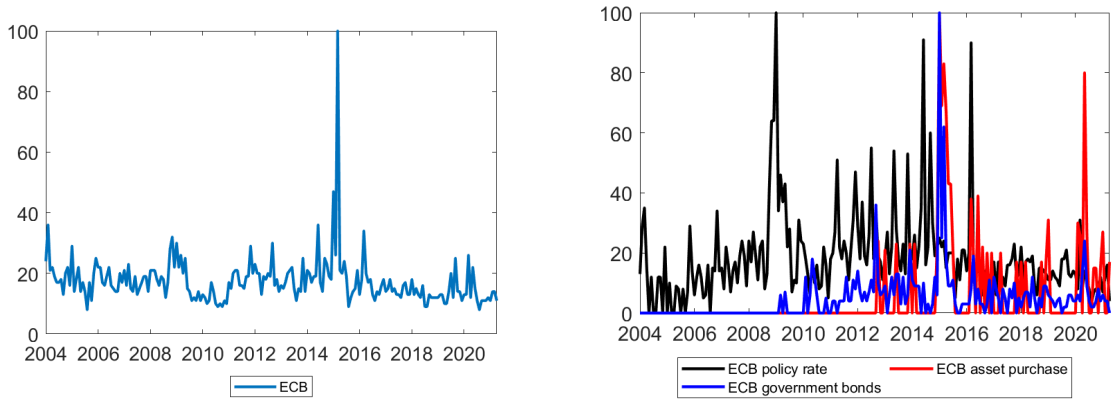

Figure 5: Search interest for different keywords on Google Search in Germany

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 such that 100 indicates the point with the maximum search interest over time. Monthly data from January 2004 until April 2021.

Figure 5 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 in 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 about 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 such as late 2008 and early 2009 when the ECB changed the key interest rates several times or June 2014 when the ECB first lowered the deposit facility rate below zero and in March 2016 when the rate on main refinancing operations was lowered to zero.

Table 5: Effect of policy announcements on Google search interest

	(1)	(2)	(3)	(4)	(5)
	ECB	ECB policy rate	ECB	ECB asset purchase	ECB government bonds
Target	0.646***	2.621***	-0.685	-5.634	-4.925
	(0.232)	(0.944)	(2.121)	(4.243)	(3.431)
Timing	0.298	1.007*	0.949	-8.519	0.634
	(0.200)	(0.587)	(2.817)	(5.654)	(3.897)
FG	0.119	-0.056	1.852	4.824	-1.275
	(0.133)	(0.321)	(2.307)	(4.682)	(3.534)
QE	2.687**	0.972	2.906**	7.496**	6.324*
	(1.178)	(0.826)	(1.328)	(3.210)	(3.680)
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.

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.[18] Table 5 shows the results. Column (1) indicates that Target and QE announcements are significantly related with increases in the search interest for the keyword ECB. Larger surprises in absolute terms lead to higher search interest and public interest. 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 with 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 significantly related with Google search interest. Overall, this indicates that announcements about changes in the policy rate and asset purchases might be more

[18]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.

likely to reach the public and generate more public interest compared to Timing and especially FG announcements. This can contribute to explaining the differential response of households' inflation expectations to the different type of policy announcements.

4.2 Financial markets and professional forecasters as benchmark

This section compares the response of household inflation expectations with the response of inflation expectations by financial markets and professional forecasters. Especially professional forecasters who are well informed economic agents can be regarded as natural benchmark for comparison to consumers.

In order to measure the response of inflation expectations by financial markets, I use German inflation linked bonds at 1-4 years maturity (see time series of inflation linked bonds in Figure G.11). I estimate the effects of policy announcements based on an event study framework.[19] 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 6 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. In particular, for FG announcements the effects are highly significant which is different from the household responses. The magnitude of the effects is fairly similar across type of announcements which is also in contrast with the responses of household inflation expectations. These results are qualitatively similar to Andrade and Ferroni (2021) who distinguish between a target and path factor and find that especially the path factor has strong positive effects on market-based inflation expectations. 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)).

In order to measure the response of inflation expectations by professional forecasters, I use survey data from a monthly Bloomberg survey that asks professional forecasters about their inflation expectations several quarters ahead. Consistent with the horizon of household expectations I focus on one-year ahead inflation expectations and I use the same local projections framework as defined in Equation 4. Figure 6 plots the impulse response functions for inflation expectations in Germany. Given that the data for Germany is only available from February 2008, I also show the response for the euro area where the data is available from October 2005 (see Appendix Figure D.7). Qualitatively, the responses show some similarities with those by households. This is not completely surprising given that the series of inflation expectations by households and professional forecasters have a correlation of 0.76 (see also Figure A.5 for the time series). The similarity is true in

[19] In Figure G.12 I also show the dynamic effects over the next 120 days using local projections.

Table 6: 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 on the four different surprise series (included simultaneously). Responses are scaled to a shock that increases the respective reference rate by 25 basis points. Due to data availability 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.

particular for Target and QE announcements. For Target surprises the effect is stronger on impact compared to the more delayed response by households. A 25 basis points Target surprise leads to a reduction in inflation expectations by up to 0.5 percentage points.

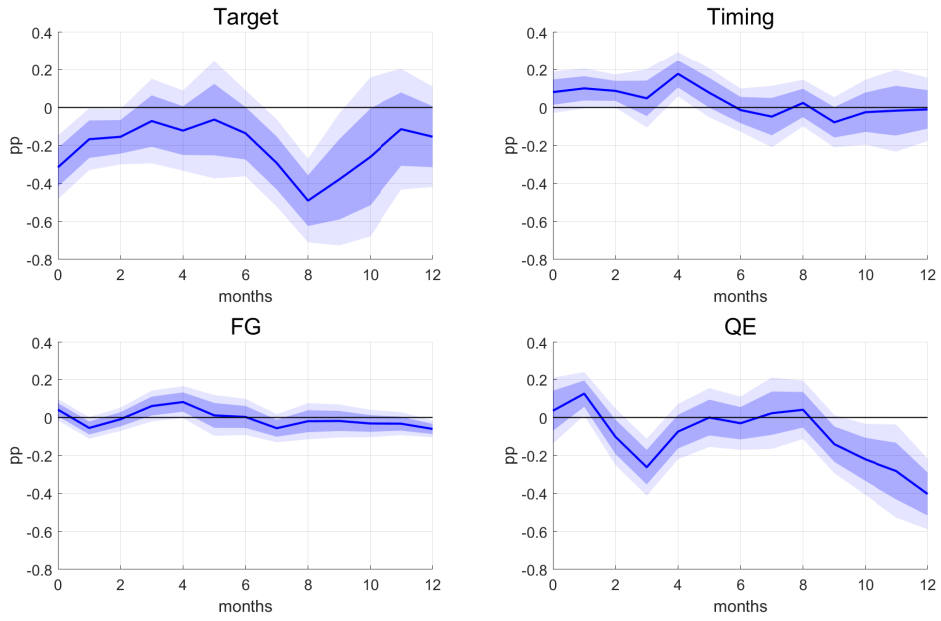

Figure 6: Response of inflation expectations by professional forecasters, Germany

Notes: Estimates based on local projections of one year ahead inflation expectations on monetary policy surprises and control variables as in Equation 4. Inflation expectations come from a monthly survey of professional forecasters conducted by Bloomberg. Sample starts only in February 2008. 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.

The results described above show that while household expectations mainly react to Target announcements, professional forecasters and especially financial markets also react to the other type of policy announcements. In particular, communication such as forward

guidance has powerful effects on financial markets in line with a large existing literature also mentioned in the related literature earlier.

5 Inflation expectations and consumer spending

Ultimately, the mandate of central banks is inflation management/stabilization. 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 in the following. First, the traditional Euler equation mechanism would suggest that higher inflation expectations should reduce real interest rates and create incentives for household to bring forward consumption, in particular durable consumption which 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 that 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 and the existing empirical literature has not reached a consensus yet.[20]

While the given dataset does not contain actual consumption data, it contains several questions on other expectations and in particular questions about consumer spending attitudes. In the following, I provide first some reduced-form evidence between inflation expectations and other household expectations and then estimate the effect of different types of policy announcements on consumer spending attitudes.

In order to study the reduced-form relationship between inflation expectations and other expectations, I use an ordered logit model with various expectation variables as dependent variable and inflation expectations as independent variable. Similar to inflation expectations the other expectation variables are also ordered categorical variables (see Appendix A for the detailed survey questions). Additionally, I include household controls and month fixed effects. Table 7 reports the marginal effects of an increase in inflation expectations on the probability that households answer the first category.

The results show that higher inflation expectations are significantly negatively related to a broad set of household expectations, i.e. households who expect higher inflation are more pessimistic about personal and general economic conditions. More specifically, the probability that the general economic situation gets a lot better, that there is much less unemployment and that households answer they expect their personal financial situation

[20]See for example Bachmann et al. (2015) who find no or only a small negative relationship, while Coibion et al. (2019) find a negative relationship for durable consumption and Duca-Radu et al. (2021) and Armantier et al. (2015) find a positive relationship.

Table 7: Inflation expectations and personal and economic expectations

	(1) Economic situation A lot better	(2) Unemployment Much less	(3) Personal financial situation A lot better	(4) Time to spend Good
Inflation expectations	-0.002*** (0.000)	-0.003*** (0.000)	-0.001*** (0.000)	-0.005*** (0.002)
	(5) Plan to spend Much more	(6) Time to save Good	(7) Plan to save Much more	(8) Confidence
Inflation expectations	-0.001*** (0.000)	0.005*** (0.001)	-0.007*** (0.000)	-0.042*** (0.003)

Notes: Results based on ordered logit model for columns (1)-(7) and linear regression for column (8). 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 such that an increase corresponds to an increase in inflation expectations. Control variables include household controls and month fixed effects. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

to get a lot better goes down. The probability that households answer it is a good time to spend or that they plan to spend much more is lower. The probability that households answer that it is a good time to save goes up 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 that households answer they plan to save much more goes down. This likely reflects that households expect a worse financial/income situation. Finally, higher inflation expectations are significantly related with a reduction in consumer confidence. Overall, these results highlight that households expect that the general and their own economic situation gets worse when inflation increases.

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 with negative income effects and depressed economic activity (see for example Kamdar (2019) and Candia et al. (2020)).

A natural question is if the above shown reduced-form relationships between inflation expectations and consumer spending attitudes also hold in response to monetary policy announcements that affect inflation expectations. In order to answer this question, I estimate the ordered logit specification from Equation 3 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.6. Alternatively, I also consider the spending plans and a composite confidence indicator as proxies for consumer spending attitudes (see question 8 and 9 in Appendix A for the detailed questions).

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	0.005	0.004***	0.047**
	(0.024)	(0.001)	(0.021)
Timing	-0.002	0.001	0.020
	(0.013)	(0.002)	(0.027)
FG	0.004	0.000	-0.003
	(0.013)	(0.001)	(0.015)
QE	0.019	-0.001	0.017
	(0.030)	(0.002)	(0.071)
N	195.560	191.159	182.548

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 that it is the right moment to make major purchases and that one plans to spend much more on major purchases, respectively. Column (3) shows results from linear regression on consumer confidence indicator where a higher value indicates higher consumer confidence. Control variables include wave dummy, household controls and month fixed effects. Standard errors clustered at the monthly level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

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 that it is a good time to make major purchases now. Except for the Timing announcement the coefficients are positive but not statistically significant and the magnitudes are rather small. These results are similar to the finding by Bachmann et al. (2015) who find that lower inflation expectations have a small positive but not significant effect on the willingness to spend.

Column (2) shows the effect on the probability that one has the plan to spend much more on major purchases over the next 12 months. The sign for Target announcements is positive as in column (1) but in this case it is significant. The effects of the other types of announcements are again imprecisely estimated. Finally, column (3) shows the response of consumer confidence which is often mentioned in the literature as good predictor for consumption growth.[21] Consumer confidence is constructed as a weighted statistic of four different questions in the survey about households past and expected financial situation,

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

general economic expectations and spending plans (see Appendix A for details). Column (3) shows that Target announcements lead to a significant increase in consumer confidence at the 5% significance level while there is no significant response for the other policy announcements. 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 0.52.

Overall, all three proxies of consumer spending attitudes respond positively to the Target surprises which are shown to reduce household inflation expectations but the magnitude of the effects are generally small. This suggests that policies that try to engineer higher inflation expectations should not be expected to necessarily result in higher consumption as many conventional theories would predict.

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 likely to be also a good proxy of firms' expectations since many firms in countries like Germany are small or medium sized companies such that it is reasonable to assume that their knowledge and expectation formation is similar to 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 not only influenced by financial market prices but also by their expectations (see Armantier et al. (2015) or Malmendier and Nagel (2016) among 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 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 small and delayed effect on inflation expectations of households. Household inflation expectations are linked with other expectations, in particular consumer

spending attitudes. I find that households relate higher inflation expectations with bad times and there is no 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 its 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 recent years central banks have relied heavily on unconventional measures different from policy rate changes but these measures seem to have no or at least less of an effect on household inflation expectations.

Looking forward it would be important to understand better what is the optimal central bank communication. First, from a normative point of view how much should central banks try to reach the general public with their policy announcements and to what extent should they consider household inflation expectations as a policy tool. Second, if it is optimal to target the general public with policy announcements how to communicate effectively such that the policies have an effect and also in the desired direction.

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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

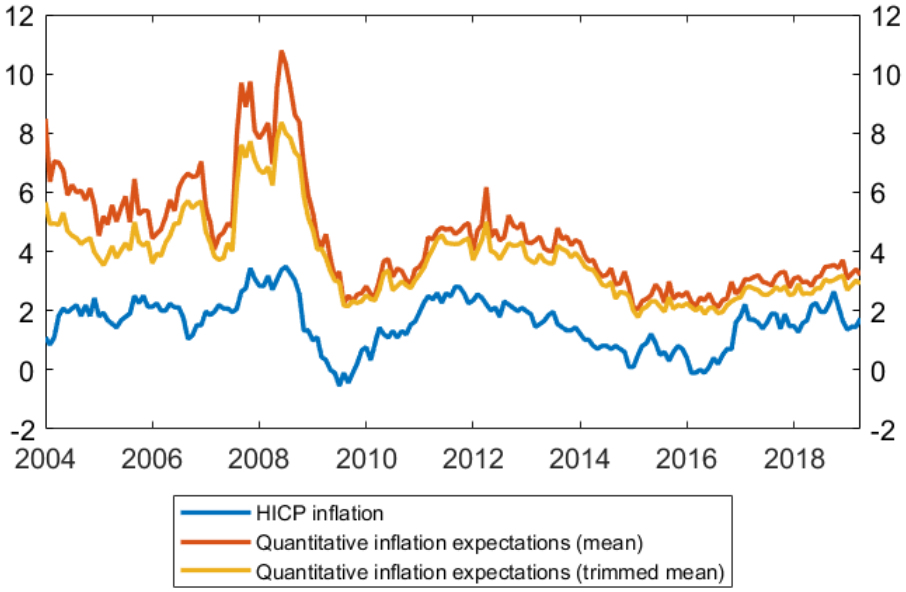


Figure A.1: Quantitative inflation expectations and actual HICP inflation

Notes: HICP inflation is year on year growth rate of seasonally adjusted HICP index for Germany. Trimmed mean of quantitative inflation expectations is excluding top and bottom 2%. of values.

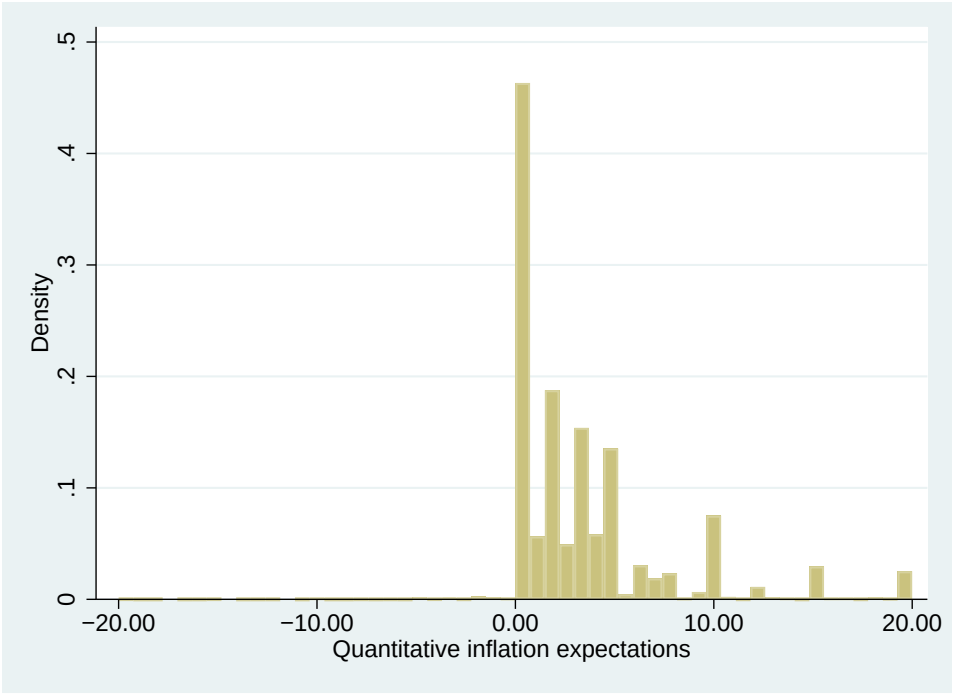


Figure A.2: Distribution of quantitative inflation expectations

Notes: Distribution is trimmed at absolute value of 20. Overall reported values range between -100% and 100%. Sample: January 2004 until April 2019.

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 0.27 and 0.11 for the full sample and 0.41 and 0.34 for the sample until December 2014.

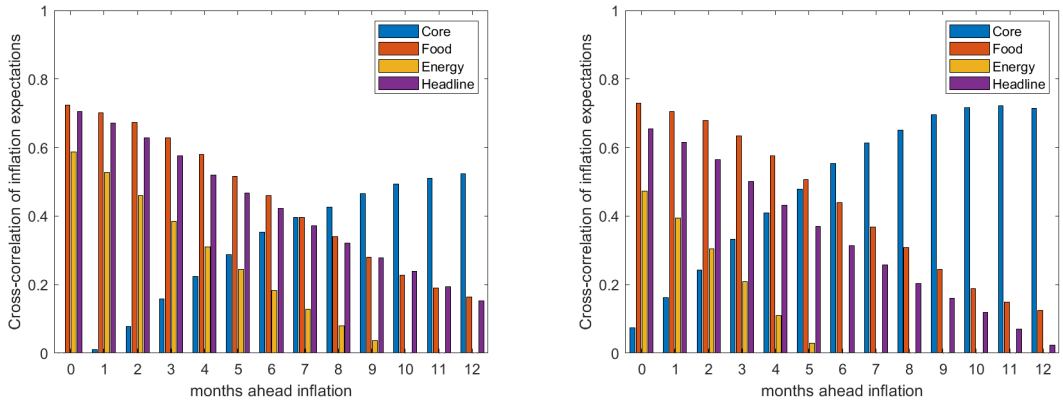


Figure A.3: Predictive power of qualitative inflation expectations for realized inflation

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.

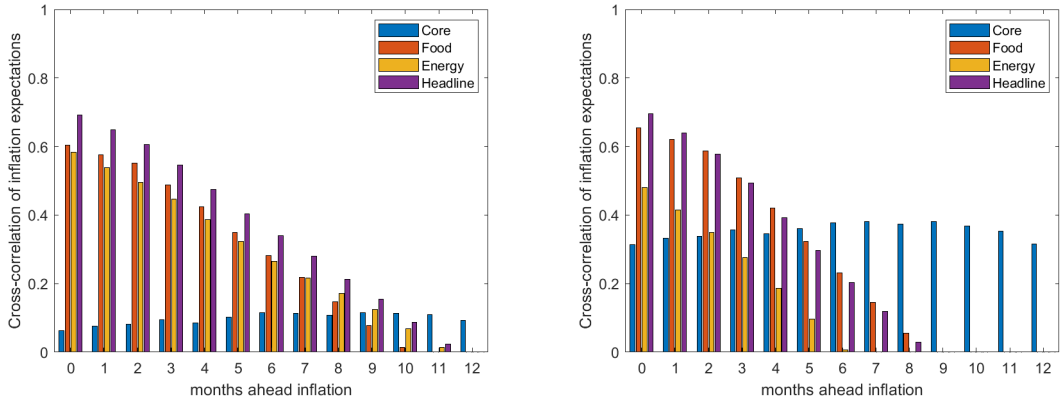


Figure A.4: Predictive power of quantitative inflation expectations for realized inflation

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.5: 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 from Bloomberg and start only in February 2008.

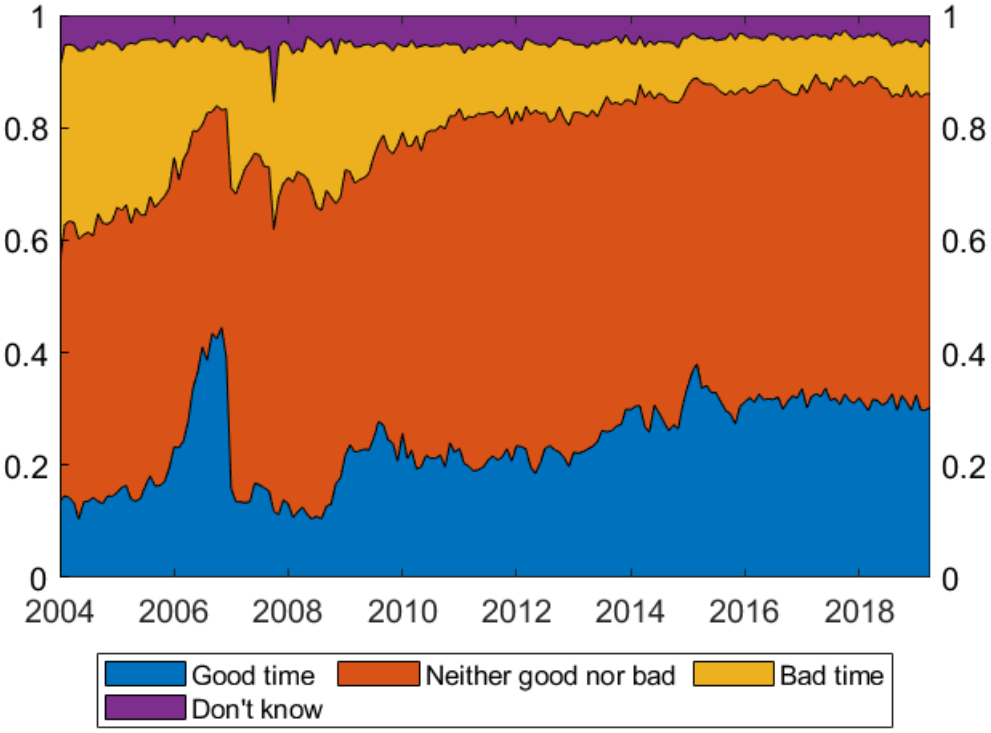


Figure A.6: Distribution of readiness to spend on durables over time

B Monetary policy surprises

The monetary policy surprises are identified using the methodology by Altavilla et al. (2019). I extended their analysis until April 2019 using data on interest rate changes around ECB Governing Council meetings from the Euro Area Monetary Policy Event-Study Database (EA-MPD). This database has been originally compiled by Altavilla et al. (2019) and is regularly updated.[22]

Figure B.1 and Figure B.2 shows the factor loadings and monetary policy surprises from the estimated factor model.

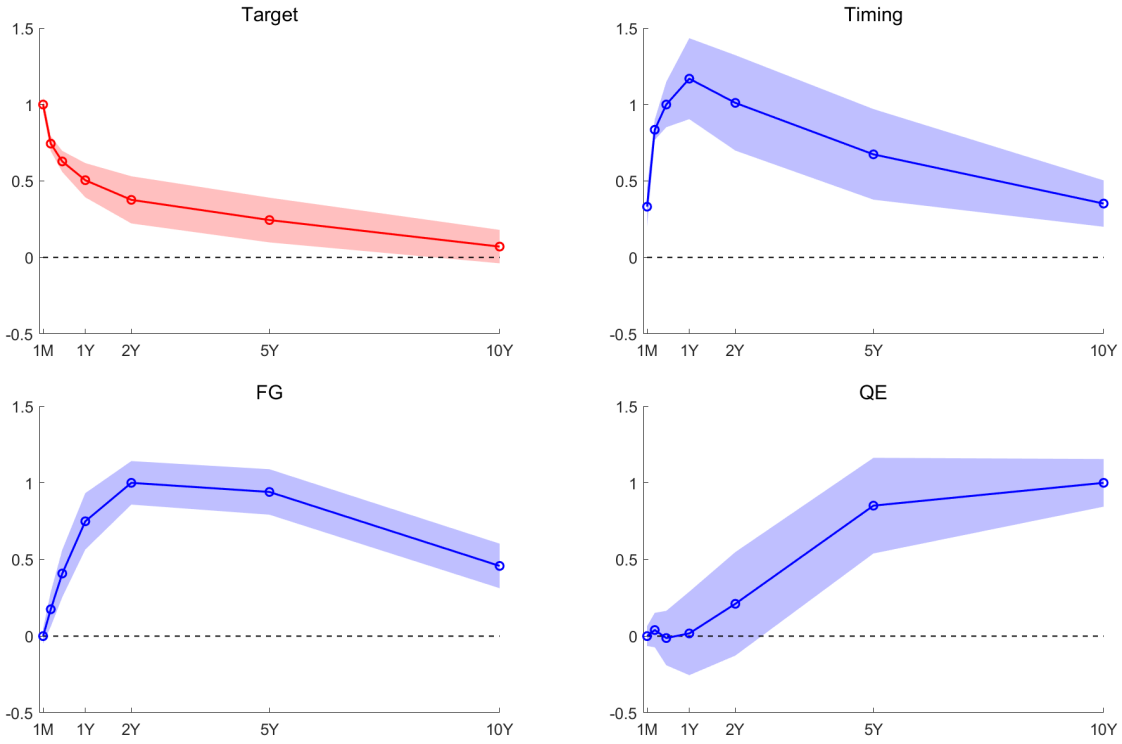


Figure B.1: Factor loadings

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

Figure B.2: 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.

C Additional event study results

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

	(1) Increase more rapidly	(2) Increase by approximately same rate	(3) Increase less strongly	(4) Stay about the same	(5) Fall
Target	-0.027***	-0.024***	0.009***	0.040***	0.002**
	(0.010)	(0.009)	(0.003)	(0.015)	(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	-0.007	0.002	0.012	0.001
	(0.007)	(0.007)	(0.002)	(0.011)	(0.001)
QE	-0.017	-0.015	0.006	0.026	0.001
	(0.015)	(0.013)	(0.005)	(0.023)	(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 C.2: Main results from Table 1 based on alternative model specification

	(1) Logit model	(2) Linear regression model
Target	-0.025***	0.112**
	(0.007)	(0.050)
Timing	0.005	0.000
	(0.017)	(0.070)
FG	-0.001	0.029
	(0.008)	(0.032)
QE	-0.013	0.074
	(0.034)	(0.068)
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 (going from 1 to 5 where 1 is higher inflation and 5 is deflation). 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 C.3: Effect of announcements on proportion of "Don't know" answers

	(1)
Target	0.000
	(0.008)
Timing	-0.004
	(0.010)
FG	-0.006
	(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 C.4: The role of inflation perceptions

	(1)	(2)
	Controlling for inflation perception	Inflation perceptions as dependent variable
Target	-0.023**	-0.016
	(0.011)	(0.022)
Timing	0.004	-0.008
	(0.014)	(0.021)
FG	-0.004	-0.008
	(0.006)	(0.013)
QE	-0.015	-0.003
	(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 C.5: Main results from Table 1 controlling for QE factor before 2014

	(1)
Target	-0.028**
	(0.012)
Timing	0.000
	(0.016)
FG	-0.009
	(0.008)
QE	-0.016
	(0.034)
QE (pre-2014)	-0.022
	(0.034)
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 C.6: Robustness of main results to dropping large Target surprises

	Baseline	Drop Oct 2011	Drop Nov 2011	Drop July 2012
	(1)	(2)	(3)	(4)
Target	-0.027***	-0.031**	-0.036***	-0.021**
	(0.010)	(0.014)	(0.013)	(0.010)
Timing	0.002	0.002	0.003	0.002
	(0.016)	(0.016)	(0.016)	(0.016)
FG	-0.008	-0.008	-0.006	-0.008
	(0.007)	(0.008)	(0.008)	(0.007)
QE	-0.017	-0.016	-0.016	-0.018
	(0.015)	(0.016)	(0.016)	(0.015)
N	203.778	201.913	201.964	201.909
Month FE	Yes	Yes	Yes	Yes
Wave dummy	Yes	Yes	Yes	Yes
HH controls	Yes	Yes	Yes	Yes
Past expectations	No	Yes	Yes	Yes
Sample	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 C.7: Robustness of main results to excluding Great Recession (March 2008-June 2009)

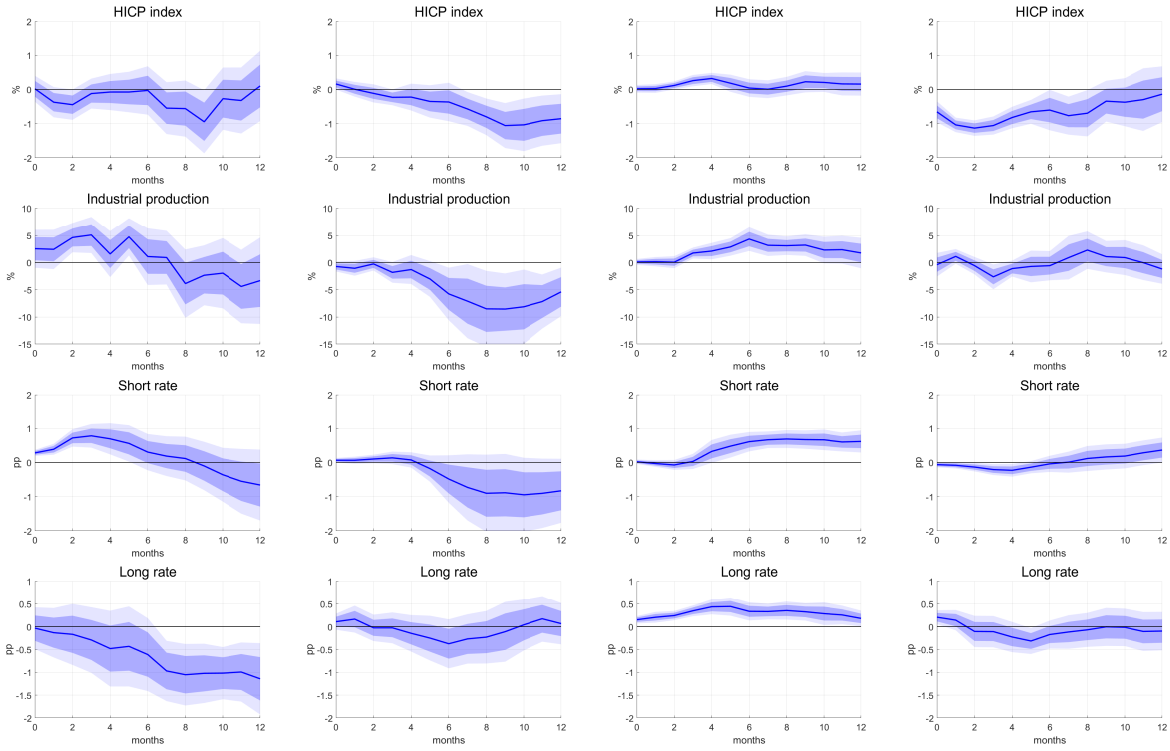
	(1)
Target	-0.029**
	(0.012)
Timing	-0.018
	(0.016)
FG	-0.007
	(0.014)
QE	-0.008
	(0.016)
N	180.367
Month FE	Yes
Wave dummy	Yes
HH controls	Yes
Past expectations	Yes
Sample	2004-2019

Notes: Results based on ordered logit model. Marginal effect of a policy surprise that increases the respective reference rate by 25 basis points 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.

D Additional local projection results

D.1 Macro results

Figure D.1 presents the response of German HICP, Industrial production, the short rate and the long rate to the four types of monetary policy surprises based on Equation 4.



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

Figure D.1: Response of macro variables and interest rates to monetary policy surprises

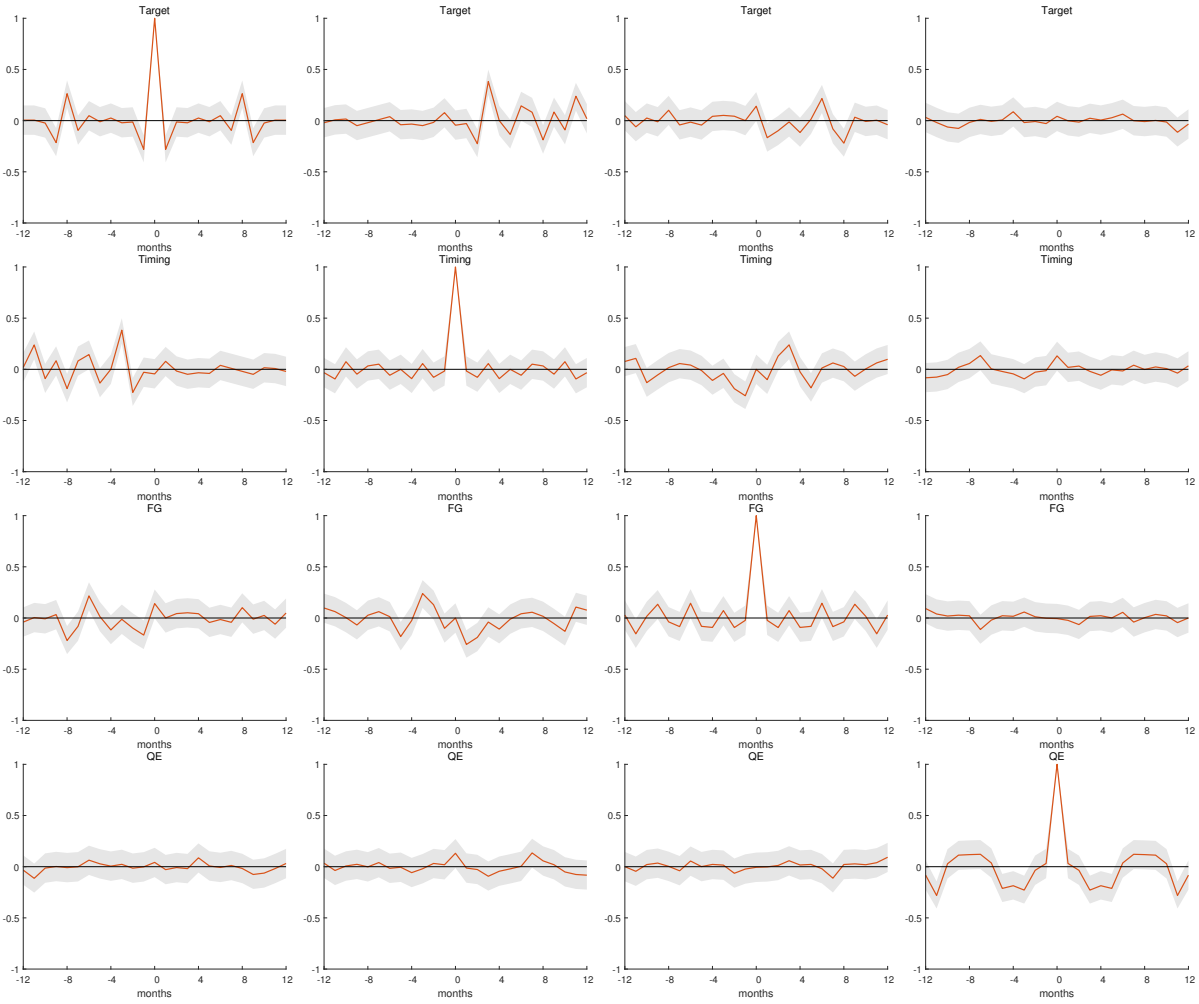
Notes: Estimates based on local projections as in Equation 4. Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled such that a surprise increases the corresponding interest rate by 25 basis points.

D.2 Robustness

Figure D.2 shows the serial and cross-correlation of the different surprises. The specification in Equation 4 already includes lags of the surprises to control for potential correlations with past surprises. However, their can be also correlation with future surprises. In particular, Figure D.2 highlights that the Timing surprises exhibit a positive correlation with leads of Target 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 D.3. The main difference to the baseline results is the much smaller and more reasonable output response of the Timing surprise. The magnitude of the response of inflation expectations to the

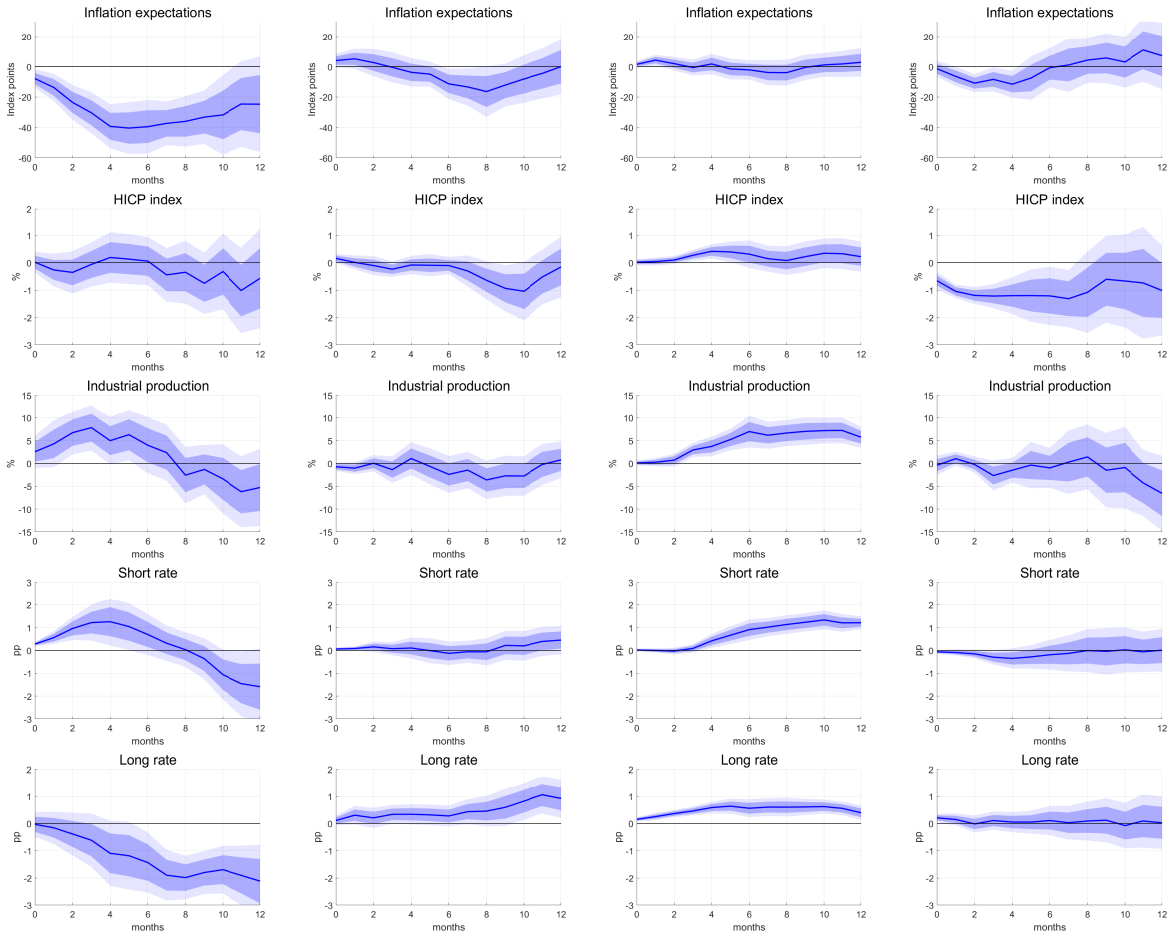
four different surprises changes slightly but overall the qualitative conclusions are very similar in the sense that Target announcement have the strongest effect.

Figure D.4 and Figure D.5 shows the robustness to choosing different number of lags and to controlling for the surprises in the QE factor before 2014.



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

Figure D.2: Serial and cross-correlation of surprises



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

Figure D.3: Response of macro variables and interest rates to monetary policy surprises (controlling for persistence)

Notes: Estimates based on local projections as in Equation 4. Following Alloza et al. (2019) I include h leads of the surprises to control for the persistence. 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.

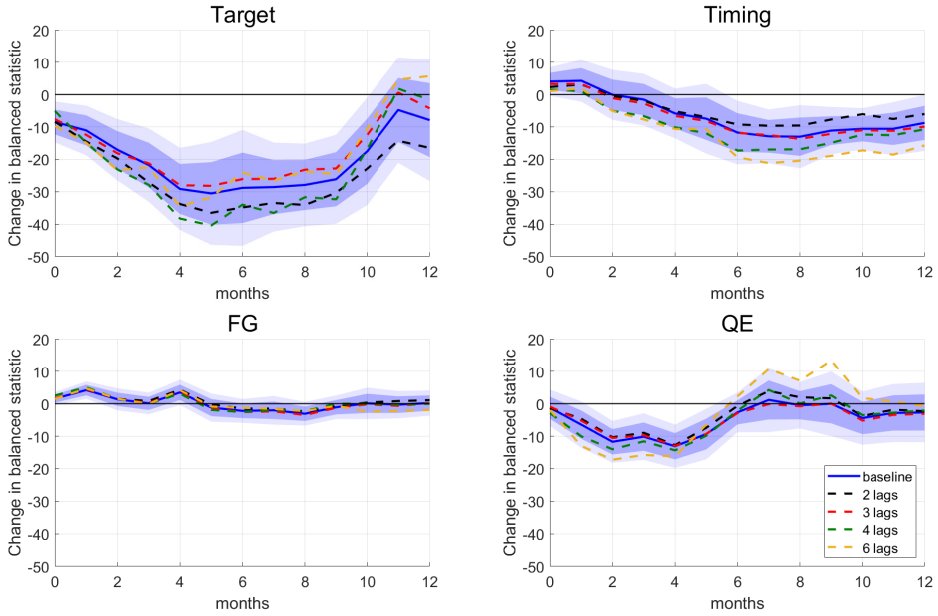


Figure D.4: Robustness to different lag lengths

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in Equation 4. 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.

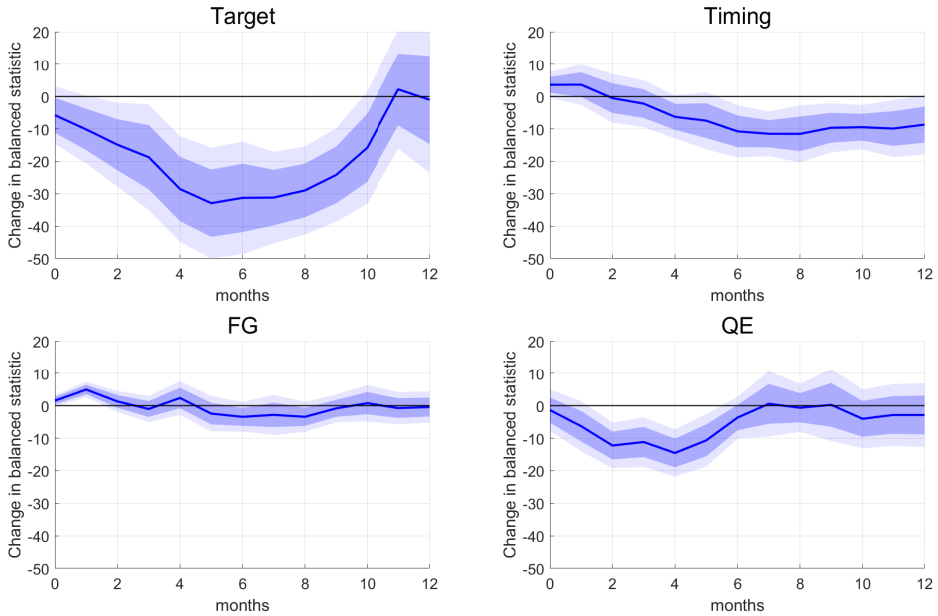


Figure D.5: Robustness to controlling for pre 2014 QE surprises

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in Equation 4. 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.

D.3 Euro area results

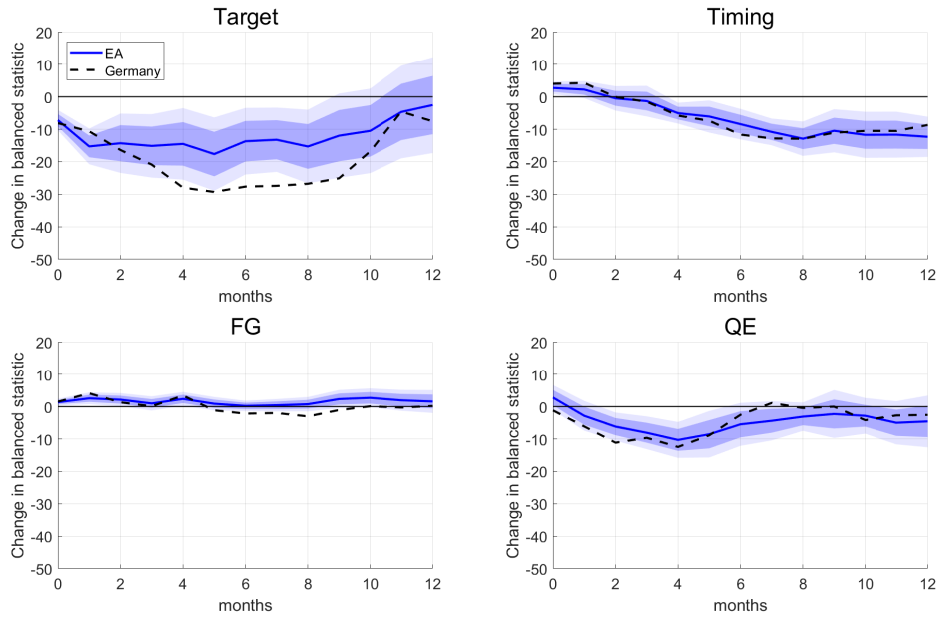


Figure D.6: Response of qualitative inflation expectations (balanced statistic), euro area

Notes: Estimates based on local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as in Equation 4. Black dashed line corresponds to IRFs for Germany. Blue areas correspond to 68% and 90% confidence intervals based on Newey-West standard errors. Responses are scaled such that surprise increases corresponding interest rate by 25 basis points.

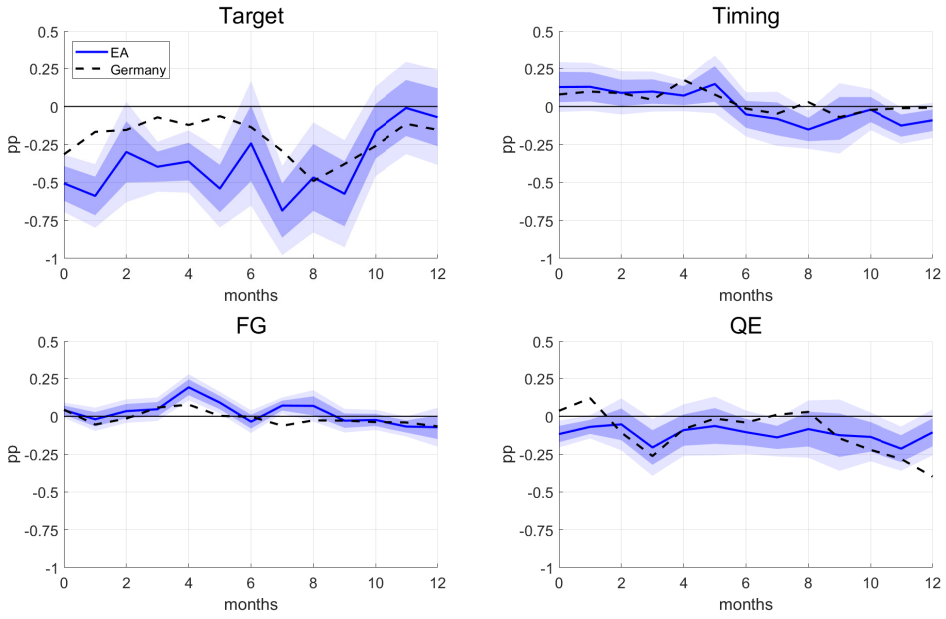


Figure D.7: Response of inflation expectations by professional forecasters, Euro area

Notes: Estimates based on local projections of one year ahead inflation expectations on monetary policy surprises and control variables as in Equation 4. Inflation expectations come from a monthly survey of professional forecasters conducted by Bloomberg. Sample starts only in October 2005. Black dashed line corresponds to IRFs for Germany. 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.

E Dynamic effects based on pseudo panel approach

An alternative to aggregating cross-sectional survey data at monthly frequency to one time series is to create a pseudo panel based on the approach by Deaton (1985). The idea is to track groups of households over time instead of individuals since the latter is not possible. More specifically, they suggest to create cohorts with fixed membership and then take at every given point the sample cohort means to obtain time series for every cohort.

I create cohorts based on birth year, gender and education. There is a trade-off between number of cohorts and number of households per cohort required for the estimation of accurate cohort means. Therefore, for the year of birth I choose 10-year bands, i.e. born before 1940,1940-1949,1950-1959,1960-1969,1970-1979,1980-1989 and born after 1989. For education there are in principle 4 categories: Volks-/Hauptschule, Realschule, Gymnasium, Universität. Since the number of households in the last two categories is relatively small I group them together in one category. Together with the two categories for gender this gives me overall 42 cohorts. In order to make sure that the cohort means are accurate and not just based on few observations I also set monthly cohort observations to missing if there are less than 30 households in a cohort in a given month.

I estimate impulse response functions to the different monetary policy announcements using panel local projections with cohort fixed effects and macro control variables as in Equation 4. In addition, I include household expectations as controls. Figure E.8 shows that the results are similar to the ones based presented in subsection 3.2.

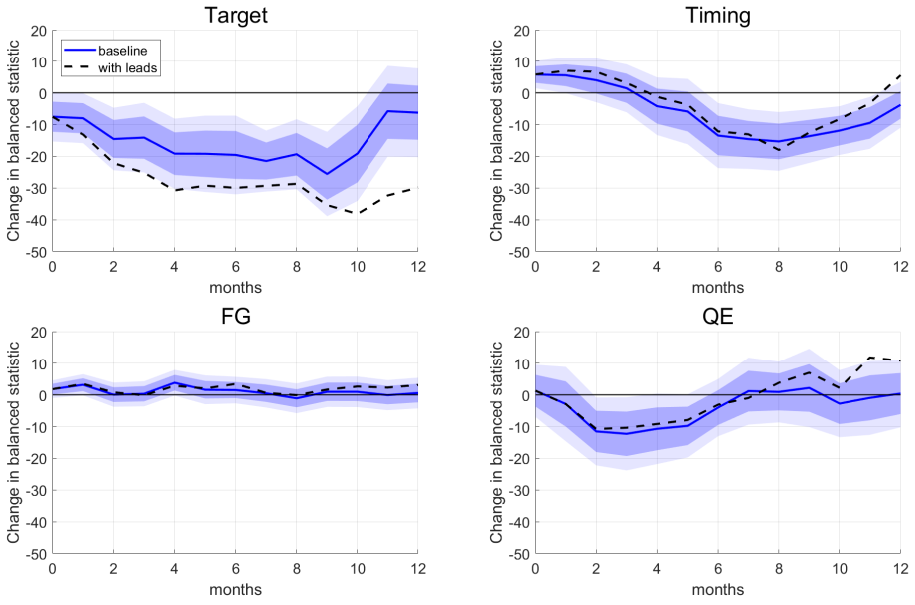


Figure E.8: Response of inflation expectations: Pseudo panel approach

Notes: Estimates based on panel local projections of qualitative inflation expectations (balanced statistic) on monetary policy surprises and control variables as specified in the text above. 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. Black dashed line shows IRFs when including h leads of the surprises.

F The effects on quantitative inflation expectations

Comparing these results to the existing literature on monetary policy and household inflation expectations might look contradictory. However, most existing studies focus on quantitative inflation expectations. As is well documented in the literature, quantitative inflation expectations of households are very dispersed and often unreasonably large. In the given survey, I find that a lot of consumers answer that they do not know the value of inflation or they answer a level of inflation that is unreasonable and ranges from -100 to 100 (see Figure A.2 for distribution of quantitative inflation expectations). This makes the analysis using quantitative inflation expectations more difficult as one has to take a stance on how to treat outliers that would otherwise bias the estimation results. Moreover, the GfK survey is designed such that the quantitative question builds on the qualitative question. For households who answer that they expect prices to stay about the same, the answer to the quantitative question is set automatically to zero and only the other households are asked to provide a point estimate. This is problematic as there are a lot of households who answer that they expect prices to stay about the same and it is not possible to distinguish if they really mean a point estimate of zero or values of very low inflation as observed during parts of the sample period.

Keeping the aforementioned aspects in mind, I shortly present the effects of policy announcements on quantitative inflation expectations. Table F.8 shows the effects of policy announcements on quantitative inflation expectations using the event study approach. Column (1) highlights that the effects of the different types of policy announcements on quantitative inflation expectations are generally very imprecisely estimated and there is no significant effect for any of the announcements. This is also true if I trim the data to remove the largest outliers (column (2)) or if I consider the difference between expected and perceived inflation as proposed by Duca-Radu et al. (2021) (see columns (3) and (4)).

Figure F.9 shows the medium-term response of quantitative inflation expectations based on local projections. The measure of inflation expectations used is a trimmed mean where the top and bottom 2% of values are excluded. As alternative Figure F.10 also shows the response using the median of inflation expectations. On impact the effect is not significant for any of the policy announcements. The overall dynamics are similar to the response of qualitative inflation expectations shown in Figure 4 (especially when using the median of inflation expectations). A 25 basis points Target surprise reduces quantitative inflation expectations by almost 2 percentage points but only after 9 months.

Overall, comparing the results for quantitative and qualitative inflation expectations illustrates that getting the direction right might be simpler and require less information and time than giving a precise inflation point estimate. At the same time it highlights that more household surveys could be helpful that include for example probabilistic questions or provide households with intervals that they can choose.

Table F.8: The response of quantitative inflation expectations

	(1)	(2)	(3)	(4)
Target	-0.228	-0.452	-0.178	-0.302
	(0.633)	(0.520)	(0.546)	(0.289)
Timing	0.325	0.393	0.362	0.236
	(0.383)	(0.375)	(0.303)	(0.354)
FG	-0.316	-0.009	-0.316	0.118
	(0.466)	(0.250)	(0.333)	(0.294)
QE	-0.330	-0.901	0.043	-0.459
	(0.664)	(0.586)	(0.401)	(0.317)
N	180.003	175.908	175.956	169.650

Notes: Results based on linear regression model with quantitative inflation expectations (columns 1 and 3) or the difference between quantitative inflation expectations and perceptions (columns 2 and 4) as dependent variable. Columns 3 and 4 use data that is trimmed at top and bottom 2%. 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.

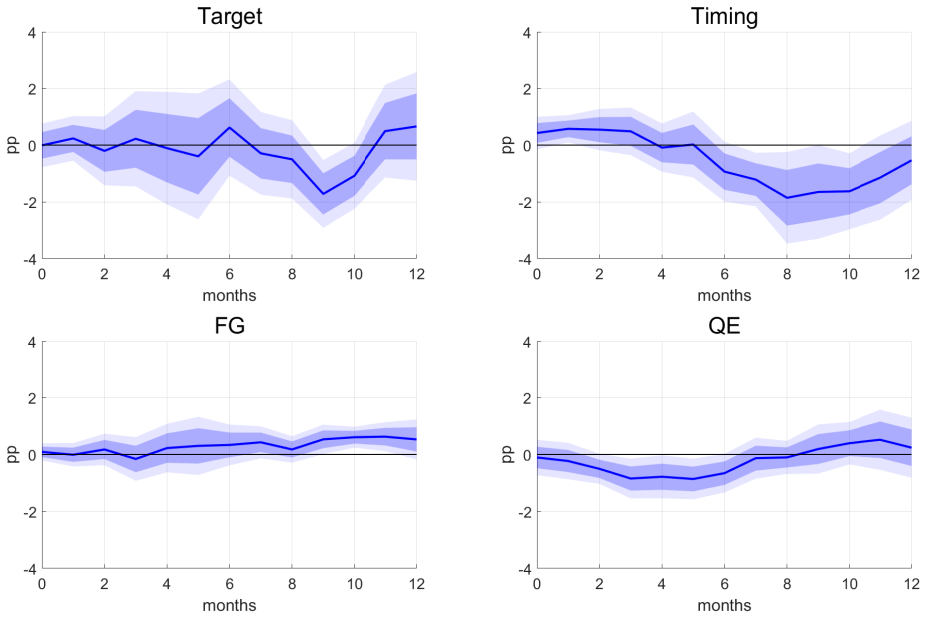


Figure F.9: Response of quantitative inflation expectations (trimmed mean), Germany

Notes: Estimates based on local projections of quantitative inflation expectations (trimmed at top and bottom 2%) on monetary policy surprises and control variables as in Equation 4. 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.

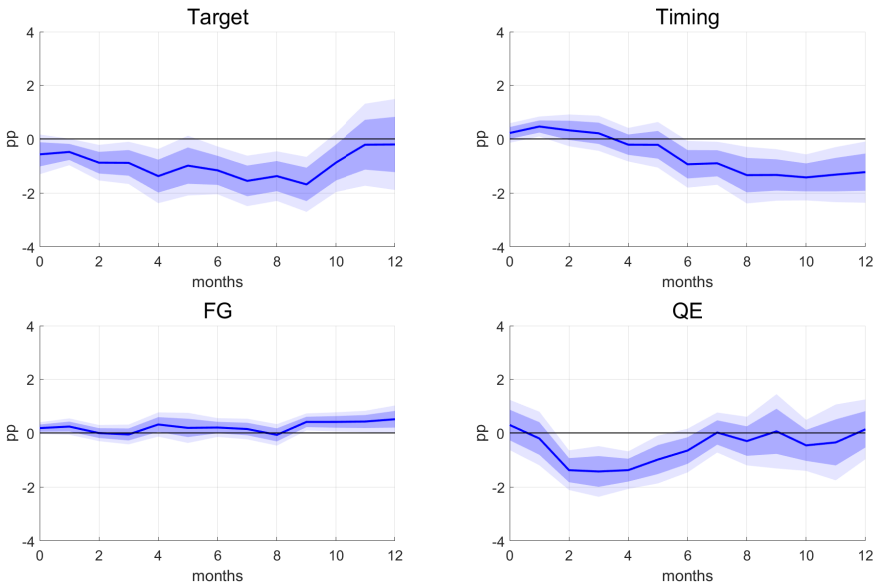


Figure F.10: Response of quantitative inflation expectations (median), Germany

Notes: Estimates based on local projections of quantitative inflation expectations (median) on monetary policy surprises and control variables as in Equation 4. 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.

G Financial market responses

Figure G.11 shows the daily time series of German inflation linked bonds for maturities 1, 2, 3 and 4 years. Figure G.12 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.

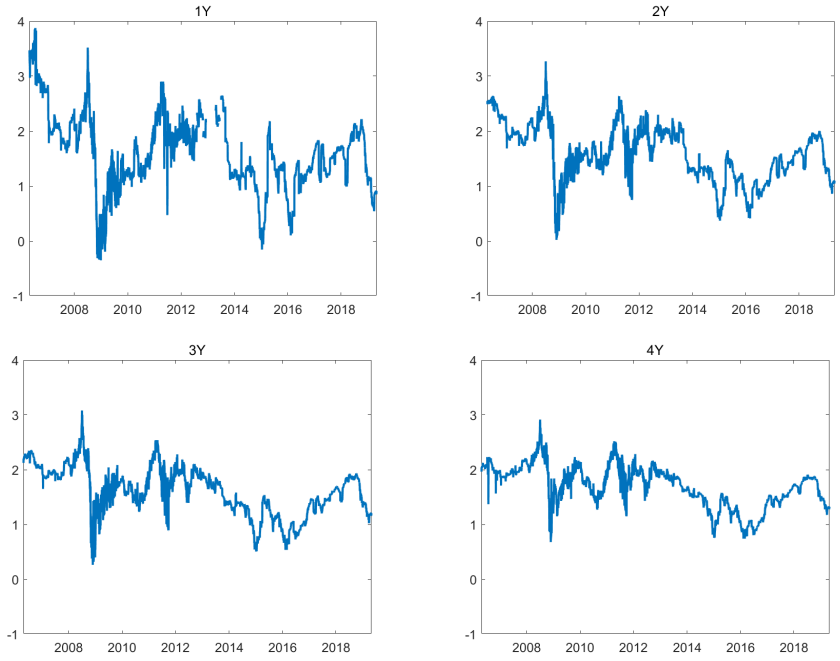
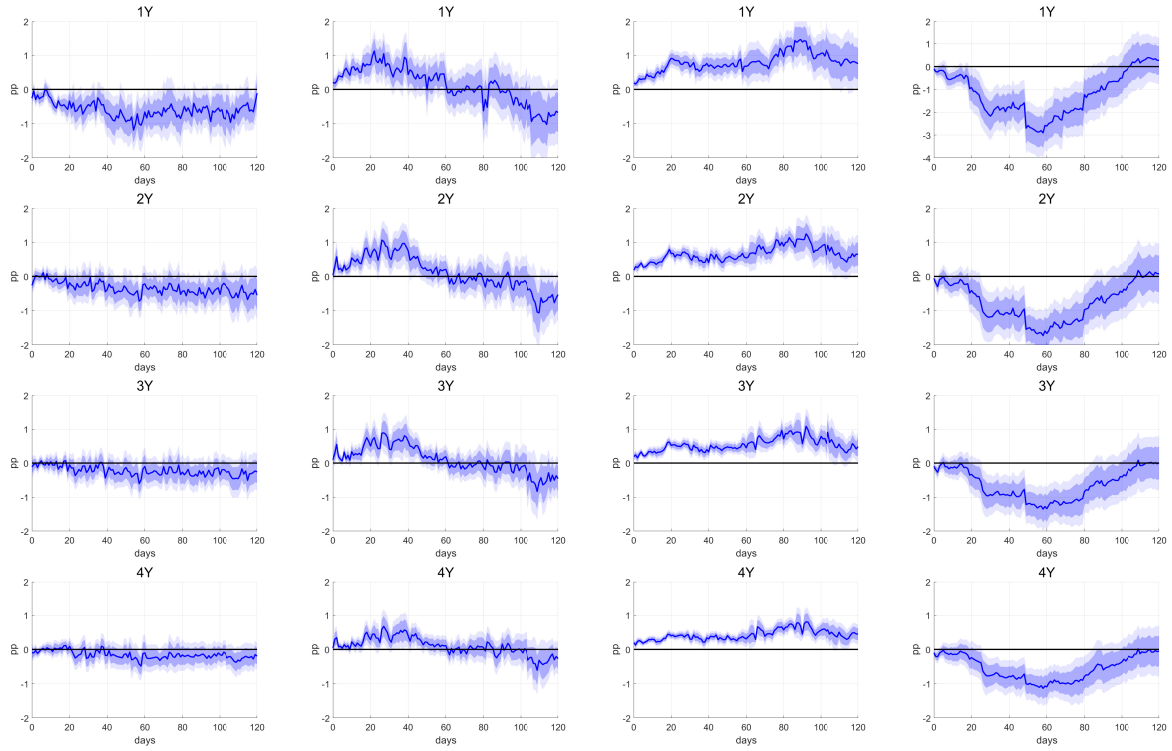


Figure G.11: Time series of German inflation linked bonds



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

Figure G.12: 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.