Central Bank Inflation Forecasts and Firms' Price Setting in Times of High Inflation*

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Abstract

Using a randomized survey among firms, we study how information about inflation, energy costs, and wage dynamics affects firms' pricing strategies in a high-inflation environment. Firms exposed to information about central bank inflation forecasts intend to raise prices less than uninformed firms. The effect is more pronounced for firms whose inflation expectations are less aligned with central bank forecasts, those that are less attentive to past inflation dynamics, and those that are more satisfied with overall economic policy. The study highlights the important role of central bank communication in managing inflation, which is particularly crucial during periods of high inflation.

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After all, it is the everyday economic decisions of people and companies that we seek to influence with our policy and communication.

(Lagarde, 2020)

1 Introduction

Firms' expectations of future inflation are believed to be a key determinant of actual inflation (Coibion et al., 2018, 2020b; Weber et al., 2022; Werning, 2022). This relationship suggests that central banks might benefit from monitoring and influencing these inflation expectations through enhanced communication strategies. A pivotal question emerges from this premise: Can an effective information policy, such as sharing current and projected inflation figures, directly impact the way firms set their prices?

While this question is vital for assessing the role of central bank communication in managing inflation dynamics, empirical evidence on the causal effect of inflation information on firms' price-setting is scarce, which is, among other factors, mainly due to the limited availability of firm surveys (compared to household surveys). We aim to address this gap by providing causal evidence of how information on current and expected future inflation rates influence firms' pricing plans in a high-inflation environment. To this end, we survey 2,000 firms in Germany during the high-inflation year 2022 and conduct an information provision experiment.[1] In the survey, we start by eliciting firms' expectations of inflation over various time horizons. Following this, firms in an active control group are merely reminded of their inflation forecasts, whereas firms in the treatment group receive the central bank's official inflation projections (in addition to what control group firms see). The survey then proceeds to collect data on firms' planned price changes, which are known to closely align with realized price changes of firms (Coibion et al., 2018, 2020b; Kumar et al., 2023).[2]

We obtain two main results. First, providing information on the central bank's inflation forecasts for 2023—which are around 7 percentage points lower than average firm expectations for this year—reduces planned prices of firms by 22%. Thus, information-induced updates about future inflation rates induce firms to adjust their pricing plans, suggesting that providing information about inflation dynamics can be an effective way for central banks to break the transmission of elevated and distorted inflation expectations into price setting and dampen upward inflation dynamics.

Second, firms in two additional treatment groups receive the central bank's energy and labor cost projections, in addition to the central bank inflation forecasts. This allows

[1] We simplify terminology by talking about "firms" when we mean "firm decision-makers".

[2] Evidence suggesting that planned price changes align with actual price changes is derived from survey questions asking about expected and past price changes, or from analyzing current prices of only a selected subgroup of firms with available price data (Coibion et al., 2018, 2020b; Kumar et al., 2023). Moreover, it has been shown that survey-reported behavior is often close to revealed preference results in archival data (Parker and Souleles, 2019; D'Acunto et al., 2022; Coibion et al., 2023).

us to investigate whether the extent and type of inflation-related information matters for firms' price-setting behavior. In particular, we can test if additional information on single components of the central bank's inflation forecasts, which should be relevant for firms' input cost perceptions, have an additional effect on firms' price-setting behavior compared to information on inflation dynamics alone. We find that this is not the case: treatment effects on planned price changes in these additional treatments are similar to the simple information treatment on general inflation forecasts alone, with reductions of 19% (energy cost projections) and 22% (labor cost projections). This suggests that the additional treatments contain no incremental information for firms, as firms are potentially aware that the additional projections are already incorporated in the overall central bank inflation forecast.

In additional tests, we investigate the mechanisms and explanatory factors behind our treatment effects by conducting a series of sample splits. First, we consider the role of pre-treatment inflation expectations and find that firms with high pre-treatment inflation expectations, i.e., those further away from the central bank prediction, demonstrate a more pronounced price-plan response to the treatments. That is, respondents that experienced a greater information shock, are more significantly affected in their pricing strategies. This indicates that treatment effects stem from changes in beliefs rather than mere priming (Haaland et al., 2023). Second, we find that firms previously inattentive to past inflation dynamics adjust their prices more significantly upon receiving central bank inflation forecasts than their more informed counterparts. This is consistent with the previous finding that the extent of the information shock matters. Among equally inattentive firms, we observe that additional information on input cost developments is generally more effective in moderating pricing plans.

Third, we assess the role of labor and energy as input costs. Firms considering these factors crucial for their pricing are less responsive to central bank forecasts about these costs. This suggests that highlighting energy or labor costs might inadvertently draw attention to increasing cost burdens, thereby neutralizing the intended effect of reducing inflation expectations through information dissemination. Conversely, firms placing less importance on these factors in their pricing decisions respond more markedly to the combined information about labor and energy costs, suggesting enhanced credibility of the information provided. Fourth, our findings indicate that firms dissatisfied with economic policy do not significantly alter their prices upon receiving central bank forecasts, emphasizing the role of institutional credibility. This finding complements results from household studies, which show that low trust in the central bank is typically linked with a diminished desire to be informed (Hayo and Neuenkirch, 2014). Therefore, the credibility and trust in the central bank seem to significantly affect the effectiveness of monetary policy communication (Christelis et al., 2020; Ehrmann et al., 2023). Finally, we explore the frequency of firms' price setting. Our data shows that although firms plan to adjust

prices more frequently in times of high inflation, their planned frequency of price setting remains largely unchanged when exposed to our information treatments. The observed increase in the frequency of price setting by firms is consistent with recent research that suggests state-dependent pricing behavior among firms (Cavallo et al., 2023).

In a final step of our empirical assessment, we incorporate inflation expectations directly into our regression analyses to shed light on the pass-through of inflation expectations to prices.[3] To this end, we investigate for firms in the control group how (untreated) inflation expectations translate to pricing plans. In addition, we estimate separate slope coefficients and intercepts for each treatment group. While the slope coefficient can be interpreted as how untreated and treated inflation expectations translate to post-treatment price plans, we interpret the group-specific intercept as the average effect of our information treatments on pricing plans.

We observe a one-to-one relationship between expectations and firms' pricing plans for firms in the control group. Even though this one-to-one relationship is not a causal estimate, it is striking that firms' inflation expectations fully translate to prices. This finding indicates that in *high-inflation environments*, inflation expectations appear to be highly relevant for firms' price setting behavior. In contrast, in low-inflation environments, Coibion et al. (2018, 2020b) as well as Rosolia (2021) document only insignificant relationships between inflation expectations and firms' pricing plans.

Furthermore, our results suggest that firms incorporate less of their pre-treatment inflation expectations into their pricing plans when they receive forecasts about energy and labor costs from the central bank in addition to general inflation forecasts (lower slope coefficients). This implies that adding energy and labor cost projections to the overall inflation forecasts leads firms to give more weight to the information provided when deciding on their planned price setting. At the same time, the expectation of increased energy and labor costs results in higher average planned price levels (higher intercepts) in the energy and labor cost treatments, as input costs relevant for firms price setting are explicitly stressed to them. Our observation that there are no notable differences in average treatment effects among our three treatments can be attributed to these two offsetting effects. That is, stressing input cost factors reduces the weight firms place on pre-treatment inflation expectations but increases inflation-independent planned prices, potentially due to higher awareness of the cost inflation developments.

We contribute to existing work along several dimensions. First, we contribute to the literature assessing the role of information as a suitable policy tool for central banks striving for price stability. The importance of communication strategies to dampen over-

[3]The primary purpose of our experiment is to examine the planned price response to inflation information, rather than the effect of treatment-induced updates in expectations on prices. Therefore, we do not survey post-treatment expectations, but elicit planned prices immediately after the treatment to ensure that participants take the provided information into account when reporting their price plans (see Section 3 for more discussion of this design choice).

all uncertainty with regard to economic and monetary policy has risen since the 1990s (Blinder et al., 2008). Nevertheless, empirical evidence on the success of communication strategies related to inflation rates to affect firm decisions is still scarce (Coibion et al., 2020a). Testing this channel, we find that central bank communication can be a successful tool for dampening the transmission of biased high-inflation expectations to higher prices. Thereby, central banks can control and curb inflation by breaking expectations-price spirals of price-setters. This is particularly relevant when traditional instruments such as interest rate changes are costly and take time to materialize in the economy.

Second, we are the first to explicitly test how providing inflation information affects firms' pricing strategies in a *high-inflation environment*. Prior studies in the literature are conducted in *low-inflation environments*, which may be the reason that they document only relatively small (Coibion et al., 2018, 2020b) or zero (Rosolia, 2021) effects. This difference in findings highlights the importance of the inflationary context in which firms operate. In low-inflation environments, the benefits of price changes due to rather small revisions in expected inflation might not outweigh price adjustment costs, which may explain the observations of a small or zero effects (Rosolia, 2021). In contrast, in our high-inflation setting, where information on price dynamics is highly relevant, information provision with regard to inflation translates into higher price adjustments, because the benefits of these adjustments outweigh the costs. The significance of the inflationary context regarding the magnitude of treatment effects is supported by literature on households and firms (Weber et al., 2023).

Third, whereas previous firm surveys test the impact of *central bank inflation targets* or most recent *annual realized inflation* on inflation expectations (Coibion et al., 2018, 2020b; Savignac et al., 2024; Hunziker et al., 2022; Huber et al., 2023), we focus on *central bank inflation forecasts*, which previous research has shown to be useful in affecting household expectations (Coibion et al., 2022; Dräger et al., 2024) and which are arguably more important for firm decisions that are a function of future economic circumstances. We test the relevance of central bank inflation forecasts for firms' price-setting in times of high uncertainty about future price developments, an environment in which inflation forecasts could become an even more important factor for firms' decision-making process. Moreover, our results for an advanced economy (Germany) add to the findings for developing countries with persistently high inflation. Using an information provision experiment with firms in Uruguay, Caruso-Bloeck et al. (2023) find that firms adjust their inflation and GDP growth expectations but observe no effect on price changes when treating firms with expected disinflation projections due to a new monetary policy regime.

Fourth, we add another layer of information to our experiment that features components of the overall central bank inflation forecasts which are relevant for firms' input cost developments, i.e., energy and wage costs. This allows us to make inferences about how information about input cost developments affects firms' planned price-setting, thereby

addressing a gap in the existing literature (Weber et al., 2022).

Fifth, an advantage of our setting is that our sample is not restricted to certain industries or larger firms, but includes firms from a wide range of industries, and of different sizes. Furthermore, we show that the firms we survey are, on average, relatively well-informed about past inflation dynamics ex ante, which works against us finding an effect of our information treatment. The fact that we still find a treatment effect suggests that the effects of similar information policies could be even larger in settings where firms are less well informed (Weber et al., 2023).[4]

Finally, on a broader level, we add to the literature studying the effects of aggregate-level variables on firm-level decisions and to the literature on managerial inattention. The fast-growing literature that studies the effects of aggregate-level variables on firm-level decisions shows that macroeconomic conditions explain variation in managers' decisions (Ball et al., 2009; Bonsall IV et al., 2013; Binz, 2022). In addition, firms' profitability and investments are influenced by monetary policy and macroeconomic announcements (Binz et al., 2022a,b). We contribute to this stream of literature by providing causal evidence that (inflation) forecasts by monetary authorities directly influence managers' (pricing) plans. Moreover, literature on managerial inattention posits that managers, as all economic agents, have limited capacities (Ocasio, 1997; Sims, 2003; Dessein et al., 2016; Dessein and Santos, 2021). Ample empirical evidence exists showing that managerial capabilities explain the quality of managerial decisions and thereby eventually firms' performance (Helfat and Martin, 2015). We show that a substantial portion of managers are inattentive to inflation dynamics, and that more attentive firms are influenced in their pricing plans to a lower extent when receiving central bank inflation forecasts.

The paper proceeds as follows. Section 2 describes the data. Section 3 describes the experimental setup. Section 4 provides descriptive information on firms' beliefs on past and future inflation, and their pricing plans. Section 5 presents the main results of our analyses, while Section 6 provides evidence on heterogeneous treatment effects. Section 7 dives deeper into the mechanism underlying our main results. Finally, Section 8 provides policy implications emerging from our results.

2 Data

Our analysis rests on survey data collected by the German Business Panel between July 26, 2022, and November 2, 2022. Bischof et al. (2023) provide a detailed description of the German Business Panel. Contact information of firms was obtained from the *Bureau van Dijk Orbis* database and using web scraping techniques. The sample of firms that

[4]Previous survey studies include Coibion et al. (2020a); Candia et al. (2024); Weber et al. (2022); Savignac et al. (2024); Link et al. (2023). Coibion et al. (2020a) provide an overview. The overall results indicate that the inflation environment affects how well households and firms are informed about recent inflation developments.

participated in our survey was drawn randomly from the overall address pool and invited to participate in our online survey via email. A total of 1,944 respondents completed our questionnaire. The survey collects data on firm characteristics including firm revenues, the number of employees, its industrial sector and its legal form. Moreover, respondent characteristics like gender, education and position in the company are collected. Our set of surveyed firms is largely representative of the underlying population of German firms in terms of industry sector, and slightly larger with regard to the number of employees and revenues (see Table B.4 in the Appendix B). Approximately 87% of survey respondents are the owner or CEO of the corresponding firm. The majority of firms in our sample has less than 50 employees (94%) and less than 10 million € in revenues (93%). With regard to industry composition, firms mainly come from the manufacturing and trade sector (28%). In the Appendix, we offer comprehensive information on the variable definitions and survey questions (Appendix A), along with detailed summary statistics on both firm and manager characteristics of the participating firms (Appendix B).

3 Experimental Setup

For the survey experiment, we assign respondents randomly to three treatment groups that receive information on the German central bank's inflation assessment and a control group which does not receive central bank information. The information underlying the three treatments was retrieved from the June 2022 report of the German central bank (Deutsche Bundesbank, 2022). The German central bank did not update these forecasts during our period of data collection.[5]

Figure 1 presents an overview of the survey flow. At the start of the survey, all participants are asked to inform us about their inflation assessment for the year 2021 (realized at the time of the survey), and their inflation expectations for the years 2022 (current) and 2023 (future). This allows us to measure beliefs prior to providing participants with additional information. This practice is in line with suggestions on the design of information provision experiments by Haaland et al. (2023). Then we apply our information treatments.[6]

[Figure 1 ABOUT HERE]

[5]We use inflation forecasts from the German Bundesbank because inflation data for Germany is likely more relevant for our sample of German firm decision-makers. Additionally, the German Bundesbank is regarded as a trusted institution by the German public due to its well-known focus on price stability (Ehrmann and Tzamourani, 2012; Hayo and Neuenkirch, 2014). However, we acknowledge that the European Central Bank (ECB), not the Bundesbank, is the institution responsible for setting the monetary policy strategy for the Eurozone. Nevertheless, the Bundesbank holds a seat on the ECB's governing council, which allows it to influence EU monetary policy and assess its implications for future inflation in Germany.

[6]Translated experimental treatments can be found in Figure A.1 in Appendix A.

First, around one-quarter of survey participants receive our baseline **INFLATION treatment**. Firms in this group see their own inflation assessment from the previous question vis-à-vis the German central bank's inflation estimates for the three years (2021, 2022, 2023). The reported central bank estimates are 3.2% (2021), 7.1% (2022), and 4.5% (2023). Second, another quarter of participants receive the **ENERGY treatment**. In addition to the information set provided in the INFLATION treatment, firms receive information on the central bank forecasts of energy prices for 2021 to 2023. These central bank estimates for energy price changes are 10.1% (2021), 27.2% (2022), and 8.5% (2023). A third group receives the **WAGE treatment**. This information treatment is very similar in structure to the previous ENERGY treatment. However, instead of energy prices, firms receive central bank estimates on the development of wages (in addition to the information provided in group INFLATION). These estimates are 3.5% (2021), 4.3% (2022), and 4.5% (2023). Finally, a **CONTROL group** is provided with an overview of their own inflation estimates originating from the first survey question. Balancing tests (Appendix B) show that randomization worked well: Inflation expectations, firm and respondent characteristics are balanced across groups.

Our experimental design has several features worth emphasizing. First, we ensure that CONTROL group firms are as reflective of inflation as treatment firms by exposing firms in the CONTROL group to the same amount of survey steps covering the topic of inflation (rather than having CONTROL firms skip the treatment screen). We accomplish this by explicitly treating firms in the CONTROL group with their pre-treatment assessment of inflation. Therefore, any effect observed on planned prices in the CONTROL group can be interpreted as the result of reminding firms about their inflation forecast.

Second, between subject designs like ours typically have no natural anchor and, therefore, results inherently have substantial noise. This is particularly the case with forecasts. We reduce this noise by asking for the 2021 inflation rate, which was realized at the time of the survey. This provides a natural anchor and allows within subject comparison of realized and expected inflation.

Third, note that our survey was designed to analyze the planned price response to our interventions. Therefore, to ensure participants incorporate the provided information into their pricing plans, we collect planned prices immediately after the treatments. Although we assess inflation expectations before the treatment, we do not reassess them post-treatment, preventing us from linking updated expectations to prices for our treatment groups. We decided for this strategy as eliciting pre- and post-treatment inflation expectations requires asking the same question twice and thus entails problems related to consistency bias, ordering, over-sensitivity to context, and experimenter demand (Haaland et al., 2023). Moreover, the alternative of using a different question design to elicit post-treatment inflation expectations can lead to different answers solely due to the difference in question-wording or design (Weber et al., 2023; Pavlova, 2024). Additionally, in

settings where outcomes of interest are firm-level employment or investment, it is easier to elicit both the outcome of interest and inflation expectations before and after an information treatment using slightly similar question wordings. However, the problem of asking a similar question several times becomes, however, more severe in our setting when the outcome of interest is firm-level prices, since inflation and price-levels are closely related concepts. Thus, eliciting price plans and inflation expectations before and after the information treatment would mean asking a similar question *four times*, which we try to avoid in our survey design. However, to explore pass-through effects from inflation expectations to prices, we analyze the relationship between inflation expectations and prices of firms in the CONTROL group (only treated with their own forecasts) and investigate how their inflation expectations influence pricing plans.

Finally, our setup combines three levels of information additions. These are participants' own estimates (CONTROL), plus inflation forecasts (INFLATION) plus forecast components (ENERGY, WAGE). This design allows us to estimate the incremental effect of each piece of information. We expect that firms revise their expectations and plans to a stronger degree when receiving more information. A second dimension is the kind of information. ENERGY and WAGE treatments have distinctly different properties. Energy prices are highly volatile key drivers of the current inflation rates and expectations (Wehrhöfer, 2023). They may decrease in the future as quickly as they have increased before, which is why they rather affect firms' short-term planning. Labor costs are predicted to be increasing at a much lower rate, but are rather stable and relevant for firms' long-term decisions. In sum, both ENERGY and WAGE treatments contain information on input cost (expectations) that relates more directly to firms' price setting, compared to the INFLATION treatment.

4 Pre-treatment Beliefs on Inflation Expectations

As a first step, we study how well-informed firms are about realized inflation in 2021. We find that they are surprisingly well-informed. Figure 2a shows that 75% of respondents indicate inflation rates (measured before treatment) for 2021 that are within a 2-percentage-point range of the central bank's reported 3.2%. Firms in our high-inflation environment seem to be better informed about inflation dynamics compared to previous studies in low-inflation environments, presumably because higher inflation makes the topic more salient and increases the benefit of being informed.[7] Still, on average, firms slightly overestimate inflation by around 1.5 percentage points (Mean: 4.7%), in line with

[7] Coibion et al. (2018) report a share of only 49% when inflation rates were relatively low. For Germany, Link et al. (2023) find that firms are better informed about macroeconomic indicators (e.g. inflation) than households. Cavallo et al. (2017) show that the environment matters, as households in high-inflation environments (e.g., Argentina) are better informed about inflation than households in low-inflation environments (e.g., U.S.).

previous results finding that firms overestimate inflation (Weber et al., 2022).

When assessing the current (2022) and future (2023) inflation rates, the distribution becomes wider and deviates more from the German central bank's forecasts. For 2022, firms are around 3 percentage points above the central bank's forecast of 7.1% (mean: 10.5%) with only 50% of firms indicating a value within the 2-percentage-point distance (see Figure 2b). Moreover, 81% of the firms in our sample have higher inflation expectations for 2022 than the central bank. For 2023, Figure 2c reveals that only 23% of respondents are somewhat close to the central bank's forecast of 4.5%. The mean firm expects inflation to be almost 7 percentage points higher (mean: 11.3%). Overall, 94% of our participants indicate inflation expectations, which are higher than the central bank's forecast. Thus, our results indicate that firms' inflation expectations appear to be well above the central bank's inflation target of 2% in our high-inflation environment. This is in line with results for households and firms in Germany (Coleman and Nautz, 2023; Wehrhöfer, 2023).

Finally, Figure 2d shows the distribution of planned price changes for firms in the CONTROL group. Firms in the CONTROL group are not influenced by additional information on the inflation assessment from the central bank, as we only remind them of their own inflation assessment. On average, these firms plan to increase prices by 15.4% in the next 12 months. Approximately 90% of firms plan to increase prices, and less than one percent plan price reductions.

[Figure 2 ABOUT HERE]

5 Main Experimental Effects on Planned Price Changes

Next, we investigate how the information treatments affect firms' price-setting plans. The scope for change in beliefs is large, as the majority of firms (94%) have higher inflation forecasts for 2023 compared to the central bank's prediction. We hypothesize that in response to the information provision, firms will adjust their pricing plans, on average, downward. To test this hypothesis, we estimate the following regression model:

$$\Delta Price_{i+12m} = \alpha_0 + \alpha_1 \times INFLATION_i + \alpha_2 \times ENERGY_i + \alpha_3 \times WAGE_i + X_i'\gamma + \varepsilon_i. \quad (1)$$

The dependent variable $\Delta Price_{i+12m}$ represents the planned change of firm i's main product's or service's price in the next 12 months. The binary variables $INFLATION_i$, $ENERGY_i$ and $WAGE_i$ take the value of one, if firm i was allocated to the INFLATION, ENERGY or WAGE treatment, respectively, and zero otherwise. α_0 represents the expected price change in the CONTROL group. α_1, α_2 and α_3 measure the incremental

effect of the INFLATION, ENERGY and WAGE treatments, respectively, relative to the CONTROL group.

X_i is a vector of control variables which we include in some specifications to enhance precision. It includes manager controls, firm controls, and time controls. Manager controls are the respondent's gender, education (no training, apprenticeship & other, master (crafts, technicians), University Degree or PhD), and the respondent's position in the company (owner/CEO, department head, other). Firm controls include the size group of the firm (micro-enterprise, small company, medium-sized company, large company)[8], the legal form of the firm (sole proprietor, private company, corporation, other), and the industry (NACE Revision 2 industry sections). As the survey is conducted on an ongoing basis, we also include the survey week into the vector of control variables. Descriptive statistics for the control variables can be found in Appendix B. The regression analysis employs ordinary least squares (OLS), and standard errors are clustered at the industry and survey-week level.

[Table 1 ABOUT HERE]

Results are summarized in Table 1. Column (1) presents the baseline experimental effects without conditioning on any control variable. Firms in the CONTROL group plan to increase prices of their main product or service by 15.4% in the 12 months ahead. Compared to the CONTROL group, firms that receive central bank forecasts in the INFLATION treatment plan to increase prices by 3.4 percentage points less, leading to a price increase of just 12%. This difference of 22% implies a strong economic effect of our treatment. Furthermore, we find reduced price changes of similar magnitude when providing firms additionally with energy price and labor cost developments as predicted by the central bank. Firms receiving the ENERGY (WAGE) treatment plan to increase prices by 19% (21%) less compared to the CONTROL group.[9] All results are robust to the inclusion of control variables, as shown in column (2).[10]

Overall, two main insights emerge. First, information about current and forecasted future inflation rates matter for firms' price-setting plans. Providing firms with the inflation assessment of the central bank reduces planned prices of firms in a statistically and economically meaningful way, suggesting that firms update their price-setting plans towards the inflation forecasts of the central bank. Thus, adequate communication policies towards firms can be an effective additional instrument for monetary policy-makers to better control firms' price setting, and thereby inflation in the economy as a whole.

[8]Classification is in line with the European Commission's definition for small and medium-sized enterprises (SMEs).

[9]We do not find a significant difference between the experimental groups INFLATION, ENERGY, and WAGE. P-values from the respective t-tests for specification (1) in Table 1 are: 0.775 (INFLATION vs. ENERGY), 0.955 (INFLATION vs. WAGE), and 0.665 (ENERGY vs. WAGE).

[10]Our findings remain robust when limiting the sample to firms with non-negative inflation expectations, and excluding firms with exceptionally high inflation expectations (>30%). Results can be found in Table C.1 in Appendix C.

Second, providing firms with additional information on energy price and wage developments does not lead to substantial differences in planned price-setting behavior as compared to providing information on inflation alone.

6 Heterogeneity in Treatment Effects

6.1 Divergence between Treatment Information and Expectations

A major challenge in information experiments is distinguishing the effects of priming from actual belief updating (Haaland et al., 2023). The observation of stronger treatment effects among respondents whose priors are less aligned with the information treatment is frequently interpreted as evidence of an actual change in beliefs (Armantier et al., 2016; Haaland et al., 2023). Therefore, we first investigate heterogeneity with respect to treatment intensity, which depends on the divergence between firms' pre-treatment expectations and the inflation forecast of the central bank for 2023 (4.5%). Following Coibion et al. (2018), we define firms to be close to the central bank's forecast if they deviate at most 2 percentage points upwards (low prior, n=447). Otherwise, firms are categorized as having a high prior (n=1,192). We estimate equation (1) separately for both groups. Results are displayed in columns (3) through (6) of Table 1.

We find that firms with a high prior show a larger reaction to the treatments compared to firms with a low prior, which exhibit no significant treatment effect. Note that firms in the CONTROL group with lower prior inflation expectations also plan lower price increases of about 10%, as compared to firms with high prior expectations, who plan to increase prices by about 17%. Given this difference, the relative effect sizes for the treatment groups compared to the CONTROL group are rather similar (e.g., 17% for low-prior firms vs. 22% for high-prior firms in the INFLATION treatment), even though absolute effect sizes for the firms with a high prior are larger than for firms with low prior inflation expectations.

This finding suggests that firms with larger deviations from the information treatment also adjust their planned prices downwards to a larger extent, on average, when compared to control group firms. We interpret this as indication that observed treatment effects are not due to priming but due to actual updating of participants' beliefs.

6.2 Inattention with regard to Inflation Dynamics

Next, we explore how inattention to inflation dynamics affects firms' price planning strategies and the effectiveness of our experimental interventions. A feature of our survey is that, pre treatment, we ask firms not only about their expectations about future inflation, but also about their perception of recently *realized* inflation rates in 2021. Therefore, we

can control for firms' general (in)attention to inflation dynamics and compare the differential impact of our information treatments on price setting plans of attentive and inattentive firms.[11]

The idea and our implementation closely follow Coibion et al. (2018). They show that firms in New Zealand, which were initially uninformed about the inflation target of the Reserve Bank of New Zealand, revised their employment and investment decisions to a significant extent when provided with information on the *inflation target* compared to firms which did not receive any information, but they could not find a revision in firms' price setting.[12] Similar to Coibion et al. (2018), we find in Figure 2a that there is a portion of firms that is not well-informed about past inflation dynamics. We conjecture that well-informed firms will exhibit less adjustment in their pricing plans upon receiving our information treatment, compared to those with relatively limited knowledge. To explore this, we estimate the following equation:

$$\Delta Price_{i+12m} = \alpha + \beta \times Inattention2021_i + \sum_{k=1}^{3} \delta_k TREATMENT_{ik} + \sum_{k=1}^{3} \theta_k Inattention2021_i \times TREATMENT_{ik} + X_i'\gamma + \varepsilon_i. \quad (2)$$

We define $Inattention2021_i$ as the absolute difference between firms' perceived inflation for 2021 and the realized inflation rate published by the central bank (3.2%). To explore the impact of inattention on future pricing decisions, we include $Inattention2021_i$ both as a standalone variable and in interaction with our three treatment groups. The coefficient estimate, denoted as β, allows us to quantify the effect of higher levels of inattention on pricing decisions in the CONTROL group, when firms are only reminded about their own assessment.

[Table 2 ABOUT HERE]

[11] In our analysis, we concentrate on *central bank inflation forecasts*. We decide to focus on *central bank inflation forecasts* instead of *realized inflation* for two reasons. First, previous research, such as Coibion et al. (2022), indicates that using the *central bank's inflation forecasts* is particularly effective in influencing household expectations. However, this approach has not been extensively explored in firm surveys. Second, in periods of heightened uncertainty about future price developments, central bank inflation forecasts should become more relevant for firms' decision-making processes than past inflation dynamics. Nevertheless, given that we also assess firms' attentiveness to realized inflation in 2021, our results in Section 6.2 can be compared with findings from previous firm surveys. These surveys examine the effect of information on *central bank inflation targets* or the most *recent annual realized inflation* on inflation expectations and firm decision-making (Coibion et al., 2018, 2020b; Savignac et al., 2024; Hunziker et al., 2022).

[12] Similar to an *inflation target*, the *inflation rate in 2021* is a realized number at the time the survey was conducted. Although we agree that perceptions of current and future inflation can depend on the specific environment firms are in, testing knowledge about a specific value already realized at the time of the survey should reasonably capture the concept of attentiveness to inflation dynamics.

In Table 2, column (1), we observe that firms in the CONTROL group who possess perfect knowledge of realized inflation ($Inattention2021_i = 0$) have an average planned price adjustment of 11.1%. For each one percentage point deviation in inflation assessment from the realized inflation rate in 2021, firms, on average, increase their prices by an additional 2.1 percentage points. Next, the coefficients θ_k can be interpreted as the incremental effect of a one percentage point larger inattention on the effectiveness of our treatments, while the coefficients δ_k show the treatment effects on perfectly informed firms in the respective experimental group. Results presented in column (1) of Table 2 indicate that the information treatments do not have a statistically significant effect on firms that are well-informed. However, for firms which are more inattentive to inflation rates in 2021, the treatments are more effective. For firms receiving the INFLATION treatment and deviating by one percentage point in their past inflation assessment from the realized inflation rate, their planned price increases are 0.9 percentage points lower compared to their equally uninformed peers in the CONTROL group. The corresponding values for the ENERGY and WAGE treatments are 1.4 percentage points and 1.9 percentage points, respectively.

In sum, this indicates that our information treatments are more effective for less informed firms. Additionally, we find that providing more detailed information exerts a greater impact than less detailed information when considering uninformed firms. Our findings in a high inflation environment complement previous results from Coibion et al. (2018) in a low inflation environment. They report a revision effect for inattentive firms regarding employment and investment decisions, but not for prices, when provided with information on the inflation target of the central bank. Our results concerning price plans suggest the relevance of information on inflation dynamics for firms' price-setting strategies in high inflation environments, where the benefits of price adjustments appear to outweigh the costs.

6.3 Importance of Input Costs

Little research exists on how firms' inflation expectations interplay with the relationship between their input costs and their price setting (Weber et al., 2022). A feature of our survey is that we have different information treatments, two of which include the central bank's projected developments of energy costs (ENERGY) and labor costs (WAGE) on top of the central bank's inflation forecasts. In addition, we ask firms about the most important factors for their price setting. The two most frequently selected answers to this question are *energy/material costs* and *labor costs*. Nearly half of our participants (46 %) indicate both of these factors to be important.[13]

[13]In Appendix B, we show that the relevance of these cost factors holds true across all experimental groups, indicating that energy/material costs and labor costs are consistently regarded as among the most crucial factors in the price-setting decision of firms.

Using this information, we investigate whether firms, for which labor and energy costs are important, react differently to our information treatments. Thereby, we are particularly interested in the difference between the INFLATION treatment on the one side and the ENERGY and WAGE treatments on the other side. We re-estimate equation (1) for the two different groups. Results are displayed in Table 3.

[Table 3 ABOUT HERE]

Columns (1) and (2) replicate the information from Table 1 for comparability. Recall that all three information treatments have a similar average effect on firms' planned price setting. This changes when we observe only firms which indicate energy and labor costs to be important pricing factors in Columns (3) and (4). For these firms, we find significant treatment effects of comparable size for the INFLATION treatment, but not for the ENERGY and WAGE treatment. In other words, informing these firms about central bank inflation forecasts alone (INFLATION) makes them adjust their price plans, on average, downwards. However, when they are additionally informed about expected increases in input costs that are particularly relevant to them (ENERGY, WAGE), they no longer adjust their prices significantly. That is, by stressing energy or labor costs, we potentially draw attention to increases in their cost burden, thereby mitigating the downward shift of providing information on inflation forecasts.

Turning to columns (5) and (6) of Table 3, we observe an inverted pattern, when considering only firms for which energy and labor costs are *not* similarly important. Here, the additional information provided in the ENERGY and WAGE treatments seem to amplify the treatment effect of central bank inflation forecasts on pricing plans. While firms in the INFLATION group reduce their price plans on average (insignificantly) by around 3.5 percentage points compared to CONTROL group firms, the effect is significant and on average around 5 percentage points (4 percentage points) for firms receiving the ENERGY (WAGE) treatment. That is, for firms for whom energy and labor costs are not a primary consideration in their pricing, the additional information about the developments of these costs tends to reinforce, rather than mitigate, the effect of central bank inflation forecasts. One could interpret this as follows: providing additional forecasts on inflation components lends credibility to the inflation forecast itself, as long as the components are not of first order importance to the firms receiving the information.

In sum, we interpret these findings as input costs not affecting the relationship between firms' inflation expectations and pricing plans as long as they are not explicitly mentioned (INFLATION). Confronting firms, however, directly with input cost projections in addition to central bank inflation forecasts (ENERGY, WAGE), can have differential effects on firms' price setting. Depending on whether firms deem these input costs important, the additional information can either mitigate or strengthen the impact of inflation forecasts on firms' pricing plans.

6.4 Satisfaction with Economic Policy

The effectiveness of central bank communication critically hinges on the credibility of the central bank regarding the public. The central bank's credibility, in turn, is enhanced with trust into the central bank and the general institutional environment (Blinder et al., 2024). In our survey, we ask firms the question *How satisfied are you with economic policy?* on a scale from zero (dissatisfied) to ten (satisfied). In this section, we use the answer to this question as a proxy for trust in the general institutional environment.

Descriptively, satisfaction with economic policy in our sample is quite low (mean: 2.9/10, median: 3/10). Therefore, we define firms to have a low satisfaction when they indicate a value between zero and two as answer to the aforementioned question. To validate our proxy, we refer to prior literature. Among households, a low trust in the central bank is usually associated with less factual knowledge about central bank policies and a lower desire to be informed (Hayo and Neuenkirch, 2014; Dräger and Nghiem, 2023). Furthermore, household studies indicate that the credibility and trust in the central bank significantly influence the effectiveness of monetary policy communication (Christelis et al., 2020; Ehrmann et al., 2023). As we also measure firms' inattention with respect to past inflation dynamics (see section 6.2), we can assess whether firms that are rather unsatisfied with economic policy are less attentive to past inflation dynamics, which would increase the validity of our proxy. Indeed, firms with lower (higher) satisfaction estimate inflation in 2021 to be on average 5.3% (4.2%), while realized inflation in 2021 was at 3.2%. The difference between the groups is statistically significant at all conventional levels ($p<0.001$).

[Table 4 ABOUT HERE]

As in the previous section, we separately re-estimate equation (1) for firms with a higher and lower satisfaction with economic policy. We conjecture that firms that are generally more dissatisfied lend less credibility to the central bank information provided in our treatments, and therefore show weaker price plan adjustments as a reaction to our treatments. The estimation results are displayed in Table 4. We indeed find that firms in the low satisfaction group do, on average, not significantly adjust their pricing plans as a reaction to any of the information treatments. The remaining firms with a higher satisfaction, however, show significant average downward price plan adjustments as reactions to all information treatments. This is particularly noteworthy as firms that are more satisfied generally expect inflation to be *lower* (mean: 9.1%) and therefore have less room for updating their inflation expectations, as compared to their dissatisfied peers (mean: 13.6%).

In sum, even though we can only broadly approximate firms' institutional trust in the central bank by considering their satisfaction with economic policy, our results indicate

that central bank communication is more effective when firms' institutional trust is higher, which should also be associated with greater satisfaction with the current economic policy environment.

6.5 Price Setting Frequency

An increase in the average level of inflation should lead to an increase in the share of firms changing prices more frequently. As the price level rises, the benefits of a price change exceed the expected costs of not changing prices (Ball et al., 1988). Empirically, Cavallo et al. (2023) confirm that depending on the inflation environment, firms adjust their price setting frequency, with more frequent price changes in higher inflation regimes. This idea contrasts with traditional price setting models like Calvo (1983), that do not allow for state-dependent price setting and assume a constant probability for changing prices. Following Cavallo et al. (2023), we would expect firms absent any treatment not only to increase their price level, as demonstrated in Panel (d) of Figure 2, but also the frequency at which they set their prices.

To explore this, we pose the following question in our survey: *Compared to past years: Do you think you will adjust the price of your main product or service more or less frequently in the next 12 months?* We offer the following options to choose from: *Much less frequently* (e.g. every 12 months in future, previously every 3 months), *Rather less frequently* (e.g. every 12 months in future, previously every 6 months), *Unchanged* (e.g. in future every 12 months, previously every 12 months), *Rather more frequently* (e.g. every 6 months in future, previously every 12 months), *Much more frequently* (e.g. every 3 months in future, previously every 12 months).

[Table 5 ABOUT HERE]

We provide some descriptive details on the answers to this question in Table 5. Panel A confirms that 64% of the firms in the CONTROL group indicate to increase prices more frequently in the near future. This confirms that firms do not only plan to increase price levels but also the frequency of their price setting, as conjectured. To quantify this, we also ask a subset of firms at which interval they adjusted their prices for their main product or service in the past *low inflation environment* and in the current *high inflation environment*. Firms in the CONTROL group indicate on average 16 months (9 months) as past (current) price adjustment frequency, so these firms somewhat less than halved the period between two price changes on average.

Interestingly, the distribution of answers is very similar for firms in the treatment groups (INFLATION, ENERGY, WAGE) when compared to the CONTROL group. Independent of the randomly assigned group, around 60% of firms indicate to increase prices more frequently. Panel B of Table 5 confirms the general impression that the distributions

of answers between groups are not statistically different. This means that upon receiving our information treatments, firms do not adjust the price change frequency, but only the levels of planned prices (see Table 1).

Vice versa, we note that firms who plan to increase their price setting frequency have higher pre-treatment inflation expectations compared to their peers that do not plan to adjust price setting frequency (12% vs. 10%, p-value of difference < 0.001). Therefore, in line with Table 1, these firms with a higher planned price setting frequency (and higher prior inflation expectations) also reduce their pricing plans more strongly, which we confirm in Table 6. Thus, the information on current and future inflation dynamics in our treatments is especially relevant for firms which plan to increase prices more often in the future.

[Table 6 ABOUT HERE]

In sum, the evidence presented in this last subsection, even though mostly descriptive, supports the notion that price setting frequency varies in different inflation environments (*state dependence*), in line with recent empirical evidence provided by Cavallo et al. (2023).

7 Price Setting Mechanism

In Section 5, we demonstrate that our experimental treatments effectively influenced firms' pricing strategies, leading to a general downward shift. Moreover, there were no significant effect differences, on average, between the INFLATION, ENERGY, and WAGE treatments. This section provides a detailed exploration of the underlying mechanisms behind this finding. We refine equation (1) to directly include firms' pre-treatment inflation expectations for 2023 in our regression analysis. This approach allows us to examine variations in both the intercept and slope coefficients across the different treatment groups, as different signals may have different value and perceived precision, conditional on pre-treatment inflation expectations. Consequently, this can influence the relative effectiveness of each treatment.

7.1 CONTROL vs. INFLATION Treatment

We start by comparing the impact of supplementing firms' own forecasts solely with central bank predictions, as is done in the experimental group INFLATION. This involves comparing firms in the CONTROL group with firms in the INFLATION group. To this end, we estimate the following equation, solely based on firms from these two groups.

$$\Delta Price_{i+12m} = \alpha + \beta \times E_{2022}Inflation_{i2023} + \delta \times INFLATION_i + \theta \times (INFLATION_i \times E_{2022}Inflation_{i2023}) + X_i'\gamma + \varepsilon_i \quad (3)$$

Like in equation (1), $\Delta Price_{i+12m}$ indicates the planned change of firm i's main product's or service's price in the next 12 months. Further, $E_{2022}Inflation_{i2023}$ indicates firm i's expectation for the inflation rate for the year 2023, as assessed in the year 2022. As 2023 was entirely in the future at the time of our survey, this variable reflects firms' inflation expectations. The binary variable $INFLATION_i$ takes the value of one, if firm i is allocated to the INFLATION treatment, and is zero otherwise. The vector X_i includes the same set of variables as described in Section 5. Standard errors are clustered at the industry and week level.

[Table 7 ABOUT HERE]

The coefficients can be interpreted as follows. β represents the pass-through of pre-treatment inflation expectations to the price setting plans of firms in the CONTROL group. As we use a control group in which we remind firms about their own inflation expectations before asking about their planned price setting, firms should be strongly anchored on their pre-treatment expectations when thinking about their pricing plans. β can therefore be interpreted as an estimate of the strength with which inflation expectations translate to near-term pricing strategies of firms. As our study is conducted during a high-inflation period, we expect that the inflationary environment becomes increasingly decisive in firms' pricing decisions. Unlike in low-inflation scenarios, where minor changes in expected inflation might not justify the cost of price adjustments, our focus is on a setting where the influence of inflation expectations on firm decisions is expected to be highly relevant. In this context, we argue that the advantages of adjusting prices in response to these expectations will surpass the associated costs. Therefore, we expect β to be positive and significantly different from zero.

Indeed, the results presented in Table 7 support this hypothesis. The estimated coefficient is 1.002 in specification (1), without controls, and 1.038 in specification (2), with controls. The coefficient estimates are statistically different from zero. These estimates suggest a one-to-one translation of inflation expectations on pricing plans, when firms are actively reminded of their own inflation forecasts through our *active control group design*. We conclude that inflation expectations are of great importance for the pricing strategies of firms in our high-inflation environment.

The coefficient δ represents the differential intercept for the INFLATION group compared to the CONTROL group. It captures the concept that the INFLATION treatment could shift average planned prices higher or lower relative to the CONTROL group.

Crucially, δ encompasses the combined effect of firms' responsiveness to the provided information and the disparity between the central bank forecast and the firms' average pre-treatment inflation expectations. Given that the majority of firms (94%) have higher inflation forecasts for 2023 compared to the central bank's prediction for the same year, we anticipate a downward adjustment in the average planned price for the INFLATION group relative to the CONTROL group. This expectation is supported by the results presented in Table 7, where we observe a negative, though statistically insignificant, δ coefficient, suggesting a downward level shift of price plans of 1.236 percentage points (column (1)).

The relationship between pre-treatment inflation expectations and the planned pricing of firms is best described by the coefficient θ. This coefficient captures the change in the slope of the relationship between pre-treatment inflation expectations and planned pricing for firms in the INFLATION treatment, relative to firms in the CONTROL group. In other words, θ can be interpreted as the weight firms place on the provided forecast of the central bank compared to their initial expectations when deciding on their price setting. If the supplied information does not influence the price-setting behavior of firms, then θ will equal zero. This would result in the slope that connects pre-treatment expectations and pricing plans being identical to that of the CONTROL group.

A negative value of θ, however, suggests that the treatment group is attributing reduced importance to their initial inflation expectations and greater significance to the newly provided information when deciding on their planned prices. In the extreme case of $\beta + \theta = 0$, firms would put all their weight on the provided information when setting prices. The proportion of β counterbalanced by θ thus becomes the crucial measure for evaluating the shift in price setting in response to the introduction of new information. Results in Table 7 suggest that 24% (represented by -(θ/β)) is counterbalanced by the provided information.

Next, we connect the results in Table 1 and Table 7. Together, the coefficients δ and θ elucidate the average treatment effect of the INFLATION treatment as observed in Table 1. With an average pre-treatment inflation expectation of 11.3%, the INFLATION treatment, according to specification (1) in Table 7, reduces the planned price by 3.98 percentage points relative to the CONTROL group. This is similar to the effect in specification (1) of Table 1. The slight variation in treatment effects between the tables (3.38 vs. 3.98 percentage points) is attributable to differences in the sample compositions, as specification (1) in Table 1 also includes firms that did not enter a value for their 2023 inflation expectation.

[Figure 3 ABOUT HERE]

Finally, Panel (a) of Figure 3 illustrates the observed effects graphically with binned scatter plots of firms' pre-experimental inflation expectations for 2023 (x-axis) and their

price setting plans in the year ahead (y-axis). The estimated slope for the CONTROL group is 1.002 while the estimated slope for the INFLATION group is 0.758 (see Table 7). Further, a dashed vertical line indicates the mean inflation expectations of firms in our sample (11.3%). At this point of the x-axis, the gap between the red and the black line corresponds in absolute value to the coefficient of the INFLATION treatment (3.38) in Table 1.

7.2 INFLATION vs. ENERGY & WAGE Treatment

As the average price plan reaction to our three information treatments (INFLATION, ENERGY, WAGE) is very similar (see Table 1), we explore the mechanisms behind this finding. In particular, we want to know whether there are differences between the groups that are not captured by the average treatment effects we present in Table 1. To this end, we modify equation (3) to include only firms from the INFLATION, ENERGY, and WAGE groups, excluding firms from the CONTROL group. In the following specification (4), we compare the three treatment groups, using INFLATION as the baseline group, as firms in the INFLATION group receive the least detailed information among the three treatment groups:

$$\begin{aligned}\Delta Price_{i+12m} = \alpha + \beta \times E_{2022}Inflation_{i2023} + \delta_1 \times ENERGY_i + \delta_2 \times WAGE_i \\ +\theta_1 \times (ENERGY_i \times E_{2022}Inflation_{i2023}) \\ +\theta_2 \times (WAGE_i \times E_{2022}Inflation_{i2023}) + X_i'\gamma + \varepsilon_i. \end{aligned} \quad (4)$$

The idea behind equation (4) is to test for the incremental effect of treating firms with the central bank's energy and labor cost projections, in addition to the central bank inflation forecasts. This allows us to investigate whether the extent and type of inflation-related information matters for firms' price-setting behavior. Specifically, the ENERGY and WAGE treatments provide information on input cost projections that is more directly relevant to firms' pricing decisions compared to the information in the INFLATION treatment. The significance of energy/material costs and labor costs in the pricing decisions of companies is evident from the responses to one of our survey questions. The data reveals that approximately 69% of firms consider energy/material costs, while 64% take labor costs into account when making pricing decisions. In comparison, other factors such as legal regulations (26%), customer demand (25%), and competitor prices (19%) appear to have less impact.[14]

[Table 8 ABOUT HERE]

[14]See Appendix B for details.

Table 8 presents the results of regressions from equation (4). The following observations are noteworthy. We observe a significant upward intercept shift in the ENERGY and WAGE treatments compared to the INFLATION treatment, for both specifications with and without controls. In specification (1), firms in the ENERGY and WAGE treatments exhibit intercepts that are 5.698 percentage points (δ_1) and 3.808 percentage points (δ_2) higher, respectively. This result suggests that treating firms with inflation predictions about their most important cost factors, in addition to general price predictions, makes them more sensitive to future cost increases. This leads to an upward shift in average planned prices.

At the same time, the slope coefficients θ_1 (for the ENERGY treatment; -0.447 in column (1)) and θ_2 (for the WAGE treatment; -0.336 in column (1)) are both significantly lower compared to the INFLATION treatment. This implies a weakened relationship between pre-treatment inflation expectations and planned prices, indicating a higher weight that firms place on the provided information when firms set their pricing strategies. This result suggests that including energy and labor cost projections in overall inflation forecasts makes the treatment more relevant, as these costs are critical for the pricing decisions of firms in our survey.

Finally, Panel (b) of Figure 3 illustrates the observed effects graphically with bin scatters of firms' pre-experimental inflation expectations for 2023 (x-axis) and their price setting plans in the year ahead (y-axis), this time only for the treatments INFLATION, ENERGY and WAGE. Most striking is the fitted line slope difference between the INFLATION (0.758) and ENERGY/WAGE (0.311/0.422) treatments. This slope difference graphically illustrates the different weights that survey participants put on the provided information when indicating their price plans. Further, the fact that all lines intersect approximately at firms' *average* inflation expectations (11.3, marked with a dotted line), illustrates graphically why a difference of *average* treatment effects is absent (Table 1) even though the groups apparently respond in different ways to the different information treatments. Collectively, these results indicate a nuanced dynamic: the increase in intercepts and the reduction in slopes essentially neutralize each other. This results in a negligible overall average difference among the INFLATION, ENERGY, and WAGE treatments, as shown in Table 1 and discussed in Section 5.[15]

In terms of policy implications, these findings suggest that central banks can enhance the relevance of their communication by incorporating predictions about significant cost factors important to firms' pricing decisions, beyond just providing general price forecasts. Furthermore, our results imply that emphasizing cost factors in central banks' communication does not compromise the overarching objective of mitigating upward inflation trends

[15]Using coefficients from specification (1) of Table 8 and the average inflation expectation for 2023 (11.3%), the calculated overall effect is 0.6469 ($5.698 - 0.447 \times 11.3$) for the ENERGY treatment and 0.0112 ($3.808 - 0.336 \times 11.3$) for the WAGE treatment.

in high-inflation contexts. This is demonstrated by the lack of significant differences in the pricing effects across the INFLATION, ENERGY, and WAGE treatments.

8 Conclusion

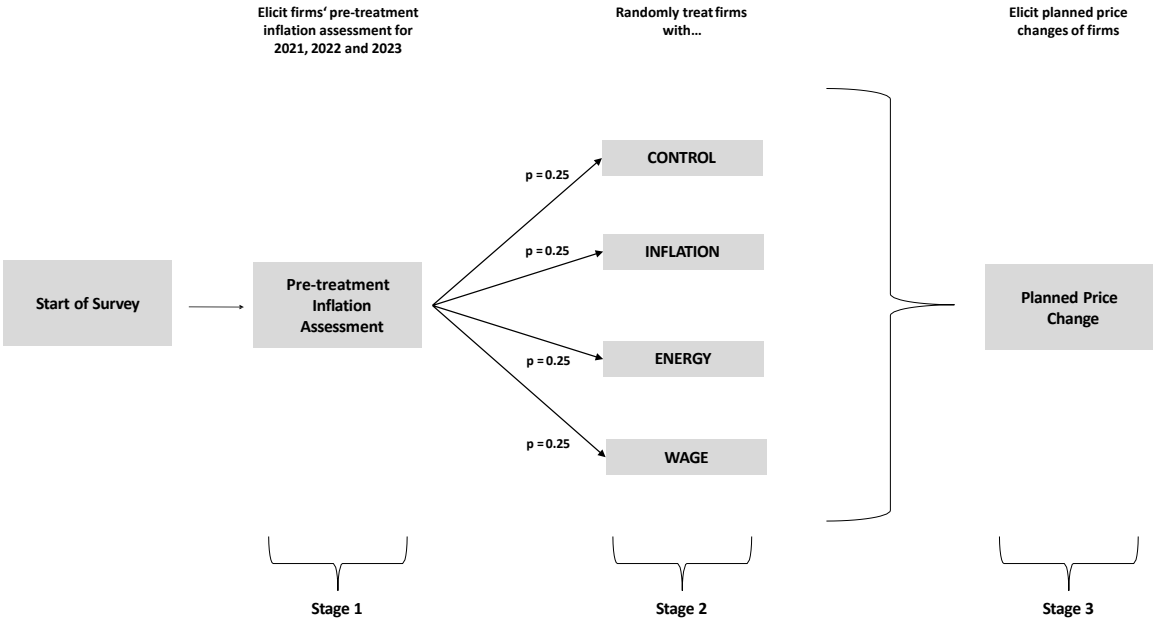
We provide causal survey evidence on the effect of inflation information on firms' price-setting behavior. Making use of a randomized information experiment, a subset of firms in our survey receives publicly available information on central banks' inflation forecasts. Treated firms indicate planned price increases that are 22% lower when compared to firms not receiving the information treatment. Additionally, providing firms with detailed information on projected input cost developments (energy and labor costs) in an extended treatment has no incremental effect compared to the simple information treatment providing general price forecasts. In additional tests, we show that overall treatment effects are stronger when firms are less informed about *past* inflation dynamics and when they are more satisfied with economic policy. Effects further depend on the importance of labor and energy as major cost factors and on the planned frequency of price setting.

Our findings bear several key implications for monetary policy-making. First, we show that central bank communication can be an effective tool to shape firms' price setting plans in high-inflation times. Therefore, central bank information policies targeted toward firms can effectively be used to break an inflation spiral. An improved information provision would also allow keeping interest rates on a lower path, thereby decreasing the risk of a hard landing. Second, our information treatments have a stronger impact on firms with higher (untreated) inflation expectations or limited knowledge with regard to realized inflation, which are precisely the types of firms that central bank communication aims to target during periods of high inflation. Third, we show that the provision of more detailed information on central bank expectations with regard to firms' input price developments further facilitates weakening the link between firms' pre-treatment inflation expectations and their intended price setting. These findings indicate that central banks can make their communication more relevant by including forecasts of key cost factors that significantly impact firms' pricing strategies.

Overall, our results suggest that adequate information policies towards firms can be an effective additional instrument for monetary policy allowing better guidance of firms' pricing decisions, and thereby inflation in the economy as a whole.

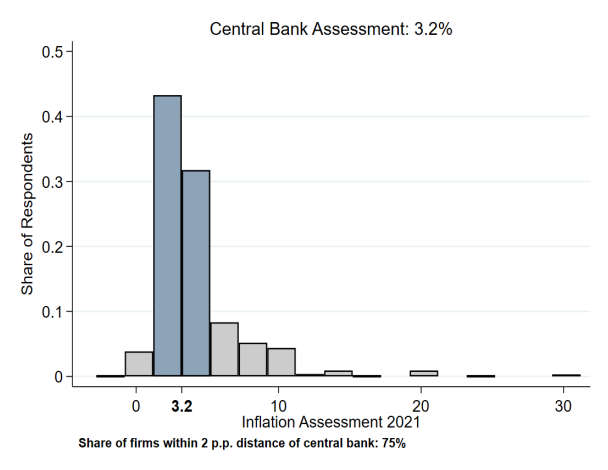
Figures and Tables

Figure 1: Experimental Design

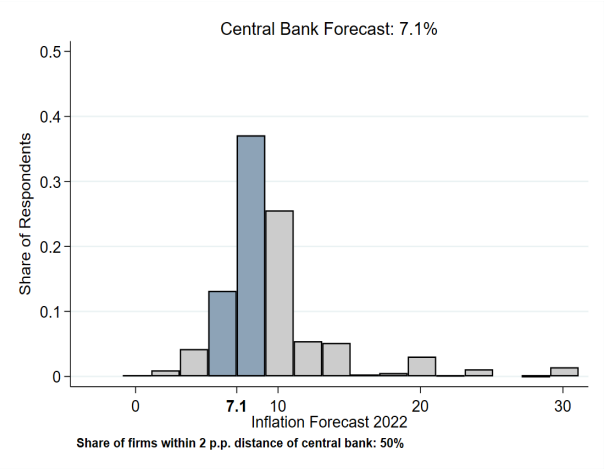


Note: Figure 1 presents the experimental design of our survey experiment.

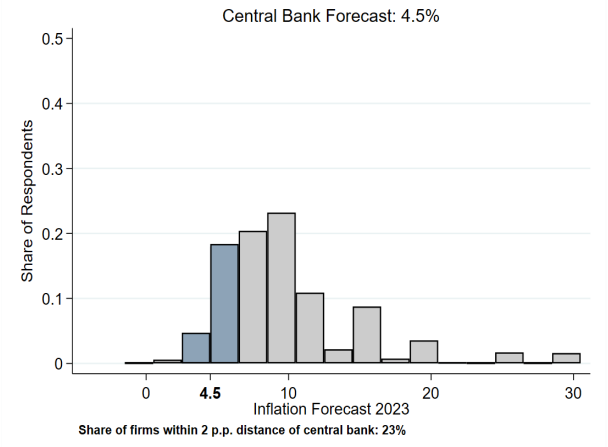
Figure 2: Firms' Inflation Assessment and Price Setting Plans



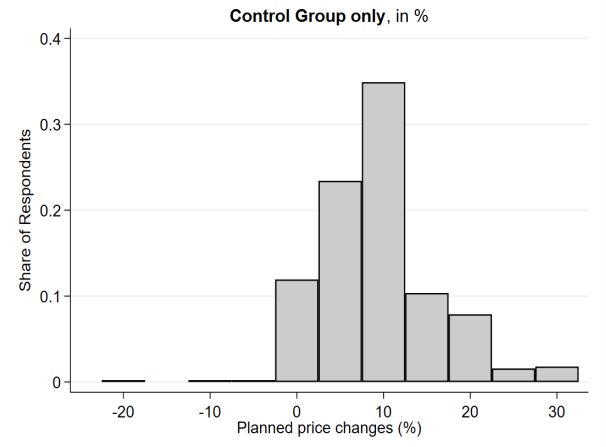
(a) Firms' 2021 Inflation Assessment



(b) Firms' 2022 Inflation Assessment



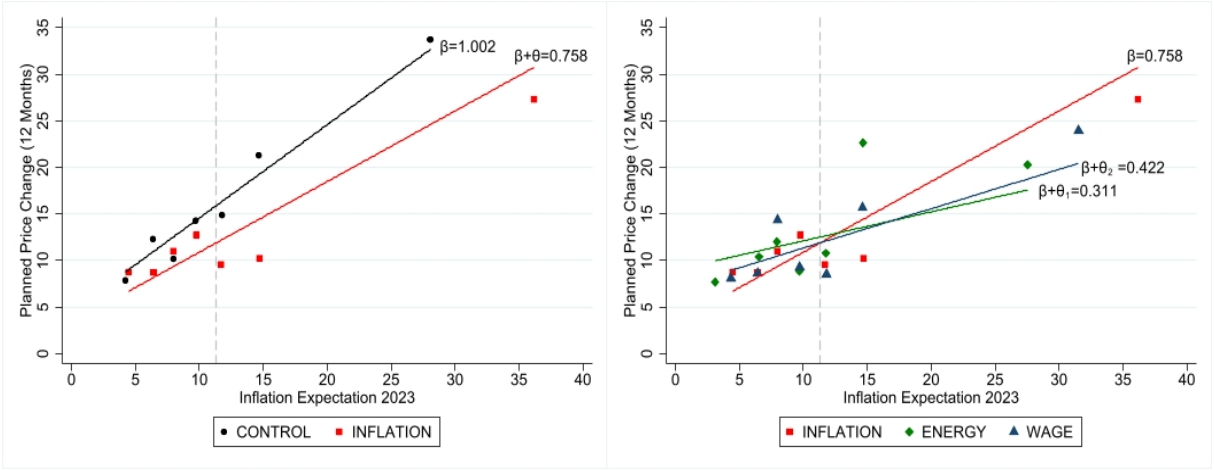
(c) Firms' 2023 Inflation Assessment



(d) Planned Price Changes in Next 12 Months

Note: Figure 2a, Figure 2b and Figure 2c present histograms of firms' inflation assessments for 2021 (N = 1,872), 2022 (N = 1,898) and 2023 (N = 1,883). Horizontal axis: indicated inflation rate (question: "How high do you estimate the inflation rate for 2021/2022/2023?"). Vertical axis: Share of survey respondents. Blue bars: answers in range of 2 percentage points distance to German central bank's inflation assessment (2021: 3.2%; 2022: 7.1%; 2023: 4.5%). Figure 2d shows surveyed firms' indicated price changes for the next 12 months. Horizontal axis: indicated price change (question: "Compared to today, how do you plan to adjust the selling price of your main product or service in the next 12 months (in %)?") Vertical axis: Share of survey respondents. Control group only (N = 444).

Figure 3: Firms' Pre-Treatment Inflation Expectations and Price-Setting Plans



(a) CONTROL vs. INFLATION

(b) INFLATION vs. ENERGY/WAGE

Note: Binscatters of firms' pre-treatment inflation expectations for 2023 (x-axis) versus their post-treatment price plans in the 12 months ahead (y-axis). Panel (a) includes only CONTROL and INFLATION group, while panel (b) contrasts INFLATION, ENERGY and WAGE treatment groups. The coefficient estimates indicate the slope of each line.

Table 1: Experimental Groups and Planned Price Changes

Sample:	**All**		**Low Prior**		**High Prior**	
Dependent Variable:						
$\Delta Price_{i+12m}$	(1)	(2)	(3)	(4)	(5)	(6)
INFLATION	-3.380**	-3.257*	-1.205	-1.748	-3.760**	-3.605**
	(1.421)	(1.701)	(2.762)	(3.593)	(1.710)	(1.677)
ENERGY	-2.973***	-2.693***	-2.392	-1.677	-3.265**	-3.203**
	(0.644)	(0.652)	(2.002)	(2.481)	(1.365)	(1.384)
WAGE	-3.313**	-3.326**	-1.909	-1.580	-3.894*	-3.848*
	(1.351)	(1.464)	(3.018)	(3.044)	(2.019)	(2.096)
Constant (Baseline CONTROL)	15.368***	15.268***	9.986***	9.910***	17.098***	17.031***
	(1.388)	(0.689)	(2.763)	(1.599)	(1.824)	(0.891)
Controls	No	Yes	No	Yes	No	Yes
N	1912	1912	449	447	1411	1411
R^2	0.004	0.051	0.002	0.160	0.004	0.058

Note: OLS estimates from the regression of firms' planned price change in the next 12 months on experimental group dummies: $\Delta Price_{i+12m} = \alpha + \beta_1 \times INFLATION_i + \beta_2 \times ENERGY_i + \beta_3 \times WAGE_i + X_i'\gamma + \varepsilon_i$. Columns (1) and (2) include all observations. Columns (3) and (4) include only firms with forecasts of inflation for 2023 $\leq$ 6.5% (i.e., 2 p.p. above central bank forecast and lower). Columns (5) and (6) include only firms with forecasts of inflation for 2023 $>$ 6.5%. Controls as indicated in each column. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2: Inflation Inattention (Absolute Difference) and Planned Price Changes

Dependent Variable: $\Delta Price_{i+12m}$	(1)	(2)
INFLATION	-1.963	-2.266
	(1.814)	(1.947)
ENERGY	-0.226	-0.427
	(1.677)	(1.557)
WAGE	0.486	0.142
	(2.035)	(1.875)
Inattention 2021	2.104***	1.966***
	(0.515)	(0.520)
INFLATION × Inattention 2021	-0.891*	-0.717
	(0.468)	(0.467)
ENERGY × Inattention 2021	-1.403**	-1.192*
	(0.649)	(0.641)
WAGE × Inattention 2021	-1.902***	-1.786***
	(0.545)	(0.544)
Constant	11.13***	11.37***
	(1.398)	(1.237)
Controls	No	Yes
N	1848	1848
R^2	0.056	0.103

Note: OLS estimates from equation (2): $\Delta Price_{i+12m} = \alpha + \beta \times Inattention2022_i + \sum_{k=1}^{3} \delta_k TREATMENT_{ik} + \sum_{k=1}^{3} \theta_k Inattention2022_i \times TREATMENT_{ik} + X_i'\gamma + \varepsilon_i$. Dependent variable: planned price change in the next 12 months. Independent variables: Experimental group dummies, absolute difference between firms' perceived inflation for 2021 and actual inflation in 2021 (i.e. inattention), constant, and controls. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Importance of Input Factors and Treatment Effects

			Labor & Energy important for pricing			
Sample:	**All**		**Yes**		**No**	
Dependent Variable:						
$\Delta Price_{i+12m}$	(1)	(2)	(3)	(4)	(5)	(6)
INFLATION	-3.380**	-3.257*	-3.084**	-2.929**	-3.573	-3.450
	(1.421)	(1.701)	(1.128)	(1.166)	(2.713)	(3.127)
ENERGY	-2.973***	-2.693***	0.069	-0.583	-5.236***	-5.077**
	(0.644)	(0.652)	(0.848)	(1.410)	(1.659)	(1.796)
WAGE	-3.313**	-3.326**	-2.175	-2.809	-4.331*	-4.349*
	(1.351)	(1.464)	(2.292)	(1.884)	(2.382)	(2.455)
Constant (Baseline CONTROL)	15.368***	15.268***	16.407***	16.687***	14.445***	14.374***
	(1.388)	(0.689)	(1.531)	(0.560)	(1.879)	(1.532)
Controls	No	Yes	No	Yes	No	Yes
N	1912	1912	877	877	1035	1035
R^2	0.004	0.051	0.003	0.071	0.008	0.073

Note: OLS estimates from the regression of firms' planned price change in the next 12 months on experimental group dummies: $\Delta Price_{i+12m} = \alpha + \beta_1 \times INFLATION_i + \beta_2 \times ENERGY_i + \beta_3 \times WAGE_i + X_i'\gamma + \varepsilon_i$. Columns (1) and (2) include all observations. Sample split in columns (3) through (6) is based on the question "Which factors have the greatest influence on pricing in your company?". Columns (3) and (4) include only firms that indicated "labor costs" and "energy/material costs". Columns (5) and (6) include only firms that did not indicate "labor costs" or "energy/material costs". Controls as indicated in each column. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Satisfaction with Economic Policy and Treatment Effects

			Satisfaction with Economic Policy			
Sample:	**All**		**Low**		**Medium/High**	
Dependent Variable:						
$\Delta Price_{i+12m}$	(1)	(2)	(3)	(4)	(5)	(6)
INFLATION	-3.380**	-3.257*	-2.911	-3.415	-3.908**	-4.331*
	(1.421)	(1.701)	(1.768)	(1.987)	(1.414)	(2.327)
ENERGY	-2.973***	-2.693***	-1.450	-2.439	-4.458***	-4.370***
	(0.644)	(0.652)	(1.746)	(1.934)	(0.405)	(1.347)
WAGE	-3.313**	-3.326**	-1.697	-2.370	-4.870***	-5.037***
	(1.351)	(1.464)	(2.146)	(2.311)	(0.833)	(1.130)
Constant (Baseline CONTROL)	15.368***	15.268***	16.930***	17.481***	13.841***	13.971***
	(1.388)	(0.689)	(1.981)	(1.181)	(0.982)	(0.596)
Controls	No	Yes	No	Yes	No	Yes
N	1912	1912	951	951	958	958
R^2	0.004	0.051	0.002	0.084	0.008	0.073

Note: OLS estimates from the regression of firms' planned price change in the next 12 months on experimental group dummies: $\Delta Price_{i+12m} = \alpha + \beta_1 \times INFLATION_i + \beta_2 \times ENERGY_i + \beta_3 \times WAGE_i + X_i'\gamma + \varepsilon_i$. Columns (1) and (2) include all observations. Sample split in columns (3) through (6) is based on the question *"How satisfied are you with economic policy in Germany?"*. Columns (3) and (4) include firms indicating a low satisfaction (0-2). Columns (5) and (6) include firms that indicated an intermediate to high satisfaction (3-10). Controls as indicated in each column. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Price Setting Frequency - Descriptives

Panel A: Price Setting Frequency (*N* - Absolute frequency)

	CONTROL	INFLATION	ENERGY	WAGE	**Total**
Much less frequently	4	8	8	10	**30**
Rather less frequently	15	17	21	19	**72**
Unchanged	141	168	168	167	**644**
Rather more frequently	171	199	180	174	**724**
Much more frequently	111	109	109	103	**432**
Total	**442**	**501**	**486**	**473**	**1,902**

Panel B: Two-sample Kolmogorov-Smirnov test (*p*-values)

	CONTROL	INFLATION	ENERGY	WAGE
CONTROL		0.954	0.777	0.557
INFLATION			1.000	0.986
ENERGY				1.000

Note: **Panel A** of Table 5 presents the absolute frequency of price adjustment revisions over our different experimental groups (CONTROL, INFLATION, ENERGY, WAGE). Statistics are based on the following survey question: *Compared to past years: Do you think you will adjust the price of your main product or service more or less frequently in the next 12 months?* We differentiate firms with regard to the following price adjustment frequencies: *Much less frequently* (e.g. every 12 months in future, previously every 3 months), *Rather less frequently* (e.g. every 12 months in future, previously every 6 months), *Unchanged* (e.g. in future every 12 months, previously every 12 months), *Rather more frequently* (e.g. every 6 months in future, previously every 12 months), *Much more frequently* (e.g. every 3 months in future, previously every 12 months). The sample is restricted to firms which indicated a planned price adjustment. **Panel B** of Table 5 presents p-values of a two-sample Kolmogorov-Smirnov tests of the equality of distributions. We test if the respective distributions of Panel A are equal between the different experimental groups.

Table 6: Price Setting Frequency and Treatment Effects

			Price Setting Frequency Change			
Sample:	**All**		**Lower/Unchanged**		**Higher**	
Dependent Variable:						
$\Delta Price_{i+12m}$	(1)	(2)	(3)	(4)	(5)	(6)
INFLATION	-3.380**	-3.257*	-2.382***	-2.098	-3.517	-3.189
	(1.421)	(1.701)	(0.762)	(1.230)	(2.891)	(3.409)
ENERGY	-2.973***	-2.693***	0.222	0.609	-4.285**	-4.415*
	(0.644)	(0.652)	(2.257)	(2.782)	(1.792)	(2.061)
WAGE	-3.313**	-3.326**	0.141	0.346	-4.772*	-4.993*
	(1.351)	(1.464)	(1.694)	(1.988)	(2.285)	(2.477)
Constant (Baseline CONTROL)	15.368***	15.268***	9.447***	9.223***	18.624***	18.622***
	(1.388)	(0.689)	(1.043)	(1.530)	(2.376)	(1.582)
Controls	No	Yes	No	Yes	No	Yes
N	1912	1912	746	744	1156	1156
R^2	0.004	0.051	0.004	0.061	0.006	0.076

Note: OLS estimates from the regression of firms' planned price change in the next 12 months on experimental group dummies: $\Delta Price_{i+12m} = \alpha + \beta_1 \times INFLATION_i + \beta_2 \times ENERGY_i + \beta_3 \times WAGE_i + X_i'\gamma + \varepsilon_i$. Columns (1) and (2) include all observations. Sample split in columns (3) through (6) is based on the question *"Compared to past years: Do you think you will adjust the price of your main product or service more or less frequently in the next 12 months?"*. Columns (3) and (4) include firms indicating the options *Much less frequently* (e.g. every 12 months in future, previously every 3 months), *Rather less frequently* (e.g. every 12 months in future, previously every 6 months) or *Unchanged* (e.g. in future every 12 months, previously every 12 months). Columns (5) and (6) include firms indicating the options *Rather more frequently* (e.g. every 6 months in future, previously every 12 months) or *Much more frequently* (e.g. every 3 months in future, previously every 12 months). Controls as indicated in each column. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Experimental Results - CONTROL vs. INFLATION

Groups included:	CONTROL + INFLATION	
Dependent Variable:		
$\Delta Price_{i+12m}$	(1)	(2)
Baseline: **CONTROL group**		
Infl. 2023	1.002***	1.038***
	(0.219)	(0.248)
INFLATION	-1.236	-0.919
	(2.816)	(3.086)
INFLATION × Infl. 2023	-0.243	-0.282
	(0.246)	(0.262)
Constant	4.543*	4.211
	(2.226)	(2.631)
Controls	No	Yes
N	922	922
R^2	0.125	0.179
$p(\beta) = 1$	0.994	0.882

Note: OLS estimates from the regression of equation (3): $\Delta Price_{i+12m} = \alpha + \beta \times E_{2022}Inflation_{i2023} + \delta \times INFLATION_i + \theta \times (INFLATION_i \times E_{2022}Inflation_{i2023}) + X_i'\gamma + \varepsilon_i$. Dependent variable: planned price change in the next 12 months. Independent variables: respondent's inflation forecast 2023, experimental group CONTROL and INFLATION, controls if indicated, and a constant. Baseline group: CONTROL. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. Standard errors in brackets. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Experimental Results - INFLATION vs. ENERGY/WAGE

Groups included:	INFLATION + ENERGY + WAGE	
Dependent Variable: $\Delta Price_{i+12m}$	(1)	(2)
Baseline: **INFLATION group**		
Infl. 2023	0.758***	0.759***
	(0.094)	(0.072)
ENERGY	5.698*	5.729**
	(2.834)	(2.642)
WAGE	3.808**	3.756**
	(1.703)	(1.654)
ENERGY × Infl. 2023	-0.447*	-0.450*
	(0.251)	(0.248)
WAGE × Infl. 2023	-0.336*	-0.340*
	(0.190)	(0.186)
Constant	3.307**	3.337**
	(1.260)	(1.545)
Controls	No	Yes
N	1424	1424
R^2	0.079	0.128

Note: OLS estimates from the regression of equation (4): $\Delta Price_{i+12m} = \alpha + \beta \times E_{2022}Inflation_{i2023} + \delta_1 \times ENERGY_i + \delta_2 \times WAGE_i + \theta_1 \times (ENERGY_i \times E_{2022}Inflation_{i2023}) + \theta_2 \times (WAGE_i \times E_{2022}Inflation_{i2023}) + X_i'\gamma + \varepsilon_i$. Split variable as indicated in the first row of the table. Dependent variable: planned price change in the next 12 months. Independent variables: respondent's inflation forecast 2023, experimental groups INFLATION, ENERGY and WAGE, controls if indicated, and a constant. Baseline group: INFLATION. CONTROL group is not included in analysis. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. Standard errors in brackets. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix

A Survey and Experimental Design

Our experimental design incorporates several stages, which are visually depicted in Figure 1 in the main text. In the initial stage, participants are requested to provide their inflation estimates for the years 2021, 2022, and 2023. This stage yields two essential pieces of information. First, we obtain participants' prior expectations regarding future inflation, specifically for the years 2022 and 2023. Notably, the expectation for 2022 is partially realized at the time of the survey, while the expectation for 2023 remains entirely in the future. Second, by soliciting firms' assessment of past inflation in 2021, we can gauge the level of knowledge of each firm concerning inflation in general. This serves as a natural anchor point and enables within-subject comparisons between realized and expected inflation.

In the second stage, after indicating their inflation assessment, firms are randomly assigned to one of four groups. Depending on the assignment to one of the four groups, firms see different information displayed on the next page of the survey. The exact layout of the information provided can be seen in Figure A.1 (translated survey question) and Figure A.2 (original survey language in German). All firms, including the CONTROL group, see their own inflation assessment for the three years as indicated in the first question. Firms in the INFLATION, ENERGY and WAGE group see, in addition, the German central bank's inflation assessment for the respective year. Finally, the ENERGY (WAGE) group is additionally informed about the central bank's assessment of energy cost (labor cost) development for all three years. All mentioned information is displayed adjacently for the respective group. Hence, participants can compare their own estimates to the displayed information. The CONTROL group only sees its own estimates. The INFLATION group receives the same screen as the CONTROL group with inflation forecasts added. Further, ENERGY and WAGE see the same information as the INFLATION group with single cost components added. This step-wise addition of information allows us to measure the incremental effect of additional information.

In the third stage, we ask participants about their pricing plans for their main product in the upcoming twelve months. Thereby, we indirectly measure posterior beliefs with regard to inflation expectations. That is, we omit the direct measurement of posterior beliefs. It is important to note that we purposely avoid directly measuring these beliefs due to various reasons, such as the desire to minimize potential experimenter demand effects, as explained in Section 3 of the main paper. Following the completion of the third stage, participants proceed to the remaining questionnaire of the German Business Panel. From this questionnaire, we extract relevant firm and manager characteristics based on

the provided questions. For our analyses, we utilize variables associated with specific survey questions, and a comprehensive description of these variables can be found in Table A.1 below.

Table A.1: Key Variables

Panel A: Outcome Variables	
Inflation	"How high do you estimate the inflation rate for the respective years?" (2021, 2022, 2023) (*Hint: The inflation rate is defined as the change in the average price development of all goods and services that private households in Germany buy for consumption purposes. It is measured as the average change compared to the previous year.*)
Price Change	"Compared to today, how do you plan to adjust the selling price of your main product or service in the next 12 months (in %)?"
Input Cost Factors	"Which factors have the greatest influence on pricing in your company?"
Future Price Adjustment	"Compared to past years: Do you think you will adjust the price of your main product or service more or less frequently in the next 12 months?"
Panel B: Manager Characteristics	
Education	"Please indicate your highest level of education completed."
Position	"What is your current position within your organization?"
Gender	"What is your preferred salutation?"
Panel C: Firm Characteristics	
Revenues	"Please indicate the annual revenue (in EUR) of your company in the previous calendar year."
Employees	"How many employees (in full-time positions) subject to social insurance contributions does your company have?"
Legal Form	"What is the legal form of your company?"
Industry	"Please select the most important industry sector in which your company is active, by selecting the corresponding category."

Note: Questions of the fifth survey wave of the German Business Panel used in the empirical analyses.

Figure A.1: Screenshots - Experimental Treatment (translated)

Below is a summary of your responses regarding inflation for the respective years.

Note:
Numbers represent the average change compared to the previous year.

Year	Your inflation Estimates (%)
2021	5
2022	8
2023	7

(a) CONTROL

Below is a summary of your responses regarding inflation for the respective years. In addition, you can see the German Central Bank's assessments regarding the development of inflation.

Note:
Numbers represent the average change compared to the previous year.

Year	Your inflation Estimates (%)	Central Bank Inflation Estimates (%)
2021	5	3.2
2022	8	7.1
2023	7	4.5

(b) INFLATION

Below is a summary of your responses regarding inflation for the respective years. In addition, you can see the German Central Bank's assessments regarding the development of inflation and energy prices.

Note:
Numbers represent the average change compared to the previous year.

Year	Your inflation Estimates (%)	Central Bank Inflation Estimates (%)	Central Bank Energy Price Developent Estimates (%)
2021	5	3.2	10.1
2022	8	7.1	27.2
2023	7	4.5	8.5

(c) ENERGY

Below is a summary of your responses regarding inflation for the respective years. In addition, you can see the German Central Bank's assessments regarding the development of inflation and wages.

Note:
Numbers represent the average change compared to the previous year.

Year	Your inflation Estimates (%)	Central Bank Inflation Estimates (%)	Central Bank Wage Developent Estimates (%)
2021	5	3.2	3.5
2022	8	7.1	4.3
2023	7	4.5	4.5

(d) WAGE

Note: Translation of screenshots of the experimental information treatment in the online survey for the four experimental groups. Top left: **CONTROL** group is shown their own inflation estimates they indicated in the previous survey question. Top right: firms in baseline **INFLATION** treatment are shown their own inflation estimates contrasted with the forecasts of the German central bank (Bundesbank) at the time of the survey. Bottom left: firms in extended **ENERGY** treatment are shown their own inflation estimates contrasted with the forecasts of the German central bank (Bundesbank) on both inflation rates and energy price development at the time of the survey. Bottom right: firms in extended **WAGE** treatment are shown their own inflation estimates contrasted with the forecasts of the German central bank (Bundesbank) on both inflation rates and wage development at the time of the survey.

Figure A.2: Screenshots - Experimental Treatment (Original Survey Questions)

Im Folgenden sehen Sie eine Übersicht Ihrer Antworten bezüglich der Inflationsentwicklung für die jeweiligen Jahre.

Hinweis: Die Angaben stellen die durchschnittliche Veränderung im Vergleich zum Vorjahr dar.

Jahr	Ihre Inflations-angaben (%)
2021	5
2022	8
2023	7

(a) CONTROL

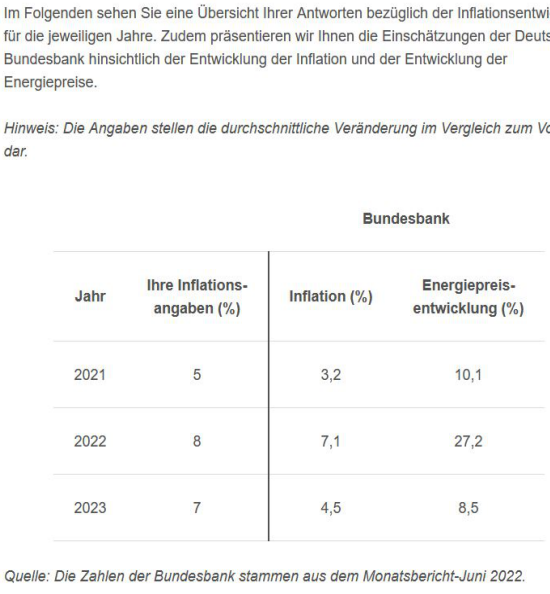
Im Folgenden sehen Sie eine Übersicht Ihrer Antworten bezüglich der Inflationsentwicklung für die jeweiligen Jahre. Zudem präsentieren wir Ihnen die Einschätzungen der Deutschen Bundesbank hinsichtlich der Entwicklung der Inflation.

Hinweis: Die Angaben stellen die durchschnittliche Veränderung im Vergleich zum Vorjahr dar.

Jahr	Ihre Inflations-angaben (%)	Bundesbank (%)
2021	5	3,2
2022	8	7,1
2023	7	4,5

Quelle: Die Zahlen der Bundesbank stammen aus dem Monatsbericht-Juni 2022.

(b) INFLATION



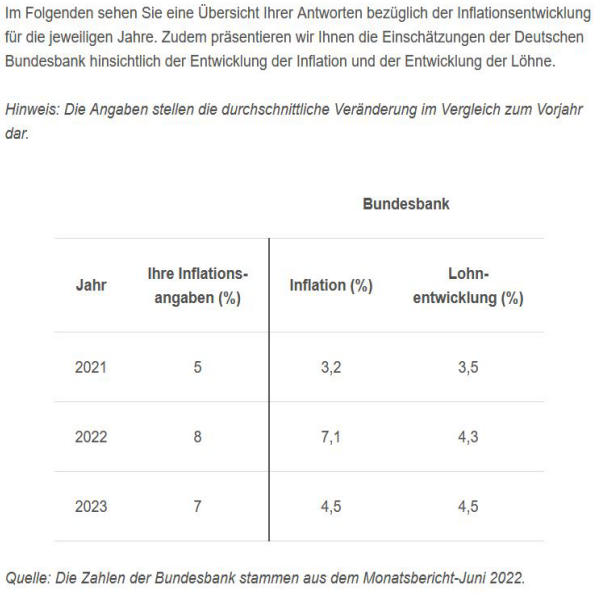
Im Folgenden sehen Sie eine Übersicht Ihrer Antworten bezüglich der Inflationsentwicklung für die jeweiligen Jahre. Zudem präsentieren wir Ihnen die Einschätzungen der Deutschen Bundesbank hinsichtlich der Entwicklung der Inflation und der Entwicklung der Energiepreise.

Hinweis: Die Angaben stellen die durchschnittliche Veränderung im Vergleich zum Vorjahr dar.

		Bundesbank	
Jahr	Ihre Inflations-angaben (%)	Inflation (%)	Energiepreis-entwicklung (%)
2021	5	3,2	10,1
2022	8	7,1	27,2
2023	7	4,5	8,5

Quelle: Die Zahlen der Bundesbank stammen aus dem Monatsbericht-Juni 2022.

(c) ENERGY



Im Folgenden sehen Sie eine Übersicht Ihrer Antworten bezüglich der Inflationsentwicklung für die jeweiligen Jahre. Zudem präsentieren wir Ihnen die Einschätzungen der Deutschen Bundesbank hinsichtlich der Entwicklung der Inflation und der Entwicklung der Löhne.

Hinweis: Die Angaben stellen die durchschnittliche Veränderung im Vergleich zum Vorjahr dar.

		Bundesbank	
Jahr	Ihre Inflations-angaben (%)	Inflation (%)	Lohn-entwicklung (%)
2021	5	3,2	3,5
2022	8	7,1	4,3
2023	7	4,5	4,5

Quelle: Die Zahlen der Bundesbank stammen aus dem Monatsbericht-Juni 2022.

(d) WAGE

Note: Screenshots of the experimental information treatment in the online survey for the four experimental groups. Top left: **CONTROL** group is shown their own inflation estimates they indicated in the previous survey question. Top right: firms in baseline **INFLATION** treatment are shown their own inflation estimates contrasted with the forecasts of the German central bank (Bundesbank) at the time of the survey. Bottom left: firms in extended **ENERGY** treatment are shown their own inflation estimates contrasted with the forecasts of the German central bank (Bundesbank) on both inflation rates and energy price development at the time of the survey. Bottom right: firms in extended **WAGE** treatment are shown their own inflation estimates contrasted with the forecasts of the German central bank (Bundesbank) on both inflation rates and wage development at the time of the survey.

B Descriptive Characteristics and Balancing Tests

A key assumption of randomized control trials is that a random assignment of participants to treatments leads to balanced participant characteristics across treatment groups. In this section, we investigate whether this key assumption holds for our experiment, i.e., whether firms in our different experimental groups have comparable prior inflation expectations. In other words, our tests show whether we were successful in randomizing firms in our different experimental arms. This ensures that participating firms do not exhibit systematic differences in their inflation assessment prior to receiving the information treatment.

Table B.1 shows descriptive statistics for each experimental group's inflation assessment for 2021, 2022, and 2023. We perform a Wald chi-square test for equality of means across all four experimental groups. P-values are displayed in the last column of Table B.1 and support that inflation expectations among the four groups do not significantly differ from each other, confirming the effectiveness of our randomization procedure. Similarly, as our ENERGY and WAGE treatment inform firms about energy and wage components of the central bank's inflation forecasts, we test whether firms in the four groups differ systematically in which input costs are important for them. Table B.2 displays the results. Approximately 69% of firms consider energy/material costs, while 64% take labor costs into account when making pricing decisions. In comparison, other factors such as legal regulations (26%), customer demand (25%), and competitor prices (19%) appear to have less impact. Importantly, this pattern holds true across all experimental groups, indicating that energy/material costs and labor costs are consistently regarded as among the most crucial factors in the price-setting process.

Table B.3 displays descriptive statistics for firm and manager characteristics we use in our analyses by experimental group. Again, the last column of Table B.3 displays the p-values of Wald chi-square tests for equality of means across all four experimental groups for each variable. P-values demonstrate that our randomization was also successful regarding firm characteristics, as the distributions do not display systematic differences.

Finally, Table B.4 shows that the industry composition of our firm sample is largely comparable to the industry composition of the overall German firm population German Federal Statistical Office (2021). Our sample includes more firms from the manufacturing and information sector and fewer firms from the hospitality and health service industry, in contrast to the German firm population in 2021. Moreover, firms in our sample are slightly larger with regard to employees and revenues compared to the German firm population.

Table B.1: Descriptive Statistics and Balancing Tests – Inflation Assessment

	Total	CONTROL	INFLATION	ENERGY	WAGE	P-value for equality across groups
Inflation 2021 (in %)						
Mean	4.68	4.53	5.03	4.37	4.74	0.25
SD	(4.93)	(3.72)	(6.28)	(4.42)	(4.76)	
N	1,872	437	496	474	465	
Inflation 2022 (in %)						
Mean	10.48	10.09	10.80	10.22	10.78	0.25
SD	(7.14)	(5.47)	(8.49)	(6.33)	(7.68)	
N	1,898	441	504	480	473	
Inflation 2023 (in %)						
Mean	11.31	10.75	11.80	10.89	11.75	0.21
SD	(10.06)	(7.58)	(12.02)	(9.32)	(10.51)	
N	1,883	440	494	477	472	

Note: Descriptive statistics for prior inflation assessment for 2021, 2022 and 2023 in % for the total sample and the experimental groups, respectively. *P*-values in the last column from a Wald chi-square test for equality of means across all four experimental groups. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.2: Descriptive Statistics and Balancing Tests – Factors Influencing Prices

	Total	CONTROL	INFLATION	ENERGY	WAGE	P-value for equality across groups
Which factors have the greatest influence on pricing in your company?						
Energy/Material Costs						
Mean	0.69	0.70	0.68	0.67	0.70	0.77
SD	(0.46)	(0.46)	(0.47)	(0.47)	(0.46)	
Labor Costs						
Mean	0.64	0.64	0.64	0.64	0.63	0.94
SD	(0.48)	(0.48)	(0.48)	(0.48)	(0.48)	
N	1,934	445	515	495	479	

Note: Descriptive statistics of firms naming energy and labor costs as having the greatest influencing on their price setting behavior for the total sample and the experimental groups, respectively. *P*-values in the last column from a Wald chi-square test for equality of means across all four experimental groups. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.3: Descriptive Statistics and Balancing Tests – Firm and Manager Characteristics

	Total Sample	CONTROL	INFLATION	ENERGY	WAGE	P-value for equality across groups
Size groups - Revenues/Employees						
Very Small	0.68	0.65	0.69	0.67	0.70	0.36
Small	0.24	0.26	0.24	0.25	0.21	0.30
Medium	0.06	0.05	0.05	0.06	0.07	0.64
Large	0.02	0.03	0.01	0.02	0.01	0.07*
Missing	0.01	0.00	0.01	0.00	0.01	0.57
Legal Forms						
Sole Proprietorship	0.23	0.22	0.23	0.21	0.24	0.65
Partnerships	0.13	0.14	0.15	0.12	0.11	0.12
Corporations	0.56	0.56	0.52	0.59	0.58	0.13
Other	0.07	0.07	0.08	0.07	0.06	0.63
Missing	0.01	0.00	0.01	0.00	0.01	0.76
Economic Sector (1-digit WZ08)						
A Agriculture	0.01	0.02	0.01	0.02	0.01	0.54
B Mining and quarrying†	0.00	0.00	0.00	0.00	0.00	-
C Manufacturing	0.14	0.15	0.14	0.13	0.14	0.88
D Energy Supply	0.01	0.01	0.01	0.00	0.01	0.41
E Water supply	0.00	0.01	0.00	0.00	0.00	0.34
F Construction	0.10	0.10	0.11	0.09	0.09	0.44
G Trade	0.14	0.15	0.14	0.14	0.12	0.54
H Transport and Storage	0.03	0.02	0.02	0.03	0.04	0.49
I Accommodation/Food	0.04	0.04	0.04	0.03	0.04	0.93
J Information	0.08	0.08	0.05	0.08	0.10	0.07*
K Financial/Insurance	0.03	0.02	0.02	0.03	0.03	0.82
L Real Estate	0.03	0.03	0.02	0.03	0.02	0.66
M Professional, scientific, and technical activities	0.14	0.12	0.16	0.15	0.14	0.34
N Other econ. services	0.04	0.04	0.05	0.04	0.04	0.79
O Public administration	0.00	0.00	0.00	0.00	0.00	0.86
P Education	0.02	0.02	0.01	0.03	0.01	0.52
Q Health/Social Services	0.03	0.03	0.03	0.03	0.03	0.91
R Arts/Entertainment	0.03	0.02	0.04	0.03	0.02	0.66
S Other services	0.04	0.04	0.04	0.04	0.04	0.92
Missing	0.10	0.08	0.08	0.11	0.12	0.11
Gender						
Male	0.75	0.78	0.74	0.73	0.74	0.28
Missing	0.08	0.07	0.08	0.09	0.09	0.65
Education						
Apprenticeship (voc.)	0.13	0.14	0.12	0.13	0.14	0.69
Bachelor Degree	0.06	0.04	0.06	0.05	0.07	0.16
Master (voc.)	0.14	0.15	0.15	0.12	0.13	0.46
Master Degree or higher	0.37	0.40	0.39	0.38	0.32	0.05*
Missing/Other/No degree	0.31	0.27	0.28	0.32	0.34	0.08*
Position						
Clerk	0.02	0.02	0.01	0.02	0.02	0.40
Department Head	0.02	0.02	0.03	0.03	0.02	0.83
Owner/CEO	0.87	0.88	0.87	0.86	0.88	0.72
Missing/Other	0.09	0.09	0.10	0.09	0.07	0.59
N	1,944	449	515	499	481	

Note: Descriptive statistics of firm and manager characteristics for the total sample and the experimental groups, respectively. *P*-values in the last column from a Wald chi-square test for equality of means across all four experimental groups. Sizegroups - Revenues/Employees (SME- EU Definition 2003/361): Very small ($\leq$ 9 employees & $\leq$ 2 mio. revenues), Small ($\leq$ 49 employees & $\leq$ 10 mio. revenues), Medium ($\leq$ 249 employees & $\leq$ 50 mio. revenues), Large ($>$ 249 employees or $>$ 50 mio. revenues). The economic sector classification follows the classification of economic activities from the German statistical office (2008 edition; WZ 2008). †: Due to missing observations in the experimental group ENERGY for the sector B, no test for equality of means across experimental groups can be conducted. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.4: Firm Characteristics - Sample vs. Population

	Total Sample	Company Register 2021
No. of Employees		
0-9	0.72	0.87
10-49	0.22	0.10
50-249	0.04	0.02
>250	0.01	0.00
Missing	0.01	-
Revenues (in million €)		
0-2	0.80	0.93
2-10	0.13	0.06
10-50	0.04	0.01
>50	0.01	0.00
Missing	0.03	-
Economic Sector (1-digit WZ08)		
A Agriculture	0.01	- †
B Mining and quarrying	0.00	0.00
C Manufacturing	0.14	0.06
D Energy Supply	0.01	0.02
E Water supply	0.00	0.00
F Construction	0.10	0.11
G Trade	0.14	0.17
H Transport and Storage	0.03	0.03
I Accommodation/Food	0.04	0.07
J Information	0.08	0.04
K Financial/Insurance	0.03	0.02
L Real Estate	0.03	0.06
M Professional, scientific, and technical activities	0.14	0.15
N Other econ. services	0.04	0.07
O Public administration	0.00	- ‡
P Education	0.02	0.02
Q Health/Social Services	0.03	0.08
R Arts/Entertainment	0.03	0.03
S Other services	0.04	0.06
Missing	0.10	-
N	1,944	3,390,704

Note: Firm characteristics of the total sample and the German company register for 2021 for comparison German Federal Statistical Office (2021). †, ‡: Information on marginal distributions for these industries not available from German company register.

C Additional Results

Table C.1 presents the results of the experimental treatments on firms' planned price settings, excluding those firms with extremely high or negative inflation expectations for 2023 (greater than 30% or negative). Overall, the experimental results are comparable to those of the entire sample. Therefore, we conclude that our overall findings are not driven by outlier firms in terms of inflation expectations.

Table C.1: Robustness Check: Experimental Groups and Planned Price Changes (outliers excluded)

			Inflation Expectations 2023			
Sample:	**All**		$E_{2022}Inflation_{i2023} <= 30$		$0 <= E_{2022}Inflation_{i2023} <= 30$	
Dependent Variable:						
$\Delta Price_{i+12m}$	(1)	(2)	(3)	(4)	(5)	(6)
INFLATION	-3.380**	-3.257*	-3.377**	-3.487*	-3.410**	-3.541*
	(1.421)	(1.701)	(1.495)	(1.710)	(1.495)	(1.703)
ENERGY	-2.973***	-2.693***	-2.019***	-1.871**	-2.028***	-1.919**
	(0.644)	(0.652)	(0.609)	(0.775)	(0.620)	(0.773)
WAGE	-3.313**	-3.326**	-2.778**	-2.891*	-2.830**	-2.973**
	(1.351)	(1.464)	(1.167)	(1.363)	(1.170)	(1.356)
Constant (Baseline CONTROL)	15.368***	15.268***	14.222***	14.242***	14.256***	14.298***
	(1.388)	(0.689)	(1.202)	(0.531)	(1.205)	(0.517)
Controls	No	Yes	No	Yes	No	Yes
N	1912	1912	1803	1803	1799	1799
R^2	0.004	0.051	0.004	0.050	0.004	0.051

Note: OLS estimates from the regression of firms' planned price change in the next 12 months on experimental group dummies: $\Delta Price_{i+12m} = \alpha + \beta_1 \times INFLATION_i + \beta_2 \times ENERGY_i + \beta_3 \times WAGE_i + X_i'\gamma + \varepsilon_i$. **Columns (1) and (2)** include all observations in our sample. **Columns (3) through (4)** only include firms with inflation expectations for 2023 smaller or equal to 30% ($E_{2022}Inflation_{i2023} <= 30$) answering the survey in 2022. **Columns (5) and (6)** only include firms with inflation expectations for 2023 larger or equal to 0% and smaller or equal to 30% ($0 <= E_{2022}Inflation_{i2023} <= 30$) answering the survey in 2022. Controls as indicated in each column. Controls include firm controls (size groups, legal forms and 1-digit industries (WZ08 classification)), manager controls (education, position in the firm and the gender of the decision-maker) and week fixed effects. Standard errors clustered on industry and survey-week level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

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