

How Wages Adjust to Expected and Realized Inflation

Preliminary and Incomplete

Lukas Buchheim Sebastian Link Sascha Möhrle*

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This paper studies how expected and realized inflation pass through into wage setting using a novel quarterly panel of German firms from 2021–2025. Wages respond only weakly to both expected and past inflation, with short-run forward- and backward-looking pass-through of roughly 0.1–0.2. The similarity of forward- and backward-looking pass-through, together with the absence of pass-through from medium-run inflation expectations, is consistent with Taylor-style wage rigidities, although our estimates are smaller than predicted by theory. We further show that wage bargaining institutions shape both the level and timing of pass-through: Collective bargaining agreements tilt wage adjustments toward a more backward-looking stance. Exploiting variation in bargaining calendars and labor market tightness, we find that pass-through is larger when wage renegotiations are imminent and when labor markets are tighter.

Keywords: Wage expectations, inflation, pass-through, firms, survey data.

JEL Classification: E24, E31, D84

*Buchheim: TU Dortmund and CESifo. lukas.buchheim@tu-dortmund.de; Link: ifo Institute, University of Munich, IZA, and CESifo; link@ifo.de; Möhrle: Deutsche Bundesbank; sascha.moehrle@bundesbank.de. This paper updates and extends the firm-level results in our 2024 paper “Inflation and Wage Expectations of Firms and Employees”. For helpful comments and fruitful discussions we thank Benjamin Born, Yuriy Gordonichenko, Ina Hajdini, Patrick Kline, Michael Lamla, Sarah Lein, Chen Lian, Emi Nakamura, Christopher Roth, Benjamin Schoefer, Jón Steinsson, Johannes Wohlfart, Maik Wolters, Josef Zweimüller and participants of various seminars and conferences. We are grateful to the survey department of the ifo Institute, in particular Felix Leiss, Agnesa Nimanaj, and Klaus Wohlrabe for their help and the opportunity to amend the ifo Business Survey. The views expressed in this paper are those of the authors and do not necessarily coincide with the views of the Deutsche Bundesbank or the Eurosystem.

1. Introduction

How large is the effect of expected and realized inflation on wages? During the recent surge of inflation in Western economies in the aftermath of the Covid-19 pandemic and the Russian invasion of Ukraine, this question has regained importance, not least because inflation-wage-dynamics may fuel wage-price spirals: If the wage bargaining partners adjust wages predominantly based on the *expected decline in real wages due to expected inflation*, the mere presence of high expected inflation leads to high wage growth and, thus, high costs for firms, which are in turn a potential driver of future price inflation. If, on the other hand, wage setting reacts primarily to *realized decline of real wages due to realized inflation*, the potential for accelerating inflation via the wage cost channel is muted.

Despite its macroeconomic relevance, we know little about the absolute and relative importance of expected and realized inflation for wage dynamics. Guided by [Werning \(2022\)](#), who provides quantitative predictions for pass-through under different models of wage rigidity, the first goal of this paper is thus to deliver empirical benchmarks for *forward-looking pass-through (the effect of expected inflation on wage growth)* and *backward-looking pass-through (the effect of realized inflation on wage growth)*. Given the benchmarks for forward-looking and backward-looking pass-through, the second goal of the paper is to study the role of bargaining institutions for the magnitude of pass-through. Specifically, we first ask whether forward- and backward-looking pass-through differs on average with respect to whether wages are covered by collective bargaining agreements or not. Second, we use the timing of collective agreements to distinguish average pass-through from pass-through along the intensive margin, i.e., conditional on wages being re-set. The paper's third goal is to assess to what extent forward- and backward-looking pass-through, together with the institutional setting, account for the aggregate dynamics of wage inflation.

We make progress on these questions using a rich firm-level panel of German survey data from December 2021 to September 2025. Each quarter, roughly 2,900 firms report expected aggregate inflation and expected own wage growth over the next 12 months, realized wage growth over the past 12 months, and whether wages are covered by collective bargaining agreements. We also elicit information on determinants of the real wage—such as the surplus of the match or the (expected) unemployment rate—to more cleanly isolate the nominal effects of expected inflation dynamics on wages. Our data encompasses the entire surge and decline of the inflationary period in the aftermath of the Covid19-pandemic and the Russian invasion of Ukraine. Compared to the literature, this is an exceptionally long panel on both expected inflation and wages, which is precisely the feature that allows us to estimate the association of wage growth with expected *and* realized inflation.

Forward- and backward-looking pass-through are of similar magnitude but low

In our data, both forward- and backward-looking pass-through are of similar magnitude but low. We estimate forward-looking pass-through to be between 0.10 and 0.18, meaning that a one percentage point increase in expected inflation for the next 12 months is associated with an increase in expected own wage growth between 0.10 and 0.17 percentage points over the same period. We estimate backward-looking pass-through for the realized 24 month accumulated inflation—a choice reflecting the typical length of collective bargaining agreements—to be around 0.15. Forward- and backward-looking pass-through being of similar size is consistent with Werning’s (2022) predictions for Taylor pricing, but both are smaller than the quantitative predictions.

In line with theory, however, we estimate that expected inflation for the medium-run—12 months inflation in three or five years—does not play a role for firms’ current wage growth expectations.

Various alternative empirical specifications confirm that firms’ forward- and backward-looking pass-through are generally small. Most notably, we provide evidence that the estimated forward-looking pass-through is indeed informative for the (partial equilibrium) causal effect of expected inflation on wage inflation. To this end, we show that our baseline estimates are comparable in size to pass-through estimates from two alternative approaches: (1) hypothetical scenarios, where we ask firms to state their wage growth expectations given different counterfactual inflation expectations, and (2) an instrumental variable strategy, where we use a shift-share instrument for inflation expectations based on the energy intensity of a firm’s production (the “share”) and the development of a production price index for energy (the “shift”) for identification. Moreover, we show that the pass-through of expected and realized inflation into ex-post realized wage growth over the subsequent 12 months is of similar magnitude as the pass-through into expected wage growth, confirming our baseline results. We also ask whether pass-through is potentially state-dependent and, hence, time-varying, and show that the cross-sectional estimates for pass-through from each survey wave are remarkably stable between 0.10 and 0.20 for almost all survey waves.

Wage bargaining institutions are important for the magnitude and timing of pass-through

Next, we ask how bargaining institutions and bargaining power affect pass-through. The setting of Germany is ideal for studying the effect of unionized bargaining on wages, as about half of the private sector employment contracts is covered by collective bargaining agreements (CBA) while the other half is not. What is more, whether or not an employment relationship is covered by a CBA is decided at the firm level.

We first descriptively show that firms covered by CBAs (CBA firms) and firms not covered by CBAs (non-CBA firms) differ substantially in their wage adjustments to inflation: Forward-looking pass-through of CBA firms is smaller than that of non-CBA firms, while the reverse is true for backward-looking pass-through. This implies that, over time (and especially so with rising inflation), workers at CBA firms temporarily experience higher real wage losses than workers at non-CBA firms.

This finding constitutes a new puzzle, because one would expect that unionized bargaining increases workers' bargaining power, thereby enabling workers to bargain for better compensation of *expected* real wage losses. Indeed, with an alternative proxy for workers' bargaining power—labor market tightness at the firm or sector \times industry level—, we find that higher labor market tightness is associated with higher forward-looking pass-through, as one would expect if labor market tightness increases the bargaining power of workers.

Finally, the timing of collective bargaining creates lumpiness in wage adjustments and may, as such, contribute to aggregate inflation. We test the precondition for this hypothesis, namely that pass-through should be higher along the intensive margin—i.e., for firms and employees who anticipate wage changes—than on average. The timing of collective bargaining provides us with a measure of whether firms can plausibly expect wage adjustments within the next 12 months (the forecast window of the wage growth expectations) by exploiting the nature of collective bargaining agreements in Germany. Since CBAs are valid for a certain time period (typically around two years), firms know that wages are likely to be re-set within the next year if their CBA expires within that period. In contrast, there is less scope for wage readjustments within the next year for those firms and employees covered by a CBA that remains valid for more than a year. Administrative data allows us to track the share of employees within two-digit industries covered by a valid CBA for the next 12 months, which provides a measure of the degree of which wages are fixed, which varies in both the cross-sectional and the time dimension.

We show that pass-through is substantially higher along the intensive margin than average pass-through. This is true for both forward- and backward-looking pass-through. In addition, in most specifications, our estimates imply that pass-through is close to zero when collective agreements within an industry are valid for more than 12 months. As a placebo check, we also confirm that the pass-through of firms not covered by collective bargaining is independent of the validity of collective agreements within their industry.

Contribution This paper is part of a body of contemporaneous work that uses survey data to quantify pass-through of firms' inflation expectations into their wage growth expect-

tations (Abberger, Funk, Lamla, Lein and Siegrist, 2025, Akarsu, Aktug and Torun, 2025, Baumann, Ferrando, Georgarakos, Gorodnichenko and Reinelt, 2024, Gautier, Savignac and Coibion, 2025, Granziera, Reiche, Maffei-Faccioli, Weber and Fastbø, 2025, Savignac, Gautier, Gorodnichenko and Coibion, 2024).¹ All of these papers quantify pass-through within a broader focus on the determinants and/or consequences of firms’ inflation expectations. This paper is thus the only one that estimates pass-through of expected and realized inflation into expected and realized wage growth.

In addition, we contribute to this literature by testing potential mechanisms of pass-through. Parallel work of Abberger et al. (2025) and Gautier et al. (2025) also confirm the prediction from Taylor pricing that pass-through of medium run inflation expectations is zero, and the latter paper also shows a positive backward-looking pass-through. In addition to these papers, we are first to investigate the effects of firms’ bargaining power on pass-through, and we are also the only ones who study the role of bargaining institutions and the timing of collective bargaining for pass-through.

In addition, among the aforementioned studies, Abberger et al. (2025), Akarsu et al. (2025), and Baumann et al. (2024) use survey experiments to identify the pass-through of expected inflation into expected wage growth. Our causal estimates via an IV strategy with naturally occurring variation in observational data confirm the magnitude of these experimental results.²

While our main contribution is to estimate the empirical literature on pass-through, there is recent theoretical and quantitative work that seeks to better understand the potential link between inflation expectations, wage growth, and aggregate inflation in wage posting (e.g., Lorenzoni and Werning, 2023; Werning, 2022) or wage bargaining frameworks (e.g., Bloesch, Lee and Weber, 2023; Guerreiro, Hazell, Lian and Patterson, 2024; Pilossoph and Ryngaert, 2024). In all these models, average pass-through and, hence, the resulting inflation dynamics are determined by the interplay of different (bargaining) mechanisms at the extensive and intensive margins of wage setting. We explicitly test predictions of wage posting models, and highlight the role of bargaining power for pass-through.

We proceed as follows. The next section describes the data. Section 3 provides hypotheses for the empirical analysis on the basis of Werning (2022). In Section 4 we report the estimates of

¹Section 4.6 compares our findings with the results of these papers. In addition, Hajdini, Knotek, Leer, Pedemonte, Rich and Schoenle (2023) and Jain, Kostyshyna and Zhang (2024) provide estimates of forward-looking pass-through for households.

²More broadly, this paper is also related to the extensive literature that studies the effect of inflation expectations on economic decisions of firms Candia, Coibion and Gorodnichenko (2023) and Weber, d’Acunto, Gorodnichenko and Coibion (2022) are recent survey of this literature.

average pass-through across a range of empirical specifications. Section 5 studies the role of bargaining institutions for pass-through, both in terms of timing and in terms of estimating intensive margin pass-through. Section 6 concludes.

2. Data

2.1. Survey Setting and Sample

Our analysis is based on quarterly surveys of a German firm panel that were specifically designed to examine the pass-through of expected inflation into wages. These surveys were conducted between December 2021 and September 2025.³ As shown in Appendix Figure A.1, the sample period covers a period of historically large variation in inflation: German CPI inflation exceeded the ECB’s inflation target of 2 percent in the summer of 2021 and marked at 5 percent at the start of our sample period. Inflation accelerated further after Russia’s invasion of Ukraine in early 2022, reaching levels of around 10 percent by the end of 2022 before reverting back close to pre-Covid levels at the end of our sample period. In parallel, wages continued to grow at comparably moderate year-over-year growth rates of approximately 2 percent until mid-2022, before accelerating to rates greater than 6 percent in 2023. Towards the end of the sample period, wage growth receded but continued to be above inflation in September 2025.

The quarterly firm survey is conducted among firms participating in the ifo Business Survey (IBS), a long-standing monthly survey of a large and representative panel of German firms.⁴ Respondents to the online version of the IBS received a separate link to our survey in the invitation email to the regular IBS of the last month of each quarter. On average, approximately 2,900 respondents participated in each wave of our surveys. Given the focus of our analysis on wage setting, we exclude firms with less than 5 employees. Additionally, we restrict the analysis to respondents who participated in at least two waves and provided information on all variables used in our regressions, resulting in an average of 2,400 observations per wave. 34 percent of firms operate in manufacturing, 34 percent in services,

³We began adding wage-related questions to the existing quarterly panel of firm surveys initiated by [Link, Peichl, Pfäuti, Roth and Wohlfart \(2026\)](#) in December 2021. Data on other variables, including expected inflation, has already been available since December 2020.

⁴The IBS provides the basis for the ifo Business Climate Index, the most recognized leading indicator of the German business cycle. See [Sauer, Schasching and Wohlrabe \(2023\)](#) for details on the IBS and its representativeness. The IBS microdata have been used extensively in previous research in economics (e.g., [Bachmann, Born, Elstner and Grimme, 2019](#); [Bachmann, Carstensen, Lautenbacher and Schneider, 2021](#); [Bachmann, Elstner and Sims, 2013](#); [Buchheim, Doovern, Krolage and Link, 2022](#); [Link, Peichl, Roth and Wohlfart, 2023](#)).

9 percent in construction, and 22 percent are retailers or wholesalers.

Appendix Table A.1 shows summary statistics for the firm sample. The median number of employees is 49, and the average share of exports in firms’ revenues is 18 percent. In 31 percent of the firms, the job of a “typical employee” is covered by a collective bargaining agreement. 80 percent of respondents report having “very high influence” on their firms’ decisions, which corroborates evidence by Sauer et al. (2023) documenting that respondents usually hold upper management positions such as owner, CEO, or department head.⁵

2.2. Survey Design and Variable Encoding

Our main survey outcomes focus on expected inflation and wage growth.⁶ In each survey wave, we ask respondents about their expected CPI inflation and gross wage change over the next 12 months. To ensure that firms have a specific employee in mind when answering our questions, we ask firms to consider the gross wage growth of a “typical” employee with average qualifications, tenure, and job profile. To prevent respondents from reporting only wage changes that have *already been agreed upon* at the time of the survey, we proceed in two-steps: First, we ask about the portion of future gross wage growth already agreed upon, such as through currently valid collective bargaining agreements (CBAs). Then, we ask for the *total* expected wage growth over the next 12 months, including both pre-agreed changes and anticipated outcomes from potential additional wage negotiations or new collective agreements. In some waves, we also collect data on realized wage growth (from December 2022 onward) and expected 12-month inflation in the more distant future.

We also gather detailed information on the wage-setting process. Most importantly, we elicit whether the (typical) employment relationship is subject to a CBA. This allows us to study differences in pass-through between firms covered and not covered by CBAs in Section 5. In addition, with administrative data on the scheduling of CBAs, this information also allows us to estimate pass-through at the intensive margin. Further, we collect data on the extensive margin of wage setting (e.g., intention to ask for pay rise), job search, and proxies for bargaining power, which we introduce when relevant.

To better isolate the nominal effects of expected inflation dynamics on wage growth, the surveys also cover other potential determinants of real wages. First, we use assessments

⁵In the June 2021 wave, Link et al. (2026) elicited the respondent’s influence on the firm’s decisions regarding investment, production, personnel, and pricing on a 5-point scale. 65 percent of managers report having “very high influence” (highest category) on personnel decisions in the firm and 77 percent report to have “very high influence” on decisions in at least one of these areas.

⁶Appendix E lists the English translations of the survey questions.

of firms’ current and expected future business conditions as proxies for the surplus of the match and the scope for wage negotiations.⁷ Second, the survey contains macroeconomic expectations regarding the unemployment rate 12 months after the survey. Third, we use information from the April 2022 wave of the regular IBS on the share of energy costs prior to the Russian invasion of Ukraine, which we use to construct a shift-share instrumental variable for expected inflation in Section 4.3. Lastly, the surveys contain standard demographics for firms listed in Appendix Table A.1.

2.3. Data Validation and Descriptive Statistics

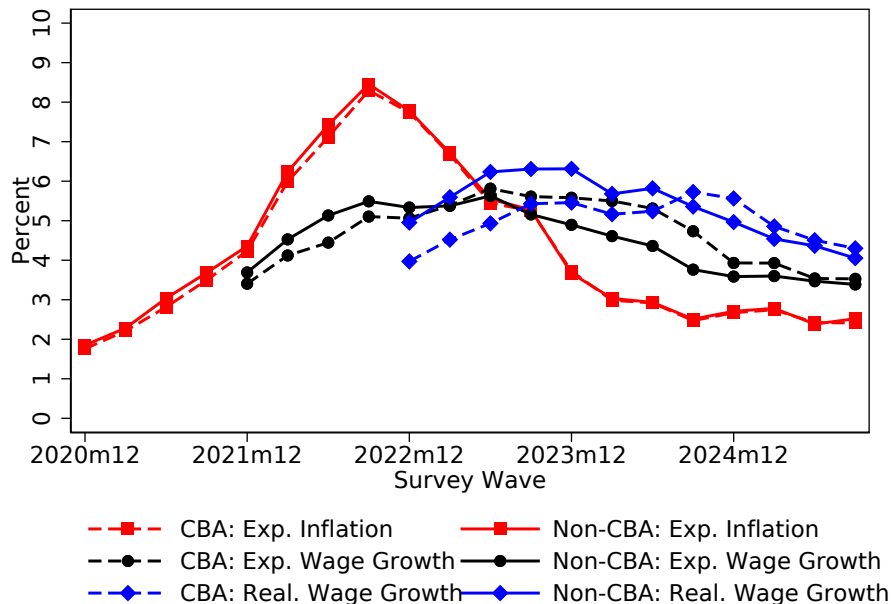
Validation of Expectations Data Respondents provide accurate and informative expectations in our surveys. Expected wage growth for the next 12 months, elicited between December 2021 and September 2024, is strongly correlated with the ex-post realized wage growth reported by the same firms 12 months later, see Appendix Figure A.2. Additionally, average expected CPI inflation in our samples closely tracks the developments reported in the Bundesbank’s representative firm and consumer surveys, see Appendix Figure A.3. This suggests that our expectations data are of high quality.

Aggregate Dynamics in Survey Data Mimicking the surge in inflation, Figure 1 shows that average inflation expectations of firms fluctuated strongly over the sample period. Starting near the ECB’s target of 2 percent, firms’ average expectations rose steadily to 4.4 percent in December 2021 and 8.5 percent in September 2022, before reverting to about 2.5 percent in Fall 2024. Average inflation expectations of firms covered and not covered by CBAs are indistinguishable.

In contrast, the time variation in expected wage growth for the next 12 months is more modest and tends to lag inflation. On average, firms expected their “typical” employee’s wage to increase by 3.6 percent in December 2021, peaking at 5.7 percent in June 2023, before slightly declining towards 3.5 percent at the end of the sample period. Firms covered and not covered by CBAs thereby expected different patterns of wage growth: CBA-covered firms’ expected wage growth was smaller than the non-CBA firms’ wage growth expectations during the initial periods of the high inflation period, but surpassed the latter in March 2023. Both CBA and non-CBAs expected wage growth converged towards the end of the sample period once inflation (expectations) stabilized during 2024. The ex-post realized

⁷Sauer et al. (2023) document that firms mainly consider their expected profits and sales when answering these regular IBS questions.

Figure 1: Aggregate Dynamics of Expected Inflation and Expected/Realized Wage Growth



Notes: This figure shows the average expected CPI inflation rate in Germany over the next 12 months (red squares), expected wage growth over the next 12 months (black dots), and realized wage growth over the past 12 months (blue diamonds) for firms whose wage setting is covered by CBAs (dashed lines) and firms not covered by CBAs (solid lines). Gross wages refer to a “typical” employee with average qualifications, tenure, and job profile.

wage growth reported by firms 12 months after the corresponding wage growth expectations display a similar pattern (shifted by 12 months, as should be expected).

Overall, the time variation indicates a positive but small correlation between expected inflation and wage growth, given the latter’s more muted and lagged development.

3. Theoretical Considerations and Predictions

To fix ideas and guide our empirical analysis, we briefly outline theoretical considerations governing the pass-through of realized and expected inflation into wages. These considerations are based on Werning’s (2022) partial-equilibrium wage posting framework.

Werning’s main point is that the specific type of wage rigidity determines the magnitude of pass-through of *expected* inflation into wages, but his analysis also contains predictions regarding the pass-through of expected inflation for different forecast horizons as well as for past inflation. Here, we will give an intuitive account of these ideas, and Appendix Section B provides a more formal summary of Werning’s arguments for the case of Taylor pricing.

Werning’s (2022) first prediction concerns the *forward-looking pass-through*: In general, nominal wages are set to minimize the average distance of the fixed nominal wage to the expected real target wage over the duration of the expected wage spell. For Taylor pricing, when wages are set for wage spells with fixed duration, Werning shows that this implies a forward-looking pass-through close to 1/2: The nominal wage will be at the average of the target wage at the beginning and at the end of the wage spell. With Calvo-pricing, when wages can be re-set according to a time-constant hazard rate, the risk of not being able to adjust wages for a longer period of time drives pass-through upwards, and Werning shows that for this case (and no discounting), forward-looking pass-through equals 1. A Sheshinski-Weiss type of menu cost models that allows adjusting the wage setting frequency with a lag delivers pass-through between 0 and 1/2,⁸ while other menu cost models deliver any pass-through between zero and infinity.

Given that in around 50 percent of employment relationships in Germany, wages are set through regular instances of unionized wage bargaining. Hence, Taylor pricing or its Sheshinski-Weiss menu cost modification are plausible types of wage rigidity describing wage setting in the German context. Hence, our hypothesis is:

Hypothesis 1 (Magnitude of Forward-Looking Pass-Through) *The magnitude of pass-through of (short-run) expected inflation into wage growth is expected to be 1/2 or lower.*

Werning’s second prediction relevant for this paper concerns pass-through for inflation at different horizons (see Werning’s Proposition 7 for the formal statement and Appendix Section B for formal results for the case of Taylor pricing). For the case of *backward-looking pass-through*, i.e., the pass through of realized inflation, note that the knowledge of past inflation implies knowledge of the nominal value of the target real wage. The wage setter’s response to past inflation is hence to simply reset the wage to the target.⁹ The magnitude of the reset is given by the accumulated real wage loss at the end of the previous wage spell. The latter, in turn, is determined by whether or not the forward-looking pass-through fully incorporates inflation over the wage spell on average, and on the inflation forecast error over the previous wage spell. Both of these factors lead to a positive effect of past inflation on current wages, although the exact magnitude strongly depends on the type of wage rigidity.¹⁰

⁸The intuition is similar as the one for Taylor pricing noting that higher expected inflation increases the frequency of wage setting and hence lowers the target nominal wage at the end of the (shorter) wage spell.

⁹The forward-looking pass-through will then lead to the nominal wage “overshooting” the nominal value of the target real wage.

¹⁰In general, Werning shows that for all but the menu cost types of wage rigidities, the pass-through of (expected) inflation over all horizons combined equals one.

Hypothesis 2 (Magnitude of Backward-Looking Pass-Through) *The effect of past inflation on wage growth is positive.*

For the case of *forward-looking pass-through for longer horizons*, Werning’s prediction is that only those horizons that are included in the current wage spell should matter for wage setting. This is, because wages can reset to the nominal value of the target real wage at the next instance of wage setting, so that any inflation expectations for time periods later than the next wage setting instance are irrelevant. For example, for Taylor pricing with two-year wage spells, expected inflation for a horizon longer than two years should not matter for the current wage, as at the next instance of wage setting (i) the wage will adjust to the target in two years time and (ii) in two years time the forward-looking pass-through will be determined by the future expectation of two year inflation.¹¹ Since wage setting is plausibly governed by Taylor pricing or its menu cost extension, we state the following hypothesis:

Hypothesis 3 (Magnitude of Pass-Through for Medium-Run Expectations) *Pass-through of expected inflation with horizons longer than the typical wage contract (3 year and longer) is zero.*

Finally, when wages are rigid, some employment relationships may be *at the extensive margin of wage setting*—i.e., they can reset the wage—while others are not. Clearly, only those wages of employment relationships at the extensive margin can reset.

Hypothesis 4 (Pass-through at the extensive and intensive margin) *Forward- and backward-looking pass-through is positive if wages can reset and zero otherwise.*

In the remainder of the paper, we test Hypotheses 1-3 in Section 4. We test Hypothesis 4 in Section 5, where we use the timing of centralized bargaining to identify firms at the extensive margin of wage setting.

4. Expected and Realized Inflation and Wages

This section uses the cross-sectional and time dimensions of the panel data on firms’ expected inflation and wage growth to provide benchmark estimates for average forward- and backward-looking pass-through, showing that pass-through is generally low (below 0.2)

¹¹This is in contrast to Calvo pricing, where the current wage spell can randomly last for any period of time.

along both dimensions. Pass-through is also low when utilizing alternative empirical approaches that use ex-post realized wage growth—instead of expected wage growth in the main specification—for the estimations, or address potential endogeneity concerns using an instrumental variable approach and hypothetical scenarios. We further assess how pass-through varies during the rise and fall of inflation between December 2021 and September 2025. Lastly, we present evidence in line with Hypothesis 4, i.e., that, under Taylor pricing, medium-run inflation expectations are irrelevant for wage setting in the short-run.

4.1. Average Pass-through

Empirical Specification To estimate the average forward- and backward-looking pass-through, we exploit various dimensions of variation in inflation and wage growth expectations across firms and over time by estimating different versions of the following baseline specification:

$$w_{i,t}^e = \phi^F \pi_{i,t}^e + \phi^B \pi_t + \mathbf{X}'_{i,t} \boldsymbol{\gamma} + \delta_t + \alpha_i + \varepsilon_{i,t}, \quad (1)$$

where $w_{i,t}^e$ denotes firm i 's expected growth rate of the wage of its typical employee over the next 12 months, elicited in survey wave t . The variable $\pi_{i,t}^e$ is firm i 's expectation of CPI inflation over the next 12 months, and π_t is the realized CPI inflation accumulated over the previous 24 months.¹² These are our main explanatory variables of interest and identify the average degrees of forward-looking ($\hat{\phi}^F$) and backward-looking pass-through ($\hat{\phi}^B$) across firms.

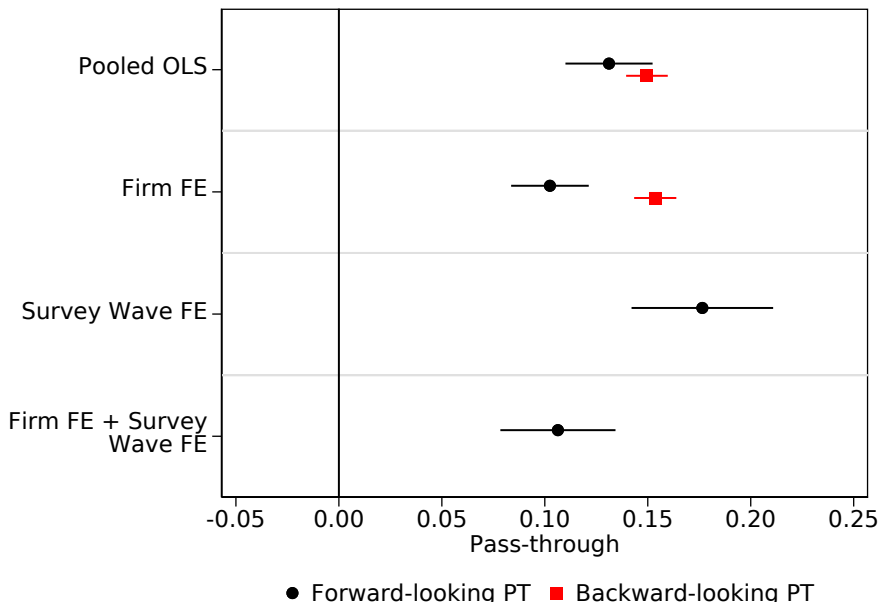
The control vector $\mathbf{X}_{i,t}$ captures additional determinants of (real) wage growth. It includes time-varying controls such as the expected unemployment rate, which reflects both aggregate macroeconomic conditions and the anticipated tightness of the labor market (and thus workers' outside options), as well as assessments of the firm's current and expected future business conditions, which proxy the value of the match. Other elements of $\mathbf{X}_{i,t}$ are time-invariant demographic and firm-specific characteristics.¹³ $\varepsilon_{i,t}$ is the error term, and standard errors are clustered at the firm level.

To assess the range of plausible values for forward- and backward-looking pass-through,

¹²While the official inflation rate is defined as the price change over the past 12 months, our baseline estimation uses the 3-month average of the accumulated change in the CPI over the past 24 months, as wage negotiations often occur less frequently than annually. We present additional results using inflation over the past 12 months below.

¹³Specifically, we control for the (log) number of employees, the export share, and an indicator equal to one if the respondent reports having a "very high" influence on the firm's decisions regarding investment, production, personnel, or pricing, elicited in June 2021. We code missing values for the number of employees, the export share, and the respondent's influence as zero and include separate dummies indicating missing values in the respective variables.

Figure 2: Average Forward- and Backward-looking Pass-through



Notes: The figure reports estimated coefficients from regressions of firm i 's expected wage growth over the next 12 months on expected CPI inflation over the next 12 months (forward-looking pass-through $\hat{\phi}^F$; black dots) and realized CPI inflation over the previous 24 months (backward-looking pass-through $\hat{\phi}^B$; red squares) for different specifications of the empirical model (1). All specifications control for respondents' expectations about the unemployment rate in 12 months and for firms' current and expected future business conditions. The first two specifications additionally control for time-invariant demographic and firm-specific characteristics; see Footnote 13 for details. Horizontal lines indicate 95% confidence intervals based on standard errors clustered at the firm level. The corresponding regression results are reported in Appendix Table XY.

we estimate several specifications that differ in their treatment of unobserved heterogeneity and aggregate variation. In some specifications, we replace the time-invariant components of $\mathbf{X}_{i,t}$ with firm fixed effects α_i , thereby absorbing all time-invariant observed and unobserved firm characteristics. In other specifications, we add survey-wave fixed effects δ_t to absorb aggregate time variation, including changes in the macroeconomic and inflationary environment prevailing at survey month t . Such aggregate conditions may (i) directly affect wage growth—unless fully captured by firm-specific business conditions and expectations, which we always control for—and (ii) shape firms' inflation expectations through common information sources, which are particularly relevant in wage bargaining.

By construction, realized inflation π_t and survey-wave fixed effects δ_t are perfectly collinear, as $\pi_{i,t}$ varies only at the survey-wave level. Hence, the average backward-looking pass-through coefficient $\hat{\phi}^B$ cannot be identified in specifications that include δ_t .

Results The results are broadly consistent with the theoretical predictions of wage rigidities discussed in Section 3. First, the average forward-looking pass-through is positive but small and varies little across the empirical specifications: As shown in Figure 2, we estimate forward-looking pass-through coefficients $\hat{\phi}^F$ between 0.10 and 0.18 for firms.¹⁴ Hence, a one percentage point increase in expected inflation over the next 12 months is associated with an increase in expected wage growth over the same horizon of between 0.10 and 0.18 percentage points. Taken at face value, these estimates are consistent with Section 3’s Hypothesis 1, but lie at the lower end of what standard models with wage rigidities, such as Taylor pricing, would suggest.

Specifically, the first row of Figure 2 shows that, when exploiting the full variation in expected inflation across firms and over time, the point estimates lie roughly in the middle of this range. The estimated forward-looking pass-through is highest in the specification with survey-wave fixed effects (third row), even though identification in this case relies exclusively on cross-sectional variation in expected inflation and we net out all common time variation, including aggregate inflation and the common component of expectations. At the same time, the estimated coefficients decline only slightly when we control for unobserved heterogeneity with firm fixed effects. The smallest pass-through estimates arise in the most restrictive specification that includes fixed effects in both the firm and time dimensions.

Second, and also in line with the theoretical predictions (Hypothesis 2), the results indicate that realized inflation plays an important role in firms’ wage-setting plans. Figure 2 shows that accumulated past inflation is associated with higher expected future wage growth. In both specifications without survey-wave fixed effects, a one percentage point increase in realized inflation over the previous 24 months is associated with about a 0.15 percentage point increase in expected wage growth over the next 12 months. As shown in Appendix Table C.1, we obtain very similar results when instead using accumulated inflation over the past 12 or 18 months. In line with predictions for Taylor pricing, pass-through of realized inflation is therefore quantitatively comparable to the pass-through of expected inflation—even though both backward- and forward-looking pass-through combined are too small relative to theory.

In general, consistent with Taylor pricing (or its menu cost extensions discussed in Section 3, the results thus far show that wage setting tends to lag behind inflation. Firms plan to account for some expected inflation when re-setting wages, but also compensate past real wage losses. Accordingly, variation in both expected and realized inflation helps explain firms’ wage growth expectations.

¹⁴The complete regression output underlying Figure 2 is reported and discussed in Appendix Section XY.

Table 1: Pass-through into Realized Wage Growth

	Realized Wage Growth over next 12 Months		
	(1)	(2)	(3)
Expected Inflation next 12m	0.150*** (0.017)	0.143*** (0.017)	0.068*** (0.026)
Realized Inflation past 24m		0.070*** (0.011)	
Observations	11160	11160	11160
R2	0.036	0.041	0.047
Expectation Controls	yes	yes	yes
Firm-specifics	yes	yes	yes
Firm FE	no	no	no
Survey Wave FE	no	no	yes

Notes: This table reports results from regressions of ex-post realized wage growth (in percent) over the past 12 months on ex-ante expected inflation over the same horizon and—in Column (2)—on realized CPI inflation over the previous 24 months. Realized wage growth is elicited between December 2022 and September 2025, implying that the corresponding expectations sample spans December 2021 to September 2024. All specifications control for the expected unemployment rate in 12 months, firms’ current and expected future business conditions, and the time-invariant firm-specific controls listed in Footnote 13. Standard errors are clustered at the firm level. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2. Pass-through into Realized Wage Growth

The panel dimension of the data enables us, as the first paper in the literature, to estimate the pass-through of expected and realized inflation into realized wage growth. We elicit realized wage growth retrospectively for the past 12 months, allowing us to relate forward-looking inflation expectations and realized inflation from the 12 waves between December 2021 and September 2024 to the realized wage growth reported in the survey waves between December 2022 and September 2025. We estimate pass-through into realized wage growth by estimating equation (1) as above, but with realized wage growth over the subsequent 12 months, i.e., realized wage growth lagged by 12 months, as the dependent variable.

Table 1 reports the results. We find forward-looking pass-through between 0.07 (in the specification with survey wave fixed effects) and 0.15 (for pooled OLS and when additionally controlling for accumulated inflation in the previous 24 months), and thus in the same range as the corresponding results for expected wage growth.¹⁵ Backward-looking pass-through is somewhat smaller than in the main specifications above, but is still associated with realized wage growth.

¹⁵Because retrospective wage growth overlaps with four quarters of expected inflation, it is difficult to link the time variation in expected inflation to the time variation in wage growth. The results for estimations that add firm-level fixed effects are thus omitted.

These results suggest that within the 12-month period between measuring inflation expectations and retrospective wage growth, wages have adjusted to the expected inflation as initially expected. This is notable because, within this period, wages may have responded not only to the original inflation expectations but also to developments that were not anticipated at the time of measuring expectations.

4.3. Causality

Our preferred interpretation of the forward-looking pass-through estimates $\hat{\phi}^F$ in Equation (1) is that they capture the immediate causal effect of expected inflation on (expected) wage growth in partial equilibrium, as perceived by firm managers in the short run. This interpretation might be questionable, however, because our baseline specification does not rely on (quasi-)random variation in inflation expectations.

A first concern is that the estimated association could be driven by omitted variables. Note, though, that we already mitigate this by controlling for a rich set of potential confounders, including other macroeconomic expectations and firms' current and expected future business conditions, which might be correlated with both expected inflation and expected wage growth.¹⁶

A second concern is the direction of causality. Firms might anticipate that stronger wage growth will lead to higher future prices in order to prevent markups from falling too sharply. If managers viewed such wage-induced price reactions as broad-based, they could revise upward their expectations about aggregate inflation. Nevertheless, we view the channel running from expectations about *aggregate* inflation to expected wage growth at the *firm level* as more immediate and conceptually appealing, particularly in the presence of wage rigidities.

While our empirical setup already makes this interpretation plausible, we go one step further and address causality more directly using two complementary strategies. First, we estimate forward-looking pass-through using a shift-share instrument for firms' inflation expectations. Second, we compute pass-through from hypothetical scenarios in which we elicit expected wage growth under exogenously given paths for future inflation.

Instrumental Variable Approach The instrumental variable (IV) strategy exploits the strong fluctuations in energy prices during the sample period in a shift-share design. The

¹⁶Note, though, that our main estimates do not vary much when these control variables are omitted.

idea is that firms with more energy-intensive production pay closer attention to these fluctuations than firms with low energy intensity, leading to differential extrapolation from energy cost dynamics to overall inflation expectations (see Wehrhöfer, *forthcoming*, for a similar argument). We measure energy prices using the energy component of the producer price index (“PPI Energy”). The PPI Energy roughly tripled between late 2020 and September 2022, following the recovery from the Covid-19 recession and the Russian invasion of Ukraine, before declining substantially thereafter. Firms’ exposure to this shock is captured by the energy intensity of production—defined as the ratio of energy costs to revenues—prior to the Russian invasion; these variables were elicited in the April 2022 wave of the regular IBS. According to this measure, the median firm spent about 3 percent of its revenues on energy before the war.

Figure C.1 in Appendix Section C.1 graphically verifies the hypothesized first stage: firms that were more strongly affected by the energy price shock expected higher inflation. The difference in inflation expectations between firms with above- and below-median energy cost shares closely tracks the dynamics of the PPI Energy. At the peak of energy prices in September 2022, inflation expectations of more exposed firms were, on average, about 0.8 percentage points higher than those of firms with below-median energy cost shares.

Columns (1) and (2) of Table 2 report IV estimates of the baseline specification using the shift-share term $energy\ cost\ share_i \times PPI\ Energy_t$ as an instrument for expected inflation $\pi_{i,t}^e$.¹⁷ In Column (1), we additionally control for firms’ energy cost share to account for its general association with inflation expectations (see Figure C.1), as well as the usual firm-specific and time-invariant controls. Column (2) replaces the time-invariant firm controls with firm fixed effects.¹⁸

The IV estimates of the forward-looking pass-through are 0.10 and 0.14, respectively, and thus very similar to the corresponding OLS estimates. Notable, estimated backward-looking pass-through is around 0.15 in Columns (2) and (4), similar to our main specification as well. Hence, our main conclusion remains unchanged: inflation expectations only weakly affect the magnitude of expected wage growth.

Hypothetical Inflation Scenarios We also compute pass-through based on hypothetical scenarios in which we ask firm managers to state their expected wage growth when consider-

¹⁷The first-stage results are not reported in the table because Figure C.1 already documents the strong association over time. The high first-stage F-statistics (exceeding 1,000) reflect this strong relationship.

¹⁸All 2SLS regressions further control for respondents’ expected unemployment rate and their assessments of their firms’ current and expected future business conditions. These controls mitigate endogeneity concerns stemming from potential differential effects of the energy crisis on firms’ business outlooks.

Table 2: Pass-through Estimates from Shift-Share IV and Hypothetical Scenarios

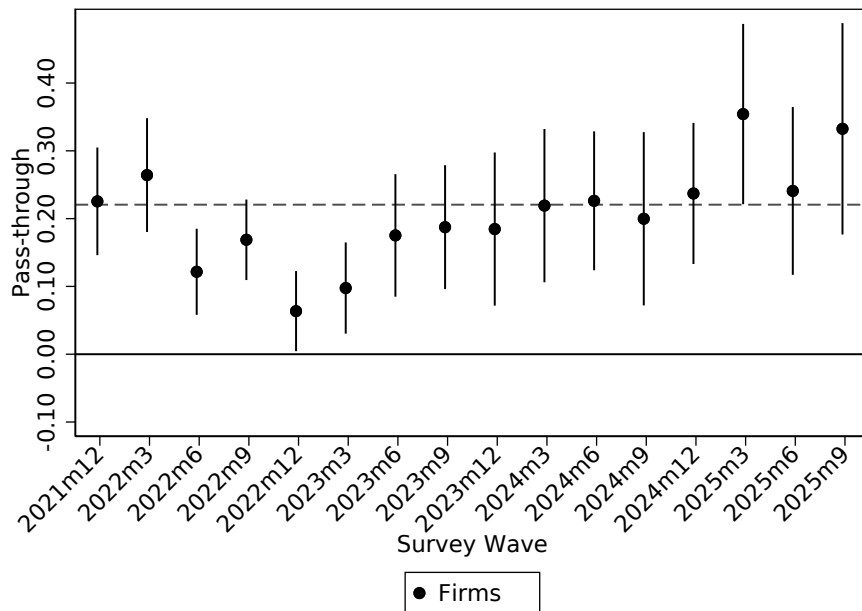
	Expected Wage Growth next 12 Months				
	Shift-Share IV				Hypothetical Scenarios
	(1)	(2)	(3)	(4)	(5)
Expected Inflation next 12m (IV)	0.262*** (0.017)	0.098*** (0.023)	0.293*** (0.016)	0.135*** (0.021)	
Energy Cost Share	0.016*** (0.002)	0.019*** (0.002)			
Expected Inflation next 12m (Scenarios)					0.454*** (0.021)
Realized Inflation last 24m		0.161*** (0.008)		0.149*** (0.007)	
First Stage F	4805	2921	4812	3031	
Observations	26599	26599	26545	26545	1120
R2	0.060	0.089	0.053	0.103	0.179
Expectation Controls	yes	yes	yes	yes	no
Firm-specifics/ Demographics	yes	yes	no	no	no
Firm FE	no	no	yes	yes	no
Survey Wave FE	no	no	no	no	no

Notes: The dependent variable is expected wage growth over the next 12 months for firms (Columns 1–3) and employees (Column 4). In Columns 1 and 2, expected inflation for the next 12 months is instrumented by a shift-share instrument based on the energy intensity of a firm’s production (the “share”) and the energy component of the PPI at the time of the survey (the “shift”). Firms’ energy intensity is the ratio of energy costs to revenues prior to the Russian invasion of Ukraine elicited in the April 2022 wave of the regular IBS. The 2SLS regressions control for respondents’ expected unemployment rate and their assessment of current and expected future business conditions. In Column 1 we further control for the firm-specific energy cost share and the time-invariant firm-specific controls listed in Footnote 13, while in Column 2 we control for firm fixed effects. Column 3 estimate pass-through based on hypothetical scenarios conducted in the December 2023 wave, when a random subset of respondents was asked to provide their wage growth expectations for the next 12 months for two scenarios: if they expected consumer prices to increase (i) by either 2 percent or (ii) by 8 percent over the same horizon. Each respondent answered the questions under both scenarios. Standard errors are clustered at the firm-level. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

ing different counterfactual outlooks for future inflation (for other recent uses of hypothetical scenarios in the literature, see, e.g., [Andre, Pizzinelli, Roth and Wohlfart, 2022](#), [Coibion, Gorodnichenko, Knotek and Schoenle 2023](#), or [Pilossoph and Ryngaert, 2024](#)). Specifically, in the December 2023 wave, we asked a random subset of respondents to provide their wage growth expectations for the next 12 months for two scenarios: if they expected consumer prices to increase (i) by either 2 percent or (ii) by 8 percent over the same horizon. Each respondent answered the questions under both scenarios. This holds a respondent’s remaining information set constant and thus mechanically eliminates any potential channel of reverse causality from expected wages to inflation.

For direct comparability with the main results, we estimate pass-through based on the exogenously given and hypothetical inflation expectations of 2% and 8%. Column 3 of Table 2

Figure 3: Forward-looking Pass-through over Time



Notes: The figure plots the conditional association between expected inflation and expected wage growth for each survey wave, estimated by including interaction terms $Expected\ Inflation_{it} \times \mathbb{I}_t(\text{survey wave} = t)$ in the empirical model (1). The regression controls for firms’ expected unemployment rate, firms’ current and expected future business conditions, and for the firm-specific controls listed in Footnote 13. Standard errors are clustered at the firm level. Confidence intervals are displayed at the 95% level. For comparison, the dashed horizontal lines indicate the average pass-through across all survey waves

shows the results. We find a positive effect of the hypothetical inflation expectations on wage growth, indicating that firms perceive expected future inflation as a driver of wage growth—the causal channel we are interested in. With a point estimate of 0.45, we again find that pass-through is clearly below 1. Yet, the estimates are larger than the previous estimates. Part of this difference may arise because the hypothetical scenarios strongly prime respondents to consider the potential role of expected inflation for their future wage growth. In addition, the hypothetical scenario may be prone to experimenter demand effects. Both of these issues are no concern for the main estimates, but rather highlight that pass-through is far below one *despite* these potential sources of upward bias.¹⁹

4.4. State-dependence of Forward-looking Pass-through

Next, we analyze how the forward-looking pass-through of expected inflation to wage growth varies over the sample period. To this end, we interact expected inflation with indicators

¹⁹More detailed results in Appendix Section C.1 corroborate this notion by showing that 23 percent of firms anticipate the exact same pay increase irrespective of the hypothetical scenario of expected inflation.

for each survey wave in Equation (1) and report the resulting wave-specific pass-through coefficients in Figure 3. Across all waves, the estimated pass-through is small in economic terms, ranging from 0.09 to 0.36. In most periods, the wave-specific estimates lie close to their overall average, indicating that the degree of pass-through has been relatively stable and low throughout the sample.

An interesting exception occurs in the four quarters following the Russian invasion of Ukraine (2022Q2–2023Q1), when inflation was particularly high. During this period, the estimated pass-through is even lower than its average level. This pattern suggests some degree of state dependence in forward-looking pass-through. But the overall stability of forward-looking pass-through over the full four-year horizon also implies that the persistently low pass-through cannot be attributed solely to adverse macroeconomic conditions.

One potential explanation for the low pass-through in the aftermath of the Russian attack on Ukraine is that, at that time, firms formed stagflationary views about the economy (e.g., [Andre et al., 2022](#)). The sharp reduction in the availability of key natural resources (and, hence, productivity) may have constrained firms’ scope to grant wage increases despite higher realized and expected inflation, thereby dampening pass-through. However, pass-through is already small in economic terms prior to the invasion and remains low thereafter. In addition, Appendix Section C.2 investigates heterogeneity in firms’ exposure to the Russo-Ukrainian war and provides further evidence that stagflationary views triggered by the war might have resulted in even lower pass-through, but are unlikely to account for the consistently low pass-through observed over the entire sample period.

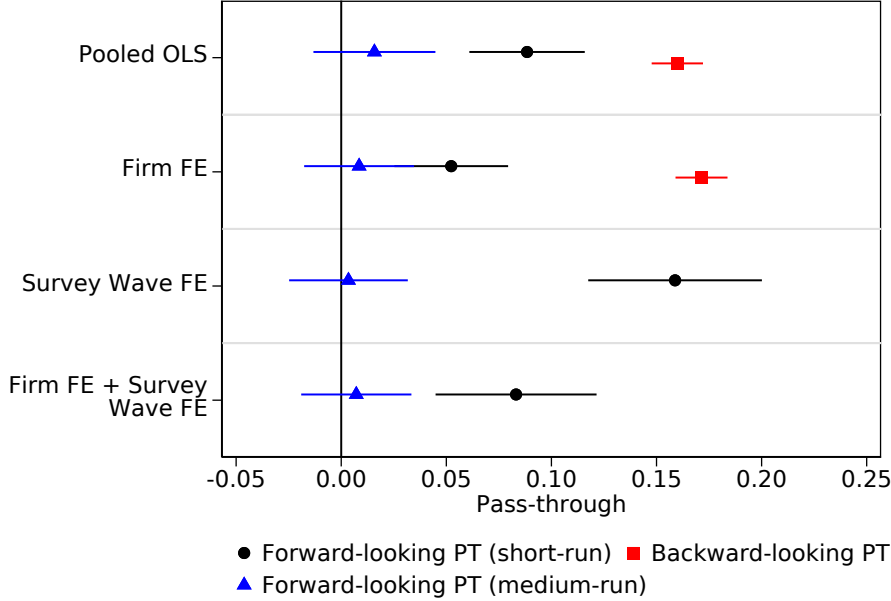
4.5. (No) Pass-through of Medium-run Inflation Expectations

While there is positive pass-through of short-run expected inflation and realized inflation, medium-run inflation may or may not affect wage growth depending on the type of wage rigidity. As discussed in Section 3 around Hypothesis 4, under Taylor pricing, only short-run inflation expectations should matter for wage decisions: expectations with a horizon longer than τ are irrelevant, because agents know they can reset wages at least once within τ periods. By contrast, under Calvo pricing, where the maximum duration of a wage spell is unknown, medium-run inflation expectations can affect current wage setting.

We assess these predictions by augmenting the empirical model (1) with survey measures of medium-run inflation expectations (three or five years ahead) that are available in a subset of waves.²⁰ Figure 4 shows that medium-run inflation expectations have no statistically or

²⁰We elicit five-year-ahead inflation expectations (the expected one-year inflation rate in five years) in the

Figure 4: Pass-through of Short-run vs. Medium-run Inflation Expectations



Notes: The figure reports estimated coefficients from regressions of firm i 's expected wage growth over the next 12 months on expected CPI inflation over the next 12 months (forward-looking pass-through $\hat{\phi}^F$; black dots) and realized CPI inflation over the previous 24 months (backward-looking pass-through $\hat{\phi}^B$; red squares) for different specifications of the empirical model (1). All specifications control for respondents' expectations about the unemployment rate in 12 months and for firms' current and expected future business conditions. The first two specifications additionally control for time-invariant demographic and firm-specific characteristics; see Footnote 13 for details. Horizontal lines indicate 95% confidence intervals based on standard errors clustered at the firm level.

economically significant effect on expected wage growth over the next 12 months once short-run inflation expectations are controlled for, irrespective of the fixed-effects specification.

This pattern is in line with the predictions of wage posting models with Taylor pricing—hence confirming Hypothesis 3—and suggests that the relevant wage spells in our data are at most about two to three years in length. Such durations are plausible in the German context, where a large share of wages is directly or indirectly adjusted through collective bargaining agreements, which typically re-open every two years or less, and where wages of employees not covered by CBAs are usually adjusted even more frequently.

June 2022 and December 2022 waves, and three-year-ahead inflation expectations (the expected inflation rate between 24 and 36 months from the time of the survey) in the waves from June 2023 to September 2025. To facilitate readability and increase sample size, we combine these into a single measure of medium-run inflation expectations, which equals the three- or five-year-ahead expectation, depending on availability in a given wave.

4.6. Evidence from Other Countries and Other Time Periods

The panel estimates of average pass-through in our study are unique in the literature in several respects: First, the panel structure of our data allows us to leverage various sources of variation to estimate pass-through and to construct a shift-share instrument for causal identification. Second, the panel fully covers the recent high-inflation period that commenced in mid-2021 and the subsequent period of declining inflation rates, allowing us to estimate pass-through based on four years of data and to compare pass-through across different survey waves. Third, and finally, our study is the only one that compares pass-through into expected wage growth with pass-through into ex-post realized wage growth.

In terms of magnitude, our panel estimates of low forward-looking pass-through ($\hat{\phi}^F \in [0.1, 0.18]$) and backward-looking pass-through ($\hat{\phi}^B \in [0.15, 0.18]$) for firms are consistent with recent evidence from other countries and across different time periods (see ? for a review). Closest to our setting, [Gautier et al. \(2025\)](#) document very small degrees of forward- ($\hat{\phi}^F \in (0.04, 0.08)$) and backward-looking pass-through ($\hat{\phi}^B \in (0.05, 0.19)$; measured via perceived inflation over the past 12 months) in panel survey data of French firms covering the similar study period. Similiar to our findings, they also do not find evidence for pass-through of medium-term inflation expectations.²¹ In addition, RCTs conducted among firms in Switzerland ([Abberger et al., 2025](#)) and the Euro-area ([Baumann et al., 2024](#)) at the height of the inflationary shock in late 2022/first half of 2023, delivered quantitatively quite similar pass-through estimates of between 0.1 and 0.3, and 0.15 and 0.17, respectively, while the former also document zero relationship between medium-term inflation expectations and short-run wage setting.

In a broader perspective, the evidence from firms is also in line with recent evidence on low inflation pass-through found in samples of employees. [Hajdini et al. \(2023\)](#) estimate the pass-through from expected inflation to expected total household income to be approximately 0.2 using a one-time survey experiment conducted in early 2022. [Jain et al. \(2024\)](#) present pass-through estimates between 0.15 and 0.20 for repeated cross-sections of Canadian consumers, focusing on a longer sample period between 2014 and early 2022.

Taken together, these findings suggest that a low pass-through of expected inflation into wage growth is neither a phenomenon limited to the recent period of high inflation nor specific to the German context, and that both expected and realized inflation are only marginally reflected in expected wage growth, regardless of the general economic conditions, country-specific labor market institutions, or the prevailing inflation rate at the time of the survey.

²¹In addition, [Savignac et al. \(2024\)](#) document very low pass-through in the pilot phase of the French survey conducted in 2020 and 2021, i.e., prior to the inflation surge.

5. The Role of Bargaining Institutions for Pass-Through

The evidence presented thus far points to a central role for wage rigidities in explaining the pass-through of inflation into wages. To make further progress, we now investigate the role of wage bargaining institutions, which provide a well-defined framework for how wages are negotiated and when wage adjustments take place. Germany’s institutional setting offers an ideal environment to study how bargaining institutions shape the pass-through of inflation into wages. Roughly half of all employees are covered by collective bargaining agreements (CBAs), which are typically negotiated at the industry level by unions and employer associations at predefined dates that differ across industries and usually remain in place for around 24 months on average (Schulten, 2022). The staggered expiry dates and varying durations of CBAs give rise to a bargaining calendar that differs strongly across industries and over time.

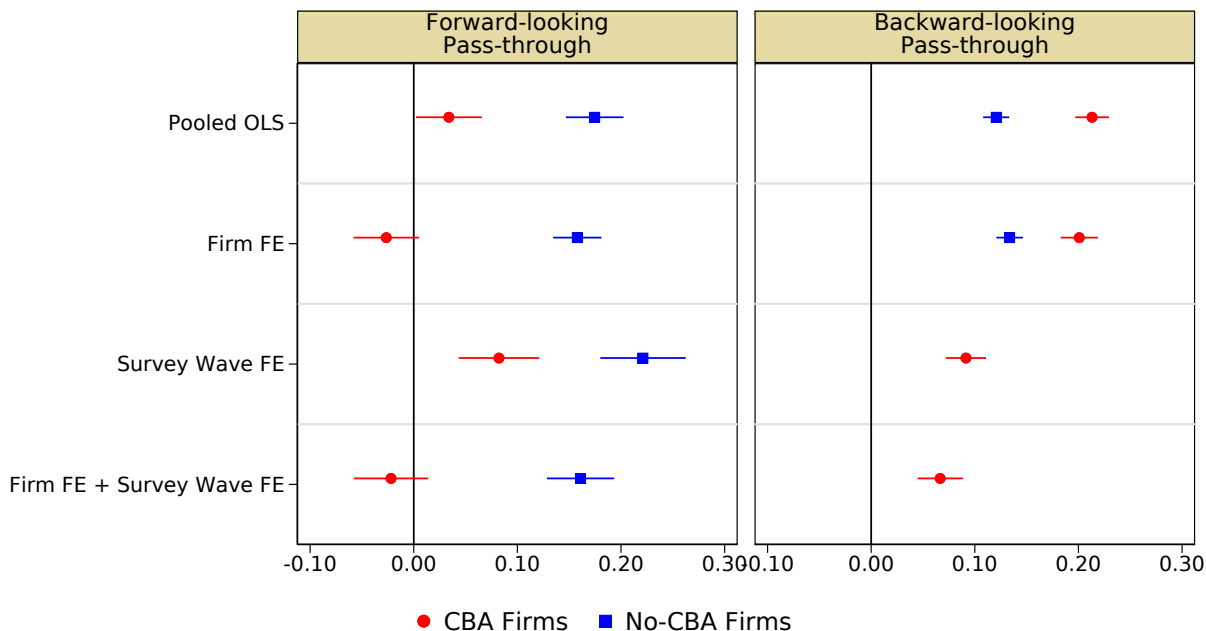
In this section, we use this institutional structure to address two questions. First, we examine whether forward- and backward-looking pass-through differ systematically between CBA and non-CBA firms. Second, we exploit the aforementioned exogenous variation in the expiry dates of CBAs across time and industries to investigate the magnitude of pass-through at the intensive margin, that is, when CBAs are known to expire in the near future and firms therefore expect wages to be adjusted.

5.1. Implications of Wage Bargaining Institutions for Average Pass-Through

As shown in Figure 1 and discussed in Section 2, firms covered and not covered by CBAs expected different patterns of wage growth, despite virtually identical average inflation expectations. Wage growth expectations of CBA-covered firms systematically lagged those of non-CBA firms during the initial phase of the high-inflation period: they were lower at first, but surpassed those of non-CBA firms around March 2023. Towards the end of the sample period, once inflation (and inflation expectations) had stabilized in 2024, expected wage growth of CBA and non-CBA firms converged.

To examine whether these patterns are reflected in systematic differences in the degree of forward- and backward-looking pass-through between firms covered by a CBA and those that are not, we extend our baseline specification in Equation (1) by interacting both expected and realized inflation with survey-based indicators for CBA and non-CBA firms. This allows the coefficients for forward-looking pass-through, $\hat{\phi}^F$, and backward-looking pass-through, $\hat{\phi}^B$, to vary by CBA coverage status. In specifications that include survey-wave fixed effects, the coefficients on realized inflation identify only the *differential* backward-looking pass-through

Figure 5: Average Forward- and Backward-looking Pass-through: CBA vs. Non-CBA Firms



Notes: The figure reports estimated coefficients from regressions of firm i 's expected wage growth over the next 12 months on expected CPI inflation over the next 12 months (forward-looking pass-through $\hat{\phi}^F$; left-hand panel) and realized CPI inflation over the previous 24 months (backward-looking pass-through $\hat{\phi}^B$; right-hand panel), separately for firms covered and not covered by collective bargaining agreements (CBAs). To this end, the measures of expected and realized inflation are interacted with indicators for CBA and non-CBA firms in the different specifications of the empirical model (1). All specifications control for respondents' expectations about the unemployment rate in 12 months and for firms' current and expected future business conditions. The first two specifications additionally control for time-invariant demographic and firm-specific characteristics; see Footnote 13 for details. In the specifications including survey-wave fixed effects, the coefficients for backward-looking pass-through identify the *differential* effect between CBA and non-CBA firms due to perfect multicollinearity between realized inflation and the wave fixed effects. Horizontal lines indicate 95% confidence intervals based on standard errors clustered at the firm level.

between CBA and non-CBA firms, due to perfect multicollinearity between realized inflation and the time dummies. Figure 5 summarizes the resulting group-specific coefficients, with 95% confidence intervals based on standard errors clustered at the firm level. In addition, additional results presented in Appendix D.1 confirms that the differences between firms covered by a CBA and those that are not driven by firm size differentials.

The figure reveals pronounced differences in how CBA and non-CBA firms adjust expected wages to inflation. First, forward-looking pass-through is substantially lower for CBA firms than for non-CBA firms across all specifications. Without firm fixed effects, the estimated coefficients for CBA firms remain below 0.1, and once firm fixed effects are included, forward-looking pass-through among CBA firms becomes statistically indistinguishable from zero. In contrast, forward-looking pass-through for non-CBA firms is clearly positive and sizeable,

ranging between 0.16 and 0.23.

By contrast, backward-looking pass-through is considerably stronger in CBA firms. The estimated coefficients on realized inflation are roughly twice as large for CBA firms as for non-CBA firms, with backward-looking pass-through around 0.2 for CBA firms, compared to estimates in the range between 0.11 and 0.13 for non-CBA firms. For non-CBA firms, these backward-looking coefficients are thus, if anything, slightly smaller than the corresponding forward-looking pass-through estimates. The pronounced difference of backward-looking pass-through is also present in the specification with survey wave fixed effects, where the estimates imply that backward-looking pass-through differs by 0.07 to 0.1 points between CBA and non-CBA firms.

Taken together, these results indicate that wage setting in CBA firms places relatively more weight on realized past inflation and much less weight on inflation expectations than in non-CBA firms. This stronger backward-looking component provides a natural explanation for the slower and more delayed adjustment of wage growth expectations among CBA-covered firms documented in the time-series patterns.

Additional Evidence on Role of Bargaining Power for Pass-through Our finding that forward-looking pass-through is smaller among CBA firms than non-CBA firms is somewhat surprising in light of the conventional view that unionization strengthens employees' bargaining power, which, in turn, could help them better offset expected future real wage losses due to expected inflation. To shed more light on whether bargaining power is potentially associated with higher or lower forward-looking pass-through, Appendix Section D.2 uses measures of labor market tightness to proxy for the distribution of bargaining power between firms and employees. The results indicate that forward-looking pass-through is indeed larger for firms operating in tighter labor markets, while the degree of backward-looking pass-through remains relatively stable across these groups. This pattern suggests that firms' bargaining power (or the lack thereof) is an important determinant of the magnitude of forward-looking pass-through and thus of the extent to which real wage losses are offset overall.

5.2. Pass-through at the Intensive Margin of Wage Setting

As argued in Section 3 (Hypothesis 4), theory predicts that pass-through is larger if agents expect to renegotiate wages soon. In other words, the intensive margin of pass-through, i.e., the degree of pass-through conditional on wage adjustments taking place, is larger than

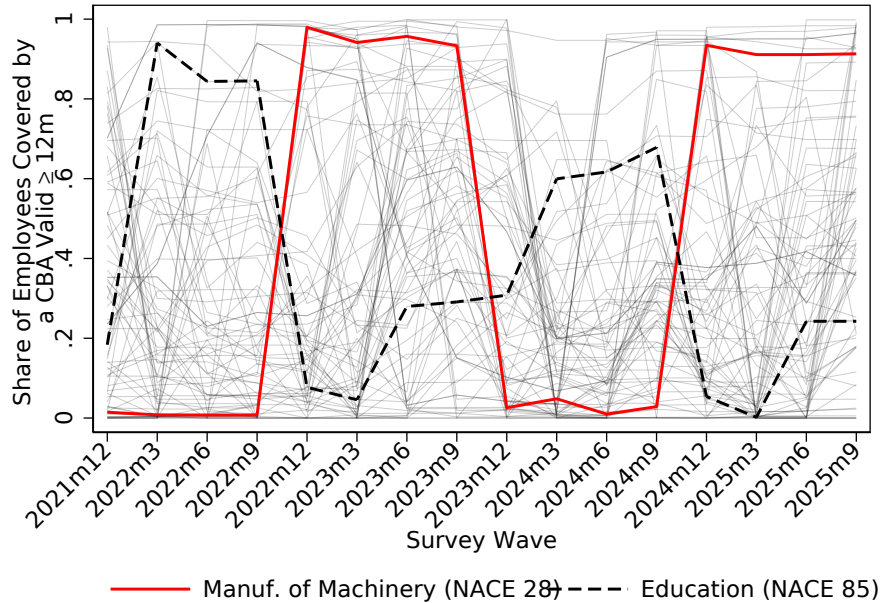
the average pass-through. To investigate this hypothesis, we utilize the exogenous variation in the expiring dates of collective bargaining agreements (CBA) across time and industries. Given that CBAs are typically in place for more than one year, this results in variation across time and industries in whether wage bargaining will occur during the 12-month forecast horizon. If a CBA has expired or will expire within the next 12 months, the parties involved may understand that a significant portion of wage negotiations will take place during this period. Therefore, they may anticipate that some of the expected inflation will lead to increased wage growth. In contrast, firms covered by a CBA that does not expire within the next 12 months should expect less scope for wage adjustments when expecting higher inflation, resulting in lower pass-through.

CBA-based Measure for the Timing of Wage Adjustment To evaluate the importance of this channel, we merge the survey data with external information on the timing of collective agreements at the two-digit NACE industry level, as provided by the German Federal Statistical Office. This data allows us to measure the share of employees covered by collective bargaining in a given industry whose current agreement is valid for at least 12 months after the survey date. Since industries may be governed by multiple CBAs, each applying to different subsets of firms and employees, the measure ranges from 0 to 1. A value of 0 means that all CBAs in the industry will expire and need to be renegotiated within the next 12 months. Conversely, a value of 1 indicates that all CBAs in the industry will remain valid for at least 12 months following the survey date, implying that the wage (or the wage component defined by a CBA) is likely to remain fixed for at least one year. Hence, this measure captures the degree to which wages are fixed over the 12-months time window of the expected wage growth in our data. For conciseness, we will refer to the CBA coverage share as a measure for the (short-run) wage rigidity in an industry. The extensive margin of wage setting—the degree to which wages are scheduled to be reset in an industry and within the 12-month expectation window—is given by 1 minus the CBA coverage share.

Figure 6 illustrates the CBA-based measure for the short-run wage rigidity for all 2-digit NACE industries over the survey period. The measure varies significantly over time within industries and the timing of these patterns differs across industries. As an example, the red line represents the “Manufacture of Machinery” industry (NACE 28), where the majority of CBA-eligible employees are covered by one of the many CBAs in the “Metal and Electronics Industry.”²² At the start of our sample period in December 2021, the current CBA in this

²²As is common in other industries, the “Metal and Electronics Industry” has many different CBAs that apply to specific regions or larger firms. CBAs are typically negotiated in a designated pilot district and then are quickly adopted in the other districts, resulting in synchronized expiration dates. Due to this

Figure 6: CBA-based Measure of Short-run Wage Rigidity: Illustration



Notes: The figure illustrates the CBA-based measure of short-run wage rigidity for all 2-digit NACE industries (thin lines), along with two specific examples: the industries “Manufacture of Machinery” (NACE 28, red solid line) and “Education” (NACE 85, black dashed line). The measure captures the share of employment relationships within each industry that will continue to be covered by an existing CBA 12 months after the specific survey date. As industries can be governed by multiple CBAs, each applicable to different subset of firms, the measure ranges from 0 to 1. A value of 0 indicates that all CBAs in the industry will expire and need to be renegotiated within 12 months. Conversely, a value of 1 means that all CBAs will remain valid for 12 months after the survey date.

industry was set to expire by the end of September 2022. Therefore, our measure for the short-run wage rigidity is close to zero during the first four survey waves, meaning that the wage bargaining partners should have expected to reset wages within the next 12 months (they were at the extensive margin of wage setting). In fact, in November 2022 they agreed on a new CBA with a term extending until the end of September 2024. Consequently, during the survey waves between December 2022 and September 2023, almost all CBA-eligible employees in this industry were covered by a CBA that was still in force for at least 12 more months. This share dropped to zero again in the December 2023 wave when the expiration date entered the 12 month forecasting window. While the overall pattern is similar, the exact timing varies significantly across other industries, such as the “Education” industry (NACE 85, black line).

Since the timing of wage negotiations largely depends on the duration of the CBAs initially in

synchronization of CBAs within industries, the measure for the extensive margin often tends to be either close to zero or one.

place at the beginning of the sample period, the CBA-based measure for the short-run wage rigidity exhibits exogenous variation across and within industries over time. Importantly, agents typically know when wages are scheduled to be reset: In Appendix D.3 we show that the CBA-based measure of short-run wage rigidity is strongly correlated with a survey-based measure that elicits firms' expectations regarding the share of employees that will be subject to wage negotiations or collective bargaining rounds in the next 12 months.

Pass-through Is Larger when Wage Adjustments Are Scheduled We now investigate forward- and backward-looking pass-through of inflation into wage growth at the intensive margin, i.e., at a time when wage adjustments are scheduled for the next 12 months. Pass-through at the intensive margin should be larger than average pass-through, because average pass-through includes both employment relationships for which re-setting wages is expected (with potentially positive pass-through along the intensive margin) and those for which wages are fixed in the short term (with a pass-through near zero).

We test this hypothesis and measure pass-through along the intensive margin by adding interaction terms between the CBA-based measure of short-run wage rigidity and the expected inflation over the next 12 months as well as the accumulated realized inflation over the past 24 months, respectively, to the main empirical model (1). In order to estimate the effects separately for firms that are actually covered by a CBA, we further interact all of these terms with indicators that are one if the firm is covered by a CBA or not ("no CBA"). These latter firms serve as a placebo, because the variation in the timing of CBA-expiration dates should only be relevant for the wage setting of CBA firms (at least absent general equilibrium effects of the unionized bargaining results).

Note that in this empirical specification, the coefficients of *expected inflation* measure forward-looking pass-through at the intensive margin for the CBA firms: This coefficient represents the estimated pass-through when the measure of short-run wage rigidity equals 0, indicating that wage renegotiations are expected within the next 12 months. The sum of the coefficients of *expected inflation* and the interaction term including the measure of short-run wage rigidity reflects forward-looking pass-through when the collective bargaining component of wages is expected to be fixed (that is, if the CBA-based measure of short-run wage rigidity equals 1). The same logic applies to backward-looking pass-through based on the coefficients of *realized inflation* in the previous 24 months.

Consistent with theoretical predictions from wage posting models with rigid wages, the regression results displayed in Table 3 demonstrate that pass-through is higher at the intensive margin when CBAs are expected to expire soon. While forward-looking pass-through at the

intensive margin is estimated to equal 0.109 for CBA-firms ($p < 0.01$) in the pooled cross-section presented in Column 1, estimates range between 0.064 and 0.161 in the remaining empirical specifications (at least $p < 0.05$). In contrast, forward-looking pass-through is absent if the collective bargaining component of wages is fixed for the next year—and even turns negative in some specifications.

For CBA-firms, there is a comparable pattern with respect to backward-looking pass-through. If unionized wages are expected to be renegotiated within the next 12 months, backward-looking pass-through is estimated to be 0.2-0.24 in the specifications without survey fixed effects. In the specifications with survey fixed effects, CBA firms' wages growth between 0.56 and 0.1 percentage point stronger with each percentage point of accumulated 24 months inflation than non-CBA firms. If unionized wages cannot be renegotiated, the pass-through of accumulated inflation is 0.05 to 0.07 percentage points lower at least in the specifications with firm fixed effects in Columns (2) and (4).

Reassuringly, inflation adjustments of non-CBA firms are not affected by industry-level centralized. Both, forward- and backward-looking pass-through of those firms that are *not* covered by a collective agreement are not found to be lower if the collective bargaining component of wages in their industry is fixed for the next year. This demonstrates the importance of the collective bargaining schedule for the magnitude of pass-through for agents covered by these agreements, and rules out the possibility that the previous results are driven by unobserved industry-level variation.

Moreover, using an alternative survey-based measure of expected wage negotiations for all firms, Table D.3 confirms that forward-looking pass-through of expected inflation is approximately twice as large when firms expect wage adjustments for more than half of their employees, compared with firms expecting fewer adjustments.

6. Conclusion

In this paper, we make progress in measuring pass-through of realized and expected inflation into wage growth using new, firm-level panel data. We document that average pass-through is low across a wide range of empirical specifications: Forward-looking pass-through is at most 0.18 and backward-looking pass-through is around 0.15. This holds regardless whether we estimate pass-through into expected or realized wage growth.

We also study the roles of bargaining institutions and bargaining power in determining the magnitude of pass-through. Specifically, we are the first to measure pass-through at the

intensive margin of wage setting, i.e., when wages are expected to be re-set. We also show that forward-looking pass-through is higher for firms with lower bargaining power.

The evidence of pass-through being low may mitigate concerns about potential wage-price spirals emanating solely from inflation expectations. However, before this conclusion can be drawn with certainty, our findings need to be confirmed in other empirical settings. Another challenge is to reconcile the finding of low pass-through with theory. Our evidence suggests that bargaining power—and, hence, wage bargaining *per se*—is an important determinant for the magnitude of pass-through. Theoretically, though, it is an open question how inflation expectations affect wage bargaining in the presence of wage rigidities.

Table 3: Pass-through at the Intensive Margin Based on Timing of Collective Bargaining

	Expected Wage Growth next 12 Months			
	(1)	(2)	(3)	(4)
Expected inflation \times CBA	0.109*** (0.021)	0.064*** (0.021)	0.161*** (0.025)	0.069*** (0.023)
Expected inflation \times no CBA	0.159*** (0.016)	0.161*** (0.014)	0.212*** (0.023)	0.168*** (0.019)
Expected inflation \times Share valid CBA in 12 m \times CBA	-0.171*** (0.031)	-0.172*** (0.033)	-0.187*** (0.031)	-0.179*** (0.033)
Expected inflation \times Share valid CBA in 12 m \times no CBA	0.065* (0.036)	-0.009 (0.028)	0.047 (0.036)	-0.016 (0.029)
Inflation last 24 m \times CBA	0.201*** (0.014)	0.243*** (0.013)	0.056*** (0.017)	0.099*** (0.016)
Inflation last 24 m \times no CBA	0.133*** (0.010)	0.136*** (0.009)		
Inflation last 24 m \times Share valid CBA in 12 m \times CBA	-0.015 (0.021)	-0.069*** (0.021)	0.019 (0.022)	-0.049** (0.021)
Inflation last 24 m \times Share valid CBA in 12 m \times no CBA	-0.012 (0.020)	-0.001 (0.017)	-0.004 (0.021)	-0.001 (0.018)
Observations	35613	35524	35613	35524
R2	0.096	0.445	0.102	0.450
Expectation Controls	yes	yes	yes	yes
Firm-specifics/ Demographics	yes	no	yes	no
Interactions Share Valid CBA \times CBA	yes	yes	yes	yes
Firm/Empl. FE	no	yes	no	yes
Survey Wave FE	no	no	yes	yes

Notes: This table shows the results of regressions of expected wage growth (in percent) on interactions of indicators that are one if the firm is covered by a collective bargaining agreement (“CBA”) or not (“no CBA”) and expected inflation for the next 12 months or accumulated realized inflation over the past 24 months, respectively. In addition, each of these terms is further interacted with the industry-specific share of valid collective bargaining agreements (CBA) in 12 months, our measure of short-run wage rigidity, defined between 0 and 1, where 1 indicates that in the respondent’s industry, all CBA-eligible employees are covered by a CBA valid at least 12 months. A measure of 0 means that all CBAs in a given industry expire and are expected to be renegotiated within the next 12 months (the forecast window of expected wage growth). All regressions control for the expected unemployment rate, firms’ current and expected future business conditions, and for the firm-specific controls listed in Footnote 13. Standard errors are clustered at the firm-level. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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How Wages Adjust to Expected and Realized Inflation: Supplemental Appendices

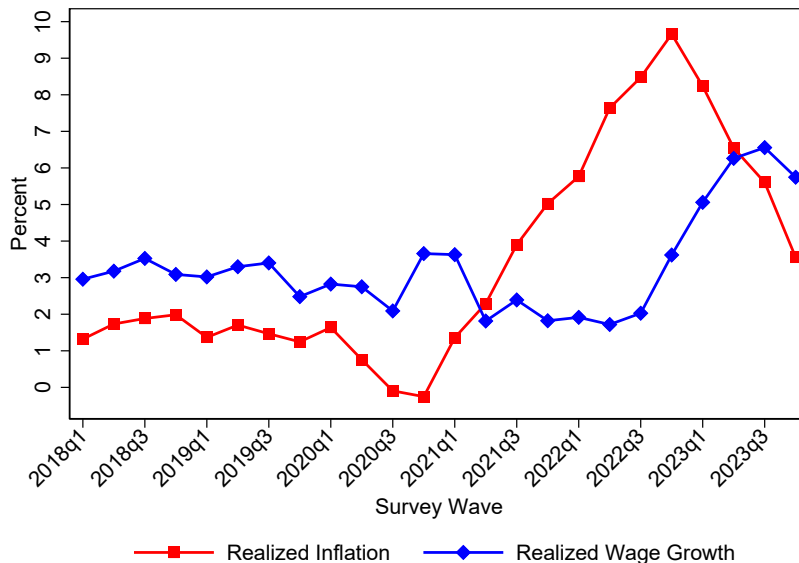
Lukas Buchheim Sebastian Link Sascha Möhrle

A. Appendix to Section 2

This section provides supplementary material to Section 2 of the main text. Figure A.1 presents aggregate inflation and wage dynamics before and during our sample period. Table A.1 shows summary statistics of the firm survey.

Moreover, we include additional material corroborating the high quality of our expectations data, such as a binscatter plot showing the relationship between ex-ante expected and ex-post realized wage growth at the employee and firm levels (Figure A.2) and a comparison of the development of average expected CPI inflation in our surveys over time with mean expectations from the representative Bundesbank Online Panels of Firms (BOP-F) and Households (BOP-HH) (Figure A.3).

Figure A.1: [TO BE UPDATED] Inflation and Wage Growth in Germany since 2018



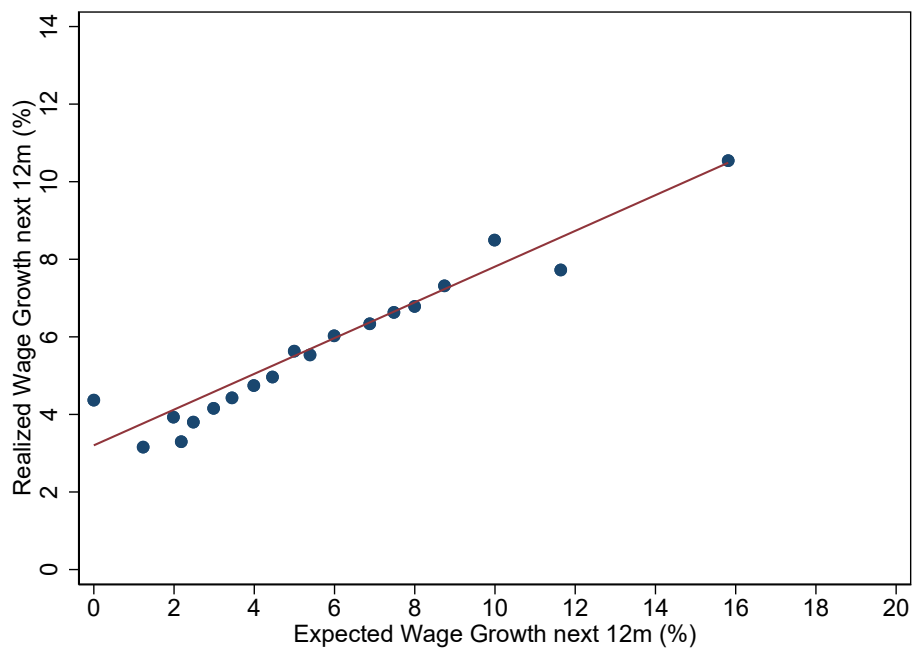
Notes: This figure plots quarterly CPI inflation (red squares) and realized year-over-year wage growth (blue diamonds) in Germany, based on administrative data from the German Federal Statistical Office. The wage series refers to gross wages per employee as reported in the quarterly national accounts data released in February 2024. The data is manually adjusted to account for the impact of short-time work, which reduced both working hours and monthly gross wages, particularly in 2020 and 2021 due to the Covid-19 pandemic.

Table A.1: Summary Statistics of Survey Data

	Survey Samples					
	(1) Mean	(2) p25	(3) Median	(4) p75	(5) SD	(6) N
Expected Inflation next 12m	4.57	2.50	4.00	6.00	2.63	39,171
Expected Wage Growth next 12m	4.54	3.00	4.00	5.60	2.91	39,171
Realized Wage Growth over next 12 Months	5.42	3.00	5.00	7.00	3.34	11,160
Expected Unemployment Rate next 12m	6.02	5.00	6.00	6.80	1.62	39,171
Expected Business Conditions (0-100)	43.74	31.00	47.00	54.00	19.39	39,171
Current Business Conditions (0-100)	46.79	31.00	48.00	62.00	23.25	39,171
Number of Employees	304.79	20.00	49.00	143.00	2487.48	39,171
Export Share	0.18	0.00	0.05	0.30	0.26	37,169
1[High Influence on Decisions in Firm]	0.80	1.00	1.00	1.00	0.40	33,665
1[Covered by Collective Agreement]	0.31	0.00	0.00	1.00	0.46	35,613
Energy Cost Share	5.73	1.30	3.00	7.00	7.43	26,599
1[Reported Lack of Skilled Labor]	0.36	0.00	0.00	1.00	0.48	35,260

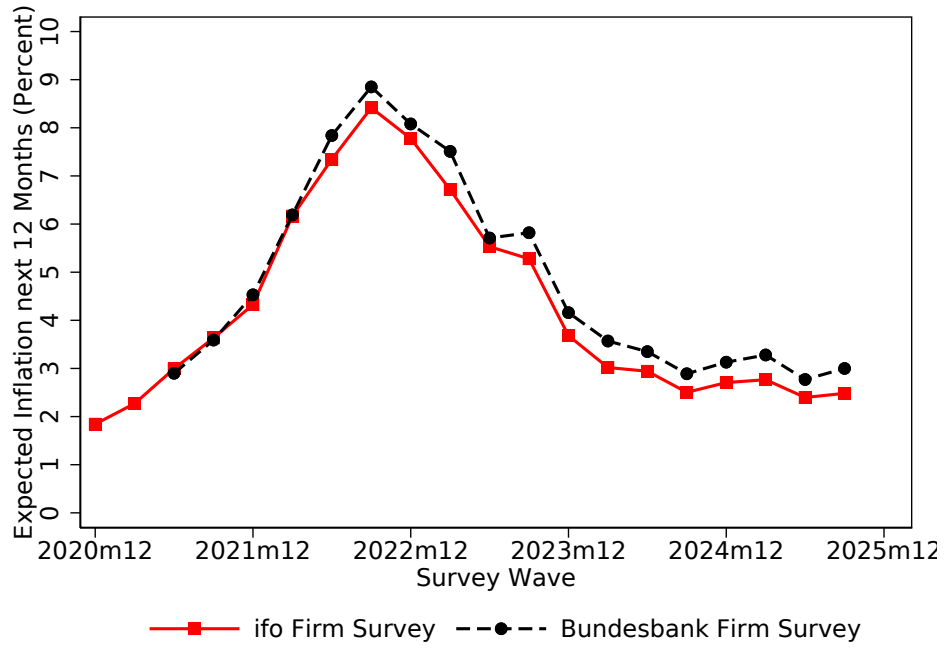
Notes: This table provides summary statistics for the sample. Column 7 indicates for how many observations in our panel dataset (covering the period between December 2021 and September 2025) a particular variable is available, counting repeat respondents multiple times. Appendix E lists all survey questions elicited during our sample period except standard demographics. In addition, we use information from earlier waves of the IBS, i.e., firms' export share from September 2018 and "High influence on decisions in firm" capturing whether respondents stated to personally have "very large influence" (highest category on a 5-point Likert scale) on their firm's decisions regarding investment, production, personnel, or pricing elicited in June 2021.

Figure A.2: Expected and Ex-post Realized Wage Growth



Notes: The figures show, bins of expected wage growth, the average ex-post realized wage growth over the past 12 months reported in the survey 12 months later. By construction, the sample is restricted to observations referring to wage growth over the same period, i.e., expectations elicited between December 2021 and September 2024 and ex-post realizations reported between December 2022 and September 2025.

Figure A.3: Mean Expected Inflation in Our Surveys Compared to Bundesbank Surveys



Notes: This figure compares the development of average expected CPI inflation (12 months ahead) in Germany in our firm surveys over time to the development of average expectations in the representative Bundesbank Online Panels of Firms (BOP-F).

B. Appendix to Section 3: Theoretical Considerations

This section provides a brief description of the arguments in [Werning \(2022\)](#) for the case of Taylor pricing. Werning establishes the quantitatively plausible pass-through of expected inflation into aggregate (price or wage) inflation for an exogenous shock to expected inflation in a partial equilibrium framework (or, in his terminology, “temporal equilibrium”). “Temporal equilibrium” means that inflation expectations do not need to be consistent with the implied future inflation and, thus, future real marginal costs. Prices (or wages) are set via price (or wage) posting, and the fundamentals determining real prices are assumed to be constant. These assumptions allow Werning to focus on how shocks to inflation expectations affect inflation for different models of price or wage rigidities (most prominently Calvo and Taylor pricing).

We now present a simplified version of Werning’s model to illustrate his argument. Assume that wages are posted (e.g., by firms or by unions), and that, at time t , the optimal *log real wage* is determined by some function of fundamentals a_t , $f(a_t)$. Further, we assume that the influence of the price level and the fundamentals a_t on the *frictionless log nominal wage* w_t^* is additive separable. Then, the growth rate of the frictionless nominal wage is given by the sum of inflation π_t and the effect of changes in fundamentals:

$$w_t^* - w_{t-1}^* = \pi_t + f(a_t) - f(a_{t-1}).$$

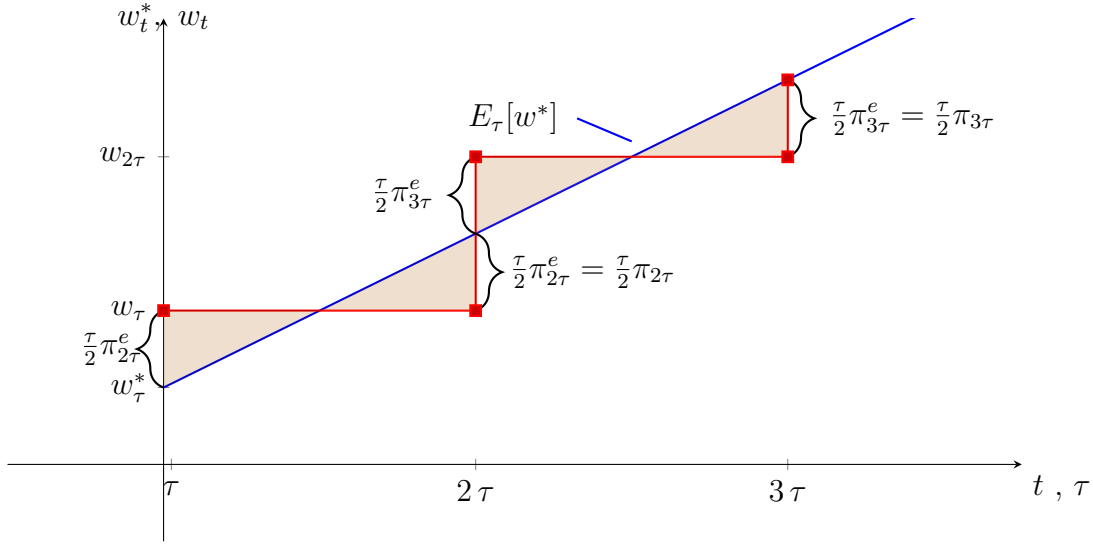
For constant fundamentals this directly implies that the frictionless nominal wage grows with inflation.

The presence of wage rigidities means that the observed nominal wages w_t cannot be reset every period. Instead, we will assume here that nominal wages can only be adjusted every τ periods, i.e., Taylor pricing with wage spells of length τ . Then, the wage w_t set at $t \in \{0, \tau, 2\tau, \dots\}$ will take into account expected inflation π_t^e of the wage-setting agent in order to minimize the average distance between the evolving target wage w^* and the fixed wage w_t .

The specific way how π_t^e influences w_t depends, in general, on the agent’s objective function. Here, we will assume that the wage setting agent minimizes a quadratic loss function around the target wage w_t^* in continuous time with no discounting. If fundamentals a_t and expected inflation π_t^e are expected to be constant for $t \in [0, \tau]$, the objective function is given by

$$\min_w \int_0^\tau (w_t^* - w)^2 dt = \min_w \int_0^\tau ((\pi_0^e t + w_0^*) - w)^2 dt.$$

Figure B.1: Pass-through with Taylor Pricing: Illustration



The solution to this problem delivers wage growth of

$$w - w_0^* = \frac{\tau}{2}\pi_0^e.$$

Since at $t = 0$, the optimal wage w_0^* can adjust to past realized inflation, *pass-through at the intensive margin*—i.e., for wages that can be re-set at $t = 0$, equals $\tau/2$.

Assuming that at each instance $1/\tau$ agents can re-set their wage, *average pass-through* is given by $1/2$.

Figure B.1 illustrates this argument. The increasing linear function represents the expected target nominal wage $E_0[w_t^*]$ when expected inflation π_0^e is constant. The jumps represent the fixed nominal wages w_t that are re-set every τ periods with intensive-margin pass-through of $\tau/2$, thereby minimizing the average distance to the flexible target nominal wage.

In addition to the magnitude of pass-through at the intensive margin, Figure B.1 reveals two additional predictions following from wage setting in the presence of wage rigidities:

1. At each instance when wages can be re-set (at $t = \tau, t = 2\tau$, etc.), wages “catch-up” to the target wage w_t^* . The magnitude of “catch-up” is a function of the accumulated inflation between the last and the current instance of wage setting. In the figure, we assume that expectations are correct, so that past inflation enters wages as the difference of accumulated inflation and the intensive margin pass-through: $\tau\pi_\tau - \tau/2\pi_0^e = \tau/2\pi_\tau$. Obviously, if expectations turn out to be incorrect, “catch-up” will be a function of the forecast error $\pi_\tau - \pi_0^e$. It is easy to see that this general argument is true for

virtually any model of wage rigidity. Section 4 in the main text provides evidence for this prediction.

2. With Taylor pricing, only short-run inflation expectations affect wage setting: Inflation expectations with a forecast horizon greater than τ are irrelevant, because agents know that they can re-set wages in at most τ periods. The magnitude of the future wage reset depends on the *future* inflation expectations with a forecast horizon of up to τ periods. We provide evidence for this prediction in Section 4.5.

Note, however, that long-run inflation expectations are only irrelevant if agents know the maximum duration of their current wage spell. This is the case for Taylor pricing considered here, but not for Calvo pricing, where there is a positive probability attached to spells of any duration.

Werning (2022) derives pass-through for other types of wage rigidities following the same general idea as above. Two results are worth mentioning for our empirical context: First, for Calvo pricing Werning predicts an intensive-margin pass-through of greater than 1 and average pass-through of 1. Second, with no discounting, pass-through may plausibly be smaller than 1/2 (as derived for Taylor pricing) only for models in which agents can adjust the wage setting frequency (e.g., menu cost models). See Werning’s paper for details.

C. Appendix to Section 4

Table C.1: Pass-through of Expected and Realized Inflation

	Expected Wage Growth next 12 Months							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Expected Inflation next 12m	0.221*** (0.009)	0.209*** (0.008)	0.140*** (0.016)	0.082*** (0.012)	0.090*** (0.013)	0.041*** (0.011)	0.131*** (0.011)	0.102*** (0.009)
Realized Inflation past 12m			0.112*** (0.013)	0.157*** (0.010)				
Realized Inflation past 18m					0.159*** (0.007)	0.181*** (0.006)		
Realized Inflation past 24m							0.150*** (0.005)	0.154*** (0.005)
Observations	39171	39035	39171	39035	39171	39035	39171	39035
R2	0.059	0.420	0.064	0.426	0.079	0.442	0.088	0.447
Expectation Controls	yes	yes	yes	yes	yes	yes	yes	yes
Firm-specifics/ Demographics	yes	yes	yes	yes	yes	yes	yes	yes
Firm/Empl. FE	no	yes	no	yes	no	yes	no	yes
Survey Wave FE	no	no	no	no	no	no	no	no

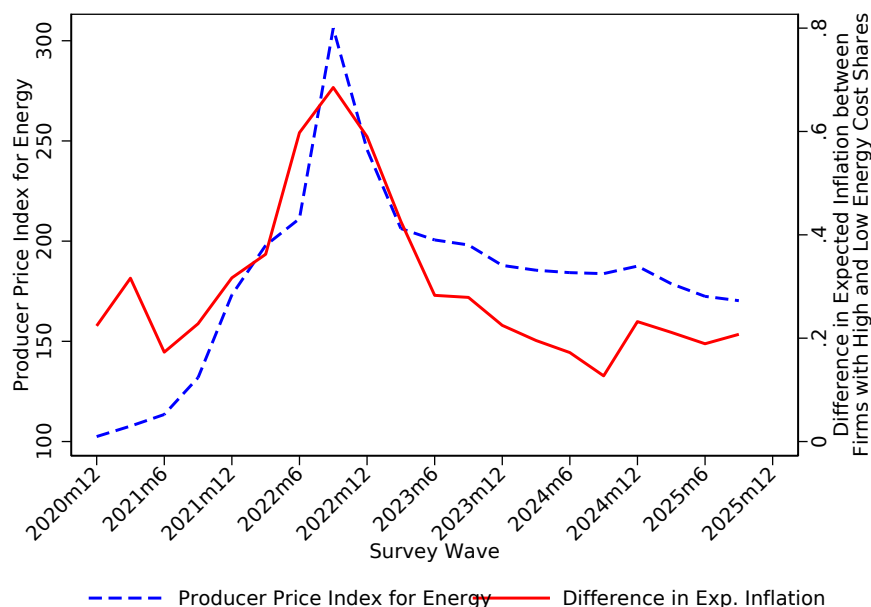
Notes: This table shows the results of regressions of expected wage growth (in percent) on respondents' expected inflation rate for the next 12 months and different measures of realized past inflation: the average (12 month) CPI inflation rate over the 3 months prior to the survey (Columns 3 and 4), the 3 month average accumulated CPI inflation over the past 18 months (Columns 5 and 6), and for the past 24 months (the baseline shown at the two top panels of Figure 2. In Columns 1 and 2 we estimate forward-looking pass-through without accounting for past inflation. All regressions control for the expected unemployment rate, respondents' assessment of their firms' current and expected future business conditions, and the firm- and employee-specific controls listed in Footnote 13, respectively. Standard errors are clustered at the level of firms or employees, respectively. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C.1. Causality

Shift-share IV The first stage of the IV specification relates the shift-share instrument $Energy\ Cost\ Share_i \times PPI\ Energy_t$ for firm i and survey wave t to the expected inflation of firm i at t . Figure C.1 illustrates the time dimension of this association during the sample period by plotting the dynamics of $PPI\ Energy_t$ (with values depicted on the left axis) against the *difference in average expected inflation at t between firms with energy cost shares above and below the median* ($\Delta Expected\ Inflation_t$; values depicted on the right axis). $PPI\ Energy_t$ sharply increased following the Russian attack of Ukraine in February 2022 and the subsequent destruction of the Nord Stream pipelines for natural gas in the summer of 2022. Energy prices peaked in the fall of 2022, followed by a steady decline.

The dynamics of $\Delta Expected\ Inflation_t$ show that more exposed firms initially expected 0.2 percentage points higher inflation on average than firms with low energy cost shares at the

Figure C.1: Shift-Share IV: Illustration of the First Stage

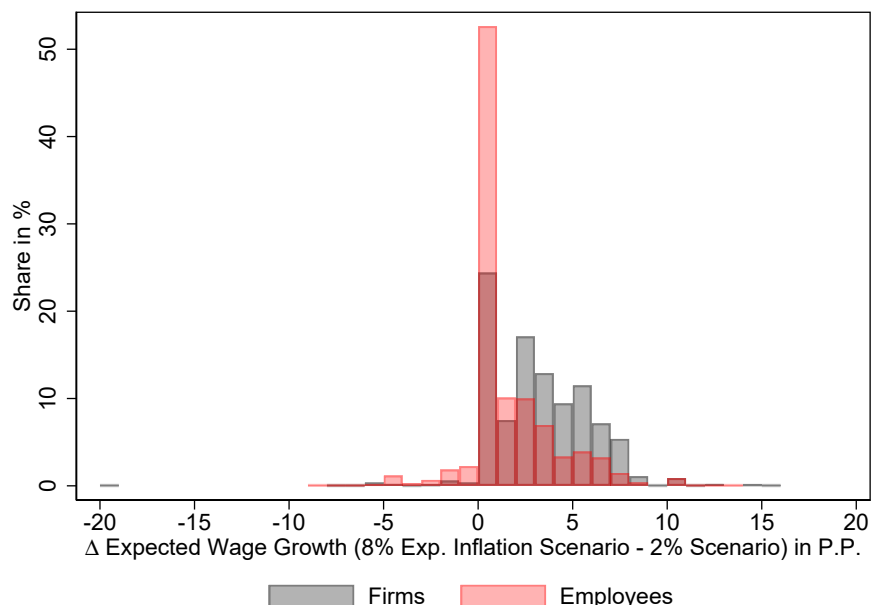


Notes: The figure plots the dynamics of the energy component of the German producer price index (blue dashed line, left axis) and the difference in expected inflation (in percentage points) between firms with energy cost shares (relative to revenues) above and below the median (red solid line, right axis).

beginning of the sample period. This difference increased in parallel with the rise in the $PPI\ Energy_t$; the peaks of both series exactly coincided in the fall of 2022.

Overall, the figure strongly suggests that firms with very energy-intensive production extrapolate more from energy price dynamics when forming inflation expectations compared to less exposed firms. Using this extrapolation as an instrument thus, at the very least, fixes the direction of causation in the main estimates as follows: energy price dynamics \rightarrow inflation expectations \rightarrow wage growth expectations (and not vice versa).

Figure C.2: Hypothetical Inflation Scenarios: Difference in Expected Wage Growth



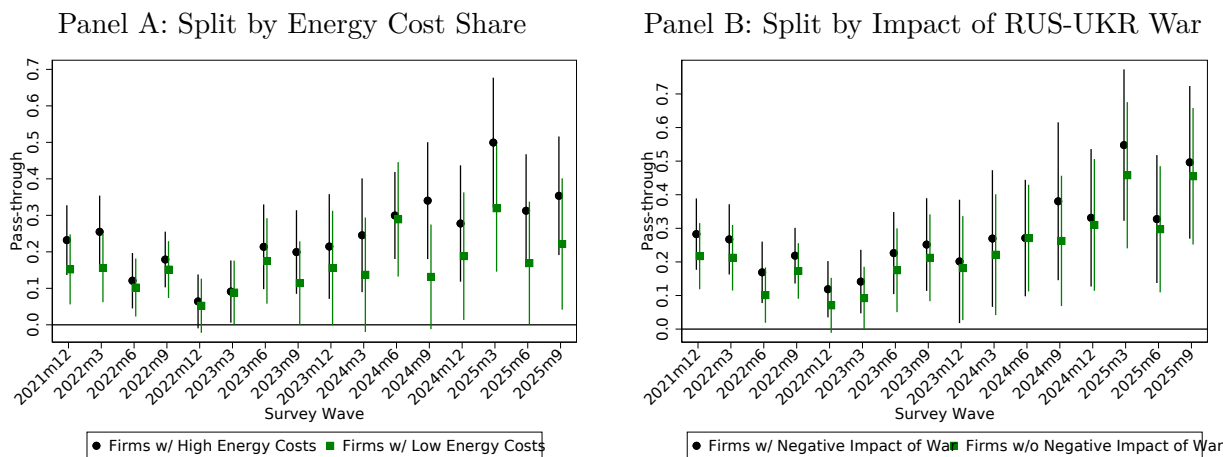
Notes: This figure displays the distribution of differences in firms’ (grey) and employees’ (red) expected wage growth over the next 12 months between two hypothetical inflation scenarios that were added at the very end of the questionnaires of our December 2023 surveys. Here, we asked a random subset of half (two-thirds) of respondents in the firm (employee) survey to provide wage growth expectations for the next 12 months if they expected consumer prices to increase by 2 percent (scenario 1) and 8 percent (scenario 2) over the same horizon, respectively. Each respondent answered the question under both scenarios.

Hypothetical scenarios Figure C.2 provides a more detailed picture of the effect of the hypothetical inflation expectations on expected wage growth. Specifically, it displays the distribution of the difference in expected wage growth between the hypothetical 2 percent expected inflation scenario and the hypothetical 8 percent expected inflation scenario.

Notably, 23 percent of firms anticipate exactly the same wage growth under both scenarios. Hence, many firms see no link between expected inflation and wage growth.

C.2. State-dependence of Pass-through: Additional Evidence

Figure C.3: Pass-through by Survey Wave and by Exposure to the Russo-Ukrainian War



Notes: The figure plots the time variation in pass-through of expected inflation into expected wage growth, conditional on two measures of firms' exposure to the Russian invasion of Ukraine and the subsequent increase in energy prices, which are both elicited in the April 2022 wave of the regular IBS: Panel (a) splits firms based on whether their pre-war share of revenues spent on energy is above or below the median, and Panel (b) groups firms according to their assessment of whether or not the war in Ukraine will negatively impact their annual revenues in 2022. The conditional pass-through estimates are obtained by including additional interaction terms in the specification underlying Figure 3 in the main text. Standard errors are clustered at the firm level; confidence intervals are displayed at the 95% level.

Figure 3 in the main text shows the estimated magnitude of pass-through has been already small in economic terms before the Russian invasion of Ukraine, and, if anything, appears to have declined only somewhat further thereafter. This section explores further whether this drop can be plausibly linked to stagflationary views, according to which the war (and the resulting energy shortages) could be interpreted as a supply shock to the European economy, leading to real wage losses, and, consequently, low expected pass-through.

Specifically, we investigate whether pass-through varies among firms based on their exposure to the shock of the Russo-Ukrainian war. The April 2022 wave of the regular Ifo Business Survey included two questions that measure firm-specific exposure to the shock. Firms reported both their pre-war share of energy costs relative to revenue (which we also use for constructing the shift-share instrument in Section 4.3) as well as their assessment of whether or not their revenues in 2022 would be negatively affected by the war.

Panel A of Figure C.3 displays the estimated pass-through across survey waves conditional on whether firms' pre-war energy cost shares were above or below the median, and Panel B plots these estimates conditional on whether or not firms expected a negative effect of the

war on revenues. The hypothesis that pass-through is independent of firms' exposure to the Russo-Ukraine war cannot be rejected for either measure across all survey waves. In terms of magnitudes, we estimate higher pass-through for firms with greater exposure to the shock throughout. However, these differences in pass-through are economically meaningful (but statistically insignificant) at best in the first and last two quarters of Panel A, where more exposed firms (as measured by the energy cost share) expect pass-through to be up to 0.1 percentage points higher than less exposed firms. We conclude that these findings confirm the assessment in Section 4.4 of the main text, suggesting that potential stagflationary views are unlikely to be the major explanation for the generally low estimates of pass-through from expected inflation to wage growth.

D. Appendix to Section 5

D.1. Implications of Wage Bargaining Institutions for Average Pass-Through: Robustness

This appendix section provides evidence that the differences in forward- and backward-looking pass-through between firms covered by a CBA and those that are not presented in Section 5.1 are not driven by firm size differentials. For this purpose, Columns 1, 4, 7, and 10 of Table D.1 replicate the estimates presented in Figure 5, while Columns 2, 5, 8, and 11 add interactions of expected and realized inflation with a dummy that is one if the number of employees is above the median. In turn, the remaining columns add interactions with the continuous measure of the number of employees in the firm (in logs). The inclusion of these interaction terms with measures of firm size do not substantially alter the estimates with respect to forward- and backward-looking pass-through of firms covered by a CBA and those that are not. Hence, the differences between firms covered by a CBA and those that are not driven by firm size differentials.

Table D.1: Average Pass-through: CBA vs. Non-CBA Firms; Control for Interactions with Firm Size

	Expected Wage Growth next 12 Months											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Expected inflation \times CBA	0.022 (0.016)	0.012 (0.022)	-0.002 (0.042)	-0.027* (0.015)	-0.049*** (0.019)	-0.067* (0.034)	0.070*** (0.020)	0.057** (0.025)	0.034 (0.043)	-0.022 (0.017)	-0.043** (0.020)	-0.059* (0.035)
Expected inflation \times no CBA	0.180*** (0.014)	0.174*** (0.018)	0.160*** (0.036)	0.158*** (0.011)	0.142*** (0.014)	0.124*** (0.028)	0.226*** (0.021)	0.218*** (0.024)	0.197*** (0.039)	0.161*** (0.016)	0.147*** (0.018)	0.130*** (0.029)
Inflation last 24 m \times CBA	0.190*** (0.009)	0.198*** (0.012)	0.132*** (0.022)	0.201*** (0.009)	0.194*** (0.011)	0.145*** (0.019)	0.058*** (0.011)	0.061*** (0.011)	0.046*** (0.012)	0.067*** (0.010)	0.064*** (0.011)	0.055*** (0.011)
Inflation last 24 m \times no CBA	0.131*** (0.007)	0.136*** (0.009)	0.085*** (0.017)	0.134*** (0.006)	0.129*** (0.008)	0.090*** (0.015)						
Expected inflation \times Large Firm		0.016 (0.022)			0.039** (0.018)			0.023 (0.021)			0.040** (0.018)	
Inflation last 24 m \times Large Firm		-0.012 (0.011)			0.010 (0.010)			-0.015 (0.010)			0.010 (0.010)	
Expected inflation \times Log(Employees)			0.006 (0.008)			0.009 (0.006)			0.009 (0.008)			0.009 (0.006)
Inflation last 24 m \times Log(Employees)			0.012*** (0.004)			0.012*** (0.003)			0.011*** (0.004)			0.011*** (0.003)
Observations	35875	35875	35875	35786	35786	35786	35875	35875	35875	35786	35786	35786
R2	0.094	0.094	0.095	0.443	0.443	0.443	0.100	0.100	0.101	0.447	0.448	0.448
Expectation Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-specifics/ Demographics	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no
Interactions Share Valid CBA \times CBA	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm/Empl. FE	no	no	no	yes	yes	yes	no	no	no	yes	yes	yes
Survey Wave FE	no	no	no	no	no	no	yes	yes	yes	yes	yes	yes

Notes: Columns 1, 4, 7, and 10 replicate the estimates presented in Figure 5 and shows the results of regressions of expected wage growth (in percent) on on expected CPI inflation over the next 12 months and realized CPI inflation over the previous 24 months, separately for firms covered and not covered by collective bargaining agreements (CBAs). Columns 2, 5, 8, and 11 add interactions of expected and realized inflation with a dummy that is one if the number of employees is above the median, while the remaining columns add interactions with the continuous measure of the number of employees in the firm (in logs). All regressions control for the expected unemployment rate, firms' current and expected future business conditions, and for the firm-specific controls listed in Footnote 13. In the specifications including survey-wave fixed effects, the coefficients for backward-looking pass-through identify the *differential* effect between CBA and non-CBA firms due to perfect multicollinearity between realized inflation and the wave fixed effects. Standard errors are clustered at the firm-level. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.2. Bargaining Power and Pass-through

This appendix provides additional evidence on the role of bargaining power for pass-through, using measures of labor market tightness to proxy for the distribution of bargaining power between firms and employees. The underlying idea is that higher bargaining power for employees might enable them to better offset expected future real wage losses due to inflation.

We proxy the distribution of bargaining power using two measures of labor market tightness. The first measure relies on a survey question from the regular IBS, in which firms report whether they “lack skilled labor.”¹ The second measure is labor market tightness in 2022,

¹The regular IBS elicits information on obstacles to firms' current business activity, including a lack of skilled workers, during the first month of each quarter, which is not concurrent with our questions on expected inflation and wage growth. Still, this information is useful to capture the general degree of slack in the labor market that firms face during the sample period. Firms are sorted into three groups: (i) those reporting being constrained by a lack of skilled workers across all survey waves in the sample (16% of firms), (ii) those never reporting labor shortages as an obstacle to business activity (32%), and (iii)

defined as the average ratio of vacancies to unemployed individuals in the county where the firm is located. Based on both measures, we sort firms into three time-invariant groups, either according to whether they never, sometimes, or always reported a lack of skilled labor, or according to terciles of local labor market tightness.

Table D.2 shows that firms' forward-looking pass-through varies strongly with both measures of labor market tightness. Columns 1 and 2 indicate that the magnitude of pass-through is approximately twice as large for firms facing strong difficulties in recruiting or retaining workers compared to firms that do not, regardless of whether we control for survey-wave fixed effects. Columns 3 and 4 show a similar, though slightly less pronounced, pattern when conditioning on local labor market tightness. In addition, Columns 1 and 3 suggest that the degree of backward-looking pass-through is roughly constant across all groups. We conclude that firms' bargaining power (or the lack thereof) appears to be an important determinant of the magnitude of forward-looking pass-through and—together with similar backward-looking pass-through—thus of the extent to which real wage losses are offset overall.

those reporting these obstacles in some, but not throughout the entire sample period (52%).

Table D.2: Labor Market Tightness and Pass-through (Firms)

	Expected Wage Growth next 12 Months			
	(1)	(2)	(3)	(4)
Expected Inflation next 12m				
× 1[Never Constrained by Lack of Skilled Workers]	0.058*** (0.017)	0.111*** (0.020)		
× 1[Sometimes Constrained by Lack of Skilled Workers]	0.156*** (0.014)	0.200*** (0.020)		
× 1[Always Constrained by Lack of Skilled Workers]	0.149*** (0.029)	0.187*** (0.028)		
× 1[First Tertile Local Labor Market Tightness]			0.116*** (0.017)	0.167*** (0.020)
× 1[Second Tertile Local Labor Market Tightness]			0.108*** (0.020)	0.155*** (0.023)
× 1[Third Tertile Local Labor Market Tightness]			0.157*** (0.020)	0.197*** (0.023)
Realized Inflation past 24m				
× 1[Never Constrained by Lack of Skilled Workers]	0.164*** (0.009)			
× 1[Sometimes Constrained by Lack of Skilled Workers]	0.145*** (0.007)			
× 1[Always Constrained by Lack of Skilled Workers]	0.146*** (0.017)			
× 1[First Tertile Local Labor Market Tightness]			0.141*** (0.009)	
× 1[Second Tertile Local Labor Market Tightness]			0.151*** (0.009)	
× 1[Third Tertile Local Labor Market Tightness]			0.142*** (0.009)	
Observations	38945	38945	36274	36274
R2	0.094	0.100	0.085	0.093
Dummies for Lack of Skilled Labor	yes	yes	no	no
Dummies for Labor Market Tightness Tertiles	no	no	yes	yes
Expectation Controls	yes	yes	yes	yes
Firm-specifics	yes	yes	yes	yes
Firm FE	no	no	no	no
Survey Wave FE	no	yes	no	yes

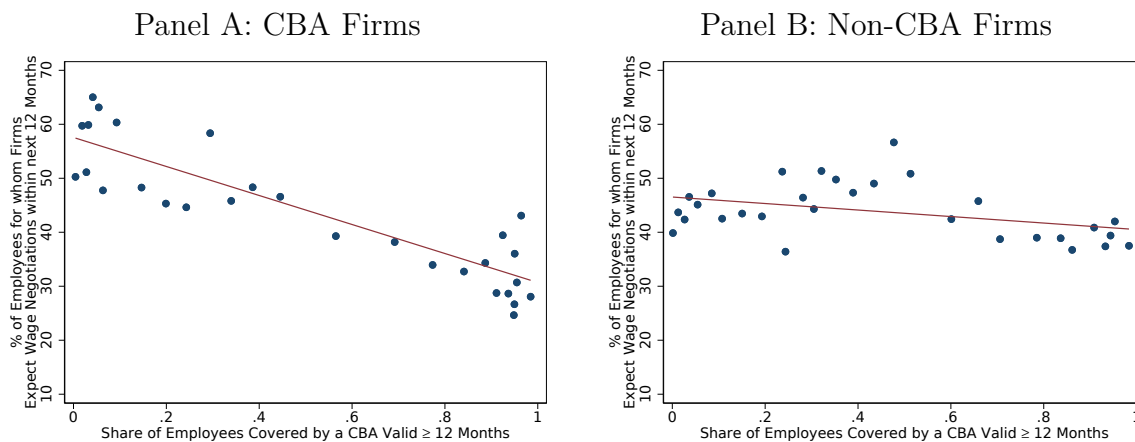
Notes: This table shows the results of regressions of firms' expected wage growth (in percent) on the expected inflation rate in the next 12 months as well as accumulated realized inflation over the past 24 months separately for different groups of firms. In Columns 1 and 2, firms are sorted into 3 groups according to how often they report labor shortages to the IBS: those reporting to be constrained by a lack of skilled workers across all survey waves in the sample, those never reporting labor shortages as an obstacle to business activity, and those reporting these obstacles in some waves, but not throughout the entire sample period. In Columns 3 and 4, firms are grouped according to the labor market tightness in the county they are located in, defined as the average ratio of vacancies over the number of unemployed over the course of 2022. Each specification further controls for indicators for the respective groups of labor market tightness, the expected unemployment rate, firms' current and expected future business conditions, and for the firm-specific controls listed in Footnote 13. Columns 2 and 4 purge for survey wave fixed effects. Standard errors are clustered at the firm level. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.3. Pass-through at the Extensive Margin of Wage Setting: Additional Analyses

Validation of the CBA-based measure for the timing of wage adjustments We validate the industry-level CBA-based measure for short-run wage rigidity introduced in Section 5.2 using a survey-based measure for the expected intensity of firms' future wage negotiations. Specifically, starting in March 2023 we elicited firms' expectations regarding the share of employees who will be subject to wage negotiations or collective bargaining rounds in the next 12 months.

Comparing the CBA-based measure of wage rigidity with the survey-based measure for the subsample of firms that are covered by collective bargaining, Panel A of Figure D.1 shows that there is a strong negative correlation of both measures. This should be expected, because the CBA-based measure captures the share of employees covered by a CBA valid for more than 12 months—which do not have to be renegotiated within the next year—, while the survey-based measure captures the share of employees subject to wage negotiations within the next year. Panel B shows the same relationship for the subsample of firms that are not covered by collective bargaining and whose wage bargaining intensity should thus be, at most, indirectly affected by the coverage duration of CBAs in their industries. For these firms, the figure reassuringly shows that there is a much weaker correlation between the CBA-based measure of wage rigidity and the survey-based wage bargaining intensity. Overall, the evidence shown in Figure D.1 validates that the industry-level variation in expiring dates of CBAs indeed reflects relevant variation in the intensity of wage negotiations that is known and anticipated by the firms.

Figure D.1: Coverage of CBAs and Survey-based Measure of Wage Negotiations



Notes: The figures show, for bins of the industry-level CBA-based measure for wage rigidity introduced in Section 5.2, the average of a survey-based measure that elicits firms’ expected share of employees who will be subject to wage negotiations or collective bargaining rounds in the next 12 months. The sample period is restricted to those survey waves for which the latter measure is available (March 2023 to September 2025). Panel A restricts the sample to firms that indicate that their “typical” employee is covered by a CBA, Panel B to those not covered by a CBA.

Table D.3: Pass-through at the Extensive Margin: Survey-Based Measure

	Expected Wage Growth next 12 Months			
	(1)	(2)	(3)	(4)
Expected Inflation next 12m	0.161*** (0.018)	0.114*** (0.021)	0.185*** (0.024)	0.139*** (0.025)
× 1[% Wage Negotiations >50%]		0.113*** (0.030)		0.114*** (0.029)
Realized Inflation past 24m	0.145*** (0.008)	0.146*** (0.009)		
× 1(Share bargain with >50%)		-0.001 (0.013)		-0.000 (0.013)
1[% Wage Negotiations >50%]	0.802*** (0.046)	0.384*** (0.097)	0.798*** (0.046)	0.373*** (0.097)
Observations	24548	24548	24548	24548
R2	0.131	0.132	0.133	0.135
Expectation Controls	yes	yes	yes	yes
Firm-specifics	yes	yes	yes	yes
Firm FE	no	no	no	no
Survey Wave FE	no	no	yes	yes

Notes: This table shows results of regressions of expected wage growth over the next 12 months (in percent) on the expected inflation rate for the next 12 months, accumulated inflation over the past 24 months, an indicator that equals 1 if firms expect wage adjustments for more than half of their workforce within the next 12 months, and interaction terms of the latter variable and the inflation measures. The sample is restricted to survey waves from March 2023 onwards, when we started to elicit firms' expected share of employees who will be subject to wage negotiations or collective bargaining rounds in the next 12 months. Each specification controls for respondents' expected unemployment rate, firms' current and expected future business conditions, and for the firm-specific controls listed in Footnote 13. The regressions also purge for fixed effects for the survey wave in Columns 3 and 4. Standard errors are clustered at the firm level. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Evidence from Survey-Based Measure of the Extensive Margin Lastly, we confirm that forward-looking pass-through is larger at the intensive margin than on average using the alternative survey-based measure of firms' expected wage bargaining intensity introduced for Figure D.1 above. We do so by interacting expected and realized inflation with an indicator variable that equals 1 when a firm expects wage adjustments for more than half of their workforce within the next year. The results presented in Table D.3 show a strong and statistically significant positive interaction effect, indicating that pass-through of expected inflation is approximately twice as large when firms expect wage adjustments for more than half of their employees, compared to firms expecting fewer adjustments. In con-

trast, backward-looking pass-through is not larger among those firms that expect upcoming wage adjustments for a larger share of their workforce.

E. Survey Questions Translated into English

This appendix provides an overview of the translated survey instructions of the key questions in the household and firm surveys. There are three sets of questions: The first block is dedicated to questions about the macroeconomy. The second block lists questions about expected and realized wage growth as well as other wage related questions. The last block summarizes questions regarding other topics. We specify when a question was elicited in a particular wave or asked only in the household or firm panel.

E.1. Questions Regarding the Macroeconomy

Expected Unemployment Rate (12 months ahead):

What do you think, what will the unemployment rate likely be in Germany in 12 months (i.e., in month MM/YYYY)? ____%

Expected Inflation (12 months ahead):

What do you think, what will the inflation rate (measured by the consumer price index) likely be in Germany over the next 12 months (i.e., until month MM/YYYY)? __%

Expected Inflation (2 and 3 years ahead) [starting in 2023m6]:

What do you think, what will the inflation rate (measured by the consumer price index) likely be in Germany in two and three years' time (i.e., in months MM/YYYY and MM/YYYY)?

In two years: __%

In three years: __%

Expected Inflation (5 years ahead) [Firms: 2021m6 & 2021m12; Employees: 2022m6 - 2023m3]:

What do you think, what will the inflation rate (measured by the consumer price index, relative to the previous year) likely be in Germany in five years' time (i.e., in year YYYY)? __%

Perceived Current Inflation [Employees only]:

What do you think was the inflation rate in Germany over the last 12 months (i.e., over the period from MM/YYYY to MM/YYYY)? ____%

E.2. Wage-related Questions

The survey questions on expected and realized wage growth as well as other wage related questions refer to the firm's "typical employee".

General Introduction:

We would like to request your assessment of the expected evolution of gross wages in your firm over the next 12 months. Please differentiate between the gross wage change that has already been agreed upon today and the overall expected gross wage change. Please refer to a "typical employee" (average qualification, average job tenure, and medium job requirements) within your organization. Additionally, please assume that the working hours and other job profile characteristics remain constant over the next 12 months.

Agreed Wage Growth:

For your typical employee: What is the projected growth in gross wages over the next 12 months (i.e., until MM/YYYY) that has already been agreed upon today (e.g., due to an existing collective agreement, an agreement with employees, or similar)? Please enter 0 if no wage change has yet been agreed upon.

____%

Expected Wage Growth:

For your typical employee: What is your estimation of the total gross wage growth over the next 12 months (i.e., until MM/YYYY) (including any potential new collective agreements, upcoming wage negotiations with employees, or similar)? Please enter your answer from the previous question if you do not expect any additional wage changes beyond those already agreed upon today.

____%

Realized Wage Growth [starting 2022m12]:

For your typical employee: What is your estimation of the total gross wage growth over the past 12 months (i.e., since MM/YYYY)? ____%

Demand for Wage Increases [starting 2022m3]:

Do you expect your employees to ask for wage increases with greater frequency than usual over the next 12 months?

Yes No

Expected Share of Employees to Bargain with [starting 2023m3]:

What proportion of your typical employees do you anticipate will engage in individual wage negotiations or collective bargaining rounds over the next 12 months?
____%

Collective Bargaining Agreement (2021m12 & 2022m12)

Is the employment relationship in your company typically subject to a collective agreement?

Yes No

Hypothetical Scenarios: [December 2023; random subset of 50% of firms; questions placed at the end of the questionnaire]

Please consider the following two hypothetical scenarios for the further course of inflation (measured by the consumer price index) over the next 12 months (i.e., until December 2024).

Scenario 1: Suppose that you expect an inflation rate of 2% for the next 12 months. What would be your estimation of the gross wage growth over the next 12 months for your typical employee in this scenario (including any potential new collective agreements, upcoming wage negotiations with employees, or similar)?
____%

Scenario 2: Now suppose that you expect an inflation rate of 8% for the next 12 months. What would be your estimation of the gross wage growth over the next 12 months for your typical employee in this scenario (including any potential new collective agreements, upcoming wage negotiations with employees, or similar)?
____%

E.3. Additional Survey Questions

Current Business Conditions:

Current situation: We evaluate our current business condition (latest business trends) as ... (quantitative scale between 0 and 100, where [0] is bad, [50] satisfactory, and [100] good.)

Expected Business Conditions:

Expectations for the next six months: After elimination of purely seasonal fluctuations the development of our business will be ... (quantitative scale between 0 and 100, where [0] more unfavorable, [50] about the same, and [100] more favorable.)

Lack of Skilled Labor:

Our domestic production/business activity is currently constrained: Yes No

If yes: the constraint is due to a lack of skilled workers: Yes

Energy Cost Share [2022m4]:

What share of revenue do you estimate your company had to spend on energy expenses in 2021 (energy intensity)? ____%

Impact by War in Ukraine [2022m4]:

Has your company's expected sales volume for the current year changed as a result of the war in Ukraine?

Increase by ____% No change Decrease by ____%