The impact of interest: Firms' investment sensitivity to interest rates*

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Abstract

We study how firms' investment responds to interest rate changes based on a German firm survey, combining hypothetical vignettes, open-ended questions, and rich firm data. We estimate a 7 percent semi-elasticity of investment to loan rates—about half the total corporate investment response to monetary policy shocks. Adjustment is heterogeneous: many firms do not react, citing cash buffers or a lack of opportunities, while adjusters revise sharply. Managers' narratives about monetary policy transmission to investment emphasize direct borrowing-cost effects and rarely mention general-equilibrium channels. Local projections show this direct channel is central to output dynamics after monetary policy shocks.

Keywords: Interest rates, firm investment, survey experiment, monetary policy, narratives, hurdle rates, aggregate investment

JEL-Codes: D25, E43, E52, G31

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1 Introduction

How firms' investment responds to interest rate changes is a long-standing research question and central to policy. While we know that monetary policy has a large impact on aggregate investment (e.g., Christiano et al., 2005), fleshing out the direct effect of borrowing costs is challenging given scarce exogenous variation and confounding general-equilibrium forces. Identifying this direct effect matters because it is central to models of monetary policy transmission with heterogeneous households (Auclert et al., 2020) and firms (Koby and Wolf, 2020). Beyond magnitudes, *why* managers (not) adjust investment—and what comes to mind when they face policy rate changes—remains a "black box" because managerial narratives are rarely observed.

We provide a comprehensive analysis of the micro and macro effects of interest rates on investment, adapting survey methods mostly used in household studies (Haaland et al., 2025; Stantcheva, 2023). We build on hypothetical vignettes that elicit firms' investment adjustments to loan rate changes, isolating the direct impact of borrowing costs. We use qualitative evidence from open-ended survey questions to uncover firms' investment adjustment narratives and to assess how prominently borrowing costs features in their monetary policy narratives. Additional vignettes, survey modules, and linked financial statements complement the analysis. Finally, by embedding the vignettes in a large German firm panel survey, we compare firms' vignette responses with their responses to monetary policy shocks.

A one percentage point (pp) reduction in the lending rate raises investment by 7 percent over the next two years. This direct response is roughly half of the total effect of monetary policy on corporate investment. The average masks substantial heterogeneity: many firms do not adjust, while adjusters revise their investment sharply. Firms' non-adjustment narratives emphasize no financing needs due to high cash buffers and not being at the margin—consistent with being above the optimal capital stock or interest rates not being decisive as investment is rather driven by technological needs and capacity constraints. The effects are particularly pronounced for firms relying on external finance and for firms facing labor shortages. When eliciting firms' hurdle rate adjustment—the minimum required return—we find that they are sticky and an important driver of the investment response (Gormsen and Huber, 2024, 2025).

Managers' narratives about monetary policy emphasize the direct interest rate channel, suggesting its first-order importance for transmission. While more than half of the firms do not discuss monetary policy changes, even among those that do, general equilibrium effects are mentioned only occasionally—though more often in firms with high business cycle attachment. Finally, firm-level responses to borrowing costs in the vignettes strongly predict the dynamics that follow identified monetary policy shocks.

In more detail, our core hypothetical vignette asks firms to consider a two-year scenario in which loan interest rates at all maturities are 0.5, 1.0, 3.0, or 4.0 pp lower than currently anticipated. The size of the reduction is randomized across four groups to test for non-linearities. Firms then report the percent change in planned total investment for the following two years (if investment was planned), and we elicit extensive margin responses for firms not planning to invest. The vignette is designed to cleanly identify the partial equilibrium investment response to interest rate changes. The questionnaire instructs respondents to hold all other dimensions (credit conditions, firm-specific and macroeconomic factors) constant. This design isolates the borrowing cost channel of monetary policy and avoids confounding general equilibrium effects, easing interpretation and mapping to theory.

We field the core vignette in the December 2023 wave of the ifo Business Survey (IBS), a monthly panel of about 6,500 German firms. The survey, administered by the Munich-based ifo institute, is typically answered by C-level executives or firm owners (Hennrich et al., 2023). At the time, the ECB's main refinancing rate stood at 4.5 percent and was expected to remain elevated (European Central Bank, 2023). For most German firms, rates on newly issued loans are the relevant marginal cost of external finance.

Our first finding is that a 1 pp cut in loan rates raises planned investment by 6 percent in the subsequent year and an additional 7 percent the year after. Larger cuts of 3–4 pp raise investment by 12–15 percent, implying a lower semi-elasticity for bigger moves, consistent with convex capital adjustment costs. Only about 30–35 percent of firms adjust (extensive margin). Among adjusters, planned investment rises by roughly 18–23 percent for 0.5–1 pp cuts and 27–30 percent for 3–4 pp cuts (intensive margin). Firms without any investment plans are significantly less likely to respond to rate changes, suggesting also sizable fixed capital adjustment costs.

To gain a deeper understanding of non-adjustment, we ask firms in open-ended text questions why they would not adjust at all; we refer to these as non-adjustment narratives. The format avoids priming with pre-set categories. We then code answers into six narratives. Two overarching narratives emerge: First, about 37 percent of firms describe a pecking order logic (Myers, 1984): they prefer internal funds and have no financing needs given sufficient internal funds. Second, about 39 percent of firms report that they are not at the margin to change investment. This reflects either a *low* marginal return to capital ("overhang of capital"), consistent with being above the optimal capital stock, or a *high* marginal return to capital ("interest rate not decisive"), where investment is driven by capacity or technological requirements rather than financing costs. The latter do not invest up to the optimum because, operating at capacity, they face steep adjustment costs (e.g., managerial constraints). We validate the identified channels by correlating narratives with survey measures: "pecking-order

firms" have higher equity and cash-to-assets; "overhang of capital firms" show higher shares of replacement investment and more certain business models; "interest rate not decisive firms" report better business situations and higher capacity utilization.

Another reason for interest rate insensitivity is sticky, conservative decision rules. Prior work finds that firms adjust required returns ("hurdle rates") only infrequently (Gormsen and Huber, 2025; Graham, 2022). To link investment adjustment to hurdle rate changes, we field a follow-up vignette one month after the core vignette that asks firms whether they would adjust their hurdle rate under the same loan rate scenarios. In theory, lower loan rates reduce the weighted average cost of capital against which projects are evaluated. Consistent with stickiness, the majority of firms do not adjust their hurdle rate after a loan rate cut (17 percent for -0.5 pp; 36 percent for -4 pp). Hurdle rate and investment adjustments are highly correlated at the firm level, yet firms are more likely to adjust investment than the hurdle rate, suggesting that insensitivity of hurdle rates to transitory loan rate changes does not necessarily impede investment.

We further analyze heterogeneity in investment adjustment along the extensive and intensive margins using additional survey measures and external data. Financially constrained firms (self-reported) show a 20 pp higher extensive margin response on average, with little change on the intensive margin. Firms that recently negotiated loans are 15 pp more likely to adjust, consistent with fixed costs of borrowing. We also study interactions with labor shortages: firms lacking skilled labor respond more on the intensive margin; among medium- and large-sized firms, investment rises 7 pp more under shortages, consistent with substitution. Finally, firms in industries with more durable assets (lower depreciation) exhibit significantly larger adjustments, consistent with temporary loan-rate declines lowering the user cost over a longer horizon and strengthening investment incentives.

We use two approaches to assess the importance of the identified interest rate channel for macroeconomic investment dynamics after monetary policy changes. First, in a later survey wave, we ask firms, in an open-text question, what discussions and considerations typically arise for their investment planning when the ECB changes its key rate. As with the non-adjustment narratives, we code answers into categories and refer to them as monetary policy narratives. Strikingly, more than half of the firms do not discuss the implications of monetary policy changes for their investment plans at all. A quarter refer to concrete transmission channels, with one dominating: 83 percent cite the direct interest rate channel via external financing, underscoring the crucial role of the mechanism we consider in our vignette for aggregate dynamics. 12 percent mention changes in demand due to interest rate changes, and 11 percent refer to general-equilibrium effects—both of which are especially common among firms with high business cycle attachment, consistent with models of rational

inattention. The variety of channels mentioned by the managers highlights the importance of focusing on a specific, well-defined channel in our vignette design to avoid mixing direct and general-equilibrium considerations.

Second, we exploit the survey's panel dimension and examine whether one-time vignette responses to borrowing cost changes predict dynamics after monetary policy shocks. Specifically, we analyze output dynamics—using a regular survey question applied in many settings (e.g., Bachmann et al., 2013b)—for manufacturing firms following high-frequency identified monetary policy shocks over the past 23 years. We find that firms that do not adjust investment in the vignette also exhibit lower output responses after monetary policy shocks, a relationship robust to many potential confounders. This underscores the importance of firms' investment sensitivity to interest rates for the monetary transmission mechanism. The differences are driven by non-adjusters arguing with sufficient internal funds or a high return to capital, but not those arguing with a lack of investment opportunities, suggesting the first two are time-invariant firm traits, whereas the latter is time-varying.

We now situate our paper in the literature. Then, in the next section, we outline the experimental design, context, and data. Section 3 reports vignette results, non-adjustment narratives, hurdle rates, and heterogeneity. Section 4 analyzes managers' monetary policy narratives and links vignette responses to post-shock macro dynamics. Finally, we conclude.

Related Literature. This paper contributes to four strands. First, it relates to work on how firms' cost of capital impacts investment. Early studies typically struggled to detect significant cost of capital effects (e.g., surveyed by Chirinko, 1993), likely reflecting identification issues. To address this, later work exploits natural experiments in tax policy that shift components of the user cost of capital—tax rates, depreciation schedules, or capital goods prices (e.g., Chirinko et al., 1999; Cummins et al., 1994, 1996; Hartley et al., 2025; Link et al., 2024; Ohrn, 2018; Zwick and Mahon, 2017). These designs yield larger user-cost effects, though what they imply for the *interest rate* elasticity remains unclear.[1] Instead, Wroblewski (2025) exploits heterogeneity in capital durability to estimate the sensitivity of capital to interest rates, finding a semi-elasticity of 4. Sharpe and Suarez (2021) use a qualitative survey question to study the extensive margin response to borrowing rate changes in a low-interest rate environment, finding a very low sensitivity. Related work highlights managerial practices that may dampen the interest rate sensitivity such as large, sticky hurdle rates (Gormsen and Huber, 2024, 2025; Graham, 2022; Graham and Harvey, 2001; Jagannathan et al., 2016). We provide direct quantitative evidence on the semi-elasticity to borrowing costs and its mapping

[1]For example, Schaller (2006) estimates a large long-run user cost elasticity via cointegration. However, when decomposing the user cost, the interest rate elasticity is near zero.

to monetary policy using a causal survey experiment, rich open-ended text evidence on loan rate insensitivity, and direct measurements of how hurdle rates respond to loan rate changes.

Second, our findings speak to the investment channel of monetary policy. Aggregate investment responses to policy shocks are sizable and persistent (e.g., Christiano et al., 2005). We complement this literature by causally identifying the direct effect of interest rate changes on investment and showing that it is first-order in firms' responses to monetary policy. Our open-ended and quantitative survey questions also enable a rich heterogeneity analysis, along complementary dimensions highlighted in recent work: default risk (Ottonello and Winberry, 2020); financial frictions related to firms' life-cycle and size (Cloyne et al., 2023; Durante et al., 2022; Gertler and Gilchrist, 1994; González et al., 2024); firm age (Gnewuch and Zhang, 2025; Krusell et al., 2025); and firms' financing structure, e.g., debt maturity (Jungherr et al., 2024) or balance sheet liquidity (Jeenas, 2023).

Third, our methodology relates to survey work that elicits otherwise hard-to-identify parameters using hypothetical scenarios (e.g., Ameriks et al., 2020; Armantier et al., 2022; Christelis et al., 2025, 2019, 2021; Colarieti et al., 2025; Fuster et al., 2021; Gorodnichenko et al., 2025; Jappelli and Pistaferri, 2014). On firms, hypothetical vignettes have been recently used to study responses to uncertainty shocks (Dibiasi et al., 2025), oil price shocks (Drechsel et al., 2022), and price pass-through (Gödl-Hanisch and Menkhoff, 2025). Elfsbacka-Schmöller et al. (2025) and Abberger et al. (2025) document firms' assessment of the overall impact of monetary policy on (innovation) investment; we instead unpack the underlying mechanism by pinning down the direct borrowing-cost channel and linking it explicitly to monetary policy. Similar to Colarieti et al. (2025) in a different context, we not only elicit the parameter of interest but also assess rationales behind firms' decisions in open-ended questions; connecting to a growing literature using open-ended questions to understand agents' beliefs and choices (see Haaland et al., 2025, for a survey).[2]

Fourth, we contribute to the ongoing debate on how lumpy micro-level investment maps into aggregate dynamics (e.g., Bachmann et al., 2013a; Caballero and Engel, 1999; Khan and Thomas, 2008; Winberry, 2021). Koby and Wolf (2020) show that aggregation depends crucially on the partial equilibrium interest rate elasticity of investment: general equilibrium price effects smooth out the dependence on the cross-sectional capital distribution only if investment is sufficiently price elastic. Our estimated semi-elasticity of 7 percent lies in the range derived by Koby and Wolf (2020) and assumed by Winberry (2021), supporting the view that the observed price elasticities of investment are too small for significant general equilibrium smoothing. We also provide direct evidence on the underlying adjustment costs.

[2]Earnings call transcripts and related documents provide a complementary lens on managers' narratives, covering risks and exposures (e.g., Hassan et al., 2019), perceived cost of capital (Gormsen and Huber, 2024, 2025), and investment plans (Selgrad and Siani, 2025).

2 Experimental design, data, and institutional context

In this section, we lay out our experimental design and the datasets we use, and we summarize the monetary and credit environment at the time of fieldwork.

2.1 Survey experiment: vignette design and elicitation

We design hypothetical vignettes to estimate the causal effect of changes in loan rates on investment. The vignette isolates a partial-equilibrium response by shifting only the cost of external finance while holding other credit terms, firm-specific factors, and macro conditions fixed. The use of hypothetical scenarios in household and firm surveys to study mechanisms that are otherwise difficult to identify has seen wider adoption; see Haaland et al. (2023) and Stantcheva (2023). Two objectives guide our design. First, the vignette should identify a partial-equilibrium investment response that maps directly to macroeconomic models. Exposing firms to a general change in interest rates would confound the interpretation with general-equilibrium forces that respondents may omit, weakening the mapping to theory. Second, the scenarios should be intuitive and empirically plausible—reflecting situations firms have encountered in the past—to mitigate any gap between hypothetical responses and actual decision-making. If scenarios are familiar, hypotheticals closely match quasi-experimental or experimental results (Colarieti et al., 2025; Kumar et al., 2023). We include our main vignette in a survey among German firms in December 2023, see the next subsection for more details.

Specifically, we ask firms to consider a change in loan rates. The vignette is designed to isolate the partial-equilibrium investment response by shifting only the cost of external finance. We explicitly state that competitors face the same change in loan rates to avoid strategic competition effects, while all other determinants of investment remain unchanged.[3]

From a modeling perspective, the hypothetical scenarios can be viewed as an innovation in the financial sector that reduces the external-finance premium. From a practical perspective, firms have likely encountered and thought through similar situations—for instance, when comparing lending offers across banks or when using fiscal subsidies that reduce interest payments or directly lower loan rates. Prior to the vignette, we first elicit each firm's current investment plans for the next two years in order to tailor the response format in the vignette accordingly. The vignette scenario is as follows:

[3]In principle, an interest rate change concentrated in one industry could alter relative prices in general equilibrium. However, most firms face only a handful of direct competitors (median = 10) and therefore are unlikely, for example, to influence relative labor costs; moreover, most identifying variation is within-industry (see Section 4).

*For the following questions, please imagine that the **financing conditions improve** for you and your competitors. For the next 2 years, **loan interest rates** for all maturities are **X percentage points lower** than currently expected. Assume that nothing else changes in terms of credit conditions, firm-specific or macroeconomic conditions.*

[*If investments were planned in 2024/2025*]
To what extent would you adjust the amount of the planned total investments for 2024 and 2025 as a result (in %)? (Rough estimate is sufficient) 2024:___ / 2025:___

[*If investments were not planned*]
In this case, would you plan investments for [2024/2025]? Yes / No / I don't know

We elicit investment responses as percentage revisions relative to current plans, which provides a natural scale for managers.[4] This quantitative elicitation directly yields a firm-level semi-elasticity of investment with respect to loan rates. In addition, for firms without investment plans, we record the extensive-margin response, i.e., whether they would start investing. To capture both short- and medium-run sensitivities, responses are collected for one and two years ahead. We maintain a scenario that is intuitive for firms by assuming a uniform reduction in loan rates across all maturities.

The investment response may not scale linearly with the size of the loan-rate change. We therefore explore potential non-linearities by varying the magnitude of the reduction: each firm is presented with only one vignette, and the loan-rate cut is randomized across four groups (0.5 / 1.0 / 3.0 / 4.0 pp). Randomization is stratified at the sector level (services, manufacturing, retail/wholesale, and construction) to ensure balanced coverage across sectors. The between-firm setup reduces respondent burden—improving response quality and reducing experimenter-demand concerns. We focus on *reductions* in loan rates, as this was the relevant and realistic scenario at the time; accordingly, estimates should be interpreted as local to more favorable borrowing conditions.[5]

Subsequently, for firms that report no adjustment of investment plans in response to the loan rate change, we elicit an *open-ended* explanation for non-adjustment. The free-text format avoids priming respondents with pre-specified categories (see Haaland et al., 2025)

[4] In our survey, investment is usually defined as expenditure on structures, equipment, software, databases, and R&D.

[5] In Appendix D, we compare the vignette results to firms' investment adjustment during the ECB's 2022-2023 hiking cycle and find a strong correlation, suggesting broadly symmetric responses to interest rate hikes and cuts.

and provides rich insight into managers' subjective models. We then classify the narratives into economic mechanisms using a coding scheme described in the next section.

Motivated by Graham (2022) and Gormsen and Huber (2025), one potential driver of non-adjustment after loan rate changes is that firms' hurdle rates—the required rate of return for new investment projects—are sticky. To test this mechanism, we present the same vignette as before, but instead of eliciting changes in investment plans, we ask:

Would you lower your hurdle rate in this scenario?

To introduce the concept and allow for heterogeneity by level, we first elicit each firm's current hurdle rate prior to the vignette; see Appendix E for the exact wording.

2.2 ifo Business Survey and financing environment

We embed our survey experiment in the ifo Business Survey (IBS), one of the oldest and largest firm surveys (Born et al., 2023) that is increasingly used to study firm behavior (see, e.g., Bachmann et al., 2019; Born et al., 2024; Link et al., 2025, 2023; Menkhoff, 2025). The IBS is a monthly survey launched in 1949 that covers around 6,500 German firms across four sectors: manufacturing, construction, retail/wholesale, and services. The questionnaire includes questions on firm characteristics, the state of business, and expectations. This richness of firm-level measures allows us to assess heterogeneity in the responses to our experiment, and the long panel dimension enables us to link experimental responses to firms' historical reaction to past monetary policy shocks. For a subset of firms, we also match Orbis financial statement data to the survey.

Our main hypothetical vignette was added to the online module of the December 2023 wave of the IBS.[6] At the time of the vignette, the ECB's main refinancing rate stood at 4.50 percent and had been unchanged since September 2023. For non-financial corporations, euro-area bank data indicate borrowing costs of around 5.2 percent in December 2023 (European Central Bank, 2024). Interest rates were expected to remain elevated over the course of 2024 and 2025 (European Central Bank, 2023). Note that the vignette setup, together with the high-interest-rate environment, enables us to study investment responses to sizable interest rate changes of up to 400 basis points. This is not feasible using recent time-series evidence based on high-frequency-identified monetary policy shocks, which are typically smaller than 30 basis points. Central banks have become more systematic, and truly sizable shocks are rare, as emphasized by Ramey (2016).

German firms typically have fixed-rate loans; e.g., Core et al. (2024) document that more than 70 percent of the total corporate loan volume is at fixed rates. Additionally, firms rely

[6]While there is still the option to answer the survey on paper, the online module is used by the vast majority of firms. In the December 2023 wave, 85 percent of all respondents.

Table 1: Summary statistics

	Mean	Std. Dev.	P10	P25	Median	P75	P90	N
Panel A: Full sample								
Employees	196	1013	6	15	38	107	300	3294
Firm age	61	49	20	28	45	85	121	1841
Equity ratio (%)	46	28	11	25	41	65	90	1754
Cash ratio (%)	21	20	2	8	15	30	50	1012
Investment 2023 (TEUR)	6430	71009	5	40	200	1000	4000	2168
Revenues 2023 (TEUR)	807341	24716411	602	2375	7300	27500	93007	2293
Investment/Revenues 2023 (%)	6	12	0	1	3	6	12	2071
Panel B: Firms that planned investments in 2024 and 2025								
Employees	322	1384	13	30	72	187	501	1676
Firm age	65	49	21	31	52	93	123	958
Equity ratio (%)	46	26	15	25	42	64	86	956
Cash ratio (%)	20	20	2	8	15	29	50	576
Investment 2023 (TEUR)	10795	95986	28	100	401	2000	6000	1168
Revenues 2023 (TEUR)	1481399	33955970	1713	4700	12983	50000	142857	1214
Investment/Revenues 2023 (%)	7	13	1	2	4	7	13	1131

Notes: Panel A: Summary statistics of relevant firm characteristics for all firms answering the vignette question. Panel B: Summary statistics for all firms answering the vignette question and having planned investments for 2024 and 2025. The number of observations varies, as not all characteristics are elicited in the same wave. Firm age: year since founding, elicited in 2018. Equity Ratio: as of end-2019. Cash-to-total assets: as of March 2020. Investment and Revenues in 2023: nominal, elicited in 2024. See Appendix E for the wording of the corresponding survey questions.

primarily on banks rather than bond markets (Deutsche Bundesbank, 2024). Hence, loan rates for newly issued loans are the relevant marginal price of external finance for most firms.

In total, 3,295 firms answered our survey questions (Manufacturing: 1,094; Services: 986; Retail/Wholesale: 817; Construction: 398), yielding around 800 respondents per treatment arm.[7] Table 1 provides summary statistics for our sample. The median firm has 38 employees, was founded 45 years ago, and invested €200,000 in 2023 (Panel A). The subsample of firms that initially planned investments for 2024 and 2025 is somewhat larger, with a median of 72 employees and €401,000 of investment (Panel B). Appendix Figure A.1 shows that the assigned size of the loan rate cut across treatment groups is not predictable from observable firm characteristics. In more detail, Appendix Table A.1 provides summary statistics by treatment group and investment plan status and confirms successful random assignment.

Two factors are crucial for the external validity of our results. First, the questions should be answered by individuals responsible for investment decisions. Reassuringly, in more than

[7]The four industry-specific surveys are harmonized according to Link (2020).

85 percent of the firms, the IBS is completed by C-level executives or firm owners (Hennrich et al., 2023), increasing the likelihood that responses reflect actual decision-making.[8]

Second, to draw meaningful conclusions about aggregate effects, responses should come from a sample that is representative of the firm population. Appendix Table A.2 shows that the industry and size distribution of our sample closely matches that of German firms. Relative to unweighted firm counts, we somewhat oversample manufacturing and medium-sized firms; however, when weighting the German firm population by employees or gross value added, these segments account for a disproportionately large share of economic activity.[9] The macroeconomic relevance of the sample is further underscored by the forecasting power of indicators constructed from the IBS—most prominently the ifo Business Climate—for the German economy (Lehmann, 2023) and by their influence on global asset prices (Kerssenfischer and Schmeling, 2024).

3 Empirical results

We begin by using the hypothetical vignettes to estimate the partial-equilibrium semi-elasticity of investment with respect to loan rate changes and decompose the response into extensive and intensive margins. We then analyze managers' non-adjustment narratives. Next, we turn to hurdle rates—eliciting levels and adjustments in a follow-up vignette with the same design—as a potential mechanism behind non-adjustment. Finally, we examine cross-sectional heterogeneity in the vignette-based sensitivities, drawing on survey and external measures of financial conditions, skilled-labor shortages, and industry-level capital durability.

3.1 Results from hypothetical vignettes

We now present results from the hypothetical vignettes introduced in Section 2.1.

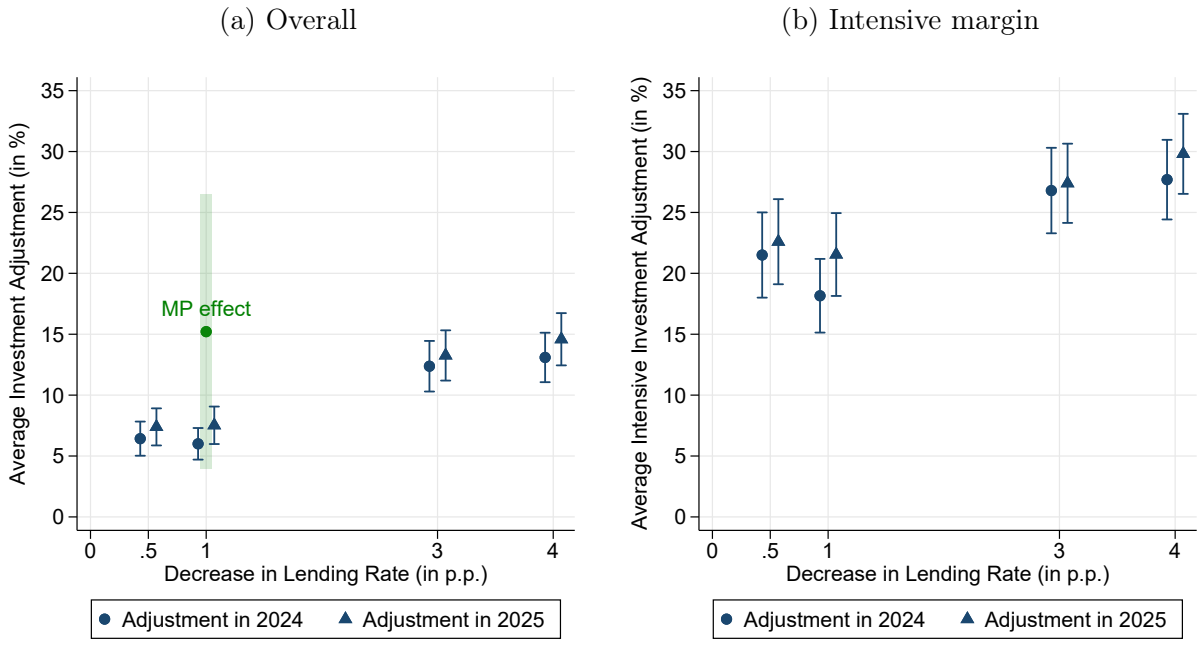
3.1.1 Overall and intensive-margin responses

Figure 1 summarizes the main patterns. The horizontal axis reports the randomized loan-rate cuts (0.5, 1.0, 3.0, 4.0 pp); the vertical axis shows the average revision in planned investment

[8]While this survey does not elicit quantitative investment plans, the ifo Investment Test—a companion survey—shows that firms' quantitative plans have very strong predictive power for realized investment. On average, firms invest as much as they plan, suggesting that respondents have a good sense of their firms' investment volumes.

[9]For further evidence on the representativeness of the regular IBS sample by firm size, industry, and region, see Hiersemenzel et al. (2022).

Figure 1: Semi-elasticity of investment with respect to loan rate changes



Notes: Panel (a): average investment adjustment in percent following hypothetical change in loan rate; Panel (b): average adjustment conditional on adjusting. Bars represent 95 percent confidence intervals. Investment adjustment winsorized at 100 percent; sample restricted to firms that initially planned to invest in 2024 and 2025. Panel (a) also includes the average aggregate investment response in the first year after a monetary policy shock (green dot with shaded 90 percent confidence interval); response scaled to 1 pp reduction in firms' cost of external financing. See the text for details about construction.

for 2024 (blue circles) and 2025 (blue triangles) among firms that, prior to the vignette, planned to invest in both years. Vertical bars denote 95 percent confidence intervals.[10]

Panel (a) shows that a one-percentage-point decrease in the loan rate raises planned investment by about 6 percent in the following year and by a further 7 percent in the year after. The response is very similar for a half-percentage-point cut. Larger reductions of 3–4 pp induce average upward revisions of 12–15 percent, so the response is clearly concave in the size of the rate cut.

The investment response is thus non-linear: the implied semi-elasticity becomes smaller for larger loan-rate cuts. A possible explanation is the discreteness of investment plans, where firms either undertake an additional project or leave plans unchanged. A small reduction may turn a marginal project profitable for many firms, whereas a larger reduction need not trigger further projects, for example, because of convex capital adjustment costs (e.g., Hamermesh and Pfann, 1996).

This interpretation is consistent with the large intensive margin adjustments observed across all rate cuts. Panel (b) shows the intensive margin by restricting the sample to

[10]Appendix Table A.3 reports the corresponding estimates pooled across the two years.

firms that revise investment plans after a decline in loan rates. For these firms, the average adjustment is about 18–23 percent for small cuts (0.5–1 pp) and 27–30 percent for large cuts (3–4 pp). The stark difference relative to the overall effect sizes in Panel (a) indicates that a sizable share of firms does not adjust investment at all when borrowing costs change.

3.1.2 Benchmarking against monetary policy shocks

Before turning to the extensive margin of adjustment, it is useful to benchmark the vignette-based responses against aggregate investment dynamics following monetary policy shocks. On average, the partial-equilibrium semi-elasticity of investment to changes in the lending rate amounts to 7 percent across the different cuts. To gauge the importance of this channel for the overall effect of monetary policy, which potentially includes a range of additional effects, we compare this number to the aggregate corporate investment response to identified monetary policy shocks. Section 4 analyzes the link from the vignette channel to monetary policy in more detail.

To this end, we use the high-frequency shocks identified in Jarociński and Karadi (2020) and estimate local projections (Jordà, 2005) at a quarterly frequency from 1999 to 2019. The full impulse response is shown in Appendix Figure A.2, Panel (a). Following a one-percentage-point cut in the policy rate, corporate investment increases by about 19 percent in the first year, peaking at roughly 27 percent.[11]

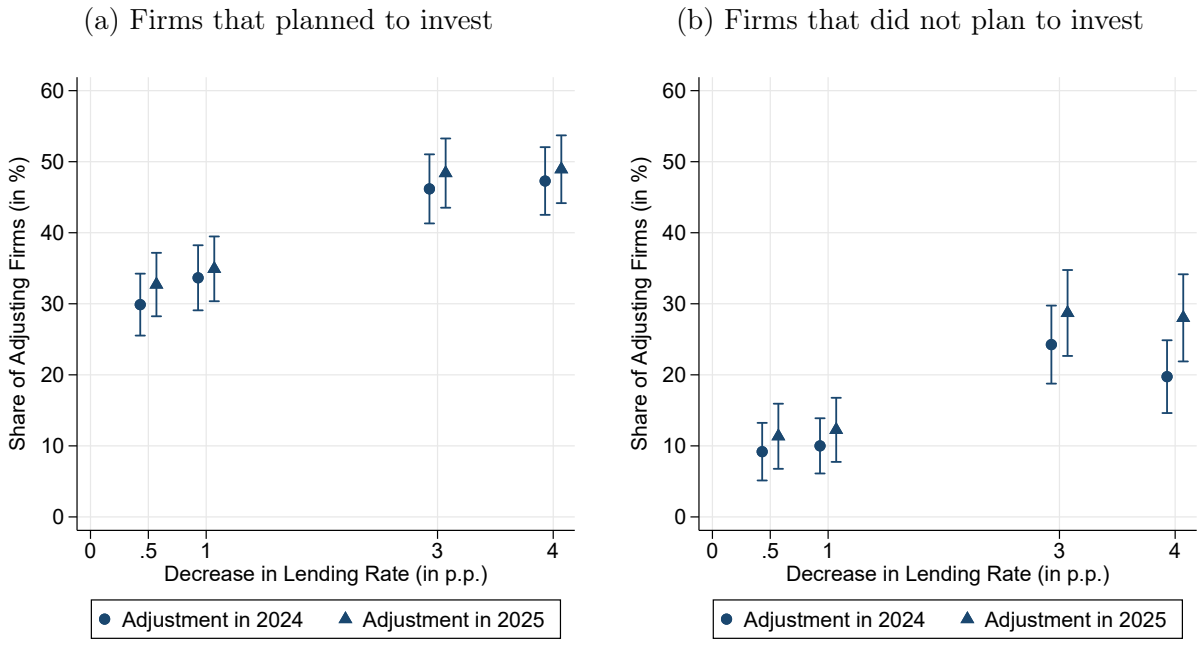
To make this response comparable to the vignette-based semi-elasticity, we rescale it such that the implied change corresponds to a one-percentage-point reduction in firms' cost of external financing over the first year.[12] This results in a scaled effect of about 15 percent, shown by the green dot in Figure 1, Panel (a).

Thus, the partial equilibrium response to a cut in the lending rate is roughly half the size of the total effect of monetary policy on investment. The wide confidence intervals around the aggregate response underscore the statistical uncertainty inherent in time-series identification, especially when compared to the sharper estimates from our partial-equilibrium, survey-based approach. In Section 4.2, we directly relate firms' vignette-based sensitivities to their observed responses after identified monetary policy shocks.

[11]The estimated investment response is consistent with the response of aggregate corporate goods production in Germany. The average effect in the first year is 13 percent; see Appendix Figure A.2, Panel (b). Appendix Table A.4 provides an overview of estimates from the literature for the investment response one year after a one-percentage-point cut in the policy rate, which range from 13 to 30 percent.

[12]Appendix Figure A.3 shows that a 1 pp monetary policy shock on impact translates into a 1.2 pp change in corporate bond yields. These yields serve as a proxy for firms' cost of external financing and are highly correlated with loan rates ($\rho = 0.8$).

Figure 2: Semi-elasticity of investment with respect to loan rate changes: extensive margin



Notes: Figure shows share of firms adjusting their investment plans following hypothetical change in loan rate. Panel (a): firms that initially planned to invest in 2024 and 2025; Panel (b): firms that did not plan to invest in respective year. Bars represent the 95 percent confidence intervals.

3.1.3 Adjustment at the extensive margin

Panel (a) of Figure 2 shows that only about 35 percent of firms that had planned to invest in both 2024 and 2025 revise their plans after a one-percentage-point cut in the lending rate. By contrast, firms that had not planned to invest at all are significantly less likely to respond—only about 10 percent adjust after the same cut, as shown in Panel (b). This pattern points to sizable fixed capital adjustment costs. Further evidence is provided in Appendix Table A.5: relative to firms that planned to invest in both 2024 and 2025, firms that planned to invest in 2025 but not in 2024 are almost 30 pp more likely to revise their 2025 plans. In other words, it takes time to adjust.

A natural explanation is that investment projects typically span several years. Starting an additional project in 2024, therefore, also affects investment plans for 2025. The close link between investment plans for 2024 and 2025 is further illustrated by firms that initially planned to invest only in 2025: with more time to adjust, their plans exhibit greater flexibility.

3.1.4 Comparison to prior estimates

Sharpe and Suarez (2021) use a survey of U.S. firms to elicit the extensive-margin investment response to borrowing cost changes. Specifically, they ask about the change in borrowing costs

required to "initiate, accelerate, or increase investment projects in the next year" (Sharpe and Suarez, 2021, p. 7). They find a lower sensitivity: 68 percent (37 percent) of firms report that they would not react to a fall (rise) in borrowing costs. A possible explanation is that their survey was fielded in September 2012, when the federal funds rate stood at 0.14 percent and policy rates were constrained by the zero lower bound. Notably, they do not ask about the size of investment responses.

To further benchmark the magnitude of our semi-elasticity, we can compare it to estimates of the investment response to changes in the tax term of the user cost of capital, such as those reviewed in Zwick and Mahon (2017). Under the assumptions set out in Appendix B, our interest rate semi-elasticity of 7 percent translates into a user cost elasticity of 1.3. While this is only about one-fifth of the elasticity suggested by Zwick and Mahon (2017), Curtis et al. (2021) show that user cost elasticities implied by tax term estimates fall sharply once financial frictions are incorporated. Using the same variation as Zwick and Mahon (2017) but allowing for frictions, they estimate a user cost elasticity of 1.4—remarkably close to the value implied by our vignette evidence.

3.2 Narratives of non-adjustments

In a frictionless world, it is difficult to rationalize why firms would leave investment plans unchanged after borrowing costs fall. Yet in our vignettes, the median firm does not adjust investment plans at all. To open up this black box of non-adjustment, we asked firms with existing investment plans to provide open-ended explanations for why they made no changes. Of the non-adjusters, 77 percent offered a response. The average answer was 45 characters long, and most contained substantive economic reasoning rather than vague statements.

Using a coding scheme, we classify these open-text responses into six narratives—some containing multiple sub-narratives—and an "other" category (see Appendix Table A.6 for the full codebook with examples). Almost all responses can be uniquely assigned to one category, so we rule out multiple classifications. A research assistant (RA) and two authors independently hand-coded the responses, resolving any discrepancies jointly.[13] To validate the identified channels, we correlate the narratives with firms' quantitative survey characteristics.

Table 2 reports the narratives based on firms' open-text responses; Appendix Table A.7 offers a more granular sub-narrative breakdown. Figure 3 then visualizes various quantitative firm characteristics, showing averages with 95 percent confidence intervals across the different reasons for not adjusting investment after a change in interest rates. For comparison, the

[13]The same categories were independently assigned by the authors and the RA in 87 percent of the cases.

Table 2: Narratives for not adjusting investment

	Total		By size of interest rate change					
			0.5 – 1 pp		3 – 4 pp		Difference	
	N	%	N	%	N	%	pp	SE
Sufficient internal funds	277	37	131	32	146	43	-11.63	3.54
Interest rate not decisive	166	22	93	22	73	22	0.81	3.04
Overhang of capital	129	17	72	17	57	17	0.49	2.76
High adjustment costs	92	12	71	17	21	6	10.90	2.27
Expectations	51	7	26	6	25	7	-1.13	1.86
Constraints	17	2	11	3	6	2	0.88	1.07
Other	21	3	11	3	10	3	-0.31	1.21
Total	753	100	415	100	338	100	–	–

Notes: Distribution of the answers to the open-ended question across the hand-coded categories. Column 3–4: Firms that were confronted with a 0.5 or 1 pp interest rate change in the vignette. Column 5–6: Firms that were confronted with a 3 or 4 pp interest rate change in the vignette. Column 7-8: Difference between share of answers in 0.5–1 pp group and 3–4 pp group with corresponding standard errors. The sample is restricted to firms that planned to invest in 2024 and 2025. See Appendix Table A.7 for a more granular sub-narrative breakdown.

orange markers plot the corresponding averages for firms that do adjust their investment plans in the vignettes.

Three main narratives emerge. The first, cited by about 37 percent of firms, attributes non-adjustment to sufficient internal funds. Within this group, roughly a quarter state that they always rely on internal financing ("always internally financed"), while the remaining three quarters report having enough funds at present ("no financing needs"). This narrative is consistent with the pecking order theory (Myers, 1984), whereby firms prefer internal to external financing and thus face no funding needs when cash buffers are high. Panels (a) and (b) of Figure 3 confirm this interpretation: firms citing sufficient internal funds display significantly larger cash holdings and higher equity ratios than those that adjust investment in the vignettes and those with other non-adjustment narratives. The differences are quantitatively meaningful—cash-to-asset ratios are about 8 pp higher and equity ratios about 18 pp higher. These findings are corroborated by financial statement data that we can link to the survey for a subset of firms, allowing us to calculate averages over several years, see Appendix Figure A.4. Given the well-documented rise in corporate cash buffers in recent

decades (Graham and Leary, 2018; Schnabel, 2024), this mechanism suggests that higher liquidity may dampen firms' sensitivity of investment to interest rate changes.[14]

The second and third main narratives, reported by about 39 percent of firms, relate to not being at the margin to adjust investment. Firms in the second group (22 percent of firms, "interest rate not decisive") argue that their investment decisions are driven by capacity or technological requirements rather than borrowing costs. This implies that their investments usually generate a return that exceeds their cost of capital, allowing firms to disregard interest rates in the decision-making process, as is explicitly mentioned by some of the firms. Consistent with a high marginal return to capital, Panels (c) and (d) of Figure 3 show significantly higher business expectations and capacity utilization rates for this group. That these firms do not increase their investment up to the optimum is likely due to frictions such as limited managerial capacity for planning projects or the discrete nature of investment projects. From a modeling perspective, this corresponds to firms facing steep convex, almost vertical, capital adjustment costs.

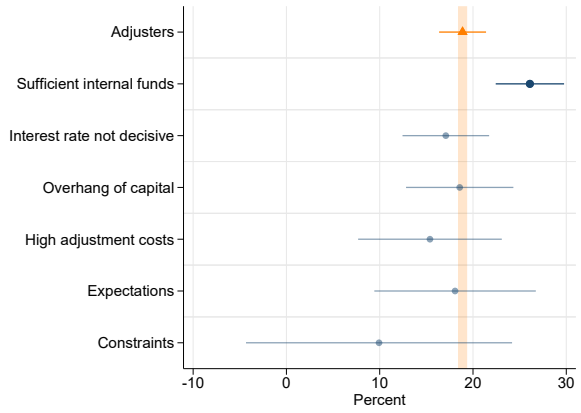
The third narrative (17 percent, "overhang of capital") reflects the opposite situation: firms report a lack of additional profitable investment opportunities, implying a low marginal return to capital. In line with being above their optimal capital stock, these firms are more likely to focus solely on replacement investment and less likely to engage in R&D (Panels (e) and (f)). They also report lower subjective uncertainty about their business outlook (Panel (d) of Appendix Figure A.4). These patterns suggest a state-dependent sensitivity of investment to interest rates. In the short run, non-convex capital adjustment costs can cause overshooting of capital, reducing the responsiveness of investment to interest rates. In the medium run, after several years of expansion, firms may have overaccumulated capital and become less sensitive due to trading frictions (Ottonello, 2024). In the long run, lower investment sensitivity is consistent with mature economies where potential growth is less dynamic.

A further 12 percent of firms point to high adjustment costs of investment plans. Consistent with fixed costs, this narrative is especially common when loan rate changes are small (0.5 or 1 pp). Another 7 percent highlight negative demand expectations or economic uncertainty as non-adjustment reasons, while 2 percent mention constraints on other inputs, and 3 percent of responses cannot be classified. Appendix Table A.8 shows that the distribution of narratives is broadly stable across 2024 and 2025, indicating that—conditional on having investment plans—the reasons for non-adjustment do not depend on the planning horizon.

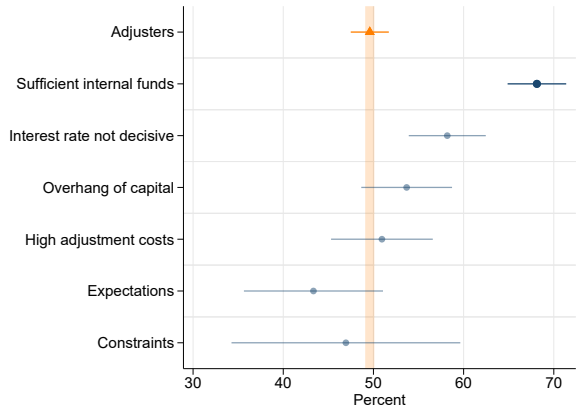
[14]While firms with larger cash buffers are less affected by borrowing costs, they may be more sensitive to deposit rate changes. For example, Altavilla et al. (2022) find stronger investment responses to negative deposit rates among highly liquid firms.

Figure 3: Firm characteristics by non-adjustment narratives

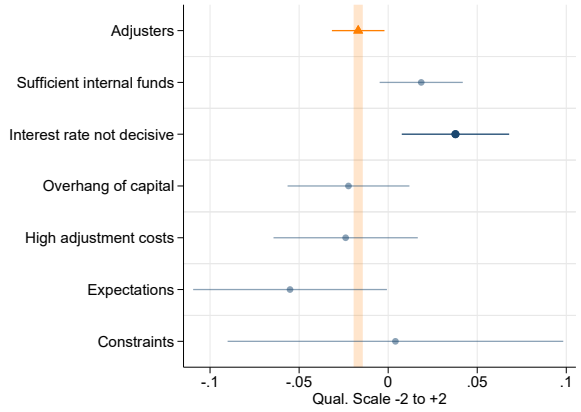
(a) Cash to total assets 2020



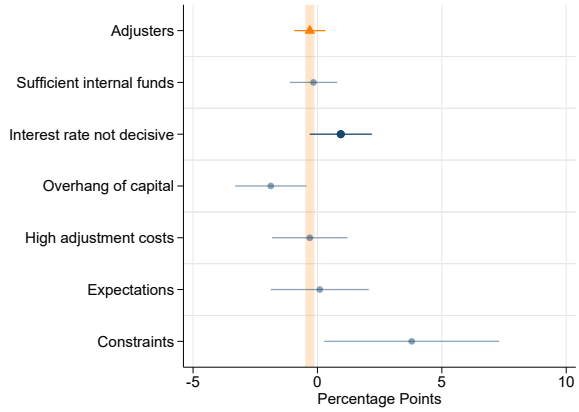
(b) Equity ratio 2022



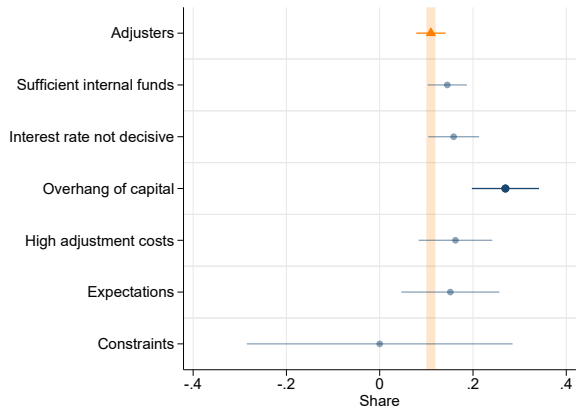
(c) Business expec. 2021–23 rel. to firm average



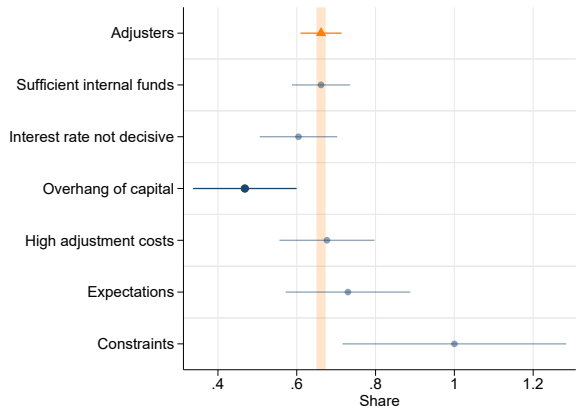
(d) Capacity util. 2021–23 rel. to firm average



(e) Focus on replacement investment 2021–23



(f) R&D activity 2021 – 2023



Notes: Figure shows average values of different firm characteristics for classified non-adjustment narratives. Average values for group that adjusts investment plans in the vignette is shown in orange. Panel (a): cash-to-asset ratio in March 2020. Panel (b): equity ratio at the end of 2022. Panel (c): average business expectations (−1/0/1) 01/2021 – 12/2023 minus long-run firm-average. Averages are calculated after absorbing month fixed effects to account for non-balancedness of the panel. Panel (d): average capacity utilization in 01/2021–10/2023 minus long-run firm-average. Panel (e): share of firms focusing investment only on replacement investment in 2021–2023. Panel (f): share of firms engaging in R&D activity in 2021–2023. See Appendix E for wording of survey questions. Sample is restricted to firms that planned to invest in 2024 & 2025. Bars represent 95 percent confidence intervals.

3.3 Hurdle rate sensitivity

A large share of firms does not adjust investment when loan rates change. Reported reasons include frictions such as low returns to capital or high costs of revising investment plans. While such frictions hinder short-term adjustments, firms could still incorporate borrowing costs into their decision-making by revising the required return on investment—the hurdle rate. To test this mechanism directly, we included another hypothetical vignette experiment in the January 2024 survey (see Section 2.1) that asks firms how their hurdle rate would change when loan rates fall. Conceptually, the hurdle rate represents a prior stage of the investment decision that is not directly affected by capital adjustment costs or the absence of profitable opportunities. In theory, firms should undertake projects with returns above the cost of capital and reject those below it, so changes in the cost of capital directly shift the investment margin. As noted by Graham (2022), most firms evaluate projects using a minimum required return, often termed the hurdle rate.[15]

In practice, hurdle rates often deviate from the cost of capital. Firms typically require returns above their cost of capital, for example due to managerial constraints or unpriced idiosyncratic risk (Gormsen and Huber, 2025; Jagannathan et al., 2016). Moreover, hurdle rates appear sticky: they do not adjust one-for-one with changes in the cost of capital (Gormsen and Huber, 2025; Graham, 2022). As argued by Gormsen and Huber (2025), the combination of elevated and sticky hurdle rates can reduce the investment sensitivity to the cost of capital by up to an order of magnitude.

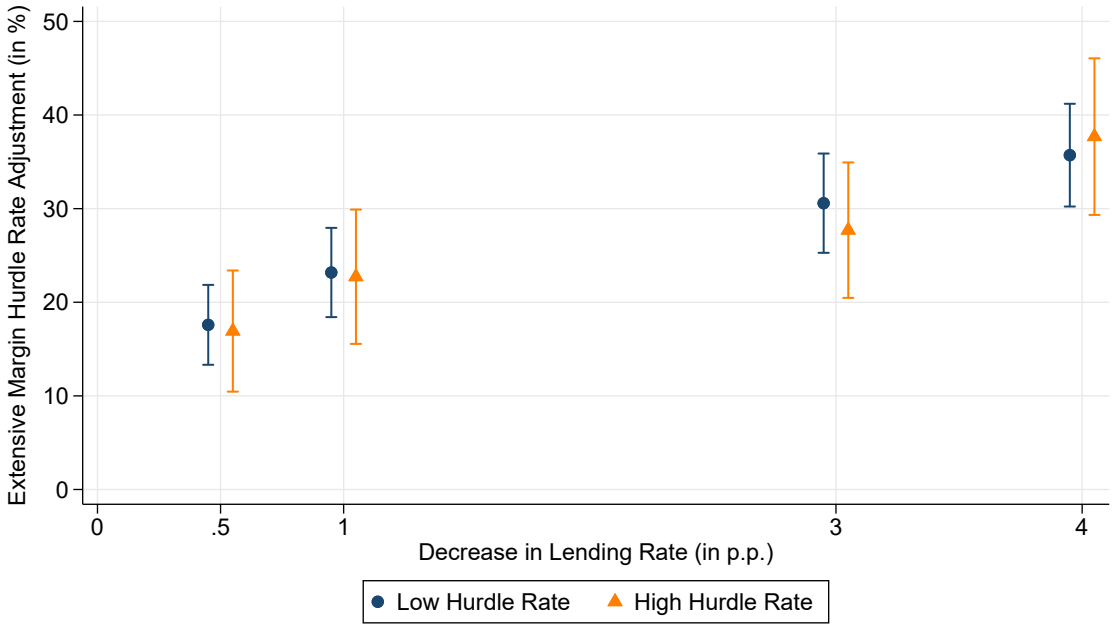
Our survey first elicits firms' current hurdle rates. The mean is 11 percent, closely matching the average predicted for German firms by Gormsen and Huber (2025).[16] At the same time, about two-thirds of firms report no explicit hurdle rate, suggesting that many rely on alternative but related investment decision rules. Column 1 of Appendix Table A.9 shows that knowledge of the hurdle rate is more common when the survey is answered by the CEO or owner, when the respondent has at least a college degree, when the firm is more investment-intensive (as measured by the investment per revenue), and when the firm relies more on external finance. These patterns are consistent with Graham and Harvey (2001), who document that investment decision rules vary systematically with CEO characteristics and firm leverage.

Figure 4 shows that fewer than half of the firms reporting a valid hurdle rate adjust it in response to a decline in loan rates. The probability of adjustment increases with the size

[15]Firms either compare the internal rate of return (IRR) on a project to the hurdle rate or compute the net present value (NPV) using the hurdle rate as the discount rate; see Gormsen and Huber (2025) on the equivalence of the two approaches.

[16]Appendix Figure A.5 shows the full distribution, trimmed at the one-percent level.

Figure 4: Semi-elasticity of hurdle rate: extensive margin by hurdle rate level



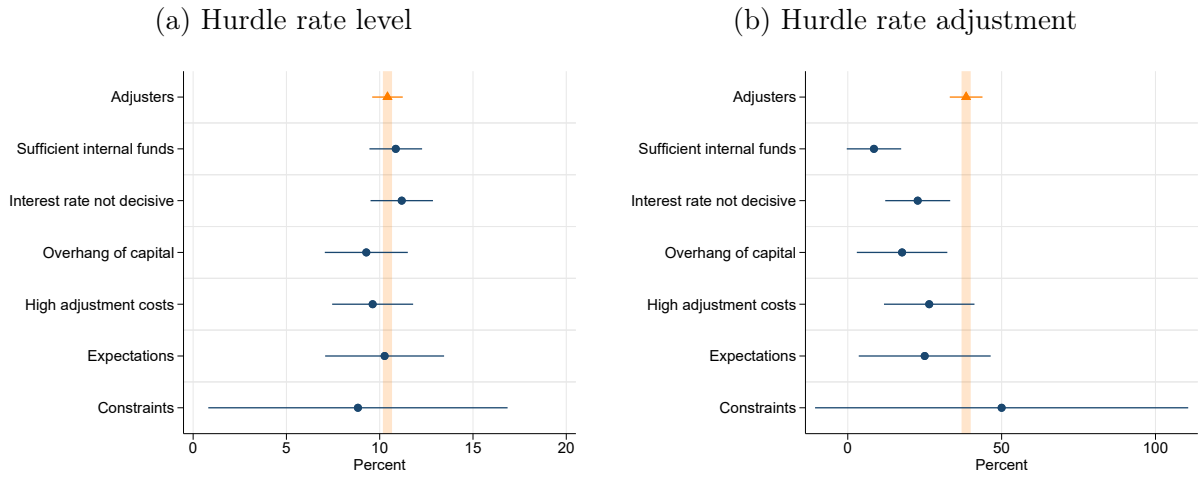
Notes: Share of firms adjusting their hurdle rate in the vignette for firms with hurdle rate level $\leq$ p50 (blue dot) and firms with hurdle rate level $>$ p50 (orange triangle). The sample is restricted to firms knowing their hurdle rate and firms with a hurdle rate within p1/p99. Bars represent 95 percent confidence intervals.

of the rate cut, consistent with fixed costs in updating hurdle rates and with the stickiness documented by Graham (2022) and Gormsen and Huber (2025). The initial level of the hurdle rate does not predict adjustment of the hurdle rate. A median split in Figure 4 shows no difference in adjustment propensities across high- vs. low-hurdle firms, and Panel (a) of Figure 5 indicates that required return levels do not differ systematically across adjusters and the various non-adjustment narratives. This suggests that differences in the initial risk premia embedded in firms' hurdle rates are not the main determinant of adjustment behavior. It also implies that heterogeneous pass-through of policy rate changes to spreads is orthogonal to the vignette responses.

On average, the hurdle-rate adjustment is closely linked to investment behavior in the vignette. Column 1 of Table 3 shows that firms that revise their hurdle rate in the vignette are about 27 pp more likely to also adjust investment. This correlation, based on data elicited in a follow-up survey one month after the investment vignette, validates our main finding by demonstrating consistency across survey waves. By contrast, conditional on adjusting investment, the size of the adjustment is not correlated with whether the firm updates its hurdle rate (Column 2).

Even though investment and hurdle rate adjustments are strongly correlated, the relationship is far from one-to-one. In fact, 37 percent of firms adjust only one margin while leaving

Figure 5: Hurdle rate level and adjustment by non-adjustment narratives



Notes: This figure shows average values of different variables for the classified non-adjustment narratives. The average values for the group that adjusts investment plans in the vignette is shown in orange. The sample is restricted to firms that planned to invest in 2024 and 2025. Panel (a): mean of the current hurdle rate as of January 2024. Panel (b): share of firms adjusting their hurdle rate following the hypothetical decline in the loan rate. Bars represent 95 percent confidence intervals.

the other unchanged. About one quarter of these firms revise their hurdle rate but not their investment. As noted above, this pattern could be rationalized by a lack of profitable projects or high adjustment costs. Yet Panel (b) of Figure 5 shows that only around 20 percent of firms invoking such narratives actually adjust hurdle rates. Overall, there is little systematic heterogeneity in hurdle rate adjustment across the different non-adjustment narratives.

The remaining three quarters adjust investment but not the hurdle rate. At first sight, this is puzzling, since loan rates affect investment through the cost of capital and hence the hurdle rate. However, as Graham (2022) emphasizes, only a minority of firms pursue all projects with expected return above their stated hurdle rate. This implies that the effective buffer on top of the cost of capital is even larger than the hurdle rate itself, leaving scope for additional investment without revising it. Consistent with this interpretation, Column 3 of Appendix Table A.9 shows that firms that reduced investment in response to 2022–23 interest rate hikes are especially likely to adjust investment without adjusting their hurdle rate, suggesting a form of catch-up investment.

Table 3: Investment adjustment and hurdle rate adjustment

	Extensive margin	Intensive margin
	(1)	(2)
Extensive margin HR adjustment	0.271***	0.028
	(0.038)	(0.034)
Constant	36.215***	24.497***
	(2.629)	(1.362)
Observations	578	250
R^2	0.058	0.004

Notes: This table shows OLS regression results of the extensive margin investment adjustment (0/100) and intensive margin investment adjustment (0–100 percent) on the extensive margin hurdle rate adjustment (0/100). Sample is restricted to firms that planned to invest in 2024 and 2025. Standard errors clustered at the 2-digit industry level in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.4 Heterogeneity in firms' interest rate sensitivity of investment

We use the vignette-based semi-elasticity to study how the investment sensitivity to loan rate changes varies across firms and industries. A simple variance decomposition shows that four-digit industry fixed effects account for less than 20 percent of the variation, implying that heterogeneity arises mainly *within* industries rather than *across* them. We therefore focus mainly on firm-level heterogeneity, complemented by one industry-level dimension, capital durability. Specifically, we examine three dimensions in turn: (i) financial conditions, (ii) labor shortages, and (iii) industry-level capital durability.

3.4.1 Financial conditions

Motivated by the observed lack of investment response to loan rate changes that many managers attribute to high cash buffers, we begin the heterogeneity analysis by examining the role of financial conditions. While prior work often relies on proxies for financing needs or constraints (firm size, age, leverage, cash-to-assets; Cloyne et al., 2023; Gertler and Gilchrist, 1994; Jeenas, 2023; Ottonello and Winberry, 2020), we exploit several *direct* survey measures of firms' financial conditions.

Table 4 reports regressions of the extensive-margin adjustment (upper panel) and the intensive-margin adjustment (lower panel) on these measures. All specifications include controls for firm size and the firms' overall business conditions to limit omitted variables concerns. We proxy size with log employment. Larger firms are significantly less likely to adjust investment when loan rates decline: a 10 percent increase in employment is associated with a roughly 20 pp lower probability of adjustment. This pattern is consistent with managerial/planning costs of investment rising with firm size. To condition on idiosyncratic conditions, we also control for the firm's average business state over the past two years; we find little evidence of state dependence along this dimension.

We expect the extent of external financing to be of first order for responses to borrowing-cost changes. In Column 1, adjustment in the vignette is related to the firm's expected share of externally financed investment in 2024. Reassuringly, the probability of adjustment rises strongly with this share; the intensive margin effect is positive as well. We therefore include this variable in subsequent specifications as a baseline control for reliance on external finance.

Next, we ask whether recent loan negotiations matter for responsiveness. In Column 2, firms that have conducted loan negotiations within the previous three months (21 percent of firms) are 15 pp more likely to adjust. This indicates that being in recent or ongoing contact with lenders is associated with greater responsiveness to loan-rate changes. The interaction in Column 3—an indicator that the bank acted restrictively during the negotiations—is signifi-

Table 4: Drivers of investment adjustment and financial conditions

	(1)	(2)	(3)	(4)	(5)
Panel (a): Extensive margin adjustment (0/100)					
Loan negotiations past 3 months		14.941***	11.770***		
		(3.729)	(4.230)		
Loan negotiations past 3 months × Bank acted restrictive			15.217**		
			(6.736)		
Financing conditions relevant for investment 2024				19.230***	
				(6.013)	
Financially constrained 10/2023					23.007***
					(6.245)
Share of externally financed investment 2024 (in %)	0.200***	0.138***	0.138***	0.169***	0.160***
	(0.034)	(0.035)	(0.036)	(0.044)	(0.034)
Log employees	-2.111**	-2.136**	-1.988**	-1.325	-1.604
	(0.874)	(0.905)	(0.938)	(0.945)	(0.968)
Avg. business state past 2 years	-4.815	-2.916	-2.030	-3.944	-5.277
	(3.302)	(3.341)	(3.190)	(3.718)	(3.823)
Constant	43.966***	41.163***	40.399***	37.508***	41.430***
	(4.347)	(4.642)	(4.763)	(4.844)	(5.098)
Observations	1243	1177	1177	1001	1133
R^2	0.027	0.039	0.042	0.048	0.033
	(1)	(2)	(3)	(4)	(5)
Panel (b): Intensive margin adjustment (in percent)					
Loan negotiations past 3 months		0.198	-0.040		
		(2.462)	(2.571)		
Loan negotiations past 3 months × Bank acted restrictive			0.915		
			(3.140)		
Financing conditions relevant for investment 2024				9.367***	
				(2.767)	
Financially constrained 10/2023					-0.763
					(3.250)
Share of externally financed investment 2024 (in %)	0.083***	0.070*	0.070*	0.052	0.065**
	(0.027)	(0.038)	(0.038)	(0.032)	(0.032)
Log employees	-1.794***	-1.698***	-1.685***	-1.948***	-1.890***
	(0.442)	(0.396)	(0.387)	(0.539)	(0.447)
Avg. business state past 2 years	0.000	0.391	0.453	0.020	-1.548
	(1.755)	(1.878)	(1.861)	(1.730)	(1.682)
Constant	27.424***	27.391***	27.331***	27.574***	28.444***
	(1.907)	(1.940)	(1.931)	(2.498)	(1.894)
Observations	495	453	453	385	446
R^2	0.033	0.027	0.027	0.074	0.031

Notes: OLS regression results. Panel (a): Dependent variable is 0 for firms not adjusting investment in the vignettes and 100 for adjusting firms. Panel (b): The sample is restricted to firms that adjust investment in response to the vignette and the dependent variable is the investment adjustment in percent, winsorized at 100 percent. "Share of externally financed investment": asked in November 2023. "Financing conditions relevant": asked in November 2023. "Loan negotiations" and "Bank acted restrictively": asked in December 2023, referring to the three prior months. "Financially constrained": asked in October 2023. "Log employees" is winsorized at the 1 percent-level. "Avg. business state" is the average of the qualitative business sate (-1/0/1) from 11/2021–11/2023 after absorbing month fixed effects. See Appendix E for the wording of the corresponding questions. The sample is restricted to firms that planned to invest in 2024 and 2025. It does not include construction firms because the variables are unavailable for this sector. Standard errors clustered at the 2-digit industry level in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

cant, suggesting that firms facing tighter financing conditions are particularly responsive.[17] On the intensive margin, we find no differential effect, consistent with sizable one-off costs of bank contact and providing an empirical microfoundation for models with fixed costs of debt issuance (Jeenas, 2023).

Relatedly, Column 4 uses a question on the relevance of financing conditions for 2024 investment. For firms reporting high importance (14 percent), the probability of adjustment rises by about 19 pp, see Panel (a). Conditional on adjusting, planned investment rises by an additional 9 pp relative to firms that do not report financing as highly relevant, see Panel (b).

In the last column, we study whether self-reported financing problems predict vignette responses. Firms reporting financing problems (4 percent)—a direct constraint measure—are 23 pp more likely to adjust, with no detectable difference at the intensive margin.

We conclude that financial conditions are a core state variable shaping firms' interest rate sensitivity of investment. Translating the cross-section into time-series implications: when a larger share of firms relies on external finance, has recently conducted loan negotiations, or faces financing constraints, monetary policy should exert stronger effects on firms' investment. We next ask whether tight labor markets dampen—or instead amplify—these sensitivities.

3.4.2 Labor shortages

Germany and other advanced economies have faced rising labor shortages in recent years. The ifo survey includes a quarterly question on whether firms are constrained by a lack of skilled workers. Because capital and labor are typically viewed as complementary inputs, we ask whether firms still raise investment when loan rates decrease, even when they do not have sufficient labor input.

In Appendix Table A.10, Column 1 examines whether firms that currently report a lack of skilled labor—39 percent in October 2023—differ in their investment response. Firms with reported shortages react *more strongly* than those without, with the effect concentrated among larger firms (Column 2). Columns 3–4 switch to a persistent measure—firms that have consistently reported above-average shortages over the past five years—and find significant effects at both margins: these firms are 5.4 pp more likely to adjust in the vignette (extensive margin) and, conditional on adjusting, increase planned investment by 3.6 pp more (intensive margin).

These findings suggest that labor shortages do not diminish firms' investment sensitivity to interest-rate changes; if anything, they amplify it. The pattern is consistent with a substitution/automation channel: when labor is scarce and borrowing becomes cheaper, firms

[17] Only 4 percent of firms both negotiated credit and reported restrictive bank behavior.

step up investment in labor-saving capital as relative input prices shift. The particularly strong effects among large firms align with models featuring fixed costs of automation, which make adoption more prevalent in bigger firms (Hubmer and Restrepo, 2025).

3.4.3 Capital durability

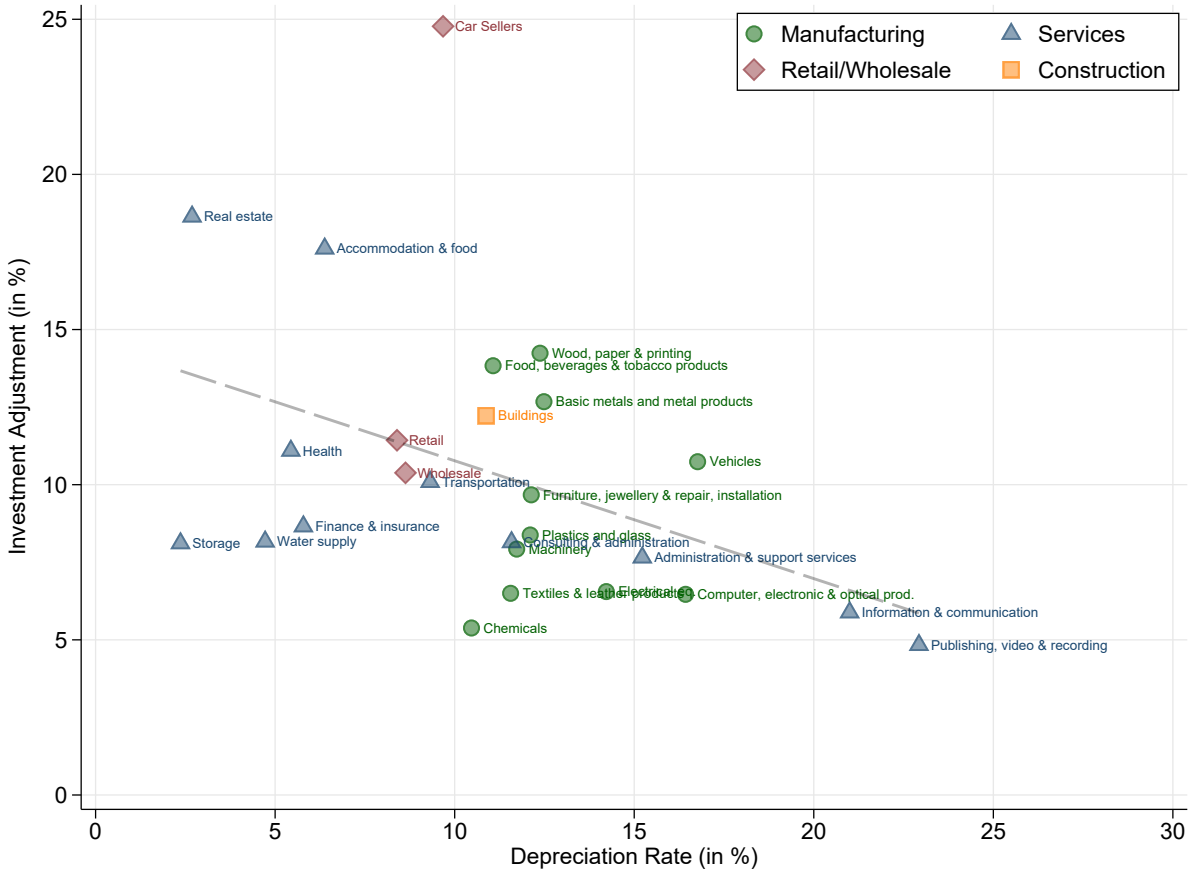
We now turn from firm-level heterogeneity to industry-level features that may shape how investment adjusts to borrowing cost changes. Our large survey allows us to exploit cross-industry variation to study a first-order dimension: the durability of capital goods. In industries with more durable assets (i.e., lower depreciation rates), a temporary decline in loan rates across the yield curve lowers the user cost over a longer horizon, strengthening incentives to invest.[18]

Consistent with this mechanism, we find that industries with lower depreciation rates exhibit, on average, significantly larger investment adjustments than those with higher depreciation rates. Figure 6 plots the industry-average depreciation rate at the 2-digit NACE industry level—constructed from EU KLEMS capital-stock and investment data—against the industry-average investment adjustment in the hypothetical vignettes. We find a statistically significant negative relationship that explains about 15 percent of the cross-industry variation. For example, firms in *information & communication* and in *publishing, video & recording*—industries with relatively short-lived assets (e.g., computers, software, other electronic equipment)—show small average investment adjustments of around 5 percent. By contrast, firms in *real estate* and in *accommodation & food*—industries with a relatively high share of long-lived assets, mainly buildings—consistently exhibit large adjustments exceeding 15 percent.[19] The relationship remains robust when controlling for firm size and the share of external financing; see Appendix Table A.11.

[18]The cross-industry lens also permits an accounting exercise on environmental exposure. We find that the direct investment effect of loan rate declines is orthogonal to firms' environmental footprint, in contrast to the ECB's unconventional policies, which are tilted toward high-emission sectors (Papoutsi et al., 2022). See Appendix C for details.

[19]Outliers such as *storage* and *water supply* may reflect very long planning horizons that, despite high asset durability, dampen short-run responses. By contrast, *car dealers* may be able to adjust planned upgrades (e.g., showrooms) more swiftly when loan rate conditions improve.

Figure 6: Vignette response and depreciation rate at industry level



Notes: The depreciation rate is calculated based on capital stock and investment data at the 2-digit industry level from the EU KLEMS database. Following the EU KLEMS data, some 2-digit industries are merged together. Investment adjustment is winsorized at 100 percent. The sample is restricted to firms that planned to invest in 2024 & 2025. The dashed line shows an unweighted linear fit.

4 From hypothetical scenarios to actual monetary policy

In this section, we examine the quantitative importance and implications of the borrowing-cost channel for monetary-policy transmission to investment. We adopt two complementary approaches. Section 4.1 uses narratives of managers collected to assess whether and how firms discuss monetary policy when making investment decisions. The salience of the different narratives sheds light on their importance for monetary policy transmission. Section 4.2 links firms' elicited sensitivities to borrowing costs with their actual responses to aggregate interest rate changes and identified monetary policy shocks. Together, these approaches provide both qualitative and quantitative evidence on the role of the direct interest rate channel via external financing in shaping macroeconomic investment dynamics.

4.1 Monetary policy narratives

The vignette analysis establishes the quantitative relevance of borrowing costs for firms' investment choices, but it does not reveal how managers themselves think about monetary policy when planning investments. To gain direct insight into the salience and perceived transmission channels of monetary policy, we complement the vignettes with a narrative approach. Importantly, the vignette isolates a *partial-equilibrium* shock to the lending rate—holding other credit terms and macro conditions fixed—so contrasting it with managers' narratives on the effects of overall monetary policy helps gauge which channels are top of mind in real planning. Our aim here is to assess the perceived importance of the direct borrowing cost channel featured in the vignette for monetary policy transmission. Specifically, we added an open-ended question to the ifo Business Survey in June 2025, asking managers:

What discussions and considerations typically arise within your firm regarding investment planning when the ECB changes its key interest rate?

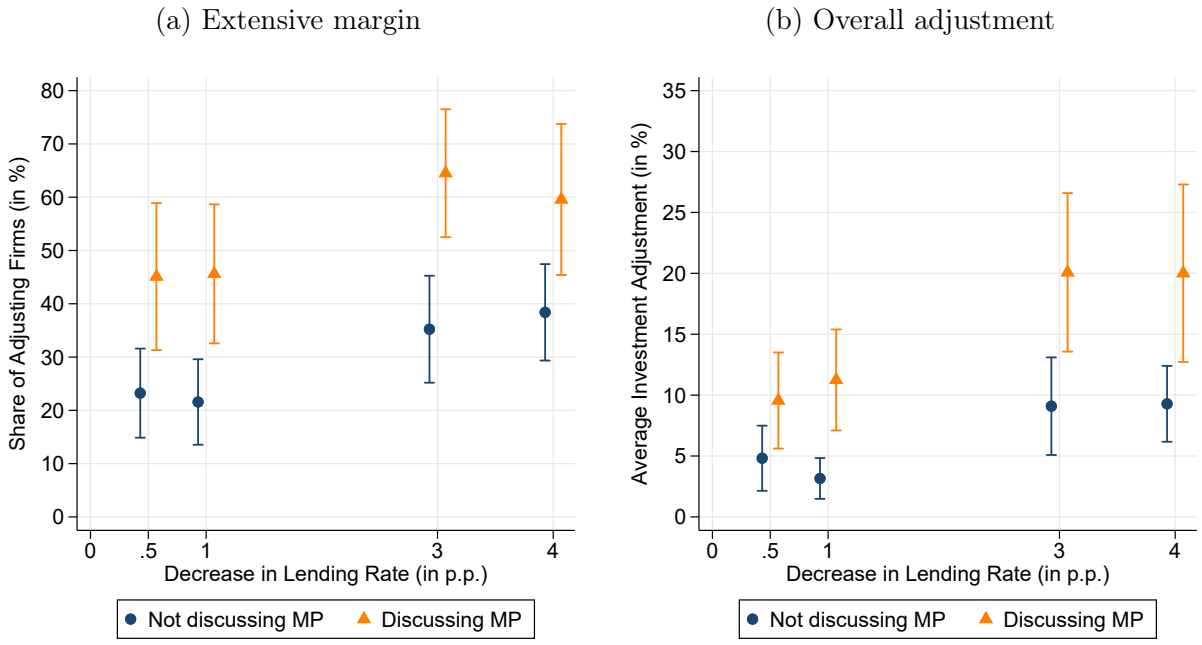
The question is deliberately open so that firms can freely express their thoughts without priming (Haaland et al., 2025), see Link et al. (2025) for another application in the IBS. We focus on investment-related considerations, and the wording is designed to be independent of current conditions to elicit general responses. In total, we obtained 2,041 high-quality responses, which we hand-coded into categories that characterize firms' perception of monetary policy changes (see Appendix Table A.12 for the codebook and example responses).

4.1.1 Do firms discuss monetary policy changes?

More than half of the firms (63 percent) report that they do not discuss the implications of monetary policy changes for their investment plans at all. Some of those firms also refer to specific channels to argue that they are irrelevant to their firm. Among the firms that do engage with monetary policy, 20 percent discuss the effects on investment in general terms, while 17 percent explicitly point to particular channels. The high share of "non-discussants" does not necessarily imply inattentiveness: firms' key interest rate expectations display little heterogeneity and are closely aligned with professional forecasts (Link et al., 2023). This pattern is consistent with the idea that monetary policy is largely predictable and its effects anticipated, such that investment plans often need not be revisited after policy meetings.

Firms that do engage with monetary policy changes in their planning exhibit significantly stronger investment responses to borrowing costs in the vignette experiment. Figure 7 illustrates this by showing the extensive margin and overall investment adjustment (as in

Figure 7: Semi-elasticity of investment by monetary policy discussion



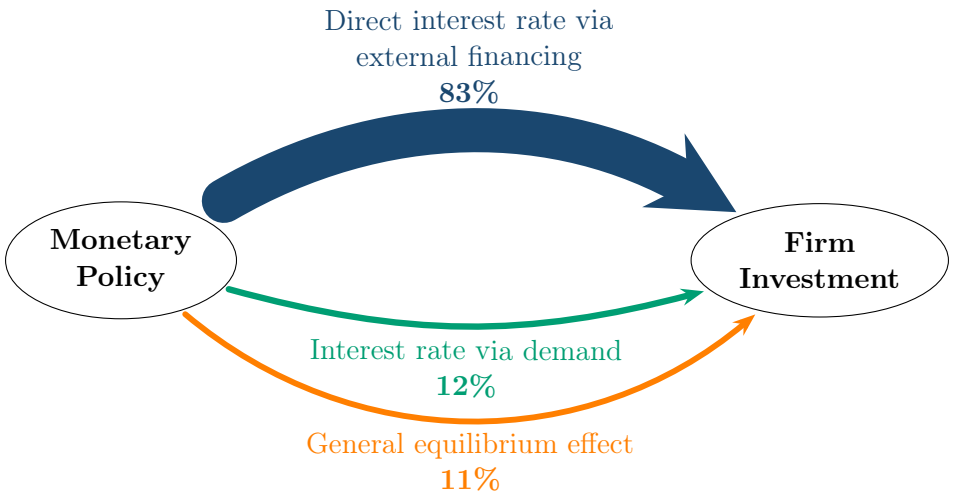
Notes: Panel (a): share of firms adjusting investment following the hypothetical change in loan rate; Panel (b): average investment adjustment, winsorized at 100 percent. Blue dots: firms indicating they do not engage with monetary policy in their investment planning. Orange triangle: firms that do engage with monetary policy. See the text for details. Bars represent 95 percent confidence intervals. The sample is restricted to firms that initially planned to invest in 2024 and 2025 and to firms that answered both in December 2023 and June 2025.

Figures 1 and 2), split by whether firms report discussing monetary policy decisions. Across the loan rate decreases we consider, firms that discuss monetary policy respond roughly twice as strongly as those that do not. This relationship provides an initial indication that the direct interest rate effect via external financing is of first-order importance for monetary policy transmission.

4.1.2 Which monetary policy transmission channels come to mind?

Next, we take a closer look at the 510 responses (around a quarter of all responses) to the open-ended question that mention a specific channel. We hand-coded the answers into three broad categories. The first corresponds to the direct interest rate channel via external financing, which is also the mechanism captured by our hypothetical vignette. For example, one manager wrote: "*Expansion of investments when the interest burden on loans is lower.*" We also include in this category responses in which firms emphasize the irrelevance of monetary policy precisely because they do not rely on external financing, e.g., "*Since we do not rely on external financing, no discussion arises.*" Such responses indicate that

Figure 8: Perceived channels of monetary policy



Notes: Hand-coded perceived channels of monetary policy elicited in an open-ended question. Subsample of firms that clearly indicate which channel(s) they have in mind.

some managers view monetary policy as operating *solely* through borrowing costs, largely neglecting general-equilibrium demand effects or the opportunity cost of internal funds.

The second category also relates to the interest rate channel but highlights its indirect impact via product demand. For instance, "*Investment incentives for firms, which may lead to an increase in demand for our products.*" Finally, the third category refers to broader general-equilibrium responses, such as households adjusting consumption in line with intertemporal substitution motives. A typical answer is: "*Domestic demand should increase when the key interest rate is low.*"

The vast majority of firms that mention a channel (83 percent) refer to the direct interest rate channel via external financing, while 12 percent highlight demand effects through interest rates and 11 percent mention more general-equilibrium mechanisms, see Figure 8 for an illustration. Because firms sometimes describe more than one channel, the reported shares exceed 100 percent. That the direct borrowing cost channel dominates firms' narratives in open-ended responses—without prompting—suggests that this mechanism is of first-order importance for monetary policy transmission.

The fact that different channels come to mind also underscores the value of focusing on a specific, well-defined channel in our vignette design. Had we simply asked firms to respond to a generic monetary policy change, the resulting answers would have reflected a heterogeneous mix of direct and general-equilibrium considerations, making it difficult to map responses to theory. By isolating the partial-equilibrium effect of borrowing costs, we can quantify

firms' investment sensitivities in a way that is both interpretable and directly comparable to macroeconomic models. This, in turn, allows us to assess their importance for monetary policy transmission.

4.1.3 Do monetary policy narratives differ by business-cycle attachment?

The narratives identified above differ in whether they emphasize partial-equilibrium effects (borrowing costs) or broader general-equilibrium forces (demand and GE channels). If the latter are more salient, this should be reflected in how closely firms perceive their activity to move with the aggregate business cycle. We therefore relate firms' monetary policy narratives to an indicator of high business-cycle attachment, based on their self-assessed co-movement with aggregate conditions (see Appendix E for the survey question).

We find that firms that mention demand or GE effects are more likely to report being strongly attached to the business cycle. Table 5 displays regressions of the business-cycle attachment indicator on (i) references to the direct interest-rate channel and (ii) references to demand/GE effects, with firms that do not discuss monetary policy as the omitted group. Relative to this group, firms referencing demand/GE effects are about 20 pp more likely to report strong business-cycle attachment, while references to the direct channel are not significantly different. The relationship holds when exploiting only within-industry variation (Column 2) and when controlling for firm size and the share of externally financed investment (Column 3).

These findings are consistent with the view that references to the direct interest rate channel mainly capture a partial-equilibrium mechanism, while references to demand or GE effects reflect broader general-equilibrium considerations. Moreover, the fact that firms more exposed to the business cycle are also more likely to invoke GE narratives is in line with models of rational inattention, in which managers allocate attention to aggregate forces when the cost of neglecting them is higher, see Maćkowiak et al. (2023) for a review.

4.2 Linking vignette sensitivities to firms' monetary policy responses

We now study how the vignette-elicited interest-rate sensitivity of investment translates into firms' responses to monetary policy. Specifically, we examine how firms with different sensitivities adjust production in response to identified monetary policy shocks. Our aim is to gauge the contribution of the direct borrowing-cost margin to transmission. We first present the empirical setup and baseline results, then assess robustness across specifications, and finally study heterogeneity by firms' non-adjustment narratives.

Table 5: Perceived channels of monetary policy and business cycle attachment

	Business cycle attachment		
	(1)	(2)	(3)
Direct interest rate channel	1.260	1.526	-4.222
	(3.856)	(3.764)	(4.103)
Other MP channels	20.933***	19.429***	20.443**
	(7.124)	(6.769)	(8.250)
Log employees			-0.390
			(0.813)
Share of ext. financed investment 2024			0.170***
			(0.040)
Constant	44.284***	44.385***	41.283***
	(2.347)	(0.724)	(3.445)
Observations	1405	1397	1089
R^2	0.011	0.085	0.093
Industry FE	–	✓	✓

Notes: OLS regression results. Direct interest rate channel: firms that refer to the direct channel of interest rates via financing costs only. Other MP channels: firms that refer to other to demand or general equilibrium effects. Control group: firms stating they would not discuss monetary policy. The dependent variable is 100 if firms state that the general economic development is very important to their business, and zero otherwise. See Appendix E for the wording of the corresponding questions. Column (3) excludes construction firms because some variables are not available for this sector. Standard errors clustered at the 2-digit industry level in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2.1 Data and empirical setup

We rely on the high-frequency identified (HFI) monetary policy shock series for the ECB provided by Jarociński and Karadi (2020). These shocks capture unexpected policy changes in financial markets and are therefore well-suited to identify causal effects of monetary policy. Jarociński and Karadi (2020) decompose the series into a monetary policy and a central bank information component using sign restrictions; we use their baseline decomposition, i.e. the median shock series satisfying the restrictions.[20] Appendix Figure A.3 shows that the impulse responses to a 1 pp monetary policy shock can be roughly interpreted as the response to a 1.25 pp change in real yields, which serve as an indicator of firms' cost of external finance and are highly correlated with movements in loan rates ($\rho = 0.8$).

Since the IBS does not provide a long time series of questions on investment, we focus on firms' production activity as the outcome variable.[21] This is available monthly for

[20]Our results are robust to using their alternative "poor man's sign-restriction" decomposition.

[21]Appendix Table A.13 shows that firms' production activity is predicting strong changes in their capital stock: when firms increase production in 10 months within a given year, their capital stock (measured in

manufacturing firms since 1980 and directly measures real activity at the firm level. The production variable is among the most widely used in the IBS, see, e.g., Bachmann et al. (2013b), Bachmann et al. (2019), and Enders et al. (2022). The survey asks whether a firm's domestic production decreased (-1), remained unchanged (0), or increased ($+1$) relative to the previous month. We therefore restrict attention to manufacturing firms and use the period from January 1999, the start of the HFI shock series, to December 2021. We end the sample before the interest rate hikes beginning in mid-2022.

To estimate the dynamic response of firms' production activity to monetary policy shocks, we use local projections following Jordà (2005). As in Cloyne et al. (2023), we allow for heterogeneity by interacting the monetary policy shock with indicator functions for firms' vignette-based groups. The non-linear local projection is given by:

$$\sum_{k=0}^{h} \Delta y_{i,t+k} = \alpha_i^h + \sum_{g=0}^{G} \beta_h^g \varepsilon_t^{MP} \times \mathbb{1}[X_i = g] + \Omega_h' Z_{i,t-1} + \sum_{j=1}^{6} \Gamma_h^{j'} Y_{t-j} + \upsilon_{i,t+h} \ . \tag{1}$$

Intuitively, this specification compares how production reacts to monetary policy shocks across different groups of firms defined by their vignette answers. By interacting the shocks with group indicators, we trace out separate impulse responses for each type of firm and can assess whether vignette-based sensitivities map into actual behavior.

Here, $\Delta y_{i,t} \in \{-1, 0, 1\}$ is the qualitative monthly production change, and the dependent variable cumulates changes from t to $t+h$ (as in Andrade et al., 2022). ε_t^{MP} is the HFI monetary policy shock, scaled to represent a 1 pp *expansionary* shock. β_h^g are the coefficients of interest, capturing the production response at horizon h for group g. α_i^h are firm fixed effects. $Z_{i,t-1}$ is a set of firm-level controls—state of business, six-month business expectations, and three-month production expectations—all measured in $t-1$ to ensure exogeneity. These are qualitative variables $\in \{-1, 0, 1\}$, included as indicators to purge production movements predictable before the shock. Y_t contains the year-on-year growth rates of industrial production and the CPI, with six lags included to control for the state of the business cycle.

X_i denotes the grouping of firms (e.g., adjusters vs. non-adjusters in the vignette). Not including time-fixed effects recovers the overall response of each group to a monetary policy shock, including general equilibrium effects. In a variant of Equation (1), we also add the non-interacted monetary policy shock ε_t^{MP}, so that β_h^g captures the additional effect of belonging to group g relative to the base group. Standard errors are clustered at the firm level to account for serial correlation within firms over time and at the two-digit industry-by-month level to allow for correlation of errors within industries facing time-varying conditions.

Orbis) rises by about 6 pp relative to firms without production increases. This supports the use of production as a proxy for real investment responses.

We estimate Specification (1) at the monthly frequency with horizons up to $h = 24$ months. To ensure that impulse responses at each horizon are based on a consistent set of firms, the estimation sample is restricted to firms observed over the entire horizon. Because the regressions include six lags of firm-level controls, as well as firm fixed effects, this requires at least 52 consecutive months of participation in the survey (2×26).

Applying this restriction leaves us with 439 manufacturing firms that also participated in our vignette experiment. As in all analyses, we further limit attention to firms with planned investments for 2024 and 2025. For specifications that do not rely on vignette responses, we can use the larger sample of all manufacturing firms that satisfy the observation-horizon requirement. This broader sample comprises 4,335 firms.[22]

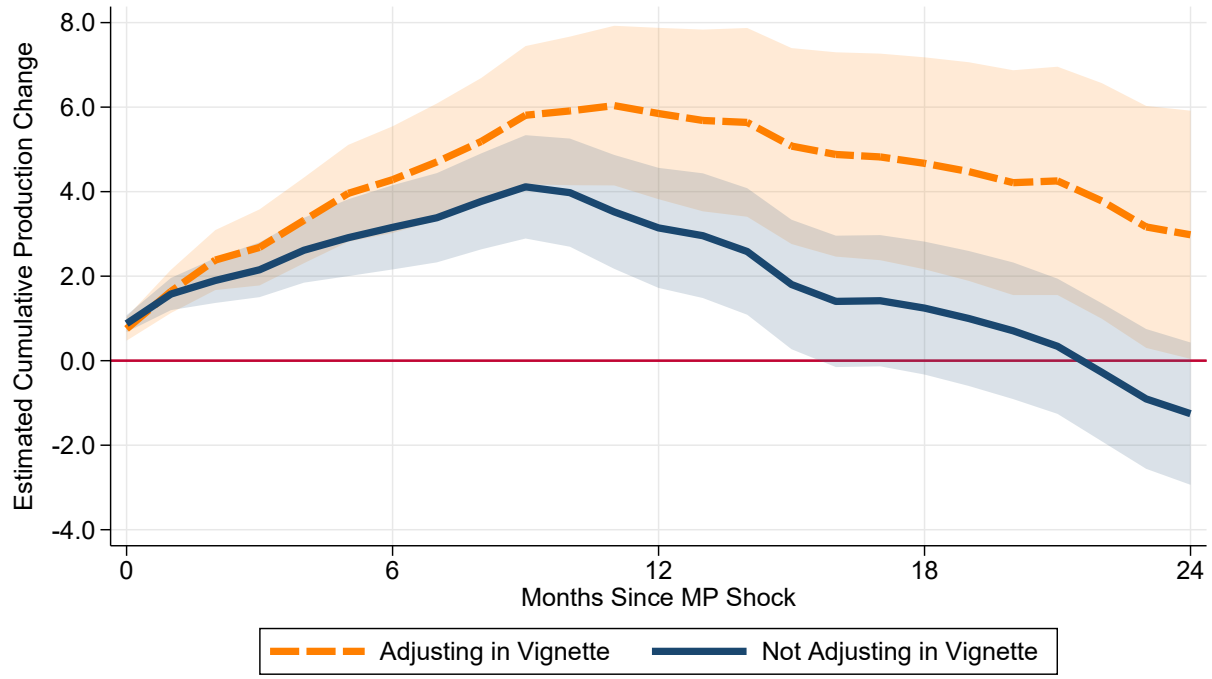
4.2.2 Responses to monetary policy shocks by interest-rate sensitivity

We ask whether firms that appear more sensitive to borrowing costs in the vignette also adjust production more strongly following identified monetary policy shocks. Three differences relative to the vignette environment are important for interpretation: (i) monetary policy surprises move the entire interest rate environment and can affect firms beyond loan-funded investment; (ii) shocks may influence production through indirect demand and other general-equilibrium forces in addition to the direct cost-of-capital channel; and (iii) vignette-based group membership is measured once in December 2023, whereas the shock series spans 1999–2021. In what follows, we keep these differences in mind and discuss what our results imply for the relative importance of the direct lending-rate channel isolated in the vignette.

Firms classified as adjusters in the vignette display larger and more persistent production responses to identified monetary-policy shocks. We show this by estimating Equation (1) with X_i indicating firms that would *adjust* or *not adjust* their investment in response to the hypothetical change in the loan rate. Figure 9 plots the resulting impulse responses of cumulative production for both groups. In the first months after the shock, the responses are indistinguishable; thereafter a widening gap emerges. Interest-rate-sensitive firms (adjusters) increase production *more often* in response to the shock, with a peak difference around month 11: at that horizon, they report production changes roughly 50 percent more frequently than non-adjusters. The difference is statistically significant over the medium run (based on 90 percent confidence bands). Non-adjusters' production peaks about three months earlier and then declines more quickly, whereas production remains elevated for adjusters. While we cannot estimate the investment response directly, these production dynamics are consistent

[22] Appendix Figure A.6 shows that the average production response in the full manufacturing sample and in the vignette sample is very similar.

Figure 9: Production response to monetary policy shock by interest sensitivity



Notes: Impulse response functions at monthly frequency of cumulative production to a 1 pp monetary policy shock estimated from equation (1). The sample is balanced over the horizons. Orange: firms adjusting investment in the vignettes. Blue: firms not adjusting investment in the vignettes. The sample is restricted to manufacturing firms that planned to invest in 2024 & 2025. Shaded areas represent the 90 percent confidence level. Standard errors are two-way clustered at the firm and the 2-digit-industry-by-month level.

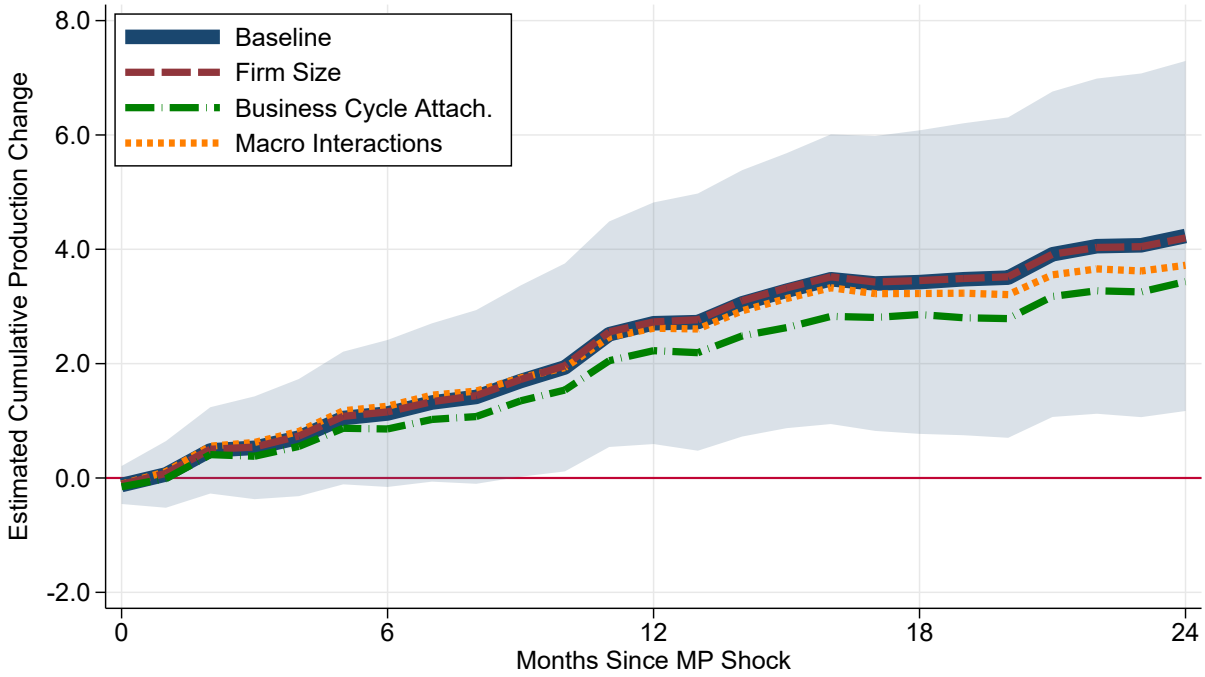
with stronger investment activity at adjusting firms—expanding capacity and sustaining higher production relative to non-adjusters.

We next examine the robustness of our results to alternative specifications, weighting schemes, and control sets, before turning to heterogeneity by non-adjustment narratives.

4.2.3 Robustness of the interest rate sensitivity results

Since interest rate sensitivity is not an exogenous firm characteristic, we investigate whether the differential responses of adjusters and non-adjusters could be driven by confounding factors or design choices. One concern is that firms' vignette responses are only correlated with reactions to monetary policy shocks because firms that are more sensitive to interest rates may also be more sensitive to the business cycle and thus more affected by general equilibrium effects. To address this concern, we consider three ways of accounting for differences in business cycle sensitivity. We compare the differential effect of a 1 pp expansionary monetary policy shock in our baseline specification, which considers only heterogeneity with respect to the vignette response, with specifications that include additional interactions.

Figure 10: Differential production effect of monetary policy for adjusting firms



Notes: Differential effect of a 1 pp expansionary monetary policy shock on cumulative production for firms adjusting investment in the vignettes. Baseline: estimated using Equation (1) and adding a non-interacted monetary policy shock ε_t^{MP}. Shaded area represents corresponding 90 percent confidence band. Standard errors are two-way clustered at the firm and 2-digit industry-by-month level. "Firm Size" adds interactions between an indicator for large firms ($>$ 250 employees) and ε^{MP}. "Business Cycle Attach." adds interactions between an indicator for a strong business cycle attachment and ε^{MP}. The indicator is 1 if firms state that the general economic development is very important to their business, and 0 otherwise. See Appendix E for the wording of the corresponding questions. "Macro interactions" adds interactions between an indicator for adjusting investment in the vignettes and the first lag of Y_t. Sample is always restricted to firms that have planned investment for 2024 and 2025.

First, we examine firm size (red, dashed) by additionally interacting the monetary policy shock with an indicator of firms with more than 250 employees. Second, we examine business cycle attachment (green, dash-dotted) by additionally interacting the monetary policy shock with an indicator of firms that report strong attachment to the business cycle (see Section 4.1). Third, following Ottonello and Winberry (2020), we additionally interact the adjuster indicator with the first lag of our macro controls (industrial production growth and inflation; orange, dotted). The blue line shows that firms that react in the vignette respond significantly more than non-adjusters. Controlling for firm size, business cycle sensitivity, and allowing for a differential response to the general macro state does not substantially alter the results.

We consider additional dimensions in Appendix Figure A.7. First, we address the possibility of differing post-shock variation across industries. To absorb industry-specific conditions at each point in time, we add month-by-2-digit-industry fixed effects to Equation (1).

Another potential concern is that differences in price-setting flexibility could influence how production responds to monetary policy. Using the IBS's monthly price-change question, we re-estimate Equation (1) on the subsample of price-flexible firms—those that adjusted prices more often than the monthly median over the preceding two years.[23] Finally, our interest-rate-sensitivity grouping is measured once (December 2023), while the shock series spans from 1999 to 2021. To address the possibility that the baseline specifications implicitly overweight more recent shocks, we equally weight shocks over time. In all these specifications, the differential effect is similar to or even larger than in the baseline.

4.2.4 Responses to monetary policy shocks by firms' non-adjustment narratives

We next ask whether the reasons firms give for *not* adjusting investment in the vignette (see Section 3.2) help predict their real responses to identified monetary policy shocks. To this end, we re-estimate Equation (1) with X_i indicating, besides the adjusting group, the three largest non-adjustment narratives: i) sufficient internal funds, ii) interest rates not decisive (high return to capital), and iii) overhang of capital (low return to capital). Figure 11 reports the impulse responses of cumulative production by narrative group relative to adjusters.

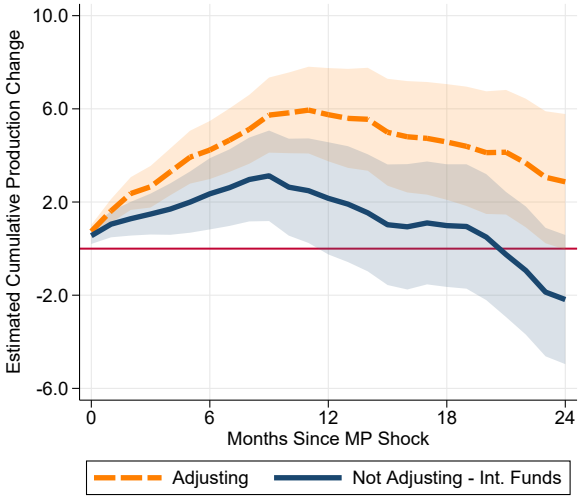
The production response of firms citing "sufficient internal funds" is significantly smaller and less persistent compared to adjusters, as visible in Panel (a). At the peak, they report increases in production only about half as often as adjusters. Panels (b) and (c) consider narratives that invoke the investment opportunity set. Firms mentioning the "interest rates not decisive" narrative also display a smaller production response than adjusters, consistent with this narrative reflecting more time-invariant management practices rather than a transitory state. By contrast, the group citing an "overhang of capital" exhibits a production response very similar to adjusters in the baseline comparison. One interpretation is that these firms respond more strongly through indirect (demand/GE) channels, offsetting differences in direct interest-rate sensitivity; another is that proximity to the optimal capital stock is a time-varying state, so that some firms were more interest-rate sensitive earlier in the sample and thus display similar average impulse responses. To explore this, Panel (d) replaces the self-reported "overhang of capital" narrative with a time-varying proxy for being close to the optimal capital stock: the share of revenues from products in stagnation or shrinking phases (measured in the year prior to each shock).[24] Firms in the top quartile of this "stagnation share" increase production *less often* after expansionary monetary policy shocks than those in the bottom quartile, in line with the low-return interpretation.

[23] We do not require firms to be observed over the entire two years prior to the shock. Before computing the monthly median and splitting the sample, we absorb month fixed effects from the price-adjustment series to accommodate different observation windows.

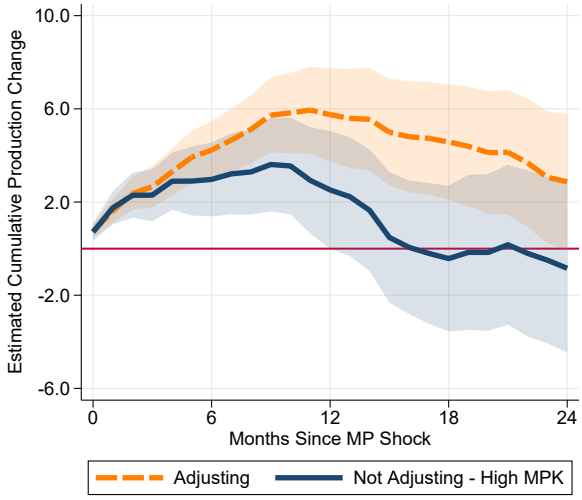
[24] Panel (c) of Appendix Figure A.4 shows the relation between the share of stagnating/shrinking products and the overhang of capital narrative.

Figure 11: Production response to monetary policy: by non-adjustment narratives

(a) Sufficient internal funds

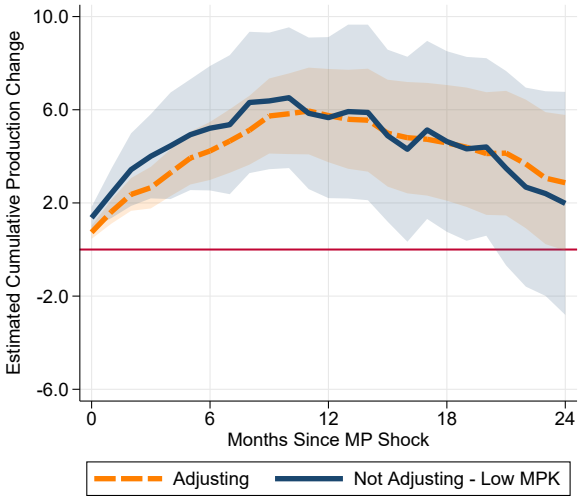


(b) Interest rates not decisive

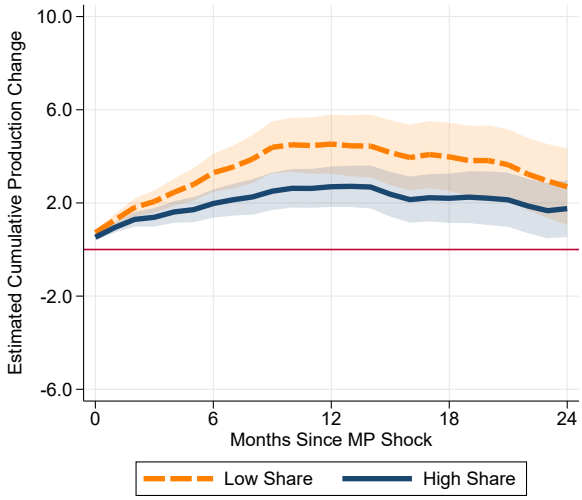


Overhang of capital

(c) Narrative



(d) Time-varying stagnation share



Notes: Impulse response functions of cumulative production from estimating Equation (1). Panel (a): firms adjusting investment in the vignettes (orange) vs. firms not adjusting and arguing with "sufficient internal funds" (blue). Panel (b): firms adjusting investment in the vignettes (orange) vs. firms not adjusting and arguing with "high return to capital" (blue). Panel (c): firms adjusting investment in the vignettes (orange) vs. firms not adjusting and arguing with "low return to capital" (blue). Panel (d): firms with below p25 (orange) and above p75 share of stagnating and shrinking products in the year prior to the shock. The sample is restricted to manufacturing firms and, in Panels (a)–(c), to firms that have planned investment for 2024 and 2025. Shaded areas represent the corresponding 90 percent confidence band. Standard errors are two-way clustered at the firm and 2-digit industry-by-month level.

Overall, the results imply that all three narratives for not responding to changes in the interest rate are also informative about firms' general-equilibrium responses to monetary

policy. In particular, the most prevalent narrative in our vignettes—sufficient internal funds—underscores the relevance of firms' financial conditions (including cash buffers, reliance on external finance, and financing constraints) for monetary transmission, consistent with a large literature (Cloyne et al., 2023; Gertler and Gilchrist, 1994; Jeenas, 2023; Jungherr et al., 2024). In contrast to these papers, our results show that cross-sectional differences in general equilibrium responses can be traced back to cross-sectional differences in partial equilibrium interest-rate sensitivity elicited in the vignette. At the same time, a sizable share of firms rationalizes low sensitivity with non-financial reasons—particularly a lack of profitable investment opportunities or returns comfortably above the cost of capital. Given the central role of investment in monetary transmission highlighted by Auclert et al. (2020), the state of these determinants is likely of first-order importance for the effectiveness of monetary policy.

5 Conclusion

We use hypothetical vignettes embedded in the ifo Business Survey to isolate the direct effect of borrowing costs on firm investment. A one percentage point reduction in the lending rate raises planned investment by about 7 percent over the subsequent two years. The effect is driven by large intensive margin responses among adjusters and widespread non-adjustment, which is rationalized by high cash buffers or not being at the margin to adjust investment plans. Hurdle rates are sticky but co-move with investment. The interest rate sensitivity is stronger for financially constrained firms, for firms facing labor shortages, and in industries with more durable capital. Managers' monetary policy narratives emphasize the borrowing cost channel, and vignette-based sensitivities predict firms' real responses to identified monetary policy shocks—underscoring that the direct interest rate channel is of first-order for monetary policy transmission.

Our evidence provides concrete calibration targets for quantitative models. Future work should incorporate the documented heterogeneity, which is relevant, e.g., for capital misallocation and state-dependent interest rate sensitivities. The prominence of fixed and convex capital adjustment costs, as well as sizable frictions in revising existing investment plans, calls for a unified heterogeneous firm framework able to match the empirical patterns.

Methodologically, we show the value of combining complementary survey tools to uncover mechanisms that are otherwise hard to analyze. Integrating hypothetical vignettes with open-ended questions in an ongoing panel enables identification of channels and validation against real-world variation, an approach that should be useful beyond our application.

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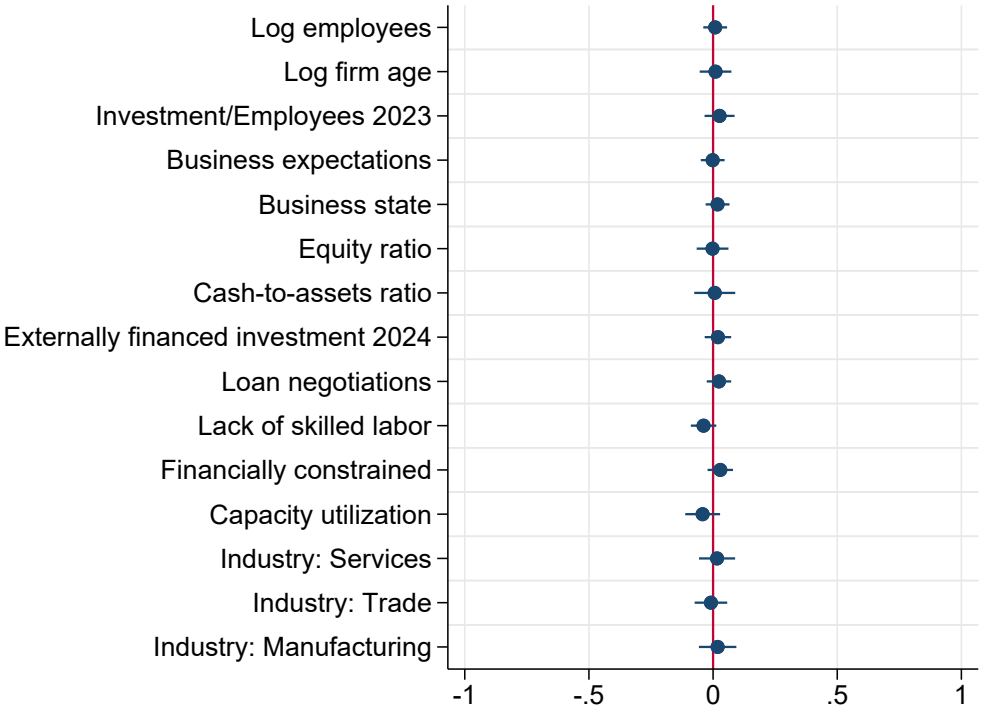
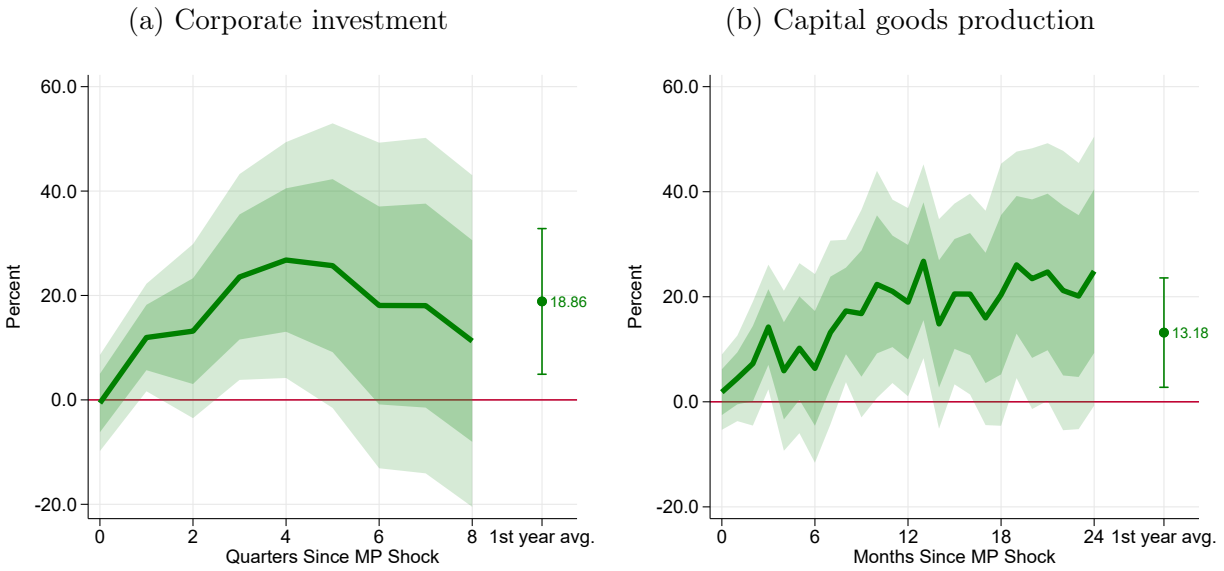
A Additional tables and figures

Figure A.1: Random group assignment



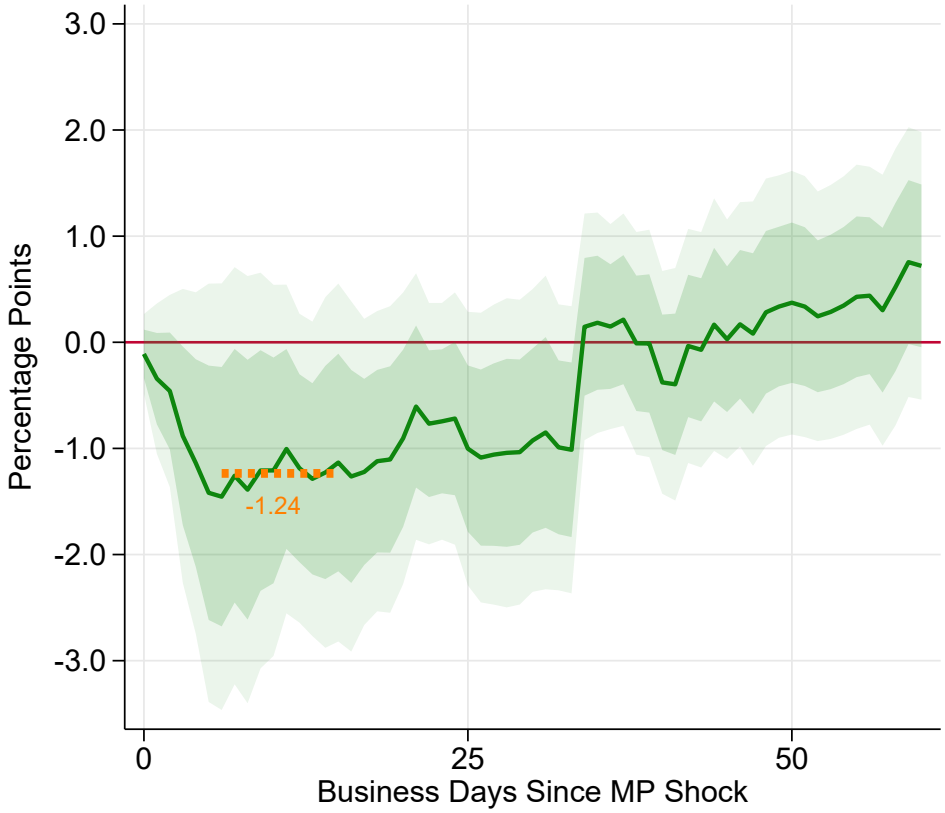
Notes: OLS regression results from univariate regressions of the interest rate reduction in the vignette 0.5–4 pp (0.5, 1.0, 3.0, or 4.0) on firm characteristics. All variables are standardized. The sample is restricted to firms that planned to invest in 2024 and 2025. Bars represent the 95 percent confidence band. Base category for industry is "Construction". See Appendix E for the wording of the corresponding survey questions.

Figure A.2: General-equilibrium response of aggregate investment to monetary policy



Notes: Impulse response functions to a 1 pp expansionary monetary policy shock. Estimated using a local projection in the following form: $\log(y_{t+h}) - \log(y_{t-1}) = \alpha^h + \beta_h \varepsilon_t^{MP} + \Omega_h' Z_{t-1} + \sum_{j=1}^{6} \Gamma_h^j Y_{t-j} + \upsilon_{i,t+h}$ over 1999–2019. Where y is German aggregate corporate investment at quarterly frequency (Panel a) or German aggregate capital goods production at monthly frequency (Panel b), Z_{t-1} is the monthly average of the firm-level controls and Y includes lags of the inflation rate, and year-on-year industrial production growth. Dark and light shaded areas represent the 90 percent and 68 percent confidence levels, based on Newey-West standard errors using lag length $h + 1$. The point estimate represents the average effect over quarters 1–4 or months 1–12, alongside 90 percent confidence bands.

Figure A.3: Monetary policy shock and real corporate bond yields



Notes: Impulse response function of daily real corporate bond yields following a 1 pp expansionary monetary policy shock, estimated using a local projection in the following form: $r_{t+h} - r_{t-1} = \alpha^h + \beta_h \varepsilon_t^{MP} + \Omega_h' Z_{m-1} + \sum_{j=1}^{6} \Gamma_h^j Y_{m-j} + \upsilon_{i,t+h}$. Where r is German real corporate bond yields at daily frequency. Z_{m-1} is the monthly average of the firm-level controls and Y includes the macro controls from Equation (1) at monthly frequency. Dark and light shaded areas represent the 90% and 68% confidence levels, based on Newey-West standard errors using lag length $h + 1$. The orange-dashed line is the average effect over weeks 2–3, i.e., business days 6–15 after the shock.

Table A.4: Investment responses to monetary policy shocks in the literature

Reference	Dependent variable	Original estimate	Transformed estimate	Notes
Ottonello and Winberry (2020)				
Footnote 5	$\log(k_{t+h})-\log(k_{t-1})$	–	20%	Transformed the estimate themselves assuming $\frac{I}{K} = \delta = 0.1$. Based on the estimate for the first quarter after the shock.
González et al. (2024)				
Footnote 35	$\log(k_{t+h})-\log(k_{t-1})$	–	19%	Transformed the estimate themselves assuming $\frac{I}{K} = \delta = 0.1$.
Cao et al. (2023)				
Figure 3, Panel (b)	$\frac{k_{t+h}-k_{t-1}}{k_{t-1}}$	∼1.3%	∼13%	Transformed assuming $\frac{I}{K} = \delta = 0.1$. The effect is further increasing up to ∼3% in year 4.
Jungherr et al. (2024)				
Appendix Figure B.1	$\log(k_{t+h})-\log(k_{t-1})$	∼0.9%	∼30%	The effect is in response to a 1 sd monetary policy shock. As noted on page 7, a 1 sd shock translates into a 30 bp change in the Fed Funds Rate. Thus the estimate is multiplied by ten thirds first, before transforming it assuming $\frac{I}{K} = \delta = 0.1$.
Durante et al. (2022)				
Appendix Figure, Panel (a)	$\log(I_{t+h})-\log(I_{t-1})$	∼0.25%	∼25%	The effect is in response to a 1 basis point shock and thus multiplied by 100.

Notes: Comparison of estimates for the effect of identified monetary policy shocks on the capital stock or investment rate. Because the capital stock in periods before $t = 0$ is orthogonal to the shock, the estimates in rows 1–4 give the percentage change in the capital stock. The original estimate is the estimate for the one-year horizon. The transformed estimate is a transformation of the original estimate as described in the notes and represents a percentage change in investment. "∼" indicates the estimates are taken from figures and are therefore imprecise.

Table A.1: Summary statistics by interest rate change

	Full sample		Planned investment	
	p50	N	p50	N
Interest rate change: 0.5 p.p.				
Employees	38	802	65	425
Firm age	42	448	51	239
Equity ratio (%)	40	438	40	255
Cash ratio (%)	15	254	15	147
Investment 2023 (TEUR)	200	541	450	285
Revenues 2023 (TEUR)	7036	576	11000	301
Investment/Revenues 2023 (%)	3	519	3	286
Interest rate change: 1 p.p.				
Employees	37	849	80	422
Firm age	48	504	54	245
Equity ratio (%)	42	471	45	243
Cash ratio (%)	15	261	19	136
Investment 2023 (TEUR)	200	573	463	295
Revenues 2023 (TEUR)	8000	604	16425	308
Investment/Revenues 2023 (%)	3	542	4	283
Interest rate change: 3 p.p.				
Employees	40	819	77	405
Firm age	45	428	57	221
Equity ratio (%)	41	421	40	216
Cash ratio (%)	15	249	15	140
Investment 2023 (TEUR)	200	521	417	281
Revenues 2023 (TEUR)	7200	553	16750	290
Investment/Revenues 2023 (%)	3	499	4	269
Interest rate change: 4 p.p.				
Employees	38	824	70	424
Firm age	46	461	52	253
Equity ratio (%)	43	424	43	242
Cash ratio (%)	12	248	13	153
Investment 2023 (TEUR)	150	533	320	307
Revenues 2023 (TEUR)	7000	560	11000	315
Investment/Revenues 2023 (%)	3	511	4	293

Notes: Summary statistics of relevant firm characteristics for all firms answering the vignette question ("full sample") and planned to invest in 2024 and 2025 ("planned investment") by treatment group. The number of observations varies, as not all characteristics are elicited in the same wave. Firm age: year since founding, elicited in 2018. Equity Ratio: as of end-2019. Cash-to-total assets: as of March 2020. Investment and Revenues in 2023: nominal, elicited in 2024. See Appendix E for the wording of the corresponding survey questions.

Table A.2: Sample distribution by industry and size compared to population of German firms

	ifo Business Survey				Distribution of German Firms by		
	Small	Medium	Large	Total	Count	Employees	Value Added
Industry	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Manufacturing	11.98	14.90	7.88	34.75	8.13	26.53	32.65
Energy, Water, & Waste	0.48	0.35	0.06	0.89	2.87	2.25	4.68
Construction	7.02	4.80	0.83	12.64	14.98	8.70	7.30
Retail, Wholesale, & Repair of Motor Vehicles	19.00	5.69	1.24	25.92	21.18	21.19	19.89
Transportation & Storage	1.52	1.08	0.64	3.24	3.96	7.62	6.39
Accommodation & Food Services	1.87	1.02	0.06	2.95	8.78	6.67	2.01
Information & Communication	3.02	1.08	0.48	4.57	5.08	5.14	7.05
Real Estate Activities	0.79	0.25	0.10	1.14	7.88	2.23	4.01
Professional, Scientific, & Technical Activities	8.04	1.94	0.41	10.39	18.56	8.79	9.25
Administrative & Support Services	1.59	1.33	0.57	3.49	8.58	10.88	6.77
Total	55.30	32.43	12.26	100.00	100.00	100.00	100.00
Distribution of German Firms by							
Count	96.79	2.57	0.64	100.00			
Employees	39.50	16.49	44.01	100.00			
Gross Value Added	27.83	15.43	56.74	100.00			

Notes: This table compares the distribution of firms in our sample to administrative data based on the 2021 Statistics on Small and Medium-sized Enterprises ("Statistik für kleine und mittlere Unternehmen") provided by the Federal Statistical Office (EVAS Code 48121). The firm size categories are: small: 0-49 employees; medium: 50-249 employees; large: 250+ employees.

Table A.3: Average investment adjustment in 2024 & 2025

	Mean	Std. Dev.	P10	P25	Median	P75	P90	N
Overall adjustment								
0.5 p.p.	7	15	0	0	0	10	20	425
1 p.p.	7	14	0	0	0	10	23	422
3 p.p.	13	21	0	0	0	20	40	405
4 p.p.	14	21	0	0	0	20	50	424
Total	10	18	0	0	0	15	30	1676
Intensive margin adjustment								
0.5 p.p.	21	19	5	10	15	25	50	139
1 p.p.	19	18	5	8	15	25	50	150
3 p.p.	26	23	7	10	20	30	50	196
4 p.p.	28	23	5	10	20	38	50	208
Total	24	22	5	10	20	30	50	693
Extensive margin adjustment								
0.5 p.p.	33	47	–	–	–	–	–	425
1 p.p.	36	48	–	–	–	–	–	422
3 p.p.	48	50	–	–	–	–	–	405
4 p.p.	49	50	–	–	–	–	–	424
Total	41	49	–	–	–	–	–	1676

Notes: Distribution of merged investment adjustments in 2024 and 2025. Overall adjustment: Average adjustment in 2024 and 2025. Intensive Margin Adjustment: Average adjustment if the average adjustment is larger than zero. Extensive Margin Adjustment: Equal to 0 if firms do not adjust investment in either of the two years, and 1 if firms adjust in at least one year. The sample is restricted to firms that planned to invest in 2024 and 2025.

Table A.5: Investment adjustment and investment plans

	Extensive Margin				Intensive Margin	
	2024	2025	2024	2025	2024	2025
Planned investments for 2024	22.398***					
	(1.590)					
Planned investments for 2025		22.262***				
		(1.778)				
Planned investment for 2024 but not 2025			3.044		3.269	
			(3.252)		(2.557)	
Planned investment for 2025 but not 2024				29.904***		1.615
				(3.265)		(2.055)
Business state 12/2023: good	-5.848**	-11.993***	-3.842	-9.326***	-2.856	-1.895
	(2.309)	(2.477)	(3.259)	(3.255)	(2.502)	(2.340)
Business state 12/2023: medium	-1.992	-4.773**	1.382	-2.431	-1.527	-1.793
	(1.964)	(2.145)	(2.955)	(2.893)	(2.176)	(1.918)
Constant	-2.376	6.130*	39.621***	45.129***	25.727***	27.318***
	(2.724)	(3.161)	(2.571)	(2.535)	(1.898)	(1.690)
Observations	3150	2897	1925	1891	764	850

Notes: OLS regression results. "Extensive Margin": 0 for firms not adjusting investment in the vignettes and 100 for adjusting firms. "Intensive Margin": The sample is restricted to firms that adjust investment in response to the vignette. The investment adjustment in % is winsorized at 100%. Columns one and two: Unrestricted sample. Columns 3–5: Compare firms that have planned investments in only one year to firms that have planned investments for both, 2024 and 2025. All explaining variables are dummies. Base category for the business state is "bad". Robust standard errors in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

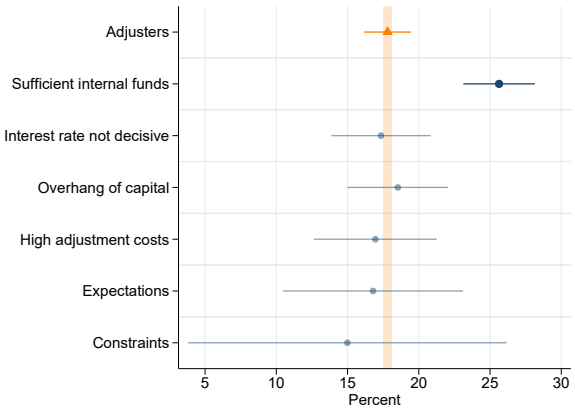
Table A.6: Codebook – Non-adjustment narratives

Category	Explanation	Translated examples
Sufficient internal funds		
no financing needs	No need for external funds, enough internal funds to finance investment.	"We have sufficient funds to finance investments from liquidity." "sufficient own liquidity" "Liquidity available, loans are not necessary", "no financing needed"
always internally financed	Signaling a general preference for financing investments using internal funds.	"Cash payer" "Because I don't want to take out a loan for investments." "Internally financed 100%" "We only spend earned money"
Interest rate not decisive – High return to capital		
interest rate not decisive	Interest rates are not a decisive criterion in investment decisions.	"Interest costs do not play a role in our investment decisions, as the returns are sufficiently high." "Interest rates do not play a decisive role in investment decisions" "Investments are based on need, not interest rates." "Purely capacity-oriented investments or new required technology"
Overhang of capital – Low return to capital		
no opportunities	No additional investment opportunities beyond plans and often focusing on replacement investment.	"The planned investments should be amortized in any case, regardless of a 4% reduction in interest rates. However, higher investments than planned would probably not result in significantly higher returns despite the more favorable interest rate." "missing projects" "Everything necessary has been purchased, max. replacement investments." "Only replacement investments planned"
High adjustment costs		
adjustment costs	Fixed investment plans or rigid long-term investment planning.	"Planning already completed" "Building permits not possible on short notice" "Long-term orders, fixed roadmap" "There is budget planning over several years"
non linear	Not reacting because lending rate change is too small.	"The impact of 1% is too small." "Interest rate changes of this magnitude are not relevant for us." "1% less interest too little incentive"
Expectations		
demand	Investment activity is dampened by current weak demand.	"Depending on the development of orders" "First observe the overall economic development" "-0.5% is useless if there is no demand" "poor order situation"
uncertainty	Uncertain economic environment hinders additional investment.	"Lack of investment certainty" "Overall situation too uncertain" "due to the overall uncertain macroeconomic development" "political uncertainties"
Constraints		
constraints	Labor, financial or capacity constraints hinder additional investment.	"No personnel resources for further projects/investments in 2024." "We are already working at capacity with the planned necessary investments." "Reduction of liabilities has priority" "Fixed debt limits defined"
Other		
other	Giving a reason that does not match the other groups.	"Corporate group target" "other reasons"

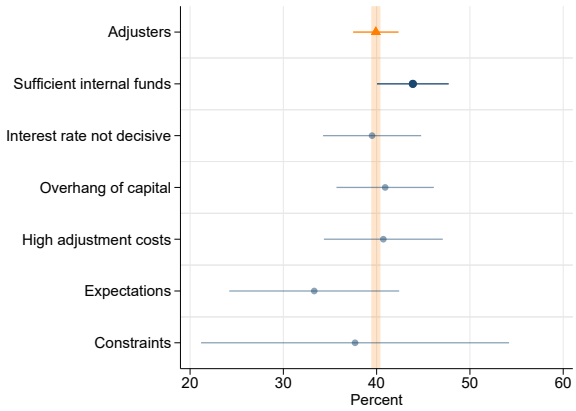
Notes: Codebook and example responses for hand-coding the open-ended text questions.

Figure A.4: Additional firm characteristics by reasons for not adjusting investment

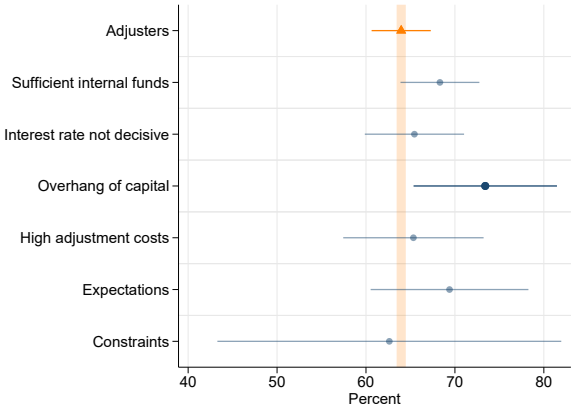
(a) Average cash to total assets 2021-2023



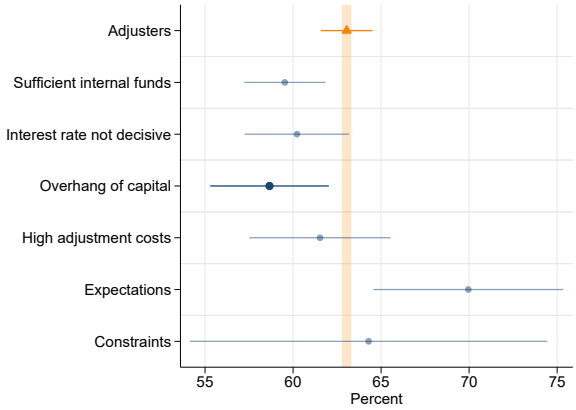
(b) Average equity ratio 2021-2023



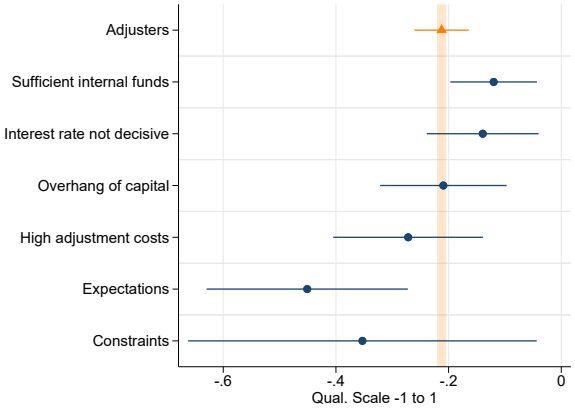
(c) Share of stagnating products



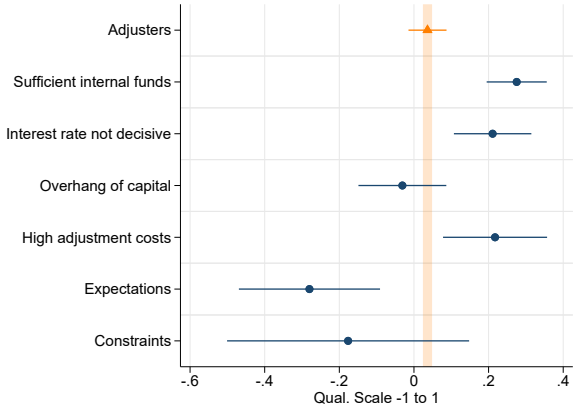
(d) Average uncertainty 2021-2023



(e) Business expectations



(f) Business state



Notes: This figure shows average values of different firm characteristics for the classified non-adjustment narratives. The average values for the group that adjusts investment plans in the vignette is shown in orange. Panel (a): average cash-to-asset ratio in 2021–23 from the Orbis database. Panel (b): average equity ratio in 2021–23 from the Orbis database. Panel (c): average of the revenue share of stagnating and shrinking products over 2019–2020. Panel (d): average uncertainty 01/2021 – 12/2023. Averages are calculated after absorbing month fixed effects to account for non-balancedness of the panel. Panel (e): business expectations (−1/0/1) in 12/2023. Panel (f) business state (−1/0/1) in 12/2023. minus long-run firm-average. See Appendix E for wording of the survey questions. The sample is restricted to firms that planned to invest in 2024 and 2025. Bars represent 95% confidence intervals.

Table A.7: Narratives and sub-narratives for not adjusting investment

	Total		By size of interest rate change					
			0.5 – 1 pp		3 – 4 pp		Difference	
	N	%	N	%	N	%	pp	SE
Sufficient internal funds								
no financing needs	221	29	112	27	109	32	-5.26	3.35
always internally financed	56	7	19	5	37	11	-6.37	1.99
Interest rate not decisive								
interest rate not decisive	199	26	112	27	87	26	1.25	3.23
Overhang of capital								
no opportunities	96	13	53	13	43	13	0.05	2.45
High adjustment costs								
adjustment costs	63	8	42	10	21	6	3.91	1.98
non linear	29	4	29	7			6.99	1.25
Expectations								
demand	33	4	14	3	19	6	-2.25	1.54
uncertainty	18	2	12	3	6	2	1.12	1.09
Constraints								
constraints	17	2	11	3	6	2	0.88	1.07
Other								
other	21	3	11	3	10	3	-0.31	1.21
Total	753	100	415	100	338	100	–	–

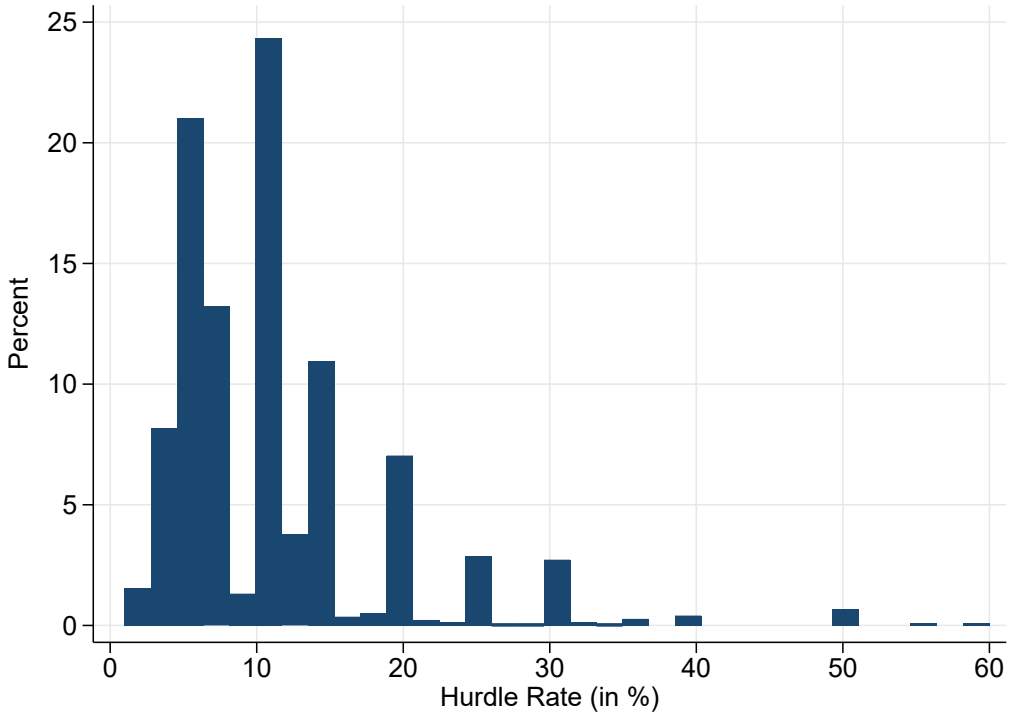
Notes: Distribution of the answers to the open-ended question across the hand-coded categories. Column 3–4: Firms that were confronted with a 0.5 or 1 pp interest rate change in the vignette. Column 5–6: Firms that were confronted with a 3 or 4 pp interest rate change in the vignette. Column 7-8: Difference between share of answers in 0.5–1 pp group and 3–4 pp group with corresponding standard errors. The sample is restricted to firms that planned to invest in 2024 and 2025.

Table A.8: Narratives for not adjusting investment by year

	2024		2025		Difference	
	N	%	N	%	pp	SE
Sufficient internal funds	275	35	273	37	-1.64	0.48
Interest rate not decisive	165	21	157	21	-0.06	0.47
Overhang of capital	135	17	131	18	-0.4	0.53
High adjustment costs	103	13	87	12	1.45	0.57
Expectations	59	8	53	7	0.4	0.54
Constraints	19	2	16	2	0.27	0.29
Other	23	3	22	3	-0.02	0.35
Total	779	100	739	100	–	–

Notes: Distribution of the answers to the open-ended question across the hand-coded categories. Column 1–2: Reasons for non-adjustment in 2024. Column 5–6: Reasons for non-adjustment in 2025. Column 7-8: Difference between share of answers in each category for 2024 and 2025 with corresponding standard errors. The sample is restricted to firms that planned to invest in 2024 and 2025.

Figure A.5: Distribution of hurdle rates



Notes: Distribution of hurdle rates elicited in 01/2024, trimmed at the 1 percent level.

Table A.9: What explains not knowing and not adjusting the hurdle rate (HR)?

	Don't know HR	Adjusting inv. but not HR	
	(1)	(2)	(3)
Family-owned firm	0.018	0.161**	0.133*
	(0.037)	(0.077)	(0.073)
Answered by CEO or owner	-0.176***	-0.190	-0.211
	(0.047)	(0.140)	(0.130)
Log employees	-0.020	-0.007	-0.017
	(0.014)	(0.028)	(0.028)
Respondent's education: at least college	-0.093***	0.106	0.086
	(0.027)	(0.082)	(0.097)
Share of externally financed investment 2024	-0.001**	0.000	-0.000
	(0.000)	(0.001)	(0.001)
Investment/Revenues 2023	-0.835**	-0.302	-0.428
	(0.349)	(0.645)	(0.657)
Extensive margin investment adjustment real world			0.310***
			(0.100)
Constant	0.904***	0.273	0.308
	(0.062)	(0.216)	(0.234)
Observations	1413	184	163
R^2	0.037	0.031	0.115
Industry FE	✓	✓	✓

Notes: OLS regression results. Column 1: dependent variable is a dummy for not knowing the hurdle rate. Columns 2–3: dependent variable is a dummy for not adjusting the hurdle rate conditional on adjusting investment. The sample excludes construction firms because some variables are unavailable for this sector. Robust standard errors in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.10: Investment adjustment and labor constraints

	(1)	(2)	(3)	(4)
Panel (a): Extensive margin adjustment (0/100)				
Lack of skilled labor 10/2023	4.585	2.697		
	(3.297)	(4.014)		
Lack of skilled labor 10/2023 × Large or medium-sized firm		3.720		
		(4.790)		
Lack of skilled labor past 5 years			5.386**	6.677*
			(2.474)	(3.989)
Lack of skilled labor past 5 year × Large or medium-sized firm				-2.501
				(5.048)
Large or medium-sized firm	-5.153	-6.592*	-5.054	-3.931
	(3.389)	(3.507)	(3.321)	(4.658)
Business state 10/2023: good	-9.002	-9.010	-9.005	-8.997
	(5.488)	(5.488)	(5.502)	(5.525)
Business state 10/2023: medium	0.884	0.838	0.836	0.834
	(4.469)	(4.492)	(4.523)	(4.535)
Constant	43.332***	44.126***	42.724***	42.137***
	(5.884)	(6.088)	(5.825)	(6.359)
Observations	1,329	1,329	1,334	1,334
R^2	0.011	0.012	0.012	0.012
	(1)	(2)	(3)	(4)
Panel (b): Intensive margin adjustment (in percent)				
Lack of skilled labor 10/2023	2.846*	-0.698		
	(1.615)	(1.881)		
Lack of skilled labor 10/2023 × Large or medium-sized firm		7.266**		
		(2.720)		
Lack of skilled labor past 5 years			3.609**	-0.697
			(1.550)	(2.121)
Lack of skilled labor past 5 years × Large or medium-sized firm				8.756***
				(2.884)
Large or medium-sized firm	1.471	-1.528	1.394	-2.812
	(1.813)	(2.242)	(1.897)	(2.746)
Business state 10/2023: good	1.584	1.518	2.045	2.091
	(2.209)	(2.171)	(2.268)	(2.221)
Business state 10/2023: medium	-0.396	-0.599	0.043	0.000
	(2.818)	(2.823)	(2.815)	(2.821)
Constant	21.638***	23.257***	20.702***	22.834***
	(2.056)	(2.183)	(1.981)	(2.082)
Observations	537	537	540	540
R^2	0.007	0.015	0.010	0.022

Notes: OLS regression results. Panel (a): dependent variable is 0 for firms not adjusting investment in the vignettes and 100 for adjusting firms. Panel (b): the sample is restricted to firms that adjust investment in response to the vignette and the dependent variable is the investment adjustment in percent, winsorized at 100 percent. "Lack of skilled labor Oct. 2023": dummy for current labor shortages. "Lack of skilled labor past five years": dummy for > 0 average residual labor shortages over past five years after absorbing month fixed effects. "Large or medium sized firm": dummy for > 49 employees. "Business state": qualitative assessment of the business state. Base category is "bad". See Appendix E for the wording of the corresponding questions. The sample is restricted to firms that have planned investments in 2024 and 2025. Standard errors clustered at the 2-digit industry level in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.11: Overall investment adjustment and depreciation rate

	Investment adjustment (in %)		
	(1)	(2)	(3)
Depreciation rate (in %)	-0.380***	-0.343***	-0.215**
	(0.112)	(0.112)	(0.098)
Log employees		-1.290***	-1.176***
		(0.283)	(0.214)
Share of externally financed investment 2024			0.080***
			(0.014)
Constant	14.311***	19.536***	14.672***
	(1.477)	(1.810)	(1.503)
Observations	1631	1630	1314
R^2	0.006	0.016	0.038

Notes: OLS regression results. The dependent variable is the overall investment adjustment in the vignette, winsorized at 100 percent. The depreciation rate is calculated based on capital stock and investment data at the 2-digit industry level from the EU KLEMS database. The sample is restricted to firms that planned to invest in 2024 & 2025. Column (3) excludes construction firms because some variables are unavailable for this sector. Standard errors clustered at the 2-digit industry level in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.12: Codebook – Monetary policy narratives

Category	Explanation	Translated examples
Not discussing monetary policy		
Not discussing – no channel	Changes to the key interest rate are not discussed/considered in investment planning.	"None" "No further considerations, investment plan independent of the key interest rate." "None. No one in our firm is concerned with the ECB's key interest rate.", "None, we invest independently of the ECB's key interest rate."
Not discussing – direct interest rate channel	Not discussing monetary policy, but revealing they have the direct interest rate channel in mind.	"Since we do not rely on external financing, no discussion arises." "None, as we are debt-free and will remain so." "None. Changes in key interest rates have no influence on our investment plans, as we finance investments without taking out loans."
Discussing monetary policy		
Discussing – no channel	Firms indicate that monetary policy is discussed in their investment planning but their answer does not include a specific channel.	"Investment activity increases when interest rates decrease" "Can the investment generate a higher return than the total costs (including interest, risk premium, etc.)" "Investments are being postponed or spread out, impact on real estate investments, risk assessment in an uncertain environment", "Does the change in the key interest rate have any impact on long-term interest rates, which are relevant to our planning"
Direct interest rate channel via external financing costs	Discussing the impact of changing borrowing costs.	"Expansion of investments if the interest burden on loans is lower." "Debt financing is expected to become cheaper if the ECB changes its key interest rate." "Rising costs for investment financing"
Interest rates via demand	Discussing direct demand effects because their costumers are affected by interest rate changes.	"Investment incentives for firms, which may lead to an increase in demand for our products." "Lowering the key interest rate boosts the construction industry, which leads to an improvement in our sales." "Investment volume of our customers declines"
General equilibrium effect	Discussing the general impact on the overall economic developments, costs, or inflation.	"Domestic demand should increase when the key interest rate is low." "Little direct impact, but highly relevant due to expected macroeconomic developments" "Profitability or payback period of an investment if the increased labor costs (linked to the key interest rate via inflation) cannot be passed on to customers."

Notes: Codebook and example responses for hand-coding the monetary policy narratives.

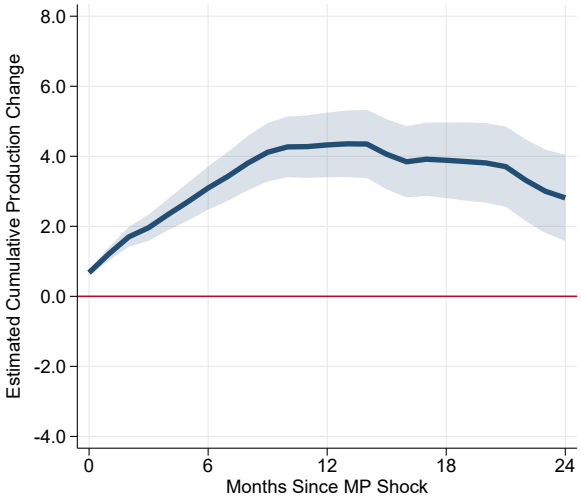
Table A.13: Predictive power of qualitative production changes for capital growth

	One Year Ahead	Two Years Ahead
	$\log(k_{i,t+11}) - \log(k_{i,t-1})$	$\log(k_{i,t+23}) - \log(k_{i,t-1})$
$\sum_{j=0}^{11} \Delta y_{i,t+j}$	0.006***	
	(0.002)	
$\sum_{j=0}^{23} \Delta y_{i,t+j}$		0.010***
		(0.003)
Constant	0.016***	0.040***
	(0.000)	(0.000)
Observations	8819	6252
R^2	0.146	0.223
Time FE	✓	✓
Firm FE	✓	✓

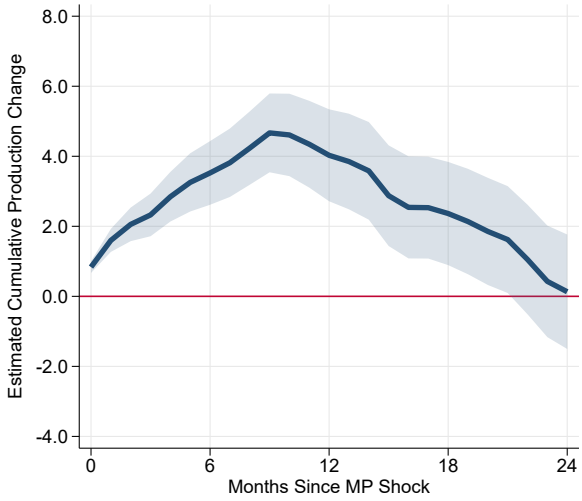
Notes: OLS regression results. k is fixed total assets deflated using the CPI. $\sum \Delta y_{i,t+j}$ is the dependent variable from Equation (1) at horizons $h = 11$ and $h = 23$. Standard errors clustered at the firm level in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure A.6: Average production response to a monetary policy shock

(a) Full manufacturing sample

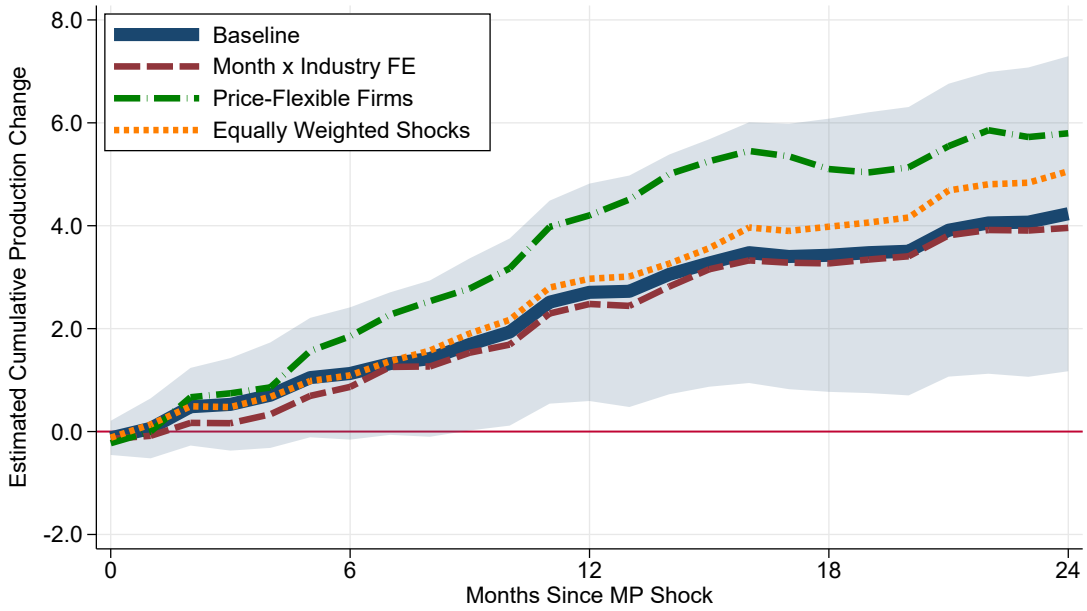


(b) Vignette sample



Notes: Impulse response functions at monthly frequency of cumulative production to a 1 pp monetary policy shock. The sample is balanced over the horizons. Panel (a): all manufacturing firms. Panel (b): only firms answering the vignette question and having planned investments for 2024 & 2025. Shaded areas represent the 90 percent confidence level. Standard errors are two-way clustered at the firm and the 2-digit-industry-by-month level.

Figure A.7: Differential production effect of monetary policy for adjusting firms: additional robustness checks



Notes: Differential effect of a 1 pp expansionary monetary policy shock on cumulative production for firms adjusting investment in the vignettes. Baseline: estimated using Equation (1) and adding a non-interacted monetary policy shock ε_t^{MP}. The shaded area represents the corresponding 90 percent confidence band. Standard errors are two-way clustered at the firm and 2-digit industry-by-month level. "Month x Industry FE" adds the respective fixed effects to Equation (1). "Price-flexible firms": sample is restricted to firms that adjusted prices more often than the median firm in the two years prior to the shock. "Equally weighted shocks": reweighting shocks in the regression such that each shock enters with the same weight. The sample is always restricted to firms that have planned investment for 2024 and 2025.

B Transformation to user cost elasticity

This appendix illustrates how our interest rate semi-elasticity of investment translates into an investment elasticity with respect to the (user) cost of capital.

The user cost of capital according to Hall and Jorgenson (1967) is given by:

$$c = q(r + \delta)\frac{1 - \tau * z}{1 - \tau} \ , \tag{A.2}$$

where q is the price of the capital good relative to the output price, r is the real interest rate, δ is the discount factor, τ is the corporate tax rate, and z is the present discounted value of the depreciation deduction. The user cost of capital represents the shadow price for a marginal unit of capital.

We make the following assumptions: $\tau = 0.3$, $\delta = 0.1$, and there is straight-line depreciation over a period T of 10 years such that

$$z = \sum_{t=1}^{T} \frac{1}{(1+i)^t} * \frac{1}{T} \ . \tag{A.3}$$

Each of these assumptions is based on information from the CBT Tax Database for equipment in Germany in 2017. i, the nominal discount rate is set to 7% following Link et al. (2024). The SPF forecast in 2023Q4 for the 5-year inflation rate was 2.1%, so we set the real interest rate $r = 0.05$. Furthermore, we set $q = 1$.

As we shift the interest rate on loans, the loan rate should be the relevant interest rate for deciding on investing in a marginal unit of capital. Since the loan interest rate is tax-deductible, we rewrite the user cost in the following way:

$$c = q(i_b(1 - \tau) - \pi^e + \delta)\frac{1 - \tau * z}{1 - \tau} \ , \tag{A.4}$$

where i_b is the tax-deductible nominal loan interest rate, and π^e is the 5-year expected inflation rate, which we set to 2.1 percent according to the SPF forecast in 2023Q4. We assume that firms' nominal discount rate used to calculate z remains unchanged by the vignette, because it is unclear how the discount rate changes with the change in the loan rate. Allowing the discount rate to change does not significantly impact the result. Using the cost of capital formulation in Equation (A.4) and calculating the percentage change in c for a 1 pp change in i_b from 5 percent to 4 percent, we get: $\left.\frac{\partial log(c)}{\partial i_b}\right|_{i_b=0.05} = 0.053$. Thus, our semi-elasticity of 7 percent translates into an elasticity of investment with respect to the user cost of 1.3, which aligns with the estimate of Curtis et al. (2021), even though the precise number is, of course, sensitive to the assumptions made.

C Interest rate sensitivities and environmental impact

The ECB is concerned about the environmental impact of monetary policy, since climate change can have effects on price stability. Our firm-level estimates allow for a detailed accounting exercise: Are firms with a larger environmental footprint stimulated more by decreases in loan interest rates in the vignette?

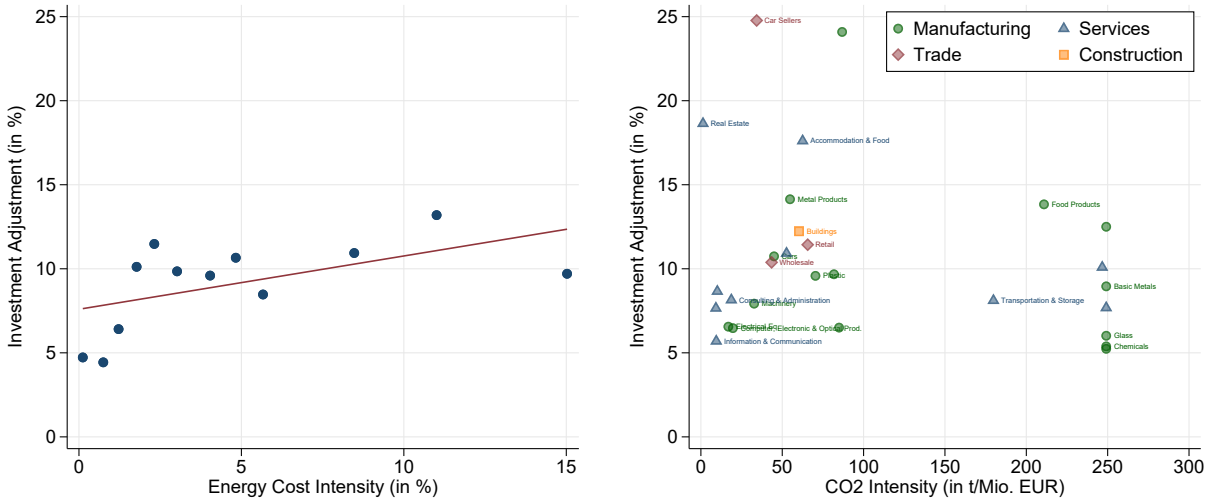
We analyze two different measures of environmental footprint. First, we exploit a special survey question on firms' energy costs in 2021 that was asked in April 2022. In Panel (a) of Figure C.8, we show a binned scatter plot with this energy cost intensity measure on the horizontal axis and firms' investment adjustment in the vignette on the vertical axis. We find a significant positive relationship between energy cost intensity and firms' investment adjustments in the hypothetical scenarios. An increase of 5 pp in energy intensity is associated with a 2 percentage point greater investment adjustment at the firm level. One potential explanation is that more energy cost-intensive firms face greater needs to invest in energy efficiency, which were further amplified by the rising energy costs during the 2022/23 energy crisis. Note, however, that energy does not necessarily have a negative impact on the environment if it comes from renewable sources.

To have a more precise measure of the environmental footprint, we merge Scope 1 CO_2 intensity at the two-digit NACE industry level with the survey. Scope 1 CO_2 emissions refer to direct greenhouse gas emissions from sources that are owned or controlled by a firm, such as on-site fuel combustion, company-owned vehicles, and industrial processes. Panel (b) of Figure C.8 shows that there is no observable relationship between CO_2 intensity and investment sensitivity to interest rates at the industry level. This suggests that the direct investment effect of the change in lending rates is orthogonal to the environmental footprint of firms, which contrasts with the ECB's unconventional policies that are biased towards high-emission sectors (Papoutsi et al., 2022).

Figure C.8: Investment response and environmental impact

(a) Energy cost intensity

(b) Scope 1 CO_2 intensity



Notes: Panel (a): binned scatter plot of the investment adjustment in the vignette (in percent) on the share of revenues spent on energy in 2021 (in percent). Energy cost intensity is trimmed at p75. Panel (b): scatter plot of the average investment adjustment in the vignette (in percent) and the CO_2 intensity (Scope 1 CO_2 emissions in tonnes by million Euro of gross value added) at the two-digit industry level. CO_2 intensity is winsorized at 250. Investment adjustment in both panels is winsorized at 100 percent. The sample is restricted to firms that planned to invest in 2024 and 2025.

D The ECB's 2022-2023 hiking cycle

This appendix reviews the recent monetary-policy tightening cycle. We do so to gauge, first, how closely firms' vignette-based investment adjustments align with their actual responses to interest-rate changes and, second, to contrast a period of rate increases with our vignette's hypothetical cuts. Between June 2022 and December 2023, the ECB raised its key policy rate in six steps, by a cumulative 4.5 pp, and—according to the Survey of Professional Forecasters—rates were expected to remain elevated through 2024–2025. Over the same period, the average interest rate on new loans to non-financial corporations in Germany rose by about 4 pp.

In December 2023, in the same survey wave in which we conducted our experiment, we asked firms how they have adjusted their investment plans in response to the interest rate increases or the tighter credit conditions since June 2022 (see Appendix E for the exact wording of the questions). This formulation is more general than the hypothetical vignettes, which isolated the direct effect of changes in the lending rate. While it still refers explicitly to the impact of interest rates and credit conditions on firms' investment, firms may now also take into account interest rate-driven changes in demand. Another difference from the clean vignettes is that the interest rate on loans increased by 4 pp on average, but the increase can vary across firms, while it was the same for all firms in the vignettes. For example, financially constrained firms may face a stronger increase in the external finance premium, resulting in a larger increase in the interest rates on loans for them.

Overall, we find that firms have reduced their investment by 8.6 percent in response to the interest rate hikes. Only 20.3 percent of firms adjusted their investment at all, but when they did, they reduced their investment by a substantial 41.5 percent.[25] Table D.14 shows that the response is highly correlated with the firms' hypothetical investment adjustment in the vignettes, at both, the extensive and the intensive margin. The overall investment adjustment in the vignette explains 16 percent of the variation in the real-world investment adjustment.

Table D.15 shows that especially firms in a better business state and firms not facing financial constraints or engaging in loan negotiations adjusted their investment *only* in the vignettes as opposed to in the vignettes *and* the real world. These effects are robust to adding industry fixed effects, which should absorb demand-driven adjustments in the real world. Among firms that do not adjust their investment in the vignettes, especially firms arguing with higher uncertainty and worse demand expectations or with being constrained are more likely to have adjusted their investment in response to the real-world interest rate hikes, as

[25] Best et al. (2024) summarize the findings of the real-world response in more detail in a policy report.

Table D.14: Investment adjustment in real-world and vignette

	Real-world response		
	Overall adjustment	Extensive margin	Intensive margin
Hypothetical response			
Overall adjustment	0.390***		
Extensive margin		0.304***	
Intensive margin			0.550***

Notes: This table shows correlations coefficients. "Overall adjustment": investment adjustment in percent, winsorized at 100 percent. "Extensive Margin": Dummy that is 1 for adjusting firms, and 0 for others. "Intensive Margin": investment adjustment in percent, the sample is restricted to adjusting firms. The sample is restricted to firms that have planned investments in 2024 and 2025.

shown in Figure D.9. This suggests that the differences between the investment adjustment in the vignettes and the real world are mainly driven by non-linear responses depending on the sign of the rate change or a heterogeneous exposure to the changes in the interest rates in the real world.

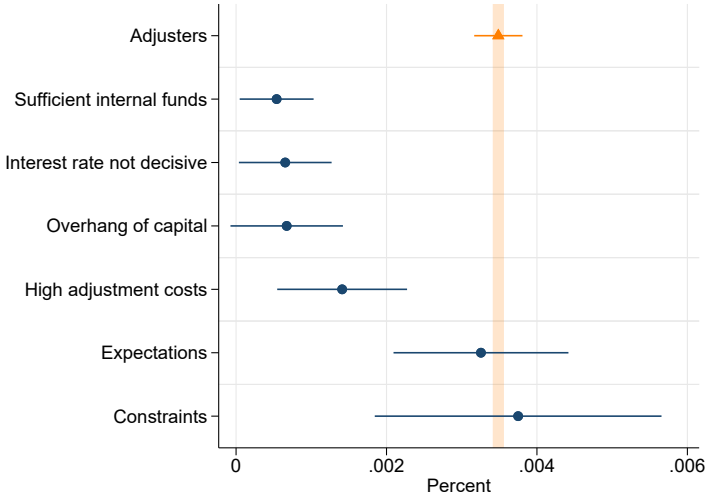
If general equilibrium effects were a major driver of firms' investment responses, this would likely operate at the industry level, for example, due to industry-specific exposure to changes in demand. Figure D.10 plots the overall investment adjustments in the real world against the response in the vignette. The variation across sectors is overall very similar in the real-world response and the vignette response.

Table D.15: Explaining differences between vignette and real-world investment adjustment

	$\mathbb{1}[\Delta I_i^{real\ world} = 0 \mid \Delta I_i^{vignette} > 0]$					
	(1)	(2)	(3)	(4)	(5)	(6)
Business state 12/2023: good	0.176**			0.203**		
	(0.071)			(0.077)		
Business state 12/2023: medium	0.107**			0.115**		
	(0.049)			(0.051)		
Loan negotiations past 3 months		-0.164***			-0.176***	
		(0.060)			(0.062)	
Loan negotiations past 3 months × Bank acted restrictive		0.053			0.074	
		(0.084)			(0.089)	
Financially constrained 10/2023			-0.183*			-0.280***
			(0.093)			(0.076)
Avg. business state past 2 years	0.117*	0.211***	0.205***	0.094	0.193***	0.172***
	(0.061)	(0.048)	(0.050)	(0.072)	(0.059)	(0.059)
Log employees	0.045***	0.041***	0.039***	0.049***	0.053***	0.042***
	(0.012)	(0.013)	(0.012)	(0.015)	(0.017)	(0.015)
Constant	0.341***	0.504***	0.484***	0.311***	0.451***	0.479***
	(0.070)	(0.062)	(0.058)	(0.076)	(0.071)	(0.066)
Observations	483	459	443	473	448	435
R^2	0.061	0.081	0.075	0.137	0.154	0.156
2-Digit Sector FE	–	–	–	✓	✓	✓

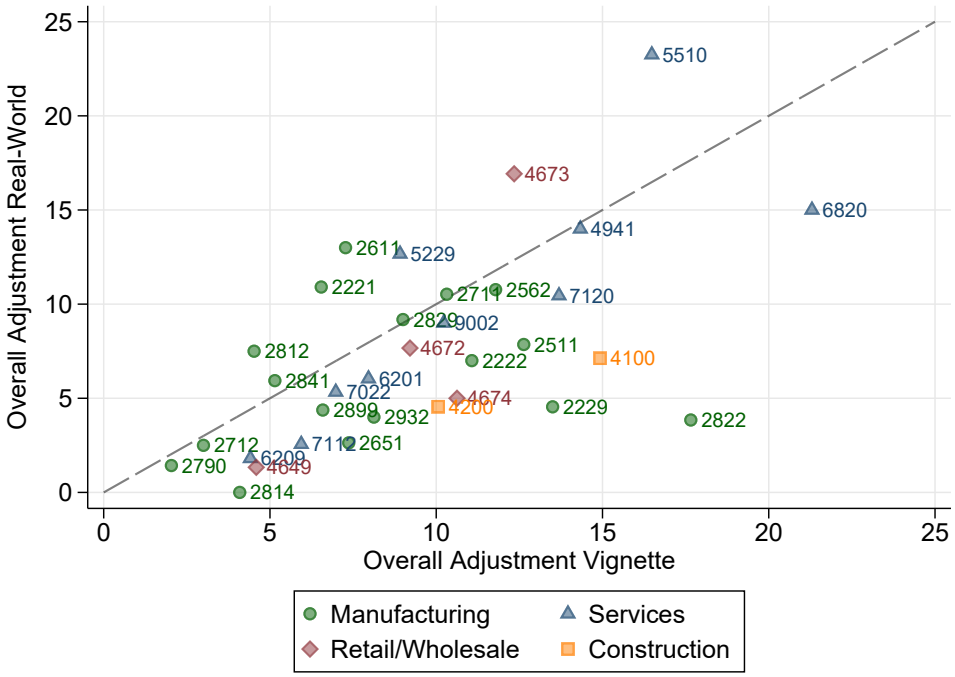
Notes: OLS regression results. The dependent variable is 1 for firms that adjusted investment in the vignettes but not in response to the increasing interest rates in the real world and 0 for firms that adjusted investment in both cases. The sample is restricted to firms that have planned investments in 2024 and 2025. Base category for the business state is "bad". Standard errors clustered at the 2-digit industry level in parentheses. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure D.9: Real-world investment adjustment by non-adjustment narratives



Notes: Share of firms adjusting investment in response to the 2022-23 interest rate hikes by the classified narratives of non-adjustment in the vignette. The share for the group that adjust investment plans in the vignette is shown in orange. Bars represent 95 percent confidence intervals. The sample is restricted to firms that planned to invest in 2024 and 2025.

Figure D.10: Investment adjustment in real-world and vignette: industry level



Notes: Scatterplot of the investment adjustment in the real-world and investment adjustment in the hypothetical vignette at the four-digit industry level. 45-degree line in black. Investment adjustment is winsorized at 100 percent. The sample is restricted to firms that planned to invest in 2024 and 2025, displaying only industries with more than 15 observations.

E Survey questions

Standard Questions of the ifo Business Survey (translated to English)

Business state:

Current situation: We evaluate our current business situation as [1] good, [0] satisfactory, or [-1] bad.

Business expectations:

Expectations for the next six months: We expect our business state, in economic terms, to [1] improve, [0] stay the same, or [-1] deteriorate.

Uncertainty:

We estimate the uncertainty regarding our business expectations in the next six months as: [continuous slider from 0 (low) over 50 (average) to 100 (high)] ___ %

Production activity:

Trends in [last month]: Compared to [two months ago] our production activity has [1] increased, [0] remained the same, or [-1] decreased.

Production expectations:

Expectations for the next three months: We expect our production activity to [1] increase, [0] remain the same, or [-1] decrease.

Demand situation:

Trends in [last month]: Compared to [two months ago] our demand situation has [1] improved, [0] remained the same, or [-1] deteriorated.

Price adjustments:

Trends in [last month]: Compared to [two months ago] our prices–taking into account changes in conditions–[1] increased, [0] remained the same, or [-1] decreased.

Loan negotiations [quarterly frequency]:

We have conducted loan negotiations with banks in the past 3 months: ☐ yes ☐ no
If yes, the banks behaved: ☐ accommodating ☐ normal ☐ restrictive

Capacity utilization [quarterly frequency]:

The utilization of our machines (full utilization = 100%) is currently: ___ % [tick box from 30% to 100% in 5/10 p.p. steps, or enter value manually if larger than 100%]

Business constraints [quarterly frequency]:

Our [production/business] activities are currently being constrained: ☐ yes ☐ no
If yes, they are being constrained by the following factors:
☐ Lack of skilled labor
☐ Financing constraints
☐ ...

Externally financed investment [annual frequency, November]:

To what extent will you finance your investments in [the following year] externally?

R&D activity [annual frequency, December]:

Did you carry out R&D activities in [the last year]? ☐ yes ☐ no

Product stages [annual frequency, November]:

[This year] our products–measured in terms of their total turnover–were in the following phases (estimates are sufficient):
___ % Market entry (innovation)
___ % Growth
___ % Stagnation
___ % Shrinking

Investment focus [annual frequency, November]:

Our investment activity (this year) is focused on:
☐ Capacity increases
☐ Rationalization (efficiency increases)
☐ Replacements
☐ Others

Planned investment focus [annual frequency, November]:

Our investment activity (next year) is focused on:
☐ Capacity increases
☐ Rationalization (efficiency increases)
☐ Replacements
☐ Others

Determinants of investment [annual frequency, November]:

Decisive factors for our investment activity (next year):
☐ No investment

☐ Demand
☐ Financial conditions
☐ Technological factors
☐ Taxes/subsidies
☐ Other factors

Revenues [annual frequency, March]:

What was your total revenues [last year]: ___ thousands/million/billion

Investment [annual frequency, March]:

What was your total investment [last year]: ___ thousands/million/billion

Firm age [one-off question, September 2018]:

In which year was your business founded?

Family business [one-off question, February 2014/2023]:

Do you consider yourself a family business? (Meaning the majority of the voting capital is held by one or more families who are related to each other): ☐ yes ☐ no

Respondents' education [one-off question, February 2020]:

What is the highest degree you have obtained?
☐ Secondary school diploma
☐ High school diploma
☐ Completed vocational training
☐ Bachelor degree or Bachelor Professional
☐ Master degree or diploma
☐ Doctoral degree
☐ Other

Equity ratio [one-off question, September 2020]:

What was your company's equity ratio at the end of 2019? ___ %

Cash-to-total assets [one-off question, September 2020]:

What was your company's "cash and cash equivalents" as a percentage of total assets in March 2020? ___ %

Energy intensity [one-off question, April 2022]:

What share of your revenues did you approximately spend on energy costs in 2021 (energy intensity)? ___ %

Respondents' position [one-off question, May 2023]:

Which term best describes the position of the person who usually answers the survey?
☐ Owner
☐ CEO/ board member/ authorized signatory
☐ Department head
☐ Team head
☐ Clerk
☐ Other

Business cycle attachment [One-off question, August 2018/February 2025]:

How important is the general economic development in Germany for your business situation?
☐ Very important
☐ Important
☐ Not as important
☐ Less important
☐ Irrelevant

Competitors [One-off question, May 2025]:

How many competitors does your firm have? _ _ _

Additional questions in December 2023 (translated to English)

Investment adjustment in real world:

Have you reduced planned investments in the last 1.5 years due to the rise in interest rates and tighter credit conditions?
Total investments:
☐ no, no investments planned ☐ no, not reduced ☐ yes, reduced by _ _ _ %

Investment in energy efficiency and usage of renewable energies:
☐ no, no investments planned ☐ no, not reduced ☐ yes, reduced by _ _ _ %

Investment in research and development:
☐ no, no investments planned ☐ no, not reduced ☐ yes, reduced by _ _ _ %

Investment plans:

Have you planned investments for the years 2024 and 2025?
2024: ☐ yes ☐ no 2025: ☐ yes ☐ no

Vignette:

For the following questions, please imagine that the **financing conditions improve** for you and your competitors. For the next 2 years, **loan interest rates** for all maturities are **[0.5/1/3/4] p.p. lower** than currently expected. Assume that nothing else changes in terms of credit conditions, firm-specific or macroeconomic conditions.

If investments were planned in 2024/2025:

To what extent would you adjust the amount of the planned total investments for 2024 and 2025 as a result (in %)? (A rough estimate is sufficient) 2024:___ / 2025:___

If investments were not planned:

In this case, would you plan investments for [2024/2025]? ☐ yes ☐ no ☐ I don't know

If answering "no" or "0%" in previous question:

Why would you not adjust the amount of the planned total investments for 2025 despite lower interest rates? ___ [open text field]

Additional questions in January 2024 (translated to English)

Hurdle rate:

What is your current minimum required return for an investment (hurdle rate)? ___ %

☐ don't know

Vignette:

For the following questions, please imagine that the **financing conditions improve** for you and your competitors. For the next 2 years, **loan interest rates** for all maturities are **[0.5/1/3/4] p.p. lower** than currently expected. Assume that nothing else changes in terms of credit conditions, firm-specific or macroeconomic conditions.

In this case, would you adjust your hurdle rate? ☐ yes ☐ no ☐ I don't know

Comment: ___ [open text field]

Additional questions in June 2025 (translated to English)

Monetary policy narratives:

What discussions and considerations typically arise within your firm regarding investment planning when the ECB changes its key interest rate? ___ [open text field]