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Asymmetric Investment Responses to Firm-specific Forecast Errors*

Abstract

This paper analyses how firm-specific forecast errors derived from survey data of German manufacturing firms over 2007–2011 affect firms' investment propensity. Understanding how forecast errors affect firm investment behaviour is key to mitigate economic downturns during and after crisis periods in which forecast errors tend to increase. Our findings reveal a negative impact of absolute forecast errors on investment. Strikingly, *asymmetries* arise depending on the size and direction of the forecast error. The investment propensity declines if the realised situation is worse than expected. However, firms do not adjust investment if the realised situation is better than expected suggesting that the uncertainty component of the forecast error counteracts positive effects of unexpectedly favorable business conditions. Given that the fraction of firms making positive forecast errors is higher after the peak of the recent financial crisis, this mechanism can be one explanation behind staggered economic growth and slow recovery following crises.

Keywords: risk climate, microeconomic survey data, forecast errors, firm investment, uncertainty

JEL classification: D22, D84, E32

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1 Motivation

During the financial crisis of 2007/08 and the subsequent European sovereign debt crises, negative news about future economic developments accumulated, and uncertainty increased significantly. In this paper, we use survey data of German manufacturing firms over the period 2007–2011 from the IWH risk climate survey to derive a measure of firm-specific forecast errors and analyze its impact on firms' propensity to invest. While forecast errors inform about whether firms have formed too optimistic or too pessimistic expectations, these errors also reveal that firms faced uncertainty when deriving their forecast. Understanding how forecast errors affect firms' investment behavior and, ultimately, macroeconomic outcomes is key to mitigating economic fluctuations and slow recovery.

Following Bachmann et al. (2013), we construct absolute forecast errors firms make when evaluating their business conditions. We argue that these forecast errors capture not only a "news component" driving a wedge between expected and actual outcome but also a firm-specific "uncertainty component". The reason is that when uncertainty is high, future outcomes become less predictable such that forecast errors increase (Jurado et al. 2015, Kalay et al. 2018). We exploit a unique element of the survey data to construct an ex-ante measure of uncertainty. This helps validating that firms' absolute forecast errors, which are derived from an ex-post perspective, comprise an uncertainty component that potentially compensates for a positive news effect. Focusing on the investment response to forecast errors at the firm level, we contribute to the scarce literature analyzing asymmetric effects regarding the size and direction of the forecast error (see e.g. Tanaka et al. 2019). Our study thereby furthers understanding of the dynamics of firms' investment responses during and in the aftermath of a recession.

In our analysis, we proceed in three steps. First, we derive firm-specific forecast errors firms make when evaluating their business condition. In line with findings by, e.g., Coibion and Gorodnichenko (2012), we find that firms adjust their expectations with a lag to economic

shocks. More firms make negative forecast errors at the beginning of the crisis period, that is, firms expected the situation to be better than actually realized. In the aftermath of the crisis, a higher fraction of firms make positive forecast errors. This suggests that firms become too pessimistic and that the realized situation is better than expected. This finding supports theoretical results by Gennaioli et al. (2015), who show that firms overreact to a series of bad news and adjust beliefs downward. On average, the share of firms making a larger forecast error, whether positive or negative, is higher during crisis times. This pattern is thus analogous to what can be observed for uncertainty proxies measured at the aggregate level, and it demonstrates a countercyclical pattern of firm-level forecast errors.

Second, in line with the existing literature, we construct the dispersion of firm-specific forecast errors across all firms in our sample and for each time period to measure uncertainty at the aggregate level (Bachmann et al. 2013, Bloom et al. 2013, Christiano et al. 2014).[1] We find that our cross-sectional uncertainty measure is increasing during crisis times, evolves similarly to standard measures of aggregate uncertainty such as stock market volatility, and is countercyclical to aggregate investment. A countercyclical pattern of uncertainty is a recurrent finding in the related literature, for instance, by Bloom et al. (2018) and Bachmann et al. (2013).[2] This commonly observed pattern gives confidence that the forecast error constructed from the IWH survey contains valid information.

Third, we analyze how firm-specific forecast errors affect the investment responses of firms. Larger forecast errors reflect not only deviations from expectations, due to e.g. surprise shocks, but also a higher level of firm-specific uncertainty such that firms can become more reluctant

[1] The key difference between the "firm-specific uncertainty component" and "aggregate uncertainty" thus stems from the aggregation level. We do not differentiate between an increase in firm-specific or aggregate uncertainty due to second moment shocks at the firm and/ or aggregate level. A recent study by Kalay et al. (2018) proceeds into this direction showing that there can be interaction effects between firm-specific and aggregate uncertainty.
[2] De Veirman and Levin (2018) construct an aggregate measure of uncertainty based on firm-specific volatility in sales or earnings growth of US firms and find weaker evidence for counter-cyclicality than dispersion-based measures.

to invest and instead decide to "wait and see". Indeed, our results show that firms are less likely to increase investment following the realization of a larger absolute forecast error while controlling for the current assessment and expectations of firms regarding key business variables such as the financing situation and the costs of raw materials. However, already simple descriptive statistics point into the direction that the relation between investment and firm-specific forecast errors is more complex. More specifically, there is evidence for an *asymmetric* relation between investment and the forecast error, which can not be observed for other commonly discussed determinants of investment like expectations, risk attitude, or financing constraints.

Extending our regression analysis accordingly, we find that the investment response is *asymmetric*, depending on the size and direction of the forecast error. If the forecast error is negative, that is, the actual situation is worse than expected, the investment propensity declines significantly. If forecast errors are positive and increasing, that is, the realized situation is better than expected, firms do not adjust their investment. Thus, increased uncertainty reflected by a higher forecast error seems to compensate the realization of unexpectedly favorable business conditions such that firms do not invest more.

Given that the fraction of firms making positive forecast errors is higher after the peak of the crisis, we provide micro evidence for uncertainty being a potential reason behind sluggish recovery at the macro level in the aftermath of financial crises (Forni et al. 2017, Reinhart and Rogoff 2014, Meinen and Roehe 2017). A high level of pessimism triggered by a recession might lead to underestimation of future prospects. In principle, such an underestimation constitutes a positive surprise from the perspective of the individual firm and might spur investment in the aggregate. At the same time, however, uncertainty increases, which might reduce incentives to invest and slowdown economic recovery. In this respect, we provide micro-level evidence confirming the findings by Forni et al. (2017) that output responses to large news

shocks are asymmetric. The underlying mechanism is that uncertainty arises from news in such a way that good news and their positive impact are counteracted by the uncertainty effect, while the negative impact of bad news is strengthened.

To validate that the firm-specific forecast error contains an uncertainty component, we take advantage of the fact that our dataset contains a question about how firms judge the stability of expectations about future developments (henceforth: stability of expectations). This can be interpreted as an *ex-ante* measure of firm-specific uncertainty. Firms that consider their expectations about future developments to be stable assume to make a smaller forecast error. This ex-ante measure is highly correlated with the (ex-post) forecast error speaking to the idea that forecast errors contain not only a news but also an uncertainty component. Analogously to our results for firms' forecast error, a higher level of ex-ante uncertainty, that is, a lower perceived stability of expectations, reduces firms' investment propensity.

The data we rely on is a unique dataset based on firm-level survey data of German firms. The "IWH risk climate survey" was obtained from the Halle Institute for Economic Research (IWH). It offers various advantages that allow one to identify the effect of firm-specific forecast errors on investment behavior. First, at a half-yearly frequency, it spans the period from the first quarter of 2007 to the third quarter of 2011, such that we can compare the evolution of firms' forecast errors and investment responses starting from a non-crisis period, covering the financial crisis, and entering a recovery phase. While the German economy recovered relatively fast after the crisis, investment has remained below pre-crisis levels (Banerjee et al. 2015). This weakness in investment is similar to other European countries and the US (Barkbu et al. 2015, OECD 2015). Additionally, the crisis came unexpectedly, which provides an exogenous event that drives firms' forecast errors independently of firm-specific characteristics. Second, we have a large number of small and medium-sized manufacturing firms located in different parts of Germany, which gives a sufficient degree of heterogeneity.

Third, the survey questions are sufficiently rich to study our questions of interest and to construct the forecast errors. The survey includes questions on firms' expectations and evaluation of the current situation regarding key firm variables, firms' investment responses, and firm-specific information such as size or revenue. By including these expectation variables, we can disentangle the effect of firm-specific forecast errors on investment from any effect on real outcomes stemming from the realization of a large unexpected (negative) shock in itself, as documented by Orlik and Veldkamp (2014). Furthermore, we have information on firms' risk attitude, which allows us to separate effects due to forecast errors from those due to risk aversion. Finally, there is information on how firms judge the stability of their expectations, which provides an ex-ante, perceived measure of uncertainty that we can compare to the ex-post, realized forecast error.

The paper relates to three main strands of literature. First, there are studies that analyze how expectations are formed. The focus is most often on whether firms form expectations in a rational way by exploiting all available information efficiently or whether expectations are formed in an adaptive way. The results obtained in this literature are ambiguous, and the rational expectation hypothesis can often not be confirmed. Early work of Zimmermann (1986), for example, uses survey data of German firms on expected and actual business conditions and rejects the hypothesis of rational expectations.[3] In a recent paper, Gennaioli et al. (2015) analyze why firms underestimate the possibility of a crisis in good times and overreact to bad news in crisis times. They argue that, in contrast to rational expectations, beliefs are formed according to previously observed data, giving less weight to other outcomes. In this paper, we are mainly interested in how firms' forecast errors affect investment responses. The motivation

[3] Similar results are found by Svendsen (1993) using Norwegian survey data regarding firms' price and demand expectations. Dave (2011) uses Canadian data on firms' expectations and actual volumes about capital expenditures and rejects both the rational and adaptive expectation formation hypothesis. Using survey data, Coibion and Gorodnichenko (2012) show that economic agents do not adapt forecasts immediately after shocks providing evidence for information frictions.

is that as soon as firms form an expectation about the future and as soon as the resulting forecast errors affect investment responses, there are real economic effects. This holds irrespective of how the underlying expectations are formed, whereas the size and direction of firms' forecast errors might affect investment behavior.

The second strand of literature analyzes investment behavior of firms under uncertainty. Uncertainty is often found to have a weakening effect on investment (Bernanke 1983, Leahy and Whited 1996, Bloom et al. 2007, Ghosal and Loungani 2000, Kellogg 2014).[4] The reason is that if uncertainty is high, firms tend to "wait and see" instead of investing, particularly if investment decisions are irreversible (Bloom 2009, Bloom et al. 2018, Stokey 2016). This can cause a slowdown in aggregate economic growth. Using micro-level data for UK manufacturing firms, Bloom et al. (2007) show that firms become more cautious in investing if uncertainty measured by firm-specific stock return volatility increases. Based on Italian survey data, Guiso and Parigi (1999) come to similar conclusions. They find that manufacturing firms increase investment less in response to demand if uncertainty is higher. The negative effect of uncertainty on investment and output growth is confirmed at the macro level (Fernández-Villaverde 2011, Bachmann et al. 2013, Born and Pfeifer 2014, Christiano et al. 2014). We add to this strand of literature in that we analyze the asymmetric effects of firm-specific forecast errors at the micro level.

The third strand of literature is related to firm-specific determinants of investment behavior, such as the financing situation and risk aversion. Firms' investment responses might depend on both internal financing resources and access to external funds and their costs. Financial frictions can impose constraints on firms that result in reduced investment (Arellano et al. 2019). Gilchrist et al. (2014) show that in times of higher uncertainty firms' credit spreads, and thus,

[4] While the literature usually finds a negative effect of uncertainty, there is less consensus about whether effects are of sizeable magnitude or not (e.g., Bloom 2009, Bachmann and Bayer 2013).

capital costs increase, resulting in a contraction of capital expenditure.[5] Additionally, risk aversion can be a key determinant of firms' investment behavior. The more risk-averse a firm is, the less willing the firm is to invest. The effect of uncertainty on investment is likely to change with firms' risk aversion (Panousi and Papanikolaou 2012). This is particularly important in crisis times, when uncertainty tends to increase and firms become more risk-averse (Guiso et al. 2018).[6]We contribute to the literature on the determinants of firm investment by asking whether investment responses are affected by firm-specific forecast errors, while controlling for financing constraints and risk aversion.

The paper is structured as follows. In section 2, we describe the data with a particular focus on the IWH risk climate survey. Furthermore, we present descriptive statistics related to the research questions. We show how forecast errors and investment responses evolved over time and across firms. Section 3 explains the regression model and shows the results. Section 4 concludes the paper.

2 Data Description and Summary Statistics

This section first describes the IWH risk climate survey, the construction of the underlying survey and its coverage. Second, we explain the computation of firm-level forecast errors and the measurement of uncertainty at the aggregate level, and we show the evolution of these series over time and across firms. Third, we provide descriptive evidence for the relationship between firms' ability to forecast and their propensity to invest.

[5] Access to external funding can also become more difficult if banks provide less loans to non-financial firms during periods of increased uncertainty. Buch et al. (2015) find that banks reduce lending if uncertainty in the banking sector increases.

[6] Also, in the asset pricing literature, time-varying risk premia have a long tradition, see e.g. Campbell and Cochrane (1999).

2.1 IWH risk climate survey

The risk climate survey of the IWH covers the period from 2007Q1 to 2011Q3.[7] While the survey data are confidential, they can be used within the IWH in accordance with the research data center of the IWH. Surveys have been conducted every half a year in spring (April) and autumn (October), and we have data for ten different waves. An example of the survey containing all questions and answer options can be found at the end of the paper[8]; variables used in the analysis are described in Appendix A1. The survey was sent to the executive directors of manufacturing firms. If firms did not respond to two continuous waves, they were dropped from the sample.[9] Firms could respond by sending a fax or letter or by answering online. For the first two waves, only selected sectors of the manufacturing industry are included. The subsequent eight waves include firms of all sectors, e.g., chemical, leather, wood, and engineering, as listed in Appendix A2. Firms were chosen based on a random sampling procedure.[10]

The survey has two main components: First, it contains "core" questions asking firms about their evaluation of current business conditions and the economic situation, their expectations with respect to future development, their judgment of the stability of the expected development, and the resulting implications for the firm. All of these questions are asked with reference to the general business and economic conditions of the firm and subcategories such as production, revenues, or competition. Firms also give an evaluation of their willingness to take risks, whether they have achieved their targeted amount of revenues, and how they expect their investment behavior to evolve. In general, firms have five answer options to indicate whether

[7] The survey was stopped in 2011 due to organizational changes within the institute.
[8] The original version (in German) is provided at the end of the Web Appendix.
[9] Per wave, the dataset contains 4,302 entries, however, not all firms responded to the survey. The median response rate across all waves is 27%.
[10] The random sampling procedure is based on the distribution of firms in the firm database "MARKUS" of Creditreform and in accordance with the number of firms per sector, firm size, and location in Eastern and Western Germany. Firms are anonymized such that no matching of firm-specific balance sheet data or income statements from other sources is possible.

they expect, for example, a (strong) deterioration (-/--), no change (0), or a (strong) improvement (+/++) of future business and economic conditions.

Second, questions are asked about the firm's sector, the most important product, the amount of revenue in the last accounting year, and the share of revenue generated abroad. Furthermore, we know whether the firm has participated in the survey, which allows calculating response rates to individual questions. For example, we find that among the participating firms, the share of firms not responding to the question on expected investment behavior is less than 3%. We also know the location of the firm (Eastern or Western Germany), and in which size range the firm falls in terms of employees. "Small" covers firms with 1-4 or 5-24 employees, "medium" refers to firms with 25-74 employees, and "large" covers firms with more than 74 employees.

Summary statistics of the number of reporting firms by wave and the share of firms across subcategories, such as the number of employees, can be found in Table 1.[11] From this table, it can be seen that the survey contains mostly smaller firms. To check whether our sample is likely to produce relevant results, we compare it to the universe of manufacturing firms in Germany using data form the federal statistical office (see Web Appendix). This shows that smaller-sized firms account for a sizeable share of total manufacturing firms and thus play a non-negligible role in the manufacturing sector. Average revenue is obviously lower for smaller firms but can be reconciled with the numbers in the IWH survey. Finally, the distribution of firms across sectors in the survey data is very similar to the one obtained from official data for the whole German manufacturing sector. This supports the appropriateness of the random sampling procedure and the representativeness of this sample of smaller firms.[12]

[11] Obviously, our results will not be representative for large German firms, e.g. Ghosal and Loungani (2000) show that profit uncertainty has larger effects on investment in industries with a large share of smaller firms. The distribution of firms across subcategories of revenues and wave can be found in the Web Appendix (Table B3).
[12] Summary statistics and correlations of the variables based on the regression sample (Table B1) as well as information on the distribution of firms across sectors for survey and official data (Table B2; Figures B1 and B2) are provided in the Web Appendix.

[Insert Table 1 here]

Given that the survey is conducted for a limited number of firms, including mostly smaller firms, besides the representativeness of the sample also the validity of the responses is crucial for further analysis. To verify whether we can rely on firms' responses, we use our data to reconstruct the balance on which the well-known Ifo business climate index for the Germany economy is based.[13] This allows us to compare the evolution of the original Ifo business climate balance to our reconstructed balance. Figure 1 shows the results. It is obvious that the two series are remarkably similar. This holds despite that the Ifo business climate survey is based on a higher number of participating firms (approximately 7,000), is conducted at a higher frequency (monthly), and contains firms from different sectors (manufacturing, construction, wholesaling and retailing). This gives us confidence in the validity of the survey outcome obtained from the IWH risk climate survey. The only discrepancy arises in the level. This can be explained by the fact that, in contrast to the Ifo business climate survey, we have mostly smaller firms in our sample. Smaller firms are more likely to be too optimistic in their expectations (Bachmann and Elstner 2015). For comparison, the figure also shows the pattern of real GDP growth in Germany.

[Insert Figure 1 here]

2.2 Firms' forecast errors

In this paper, we evaluate how firms' forecast errors affect their investment responses. Following Bachmann et al. (2013), we compute forecast errors for each firm at each point in time from the survey responses. The firm-specific forecast error compares the firm's expected

[13] While having a broader coverage, the Ifo business climate index does not contain information on the risk attitude and the stability of expectations, which we exploit to construct a measure of firms' ex-ante uncertainty. The construction of the Ifo business climate balance is explained in the Appendix A3 and corresponds to the description found here: www.ifo.de/w/45YCTv5Bp. We make use of the survey questions on firms' assessment of the current overall situation and the expected development in the following six months to reconstruct the corresponding series from the IWH risk climate survey.

situation with the actual situation one period later. The forecast error resulting from the calculation explained below then ranges from "FE -2" (situation was worse than expected) to "FE 2" (situation was better than expected).

For the calculation, we exploit that in the survey each firm had to evaluate its *current situation* on an ordinal scale. There were five possible answers ranging from "--" (very bad situation) to "++" (very good situation). The firm also had to evaluate the *expected change of the situation* over the following six months. Again, the possible answers range from "--" to "++", with "--" representing a strong worsening of the situation, "0" corresponding to no change, and a clear improvement coded with "++". To calculate the forecast error, we proceed in three steps.

First, to have a numerical scale for the calculation, we ***recode and rescale*** the survey answers. This means that we recode the plus and minus scale for the question on the actual situation and the question on the expected change of the situation into numbers: -- corresponds to 1; - to 2; 0 to 3; + to 4; ++ to 5. We then rescale the answers on the actual situation to a simpler scale with three categories. 1 and 2 are rescaled to 1 (bad situation), 3 to 2, and 4 and 5 are rescaled to 3 (good situation). For consistency, we also rescale the answers on the expected change to a simpler scale with three categories reflecting the direction of the change: 1 and 2 are rescaled to -1 (worsening), 3 to 0, and 4 and 5 are rescaled to 1 (improvement). This step can be summarized as follows:

	Survey answer	Recoding	Rescaling
very good situation/ strong improvement	++	5	3 (1)
good situation/ improvement	+	4	

neutral/ no change	0	3	2 (0)
bad situation/ worsening	-	2	1 (-1)
very bad situation/ strong worsening	--	1	

Second, given that we only know the firm's answer on the expected change of the situation, we have to ***derive the expected situation***. To do so, we calculate the expected value in *t-1* for time period *t* by summing the actual situation in *t-1* and the direction of the expected change in *t-1*: *Expected situation for t in t-1 (3 categories) = actual situation in t-1 (3 categories) + expected change in t-1 (3 categories).* We set the value for the expected situation back to scale if the actual situation is evaluated as good (bad) and an improvement (deterioration) is expected. The reason is that this would imply the expected situation to be at a value of 4 (0), which is out of range of the previously defined three categories scale of the actual situation going from 1 to 3. In this case, all values for the expected situation of 4 (0) are truncated to 3 (1), i.e. to „good" („bad").[14]

Third, we can now ***compute the forecast error*** in period *t* with five resulting categories by subtracting the expected situation for *t* made by the firm in the previous period *t-1* from the firm's actual situation in *t*: *Forecast error in t (5 categories) = actual situation in t (3 categories) – expected situation for t in t-1 (3 categories).* This forecast error has five different categories (FE -2, FE -1, FE 0, FE 1, FE 2). Negative values mean that the actual situation is worse than expected. Positive values indicate that the actual situation is better than expected.[15] For illustration, we provide a brief example of the calculation steps in Appendix A4.

[14] We check if this truncation affects our regression result by excluding those firm observations for which rescaling leads to a forecast error of zero. The results are only marginally affected both in terms of estimated coefficients and standard errors. They are available from the authors upon request.

[15] Alternatively, we compute a forecast error that has nine categories and ranges from "FE -4" to "FE 4", or three categories ranging from "FE -1" to "FE 1". For our baseline model, we prefer to use the forecast error with five categories, as it presents a sufficient degree of variation without having to make too many assumptions on the scaling and without having to deal with the problem of few observations in the tails.

This measure is, hence, a firm-specific forecast error with two components. First, positive (negative) values in *t* reflect that there was a positive (negative) shock compared to the firms' expectation in *t-1*. Second, a larger absolute forecast error reflects less predictability and thus higher uncertainty from the perspective of the individual firm. Uncertainty is hence measured from an *ex-post* perspective, as the forecast error compares the realized situation in period *t* with the expected situation in *t-1*. In further analysis, the forecast error will be linked to investment responses in period *t*. This approach underlies the assumption that a firm, being aware of having made a forecast error, incorporates this into its investment decisions. This assumption is plausible as long as a firm realizing that past expectations have been "wrong" projects this experience into the future. In this case, ex-post forecast errors matter for future decision-making.

Alternatively, we use an *ex-ante* measure of uncertainty based on how firms evaluate the stability of their expectations about future developments, and we refer to this variable as "stability of expectations". If a firm considers its expectations about future developments very unstable, this signals a high level of future uncertainty. In contrast, a firm that believes in the stability of its expectations about future developments perceives less uncertainty regarding its predictions. Hence, the IWH risk climate survey has the advantage that a comparison of the effects of ex-post versus ex-ante uncertainty measures on firms' investment decisions is feasible.[16] Figure 2 shows that a higher mean absolute forecast error relates negatively to firms' average stability of expectations. This result is confirmed by our regression analysis and corroborates the idea that the forecast error contains an uncertainty component because part of its information content is reflected in firms' ex-ante perception of uncertainty (see Section 3.1).

[16] Bachmann et al. (2019) take instead the forecast error with respect to period $\tau+3$, to evaluate the effect on firms' decisions in period τ. This underlies the assumption that firms' perceived level of uncertainty in period τ is captured by the realized forecast error as derived from $\tau+3$ data. The IWH survey has the advantage that we directly obtain an ex-ante uncertainty measure as perceived by the firm in period *t*.

[Insert Figure 2 here]

Table 2 shows the distribution of the forecast error based on the overall situation of the firm for each wave. Because the survey starts in the first quarter of 2007 (2007q1) and because we do not have firms' expectations from the previous quarter, the series of forecast errors starts from the second wave. The percentage share of firms by size of the forecast error is depicted in the columns of the table. Across the whole sample, the share of firms that had a forecast error of zero is highest, with an average of 60%. If we look at the distribution by wave, asymmetric patterns arise. At the beginning of the crisis 2008q3/2009q1, the share of firms with a negative forecast error is relatively higher compared to other waves. This suggests that more firms expected the situation to be better than realized and underestimated the crisis effect (>20% for FE -1, >5% for FE -2). In contrast, in the following quarters 2009q3/2010q1, more firms had worse expectations about the future than what was realized (>20% for FE 1, >3% for FE 2).

[Insert Table 2 here]

This demonstrates that during tranquil times, a large number of firms predict the future well. When a shock is occurring, firms do not immediately adjust expectations and forecast errors increase. This might be due to information frictions as proposed by Coibion and Gorodnichenko (2012, 2015). Forecast errors evolve in the course of crisis times as follows: at the beginning of a crisis, firms are too optimistic, while in the aftermath of the crisis, they become too pessimistic. The pattern of forecast errors derived from our data is in line with the findings by Massenot and Pettinicchi (2018). Using the Ifo business survey of manufacturing firms in Germany, these authors also find evidence for overoptimism and overpessimism evolving with the business cycle. A possible explanation is that firms did not see the crisis coming and then expected the crisis to be worse and more persistent. This finding would support the result of the theoretical model by Gennaioli et al. (2015), showing that only a sequence of bad news causes

a change in investors' beliefs. However, as soon as investors adapt their beliefs, the adjustment is relatively strong and investors become pessimistic.

We use the *firm-level* data and derive three cross-sectional measures at the *aggregate level* to capture the degree of uncertainty in the overall economy.[17] In line with the related literature, higher uncertainty is thereby assumed to be reflected by, on average, larger and/or more disperse forecast errors/expectations across firms. The first two measures are based on the firm-specific forecast error. For the first measure, we take the mean of the absolute value of the firm-specific forecast errors (*Mean abs. FE*). The higher the mean, the larger the average forecast error, irrespective of whether the forecast error is positive or negative. For the second measure, we calculate the standard deviation of the firm-specific forecast errors (*SD FE*). The third measure is derived from firms' expected changes instead of forecast errors and captures the discrepancy in firms' expectations in each period (*FDISP*). The measure can be interpreted such that a higher dispersion in firms' expectations reflects a higher level of uncertainty in the economy (Bachmann et al. 2013).

The evolution of these three measures across time is shown in Figure 3.[18] The measures derived from the firm-specific forecast error, that is, the mean absolute forecast error and the standard deviation of the forecast error, evolve similarly. They start at low levels at the beginning of the sample period, increase with the onset of the financial crisis and reach their peak in the first quarter of 2009 before declining again. In contrast, the third measure, calculated as the cross-sectional dispersion of firms' expectations, reaches its peak already in the third quarter of 2008.[19] The series stays at elevated levels before declining during the year 2010, but it shows

[17] The derivation of these measures follows Bachmann et al. (2013) and is explained in detail in Appendix A5.
[18] The pattern of the aggregate uncertainty measure is similar if we construct a forecast error with three (nine) categories: there is only a downward (upward) shift in the level.
[19] Because the third measure is based on the dispersion of expectations and does not take into account the errors firms have made in their forecasts, we would argue that uncertainty still increases from the third quarter of 2008 to the first quarter of 2009.

an increase again at the end of the sample, which might be related to events during the European sovereign debt crisis.

[Insert Figure 3 here]

For comparability with other commonly used uncertainty measures, we also depict stock market volatility of the DAX. It can be seen that the time pattern of the uncertainty measures derived from our survey data closely tracks the development of stock market volatility. This finding supports results by Tanaka et al. (2019) showing for Japanese survey data that the average of firms' absolute forecast errors evolves similar to stock market volatility, whereas the authors conclude that "periods with larger forecast errors correspond to those with larger macro uncertainty". This provides further evidence that the survey responses as well as the way the forecast error is computed deliver reliable information.

Discrepancies in firms' ability to forecast might vary across time and across firm characteristics, such as size or revenue. For example, larger firms might have access to more information and benefit more from accurate forecasts (Tanaka et al. 2019). The same might apply to firms with more financial resources. Their (perceived) ability to generate accurate forecasts, in turn, might translate into lower uncertainty. To obtain a first impression of this issue, we plot the mean absolute forecast error across all firms that fall in one size or revenue category. Figure 4 shows the evolution of the mean absolute forecast error by firm size. Consistent with the aggregated view in Figure 3, the series are increasing at the beginning of the sample period, corresponding to the start of the financial crisis, and reach lower levels again in 2011, though the decline is less pronounced for smaller firms. [20] A similar pattern can be observed if the mean absolute forecast error is shown by firm revenue (see Web Appendix, Figure B3).

[20] Larger firms have potentially more options to diversify and might therefore be more shielded against unexpected shocks and uncertainty. For this reason, our results are rather representative for small and medium-sized German firms.

[Insert Figure 4 here]

In sum, the time series pattern of our aggregate uncertainty measures shows that firms' forecast errors increase during the financial crisis, which was a period of high uncertainty regarding the stability of the financial system and future economic growth. However, the reason for the increase in absolute forecast errors differs over time. At the beginning of the crisis, firms are more likely to make negative forecast errors suggesting that it takes some time until expectations about the future are adjusted to negative news. In contrast, the fraction of firms with positive forecast errors increases during and in the aftermath of the crisis as firms underestimate future economic conditions.

2.3 Investment responses

Firms' ability to forecast and the level of uncertainty can affect firms' investment behavior. For example, Bloom et al. (2018) show that under uncertainty about future economic developments, firms might want to "wait and see" and postpone investment decisions. This holds in particular if investments are irreversible and the option value of waiting is high (real options effect) (Bernanke 1983). To obtain a first visual impression of the relation between aggregate uncertainty and investment, we plot the mean absolute forecast error and the cross-sectional dispersion of the forecast error against the percentage change in equipment investments in Germany using data from the German federal statistical office (Figure 5). Similar to related work, our aggregate measures for uncertainty derived from survey data are countercyclical to the business cycle (Bachmann et al. 2013a Bloom 2014).[21]

[21] To verify that this result also holds for the individual manufacturing sector, we compute the mean absolute forecast error (as well as the standard deviation of the forecast error) by manufacturing sector and match these series to the aggregate investment volume in the respective sector. This reveals that a higher value of sectoral uncertainty is related to lower investment volumes within the sector. These graphs are available upon request. Summary statistics for the distribution of firms' investment responses across answer possibility and wave are available in the Web Appendix (Table B4).

[Insert Figure 5 here]

To shed more light on the drivers of firms' investment behavior, we exploit the richness of our survey data and study the role of a firm's (i) forecast error, (ii) expectations about future economic conditions, (iii) risk attitude, and (iv) financial constraints. First, Figure 6 relates the investment propensity to the size of the firm's forecast error. A reduction in investment volumes is coded with a minus (-/--), zero stands for no change (0), and a plus sign indicates an increase in investment volumes (+/++). The forecast error measures the difference between the expected and realized economic situation. Therefore, negative values signal that the actual situation was worse than expected (FE -2 and FE -1), and positive values signal that the actual situation was better than expected (FE 1 and FE 2).

[Insert Figure 6 here]

The fraction of firms that intend to reduce investment is higher if the **forecast error** is negative, meaning that firms were too optimistic regarding future development (upper left panel). However, the converse does not hold true: firms with a positive forecast error do not decide to increase investment relatively more (lower right panel). This suggests that the negative experience of being too optimistic ex-ante makes firms more uncertain and more reluctant to increase planned investment ex-post. Meanwhile, firms that experience a better outcome than expected are unlikely to project this "positive surprise" into the future by increasing their investment. This is a first indication that the uncertainty effect associated with realized forecast errors prevails. The sheer fact that a firm made an error in its forecast—even when the actual realization turns out to be better than expected—dampens or at least does not increase investment. In sum, the effect of the forecast error on investment seems to be *asymmetric*.

Second, **expectations** about the future situation of the company can affect firms' investment behavior. For example, if the future economic outlook is bad, firms might be inclined to delay

costly and irreversible investment. Figure 7 depicts the distribution of firms' planned changes in investment by expected change in a firms' economic situation. A reduction in investments corresponds to a minus sign (-/--), zero stands for no change (0), and a plus sign indicates an increase in investments (+/++). The expected change in a firm's overall economic situation is ordered in five categories: minus stands for an expected deterioration (-/--), zero for no change (0), and a plus sign indicates an expected improvement in the overall situation (+/++). Similarly to before, the fraction of firms that are likely to invest less in the future is higher if the firm expects a worsening of its economic situation (upper left panel). However, if an improvement in the overall economic situation is expected, the picture reverses, and the fraction of firms that would like to increase their investment is higher (lower right panel). This *symmetric* pattern provides already some evidence that expectations are differently related to investment compared to the forecast error.

[Insert Figure 7 here]

Third, investment behavior might vary with firms' **risk attitude** because returns are not certain but depend on the success of the investment project. Thus, Figure 8 shows the distribution of firms' planned changes in investment for different sizes of the forecast error based on a firm's risk attitude. A reduction in investments corresponds to minus (-/--), zero stands for no change (0), and a plus sign indicates an increase in investments (+/++). Based on the survey question, the risk attitude is defined in terms of the willingness to take risks and is thus an inverse measure for risk aversion. The expected change in risk attitude is defined between minus (low risk attitude) and plus (high risk attitude), while zero stands for a moderate risk attitude. Figure 8 demonstrates the relationship between the willingness to take risks and planned investment changes yielding a *symmetric* pattern. The fraction of firms that are more likely to decrease investment is relatively high when firms are risk-averse (upper left panel). However, if firms

are less risk-averse, the fraction of firms that increase investments is higher (lower right panel).[22]

[Insert Figure 8 here]

Fourth, the investment behavior might be conditional on the firm's **financing situation**. Firms that report a (very) bad financial situation are more likely to be financially constrained, which potentially translates into reduced investment. The link between firms' financial situation and expected investment behavior is illustrated in Figure 9. A reduction in investments corresponds to minus (-/--), zero stands for no change (0), and a plus sign indicates an increase in investments (+/++). The financial situation can be assessed in five categories: lower values stand for (very) bad financial conditions (-/--), a reasonable financial situation is reflected by zero, and a (very) good condition is depicted by plus (+/++). Again, we observe a *symmetric* pattern. A larger fraction of firms tend to reduce investment if financial conditions are tight (upper left panel). In contrast, the distribution becomes left-skewed if firms do not face financial constraints (lower right panel).

[Insert Figure 9 here]

In sum, this section has shown that firms tend to invest more (less) if they have positive (negative) expectations about the future, a good (bad) financial situation and a higher (lower) risk attitude. By contrast, the investment response to the forecast error is *asymmetric*: firms tend to invest less if they incur a larger negative forecast error, but there is no relevant shift toward more investment for firms with a larger positive forecast error. This suggests that there is an interaction between the news and uncertainty component of the forecast error. While these

[22] The same pattern emerges if we exchange firms' current assessment of the risk attitude with their expected change in risk attitude.

conclusions are drawn from descriptive statistics, the next section studies whether these patterns can be validated using a regression framework.

3 Regression Design and Results

In this section, we present the econometric model to analyze whether firms' forecast errors affect investment propensity. We start with a baseline model in which the expected change in the investment volume is the dependent variable and our explanatory variable of interest is the firm's absolute forecast error. We then disaggregate the forecast error into positive and negative components to verify the existence of asymmetric effects. Finally, we use firms' perceived stability of expectations as an ex-ante measure of uncertainty and conduct further robustness tests.

3.1 The effect of firms' forecast errors on investment

To analyze the effect of firm-specific forecast errors on investment, we use an ordered probit regression framework and set up the following empirical model: [23]

$$Investment_{i,t} = \alpha + \delta' * CUR_{i,t} + \lambda' * EXP_{i,t} + \sigma * FirmRev_{i,t} + \gamma * RiskAttitude_{i,t} + \beta * Abs.FE_{i,t} + \tau_t + \omega_j + \epsilon_{i,t} \quad (1)$$

where $Investment_{i,t}$ is our dependent variable, denoting the expected change in the investment volume of firm *i* in period *t* measured on an ordinal scale. This scale has five outcome categories and ranges from a (strong) decrease to no change to a (strong) increase.

[23] More formally, $Investment_{i,t}$ reflects the continuous latent variable in the ordered probit model, which is linked via the normal distribution function to the five-scale outcome variable on investment, as observed in the data, depending on the internally estimated cutoff points.

One limitation of the survey is that we have no information on realized investment volumes, only on the firm's assessment of changes in the investment volume. While realized investment would be a nice complement, correctly modelling the link between uncertainty today and realized – but most likely delayed – investment volumes is not straightforward due to confounding factors. Hence, relating firm-specific forecast errors to qualitative but immediate reactions of firms regarding their investment decisions can be of advantage from an identification perspective. This holds as long as the qualitative variable contains information that is actually reflected in future investment volumes, that is if managers "put the plan into action". Comparing the average investment response in the survey and realized changes in investments in the German manufacturing sector shows that the survey responses are a good predictor of realized investment volumes at the aggregate level.[24]

Our main explanatory variable is the firm's forecast error, $Abs.FE_{i,t}$, and we take the absolute value of the five category forecast error.[25] Hence, higher values indicate a larger forecast error, that is, the actual situation differs more from the expected one. We expect that firms that learn in period *t* that they made a larger absolute forecast error with respect to their expectations in period *t-1* are less likely to invest in period *t*. This might occur because they become more careful after having realized their misjudgment.

To ensure that the estimated coefficient of the forecast error reflects the impact of firm-specific forecast error on investment and is not distorted by the effect of other factors, we include a set of control variables. Most importantly, we control for the firm's $Risk\ Attitude_{i,t}$. In the baseline specification, we use firms' current risk attitude. The variable has five outcome categories, where higher values indicate that firms are more willing to take risks. In robustness tests, we also control for the expected change in risk attitude. We expect that the higher the risk

[24] See Figure B4 in the Web Appendix. Survey data is also used by Chong and Gradstein (2009) to test the impact of volatility on firm growth.
[25] Bachmann et al. (2019) proceed similarly and take the absolute value of firms' forecast error.

attitude of firms, the more likely they will increase their investment. If firms are risk-averse and future returns are uncertain, they might prefer to delay current investments (Panousi and Papanikolaou 2012).

Additionally, we include firm-level controls that capture firms' current ($CUR_{i,t}$) and expected ($EXP_{i,t}$) assessments of key business conditions and economic variables, namely, competition, financing possibilities, cost of raw materials and inputs, and the overall economic situation in Germany. The inclusion of these variables capturing current assessment and expectations allows us to disentangle the effect of firm-specific forecast errors from the immediate effect of economic conditions on investment decisions as well as from the current impact of large shocks or tail events on firms' expectations and consequently their investment behavior (Rancière et al. 2008, Orlik and Veldkamp 2014). The variable $FirmRev_{i,t}$ indicates the approximate revenue and is grouped in five different categories (see Web Appendix, Table B3).[26] Firm revenue is highly correlated with the number of employees such that this variable should capture both firms' financial revenues and size. It thus controls for firm-specific characteristics that are potentially related to firms' ability to forecast.

The baseline model is augmented by sector fixed effects ω_j, time fixed effects τ_t, or both. This allows us to control for sector-specific characteristics that are common to all firms in that sector as well as aggregate dynamics that affect all firms alike. Standard errors are clustered by firm.

Baseline specification

Table 3a shows results for the baseline specification, including the forecast error in absolute terms, which ranges from zero (the situation at time *t* is equal to the expected situation at time *t-1*) to two (the situation at time *t* is better/worse than the expected situation at time *t-1*). It can

[26] From the survey, we also obtain information on the number of employees and revenue abroad. However, because these variables are highly correlated with revenue, we do not include them simultaneously. See also the robustness section.

be seen that a higher value of the absolute forecast error decreases the propensity to invest. The effect of the absolute value of firm-specific forecast errors remains negative and significant if we control for time and/or sector-specific fixed effects (Columns 2-4). To obtain information on the quantitative impact, Table 3b shows marginal effects of the forecast error according to the outcome category of the investment response.[27] The results show that a one-unit-larger absolute forecast error reduces the probability to invest more by 1.8 percentage points, on average (Column 4).

[Insert Tables 3a-b here]

We also obtain significant results for the other control variables. A currently (or expected) more favorable competitive situation, a good financing situation, and a good situation of the German economy tend to increase investment. A negative sign is obtained for improvements in costs of material or higher firm revenue. The former finding can, on the one hand, imply that firms use their funds to buy material (instead of investing) when material costs are low. On the other hand, it might capture a business cycle component in the sense that material costs go down in crisis times, and so does investment.[28] The latter finding suggests that it is rather the smaller firms with lower levels of revenue that are more likely to expand and thus invest. As expected, risk attitude shows a positive and significant coefficient. Thus, less risk-averse firms show a higher investment propensity. Again, the results do not vary much depending on the choice of fixed effects. Thus, when controlling for a firm's current and expected situation, its revenue, and sectoral as well as time fixed effects, we find a significantly negative effect of the firm-specific forecast error on investment responses. Following the graphical results in Section 2.3

[27] Marginal effects remain stable for the regressions, including fixed effects. For brevity, we do not include them, but they can be obtained upon request.

[28] E.g., Rotemberg and Woodford (1999) find that marginal costs based on material costs and inventories rise during cyclical expansions affecting output cyclicality. While it is standard in the literature to consider the effect of input costs of labor or capital, limited evidence exists on the specific relevance of costs of material.

about the asymmetric investment response to positive/negative forecast errors, we extend the analysis and disaggregate the forecast error accordingly.

Disaggregated forecast error and asymmetric investment response

To evaluate what drives the significant coefficient of the forecast error in Table 3a and based on our findings on asymmetric patterns in Section 2.3, we decompose the forecast error. To do so, we control for cases in which the forecast error has been larger or equal to zero and cases in which the forecast error has been smaller than zero by interacting the absolute forecast error with a corresponding indicator variable.[29] In doing so, we can disentangle the heterogeneous effects of firm-specific forecast errors on investment depending on whether firms have over- or underestimated their general situation. For the interpretation, it is important to note that we still consider the absolute forecast error of the firm; we just differentiate between periods depending on the sign of the forecast error. Otherwise, the regression model remains the same.

Table 4a shows that the coefficient of the forecast error is significantly negative when the actual situation is worse than expected (FE<0). Table 4b (upper panel) shows the marginal effects for the negative forecast error by outcome category of the investment variable. A negative forecast error increases the probability to decrease investment by 3.2 percentage points (Column 1). In contrast, no significant result is obtained for a positive forecast error (FE≥0), and the marginal effects are also not significant. Hence, we can confirm that firms' investment response is *asymmetric depending on the size and direction of the forecast error*.

[Insert Tables 4a-b here]

This suggests that the significant result found in the baseline specification is mostly driven by negative realizations of the forecast error. The combination of negative news coming in, which

[29] This approach is similar to Tanaka et al. (2019) who study the link between absolute GDP growth forecast errors and total factor productivity, respectively performance, for a sample of Japanese firms.

yields a negative forecast error, and revealed ex-post uncertainty due to a wrong forecast made in the previous period significantly reduces the probability that firms invest more. By contrast, and similar to Forni et al. (2019), the result suggests that positive surprises or news shocks are compensated by the uncertainty component inherent in a larger forecast error. If the actual situation is better than expected, this does not cause firms to become more optimistic and to invest more. Instead, it seems that firms become more careful due to their incorrect forecast as they perceive a decrease in their ability to forecast. Hence, the well-documented "wait and see" effect of an increase in uncertainty compensates the positive signal of a better-than-expected outcome.[30]

The descriptive statistics have shown that positive forecast errors occur predominantly in the aftermath of financial crises (Table 2). If firms become too pessimistic as a response to crisis times, which in turn reduces their investment propensity through the uncertainty channel, this might be one explanation behind the phenomenon of slow recovery in the aftermath of financial crises (Reinhart and Rogoff 2014). This is in line with the finding of quantitative models that the impact of policy measures is dampened if uncertainty is higher due to firms becoming more cautious (Bloom et al. 2018). Veldkamp (2000) explains the asymmetry between rapid downturns and slow recovery in financial markets by the amount of information in the market. In stable times, market participants are actively investing and a rich set of information is generated, which causes sudden downturns once negative information is transmitted. In the course of the financial crash, investment decreases and lending rates rapidly increase. In contrast, recovery is slow because the level of information is low, and uncertainty is high, such that lending rates remain at elevated levels and investment remains reduced.[31]

[30] The results support the findings by Foerster (2014) showing asymmetric effects of uncertainty on economic activity from a macro perspective.
[31] Asymmetric effects of increased volatility on stock returns have been found in the asset pricing literature, one reason being the time-varying risk premia (see e.g. Bekaert and Wu 2000, Campbell and Hentschel 1992).

In this context and regarding external validity, it is important to note that Germany adopted a number of (fiscal) policy measures to stimulate the economy during the crisis. Additionally, the German economy recovered relatively quickly after the global financial crisis compared to other European countries or the USA. Nevertheless, we find significant effects of firm-specific forecast errors on firms' willingness to invest. This might be because our sample covers mostly smaller firms that had less flexibility in adjusting during the crisis and became more careful in the aftermath of the crisis than the larger export-oriented firms. Nevertheless, Germany might still reflect a lower bound, and in countries more affected by the recent financial crisis, we would expect stronger effects of firm-specific forecast errors that explain staggered investment in the aftermath of the economic downturn.

Stability of expectations

Finally, we make use of a unique feature of the survey to corroborate that the forecast error contains an uncertainty component. More specifically, we use the survey responses to the question on the stability of expectations, which provides us an *ex-ante* measure of (perceived) uncertainty from the perspective of the firm. The variable has five possible outcomes and ranges from minus (-/--) if the stability of expected developments is judged as (very) instable to plus (+/++) if it is evaluated as (very) stable. Table 5a shows that a higher stability of expectations increases the probability to invest more. Hence, if firms believe their expectations are stable, this ex-ante certainty translates into increased investment. Table 5b presents marginal effects that are significant across all outcome categories of the investment variable. A higher stability of expectations about future developments thus increases the probability to increase investment by 4 percentage points.

Rancière et al. (2008) use the skewness of credit growth instead of the variance to capture asymmetric effects of systemic risk on per capita GDP growth.

[Insert Tables 5a-b here]

Thus, the results obtained from an *ex-ante* measure of firm-specific uncertainty point in the same direction and are consistent with those obtained from our *ex-post* measure, that is, the forecast error. To further validate the concordance of both the ex-ante and ex-post measures, we use the stability of expectations as the dependent variable in our regression framework. The results in Table 6 show that the absolute forecast error has a negative and highly significant coefficient. We take this as evidence that, first, there is a significant relationship between the ex-ante measure of uncertainty and the ex-post forecast error and that, second, firms that have a larger absolute forecast error are less likely to report stable expectations. This makes intuitive sense because if firms recognize that they have a larger absolute forecast error and thus a higher level of realized uncertainty, this is likely to erode the perceived stability in their expectations today.

[Insert Table 6 here]

In sum, we find that higher absolute forecast errors make investment at the firm level less likely. We show that looking at the absolute forecast error is insufficient to trace heterogeneous effects. Once we disaggregate positive and negative forecast errors, the investment responses are asymmetric. Overestimations of future conditions worsen the propensity to invest. Underestimations, however, do not improve the propensity to invest. This suggests that better-than-expected developments are counteracted by the effect of higher uncertainty reflected by a larger forecast error. We corroborate our finding that the forecast error contains an uncertainty component by relating it to firms' stability of expectations, which is an ex-ante measure of uncertainty.

3.2 Further robustness tests

We conduct a number of additional tests to check the robustness of our results obtained from the baseline specification (1). To do so, we repeat the analysis but change the estimation method (Table 7, columns 1-3). First, we use an ordered logit model; second, we estimate the regressions using a random effects ordered probit model; and third, we cluster the standard errors not by firm but by sector. Furthermore, we limit the sample period and use only observations starting from wave three. From then on, the survey questions and sample composition remain stable (Column 4). In column 5, we limit the estimation to the spring survey to control for the fact that in spring firms are still more likely to plan investment while in autumn their reporting might be already backward looking. In addition, we use the correlated random effects approach to control for the effect of unobserved heterogeneity at the firm level (Column 6).[32] Despite these changes, the coefficient of the absolute forecast error remains negative and significant.

[Insert Table 7 here]

To check the stability of our results regarding firms' revenues, we exchange the revenue variable with the achieved sales target (Table 8, column 1). Firms that have not achieved their sales target might be less willing to invest, as their loss aversion increases and part of this effect might be hidden in the forecast error. Thus, it can be helpful to control for it. The variable has a positive coefficient, that is, firms having achieved their sales target are more likely to increase their investment. However, the effect seems to be of minor importance, as the coefficient is not significant and the result for the absolute forecast error remains significant. Also, when

[32] The correlated random effects model goes back to Mundlak (1978) and provides an alternative to the fixed-effects estimator. It allows controlling for unobserved individual heterogeneity but does not suffer from the incidental parameter problem. See Wooldridge (2010) for nonlinear models (such as ordered probit) for the case of unbalanced panels. Technically, the correlated random effects model controls for unobserved individual heterogeneity by including all time-varying explanatory variables along with their individual-specific mean over time.

controlling simultaneously for revenue, sales target and employees, the result remains robust (column 2).

[Insert Table 8 here]

The analysis has shown that firms' risk attitude is a significant driver of investment responses. In the case of firms' future investment propensity, both the current risk attitude and firms' expectations about their future risk attitude might be a driving factor. Thus, in Table 8, column 3, we do not control for firms' current risk attitude as done in our baseline regression; rather, we test the robustness of our results when controlling for the expected change in the risk attitude. As expected, the coefficient is positive and significant, reflecting that firms that are becoming less risk-averse are more likely to increase their investment.

One shortcoming of the analysis is that we cannot introduce firm-specific fixed effects due to the incidental parameters problem. Thus, to control for a firm's general forecasting pattern, we include its average forecast error (column 4). This captures whether a firm has been, on average, too pessimistic or too optimistic. However, these robustness tests do not change our main results, namely, that the absolute forecast error significantly undermines firms' willingness to invest.

Furthermore, to verify the asymmetric result for the forecast error, we run regressions only for those observations that show a negative (column 5) or positive (column 6) forecast error. Consistent with our previous results, we can confirm the asymmetric effect: the forecast error shows a negative and significant coefficient when we focus on the negative outcomes. However, the coefficient is insignificant if firms made a positive forecast error, that is, if the actual situation is better than expected.

Finally, despite ordered probit estimation fits better to the categorical nature of the dependent variable, we conduct robustness tests relying on linear regression models. This approach has

the advantage that firm fixed effects can be included. We do so for the baseline model containing the absolute forecast error as the main explanatory variable of interest and for the model revealing the asymmetric result. Table 9 shows that our results remain robust even when controlling for firm and time fixed effects (columns 1 and 3). Hence, these findings provide evidence that time-invariant, firm-specific characteristics that are not controlled for in ordered probit regressions are no major source of omitted variable bias. We also exploit that when using a linear model, we can simultaneously control for serial correlation of error terms across time and sector by estimating the model with two-way clustered standard errors.[33] Columns 2 and 4 show that results remain again robust.

[Insert Table 9 here]

4 Concluding Remarks

This paper analyzes the effects of firm-specific forecast errors on investment behavior based on survey data of German manufacturing firms. Using data from the IWH risk climate survey offers several advantages. It spans a tranquil and a crisis period (2007–2011), it covers a large number of small and medium-sized firms, and it offers useful survey questions to study the effect of firm-specific forecast errors on firms' propensity to invest. In particular, we derive forecast errors regarding the general situation of a firm and show that firms respond asymmetrically to larger absolute forecast errors: The response depends on the size and direction of the forecast error. This result suggests that forecast errors drive investment decisions by capturing not only a news component but also an uncertainty component at the firm level, whereas the interaction of both components drives firms' investment propensity.

[33] The model has been estimated with the cluster2 command in Stata using the ado-file provided by Mitchell A. Petersen.

We proceed in three steps. First, we derive firms' forecast errors and find that during the crisis period – that is a period of bad news – firms make, on average, larger absolute forecast errors. However, the pattern of firm-specific forecast errors reveals that firms adjust their expectations with a lag to economic developments. More firms make negative forecast errors at the beginning of the global financial crisis, that is, when they expect the situation to be better than realized. In the further course of the crisis, a higher fraction of firms make positive forecast errors. This suggests that firms become too pessimistic following a sequence of bad news.

Second, calculating aggregate uncertainty measures out of the survey data, we find that cross-sectional uncertainty measures increase during economic downturns. This countercyclical pattern of uncertainty is in line with the related literature and validates the information content of the forecast errors derived from the IWH survey data.

Third, we use these firm-specific forecast errors to evaluate the effect on investment. We find that firms making a larger absolute forecast error are more likely to decrease investment. Strikingly, the investment response is *asymmetric*, depending on the size and direction of the forecast error. If the forecast error is negative, that is, the actual situation is worse than expected, the investment propensity declines significantly. However, if forecast errors are positive and increasing, that is, the realized situation is better than expected, firms do not adjust their investment upward. Thus, increased uncertainty seems to compensate for the realization of unexpectedly favorable economic conditions such that firms do not invest more. Given that the share of firms with positive forecast errors is higher in the aftermath of the crisis, this finding might explain the slow recovery following economic downturns. Firms remain too pessimistic after the peak of the crisis, which translates into positive forecast errors, making them more reluctant to increase investment.

To validate our results and to corroborate that firms' forecast errors contain an uncertainty component, we show that the forecast error yields similar results as an ex-ante measure of

uncertainty, which we obtain from the survey responses. We also document that both measures are highly correlated at the firm level suggesting that forecast errors do not only reflect a news component but also a firm-specific uncertainty component. In addition, our results remain robust to a set of various robustness tests.

Accounting for asymmetric effects of firm-specific forecast errors and separating the news from the uncertainty component might be an interesting avenue for future research regarding the extension of quantitative macroeconomic models.

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Appendix A

A1: Data Description

The data used in this paper come from the IWH risk climate survey. The data set is confidential and cannot be distributed to external researchers. It can be accessed at the IWH in accordance with the research data center. It covers a large sample of small and medium-sized firms active in the German manufacturing sector. The survey waves were conducted bi-annually starting in 2007Q1 and ending in 2011Q3. For illustration, we have added a survey at the end of the paper. In the analysis, the ordering of the answers to questions four and five have been reversed in contrast to the ordering in the survey sheets to make it consistent with the ordering of the remaining survey questions and facilitate interpretation.

Variable Name	Measurement	Interpretation				Survey Question
Dependent variable						
Change in investment	--/-/0/+/++	--	Strong decrease	++	Strong increase	6
Risk attitude and forecast errors[34]						
Risk attitude	--/-/0/+/++	--	Very low willingness to take risks	++	Very high willingness to take risks	3
Expected change in risk	--/-/0/+/++	--	Strong decrease	++	Strong increase	4
Forecast error	-2/-1/0/1/ 2	-2	Situation worse than expected	2	Situation better than expected	Own calculation
Stability of expectations	--/-/0/+/++	--	Very instable	++	Very stable	2.1
Current situation						
Competition	--/-/0/+/++	--	Very bad	++	Very good	1.1.3a
Financing	--/-/0/+/++	--	Very bad	++	Very good	1.1.4a
Cost of material	--/-/0/+/++	--	Very bad	++	Very good	1.1.5a
German economy	--/-/0/+/++	--	Very bad	++	Very good	1.2a
Expected change						
Competition	--/-/0/+/++	--	Strong deterioration	++	Strong improvement	1.1.3b

[34] For a detailed description of the construction of our forecast errors, see the next section in the appendix.

Financing	--/-/0/+/++	--	Strong deterioration	++	Strong improvement	1.1.4b
Cost of material	--/-/0/+/++	--	Strong deterioration	++	Strong improvement	1.1.5b
German economy	--/-/0/+/++	--	Strong deterioration	++	Strong improvement	1.2b
Firm controls						
Revenue (see table B3)	5 categories	1	Revenue<250 k €	5	5 bn € <Revenue	10
Employees	5 categories	1	Employees<5	5	74<Employees	9
Sales target	--/-/0/+/++	--	Absolutely not achieved	++	Absolutely achieved	5
East/west dummy		0	Located in Western Germany	1	Located in Eastern Germany	

A2: Sector Description

This table shows the sectors of the manufacturing industries based on the classification scheme WZ2008 of the German federal statistical office (www.destatis.de/EN).

Sector number	Sector name
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment

A3: Construction of the Ifo business climate balance

In the Ifo business climate survey "the firms are asked to give their assessments of the **current business situation** and their **expectations** for the following six months. They can characterize their situation as "good", "satisfactorily" or "poor" and their business expectations for the next six months as "more favorable", "unchanged" or "more unfavorable". The replies are weighted according to the importance of the industry and aggregated accordingly. The **balance** value of the current business situation is the difference of the percentage shares of firms with responses "good" and "poor", the balance value of the expectations is the difference of the percentages of the responses "more favorable" and "more unfavorable". The **business climate balance** is a mean of both the balances of the business situation and the expectations."[35]

It is calculated using the formula:

$$business\ climate = \sqrt{(situation + 200)\ (expectations + 200)} - 200$$

"The Ifo business climate balances can fluctuate between extreme values of -100 (i.e., all responding firms appraise their situation as poor or expect business to become worse) and +100 (i.e., all responding firms assessed their situation as good or expect an improvement in their business)."

To re-construct the Ifo business climate balance using data from the IWH risk climate survey, we use the answers to the question on how firms evaluate their current overall situation and the expected development of the overall situation in the following six months (survey question 1.1). Since in the Ifo business climate survey, the firms only have the possibility to rate their situation as "good", "satisfactorily" and "poor" and their expectations as "more favorable", "unchanged" or "more unfavorable", we rescale our initial five category scale to three categories. The answers 1 and 2 were combined as "poor", the third category became "satisfactorily" and answers 4 and 5 are summarized as "good". We did the same for the expected development. Furthermore, we did not weigh the answers according to the importance of the industry.

[35] This description and more information regarding the Ifo business climate balance are available here: http://www.cesifo-group.de/w/45YCTv5Bp. The corresponding data can be found here: http://www.cesifo-group.de/w/AABWVtCn

A4: Example for the calculation of the forecast error

Period *t-1*: Boom period

- Actual situation is 4 (good) and expected change is 3 (no change).
- Rescale actual situation to 3 (good) and expected change to 0 (no change).
- Calculate the expected situation in period *t-1* for period *t*:= 3 + 0 = 3 (good).

Period *t*: The crisis hits

- Actual situation is 2 (bad) and recoded to 1.
- Subtract expected situation in *t-1* from actual situation in *t*:= 1-3= "FE -2".
- A forecast error of -2 indicates that the actual situation is (much) worse than expected.

A5: Calculation of the aggregate uncertainty measures

Mean of absolute forecast errors

The aggregate measures derived from the firm-specific forecast error are calculated for any given quarter *t* by calculating, first, the mean of the absolute value of the firm-specific forecast error.

$$Mean\ abs.FE_t = mean(|forecast\ error_{i,t}|)$$

By taking the absolute value, a higher mean implies that on average more firms have made larger forecast errors irrespective of whether the forecast errors have been negative or positive.

Standard deviation of forecast errors

Second, we take the firm-specific forecast errors and compute the standard deviation.

$$SD\ FE_t = SD(forecast\ error_{i,t})$$

Dispersion of expectations

While the former measures are based on firm-specific forecast errors, the forecast dispersion (*FDISP*) measures the divergence of the firms' expected changes for each quarter *t*. The formula looks as follows:

$$FDISP_t = \sqrt{Frac_t^+ + Frac_t^- - (Frac_t^+ - Frac_t^-)^2}$$

$Frac_t^+$ = fraction of the participants that expect an enhancement.

$Frac_t^-$ = fraction of the participants that expect a worsening.

The higher the $FDISP_t$, the more diverging are the expectations. This forecast dispersion measure (*FDISP*) refers to Bachmann et al. (2013).

A6: Figures and tables

Figure 1. Comparison of the IWH risk climate and the Ifo business climate

This figure uses the answers to the IWH risk climate survey and follows the construction of the Ifo business climate balance to reproduce the corresponding series over time. The blue, solid line depicts the series for the business climate balance obtained from the IWH risk climate survey (*IWH RCI balance*). To construct the *IWH RCI balance*, we use answers to the question on how firms evaluate their current overall situation and the expected development of the overall situation in the following six months (see the appendix for more details on the construction of the series). The red, dotted line shows the original series of the Ifo business climate balance (*Ifo BCI balance*). The Ifo data are available on a monthly frequency while the IWH surveys are only conducted twice a year. To obtain a biannual series for the Ifo balance, we use data for March and September. The Ifo business climate balance can take values between -100 and + 100 (-100: every single firm rated the current situation as bad and expected a further worsening; +100: every firm rated the situation as good and expected a further enhancement). The series for the *Ifo BCI balance* is obtained from the CESifo Group Munich: http://www.cesifo-group.de/w/45YCTv5Bp. The gray, dash-dotted line shows real year-on-year GDP growth (in %) as obtained from Datastream.

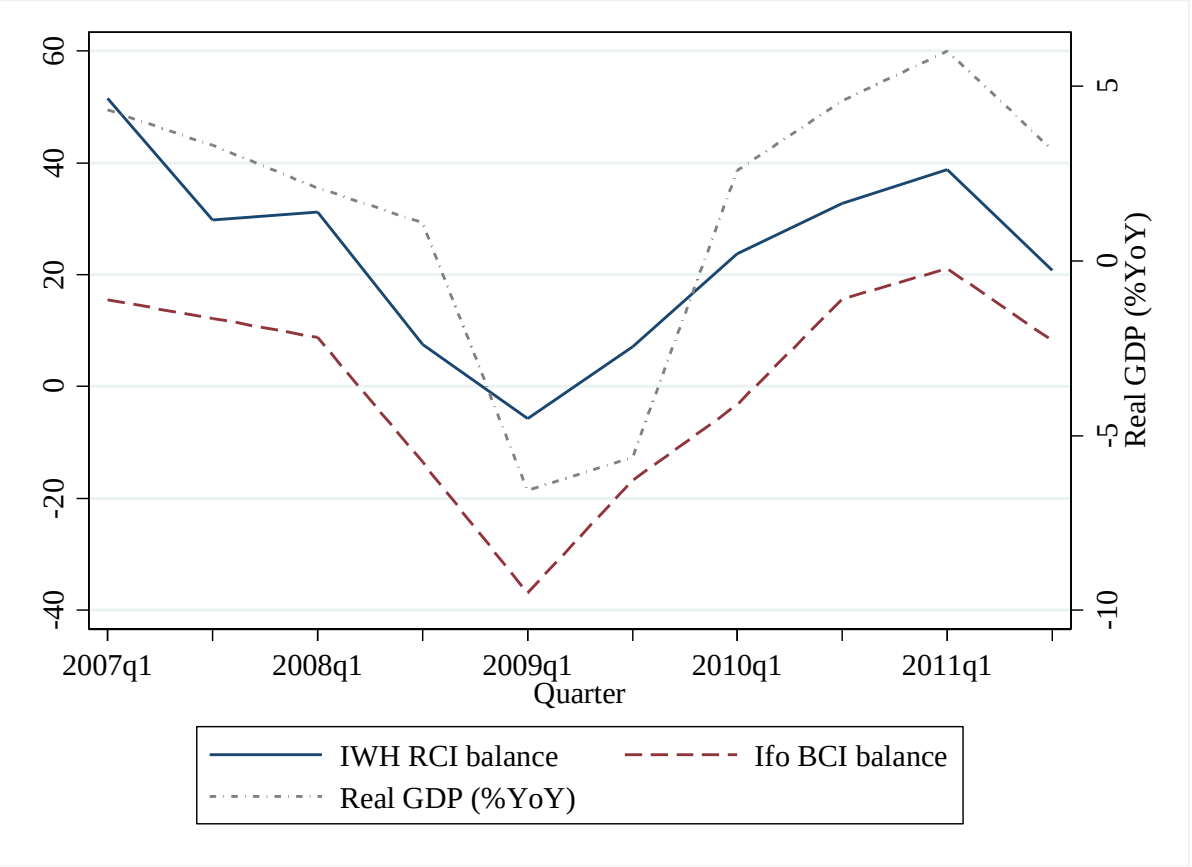

Figure 2. Ex-post and ex-ante uncertainty measure

This figure shows the mean absolute forecast error, which captures an uncertainty component from an ex-post perspective (blue, solid line). The ex-ante uncertainty measure corresponds to firms' stability of expectations and its average value is depicted by the green, dotted line. Both variables are standardized and derived from the IWH risk climate survey. For more information, see the data description in the appendix of the paper.

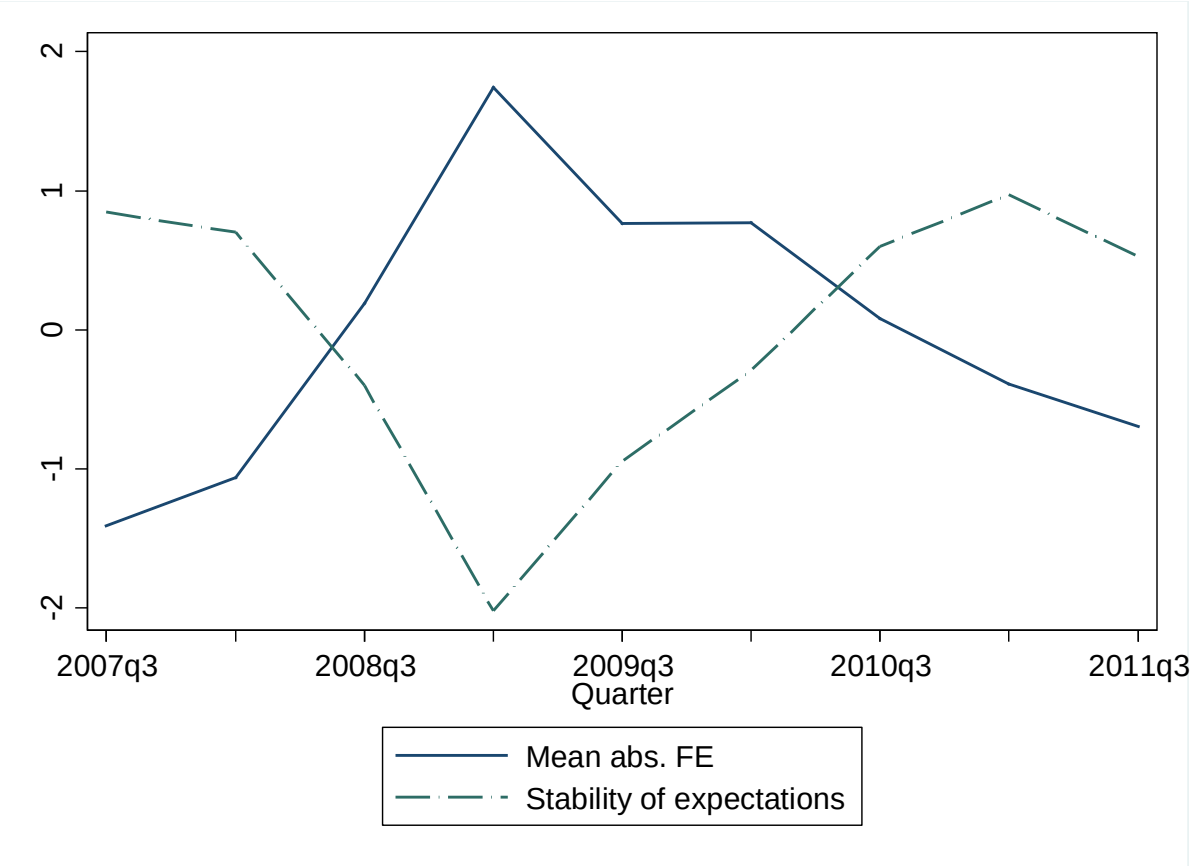

Figure 3. Aggregate uncertainty measures across time

This figure shows the three different measures for aggregate uncertainty which are calculated as follows: First, we compute firm's forecast error (FE). It compares the expected situation with the realized situation one period later. Second, we take the mean of the absolute forecast error (*Mean abs. FE*, grey dotted line) and the standard deviation across these firm-specific forecast errors (*SD FE*, red dashed line). Alternatively, we show the forecast dispersion (*FDISP*, blue solid line) which measures the dispersion of expectations across all firms in each period (Bachmann et al. 2013). All of these series are standardized (zero mean, unit standard deviation). The green dashed line is the VDAX volatility index as obtained from Datastream.

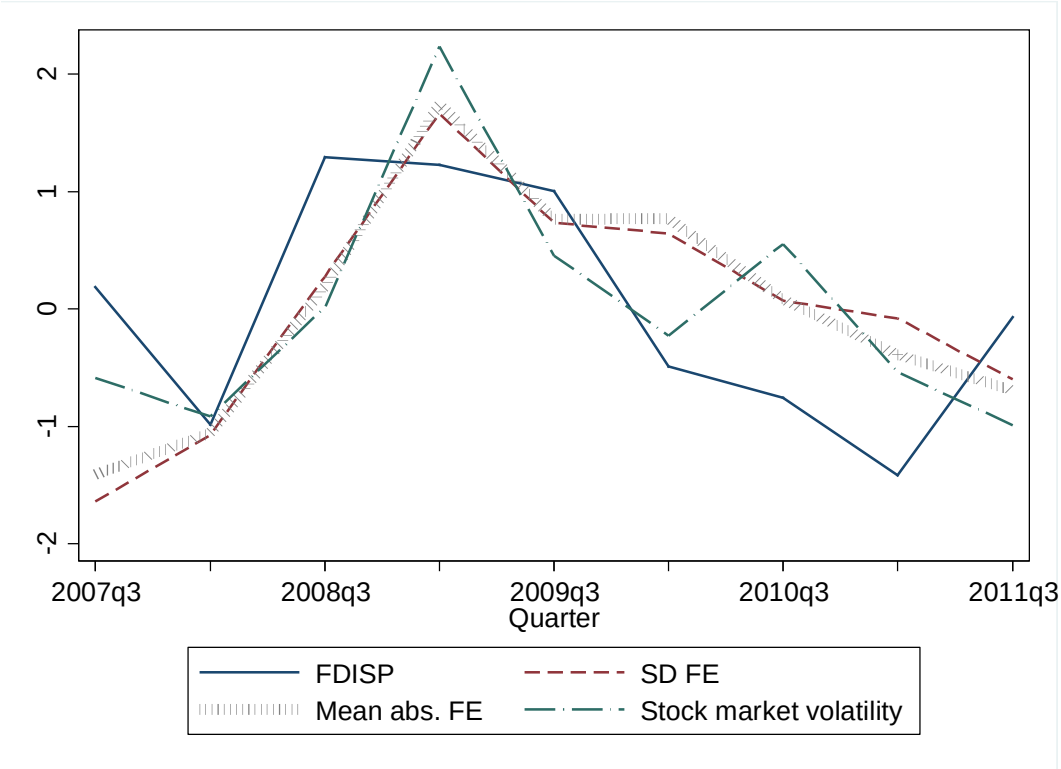

Figure 4. Evolution of mean absolute forecast error (5 categories) over time for different firm sizes

This figure shows the mean absolute forecast error of the firms' overall situation over time. The mean absolute forecast error is calculated by taking the mean of the absolute values of firms' forecast errors. The firms' forecast error is the difference between the firm's actual situation and the previously expected situation. The series is depicted by subcategory of firm size. The firms can be divided in five different subcategories: 1-4, 5-24, 25-49, 50-74, 75 and more employees.

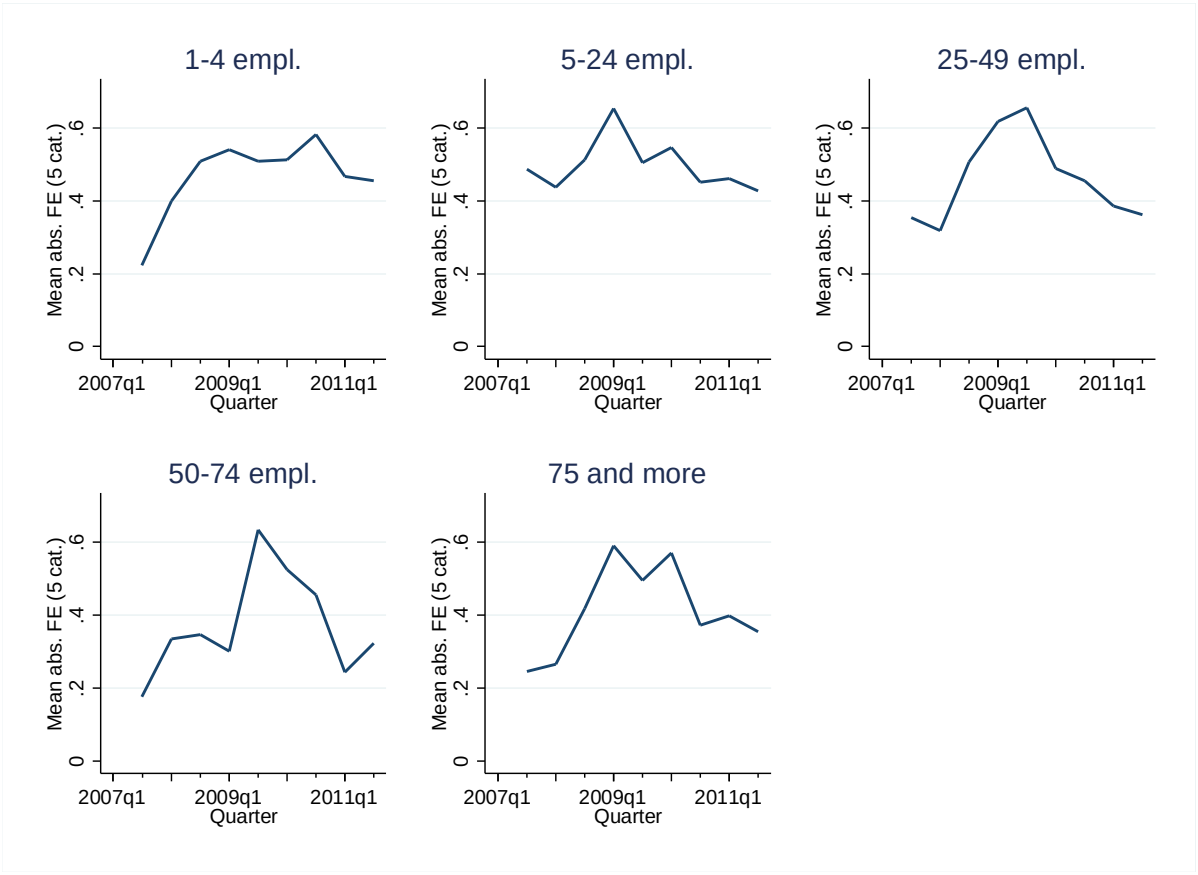

Figure 5. Survey based uncertainty measures and investment

This figure shows the pattern of the aggregate uncertainty measures derived from the survey responses and the evolution in the volume of equipment investment (percentage change). The standardized uncertainty measures (left axis) comprise the mean absolute forecast error (grey, dotted line) and the standard deviation of firms' forecast errors (red, dashed line). The change in the investment volume is depicted by the green, solid line (right axis applies). Information on the volume of equipment investment in billion Euros for the non-governmental sector is obtained from the German federal statistical office (www.destatis.de/EN).

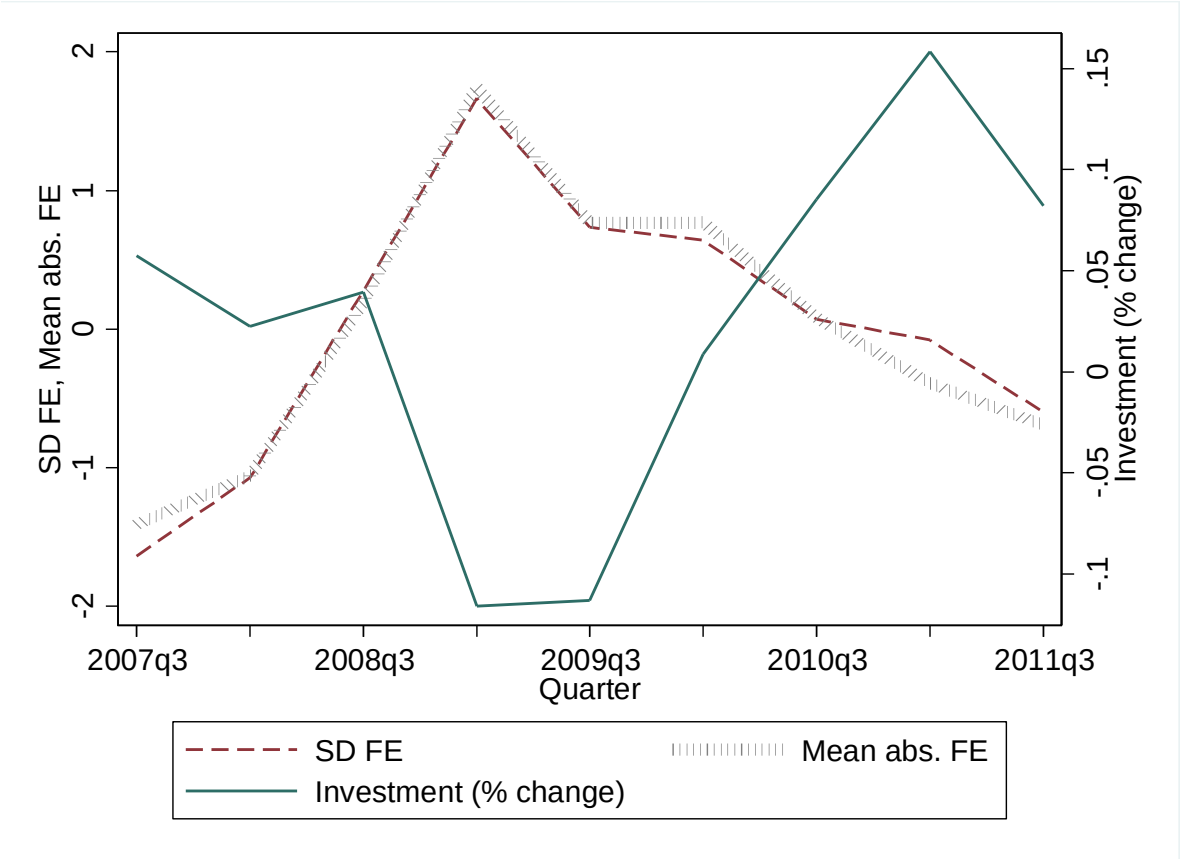

Figure 6. Planned investment change by size of forecast error regarding overall economic situation

This figure shows the distribution of firms' planned changes in investment for different sizes of the firm-specific forecast error based on the question on the firm's overall economic situation. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). The forecast error measures the difference between the actually realized situation in *t* and the expected economic situation in *t-1* for period *t*. Negative values signal that the realized situation was worse than expected (FE -2 and FE -1), positive values signal that the realized situation was better than expected (FE 1 and FE 2).

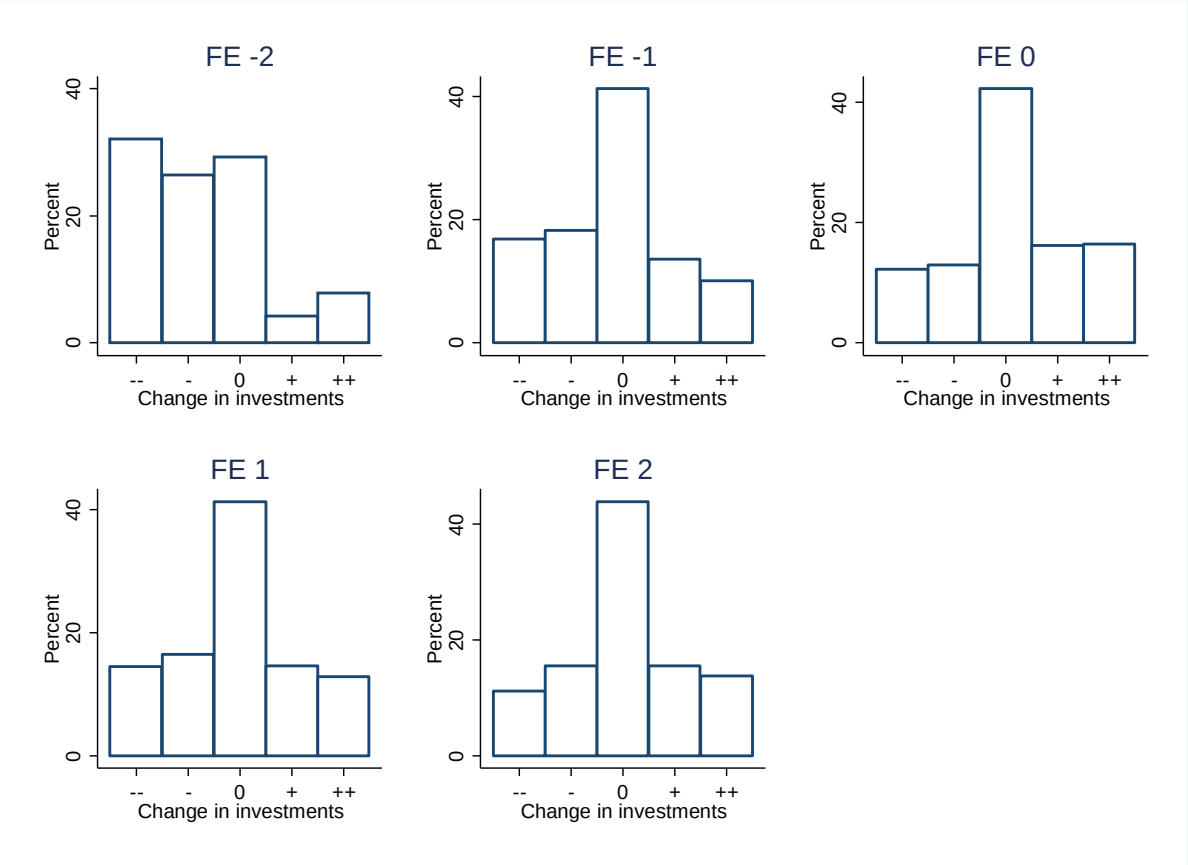

Figure 7. Planned investment change by expected change of the firms' overall economic situation

This figure shows the distribution of firms' planned changes in investment for different expected changes of the firm's overall economic situation. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). The expected change in the firm's overall economic situation is ordered in five categories: minus stands for a (strong) deterioration (-/--), zero for no change (0), and plus signals a (strong) improvement of the overall situation (+/++).

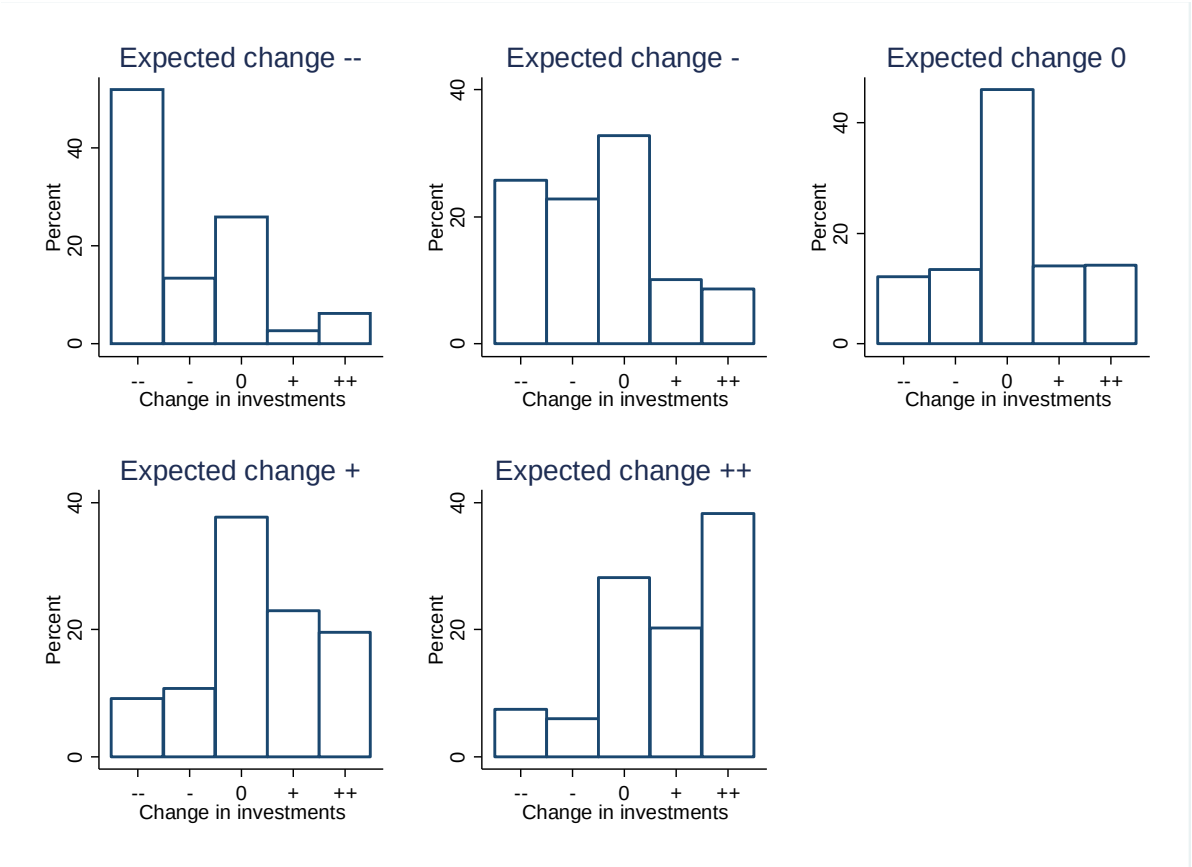

Figure 8. Planned investment change by risk attitude

This figure shows the distribution of firms' planned changes in investment for different expected changes of a firm's risk attitude. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). The risk attitude is defined as follows: minus indicates that they have a (very) low risk attitude (-/--), zero indicates that they have a moderate risk attitude (0), plus stands for a (very) high risk attitude (+/++).

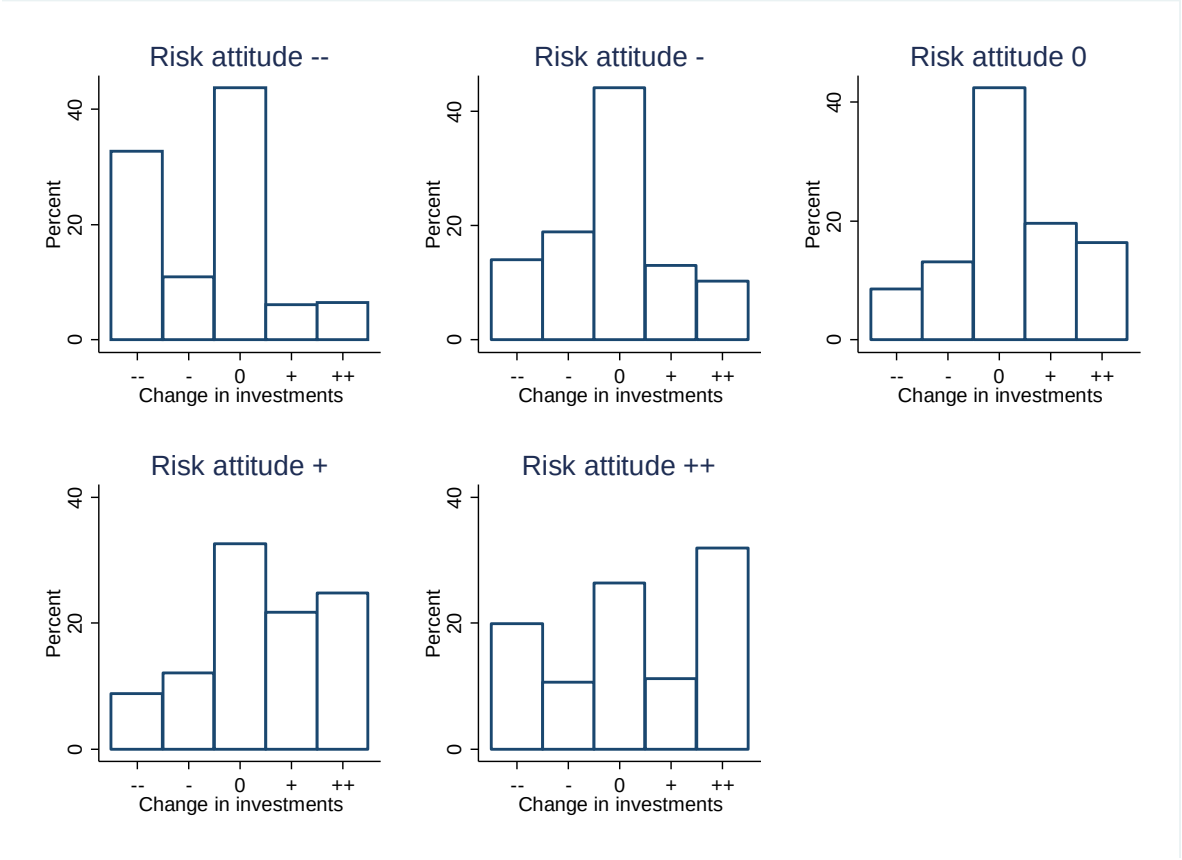

Figure 9. Planned investment change by financing situation

This figure shows the distribution of firms' planned changes in investment for different assessments of the firm's financing situation. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). The financing situation is defined as follows: lower values indicated that firms assess their financing situation as (very) bad (--/-), zero indicates that the financing situation is reasonable (0), higher values stand for a (very) good financing situation (+/++) .

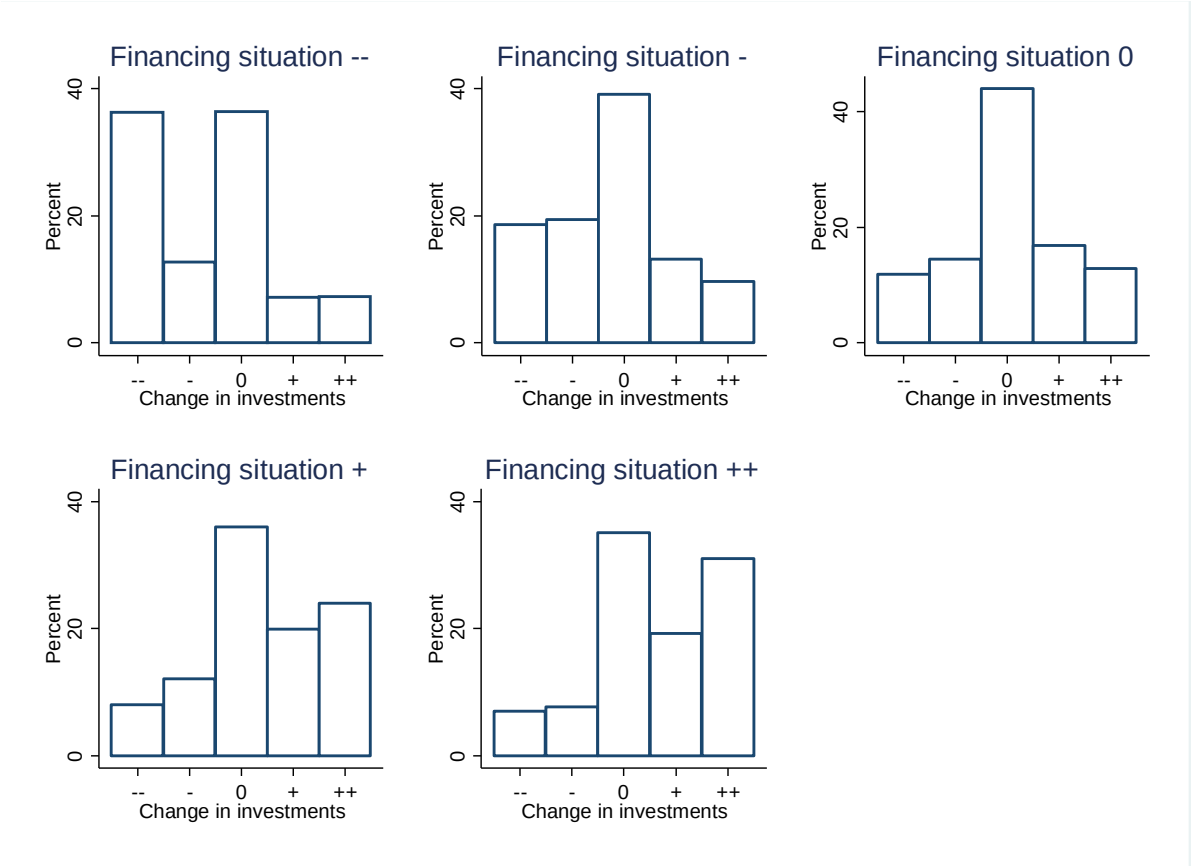

Table 1. Distribution of firms across subcategories of employees and wave

This table shows the distribution of firms across different subcategories of firm size measured by the number of employees and by wave (in %). The last column shows the total number of firms that have participated in the survey across the different waves from 2007Q1 to 2011Q3.

Wave	Emp<4	5≤Emp≤24	25≤Emp≤49	50≤Emp≤74	Emp≥75	n.a.	total #
2007q1	5	36	26	10	23	1	442
2007q3	16	43	18	5	17	1	661
2008q1	17	40	17	6	16	5	848
2008q3	16	37	14	4	15	13	1,006
2009q1	19	42	12	4	12	11	1,212
2009q3	19	42	12	4	10	13	1,182
2010q1	13	21	42	11	3	10	1,241
2010q3	21	44	10	5	10	10	1,161
2011q1	19	43	10	4	11	13	1,301
2011q3	21	41	12	3	10	13	1,212

Table 2. Summary statistics for firms' forecast error

This table shows the distribution of firms by the size of the forecast error derived from the question on the overall situation of the firm. The forecast error is divided into five categories and ranges from FE -2 (realized situation worse than expected) to FE 2 (realized situation better than expected). The columns show the percentage share of firms which made the respective forecast error for each wave and, in the lowest row, across the whole sample period from 2007Q3 to 2011Q3. Since 2007q1 has been the first wave and we do not have expectations for the preceding quarter, the forecast errors can only be calculated starting from 2007Q3. For visibility, numbers we specifically refer to in the text are depicted in bold.

Quarter	Wave	FE -2	FE -1	FE 0	FE 1	FE 2	total
2007q1	1	.	.	.	.	.	.
2007q3	2	2.8	19.2	69.2	8.4	0.5	100
2008q1	3	1.4	16.1	66.3	14.1	2.0	100
2008q3	4	**5.2**	**21.4**	58.8	12.9	1.7	100
2009q1	5	**6.9**	**24.9**	47.6	18.3	2.3	100
2009q3	6	3.2	16.2	53.3	**24.1**	**3.2**	100
2010q1	7	1.7	19.2	52.6	**22.4**	**4.1**	100
2010q3	8	2.5	18.5	57.8	18.8	2.4	100
2011q1	9	2.5	17.6	63.1	13.2	3.6	100
2011q3	10	3.1	19.2	64.6	11.1	1.9	100
2007q3-2011q3	total	3.3	19.1	58.3	16.7	2.6	100

Table 3. Baseline regression

a) Regression results

	(1)	(2)	(3)	(4)
Current situation				
Competition	0.082***	0.075***	0.083***	0.075***
	(0.026)	(0.028)	(0.026)	(0.027)
Financing	0.190***	0.197***	0.181***	0.187***
	(0.025)	(0.026)	(0.025)	(0.026)
Cost of material	-0.107***	-0.115***	-0.068***	-0.072***
	(0.024)	(0.026)	(0.026)	(0.027)
German economy	0.198***	0.204***	0.122***	0.125***
	(0.025)	(0.027)	(0.028)	(0.029)
Expected change				
Competition	0.090***	0.105***	0.081**	0.093***
	(0.032)	(0.034)	(0.032)	(0.034)
Financing	0.126***	0.116***	0.123***	0.111***
	(0.033)	(0.034)	(0.033)	(0.035)
Cost of material	-0.053**	-0.065**	-0.026	-0.035
	(0.025)	(0.026)	(0.025)	(0.027)
German economy	0.053*	0.047	0.050*	0.041
	(0.027)	(0.029)	(0.029)	(0.031)
Firm controls				
Revenue	-0.058***	-0.052***	-0.046***	-0.040**
	(0.016)	(0.017)	(0.016)	(0.017)
Risk and FE				
Risk attitude	0.185***	0.187***	0.188***	0.188***
	(0.021)	(0.022)	(0.021)	(0.022)
Absolute FE	-0.088***	-0.087***	-0.080**	-0.080**
	(0.031)	(0.033)	(0.032)	(0.033)
Observations	3,636	3,308	3,636	3,308
Pseudo R-squared	0.07	0.07	0.07	0.08
Sector-fixed effects	-	x	-	x
Time-fixed effects	-	-	x	x

Dependent variable is the change in investment measured on an ordinal 5 categories scale. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). Independent variable is the forecast error in absolute terms, such that higher values indicate a larger forecast error, that is the actual situation is different than the expected one. We control for a set of variables (competition, financing, cost of material, German economy) regarding the current situation and the expected change, both are also measured on a 5 category scale, where the lowest outcome stands for a very bad situation/strong worsening and the highest outcome for a very good situation/strong improvement. Furthermore, we control for the revenue and the risk attitude. Across the four different specifications, we include no fixed effects,

sector fixed effects, time fixed effects and both. The time span reaches from 2007 until 2011. The standard errors are clustered by firm and depicted in parentheses. The p-values are as follows: *** p<0.01, ** p<0.05, * p<0.1.

b) Marginal effects of forecast error

This table shows marginal effects of the absolute forecast error on investment across all outcome categories of investment. The marginal effects are shown for the regression model without any fixed effects (Table 3a, column 1). The standard errors are clustered by firm and depicted in parentheses. The p-values are as follows: *** p<0.01, ** p<0.05, * p<0.1.

Outcome category	(1) Strong decrease	(2) Decrease	(3) No change	(4) Increase	(5) Strong increase
Absolute forecast error	0.017***	0.010***	0.001	-0.010***	-0.018***
	(0.006)	(0.004)	(0.001)	(0.003)	(0.006)
Observations	3,636	3,636	3,636	3,636	3,636

Table 4. Direction of the forecast error

a) Regression results

	(1)	(2)	(3)	(4)
Current situation				
Competition	0.075***	0.066**	0.074***	0.064**
	(0.026)	(0.027)	(0.026)	(0.027)
Financing	0.186***	0.192***	0.176***	0.180***
	(0.025)	(0.026)	(0.025)	(0.026)
Cost of material	-0.109***	-0.116***	-0.067***	-0.070**
	(0.024)	(0.026)	(0.026)	(0.027)
German economy	0.193***	0.199***	0.113***	0.113***
	(0.025)	(0.027)	(0.028)	(0.029)
Expected change				
Competition	0.095***	0.112***	0.087***	0.101***
	(0.032)	(0.034)	(0.032)	(0.034)
Financing	0.129***	0.120***	0.126***	0.116***
	(0.033)	(0.034)	(0.033)	(0.035)
Cost of material	-0.051**	-0.062**	-0.024	-0.033
	(0.025)	(0.026)	(0.026)	(0.027)
German economy	0.055**	0.048*	0.056*	0.048
	(0.028)	(0.029)	(0.029)	(0.031)
Firm controls				
Revenue	-0.057***	-0.051***	-0.044***	-0.038**
	(0.016)	(0.017)	(0.016)	(0.017)
Risk and FE				
Risk attitude	0.187***	0.190***	0.191***	0.192***
	(0.021)	(0.022)	(0.021)	(0.022)
Forecast error < 0	-0.160***	-0.173***	-0.161***	-0.177***
	(0.039)	(0.041)	(0.040)	(0.041)
Forecast error ≥0	-0.010	0.008	0.009	0.026
	(0.039)	(0.041)	(0.040)	(0.042)
Observations	3,636	3,308	3,636	3,308
Pseudo R-squared	0.07	0.07	0.08	0.08
Sector-fixed effects	-	x	-	x
Time-fixed effects	-	-	x	x

Dependent variable is the change in investment measured on an ordinal 5 categories scale. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). Independent variable is the absolute forecast error, high values of this forecast error mean that the situation is different than expected a period before, whereas we make a distinction between a forecast error that is greater than or equal to zero and negative forecast errors. We control for a set of variables (competition, financing, cost of material, German economy) regarding the current situation and the expected change, both are also measured on a 5 category scale, where the lowest outcome stands for a very bad situation/strong worsening and the highest outcome for a very good situation/strong improvement. Furthermore we control for the revenue and the risk attitude. We run four different specifications including no fixed effects, sector fixed effects, time fixed

effects and both. The time span reaches from 2007 until 2011. The standard errors are clustered by firm and depicted in parentheses. The p-values are as follows: *** p<0.01, ** p<0.05, * p<0.1.

b) Marginal effects of forecast error

This table shows marginal effects of the forecast error on investment across all outcome categories of investment for negative forecast errors and zero/positive forecast errors separately. The marginal effects are shown for the regression model without any fixed effects (Table 4a, column 1). The standard errors are clustered by firm and depicted in parentheses. The p-values are as follows: *** p<0.01, ** p<0.05, * p<0.1.

Outcome category	(1)	(2)	(3)	(4)	(5)
	Strong decrease	Decrease	No change	Increase	Strong increase
Forecast error < 0	0.032***	0.018***	-0.000	-0.017***	-0.032***
	(0.008)	(0.004)	(0.001)	(0.004)	(0.008)
Forecast error ≥0	0.002	0.001	0.000	-0.001	-0.002
	(0.007)	(0.004)	(0.001)	(0.004)	(0.008)
Observations	3,636	3,636	3,636	3,636	3,636

Table 5. Stability of expectations as ex-ante firm-specific uncertainty

a) Regression results

	(1)	(2)	(3)	(4)
Current situation				
Competition	0.050***	0.048**	0.049***	0.048**
	(0.019)	(0.020)	(0.019)	(0.020)
Financing	0.118***	0.123***	0.114***	0.119***
	(0.018)	(0.019)	(0.018)	(0.019)
Cost of material	-0.089***	-0.101***	-0.047**	-0.055***
	(0.018)	(0.019)	(0.018)	(0.020)
German economy	0.186***	0.188***	0.116***	0.111***
	(0.018)	(0.020)	(0.020)	(0.021)
Expected change				
Competition	0.060***	0.064***	0.054**	0.055**
	(0.022)	(0.024)	(0.022)	(0.024)
Financing	0.158***	0.139***	0.151***	0.131***
	(0.024)	(0.026)	(0.024)	(0.026)
Cost of material	-0.039**	-0.035*	-0.010	-0.003
	(0.018)	(0.020)	(0.019)	(0.020)
German economy	0.057***	0.057***	0.048**	0.047**
	(0.019)	(0.020)	(0.020)	(0.022)
Firm controls				
Revenue	-0.060***	-0.061***	-0.053***	-0.053***
	(0.011)	(0.013)	(0.012)	(0.013)
Risk and FE				
Risk attitude	0.169***	0.172***	0.168***	0.170***
	(0.015)	(0.016)	(0.015)	(0.016)
Stability of expectations	0.186***	0.189***	0.180***	0.184***
	(0.019)	(0.020)	(0.019)	(0.020)
Observations	6,959	5,991	6,959	5,991
Pseudo R-squared	0.07	0.07	0.08	0.08
Sector-fixed effects	-	x	-	x
Time-fixed effects	-	-	x	x

Dependent variable is the change in investment measured on an ordinal 5 categories scale. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). Independent variable is the stability of expectations (5 categories), where small values signal that the situation is instable and high values stand for a stable situation. We control for a set of variables (competition, financing, cost of material, German economy) regarding the current situation and the expected change, both are also measured on a 5 category scale, where the lowest outcome stands for a very bad situation/strong worsening and the highest outcome for a very good situation/strong improvement. Furthermore we control for the revenue and the risk attitude. Across the four different specifications, we include no fixed effects,

sector fixed effects, time fixed effects and both. The time span reaches from 2007 until 2011. The standard errors are clustered by firm and depicted in parentheses. The p-values are as follows: *** p<0.01, ** p<0.05, * p<0.1.

b) Marginal effects of stability of expectations

This table shows marginal effects of the ex-ante firm-specific uncertainty measure captured by the stability of expectations on investment across all outcome categories of investment. The marginal effects are shown for the regression model without any fixed effects (Table 5a, column 1). The standard errors are clustered by firm and depicted in parentheses. The p-values are as follows: *** p<0.01, ** p<0.05, * p<0.1.

Outcome category	(1) Strong decrease	(2) Decrease	(3) No change	(4) Increase	(5) Strong increase
Stability of expectations	-0.036***	-0.019***	-0.003***	0.019***	0.040***
	(0.004)	(0.002)	(0.001)	(0.002)	(0.004)
Observations	6,959	6,959	6,959	6,959	6,959

Table 6. Stability of expectations as dependent variable

	(1)	(2)	(3)	(4)
Current situation				
Competition	0.213***	0.214***	0.214***	0.215***
	(0.029)	(0.032)	(0.030)	(0.032)
Financing	0.277***	0.282***	0.274***	0.278***
	(0.027)	(0.028)	(0.027)	(0.028)
Cost of material	0.034	0.031	0.046*	0.044
	(0.025)	(0.026)	(0.026)	(0.028)
German economy	0.268***	0.263***	0.252***	0.249***
	(0.027)	(0.029)	(0.030)	(0.032)
Expected change				
Competition	0.080***	0.073**	0.074**	0.068**
	(0.031)	(0.032)	(0.031)	(0.032)
Financing	0.075**	0.066*	0.074**	0.065*
	(0.033)	(0.034)	(0.033)	(0.034)
Cost of material	-0.043*	-0.055**	-0.030	-0.043
	(0.025)	(0.027)	(0.026)	(0.027)
German economy	0.054*	0.069**	0.047	0.061*
	(0.029)	(0.031)	(0.030)	(0.032)
Firm controls				
Revenue	0.105***	0.113***	0.109***	0.115***
	(0.018)	(0.019)	(0.018)	(0.020)
Risk and FE				
Risk attitude	0.091***	0.104***	0.091***	0.103***
	(0.023)	(0.024)	(0.023)	(0.024)
Forecast error	-0.129***	-0.111***	-0.125***	-0.107***
	(0.034)	(0.035)	(0.034)	(0.036)
Observations	3,604	3,279	3,604	3,279
Pseudo R-squared	0.13	0.13	0.13	0.14
Sector-fixed effects	-	x	-	x
Time-fixed effects	-	-	x	x

Dependent variable is the stability of expectations measured on an ordinal 5 categories scale. (Very) unstable expectations correspond to minus (-/--), zero stands for moderate stability (0), and plus for (very) stable expectations (+/++). Independent variable is the forecast error in absolute terms, such that higher values indicate a larger forecast error, that is the actual situation is different than the expected one. We control for a set of variables (competition, financing, cost of material, German economy) regarding the current situation and the expected change, both are also measured on a 5 category scale, where the lowest outcome stands for a very bad situation/strong worsening and the highest outcome for a very good situation/strong improvement. Furthermore, we control for the revenue and the risk attitude. Across the four different specifications, we include no fixed effects, sector fixed effects, time fixed effects and both. The time span reaches from 2007 until 2011. The standard errors are clustered by firm and depicted in parentheses. The p-values are as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 7. Robustness tests I

	Ologit	Random effects Oprobit	Clustering by sector	Wave 3-10	Only spring survey	Correlated random effects model
	(1)	(2)	(3)	(4)	(5)	(6)
Current situation						
Competition	0.137***	0.096***	0.076*	0.080***	0.070*	0.095***
	(0.045)	(0.028)	(0.039)	(0.027)	(0.037)	(0.035)
Financing	0.326***	0.213***	0.193***	0.181***	0.203***	0.231***
	(0.043)	(0.027)	(0.027)	(0.025)	(0.033)	(0.038)
Cost of material	-0.197***	-0.128***	-0.113***	-0.116***	-0.136***	-0.154***
	(0.042)	(0.026)	(0.021)	(0.025)	(0.036)	(0.032)
German economy	0.345***	0.214***	0.202***	0.203***	0.204***	0.173***
	(0.044)	(0.027)	(0.042)	(0.026)	(0.035)	(0.032)
Expected change						
Competition	0.168***	0.089***	0.102***	0.107***	0.138***	0.080**
	(0.057)	(0.034)	(0.032)	(0.033)	(0.045)	(0.040)
Financing	0.234***	0.130***	0.121***	0.131***	0.103**	0.098**
	(0.058)	(0.035)	(0.030)	(0.033)	(0.050)	(0.041)
Cost of material	-0.100**	-0.049*	-0.065***	-0.052**	-0.048	-0.021
	(0.044)	(0.027)	(0.016)	(0.026)	(0.036)	(0.032)
German economy	0.103**	0.068**	0.044*	0.042	0.062	0.071**
	(0.048)	(0.029)	(0.025)	(0.028)	(0.041)	(0.033)
Firm controls						
Revenue	-0.105***	-0.065***	-0.061***	-0.059***	-0.050**	-0.042
	(0.027)	(0.017)	(0.020)	(0.016)	(0.022)	(0.053)
Risk and FE						
Risk attitude	0.316***	0.207***	0.188***	0.184***	0.191***	0.205***
	(0.036)	(0.022)	(0.024)	(0.021)	(0.027)	(0.033)
Absolute FE	-0.163***	-0.093***	-0.085**	-0.084***	-0.097**	-0.074*
	(0.054)	(0.033)	(0.033)	(0.032)	(0.044)	(0.038)
Observations	3,636	3,636	3,308	3,453	1,660	3,636
Pseudo R-squared	0.07	-	0.07	0.07	0.08	0.07
Sector-fixed effects	-	-	-	-	-	-
Time-fixed effects	-	-	-	-	-	-

This table shows various robustness tests for the baseline model (equation 1). Dependent variable is the change in investment measured on an ordinal 5 categories scale. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). Independent variable is the absolute forecast error. We control for a set of variables (competition, financing, cost of material, German economy) regarding the current situation and the expected change, both are also measured on a 5 category scale, where the lowest outcome stands for a very bad situation/strong worsening and the highest outcome for a very

good situation/strong improvement. Furthermore, we control for the revenue and the risk attitude. Regression results based on an ordered logit model are shown in column 1. In column 2, we use a random effects ordered probit model. In column 3, standard errors are not clustered by firm but by sector. The sample starts beginning from wave 3 in column 4 and in column 5 only spring surveys are included. The final column shows results from a correlated random effects model. No fixed effects are included. The time span reaches from 2007 until 2011 if not indicated otherwise. The standard errors are clustered by firm if not indicated otherwise and depicted in parentheses. The p-values are as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 8. Robustness tests II

	Sales target (instead of revenue) (1)	Revenue & Employees & Sales target (2)	ΔRisk attitude (instead of risk attitude) (3)	Average FE (4)	Negative FE (5)	Positive FE (6)
Current situation						
Competition	0.076***	0.075***	0.099***	0.081***	0.046	0.002
	(0.025)	(0.026)	(0.026)	(0.026)	(0.058)	(0.063)
Financing	0.166***	0.181***	0.214***	0.190***	0.249***	0.100**
	(0.024)	(0.025)	(0.024)	(0.025)	(0.051)	(0.051)
Cost of material	-0.104***	-0.109***	-0.112***	-0.107***	-0.112**	-0.146***
	(0.024)	(0.025)	(0.024)	(0.024)	(0.051)	(0.055)
German economy	0.198***	0.196***	0.226***	0.198***	0.196***	0.233***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.051)	(0.054)
Expected change						
Competition	0.090***	0.094***	0.084***	0.091***	0.054	0.099
	(0.032)	(0.032)	(0.032)	(0.032)	(0.065)	(0.062)
Financing	0.128***	0.125***	0.121***	0.126***	0.002	0.295***
	(0.032)	(0.033)	(0.033)	(0.033)	(0.068)	(0.066)
Cost of material	-0.052**	-0.053**	-0.045*	-0.053**	-0.023	-0.031
	(0.025)	(0.025)	(0.025)	(0.025)	(0.055)	(0.053)
German economy	0.053*	0.056**	0.036	0.053*	0.034	-0.016
	(0.028)	(0.028)	(0.028)	(0.028)	(0.058)	(0.059)
Firm controls						
Revenue		-0.070***	-0.039**	-0.058***	-0.098***	-0.060*
		(0.023)	(0.016)	(0.016)	(0.031)	(0.031)
Employees		0.011				
		(0.022)				
Sales target	0.027	0.032				
	(0.021)	(0.022)				
Risk and FE						
Risk attitude	0.183***	0.187***		0.186***	0.147***	0.216***
	(0.020)	(0.021)		(0.021)	(0.039)	(0.043)
ΔRisk attitude			0.160***			
			(0.032)			
Absolute FE	-0.079**	-0.079**	-0.084***	-0.088***	-0.413***	0.007
	(0.031)	(0.032)	(0.031)	(0.031)	(0.118)	(0.111)
Average FE				0.016		
				(0.047)		
Observations	3,687	3,590	3,637	3,636	820	701
Pseudo R-squared	0.07	0.07	0.06	0.07	0.06	0.07
Sector-fixed effects	-		-	-	-	-
Time-fixed effects	-		-	-	-	-

This table shows various robustness tests for the baseline model (equation 1). Dependent variable is the change in investment measured on an ordinal 5 categories scale. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). Independent variable is the absolute forecast error. We control for a set of variables (competition, financing, cost of material, German economy) regarding the current situation and the expected change, both are also measured on a 5 category scale,

where the lowest outcome stands for a very bad situation/strong worsening and the highest outcome for a very good situation/strong improvement. Furthermore, we control for the revenue and the risk attitude. In column 1, the achievement of the sales target is included instead of the revenue and in column 2, the variables revenue, the achievement of the sales target, and employees are jointly included. In column 3, we exchange the current risk attitude by the expected change in the risk attitude. In column 4, we additionally include the average forecast error by firm. Finally, we run regressions for all observations at which firms have a negative forecast error (column 5) or a positive forecast error (column 6) whereas in both cases we take the absolute value of the forecast error. No fixed effects are included. The time span reaches from 2007 until 2011 if not indicated otherwise. The standard errors are clustered by firm if not indicated otherwise and depicted in parentheses. The p-values are as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 9. Robustness tests – Linear estimation

	Absolute FE		Asymmetric FE	
	SE clustered by firm	SE clustered by sector and time	SE clustered by firm	SE clustered by sector and time
	(1)	(2)	(3)	(4)
Current situation				
Competition	0.092**	0.077*	0.076**	0.067
	(0.036)	(0.043)	(0.036)	(0.043)
Financing	0.215***	0.186***	0.207***	0.179***
	(0.039)	(0.035)	(0.039)	(0.034)
Cost of material	-0.120***	-0.072**	-0.123***	-0.070**
	(0.033)	(0.034)	(0.033)	(0.034)
German economy	0.112***	0.125***	0.091**	0.113***
	(0.036)	(0.032)	(0.036)	(0.033)
Expected change				
Competition	0.074*	0.090***	0.076*	0.098***
	(0.040)	(0.029)	(0.040)	(0.028)
Financing	0.087**	0.109**	0.087**	0.114***
	(0.041)	(0.043)	(0.041)	(0.042)
Cost of material	0.006	-0.034	0.008	-0.032
	(0.033)	(0.031)	(0.033)	(0.030)
German economy	0.064*	0.040	0.064*	0.046
	(0.035)	(0.038)	(0.035)	(0.039)
Firm controls				
Revenue	-0.043	-0.040	-0.036	-0.038
	(0.052)	(0.028)	(0.051)	(0.027)
Risk and FE				
Risk attitude	0.199***	0.189***	0.197***	0.192***
	(0.032)	(0.021)	(0.032)	(0.022)
Absolute FE	-0.066*	-0.083***		
	(0.039)	(0.026)		
Forecast error < 0			-0.187***	-0.178***
			(0.048)	(0.038)
Forecast error ≥0			0.067	0.023
			(0.049)	(0.024)
Observations	3,636	3,308	3,636	3,308
R-squared	0.164	0.208	0.172	0.212
Firm-fixed effects	x	-	x	-
Sector-fixed effects	x	x	x	x
Time-fixed effects	x	x	x	x

Dependent variable is the change in investment measured on an ordinal 5 categories scale, whereas the model is estimated with ordinary least squares. A (strong) reduction in investments corresponds to minus (-/--), zero stands for no change (0), and plus for a (strong) increase in investments (+/++). Independent variable is the absolute forecast error. High values of this forecast error mean that the situation is different than expected a period before.

In columns 3 and 4, we make a distinction between a forecast error that is greater than or equal to zero and negative forecast errors. We control for a set of variables (competition, financing, cost of material, German economy) regarding the current situation and the expected change, both are also measured on a 5 category scale, where the lowest outcome stands for a very bad situation/strong worsening and the highest outcome for a very good situation/strong improvement. Furthermore we control for the revenue and the risk attitude. In columns 1 and 3, the regressions include firm (and thus also sector) and time fixed effects. Standard errors are clustered at the firm level and depicted in parentheses. In columns 2 and 4, we include sector and time fixed effects. Standard errors are clustered by sector and time using two-way clustering and depicted in parentheses. The time span reaches from 2007 until 2011. The p-values are as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Halle Institute for
Economic Research (IWH)

IWH Risk Climate Index

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Kleine Maerkerstraße 8
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Survey code: XXXX

New address:

Your answers will be treated confidentially. Statutory data protection is fully assured. No transfer of the data to a third party.

Short answer (Please fill in only if answering the questionnaire is not possible.):

☐ I'm the wrong contact person.
Please contact:

Name: _____ Phone: _____

Position in the company: _____

☐ The participation in this survey is not possible for our company,

because _____.

Survey Spring 2011

1. How do you evaluate the current situation based on the following categories from the perspective of your company? What do you expect with respect to the future development in the following six months?

	a) The current situation from the perspective of your company						b) The development in the following six months					
	very bad				very good	no response	Deteriora-tion		no change		Improve-ment	no response
	--	-	0	+	++		--	-	0	+	++	
1.1 Overall situation of the company	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.1 Production/ Goods and services	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.2 Revenue	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.3 Competitive environment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.4 Financing of investment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.5 Costs of inputs and raw materials	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.6 Labor supply	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.7 General conditions of economic policy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.2 Overall economic situation in Germany	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. How do you evaluate the stability of the expected development based on the following categories? Which are the resulting implications for your company?

	a) The stability of the development in the following six months						b) The resulting implications for your company					
	very instable				very stable	no response	negative implications		no implications		positive implications	no response
	--	-	0	+	++		--	-	0	+	++	
2.1 Overall situation of the company	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.1 Production/ Goods and services	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.2 Revenue	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.3 Competitive environment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.4 Financing of investment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.5 Costs of inputs and raw materials	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.6 Labor supply	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.7 General conditions of economic policy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.2 Overall economic situation in Germany	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. How do you evaluate the willingness to take risks of your company?

	very low				very high	no response
Current willingness to take risks	☐	☐	☐	☐	☐	☐

4. Which change in the willingness to take risks of your company do you expect in the following six months?

	increase		no change		decrease	no response
Change in the willingness to take risks in the following six months	☐	☐	☐	☐	☐	☐

5. Has the sales target of your company for the last business year been achieved?

	better than targeted		achieved		worse than targeted	no response
Achievment of sales target	☐	☐	☐	☐	☐	☐

6. Which changes in the investment volume do you expect for the current business year compared to the last business year?

	decrease		no change		increase	no response
Change of investment volume for the current business year	☐	☐	☐	☐	☐	☐

General information concerning your company

7. On which area of the sector ´Repair and installation of machinery and equipment` does the focus of your company lie?

☐ Repair of fabricated metal products, machinery and equipment

☐ Installation of industrial machinery and equipment

☐ A different area of the sector named above

☐ Our focus is not in the sector above, but: _____

8. What is your most important product? _____

9. How many employees (without apprentices) work in your company?

☐ 1 - 4 ☐ 5 - 24 ☐ 25 - 49 ☐ 50 - 74 ☐ 75 and more

10. How large was your approximate revenue in the last business year?

☐ < 250 T€ ☐ 250 - 499 T€ ☐ 500 - 999 T€ ☐ 1 - 5 Mio. € ☐ > 5 Mio. €

11. How large was the fraction of the revenue from foreign sales?

☐ < 1 % ☐ 1 - 10 % ☐ 11 - 20 % ☐ 21 - 40 % ☐ > 40 %

Contact person in your company

Name: _____ Position in your company: _____

Phone: _____ Fax: _____ Email: _____

The evaluation of the results should be sent by: ☐ Mail ☐ Fax ☐ Email ☐ not at all

Thank you very much for your cooperation.

Please provide suggestions and further comments here.

Please send us back the questionnaire until Friday **04/08/2011**

Asymmetric Investment Responses to Firm-Specific Forecast Errors*

Appendix B

* All errors and inconsistencies are solely in our own responsibility.

Table B1: Descriptive statistics

This table shows descriptive statistics for the observations included in the baseline regression sample (Table 3a, column 1). In panel a) summary statistics of the variables used in the regression analysis and in panel b) correlations among the dependent variable (*Change in investment*) and the explanatory variables used in the regression analysis are shown. For further explanation of the variables, see the data description in Appendix A1 of the paper. E() denotes expected changes of the respective variable.

Panel a): Summary statistics

	Observations	Mean	Std. Dev.	Min	Max
Change in investment	3,636	3.02	1.20	1.00	5.00
Risk attitude	3,636	2.72	1.08	1.00	5.00
Expected change in risk	3,617	2.97	0.71	1.00	5.00
Forecast error	3,636	0.48	0.61	0.00	2.00
Stability of expectations	3,576	3.32	0.87	1.00	5.00
Competition	3,636	3.08	0.86	1.00	5.00
Financing	3,636	3.04	1.05	1.00	5.00
Cost of material	3,636	2.62	0.87	1.00	5.00
German economy	3,636	2.90	0.90	1.00	5.00
E(Competition)	3,636	2.94	0.75	1.00	5.00
E(Financing)	3,636	2.86	0.75	1.00	5.00
E(Cost of material)	3,636	2.57	0.83	1.00	5.00
E(German economy)	3,636	2.79	0.83	1.00	5.00
Revenue	3,636	3.63	1.27	1.00	5.00
Employees	3,621	2.62	1.31	1.00	5.00
Sales target	3,605	2.74	1.06	1.00	5.00
East/west dummy	3,131	0.17	0.38	0.00	1.00

Panel b): Correlation table

	a)	b)	c)	d)	e)	f)	g)	h)	i)	j)	k)	l)	m)	n)	o)	p)	q)
a) Change in investment	1.00																
b) Risk attitude	0.26	1.00															
c) Expected change in risk	0.13	0.05	1.00														
d) Forecast error	-0.11	-0.06	-0.03	1.00													
e) Stability of expectations	0.30	0.21	0.07	-0.15	1.00												
f) Competition	0.19	0.16	0.04	-0.13	0.30	1.00											
g) Financing	0.28	0.21	0.02	-0.17	0.40	0.29	1.00										
h) Cost of material	-0.04	0.05	0.05	-0.04	0.08	0.15	0.17	1.00									
i) German economy	0.30	0.18	0.02	-0.15	0.35	0.23	0.30	-0.03	1.00								
j) E(Competition)	0.17	0.11	0.13	-0.03	0.20	0.45	0.10	0.07	0.16	1.00							
k) E(Financing)	0.22	0.16	0.14	-0.04	0.26	0.14	0.43	0.10	0.21	0.31	1.00						
l) E(Cost of material)	-0.01	0.03	0.02	-0.03	0.04	0.08	0.07	0.43	-0.01	0.16	0.18	1.00					
m) E(German economy)	0.17	0.11	0.17	-0.03	0.18	0.10	0.11	0.09	0.39	0.24	0.35	0.12	1.00				
n) Revenue	0.03	0.15	-0.01	-0.04	0.20	0.03	0.27	0.01	0.08	-0.03	0.09	-0.01	0.03	1.00			
o) Employees	0.04	0.16	-0.02	-0.05	0.17	0.03	0.24	0.01	0.08	-0.02	0.09	0.01	0.03	0.72	1.00		
p) Sales target	0.15	0.13	0.02	-0.14	0.29	0.21	0.33	0.12	0.18	0.07	0.11	0.06	0.02	0.18	0.11	1.00	
q) East/west dummy	0.01	0.03	0.03	-0.02	0.00	0.05	0.00	-0.04	0.03	0.04	0.01	-0.02	0.00	0.02	0.05	0.02	1.00

Table B2: Distribution of firms across subcategories of sectors and wave

This table shows the distribution of firms across different subcategories of sectors and by wave (in %). Sectors in the manufacturing industry are classified between 10 and 33 as described in Appendix A2 of the paper.

Sector	2007q1	2007q3	2008q1	2008q3	2009q1	2009q3	2010q1	2010q3	2011q1	2011q3
10	0	0	3	4	7	7	8	7	9	8
11	0	0	1	1	1	1	1	2	1	1
12	0	0	0	0	0	0	0	0	0	0
13	0	0	2	2	2	2	2	2	2	2
14	0	0	1	1	1	1	1	1	1	1
15	0	1	1	1	1	1	1	1	1	1
16	25	18	11	9	7	7	6	6	7	7
17	1	1	2	2	2	2	1	2	2	2
18	0	0	3	3	5	4	5	5	6	6
19	0	0	0	0	0	0	0	0	0	0
20	8	6	5	5	4	4	4	4	4	3
21	2	2	1	1	1	1	1	1	1	1
22	1	1	4	4	5	4	5	5	5	5
23	0	11	7	7	6	6	5	6	5	6
24	1	1	2	3	2	3	3	3	2	2
25	5	3	13	13	15	13	16	15	15	15
26	15	12	12	9	8	8	7	8	7	7
27	1	1	2	3	3	3	3	4	4	4
28	35	31	21	19	15	16	14	15	14	13
29	1	2	2	2	1	1	2	1	1	1
30	1	1	1	1	1	1	1	1	1	1
31	1	1	2	2	2	2	3	2	3	2
32	4	4	3	7	6	8	7	8	6	8
33	2	2	2	3	6	6	3	3	3	4
total	100	100	100	100	100	100	100	100	100	100

Table B3. Distribution of firms across subcategories of revenue and wave

This table shows the distribution of firms across different subcategories of revenues and by wave (in %). The last column shows the total number of firms that have participated in the survey across the different waves from 2007Q1 to 2011Q3.

Wave	Rev<250 k €	250≤Rev≤499 k €	500≤Rev≤999 k €	1≤Rev≤5 mn €	Rev>5 mn €	n.a.	total #
2007q1	3	4	6	45	40	2	442
2007q3	9	9	12	36	30	4	661
2008q1	10	10	11	34	28	7	848
2008q3	10	10	12	29	24	16	1,006
2009q1	9	11	14	32	22	12	1,212
2009q3	10	12	13	31	19	15	1,182
2010q1	11	12	17	29	17	15	1,241
2010q3	13	13	16	30	17	12	1,161
2011q1	11	11	15	30	19	15	1,301
2011q3	11	13	15	29	18	15	1,212

Table B4. Distribution of firms' responses on investment propensity across waves

This table shows the percentage share of firms answering that they expect a strong decrease (--), decrease (-), no change (0), increase (+), or strong increase (++) in their investment behavior by wave.

Wave	Strong decrease	Decrease	No change	Increase	Strong increase	n.a.	total
2007q1	5	7	38	25	23	2	100
2007q3	11	9	39	18	21	2	100
2008q1	9	14	39	17	18	3	100
2008q3	16	17	40	11	13	3	100
2009q1	32	20	28	9	8	2	100
2009q3	22	17	36	12	10	3	100
2010q1	13	14	42	15	14	3	100
2010q3	9	10	43	18	17	3	100
2011q1	7	9	43	19	18	3	100
2011q3	9	13	44	15	16	2	100

Figure B1. Distribution of German manufacturing firms across employee classes

This figure shows the number of local units in the German manufacturing sector by employee classes (left axis). The average revenue (million Euro) of the firms in one employee class is depicted on the right axis. Data refer to the year 2011 and cover all local units with 20 or more persons employed as obtained from the annual reports on manufacturing of the German federal statistical office (www.destatis.de/EN).

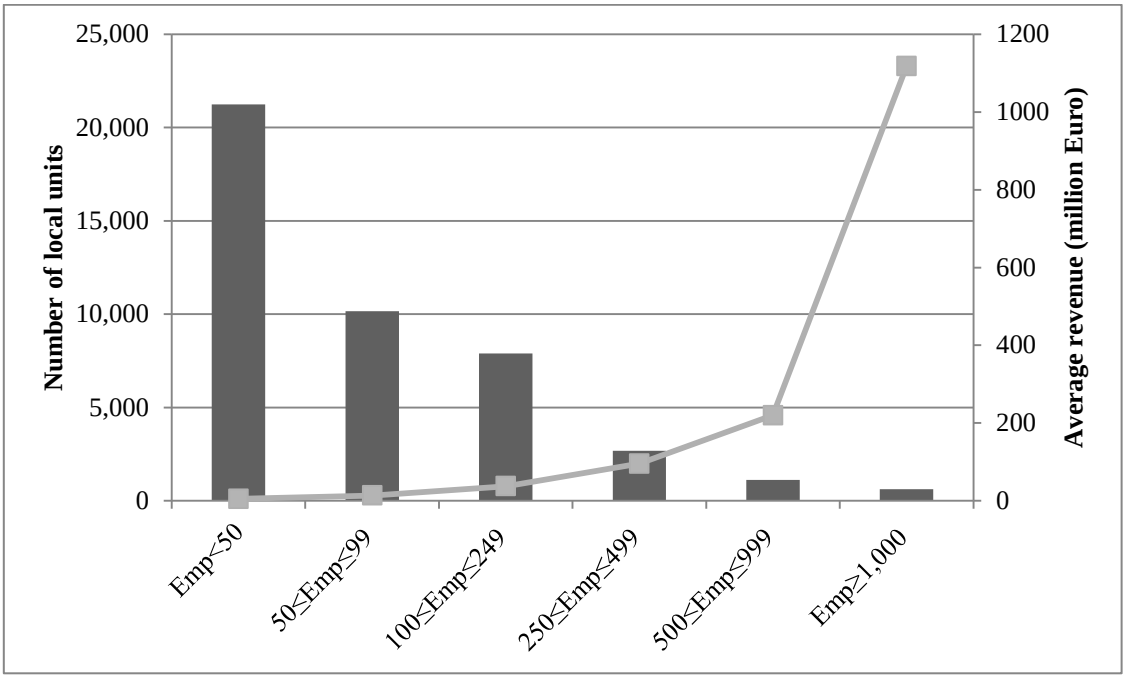


Figure B2. Comparison of firm distribution across sectors with official data

This figure shows the distribution of firms in the German manufacturing sector across sectors (in %). Data refer to the year 2011. "Official data" refers to all local units with 50 or more persons employed as obtained from the monthly report on manufacturing of the German federal statistical office. "Official data (smaller firms)" refers to all local units with 20 or more but less than 250 persons employed as obtained from the annual report of the German federal statistical office (www.destatis.de/EN). "IWH survey data" represents the share of firms by manufacturing sector derived from the IWH risk climate survey.

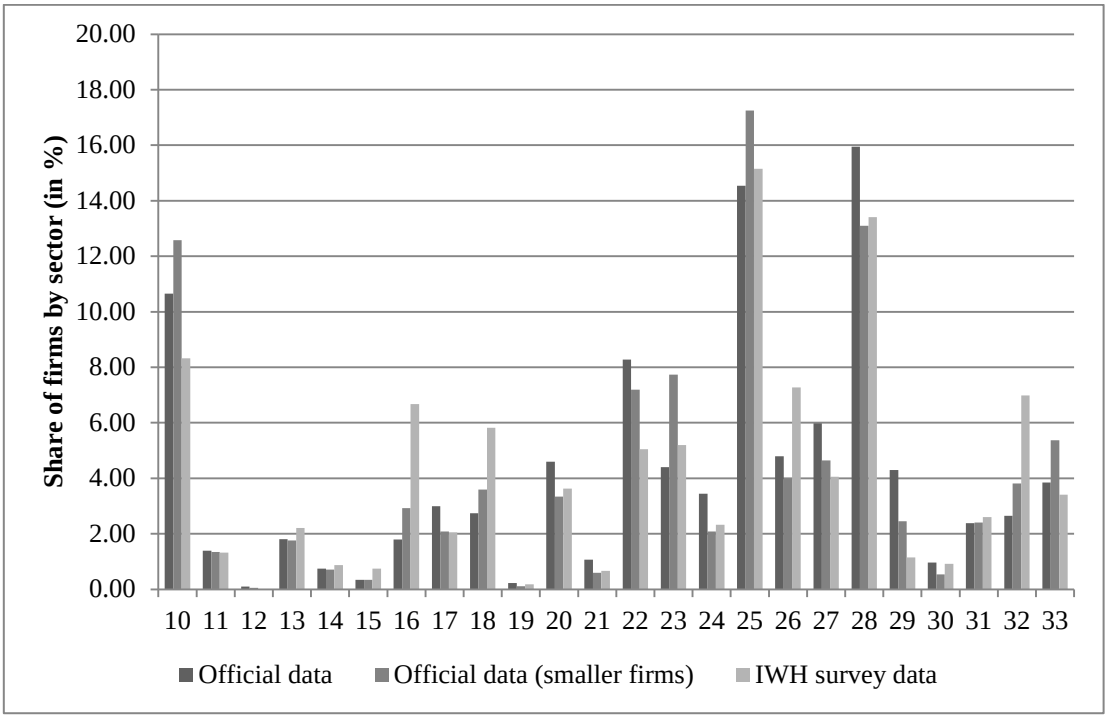


Figure B3. Evolution of mean absolute forecast error (5 categories) over time for different firm revenues

This figure shows the mean absolute forecast error of the overall situation over time. The mean absolute forecast error is calculated by taking the mean of the absolute values of firms' forecast errors. The firms' forecast error is the difference between the firm's actual situation and the previously expected situation. The series is depicted by subcategory of firm revenue. The firms can be divided in five different subcategories: 0-249 thousand Euros, 250-499 thousand Euros, 500-999 thousand Euros, 1-5 million Euros, and more than five million Euros.

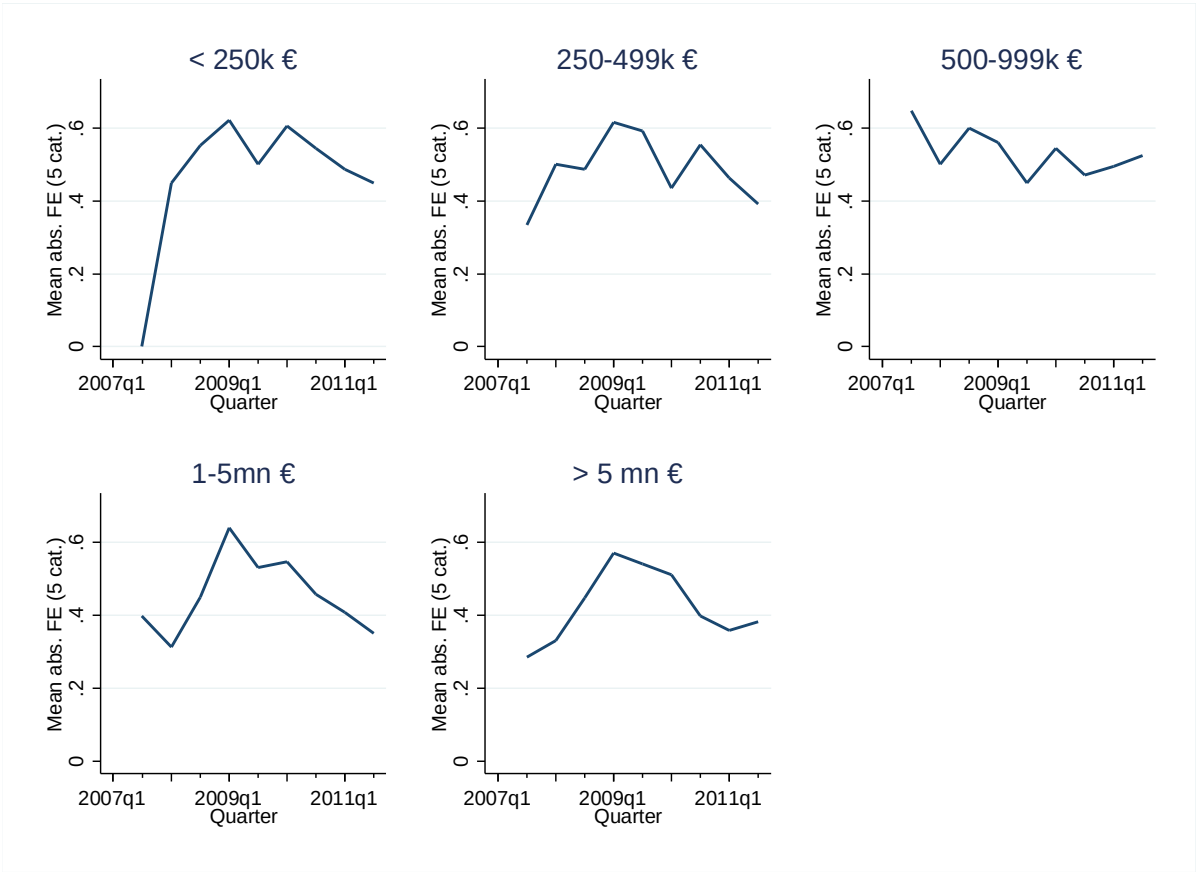
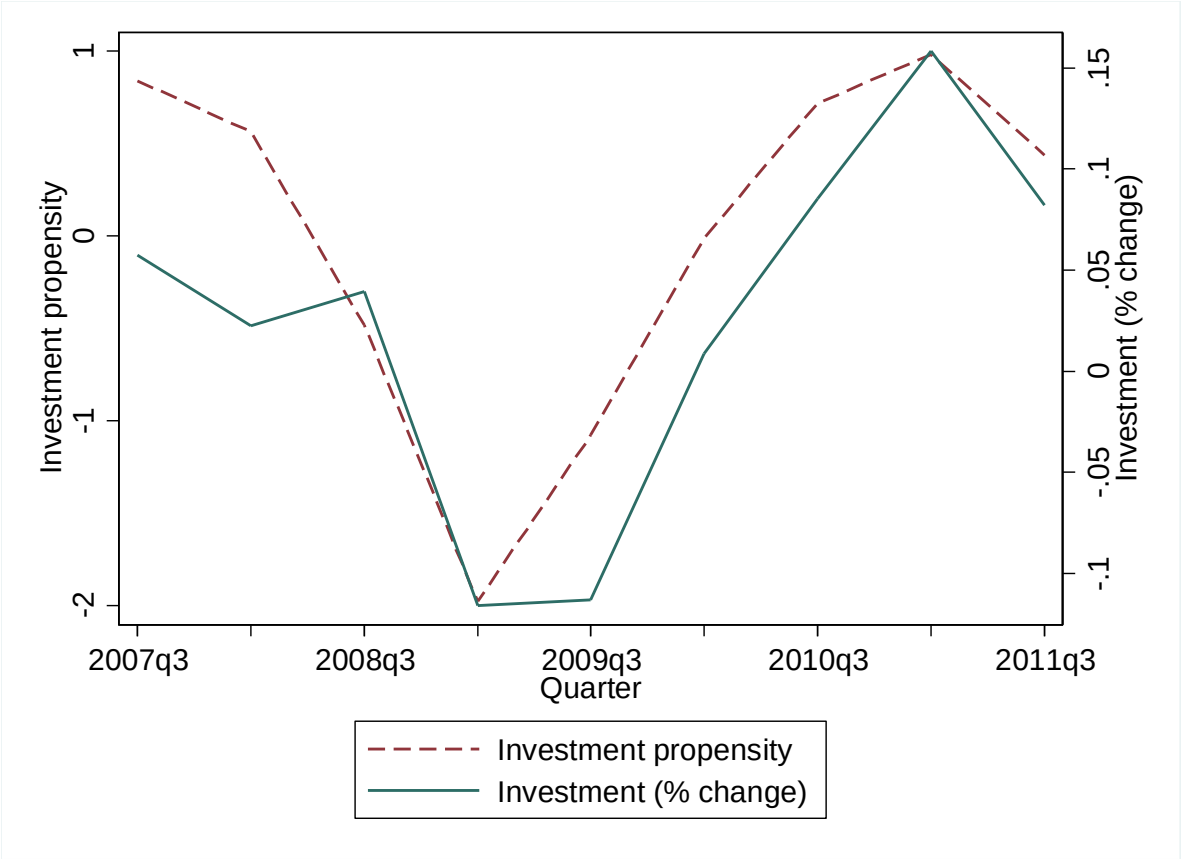


Figure B4. Comparison of investment propensity and investment change

This figure shows the standardized average investment propensity derived from the IWH risk climate survey (red, dotted line; left axis applies). The change in the investment volume is depicted by the green, solid line (right axis applies). Information on the volume of equipment investment in billion Euros for the non-governmental sector is obtained from the German federal statistical office (www.destatis.de/EN).



Institut für
Wirtschaftsforschung Halle (IWH)

IWH Risikoklima-Index

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Kleine Maerkerstraße 8
D-06108 Halle (Saale), Germany

Umfragekennwort: XXXX

Adressänderungen:

Ihre Angaben werden streng vertraulich behandelt. Der gesetzliche Datenschutz ist voll gewährleistet. Die Weitergabe an Dritte ist ausgeschlossen.

Kurzantwort (Bitte nur ausfüllen, wenn die Bearbeitung des Fragebogens nicht möglich ist.):

☐ Ich bin der falsche Ansprechpartner für die Befragung.
Bitte wenden Sie sich an:

Name: _____ Telefon: _____

Stellung im Unternehmen: _____

☐ Die Teilnahme an der Befragung ist für unser Unternehmen nicht möglich,

weil _____.

Befragung Frühjahr 2011

1. Wie bewerten Sie die aktuelle Situation für die folgenden Kategorien aus Sicht Ihres Unternehmens? Wie schätzen Sie die Entwicklung der Situation in den nächsten sechs Monaten ein?

	a) Die aktuelle Situation aus Sicht Ihres Unternehmens						b) Die Entwicklung in den nächsten sechs Monaten					
	sehr schlecht				sehr gut	keine Angabe	Verschlechterung		keine Änderung		Verbesserung	keine Angabe
	--	-	o	+	++		--	-	o	+	++	
1.1 Allgemeine Situation des Unternehmens	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.1 Produktion/ Leistungserstellung	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.2 Umsatz	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.3 Wettbewerbsintensität	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.4 Finanzierung für Investitionen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.5 Kosten für Materialaufwand und Rohstoffe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.6 Arbeitskräfteangebot	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.1.7 Wirtschaftspolitische Rahmenbedingungen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1.2 Allgemeine wirtschaftliche Situation in Deutschland	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Wie bewerten Sie die Stabilität der erwarteten Entwicklungen für die folgenden Kategorien? Welche Auswirkungen resultieren daraus für Ihr Unternehmen?

	a) Die Stabilität der Entwicklung in den nächsten sechs Monaten						b) Die resultierenden Auswirkungen für Ihr Unternehmen					
	sehr instabil				sehr stabil	keine Angabe	negative Auswirkungen		keine Auswirkungen		positive Auswirkungen	keine Angabe
	--	-	o	+	++		--	-	o	+	++	
2.1 Allgemeine Situation des Unternehmens	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.1 Produktion/ Leistungserstellung	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.2 Umsatz	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.3 Wettbewerbsintensität	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.4 Finanzierung für Investitionen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.5 Kosten für Materialaufwand und Rohstoffe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1.6 Arbeitskräfteangebot	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.1 7 Wirtschaftspolitische Rahmenbedingungen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.2 Allgemeine wirtschaftliche Situation in Deutschland	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. Wie schätzen Sie die Bereitschaft Ihres Unternehmens ein, Risiken einzugehen?

	sehr geringe Risikobereitschaft				sehr hohe Risikobereitschaft	keine Angabe
Gegenwärtige Risikobereitschaft	☐	☐	☐	☐	☐	☐

4. Welche Veränderung der Risikobereitschaft erwarten Sie für Ihr Unternehmen in den nächsten sechs Monaten?

	Erhöhung		keine Veränderung		Verringerung	keine Angabe
Veränderung der Risikobereitschaft in den nächsten sechs Monaten	☐	☐	☐	☐	☐	☐

5. Wurde das geplante Ertragsziel Ihres Unternehmens im letzten Geschäftsjahr erreicht?

	weit überschritten		erreicht		weit unterschritten	keine Angabe
Erreichung des Ertragszieles	☐	☐	☐	☐	☐	☐

6. Welche Veränderung des Investitionsvolumens erwarten Sie für das aktuelle Geschäftsjahr im Vergleich zum letzten Geschäftsjahr?

	Verringerung		keine Veränderung		Erhöhung	keine Angabe
Veränderung des Investitionsvolumen im aktuellen Geschäftsjahr	☐	☐	☐	☐	☐	☐

Allgemeine Information über Ihr Unternehmen

7. In welchem Teilbereich der Branche ´Reparatur und Installation von Maschinen und Ausrüstungen` liegt der Tätigkeitsschwerpunkt Ihres Unternehmens?

   ☐ Reparatur von Metallerzeugnissen, Maschinen und Ausrüstungen

   ☐ Installation von Maschinen und Ausrüstungen anderweitig nicht genannt

   ☐ Anderer Bereich der oben genannten Branche

   ☐ Tätigkeitsschwerpunkt liegt nicht in diesem Gewerbe, sondern in der folgenden Branche: _____

8. Was ist Ihr wichtigstes Produkt? _____

9. Wie viele Beschäftigte (ohne Auszubildende) hat Ihr Unternehmen?

   ☐ 1 - 4 ☐ 5 - 24 ☐ 25 - 49 ☐ 50 - 74 ☐ 75 und mehr

10. Wie hoch war in etwa der Umsatz im letzten Geschäftsjahr?

    ☐ < 250 T€ ☐ 250 - 499 T€ ☐ 500 - 999 T€ ☐ 1 - 5 Mio. € ☐ > 5 Mio. €

11. Welchen Anteil hatte der Auslandsumsatz?

    ☐ < 1 % ☐ 1 - 10 % ☐ 11 - 20 % ☐ 21 - 40 % ☐ > 40 %

Ansprechpartner in Ihrem Unternehmen

Name: _____ Stellung im Unternehmen: _____

Telefon: _____ Fax: _____ E-Mail: _____

Den Ergebnisbericht möchte ich zugesendet bekommen ☐ per Post ☐ per Fax ☐ per E-Mail ☐ gar nicht

Vielen Dank für Ihre Mitarbeit.

Hier ist Platz für Ihre Anregungen und Kommentare.

Wir bitten um Rücksendung des Fragebogens bis zum Freitag, den **08.04.2011**

Halle Institute for Economic Research –
Member of the Leibniz Association

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