Journal of Monetary Economics xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Monetary Economics

journal homepage: www.elsevier.com/locate/jmoneco

Local information and firm expectations about aggregates☆

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ARTICLE INFO

Article history:
Received 30 June 2022
Revised 28 March 2023
Accepted 28 March 2023
Available online xxx

JEL classification:
D84
E2
E32

Keywords:
GDP expectations
Expectation heterogeneity
Disagreement
Rational inattention
ifo business tendency survey

ABSTRACT

Using new survey data on quantitative growth expectations of firms in Germany, we show that firms resort to local information when forming expectations about aggregate growth. Firms extrapolate from the economic situation in their county, industry growth and their individual business situation. Variables (fixed effects) measuring local signals account for up to 26 % (47 %) of the expectation dispersion across firms. The effect is particularly strong for small firms. Our results confirm predictions of theoretical models with rational inattention.

1. Introduction

Expectations play a central role in current macroeconomic models and it is widely believed that they are a key driver of aggregate fluctuations (Angeletos and La'O, 2013; Beaudry and Portier, 2007). Yet, it remains controversial how macroeconomic expectations are formed and how macroeconomists should model this process. In particular, evidence on how firms form macroeconomic expectations remains very scarce. As firms are of central importance for price setting as well as labor and investment demand, a better understanding of what determines their expectations is of crucial importance for macroeconomic research and policy. Recently, Andrade et al. (2022) provide empirical evidence that—in line with the "island" model proposed by Lucas (1972)—industry conditions affect firms' views of macroeconomic conditions. In this paper, we provide further evidence that local business conditions do indeed play a role when firms form expectations about aggregate economic variables in a way that is consistent with the predictions of a model with rational inattention as in Maćkowiak and Wiederholt (2009).

☆ We would like to thank the team of ifo's Economics and Business Data Center for excellent support and provision of the data. We also thank Tobias Lohse and Sebastian Link for sharing their Stata code. We are grateful to Mirko Wiederholt for the very valuable comments on an earlier draft. Furthermore, we thank the editor and an anonymous reviewer for their very helpful comments on an earlier draft. Jonas Dovern acknowledges financial support by Deutsche Forschungsgemeinschaft through SPP 1859 (project number DO 2296/1-1).

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https://doi.org/10.1016/j.jmoneco.2023.03.005
0304-3932/

In particular, we show that firms' expectations of the growth rate of the (real) gross domestic product (GDP), henceforth "growth expectations", are driven by economic conditions in the firms' headquarters' counties and in their industries as well as by their idiosyncratic business situation. This means that the local signals that firms use to form macroeconomic expectations are not limited to industry-specific information. On balance and consistent with models of rational inattention, these effects are larger for small firms that presumably do not have the capacity to allocate attention to aggregate conditions and thus away from idiosyncratic signals (Maćkowiak and Wiederholt, 2009).

We obtain this evidence by using the ifo Business Tendency Survey (BTS), a large-scale, high-level,[1] and fairly representative business survey in Germany (Hiersemenzel et al., 2022). We augment the survey with a question that elicits quantitative growth expectations of firms in several survey waves during the period from 2018 to 2020. We can link these expectations about aggregate growth to i) other firm-level information from the survey (such as business assessment, price expectations, and firm size), ii) local unemployment (which we use as a proxy for regional economic conditions), and iii) industry-specific information. This allows us to estimate the nexus between local signals and macroeconomic expectations using panel regressions that feature a wide range of fixed effects to control for unobserved confounders. To mitigate potential endogeneity problems, we use carefully selected subsamples of firms whose local conditions are unlikely to be driven by their growth expectations (e.g., because their business expectations were noncyclical in the past). The large (roughly 4,800 firms) and fairly representative sample of firms in Germany makes it ideal for studying heterogeneity in expectation formation across different types of firms.

We study growth expectations—thereby complementing other studies that focus on inflation expectations of firms—because aggregate demand is a key variable for fluctuations in corporate investment demand (Bachmann and Zorn, 2020). Since GDP is the broadest measure of aggregate demand available, firms' expectations of GDP growth are an important driver of their business decisions (Tanaka et al., 2020).[2]

We first document that the heterogeneity of growth expectations across firms is large, indeed more similar to macroeconomic expectation dispersion observed for private households than for professional macroeconomic forecasters. This is in line with evidence in Coibion et al. (2018); Tanaka et al. (2020) and Candia et al. (2021, 2022). In all economic sectors that we investigate (manufacturing, trade, and services), the dispersion of growth expectations is higher for small firms than for large firms. Heterogeneity is also higher for firms whose business does not depend on the general business cycle in Germany. These findings support theories of rational inattention that imply that firms pay less attention to economic information if the fixed cost of doing so are large relative to the size of the firm and/or the benefits of closely monitoring the business cycle are low.

We then turn to the question of whether information that firms gather in their local environment ("island") shape their expectations for aggregate growth and, thus, partially explain the heterogeneity of macroeconomic expectations. We find that firms which are located in a county that is not doing well economically (as indicated by high local unemployment) tend to have more pessimistic growth expectations. A 1 percentage point increase of the unemployment rate in the home county of a firm is associated, on average, with roughly 31 basis points lower growth expectations of this firm. We observe a similar—albeit small—effect from industry-specific economic conditions on firms' aggregate growth expectations. Finally, we find that firms which report a positive current business situation or expectations of rising product prices report more optimistic growth expectations. Considering the full data sample including responses from the wave conducted during the pandemic, these effects are often driven by the small firms in our sample while growth expectations of larger firms are more independent of local information. We find that extrapolation was particularly strong during the COVID-19 pandemic. We attribute this result to the uncertain macroeconomic situation which led to increased macroeconomic uncertainty and higher ambiguity about the relation between aggregate and idiosyncratic variables.

The evidence that firms extrapolate from their own economic experiences to the broader national business cycle situation is in line with "island models" (Lucas, 1972) that have recently been picked up by the modern macroeconomic literature on models with rational expectations and information frictions (e.g. Angeletos and La'O, 2013; Lorenzoni, 2009; Nimark, 2014). The fact that small firms pay more attention to local information when forming expectations of aggregate variables is consistent with models of rational inattention which postulate that firms need to optimally allocate a limited amount of attention. It is plausible that small firms have less attention capacity at disposal overall (Maćkowiak and Wiederholt, 2009). When the correlation between local and aggregate shocks is large, it may be rational to form growth expectations based on local information since the latter can be acquired at lower cost and contain similar information. For firms that extrapolate from local conditions to the aggregate economy the bias should be smaller under such conditions. In line with these thoughts, we find that firms with close ties to the German business cycle make smaller errors, on average, when forecasting aggregate growth.

Our evidence complements several studies that show in other contexts how "local" information significantly affects macroeconomic expectations and is an important driver of expectation heterogeneity (Andrade et al., 2022; Berger et al., 2009; 2011; Kuchler and Zafar, 2019).

[1] Sauer and Wohlrabe (2019) document that the BTS is usually answered by senior managers.

[2] Even if sector-specific demand is eventually what firms are interested in, the demand for specific products depends strongly on aggregate demand in most industries.

Table 1
Descriptive Statistics for Quantitative Growth Expectations.

Survey	Aug '18	Mar '19		Aug '19		Aug '20	
Expectation	2018	2019	2020	2019	2020	2020	2021
N	4,641	4,831	4,774	4,856	4,831	5,010	4,961
Mean	1.8	1.2	1.1	0.9	0.8	-6.2	1.5
Median	1.8	1.2	1.0	1.0	1.0	-7.5	2.0
Std. Dev.	1.3	1.4	1.5	1.6	1.7	7.9	6.2

Notes: We drop any observation that is more than three standard deviations away from the median in each survey wave (about 1 % of the raw data).

From a broader perspective, our paper contributes to a booming literature that studies how market participants—most importantly private households and firms—form macroeconomic expectations (Manski, 2018). Contributions by, inter alia, Manski (2004), Mankiw and Reis (2002), Sims (2003), Woodford (2003), and Coibion and Gorodnichenko (2015) have spurred a rapidly growing theoretical and empirical literature that aims to measure and model macroeconomic expectations more realistically and more coherently with properties of observed macroeconomic expectations than the full information rational expectations model.

The empirical evidence on how firms form expectations remains limited as many surveys collect only qualitative data or are restricted to specific subsets of firms based on a firm's sector or size (Andrade et al., 2022; Tanaka et al., 2020).[3] Kumar et al. (2015) and Coibion et al. (2018) analyze a representative sample of firms in New Zealand. Candia et al. (2021) use a monthly panel of survey-based inflation expectations of US firms to show that the size and in particular the industry of a firm affects expectations. Link et al. (2023) combine data from the BTS with a survey among private households to compare firm expectations with those of households. With the exception of Tanaka et al. (2020), these papers primarily focus inflation expectations. Candia et al. (2022) provide an overview of the literature on inflation expectations of firms.

The remainder of this paper is structured as follows. Section 2 describes the data that we use, in particular the novel data on quantitative corporate growth expectations. Section 3 presents evidence on the expectation formation process of firms, which includes details on the dispersion of expectations (Section 3.1), results on the impact of local conditions on expectations (Section 3.2), an analysis of forecast errors (Section 3.3), and a review of the consistency of our findings with theoretical macroeconomic models (Section 4). Section 5 concludes.

2. Data and Descriptive Statistics

Most of our data come from the ifo Business Tendency Survey (BTS) conducted monthly by the ifo Institute. The survey covers various business aspects for a panel of firms.[4] We use data on firms from the manufacturing sector, the trade sector, and the service sector. For about 98 % of firms, one particular person is responsible for regularly answering the questionnaire (Sauer and Wohlrabe, 2019). More than 80 % of those persons are in an upper management position such as owner, CEO, or department head. This suggests that respondents have a good overview of their company and provide answers that accurately reflect sentiments representative of the firm.

We elicit quantitative growth expectations in the survey waves conducted in August 2018, March and August 2019, and August 2020. We asked firms to report the expected annual growth rate of real GDP for the current and next year with one decimal.[5] This results in expectations data for four different target years collected at four time points. On average, about 80 % of firms that returned a questionnaire answered our question, leaving us with about 4,500 to 5,000 observations per survey wave.[6]

In the first three survey waves, average growth expectations range from 0.8 % to 1.8 % (Table 1). This is slightly above actual GDP growth rates that were later recorded for those years. In the survey from August 2020, average expectations for the same year drop sharply in response to the COVID-19 pandemic. A similar disruption is visible when considering the dispersion of expectations. Standard deviations increase slightly from 1.3 % to 1.7 % between the surveys in 2018 and 2019, followed by a stark rise beyond 6 % in August 2020. We do not observe strong differences in average growth expectations across sectors (Table A.1 in the online appendix).

[3] The literature on household expectations is more comprehensive. Consider for example Bruine De Bruin et al. (2011), Das et al. (2020), Malmendier and Nagel (2011), and Malmendier and Nagel (2016). For a recent overview see D'Acunto et al. (2022).

[4] The BTS is technically conducted at the product level, i.e., some larger firms answer more than one questionnaire. We aggregate the answers to the firm level by using the mean over all questionnaires returned by one firm as proposed by Link (2020). For qualitative questions we transform the mean of all questionnaires returned by one firm back into discrete answer categories.

[5] See Online Appendix C for the exact wording of the special questions. In the wave of August 2018, we asked about growth expectations for the current calender year only.

[6] We drop all observations that lie outside a three-standard-deviations interval around the median growth expectation for each combination of survey wave and target year to exclude unreasonably high or low expectations (in total about 1 % of the raw data).

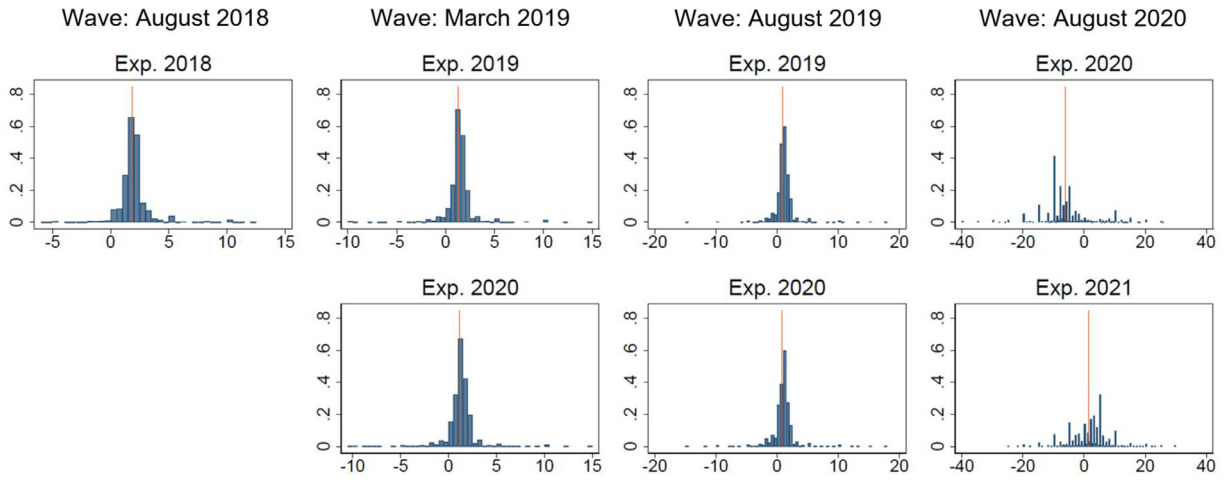

Fig. 1. Dispersion of Growth Expectations for Different Waves and Target Years. *Notes:* This figure shows histograms of firms' GDP expectations for the years 2018 to 2021 elicited in four different survey waves. The red lines indicate mean expectations.

We link three different types of local information to growth expectations of firms and further use these information to compute historical correlations of local economic conditions with the German business cycle to construct subsamples of "acyclical" firms. Table A.2 in the online appendix contains a set of descriptive statistics for all variables considered.

First, we use local unemployment rates to approximate local business cycle conditions. These data are provided by the German Federal Employment Agency (Bundesagentur für Arbeit, BA). The monthly observations for 401 counties cover the period from 1991 to August 2020.[7] To eliminate the effect of any seasonal movements in unemployment which tend to differ substantially across counties, we consider twelve-months moving averages of unemployment rates. Second, we measure industry conditions by the (quarterly) growth rates of sales or production in 197 industries.[8] The data are from the German Federal Statistical Office (Statistisches Bundesamt). Finally, we use two measures from the regular BTS to measure firm-specific idiosyncratic business assessment and firms' expectations of their own product prices, both reported on a trichotomous scale from −1 (bad/decreasing) to 1 (good/increasing).

To analyze heterogeneity across the size distribution of firms, we construct a measure of firm size based on information from the BTS. Unfortunately, the survey does not provide a harmonized measure of firm size because the questionnaires differ across sectors. Therefore, we create a categorical measure of firm size with values ranging from 1 (very small) to 5 (very large). In the trade and service sector the measure is based on turnover, in the service sector it is based on the number of employees.

In addition, we control for the historical volatility of business expectations, a firm's success in predicting their own business situation in the past and whether a firm answered the questionnaire online or on paper.[9]

3. Heterogeneity of Corporate Growth Expectations

3.1. Expectation Dispersion and Firm Size

It is a well known fact that macroeconomic expectations are dispersed if compared across individuals (e.g., Dovern et al., 2012; Mankiw et al., 2003). Similar to previous findings by, inter alia, Coibion et al. (2018) and Tanaka et al. (2020), we find that the dispersion of firms' growth expectations is large. The histograms in Fig. 1 show very broad distributions, especially during the COVID-19 pandemic in 2020.

The cross-sectional standard deviation of growth expectations of German firms is much higher than those of professional forecasters (Panel A in Table 2). This is in line with findings for inflation expectations of firms (Andrade et al., 2022; Candia et al., 2022). Panel B of Table 2 shows that the standard deviation in our sample (before the pandemic) is very similar to that observed for growth expectations of firms in Japan and New Zealand (Coibion and Gorodnichenko, 2015; Tanaka et al., 2020).[10] Overall, the large disagreement indicates that growth expectations are formed based on different and potentially

[7] The firms in our sample cover all of the 401 administrative districts, called "Kreise und kreisfreie Städte".

[8] Growth rates for industries in the trade sector are based on sales, growth rates for industries in the manufacturing and service sector are based on production. We match industry information using five-digit industry identifiers from the German standard classification system of 2008 (*WZ 08*) and aggregations thereof.

[9] We measure historical volatility by the standard deviation of the monthly responses between 1991 and 2018. We compute a firm's success in predicting its own business situation by the firm-specific expectation error as in Bachmann and Elstner (2015).

[10] Due to the lack of surveys that contain information about quantitative growth expectations of households a comparison to corresponding results for private households is not possible. Link et al. (2023) document lower levels of dispersion among firms than among households for expectations of inflation, unemployment, and the policy rate.

Table 2
Dispersion of Growth Expectations in Different Surveys.

Panel A: ifo BTS and Professional Forecasters

	ifo BTS		Consensus Econ.		SPF (ECB)		SPF (Fed)	
Target	Survey	Std. Dev.	Survey	Std. Dev.	Survey	Std. Dev.	Survey	Std. Dev.
Same Year	Aug. 18	1.3	Aug. 18	0.1	Oct. 18	0.1	Aug. 18	0.1
Same Year	Mar. 19	1.4	Mar. 19	0.3	Apr. 19	0.2	Feb. 19	0.2
Next Year	Mar. 19	1.5	Mar. 19	0.3	Apr. 19	0.3	Feb. 19	0.5
Same Year	Aug. 19	1.6	Aug. 19	0.2	Oct. 19	0.1	Aug. 19	0.1
Next Year	Aug. 19	1.7	Aug. 19	0.4	Oct. 19	0.2	Aug. 19	0.5
Same Year	Aug. 20	7.9	Aug. 20	0.7	Oct. 20	0.6	Aug. 20	0.8
Next Year	Aug. 20	6.2	Aug. 20	1.2	Oct. 20	0.8	Aug. 20	2.5

Panel B: ifo BTS and Other firm surveys

	ASBC Japan		Firm Survey NZ	
Target	Survey	SD	Survey	SD
4q ahead	Various	1.3*	Various	0.5–1.0†

Notes: Measures from the ifo BTS refer to the trimmed sample. * Tanaka et al. (2020) report the average standard deviation across all survey waves from 1989 to 2015. † The survey was conducted four times and the standard deviations of growth expectations where 0.7, 1.0, 0.5, and 0.6 percentage points, respectively.

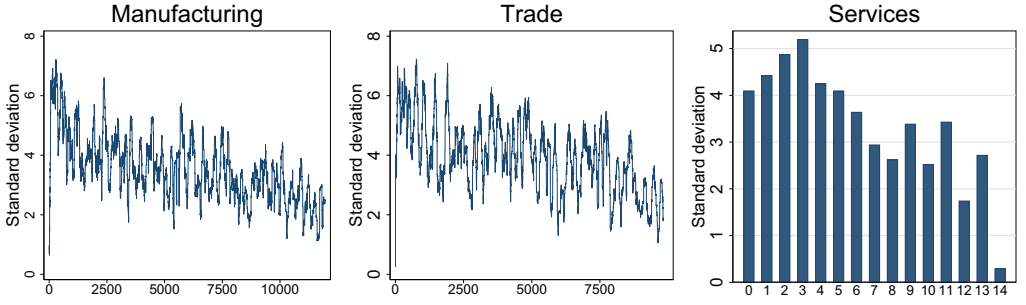

Fig. 2. Standard Deviation of Growth Expectations and Firm Sizes. *Notes:* The graph shows the standard deviation of firms' GDP growth expectations for different firm sizes. For the manufacturing sector and the trade sector, we measure firm size by the number of employees and calculate the standard deviation over rolling windows of 100 firms after ordering the firms by firm size. In the service sector we calculate standard deviations across all firms in each of the turnover categories available in the BTS.

noisy signals about the state of the economy that firms are exposed to. We analyze the role of local information in that context in Section 3.2.

Fig. 2 shows, for each sector, how the cross-sectional standard deviation of growth expectations varies with firm size. There is a clear downward trend in dispersion with increasing firm size. We observe the same trend when using the categorical measure that we use to measure firm size homogeneously across the three sectors (Figure A.1 in the online appendix). The differences in standard deviations across the five size categories are significantly different from zero (Table A.3 in the online appendix).[11]

Overall, we find that growth expectations of firms are much more dispersed than those of professional forecasters and that the level of dispersion varies across the size distribution of firms. We now turn to the question of whether differences in local information explain the heterogeneity of expectations.

3.2. Local Conditions and Growth Expectations

To empirically analyze the link between local information and expectations of aggregate growth, we resort to local unemployment (as a proxy for the local business situation), industry growth (as a proxy for the economic situation of individual industries), business assessment and expectations of future product prices (as proxies for idiosyncratic information and shocks they face). Our focus is the analysis of the cross-sectional variation. We use the following specification

$$E_t^{ijc} g_y = \alpha + \beta LC_t^{c/j/i} + X_{it}'\delta + \gamma_{ty} \times \lambda_j + \nu_c + error, \tag{1}$$

[11] The pattern is less pronounced when we split the sample according to the self-reported measure for the importance of the business cycle (Panel B of Figure A.1 and Table A.4 in the online appendix).

where $E_t^{ijc}g_y$ is the expectation of firm i in industry j and county c at time t for GDP growth in year y, $LC_t^{c/j/i}$ denotes the respective proxy for local conditions (local unemployment, industry growth, business assessment or price expectations), X_{it} is a matrix of firm-specific control variables. We include firm size, historical volatility of business expectations, previous success in predicting the own business situation and a dummy for answering online (as opposed to on paper). We add wave $\times$ industry fixed effects ($\gamma_{ty} \times \lambda_j$) as well as region fixed effects (ν_c) to capture variation in growth expectations driven by unobserved industry or local conditions.[12] In additional regressions, we estimate models with firm fixed effects to capture firm-specific unobservables. The link between local information and growth expectations is identified based on within-firm variation in these cases. Specifically, we use the regression

$$E_t^{ijc}g_y = \alpha + \beta LC_t^{c/j/i} + \gamma_{ty} + \eta_i + error, \tag{2}$$

where η_i denotes the firm fixed effect.

To address potential heterogeneity in the strength of extrapolation from local conditions across the firm-size distribution, we also consider specifications that include interaction terms between our measures of local conditions/information and the categorical measure of firm size:

$$E_t^{ijc}g_y = \alpha + \beta_1 LC_t^{c/j/i} + \sum_{k=2}^{5} \beta_k \left[D_k(firm\_size_i) \times LC_t^{i/j/c} \right] + \gamma_{ty} + \eta_i + error, \tag{3}$$

where β_1 measures the effect of local conditions for small firms. $D_k(firm\_size_i)$ for firm sizes $k = 2, \ldots, 5$ are dummies that take the value 1 if firm i is part of the respective size category and 0 otherwise. Thus, β_2 to β_5 measure the effect difference between larger firms and small firms.

To minimize the risk to find correlations between growth expectations and local conditions only because the latter might be driven by the former (a mechanism that would be diametrically opposed to the one suggested by "island" models), we look at subsamples of firms for which this is unlikely. We follow Andrade et al. (2022) and select firms from regions or industries that historically have been rather acyclic. That is the 20 % of firms of regions or of industries, respectively, with the lowest historic correlation between aggregate GDP growth and unemployment or industry growth, respectively. Figure A.2 in the online appendix shows the distribution of both measures. The correlation of aggregate growth with local unemployment is much lower than with industry growth. Yet, the 20 % percentiles are relatively close to zero for both measures. In the case of business assessment as a local signal, we use additional subsamples based on measures of a firm's dependence on the German business cycle. In particular, we select firms with low historic correlation between their business assessment and GDP growth, firms with high shares of sales abroad and firms that state that the German business cycle is unimportant for their business. The bottom three rows of Table A.2 in the online appendix shows descriptive statistics of the variables that define the subsamples.

The histograms in Fig. 1 show that the COVID-19 pandemic had strong effects on disagreement among firms. To trace the influence of the pandemic on the expectation formation process, we re-estimate Eq. (3) excluding the expectations elicited in 2020. In addition, it is not clear if firms categorized as acyclical were also acyclical during these unusual circumstances. We use a question from the ifo BTS that asks firms to report the effect of the pandemic on their business (positive/neutral/negative) to test which firms were particularly negatively affected by the pandemic. The results in Table A.5 in the online appendix suggest that firms with acyclical businesses and those in acyclical regions and industries reported less adverse effects than their cyclical counterparts. Thus, the pandemic does not seem to have affected the (a)cyclicality of those firms. In contrast, firms defined as acyclical (with respect to the German business cycle) because of their high export shares tend to report stronger negative effects due to the pandemic. We attribute this result to the severe impact of the pandemic on global supply chains and international trade in general.

3.2.1. Local Economic Environment

The first local measure is the economic situation firms experience in the area where they do business. The idea is that firms extrapolate from economic signals they receive in their county to the business cycle situation of the entire country (controlling for aggregate conditions) since they confound local and aggregate shocks. Given that each individual county is too small to have a substantial impact on the overall growth rate in Germany, such behavior would constitute a deviation from optimal forecasting (under full information) and could explain some of the variation of expectations across firms.

We use the local unemployment rate to measure the strength of the local economy because it is one of the few economic indicators that is available without major publication lag—and, hence, observable for the firms in near real time.[13]

Table 3 displays the results. In column 1 where we include wave $\times$ industry fixed effects, region fixed effects and controls, the coefficient has the expected sign and is statistically significant at the 5 % level. A 1 percentage point increase in the unemployment rate (in a county) is associated with growth expectations (for Germany) of local firms that are 0.23 percentage points lower. This effect is conditional on the current economic situation in Germany for which we control with

[12] Industry fixed effects are based on 74 industries based on aggregation of the German standard classification system of 2008 (*WZ 08*).

[13] We use information about the firms' ZIP codes and the municipality names in their address to assign them to counties. We loose approximately 11 % of answers because either no information about the location is provided or because – due to reporting errors – the reported combination of ZIP code and municipality name does not allow identifying an unambiguous county.

Table 3
Impact of Local Unemployment on Growth Expectations.

	All counties				Acyclical counties	
				w/o 2020		w/o 2020
	(1)	(2)	(3)	(4)	(5)	(6)
U	-0.233*	-0.310**	-0.421***	-0.228**	-0.717**	-0.138
	(0.134)	(0.133)	(0.157)	(0.102)	(0.365)	(0.205)
U × Firm size 2			0.025	-0.010	0.352	-0.035
			(0.108)	(0.050)	(0.319)	(0.139)
U × Firm size 3			0.122	-0.099	1.139***	-0.052
			(0.148)	(0.070)	(0.412)	(0.205)
U × Firm size 4			0.274*	-0.107	0.956**	-0.242
			(0.162)	(0.078)	(0.431)	(0.224)
U × Firm size 5			0.594***	-0.078	1.167**	-0.287
			(0.180)	(0.086)	(0.499)	(0.240)
Wave FE	No	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	No	No	No	No	No
Wave x Ind. FE	Yes	No	No	No	No	No
Firm FE	No	Yes	Yes	Yes	Yes	Yes
Controls	Yes	No	No	No	No	No
N	28,451	29,366	29,366	21,231	5,874	4,255
R^2	0.33	0.37	0.37	0.09	0.33	0.09

Notes: The dependent variable is growth expectations of firms. Columns 5 and 6 show estimates for subsamples of firms in counties with low historic correlation between local unemployment and German GDP growth. Columns 4 and 6 are based on the sample excluding the responses elicited during the COVID-19 pandemic. *p<0.1, **p<0.05, ***p<0.01. Standard errors clustered at county level in parentheses.

wave-target year fixed effects. We find equivalent results when estimating Eq. (2) that includes firm fixed effects. Firms that experience an increase in local unemployment adjust expectations about aggregate growth downward by 0.31 percentage points.

Column 3 shows estimates for different firm sizes. The baseline coefficient is highly significant and suggests a stronger negative effect compared to the overall effect found in the previous column. The interaction coefficients increase with firm size, suggesting a fading impact of local unemployment on expectations for larger firms. In fact, large firms (size category four and five) do not extrapolate from local conditions. The total effect for those firms is not statistically different from zero. In the pre-pandemic sample, only the baseline coefficient stays significant (column 4).

Focusing on firms in acyclical counties, the baseline coefficient is significant (5 % level) and lower than that for the full sample. This implies that local conditions inform growth expectations of small firms more in acyclical counties. Again, the total effects for larger firms are not significantly different from zero. We do not find significant results when excluding the survey wave from 2020 in the last column. Small acyclical firms seem to rely on local information only during the pandemic. A potential explanation is that the aggregate economic situation was very uncertain and shifting rapidly during the pandemic so that tracking macroeconomic dynamics was costly relative to pre-pandemic times—too costly for many small firms as it seems.

3.2.2. Industry Environment

Firms might also confuse industry conditions with the state of the aggregate economy. Andrade et al. (2022) show empirically that expectations of French manufacturing firms about prices and production react fast to industry-specific shocks even if these shocks do not affect aggregate conditions.

Table 4 shows estimates for our regression models when we use annualized quarterly log industry growth rates as a measure of local information. The coefficient on industry growth is significantly different from zero once we include firm fixed effects. Economically however, the effect is very small: a 1 percentage point increase in industry growth is related to an upward adjustment of expectations by only 0.004 percentage points.

Including interaction terms with firm size indicates that firm size heterogeneity is no significant issue here (abstracting from the marginally significant coefficient for the fourth firm size category). The same conclusion holds for samples without answers from the 2020 survey (column 4) or with only firms in acyclical industries (column 5).

3.2.3. Idiosyncratic Business Situation

Finally, firms might see “private information” about their own business situation as a signal about aggregate growth. They could (unconsciously) assume that a positive evaluation of their own business translates to the aggregate economy. Similarly, a firm might interpret expectations about the future development of sales prices not only as a signal about the demand for its own products but as informative for aggregated demand in the whole economy. To explore this link, we relate the quantitative growth expectations of firms to their reported business assessment and expectations about future product prices.

Table 4
Impact of Industry Growth on Growth Expectations.

	All industries				Acyclical industries	
	(1)	(2)	(3)	w/o 2020 (4)	(5)	w/o 2020 (6)
Industry growth (IG)	-0.002	0.004***	0.004***	0.006**	0.019**	0.0016
	(0.002)	(0.001)	(0.001)	(0.003)	(0.008)	(0.0039)
IG × Firm size 2			0.000	-0.001	-0.013	0.005
			(0.001)	(0.003)	(0.009)	(0.005)
IG × Firm size 3			0.002	0.004	0.007	0.003
			(0.002)	(0.004)	(0.013)	(0.007)
IG × Firm size 4			-0.004**	-0.002	-0.040**	0.001
			(0.002)	(0.006)	(0.018)	(0.009)
IG × Firm size 5			0.000	-0.002	-0.020	0.002
			(0.002)	(0.004)	(0.013)	(0.007)
Wave FE	No	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	No	No	No	No	No
Wave x Ind. FE	Yes	No	No	No	No	No
Firm FE	No	Yes	Yes	Yes	Yes	Yes
Controls	Yes	No	No	No	No	No
N	27,243	32,067	32,067	22,650	7,146	5,014
R^2	0.34	0.39	0.39	0.09	0.37	0.08

Notes: The dependent variable is growth expectations of firms. Columns 5 and 6 show estimates for subsamples of firms in industries uncorrelated with German GDP growth. Columns 4 and 6 are based on the sample excluding the responses elicited during the COVID-19 pandemic. *p<0.1, **p<0.05, ***p<0.01. Standard errors clustered at county level in parentheses.

The business situation of a firm depends mainly on present economic factors rather than the future state of the economy. However, in order to fully eliminate potential reverse causality from growth expectations to business assessment, we use subsamples of firms for which the German business cycle is not very important, i.e., firms that face demand that is not strongly correlated with the German business cycle. We select these subsamples in five different ways. We rely on i) a self-reported measure of importance of the business cycle for the business of a firm, ii) information about export shares that firms reported in September 2018, iii) the historical correlation between German GDP growth and the business assessment of firms, iv) firms in counties or v) industries that are decoupled from aggregate growth as measured by the historical correlation between aggregate growth and county-level unemployment and industry growth, respectively.

The coefficient corresponding to firms' business assessment is highly significant and suggests that firms with a more positive assessment of their business situation tend to report about 0.3 percentage points higher growth expectations (Table 5).[14]

When we consider the subsamples there are two main outcomes. First, we get slightly larger effects without distinguishing by firm size (Table A.6 in the online appendix). Second, we do observe firm size heterogeneity. Except for firms in acyclical regions, the baseline coefficients are always significant at least at the 5 % level with values ranging from 0.55 for firms in acyclical industries to 3.3 for firms with high levels of foreign sales. The negative interaction coefficients indicate that extrapolation from business conditions is mainly driven by small firms. This is particularly clear in the subsamples of firms with a high export share and of firms with acyclical business models.

The estimates on business assessment reported in Table 5 may be influenced by the unusual dynamics during the COVID-19 pandemic. To address this issue we report estimates excluding data elicited in 2020 in Table A.7 in the online appendix. Again, we observe a positive effect of business assessment on aggregate expectations in the regressions without interaction terms. The results for firm size heterogeneity are based on much smaller sample sizes and turn out to be more mixed. In most subsamples the coefficients corresponding to smaller firms continue to be positive. Similarly, the interactions stay negative. An exception is the subsample of firms with high shares of sales abroad. The estimates (which are based on by far the smallest sample) are puzzling because they have counterintuitive signs. The results based on all firms suggest that in the pre-pandemic sample small firms do not extrapolate from their business assessment when forming growth expectations while such effect remains significant in the case of large firms. One potential explanation for this finding is that small firms, which normally are aware that their idiosyncratic business situation is not informative about the aggregate economy, relied on these "local signals" during the pandemic to form expectations about aggregates because this is what they could still monitor with sufficient precision—in contrast to the very uncertain macroeconomic dynamics.

Lastly, we consider expectations about individual product prices as reflections of local signals. For the full sample, we find a positive correlation between those price expectations and firms' growth expectations that is significant at the 1 % level (Table 6). A firm that expects its prices to go up in the next months, on average, reports 0.2 percentage points higher growth expectations compared to a firm that expects constant prices.

[14] When we replace business assessment with business expectations of firms as the main explanatory variable, results remain the same (see Table A.8 in the online appendix). This specification however is more likely to suffer from reverse causality.

Table 5
Impact of Business Assessment on Growth Expectations.

	Full sample			GDP imp.	F. sales	Acyclical	Acyclical	Acyclical
				≥ 4	> 75%	business	region	industry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bus. ass.	0.28***	0.29***	0.35***	1.00**	3.30***	1.98***	0.37	0.55**
	(0.04)	(0.05)	(0.11)	(0.39)	(1.02)	(0.50)	(0.24)	(0.25)
Bus. ass. × Firm size 2			-0.13	-1.14**	-3.64***	-1.59***	-0.08	-0.03
			(0.12)	(0.48)	(1.08)	(0.57)	(0.28)	(0.30)
Bus. ass. × Firm size 3			-0.03	0.14	-2.37**	-1.05	0.32	0.00
			(0.15)	(0.56)	(1.09)	(0.67)	(0.36)	(0.41)
Bus. ass. × Firm size 4			0.01	-0.32	-2.98**	-2.08**	-0.03	0.21
			(0.18)	(0.78)	(1.18)	(0.84)	(0.43)	(0.47)
Bus. ass. × Firm size 5			-0.02	-0.59	-2.84**	-2.81***	-0.39	-0.08
			(0.17)	(0.82)	(1.13)	(0.73)	(0.47)	(0.49)
Wave FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	No	No	No	No	No	No	No
Wave x Ind. FE	Yes	No	No	No	No	No	No	No
Firm FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	No	No	No	No	No	No	No
N	28,473	33,766	33,766	1,960	1,033	2,067	5,854	7,163
R^2	0.35	0.38	0.38	0.38	0.41	0.38	0.34	0.38

Notes: The dependent variable is growth expectations of firms. Columns 4–8 display estimates for subsamples consisting of firms that report that the German business cycle is unimportant for their business (4), firms that make more than 75 % of their sales abroad (5), firms with low historic correlation between their business assessment and German GDP growth (6), firms in counties where local unemployment is uncorrelated with aggregate growth (7) and firms in industries where industry growth is uncorrelated with aggregate growth (8). *p<0.1, **p<0.05, ***p<0.01. Standard errors clustered at county level in parentheses.

Table 6
Impact of Price Expectations on Growth Expectations.

	All firms				Acyclical firms	
				w/o 2020		w/o 2020
	(1)	(2)	(3)	(4)	(5)	(6)
Price exp.	0.20***	0.22***	0.49***	0.05	0.40	-0.03
	(0.06)	(0.07)	(0.15)	(0.06)	(0.68)	(0.27)
Price exp. × Firm size 2			-0.37	0.01	-0.55	-0.02
			(0.18)	(0.07)	(0.78)	(0.31)
Price exp. × Firm size 3			-0.10	0.09	-0.34	0.04
			(0.22)	(0.09)	(0.95)	(0.38)
Price exp. × Firm size 4			-0.40	-0.12	-0.83	-0.95*
			(0.25)	(0.11)	(1.15)	(0.52)
Price exp. × Firm size 5			-0.38	0.15	-1.25	-0.25
			(0.24)	(0.10)	(0.99)	(0.39)
Wave FE	No	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	No	No	No	No	No
Wave x Ind. FE	Yes	No	No	No	No	No
Firm FE	No	Yes	Yes	Yes	Yes	Yes
Controls	Yes	No	No	No	No	No
N	28,230	33,493	33,493	23,656	2,050	1,464
R^2	0.35	0.38	0.38	0.10	0.37	0.10

Notes: The dependent variable is growth expectations of firms. Columns 5 and 6 display estimates for a subsample of firms with low historic correlation between their business assessment and German GDP growth. Columns 4 and 6 are based on the sample excluding the responses elicited during the COVID-19 pandemic. *p<0.1, **p<0.05, ***p<0.01. Standard errors clustered at county level in parentheses.

Firm size heterogeneity does not seem to play a role here. While coefficients for the interaction terms are all negative, they are not statistically significantly different from 0. Furthermore, we do not find a significant correlation between product price expectations and growth expectations for the pre-COVID-19 sample and the subsample of firms whose business situation was uncorrelated with German GDP growth in the past.

Overall, variation in the local economic situation, industry conditions and the individual business situation inform growth expectations—even controlling for shifts in the aggregate economic situation over time by fixed effects. The results suggest that small firms, in particular small acyclical firms, rather than larger companies tend to extrapolate from local conditions. This heterogeneity across the size distribution of firms seems particularly strong during the COVID-19 pandemic. A potential

explanation for this finding is the unclear link between macro and micro information during this period. As a result, especially firms with little capacities to observe macroeconomic indicators (afflicted with high uncertainty during the pandemic) did apparently shift their attention even more towards local signals observable in their proximity.

3.3. Heterogeneity of Forecast Errors

In this section we analyze the forecast errors associated with growth expectations of firms. In particular, we are interested in differences in forecast errors between cyclical and acyclical firms. We also investigate if potential differences persist during the COVID-19 pandemic.

If there exists a tight relationship between local and aggregate conditions, local information can be a good (and easy to collect) proxy for aggregate growth. The situation is different for firms in acyclical industries or regions. In these cases, relying on local information might still be less costly than closely following aggregate dynamics; but extrapolating from local conditions would introduce biases in growth expectations. The previous section shows that expectations of firms in acyclical environments are at least partially correlated with local conditions. Do these firms have higher prediction errors?

We regress absolute forecast errors on dummies that are equal to one if firms are in the respective group we defined as acyclical and zero otherwise:

$$|FE^{ijc}_{t,y}| = \alpha + \beta D\left(acyclical_{i/j/c}\right) + X'_{it}\delta + \gamma_{ty} + error, \tag{4}$$

where $FE^{ijc}_{t,y} = \left(g_y - E^{ijc}_t g_y\right)$ is the forecast error of firm i in industry j and county c regarding GDP growth in year y, $D(acyclical_{i/j/c})$ is a dummy that is equal to one if a firm is categorized as acyclical according to the respective definition and zero otherwise, X_{it} is a vector of firm-specific control variables, and γ_{ty} denotes wave fixed effects.

Overall, the results indeed suggest that firms that are likely to not depend on the German business cycle produce larger growth forecast errors (Table B.1 in the online appendix). This is most clearly the case for firms that make more than 75% of their sales abroad. The coefficient is positive and significantly different from zero at the one percent level. These firms, on average, have 0.1 percentage points larger forecast errors. Also the coefficients for firms that state that the German business cycle is unimportant to their business and for those in acyclical regions and industries are positive (but not significantly different from zero). The counter intuitive estimate for the dummy of firms with acyclical businesses is not significantly different from zero, too.

Regarding the control variables, we find that larger firms were significantly better at predicting GDP growth (about 0.2 percentage points lower forecast errors) which might be seen as reconfirmation that large firms are, on average, better informed about aggregate fluctuations. High volatility of individual business expectations (in the past) is associated with larger forecast errors while forecast errors are smaller, on average, for firms that answer the questionnaire online. Somewhat counterintuitivly, the coefficient corresponding to the absolute size of the average past prediction errors of firms for their own business situation is negative.[15]

Economic uncertainty and large macroeconomic shocks during the COVID-19 pandemic led to dramatically higher growth forecast errors. We investigate whether also in this period acyclical firms produced larger forecast errors and if the size of the forecast errors in the August-2020 wave of our sample depends on how a firm was affected by the pandemic. To this end, we add dummies that indicate whether a firm reported to be unaffected or even positively affected by the pandemic (the vast majority of firms were negatively affected) and interaction terms of these dummies with our different identifiers for samples of acyclical firms to the previous regression:

$$\begin{aligned}|FE^{ijc}_{t,y}| = \alpha &+ \beta_1 D(acyclical_{i/j/c}) + \beta_2\left[D(acyclical_{i/j/c}) \times D(covid\_neutral_i)\right] \\ &+ \beta_3\left[D(acyclical_{i/j/c}) \times D(covid\_positive_i)\right] + X'_{it}\delta + \gamma_{ty} + error,\end{aligned} \tag{5}$$

where $D(covid\_neutral_i)$ and $D(covid\_positive_i)$ are one if firm i reported that the pandemic had no effects or positive effects on its business, respectively, and zero otherwise.

The estimates in Table B.2 in the online appendix indicate that, compared to firms that suffered from the pandemic, forecast errors were lower for unaffected firms (by about 1 percentage point) and firms that profited from the pandemic (by about 1.75 percentage points). During the pandemic, not only firms but also professional forecasters had a tendency, on average, to be too pessimistic about the depth of the recession. The positive effects of the pandemic on some firms mitigated this pessimism for them to some extent, ultimately resulting in lower forecast errors for these companies. This refects again that firms extrapolate form their business to the aggregate economy.

The differences are economically meaningful as Tanaka et al. (2020) quantify the loss in profitability associated with a 1 percent increase in GDP growth rate forecast errors to be around 8 percent. The coefficients associated with the acyclicality identifiers are positive throughout but only significantly different from zero for firms with large shares of sales abroad and those in acyclical industries. Thus, the finding that acyclical firms are worse at forecasting GDP growth carries over to the pandemic period. The insignificant coefficients corresponding to the interaction terms indicate that the latter effect does not depend on how a firm was affected by the pandemic.

[15] Given the reduced-form regression and correlation between the control variables, we do not want to place much emphasis on the interpretation of the estimates.

Table 7
Consistency of Theoretical Models and Empirical Results.

	Dispersion	Size Dependence	Local Information
Lucas (1972)	✓	–	✓†
Reis (2006)	✓	✓	–
Maćkowiak and Wiederholt (2009)	✓	✓	✓§
Angeletos and La'O (2013)	✓	–	–*

Notes: † The model implies additional confusion between nominal and real shocks. § Extended version of the model where firms can choose to observe linear-combinations of aggregate and idiosyncratic signals. * Model features noisy idiosyncratic signals about local conditions in other parts of the economy instead of information about a firm's own local environment.

In sum, firms that care relatively less about the German business cycle because their business is acyclical produce worse growth forecasts than firms with business models that depend more heavily on the business cycle, before and during the pandemic.

4. Consistency of Results with Theoretical Models of Expectation Formation

We now discuss the extent to which the empirical facts about growth expectations of firms that we have established are consistent with the predictions of common theoretical models with imperfect information structures that are commonly discussed in the macroeconomic literature. We focus on the "island" model by Lucas (1972), the sticky information model with endogenous updating choice as in Reis (2006), the model of Maćkowiak and Wiederholt (2009) with limited attention capacity which builds on Sims (2003), and the model with "sentiment shocks" of Angeletos and La'O (2013). We summarize the consistency between models and empirical facts in Table 7.

The first empirical fact is that expectations are highly dispersed. All four theoretical models are able to replicate this fact because different agents—at each point in time—form their expectations about the future aggregate state of the economy based on different information sets.

The second empirical fact is that the dispersion of expectations is larger for small firms than for large firms. The models by Lucas (1972) and Angeletos and La'O (2013) cannot explain such heterogeneity across the firm size distribution because they imply exogenous mechanisms of information provision that are independent of the size of firms. Hence, the nature of information flows is independent of the size of a firm which rules out a systematic relationship between the degree of expectation dispersion and firm size. In contrast, information acquisition is endogenous in the other two models. In both cases, the model structure implies that it is optimal for large firms to acquire information about the state of the aggregate economy more frequently or to a greater extent relative to small firms—leading to less dispersed expectations among large firms. In the model by Reis (2006), firms need to pay a fixed cost to update their information set; the payoff from being able to adjust prices optimally is larger for firms with large sales volumes. Therefore, large firms will update their information sets more frequently. In one of the model setups discussed in Maćkowiak and Wiederholt (2009, Section VII.B.), firms choose how much attention to pay to aggregate conditions, idiosyncratic information, and/or a linear combination of both. Maćkowiak and Wiederholt (2009) show that firms only pay substantial attention to aggregate conditions when the capacity for absorbing information is large. Presumably, this is the case only for large firms. In turn, small firms need to infer expectations about aggregates from the mixed signal that is influenced by idiosyncratic information—and, thus, have more dispersed expectations. In contrast, larger firms also pay attention to aggregate shocks—leading to smaller expectation dispersion. This model is backed by our empirical result that local signals—at least when including data from the pandemic—are often more important for small firms when forming expectations about aggregate growth while large firms do extrapolate from local signals to a lesser degree. This difference in informedness about aggregate conditions between large and small firms is reflected in our data. We find that the standard deviation of growth expectations is about 32% higher for small firms compared to large firms.

The third empirical fact is that "local" information influences expectations of firms about aggregate growth. As just described, this is a property of the model by Maćkowiak and Wiederholt (2009) when firms infer future aggregate conditions from a signal that is a linear combination of idiosyncratic and aggregate conditions. Our data sample allows to disentangle the two signals. Figure A.3 in the online appendix shows the share of the variance (R^2) that can be explained by the various proxies for local signals we consider (after controlling for common target-year fixed effects). We find that all proxy variables jointly account for about 26 % of cross-sectional expectation dispersion. Business assessment clearly contributes most. The share of variance explained by the different fixed effects is even higher. Fixed effects for regions and industries jointly explain about 47 % of the dispersion of growth expectations. Hence, in accordance with Maćkowiak and Wiederholt (2009), firms seem to react considerably to idiosyncratic signals when forming growth expectations. In contrast, the model in Reis (2006) is not consistent with extrapolation from local conditions. When firms update their information set in this model, they always obtain full information about the state of the world; dispersion arises due to outdated information sets rather than any confusion of local and aggregate information. Things are more complicated in case of the two other models. In Lucas (1972), firms indeed have to infer the aggregate state of the economy from local signals. More precisely, however, they observe local prices (a nominal variable) and have to infer aggregate demand (a real variable). So in addition to having

to infer something aggregate from local information they face the problem of distinguishing monetary from real shocks. Most of our empirical setups focus on local *real* conditions and, hence, do not fully match this theoretical framework. We provide only tentative evidence in support of Lucas' model in form of the correlations between individual product price expectations and firms' growth expectations documented in the previous subsection. The right panel of Figure A.3 in the online appendix shows that price expectations make up for about 10 % of the explained variance of growth expectations. In Angeletos and La'O (2013)—a model that features "islands" as in Lucas (1972), with imperfect information flows between those "islands"—firms receive (noisy) signals about fundamentals and information sets of one trading partner ("one other island"). Hence, their expectations about future aggregates are driven by information about conditions in *other* parts of the economy. This is not in line with our understanding of local information, which implies that firms gain information about *their own* local environment.

In sum, while all four models are consistent with dispersed macroeconomic expectations of firms, only a version of the model framework with limited information processing capacities in Maćkowiak and Wiederholt (2009) can account for all three empirical facts that we describe above. The other theoretical models either fail to generate the negative relationship between expectation dispersion and firm size or do not provide a mechanism by which information about local/idiosyncratic conditions influence macroeconomic expectations.

5. Conclusion

In recent years, macroeconomists have increasingly tried to understand how private households and firms form expectations about macroeconomic variables. Based on a large and fairly representative sample of German firms, this paper shows that local information—observed by firms in their industry, their region, or simply within the firm—influences the firms' expectations of aggregate growth.

Overall, our results highlight the importance of idiosyncratic and local information shocks to individual firms for understanding the dynamics of macroeconomic expectations. In particular, they offer an explanation for the observed cross-sectional expectation disagreement across firms. In total, local unemployment, industry growth, business expectations, business assessment, and price expectations (our measures of local information) account for about 26 % of the explained share in expectations variation. County and industry fixed effects together make up almost half of the explained variance which equals a threefold increase in the explained variance share compared to controlling for only the aggregate economic situation with wave fixed effects.

Our evidence complements findings in Andrade et al. (2022): our analysis covers not only the manufacturing sector but also the trade and service sectors, it is based on quantitative expectations of aggregate growth, and—due to our knowledge of the location of firms' headquarters—we can link expectations about aggregates to the regional economic situation rather than only to industry conditions. In addition, we provide evidence that the extrapolation from local information to expectation about aggregate growth is more pronounced for small firms than for large firms, at least if one considers the full sample including the expectations elicited during the pandemic.

A drawback of our data set is the very small time dimension. Data on growth expectations is only available from four survey waves and for four target years. This precludes any analysis of dynamic effects like the ones shown in Andrade et al. (2022) and confines our study to an analysis of cross-sectional variation in the data.

Our results have implications for theoretical modeling of expectation heterogeneity in macroeconomic models. All four models that we consider (Angeletos and La'O, 2013; Lucas, 1972; Maćkowiak and Wiederholt, 2009; Reis, 2006) are consistent with dispersed macroeconomic expectations of firms. But only one version of the model framework with limited information processing capacities in Maćkowiak and Wiederholt (2009) is additionally consistent with dispersion being larger for small firms and an impact of local information shocks on expectations about aggregate variables. The other three models miss to explain at least one of those two additional empirical facts.

From the perspective of firms, an overreaction to local information could lead to substantial misguided business decisions. We leave it to future research to analyze if firms that extrapolate from local information when forming growth expectations suffer in terms of business performance in the medium term. Complementary research based on the ifo BTS by Born et al. (2022) suggests that firms that overreact to "micro shocks", i.e., information that is firm-specific loose in terms of profitability.

Data availability

The authors do not have permission to share data.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmoneco.2023.03.005.

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