Firm Expectations and News: Micro v Macro

Benjamin Born, Zeno Enders,

Manuel Menkhoff, Gernot Müller, and Knut Niemann

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Full information rational expectations (FIRE) benchmark

- suggests immediate and correct updates
- forecast errors should not be predictable based on time-t information

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- No FI: consensus forecast underreact to news (Coibion and Gorodnichenko 2015)
- No RE: individual forecasts overreact to news (Bordalo et al. 2020)

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Literature is currently exploring explanations that can account for both observations jointly (Broer and Kohlhas 2022; Kohlhas and Walther 2021)

Our paper

New perspective

- Firm expectations about their production ($\neq$ professional forecasts about aggregates)
- Distinguish effect of micro (that is, firm-specific) and macro news

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   - overreact to micro news (trigger negative forecast errors)
   - underreact to macro news (trigger positive forecast errors)

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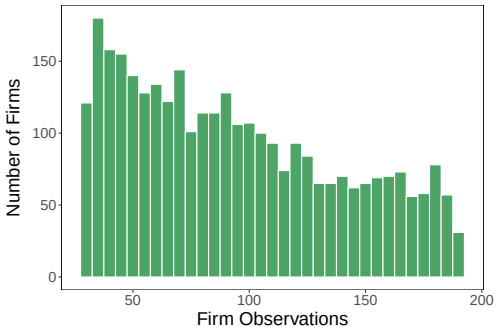
- Distinguish effect of micro (that is, firm-specific) and macro news

1. Establish evidence based on ifo survey that firm expectations
   - overreact to micro news (trigger negative forecast errors)
   - underreact to macro news (trigger positive forecast errors)
2. General equilibrium model with dispersed information and island illusion
   - Rationalize key patterns in the data
   - Derive model-based predictions and test them empirically

ifo Business Climate Survey

- Monthly, mostly qualitative firm survey
- final sample includes roughly 1,600 firm-observations per month
- used to construct expectation errors and micro news



Firm expectations and expectation errors

Production expectations for next three months:
Our production is expected to be [1] increasing, [0] not changing or [-1] decreasing.

Production realization in last month:
Compared to (month before previous month) our production increased [1], stayed about the same [0] or decreased [-1].

Production forecast error (Bachmann et al. 2013):

$$\text{Error}_{i,t} = \begin{cases} 0 & \text{if sgn}\left(x^i_{t+3}\right) = x^i_{t+3|t} \\ \frac{1}{3}\left(x^i_{t+3} - x^i_{t+3|t}\right) & \text{else,} \end{cases}$$

Details

where

- $x^i_{t+3|t} \in \{-1, 0, +1\}$ is the 3-months-ahead expectation at t
- $x^i_{t+3} \in [-3, +3]$ is the sum of subsequent 3 (monthly) realizations

Micro news

Micro (firm-specific) news based on forecast revisions of firms

$\rightarrow$ use sign of first difference of qualitative expectation about own production

$$FR_{i,t} = sgn\left(x^i_{t+3|t} - x^i_{(t-1)+3|t-1}\right)$$

and remove potential macro component via time-fixed effect

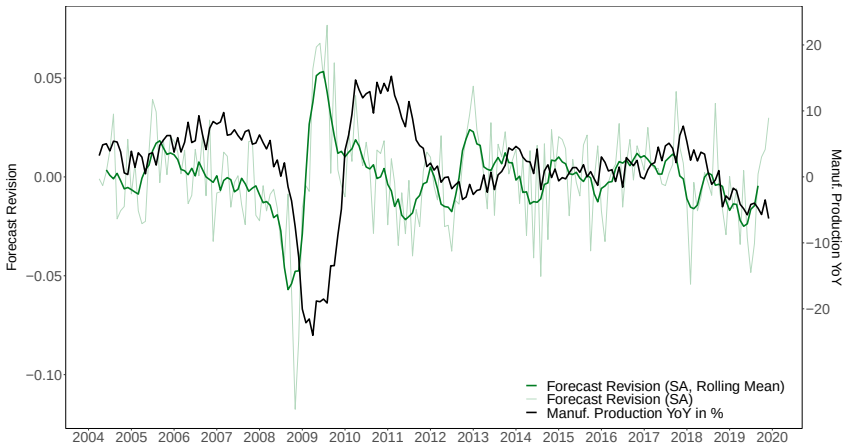
$$\text{Micro News}_{i,t} = FR_{i,t} - \mu_t$$

Potential issue: fixed forecast horizon but varying forecast period

$\rightarrow$ assume overlap in forecasting period sufficiently large to reflect actual micro news

Forecast revisions

Figure: Average Forecast Revisions and Production Growth



Notes: S.a. 6-months rolling mean of avg. forecast revisions (green) and yoy prod. growth in manuf. (black).

Macro news

Timing and construction

Surprise component of a business cycle indicator (ifo index)

In month $t-1$

- during the first two weeks: firms complete ifo survey
- until release of ifo index: professional forecasters submit forecasts to Bloomberg
- during the last week: ifo index is published

In month t define macro news as

$$\text{Macro news}_t = \text{ifo index}_{t-1} - \textit{median}\,(\text{professional forecasts for ifo index}_{t-1})$$

Details

Macro news

Why construct macro news based on the ifo index? Three advantages in our setting:

1. ifo index has high predictive power for German business cycle (Lehmann 2020)
2. firms likely know about latest ifo index release value
   → participating firms receive the results directly from the ifo Institute
   → news outlets report both ifo index and professional forecasts Examples
3. clear information structure: release of ifo index is, by construction, between 2 survey waves

Final sample: April 2004 to December 2019 (restricted by Bloomberg forecast availability)

Empirical model

Coibion and Gorodnichenko (2015)-type regression modified for firm-specific variables

$$\text{Error}_{i,t} = \beta_0 + \beta_1^i \text{Micro news}_{i,t} + \beta_2^i \text{Macro news}_t + v_t^i$$

where (as defined before)

- $\text{Error}_{i,t}$: production-expectation error (realization - expectation)
- $\text{Micro news}_{i,t}$: production-expectation revision net of time-fixed effect
- Macro news_t: surprise component in ifo index

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Rational expectations benchmark: $\beta_1^i = \beta_2^i = 0$

Coibion and Gorodnichenko (2015): $\beta^i > 0$ for underreaction, $\beta^i < 0$ for overreaction Intuition

Over- and underreaction to news

Pooled estimation - baseline

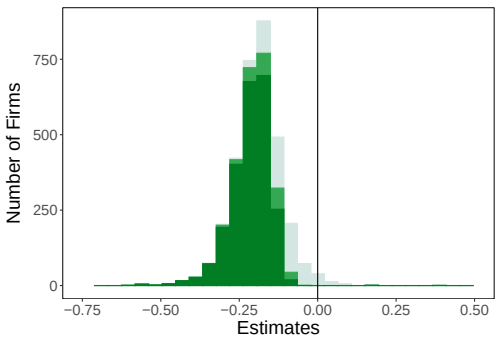
	Forecast Error			
	(1)	(2)	(3)	(4)
Micro News	-0.194***	-0.194***		
	(0.001)	(0.001)		
Macro News	0.021***		0.021***	0.022***
	(0.0007)		(0.0007)	(0.0007)
Forecast Revision				-0.191***
				(0.001)
Observations	302,737	302,737	302,737	302,737
R^2	0.16471	0.16015	0.08967	0.16260
Within R^2	0.08701	0.08202	0.00498	0.08471
Firm FE	✓	✓	✓	✓

Notes: Full, pooled sample. Standard errors clustered on firm level. *** p<0.01, ** p<0.05, * p<0.1.

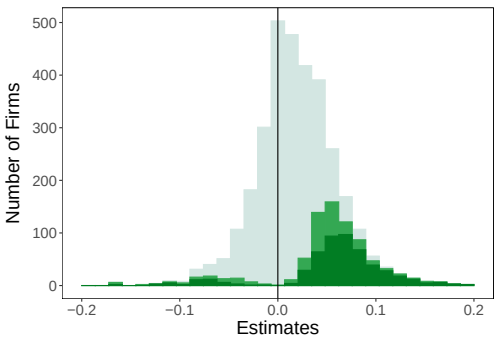
Over- and underreaction to news

Individual firm-level regressions

Overreaction to micro news (forecast revision)



Underreaction to macro news (ifo index shock)



Note: grey=not significant, bright green=10%, dark green=5%

Over- and underreaction to news: robustness

Main result holds in several robustness checks

Aspect	Baseline	Variation	
Estimation	OLS pooled across firms	ordered logit pooled across firms	Results
Forecast Error	Bachmann et al. (2013)	set small errors ($\pm 1/3$) to zero	Results
Macro News	surprise component in ifo index	surprise component in manufacturing orders	Results
		Δ ifo index	Results
		avg. forecast revision (by sector)	Results
Fixed effect	Time FE absorbed	time x sector FE absorbed	Results
Data Type	qualitative data ($+1$,0,-1) on production (expect.)	quantitative data ($0-100$) on business situation	Results

Over- and underreaction to news: Heterogeneity

When are deviations from RE benchmark largest?

Micro bias is homogenous

Results

- symmetric reaction to positive and negative news
- robust across firm size, sectors, age and time in survey

Macro bias is heterogeneous

Results

- larger for negative news than positive news
- increases with firm size and varies across sectors
- similar bias across firm age
- larger for firms that recently joined the survey

Both biases are stronger during recessions

Results

Should we care?

Firms with larger biases display larger production volatility

Measurement: firm-level standard deviation of production (Bachmann et al. 2013)

	dependent variable: $\text{sd}_i(\text{production}_{it})$		
	Sign of Bias	(1)	(2)
Constant		0.406^{***}	
Micro News Bias	$\beta_1 < 0$	-0.250^{***}	-0.248^{***}
Macro News Bias	$\beta_2 > 0$	1.66^{***}	1.64^{***}
Observations		2,204	2,204
Sector- and Size-FE			✓

Should we care? cont'd

Firms with larger biases make lower profits

Measurement: biannual, quantitative survey question on expected surplus less tax or loss in percent of net sales

	dependent variable: $\text{mean}_i(\text{profits}_{it})$		
	Sign of bias	(1)	(2)
Constant		0.199	
Micro News Bias	$\beta_1 < 0$	1.76^{**}	2.36^{***}
Macro News Bias	$\beta_2 > 0$	-0.069	-0.363
Observations		1,665	1,665
Sector- and Size-FE			✓

Over- and underreaction of decision-makers in general equilibrium

Different theoretical approaches to model over-/underreaction (of *prof. forecasters*) with respect to *macro variables* in the literature:

- **underreaction:** sticky/noisy information (e.g., Coibion and Gorodnichenko 2012)
- **overreaction:** diagnostic expectations (Bordalo et al. 2020)
- **both:** absolute + relative overconfidence (Broer and Kohlhas 2022)

Over- and underreaction of decision-makers in general equilibrium

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- **both:** absolute + relative overconfidence (Broer and Kohlhas 2022)

Our model explains why expectations about *firm-specific* developments respond differently to different type of news:

- joint effect of firm-specific and aggregate variables on firm output requires GE model
- combines noisy information (Lorenzoni 2009) + island illusion

GE Model: Setup

Continuum of islands indexed by $l \in [0,1]$, each populated by

- unit mass of producers indexed by $j \in [0,1]$ with production function $Y_{j,l,t} = A_{j,l,t} L_{j,l,t}^{\alpha}$
- representative household with utility function $U_{l,t} = E_{l,t}\left(\sum_{k=t}^{\infty} \beta^{k-t} \ln \hat{C}_{l,k} - \frac{L_{l,k}^{1+\psi}}{1+\psi}\right)$

Productivity is island specific: $A_{j,l,t} = A_{l,t}$
$\rightarrow$ log-productivity $a_{l,t}$ is sum of aggregate component x_t and island-specific component $\eta_{l,t}$:

$$a_{l,t} = x_t + \eta_{l,t}$$

$U_{l,t}$ **includes demand shifters:** $\hat{C}_{l,t} = \int_0^1 Q_{l,j,t} C_{l,j,t}$
$\rightarrow$ Household-specific demand shocks with aggregate component:

$$q_{l,t} = q_t + \hat{q}_{l,t}$$

Island illusion I

Firms forecast aggregate productivity conditional on own productivity:

$a_{I,t} - x_{t-1} = \varepsilon_t + \eta_{I,t} \rightarrow$ *private signal* for each island

Firms consider technological innovations to be mostly idiosyncratic, hence

$\rightarrow$ assess own productivity to be overly idiosyncratic: $\hat{\sigma}_\eta^2 / \hat{\sigma}_\varepsilon^2 > \sigma_\eta^2 / \sigma_\varepsilon^2$

$\rightarrow$ expect, on average, other prices to fall little after observing positive private signal

$\rightarrow$ overestimate own output, since competitors' prices turn out to be lower.

Result 1: Island illusion leads to overreaction to micro news.

Island illusion II

Firms forecast own and aggregate demand based on public signal:

$s_t = q_t + e_t$ with $e_t \sim \mathcal{N}(0, \sigma_e^2) \rightarrow$ *public signal*
for $q_{I,j,t} = q_t + \hat{q}_{I,j,t}$

Firms consider demand changes to be mostly idiosyncratic, hence

$\rightarrow$ underestimate importance of aggregate developments: $\hat{\sigma}_{\hat{q}}^2 / \hat{\sigma}_q^2 > \sigma_{\hat{q}}^2 / \sigma_q^2$

$\rightarrow$ implies underestimation of public signal-to-noise ratio: $\hat{\sigma}_e^2 / \hat{\sigma}_q^2 > \sigma_e^2 / \sigma_q^2$

$\rightarrow$ underestimate own and aggregate demand after observing positive public signal

$\rightarrow$ underestimate own output, also because competitors' prices turn out to be higher

Result 2: Island illusion leads to underreaction to macro news.

Mapping the model to the empirics

Consider the regression

$$FE_{j,l,t} = \beta FR_{j,l,t} + \delta s_t + \omega_{j,l,t}$$

$FE_{j,l,t}$: production forecast error of firm j on island l
$FR_{j,l,t}$: production forecast revision of firm j on island l
s_t: public signal about aggregate demand

In case of island illusion, we obtain

$$\beta < 0 \qquad \text{and} \qquad \delta > 0 \ .$$

Correlation of micro and macro bias | Importance of the macroeconomy

Conclusion

How do firms adjust their expectations as new information arrives?

Using a large panel of German firms we find

- *overreaction to micro news* as measured by qualitative forecast revisions
- *underreaction to macro news* as measured by surprise component of ifo index

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How can these patterns be explained?

- Study heterogeneity in the cross-section and time-series dimension
- Propose general equilibrium model featuring firms with island illusion, who consider their own technology and demand as overly idiosyncratic

Appendix

Media coverage of ifo index and professional forecasts

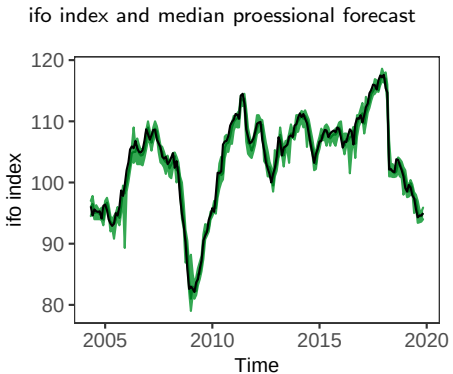
Back

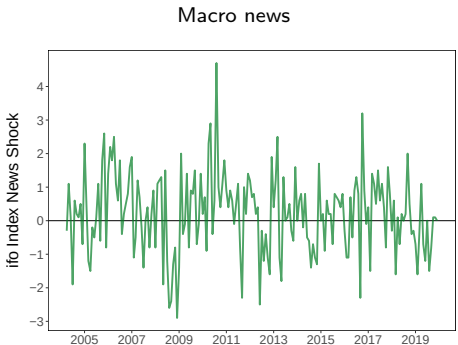
Date	Outlet	Quote
24 April 2022	Der Spiegel	[ifo index] stieg [...] auf 91,8 Zähler. Analysten hatten mit [...] 89,0 Punkten gerechnet.
22 February 2022	Handelsblatt	[ifo index] stieg im Februar [...] auf 98.9 Punkte. Ökonomen hatten mit [...] 96,5 Punkten gerechnet.
24 November 2021	Der Spiegel	Geschäftsklimaindex sank auf 96,5 Punkte. Experten hatten [...] 96,6 Punkte erwartet
27 July 2020	Süddeutsche Zeitung	[ifo index] für Juli legte auf 90,5 Zähler [...] zu. Ökonomen hatten mit 89,3 Punkten gerechnet.

Macro News

Back

Time series





Over- and underreaction to news

Back

Pooled estimation - robustness: ordered logit

term	estimate	std.error	statistic	type	exp(estim.)
Micro News	-1.16	0.01	-166.83	coefficient	0.31
Macro News	0.10	0.00	35.70	coefficient	1.11
-4/3|-1	-6.06	0.03	-174.40	scale	0.00
-1|-2/3	-3.58	0.01	-338.23	scale	0.03
-2/3|-1/3	-2.47	0.01	-371.38	scale	0.08
-1/3|0	-1.28	0.00	-282.15	scale	0.28
0|1/3	1.53	0.00	315.29	scale	4.61
1/3|2/3	2.73	0.01	374.83	scale	15.31
2/3|1	3.92	0.01	322.56	scale	50.63
1|4/3	6.68	0.05	144.49	scale	794.46

Intuition for Coibion and Gorodnichenko (2015) regressions

Back

Coibion and Gorodnichenko (2015)-type regression with more detail

$$\text{Error}_{i,t} = \text{Realization}_{i,t} - \text{Expectation}_{i,t} = \beta_0 + \beta_1^i \text{Micro news}_{i,t} + \beta_2^i \text{Macro news}_t + v_t^i$$

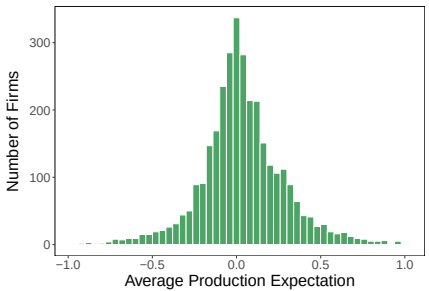
What do the signs of β_1^i and β_2^i tell us?

- $\beta_1^i = \beta_2^i = 0$ is RE benchmark, forecast errors are not predictable from news
- $\beta^i > 0$ when positive news predict positive errors, exp. revision too small, underreaction
- $\beta^i < 0$ when positive news predict negative errors, exp. revision too large, overreaction

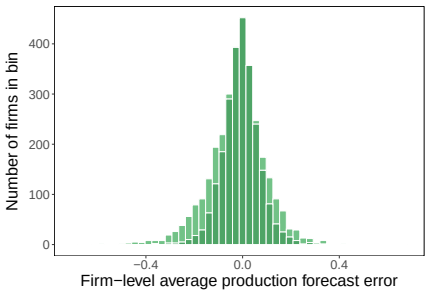
Firm expectations and expectation errors

Back

Average production expectation by firm



Average production forecast error by firm



- distributions of expectations / errors symmetric and centered around zero
- majority of average firm expectation errors insignificantly different from zero (dark green)

Over- and underreaction to news

Back

Pooled estimation - robustness: set small forecast errors to zero

	Forecast Error			
	(1)	(2)	(3)	(4)
Micro News	-0.117***	-0.117***		
	(0.001)	(0.001)		
Macro News	0.018***		0.018***	0.018***
	(0.0006)		(0.0006)	(0.0006)
Forecast Revision				-0.115***
				(0.001)
Observations	302,737	302,737	302,737	302,737
R^2	0.11483	0.11068	0.07974	0.11352
Within R^2	0.04244	0.03795	0.00449	0.04103
Firm FE	✓	✓	✓	✓

Over- and underreaction to news

Back

Pooled estimation - robustness: set small forecast errors to zero when zero expectations

	Forecast Error			
	(1)	(2)	(3)	(4)
Micro News	-0.180***	-0.180***		
	(0.001)	(0.001)		
Macro News	0.017***		0.017***	0.018***
	(0.0006)		(0.0006)	(0.0006)
Forecast Revision				-0.176***
				(0.001)
Observations	302,737	302,737	302,737	302,737
R^2	0.14873	0.14530	0.07495	0.14684
Within R^2	0.08316	0.07946	0.00369	0.08113
Firm FE	✓	✓	✓	✓

Over- and underreaction to news - Robustness

Back

Pooled estimation, macro news from manufacturing orders

	Forecast Error			
	(1)	(2)	(3)	(4)
Micro News	-0.194***	-0.194***		
	(0.001)	(0.001)		
Macro News	0.005***		0.005***	0.005***
	(0.0003)		(0.0003)	(0.0003)
Forecast Revision				-0.190***
				(0.001)
Observations	298,586	298,586	298,586	298,586
R^2	0.16100	0.16006	0.08580	0.15828
Within R^2	0.08321	0.08217	0.00103	0.08023
Firm FE	✓	✓	✓	✓

Over- and underreaction to news – Robustness

Back

Alternative fixed effects and macro news

	(1)	(2)	(3)	(4)	(5)
Micro News	-0.194***		-0.194***	-0.194***	
	(0.001)		(0.001)	(0.001)	
Macro News	0.021***	0.021***			
	(0.0007)	(0.0007)			
Micro News (Time X Sector FE absorbed)		-0.196***			-0.196***
		(0.001)			(0.001)
Δ ifo Index			0.001***		
			(0.0002)		
Average Forecast Revision				0.308***	
				(0.019)	
Average Forecast Revision by Sector					0.129***
					(0.013)
Observations	302,737	302,737	301,185	302,737	302,737
R^2	0.16471	0.16555	0.16017	0.16186	0.16169
Within R^2	0.08701	0.08793	0.08214	0.08389	0.08371
Firm FE	✓	✓	✓	✓	✓

Over- and underreaction to news – Robustness

Back

Quantitative data for business expectations – wording of questions

Expectations for the next six months:

- In cyclical regards our state of business will be
  0 [rather less favorable] to 100 [rather favorable]

Current situation:

- We consider our state of business to be
  0 [bad] to 100 [good]

A priori not clear if expectations measure levels or changes

- Link (2020) concludes that responses measure expected levels of revenue
- our results hold for both interpretations

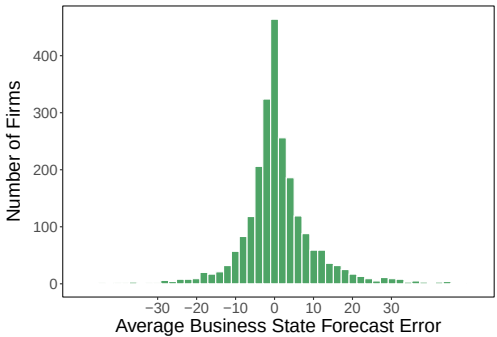
Over- and underreaction to news – Robustness

Back

Quantitative data for business expectations – forecast errors centered around zero

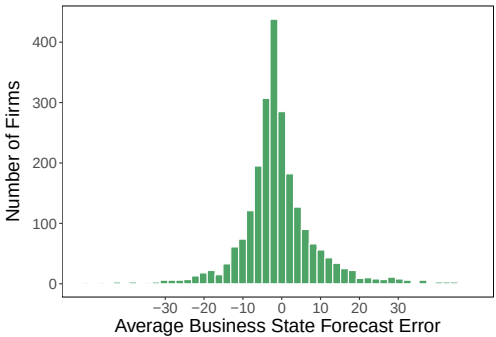
Interpret expectations as levels

$\text{Error}_{it} = \text{Busi}_{i,t+6} - \text{Busi}_{i,t+6|t}$



Interpret expectations as changes

$\text{Error}_{it} = (\text{Busi}_{i,t+6} - \text{Busi}_{i,t}) - \text{Busi}_{i,t+6|t}$



Over- and underreaction to news

Back

Quantitative data for business expectations – interpret expectations as levels

	Forecast Error			
	(1)	(2)	(3)	(4)
Micro News	-0.450***	-0.450***		
	(0.003)	(0.003)		
Macro News	0.687***		0.683***	0.843***
	(0.043)		(0.042)	(0.043)
Forecast Revision				-0.442***
				(0.003)
Observations	161,578	161,578	164,675	161,578
R^2	0.32430	0.32210	0.25535	0.32261
Within R^2	0.09227	0.08931	0.00290	0.09000
Firm FE	✓	✓	✓	✓

Over- and underreaction to news

Back

Quantitative data for business expectations – interpret expectations as changes

	Forecast Error			
	(1)	(2)	(3)	(4)
Micro News	-0.448***	-0.448***		
	(0.003)	(0.003)		
Macro News	0.697***		0.693***	0.853***
	(0.043)		(0.042)	(0.043)
Forecast Revision				-0.440***
				(0.003)
Observations	161,399	161,399	164,492	161,399
R^2	0.33211	0.32989	0.26488	0.33054
Within R^2	0.09112	0.08809	0.00298	0.08898
Firm FE	✓	✓	✓	✓

Over- and underreaction to news: Heterogeneity

Back

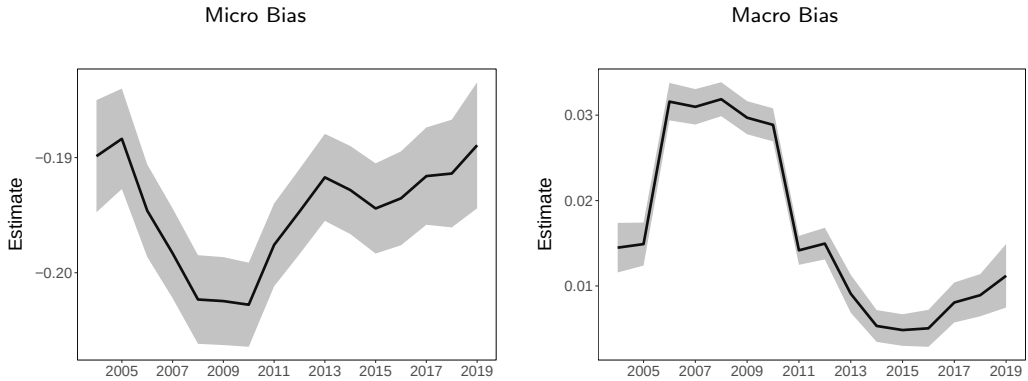
Heterogeneity in underreaction to macro news

	Micro News		Macro News	
Interaction	$\widehat{\beta}$	SE($\widehat{\beta}$)	$\widehat{\beta}$	SE($\widehat{\beta}$)
News				
Overall	-0.194^{***}	0.001	0.021^{***}	0.001
News				
$\times$ Positive sign of news	-0.199^{***}	0.002	0.011^{***}	0.001
$\times$ Negative sign of news	-0.189^{***}	0.002	0.034^{***}	0.001
News				
$\times$ 1. Quartile by employees	-0.199^{***}	0.003	0.012^{***}	0.003
$\times$ 2. Quartile by employees	-0.193^{***}	0.003	0.019^{***}	0.002
$\times$ 3. Quartile by employees	-0.192^{***}	0.003	0.021^{***}	0.001
$\times$ 4. Quartile by employees	-0.195^{***}	0.002	0.026^{***}	0.001
News				
$\times$ Time in survey $<$ half a year	-0.195^{***}	0.008	0.032^{***}	0.006
$\times$ Time in survey $\geq$ half a year	-0.194^{***}	0.001	0.021^{***}	0.001

Over- and underreaction to news: Heterogeneity over time

Back

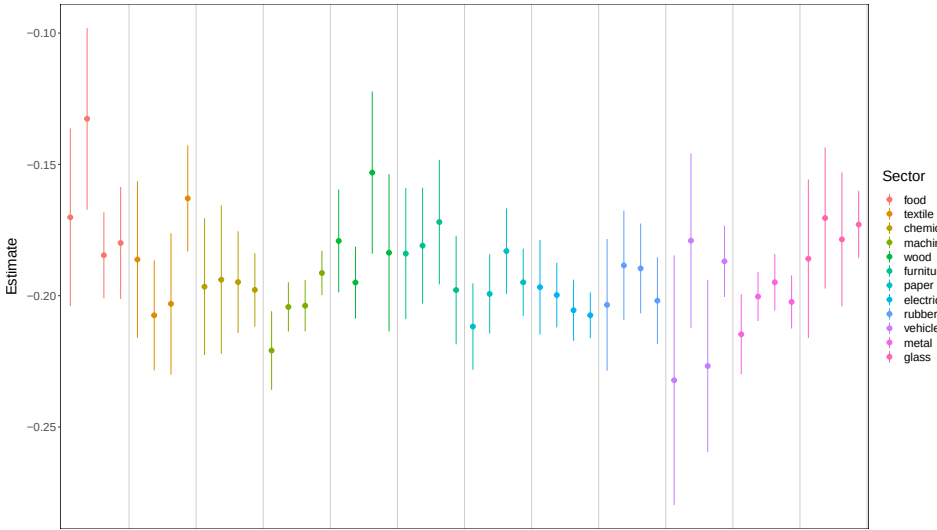
Stronger biases during financial crisis



Note: Regressions over Rolling Window (5 Periods)

Overreaction to micro news: size and sectors

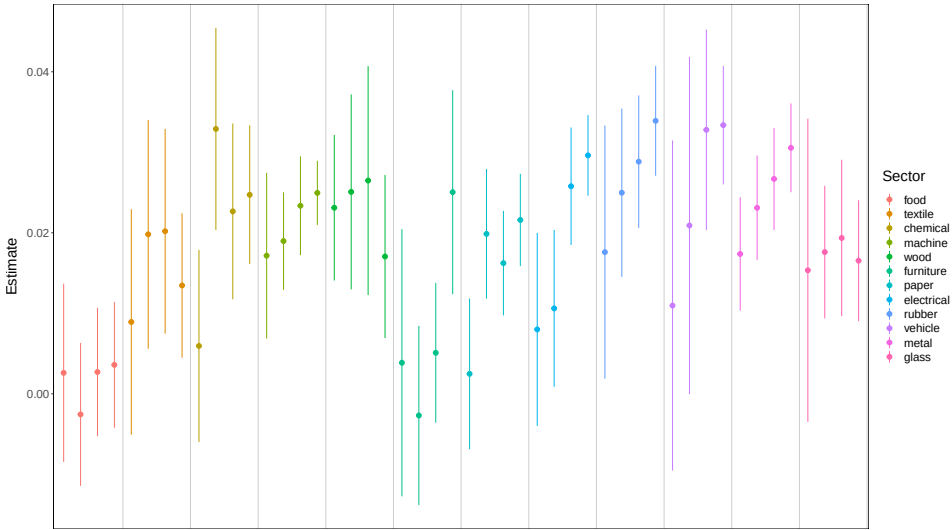
Back



Note: 95% confidence bands. Firm size approximated by quartiles of number of employees (Q1 to Q4)

Underreaction to macro news: size and sectors

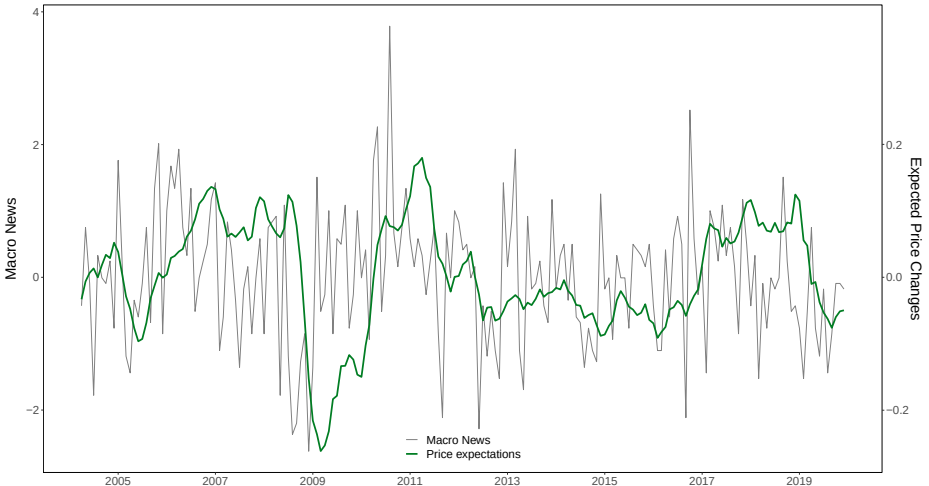
Back



Note: 95% confidence bands. Firm size approximated by quartiles of number of employees (Q1 to Q4)

Macro news and planned price changes

Back



Intraperiod timing at t Back

First stage

- information about all variables in $t-1$ is released, nominal wages are determined
- generic ("monetary policy") shock ν_t is publicly observed
- central bank sets interest rate based on expected inflation $r_t = \psi E_{cb,t}(\pi_t) + \nu_t$

Second stage

- $a_{l,t} - x_{t-1} = \varepsilon_t + \eta_{l,t}$ constitutes *private signal* for each island $\rightarrow$ micro news
- $s_t = q_t + e_t$ with $e_t \sim \mathcal{N}(0, \sigma_e^2)$ is *public signal* $\rightarrow$ macro news
- Firms forecast own demand and competitors' prices conditional on both signals

Third stage

- firms on each island produce
- households shop on $n < \infty$ islands and observe prices there

Theoretical results

Back

Island illusion leads to (output) overreaction to micro and underreaction to macro news.

Consider the regression

$$\Delta y_{j,l,t} - E_{j,l,t}\Delta y_{j,l,t} = \bar{\alpha} + \beta FR_{j,l,t} + \delta s_t + \omega_{j,l,t} \ ,$$

where

- $\Delta y_{j,l,t}$: realized change in firm j-specific output
- $FR_{j,l,t} = E_{j,l,t}x_t - E_{j,l,t-1}x_t$: forecast revision of firm j

In case of island illusion, we obtain

$$\beta < 0 \qquad \text{and} \qquad \delta > 0$$

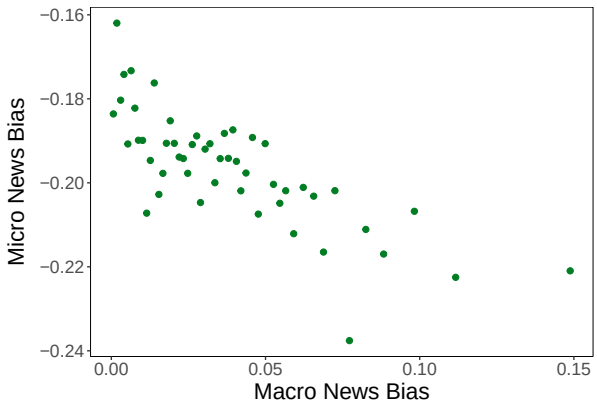
External validation: Model prediction I

Back

Firms with a stronger micro bias should also display a stronger macro bias

Intuition: island illusion drives both biases

Measurement: firm-level macro and micro biases



External validation: Model prediction II

Back

Firms with larger attachment to the business cycle have larger potential for underreaction to macro news

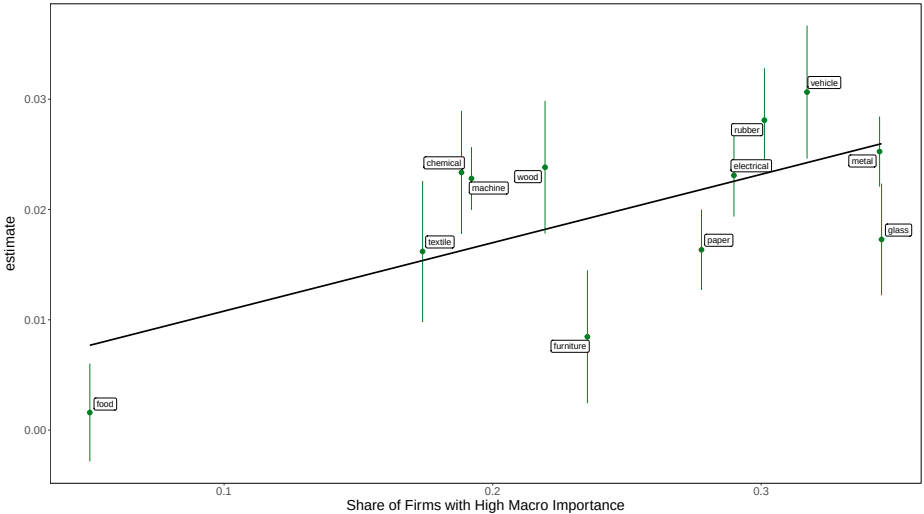
Intuition: for those firms, aggregate developments are more important

Measurement: one-time question in ifo survey:
How important is the general economic development in Germany for your business situation? very important [1] to unimportant [5]

	$1(\text{macro importance}_i = \text{very important})$	
	(1)	(2)
Constant	0.209***	
Micro News Bias	0.062	0.081
Macro News Bias	1.61**	1.37**
Observations	720	720
Sector- and Size-FE	✓	

Macro importance and macro bias

Sectors with lower attachment to business cycle display larger macro bias



Note: Sector shares of firms for which the business cycle is very important

Firm-level subjective uncertainty

	(1)	(2)	(3)	(4)	(5)	(6)
(Intercept)	51.9***	52.4***	50.4***			
	(1.71)	(0.828)	(1.74)			
Micro News Bias	-13.2		-10.4	-12.0		-9.75
	(8.71)		(8.69)	(8.65)		(8.58)
Macro News Bias		57.6***	55.3***		56.7***	55.0***
		(17.4)	(17.5)		(17.9)	(18.0)
Observations	718	718	718	718	718	718
R^2	0.00321	0.01408	0.01605	0.03624	0.04702	0.04865
Within R^2				0.00258	0.01374	0.01542
Sector FE				✓	✓	✓
Size FE				✓	✓	✓

→ Macro bias is associated with higher subjective uncertainty