

Micro Information Dynamics: Decomposing the Forecasting Power of Aggregate Indicators

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Motivation

Forecasting German industrial production with Ifo Indicators (in levels and first differences) with an standard distributed lag model. Benchmark is an AR model.

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Table : Forecasting Performance of Benchmark Indicators - Relative MSFE

horizon indicator	$h=0$		$h=1$		$h=3$		$h=6$	
	η_t	$\Delta\eta_t$	η_t	$\Delta\eta_t$	η_t	$\Delta\eta_t$	η_t	$\Delta\eta_t$
Climate	0.79	0.85	0.82	0.83	0.70	0.66	0.59	0.57
Situation	0.79	0.85	0.82	0.83	0.70	0.66	0.59	0.57
Expectation	0.81	1.00	0.78	0.98	0.63	0.86	0.50	0.92

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Expectation	0.81	1.00	0.78	0.98	0.63	0.86	0.50	0.92

⇒ Survey data proved to be very good predictors for economic development

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Research Questions

- What makes the survey indicators (e.g. Ifo) a good predictor?
 - Can we get answers by looking at micro data?
 - Is it the size or the industry sector?
 - What role does the situation and the expectation questions play for different forecasts horizons?
- Are there any new micro based measures that can improve the forecasting accuracy?

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- Calculate various 'disagreement' measures
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- 2 Measures based on the full sample
- 3 Measures based on subsamples
- 4 Data and Empirical Approach
- 5 (Preliminary) Results

Outline

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Balance Statistics

The most commonly aggregation measure is **the balance statistics**. Suppose a survey asks participants to answer questions on a three-level scale. Let N_- denote the number of negative, N_0 the number of neutral, and N_+ the number of positive responses, with all replies adding up to $N = N_- + N_0 + N_+$. The balance is therefore

Definition

Balance

$$\eta_{bs} = \frac{N_+ - N_-}{N} = N(p_+ - p_-).$$

⇒ this is our benchmark

New Measures for the Full Sample

Definition

(Shannon) Entropy

$$\eta_{ety} = - \sum_{i \in \{-,0,+\}} p_i \cdot \log_2(p_i)$$

Definition

Cross-sectional Standard Deviation

$$\eta_{std} = \sqrt{p_+(1 - \eta_{bs})^2 + p_0 \eta_{bs}^2 + p_-(1 + \eta_{bs})^2}$$

New Measures for the Full Sample

In order to capture cross-sectional uncertainty with use the disagreement measure of Bachmann et al. (2012).

Definition

Cross-sectional Variation

$$\eta_{dis} = \sqrt{p_+ + p_- - (p_+ - p_-)^2}$$

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Basic Categories

Survey participants can be classified by various characteristics, s. The *Ifo* survey, for example, provides information on the size and sectoral affiliation of each responding business unit. We classify respondents along the following three dimensions:

- Business Unit Size (5 categories, by number of employees¹)
- Branch (10 categories)²
- Sector (3 categories: consumer goods, basic materials, technology)

¹The cutoffs between categories are 1-49, 50-199, 200-499, 500-999, and >1000 employees, respectively.

²The ten categories are Food and Tobacco; Textiles and Clothing; Timber, Furniture and Jewelry; Paper and Publishing; Electronics and Optics; Chemical Industry and Petroleum; Glass and Ceramics; Metal Industry; Engineering; and Vehicle Manufacturing.

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Further Categories

Furthermore, the past behavior of survey participants may reveal information about the reliability and spontaneity of the participant. We first classify participants by their *unconditional switching* behavior in the entire sample into three categories: Participant changed response relative to previous survey in

- 1 $< 10\%$
- 2 10-20%
- 3 $> 20\%$

of all surveys.

Further Categories

We further classify participants based on their most recent response pattern. We split participants based on their *conditional switching* behavior into the following categories:

- 1) New entries: did not participate in the survey in the previous month,
- 2) Nonswitchers: did not change their response this period relative to previous
- 3) Switchers: changed their response this period relative to previous and
 - Infrequent Switchers: previous switch was 5 or more months ago,
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④ Switcher behavior (alternative Specification) over the previous 24 months:

- Infrequent Switchers: less than three switches,
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⑤ Consistent answering behavior:

Given its assessment of the firms current and expected business situation we evaluate whether a firm answers consistently within one to six months.

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We apply all measures defined in Subsection defined before to each category of each of these classifications.

Rewighted Measures

The subsample results provide guidance which categories provide most information. We therefore reweight the measures with the entropy. For example, the balance statistic weighted by entropy becomes

Definition

(Entropy-Weighted Balance Statistic)

$$\eta_{bse} = \frac{\sum_s \eta_{bs,s} \cdot \eta_{ety,s}}{\sum_s \eta_{ety,s}}.$$

The definition for entropy-weighted disagreement, η_{dise} , is analogous.

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Ifo Micro Data

Since 1949 the *Ifo* survey has asked firms to self-assess their business situation and expectations for the upcoming six months on a three-level scale. The survey question concerning current situation is

*We evaluate our state of business with respect to XY
as:*

“good” (1), “satisfactory” (2), “unsatisfactory” (3).

and for the Expectations for the next six months

*With regard to the business cycle our business
situation for XY will be:*

*“more favorable” (1), “the same” (2), “less favorable”
(3).*

Table : Profile of Survey Responses by Firm Size

business unit size (# empl.)	total		unconditional switching freq.			cons. goods	sector	
		(%)	<10%	10-20%	>20%		basic materials	tech- nology
1-49	199,745	28.6	6%	19%	76%	6.9%	16.6%	5.1%
50-199	251,245	36.0	10%	28%	61%	6.4%	20.9%	8.6%
200-499	130,760	18.7	15%	35%	50%	2.6%	10.4%	5.7%
500-999	60,007	8.6	24%	37%	39%	0.9%	4.8%	2.9%
>1000	56,854	8.1	29%	33%	37%	0.6%	3.8%	3.7%
sum	698,611	100.0						

The table lists the total number of responses from each sector during the entire sample period 1992:01 - 2010:12, as well as the share of surveys that the average business unit participated. *Unconditional switching* reports the relative shares for each category of the unconditional switching frequency in the entire sample.

Table : Profile of Survey Responses by Sector

		cons. goods	sector basic materials	technology
total response rate	('000) (%)	121,505 17.4	395,343 56.6	181,763 26.0
unconditional switching freq.	<10% 10-20% >20%	11% 26% 63%	9% 27% 64%	11% 28% 61%

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Target Variable

We forecast the h -month growth of IP at an annual rate

$$y_{t+h}^h = \frac{1200}{h} \ln \left(\frac{IP_{t+h}}{IP_t} \right), \quad (1)$$

where $h = 1, 3, 6$ and 12 .

Empirical Approach

Our forecasting model is the standard autoregressive distributed lag model. Denoting the indicator series by η_t , we have for forecast horizons $h > 0$

$$y_{t+h} = \alpha + \sum_{i=1}^p \beta_i y_{t-i} + \sum_{j=1}^q \gamma_j \eta_{t-j} + \varepsilon_t. \quad (2)$$

We perform a standard pseudo-out-of-sample forecasting exercise using a rolling window scheme. We produce forecasts from 2003 to 2011.

Benchmarks Models

Our benchmark models build on the well-known Ifo survey indicators for the German economy:

- 1 Nowcasting: *Ifo* situation industry
- 2 Forward-looking: *Ifo* expectations industry
- 3 Hybrid: *Ifo* Climate industry (climate is calculated as the geometric mean of the respective situation and expectations index)

⇒ We further consider the standard AR benchmark.

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Table 4: Decomposing the forecasting power - Full Sample

		a) Horizon $h = 0$ (Ifo Situation = 0.79)										
indicator		all	no switch	uncond. switching			Consistent Answering Behavior					
				<10%	10%–20%	>20%	1	2	3	4	5	6
Size	<50	0.81	0.94	0.96	1.01	0.97	0.95	0.92	0.78	0.85	0.84	1.02
	50–200	0.86	0.86	0.83	1.00	1.02	0.82	0.79	0.89	1.00	0.90	1.07
	200–500	0.84	0.83	1.11	0.83	1.06	0.78	0.79	0.82	0.83	0.79	0.91
	500–1000	0.83	0.88	0.88	0.95	0.94	0.87	0.83	0.87	0.86	0.84	0.92
	>1000	0.82	0.79	1.08	0.77	0.84	0.93	0.82	0.78	0.93	0.86	0.91
Sector	Consumer	1.05	1.03	1.05	1.05	1.06	1.06	1.07	1.04	1.04	1.06	1.02
	Basic Mat.	0.77	0.77	0.83	0.78	0.85	0.85	0.77	0.87	0.88	0.82	0.93
	Technology	0.83	0.83	0.84	0.86	0.85	0.89	0.76	0.79	0.84	0.83	0.85
		a) Horizon $h = 1$ (Ifo Expectation = 0.78)										
Size	<50	0.88	0.83	0.87	0.97	1.05	0.96	0.97	0.97	0.97	0.98	0.97
	50–200	0.79	0.79	0.80	0.85	1.06	0.92	0.91	0.86	0.93	0.91	0.92
	200–500	0.84	0.81	0.82	0.89	1.01	0.86	0.88	0.86	0.83	0.88	0.89
	500–1000	0.79	0.81	0.85	0.81	1.01	0.81	0.85	0.83	0.81	0.83	0.80
	>1000	0.80	0.75	0.84	0.81	0.85	0.68	0.73	0.76	0.78	0.81	0.91
Sector	Consumer	1.00	0.98	0.99	1.01	1.06	0.95	0.97	0.94	1.00	0.96	0.95
	Basic Mat.	0.77	0.78	0.78	0.84	0.89	0.84	0.82	0.82	0.79	0.85	0.81
	Technology	0.77	0.83	0.86	0.81	0.92	0.76	0.77	0.80	0.83	0.81	0.88
		a) Horizon $h = 12$ (Ifo Expectation = 0.50)										
Size	<50	0.60	0.67	0.60	0.68	0.95	0.62	0.65	0.66	0.64	0.67	0.67
	50–200	0.54	0.61	0.53	0.65	0.80	0.58	0.57	0.61	0.59	0.60	0.60
	200–500	0.57	0.57	0.57	0.59	0.80	0.81	0.63	0.62	0.57	0.64	0.63
	500–1000	0.61	0.69	0.56	0.61	0.79	0.64	0.66	0.64	0.64	0.62	0.61
	>1000	0.58	0.58	0.60	0.57	0.69	0.63	0.63	0.62	0.62	0.63	0.63
Sector	Consumer	0.70	0.74	0.63	0.78	0.94	0.67	0.66	0.71	0.70	0.72	0.72
	Basic Mat.	0.54	0.57	0.53	0.61	0.81	0.54	0.57	0.58	0.57	0.58	0.57
	Technology	0.54	0.58	0.54	0.58	0.76	0.55	0.55	0.60	0.62	0.64	0.59

This table reports relative MSFE against the AR benchmark for the full sample forecasting period. Figures in **italics** denote ratios equal or smaller than the respective benchmark.

Results based on the Balance Statistic

Which categories provide good information?

- ① Large Firms, and
- ② Firms from the Basic Materials Sector
- ③ Medium Switchers
- ④ Consistent Answering Behaviour over 1 to 3 Months

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Alternative Indicators

- 1 no improvement: Standard Deviation, Disagreement, Entropy
- 2 further improvement: weighted balance statistics with entropy
 - $h = 0$ ifo = 0.79 vs. 0.62
 - $h = 1$ ifo = 0.78 vs. 0.62
 - $h = 3$ ifo = 0.63 vs. 0.59
 - $h = 6$ ifo = 0.50 vs. 0.44

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- dynamic factor models
- forecast combination
- reconstructed index
- multiple time-series forecasting
- movements between categories

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