CESifo WORKING PAPERS

8145
2020

March 2020

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CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
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Editor: Clemens Fuest
https://www.cesifo.org/en/wp
An electronic version of the paper may be downloaded
· from the SSRN website: www.SSRN.com
· from the RePEc website: www.RePEc.org
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CESifo *Working Paper No. 8145*

Tracking and Predicting the German Economy: ifo vs. PMI

Abstract

This analysis investigates the predictive power of the most important leading indicators for the German economy, which are provided by the ifo Institute and IHS Markit. We conduct an out-of-sample, real-time forecast experiment for growth of gross domestic product and growth of gross value added in both the manufacturing and the service sector. We find that both survey providers produce valuable leading indicators to predict the current quarter of German GDP growth. Regarding forecasts for the next quarter, the ifo indicators are slightly better than the IHS Markit headline index. For the manufacturing sector, series provided by ifo are clearly superior to those of IHS Markit. For the service sector, the ifo indicators produce better nowcasts, whereas the indicators by IHS are more valuable for one-quarter-ahead predictions.

JEL-Codes: E170, E270, E370.

Keywords: forecasting nowcasting, survey data, ifo Business Climate, PMI.

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We thank IHS Markit for providing the PMI data for Germany.

1 Introduction

Business surveys are a well-established source to derive predictions on current and future development of macroeconomic variables such as gross domestic product (GDP) (see, for example, Angelini *et al.*, 2011). Regarding Germany, the most important monthly business surveys are conducted by the ifo Institute and IHS Markit. The headline indicators of these survey providers, the ifo Business Situation, the ifo Business Expectations, the ifo Business Climate, and the PMI Composite Output Index, all receive considerable media attention and are found to be important for tracking economic activity in both the Euro Area and Germany (see, for example, Basselier *et al.*, 2018; de Bondt, 2019; Lehmann, 2020). Among analysts there is an ongoing debate on which indicator is better suited to track the aggregate German economy (see, for example, the Wall Street Journal or `tradingfloor.com`)[1] or certain branches of the economy. Recently, J.P. Morgan stated that IHS Markit's service sector indicator is better in explaining movements in sectoral gross value added than the ifo Business Expectations.[2] This exemplary analysis, however, only investigates the in-sample fit of both indicators, that is, how much they are able to explain a variable's past fluctuations. From a forecaster's perspective such an analysis is of little help as it does not take a stand on the indicators' forecasting properties, that is, on the reliability of the indicators' signals for a variable's current and future development.

This paper focuses on this essential property. We conduct an out-of-sample, real-time forecast analysis which assesses the accuracy of the ifo and IHS Markit headline indices in predicting the current quarter and the one-quarter-ahead growth rate of GDP and gross value added (GVA) in the most important branches of the Germany economy, that is, manufacturing and services. Our results indicate that the headline indicators of both survey providers deliver valuable information for nowcasting quarterly German GDP growth; for one quarter-ahead predictions the ifo Business Situation is slightly better than the IHS Markit headline index. For the manufacturing sector, the ifo indicators are clearly superior to the Manufacturing PMI in terms of forecast accuracy for nowcasts and forecasts. For services, the ifo Business Expectations performs slightly better than the IHS Markit headline index in nowcasting GVA growth in services; the results are more in favor of the IHS Markit indicator for one-quarter-ahead forecasts.

The paper is organized as follows. In Section 2 we introduce the headline indices of both institutions and the forecast experiment. Section 3 presents the results and a discussion on the practical relevance of our results. The last section concludes and gives an outlook on future research activities.

[1] The Wall Street Journal, Should You Believe German PMI or Ifo Data?, February 23, 2012. TradingFloor, 3 numbers to watch: German & Eurozone PMI, French bond auctions, April 23, 2012.

[2] J.P. Morgan, Germany: PMI tracks services activity better than the IFO, August 27, 2019.

2 Data and Forecast Experiment

2.1 Target series

The ifo Institute and IHS Markit publish indicators for the aggregate German economy as well as for manufacturing and services. In our out-of-sample exercise, we therefore evaluate the forecasting performance for the three target series: GDP, GVA in manufacturing, and GVA in the service sector. Each target series is price-, seasonally- and calendar-adjusted, and transformed into quarter-on-quarter growth rates in advance. Whereas GDP and GVA in manufacturing are officially published by the German Federal Statistical Office, GVA in the aggregate service sector is not available in official German statistics. We calculate it by applying growth contributions of the single service sub-sectors, including all market-traded services and leaving service activities of the public sector such as public administration or education aside.[3]

To mimic the information set available to a forecaster at each period, we resort to the real-time database of the Deutsche Bundesbank. Each data vintage includes quarterly observations for the target series from the first quarter 1991 onwards. For each target series, our forecast exercise starts with the data vintage published in February 2012 and thus for the first release of the target series referring to the fourth quarter of 2011.

2.2 The Business Surveys by ifo and IHS Markit

In the following, we briefly describe the business surveys by ifo and IHS Markit. First, we introduce the headline indices. Second, we discuss the main differences between the indices.

2.2.1 Headline indices

We focus on the headline indices by ifo and IHS Markit for GDP, GVA in manufacturing, and GVA in services.[4] The headline indices of ifo are the ifo Business Situation, the ifo Business Expectations, and the ifo Business Climate; the headline indices of IHS Markit are the Composite Output Index (PMI) for GDP, the Manufacturing PMI, and the Business Activity Index (PMI) for GVA in services.[5]

[3] Our service aggregate comprises the following sub-sectors according to the German Classification of Economic Activities, Edition 2008 (WZ 2008): wholesale and retail trade; repair of motor vehicles and motorcycles (section G), transportation and storage (section H), accommodation and food service activities (section I), information and communication (section J), financial and insurance activities (section K), real estate activities (section L), professional, scientific and technical activities (section M), administrative, and support service activities (section N).

[4] We use the term headline index also in case of the ifo indicators and analog to IHS Markit, that is, a headline index is the one closely watched by the markets (see IHS Markit, 2017).

[5] More details on the indicators of both providers can be found in Sauer and Wohlrabe (2018) and IHS Markit (2019).

The two ifo headline indices—ifo Business Situation and ifo Business Expectations—are part of the monthly ifo Business Survey and are thus available for each single sector.[6] Each firm can choose from three qualitative answers reflecting a positive, neutral, or negative assessment. Both headline indices are calculated as the net balance of positive and negative answers; the ifo Business Climate is the geometric average of the two headline indices. The indices for the aggregate economy are calculated from the sector-specific results by applying weights based on gross value added from national accounts.

The headline index by IHS Markit for GDP—the Composite Output Index (PMI)—is based on the information from manufacturing (Output Index) and services (Business Activity Index). For services, construction, and retail, the headline indices of IHS Markit are based on a question aiming at a specific firm characteristic.[7] For manufacturing, the headline index is a composite indicator calculated as the weighted average of the following five survey questions: new orders, output, employment, suppliers' delivery times, and the stocks of materials purchased. All indicators are based on a formula given the positive answer full weight, the neutral answers half weight, and the negative answers zero weight. Thus, the indicator is centered around 50.

2.2.2 Main differences across the headline indices

The headline indicators provided by the ifo Institute and IHS Markit differ in the following dimensions: sectoral composition, question design, aggregation approach, sample size, and publication timing. First, the survey providers differ in how their headline indices are constructed. On the one hand, ifo consistently constructs its headline indices, that is, the Business Climate indices for the aggregate economy and for the sectors, as weighted averages of the Business Situation and Business Expectations. These indicators are based on questions regarding the firm's general assessment but not on a firm-specific characteristic. On the other hand, IHS Markit has different concepts for their headline indices depending on the specific sector. As described before, IHS Markit focuses on one specific firm characteristic in services, construction, and retail trade. For manufacturing, they construct a composite index based on five specific questions.

Second, the survey providers differ in the sectoral composition. On the one hand, ifo constructs its headline indicator for the aggregate economy (ifo Business Climate Germany) as a weighted average of the sector-specific headline indices for the following sectors: manufacturing, construction, retail sale, wholesale trade, and services. On the other hand, IHS Markit's headline indicator for the aggregate economy (Composite Output Index) is solely based on information from manufacturing (Output Index) and services (Business Activity

[6] The underlying question for the ifo Business Situation is: How do you assess your current business situation. For the Business Expectations, the question is: How do you expect your business to develop in the next six months.

[7] For services, construction, and retail, the headline index is based on a single question, asking if economic activity (or sales in the case of retail) is higher, the same, or lower than in the previous month.

Index). Thus, IHS Markit's headline index for the German economy mirrors a smaller part of GDP compared to ifo's headline indices.

Third, ifo also asks firms to evaluate how their business will develop to construct the ifo Business Expectations indicator that flows in the ifo Business Climate. The PMI Composite Output Index instead focuses on the development of a firm-specific indicator compared to the previous month, that is, it mirrors short-term developments. The ifo index thus incorporates a forward-looking component whereas the PMI does not.

Fourth, the surveys differ in their sample size. While the PMI Composite Output Index for Germany is based on a representative panel of 800 companies from manufacturing and services (IHS Markit, 2019), the ifo Business Climate Germany is based on 9,000 firm responses from the five sectors previously mentioned.

Finally, IHS Markit always releases a so-called flash estimate of their headline indices one day before the ifo indicators are published. This flash estimate is based, on average, on 85% of IHS Markit's full sample, thus, the flash estimate might be (slightly) revised. This is not the case for the ifo indices, which only change according to small differences due to the seasonal adjustment procedure.

2.3 Forecasting approach

To compare the indicators' predictive power for the current (nowcast, horizon: $h = 0$) and the next quarter (forecast, horizon: $h = 1$), we apply three autoregressive indicator models, AR-X(p,q), where p and q denote the lag length of the target series and the indicator, respectively:

1. AR-X(0,0) model including a constant, and the contemporaneous value of an indicator,
2. AR-X(0,q) model including a constant and up to a maximum of four lags of the indicators to consider the indicators' dynamics. We select the optimal lag number q using the Akaike Information Criterion (AIC),
3. AR-X(1,0) model including a constant, one lag of the respective target series, and the contemporaneous indicator in order to investigate whether the indicator provides a forecasting signal on top of the inherent dynamics of the respective target series.[8]

Our sample for the forecasting experiment covers the period from the first quarter 2005 (the first period for which ifo service sector data is available) to the third quarter of 2019; the first 28 quarters are used to estimate the models for the first time, thus, the first now- and forecast is generated for the first quarter of 2012. After calculating the first predictions, the sample is enlarged by one quarter of observations which is equal to a new vintage of data,

[8] We follow previous research and fix p to unity (see, for example, Carstensen *et al.*, 2020). This is motivated by the low persistence of German GDP growth.

the models are re-estimated, and new now- and forecasts are generated. This procedure is repeated until the end of our observation period. We assume that the now- and forecasts are generated at the end of each quarter, thus, the monthly survey indicators are transformed to quarterly frequency by calculating quarterly averages.[9] Moreover, we apply first differences of the indicators since the researcher should rather interpret the change in the business cycle indicators than the levels (see, for the interpretation of the ifo indicators, Wohlrabe and Wollmershäuser, 2017).

The forecast comparison is based on root mean squared forecast errors (RMSFE). We always evaluate the now- and forecasts with respect to the first release of data for a specific quarter, which usually receives the highest media attention. As these average forecast errors are silent on significant differences in the forecasting power across the indicators, we additionally apply the Diebold and Mariano (1995) test with the small sample correction of Harvey *et al.* (1997).

3 Results

3.1 Baseline results

Table 1 to Table 6 depict the real-time forecasting results for the nowcast ($h = 0$) and forecast ($h = 1$) comparisons for each of the three target series. The tables show the RMSFEs for the ifo headline indices along with the corresponding PMI headline index. The columns refer to our three model specifications. The RMSFEs are depicted in percentage points (p.p.).

For GDP growth nowcasts, Table 1 suggests that the ifo indicators perform better than the IHS Markit headline index across the three models. Either the ifo Business Expectations Germany (0.34 p.p.) in model 1 or the ifo Business Situation Germany (0.32 p.p. and 0.35 p.p.) in models 2 and 3 outperform the Composite Output Index. However, these differences are not statistically significant according to the Diebold-Mariano test.

Table 1: Nowcast performance for GDP growth, in p.p.

Indicator	**RMSFE model 1**	**RMSFE model 2**	**RMSFE model 3**
Composite Output Index (PMI)	0.36	0.37	0.48
ifo Business Situation Germany	0.38	**0.32**	**0.35**
ifo Business Climate Germany	0.38	0.37	0.44
ifo Business Expectations Germany	**0.34**	0.39	0.55

Notes: This table shows root mean squared forecast errors (RMSFE). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models. The results refer to the nowcast (horizon: $h = 0$). ***, **, and * denote statistical significance on the 1%, 5%, and 10% level according to the Diebold-Mariano test.

[9] We also tested a different timing assumption. Specifically, we calculate the predictions at the end of the second month of the quarter. The results are virtually identical and available upon request from the authors.

For GDP forecasts (see Table 2), the ifo Business Situation Germany produces significantly smaller forecast errors than the PMI for model 2 (0.36 p.p.) and is also the best performing indicator in model 1. This advantage equalizes by looking at model 3. Moreover, the results suggest that—for each indicator—including lagged GDP growth (model 3) deteriorates the absolute forecast performance. The latter results might be driven by the low autocorrelation of German GDP growth. Overall, we conclude that both institutions provide valuable leading indicators for the German economy, with some small advantages for the ifo headline indices.

Table 2: Forecast performance for GDP growth, in p.p.

Indicator	**RMSFE model 1**	**RMSFE model 2**	**RMSFE model 3**
Composite Output Index (PMI)	0.44	0.42	**0.45**
ifo Business Situation Germany	**0.38**	**0.36****	0.46
ifo Business Climate Germany	0.42	0.44	0.48
ifo Business Expectations Germany	0.42	0.47	0.52

Notes: This table shows root mean squared forecast errors (RMSFE). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models. The results refer to the forecast (horizon: $h = 1$). ***, **, and * denote statistical significance on the 1%, 5%, and 10% level according to the Diebold-Mariano test.

Turning to the manufacturing sector (see Table 3), which is far more volatile than GDP and frequently referred to as the cycle-maker of the German economy, reveals that the ifo headline indicators are clearly superior—in each specification—to the Manufacturing PMI with respect to the nowcast. The gains in nowcast accuracy range from 6% to more than 40% for either the ifo Business Expectations Manufacturing (1.14 p.p.) or the ifo Business Situation Manufacturing (0.89 p.p. and 1.17 p.p.). Moreover, while the forecast accuracy of the Manufacturing PMI shows strong variations across model specifications, the ifo indicators provide a rather stable forecast performance.

Table 3: Nowcast performance for GVA growth in manufacturing, in p.p.

Indicator	**RMSFE model 1**	**RMSFE model 2**	**RMSFE model 3**
Manufacturing PMI	1.22	1.57	1.60
ifo Business Situation Manufacturing	1.15	**0.89*****	**1.17***
ifo Business Climate Manufacturing	1.21	1.15***	1.23**
ifo Business Expectations Manufacturing	**1.14**	1.34**	1.86

Notes: This table shows root mean squared forecast errors (RMSFE). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models. The results refer to the nowcast (horizon: $h = 0$). ***, **, and * denote statistical significance on the 1%, 5%, and 10% level according to the Diebold-Mariano test.

In case of one-quarter-ahead predictions, the results provide the same conclusions as for the nowcasts: all ifo headline indicators outperform the Manufacturing PMI with an increase of forecast accuracy ranging from 21% to 45% (see Table 4).[10] Again, the ifo Business Situation

[10]Similar results are obtained by Pinkwart (2018) who documents a higher forecast accuracy of ifo manu-

Manufacturing and the ifo Business Climate Manufacturing produce, on average, the lowest forecast errors (1.19 p.p., 0.94 p.p., and 1.29 p.p.). Overall, we conclude that the ifo headline indicators for manufacturing are superior to the Manufacturing PMI.

Table 4: Forecast performance for GVA growth in manufacturing, in p.p.

Indicator	**RMSFE model 1**	**RMSFE model 2**	**RMSFE model 3**
Manufacturing PMI	1.50	1.73	1.76
ifo Business Situation Manufacturing	**1.19**	**0.94*****	1.33
ifo Business Climate Manufacturing	1.24	1.30***	**1.29****
ifo Business Expectations Manufacturing	1.35	1.71	1.71

Notes: This table shows root mean squared forecast errors (RMSFE). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models. The results refer to the forecast (horizon: $h = 1$). ***, **, and * denote statistical significance on the 1%, 5%, and 10% level according to the Diebold-Mariano test.

Considering the service sector (see Table 5), the ifo Business Expectations (0.31 p.p., 0.34 p.p., and 0.40 p.p.) outperform the headline index by IHS Markit regarding the nowcast across all models; the relative gains in accuracy range from 2% to 14%. Therefore, we cannot underpin the results of by J.P. Morgan since the ifo Business Expectations Services delivers smaller forecast errors than the PMI headline index (0.32 p.p., 0.40 p.p., and 0.41 p.p.). The remaining ifo indices only outperform the PMI index in services by applying a model with more lags of the indicators (model 2).

Table 5: Nowcast performance for GVA growth in services, in p.p.

Indicator	**RMSFE model 1**	**RMSFE model 2**	**RMSFE model 3**
Services Business Activity Index (PMI)	0.32	0.40	0.41
ifo Business Situation Services	0.34	0.36***	0.46
ifo Business Climate Services	0.34	0.37**	0.45
ifo Business Expectations Services	**0.31****	**0.34****	**0.40**

Notes: This table shows root mean squared forecast errors (RMSFE). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models. The results refer to the nowcast (horizon: $h = 0$). ***, **, and * denote statistical significance on the 1%, 5%, and 10% level according to the Diebold-Mariano test.

Turning to one-quarter-ahead forecasts (see Table 6), the results are clearly in favor of the PMI headline index for the service sector (0.44 p.p., 0.33 p.p., and 0.44 p.p.). In particular, the ifo indicators exhibit a rather poor relative forecasting performance in model 3 that incorporates a lag of GVA growth. The only ifo indicator that performs (relatively) good is the ifo Business Expectations Services (0.40 p.p., 0.36 p.p., and 0.52 p.p.).

facturing series compared to the corresponding IHS Markit indicators.

Table 6: Forecast performance for GVA growth in services, in p.p.

Indicator	RMSFE model 1	RMSFE model 2	RMSFE model 3
Services Business Activity Index (PMI)	0.44	**0.33**	**0.44**
ifo Business Situation Services	0.52	0.34	0.62
ifo Business Climate Services	0.46	0.35	0.54
ifo Business Expectations Services	**0.40**	0.36	0.52

Notes: This table shows root mean squared forecast errors (RMSFE). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models. The results refer to the forecast (horizon: $h = 1$). ***, **, and * denote statistical significance on the 1%, 5%, and 10% level according to the Diebold-Mariano test.

3.2 Discussion on the practical relevance

In the following, we discuss whether the RMSFEs from the baseline results are of practical relevance for applied forecasting work. For this purpose, we use the Noise-to-Signal Ratio (NTS) which compares the RMSFE of an indicator (enumerator) with the standard deviation of the target series (denominator). Based on this ratio, an indicator is practically relevant if its NTS is below unity, that is, the indicator produces forecast errors that are smaller compared to the volatility of a series. Additionally, we also discuss the differences between the RMSFE of the best performing ifo indicator and the IHS Markit headline index and divide those differences by the standard deviation of the target series. These figures implicitly measure the percentage gain or loss of an indicator in terms of standard deviations of the target series.

Table 7 shows the NTS for GDP now- and forecasts for the ifo indicators and the Composite Output Index (PMI). The best performing indicator per model is again typed in boldface. The standard deviation in quarterly GDP growth in our forecast period (2005-Q1 to 2019-Q3) is 0.91 p.p. and thus three times higher compared to the RMSFE of the single indicators. The NTS for the GDP nowcast range from 0.35 to 0.60; the NTS for the forecast range from 0.40 to 0.58. Overall, all headline indices do a good job in predicting German GDP growth and therefore are practically relevant. By going one step further, we again compare the best ifo indicator with the Composite Output Index (PMI) of IHS Markit. For the nowcast, either the ifo Business Expectations Germany (model 1, NTS: 0.38) or the ifo Business Situation Germany (models 2 and 3, NTS: 0.35 and 0.39) produce lower forecast errors than the PMI headline index. Expressed as percentage values from the standard deviation of the target series (RMSFE difference to the standard deviation), the ifo indicators improve the forecast results from the PMI by 1.8%, 5.2%, and 13.5% (model 1, model 2, and model 3). For GDP forecasts, either the ifo Business Situation Germany (models 1 and 2, NTS: 0.42 and 0.40) or the Composite Output Index (PMI, model 3, NTS: 0.50) produces the most accurate forecasts. The ifo indicators therefore show an improvement of 6.5% or 6.9% for the first two models, whereas the PMI improves the forecast of the best ifo indicator by 1.6% in model 3.

Table 7: Noise-to-Signal Ratio for GDP predictions

Indicator	NTS model 1	NTS model 2	NTS model 3
Nowcast (horizon: h = 0)			
Composite Output Index (PMI)	0.40	0.40	0.52
ifo Business Situation Germany	0.42	**0.35**	**0.39**
ifo Business Climate Germany	0.41	0.41	0.48
ifo Business Expectations Germany	**0.38**	0.43	0.60
Forecast (horizon: h = 1)			
Composite Output Index (PMI)	0.48	0.47	**0.50**
ifo Business Situation Germany	**0.42**	**0.40**	0.51
ifo Business Climate Germany	0.46	0.49	0.53
ifo Business Expectations Germany	0.47	0.52	0.58

Notes: This table shows the Noise-to-Signal Ratio (NTS) for each of the indicators. The NTS is defined as the ratio between the root mean squared forecasts error (RMSFE) and the standard deviation of the target series to forecast (here: GDP 0.91 p.p.). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models.

Turning to the manufacturing sector, Table 8 presents the NTS of the ifo and IHS indicators. The standard deviation in quarterly GVA growth manufacturing is 3.03 p.p. for our period under investigation. Again, all indicators have high practical relevance as all NTS lie below unity. The NTS for GVA nowcasts in the manufacturing sector range from 0.29 to 0.61 across all models. For the one-quarter-ahead forecasts, the NTS range from 0.31 to 0.58 across all models. As described in the baseline results section, the ifo indicators outperform the Manufacturing PMI across all models and horizons. In case of the nowcast situation either the ifo Business Expectations Manufacturing (model 1, NTS: 0.38) or the ifo Business Situation Manufacturing (models 2 and 3, NTS: 0.29 and 0.39) produce lower forecast errors than the Manufacturing PMI. These figures correspond to an improvement of the ifo indicators of 2.6%, 22.5%, and 14.3% in terms of the standard deviation.

For one-quarter-ahead predictions, either the ifo Business Situation Manufacturing (models 1 and 2, NTS: 0.39 and 0.31) or the ifo Business Climate Manufacturing (model 3, NTS: 0.43) improve the forecasts over the Manufacturing PMI. These improvements correspond to an increase in forecast accuracy—in terms of the standard deviation—of 10.3%, 25.8%, and 15.3%.

Table 8: Noise-to-Signal Ratio for GVA predictions, Manufacturing

Indicator	NTS model 1	NTS model 2	NTS model 3
Nowcast (horizon: h = 0)			
Manufacturing PMI	0.40	0.52	0.53
ifo Business Situation Manufacturing	0.38	**0.29**	**0.39**
ifo Business Climate Manufacturing	0.40	0.38	0.41
ifo Business Expectations Manufacturing	**0.38**	0.44	0.61
Forecast (horizon: h = 1)			
Manufacturing PMI	0.50	0.57	0.58
ifo Business Situation Manufacturing	**0.39**	**0.31**	0.44
ifo Business Climate Manufacturing	0.41	0.41	**0.43**
ifo Business Expectations Manufacturing	0.44	0.57	0.56

Notes: This table shows the Noise-to-Signal Ratio (NTS) for each of the indicators. The NTS is defined as the ratio between the root mean squared forecasts error (RMSFE) and the standard deviation of the target series to forecast (here: GVA manufacturing 3.03 p.p.). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models.

The baseline results for the service sector reveal that the ifo Business Expectations perform slightly better than the Services Business Activity Index (PMI) in the nowcast situation, whereas the IHS headline index clearly outperforms the ifo indicators for one-quarter-ahead predictions. In terms of practical relevance, all indicators produce NTS values smaller than one (see Table 9); the corresponding standard deviation in quarterly GVA growth in the German service sector is 0.89 p.p. Regarding the nowcasts, the ifo Business Expectations Services perform best across all models (NTS: 0.35, 0.39, and 0.45). This corresponds to an improvement of 0.8%, 6.2% and 1.6% over the IHS headline index.

Investigating the forecasts reveals that the ifo Business Expectations performs best in model 1 (NTS: 0.45); otherwise the Services Business Activity Index (PMI) is superior (model 2 and 3, NTS: 0.37 and 0.49). Put differently, the ifo Business Expectations Services improve over the PMI headline index by 3.6%, whereas the PMI headline improves over the best performing ifo indicator by 2.0% and 9.3%, respectively.

Table 9: Noise-to-Signal Ratio for GVA predictions, Services

Indicator	NTS model 1	NTS model 2	NTS model 3
Nowcast (horizon: h = 0)			
Service Business Activity Index (PMI)	0.36	0.45	0.47
ifo Business Situation Services	0.39	0.40	0.51
ifo Business Climate Services	0.38	0.41	0.50
ifo Business Expectations Services	**0.35**	**0.39**	**0.45**
Forecast (horizon: h = 1)			
Service Business Activity Index (PMI)	0.49	**0.37**	**0.49**
ifo Business Situation Services	0.58	0.39	0.69
ifo Business Climate Services	0.52	0.39	0.61
ifo Business Expectations Services	**0.45**	0.40	0.58

Notes: This table shows the Noise-to-Signal Ratio (NTS) for each of the indicators. The NTS is defined as the ratio between the root mean squared forecasts error (RMSFE) and the standard deviation of the target series to forecast (here: GVA services 0.89 p.p.). Columns two to four refer to the results from models 1 to 3. Bold typeface indicates the best performing indicator for each of the three models.

An interesting question arises from these comparisons: what are the reasons for these differences? We conjecture that especially the sample size and the sample composition (sectors, firm size, regional representation etc.) play a major role. However, publicly available information is missing for both suppliers, thus, we have to leave such considerations for future research activities.

4 Conclusion

This analysis contributes to the ongoing debate on the performance of the most important business cycle indicators for Germany provided by the ifo Institute and IHS Markit. Our out-of-sample, real-time forecast exercise for GDP growth shows that both institutions provide valuable leading indicators for the German economy, with some small advantages of the ifo headline indices. Turning to the more volatile manufacturing sector, which is regarded as the cycle-maker of the German economy, the ifo indicators are clearly superior to the Manufacturing PMI in terms of forecast accuracy. Regarding the service sector, the results are less clear-cut. For nowcasts, the ifo Business Expectations provide, on average the best forecast performance. For one-quarter-ahead predictions, the Service Business Activity Index by IHS Markit is clearly superior.

The headline indicators of both survey providers are capable of tracking the German economy quite well and have practical relevance, with a distinct advantage for ifo in the manufacturing sector. From a researcher's perspective, it would be interesting to investigate further the causes of the differences in forecast accuracy, for example in the service sector. However, this would require having more information on the IHS Markit panel and its sectoral coverage. Unfortunately, longer time series are not publicly available. Another interesting

research idea is to calculate a composite index based on ifo data or even a composite service index based on the IHS Markit data. From a global perspective, one could also combine both indicators and ask whether the absolute forecast performance further increases.

Our results might even be interesting for future research activities on the European level. Within the Joint Harmonised EU Programme of Business and Consumer Surveys, each member state conducts expensive business and consumer surveys on a monthly frequency. One indicator that results from these surveys is the Economic Sentiment Indicator (ESI), which is a weighted average of composite indicators across sectors. Future research activities might run a forecast experiment for each member state as IHS Markit provides PMI data for most of the European countries. It seems very interesting whether this paper's findings for Germany also hold for other European economies.

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