Discussion Paper No. 02-56

Forecasting Economic Activity in Germany – How Useful are Sentiment Indicators?

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Non-technical Summary

We analyze four economic sentiment indicators for the German economy: the ifo business expectations (ifo), the European Commission's Economic Sentiment Indicator for Germany (ESIN), the Purchasing Managers' Index (PMI) and the ZEW Indicator of Economic Sentiment (ZEW) using the year-on-year growth rate of industrial production as a reference. A look at the publication schedule of the indicators shows that all of them are released at least one month prior to the German industrial production statistics. Cross correlations indicate that the correlation between the ifo, PMI and ZEW indicators and the year-on-year growth rates of industrial production increases when the indicators are lagged. This suggests that these three indicators are indeed leading economic activity in Germany. The ESIN indicator, on the other hand, seems to lag industrial production.

Subsequent Granger causality tests reveal that the ifo business expectations, the PMI and the ZEW Indicator of Economic Sentiment lead the year-on-year growth rate of German industrial production by five months. Taking into account the publication lag of industrial production (about six weeks) this lead extends to more than six months. Analyzing lead/lag structures among the ifo, PMI and ZEW indicators we find that the ZEW indicator significantly leads the ifo business expectations by one month. Furthermore, the ifo expectations indicator has a lead of one month over the PMI.

Out-of-sample forecast evaluations suggest that both ifo and ZEW provide the best forecasts for industrial production among the three indicators ifo, PMI and ZEW. While the ZEW indicator performs better than the ifo over the whole sample period (Jan. 1994 – Mar. 2002) and especially over horizons from six to twelve months, the ifo predicts better at shorter horizons (up to three months) and is superior to the ZEW indicator when a shorter sample (Jan. 1998 – Mar. 2002) is regarded. The PMI exhibits the worst forecasting performance and does not beat a naive reference model at all forecasting horizons.

Taken both in-sample and out-of-sample results, we conclude that while the ifo, ZEW and PMI indicator lead the release of industrial production statistics in Germany by about six months, only ifo and ZEW perform well in out-of-sample forecasts (which might be due to the short sample period for the PMI). While the ifo indicator predicts better at short horizons of up to three months, the ZEW indicator is usually the first to be published and has a better forecasting ability for longer time horizons (six to twelve months).

Forecasting Economic Activity In Germany – How Useful Are Sentiment Indicators?

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Abstract

We analyze four economic sentiment indicators for the German economy regarding their ability to forecast economic activity. Using cross correlations and Granger causality tests we find that the ifo business expectations (ifo), the Purchasing Managers Index (PMI) and the ZEW Indicator of Economic Sentiment (ZEW) lead the year-on-year growth rate of German industrial production by five months. Taking into account the publication lag of industrial production this lead is even larger. On the contrary, the European Commission's Economic Sentiment Indicator (ESIN) does not exhibit a lead but rather seems to coincide or even lag economic activity. Analyzing lead/lag structures among the indicators we find that the ZEW indicator leads the ifo business expectations significantly by one month and that the latter has a one-month lead over the PMI. Out-of-sample forecast evaluations suggest that both ifo and ZEW provide the best forecasts for industrial production among the three indicators ifo, PMI and ZEW. It is found that the ZEW indicator performs better than the ifo and PMI over the whole sample (Jan. 1994 – Mar. 2002) and especially over horizons from six to twelve months. The ifo expectations predict better at shorter horizons (up to three months) and is superior to the ZEW and PMI indicator when a shorter sample (Jan. 1998 – Mar. 2002) is regarded.

JEL-Classification: C52, C53, E37

Keywords: leading indicators, Germany, ifo, zew, PMI, ESIN

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1 Introduction

Leading economic indicators anticipate a business cycle by tending to turn down before the down cycle begins and to turn up before the expansionary cycle begins. Because of this characteristic they are important for financial markets, which are by nature forward-looking. In recent years, leading indicators have become more popular in Germany as the number of indicators is increasing steadily. Besides the well-known ifo Indicator, only the European Commission's Economic Sentiment Indicator for Germany has a fairly long history of gauging economic activity with a lead to economic activity. In the past years, however, new indicators like the Purchasing Managers' Index and the ZEW Indicator of Economic Sentiment have been introduced.

In Hüfner/Schröder (2002) we presented a comparison of the ifo business expectations gauge and the ZEW indicator of economic sentiment regarding their ability to forecast German industrial production. It was shown that analysts, surveyed for the ZEW indicator, seem to be able to forecast economic activity with a longer time lead than industrial companies, which are polled for the ifo survey. This study extends the analysis by including more sentiment indicators for Germany and by using a more timely sample range. Our aim is to give an overview of the characteristics of each indicator as well as their publication schedule and to analyze their lead and forecasting abilities with regard to German industrial production. Besides the ifo and ZEW indicator, we also include the Purchasing Managers' Index (PMI) and the European Commission's Economic Sentiment Indicator (ESIN) in our analysis. Using cross correlations and Granger causality estimates we determine which of the indicators has the longest lead with regard to the year-on-year growth rates of industrial production. Additionally, we analyze lead/lag structures among the indicators, taking into account differences in the publication schedule. Finally, we evaluate out-of-sample forecasts produed with the indicators.

Earlier studies of leading indicators for Germany that rely mainly on the ifo index include Fritsche (1999), Fritsche/Stephan (2000), Wolters/Lankes (1989) and Langmantel (1999). Stadler (2001) is a recent study that compares several different survey-based indicators for Germany (she conducts cross correlation analysis of the ifo, PMI and ZEW indicators).

The organization of our analysis is as follows: chapter two comprises a survey of the indicators, chapter three presents the cross-correlation and Granger causality analysis, chapter four includes the out-of-sample forecast evaluations and chapter five concludes.

2 Economic Sentiment Indicators For Germany

There are currently four economic sentiment indicators available for the German economy that are based on different surveys: the ifo Index, the European Commission's Economic Sentiment Indicator for Germany, the Reuters/NTC Purchasing Managers' Index Germany and the ZEW Indicator of Economic Sentiment.[1] The following chapter presents a short survey of the sources, publication schedules and construction of each indicator.

2.1 Economic Sentiment Indicator (European Commission)

The Economic Sentiment Indicator (ESIN) for Germany is published monthly by the European Commission – Directorate-General for Economic and Financial Affairs since 1985.[2] It is compiled for each European country separately as well as for the EU and the Euro area as a whole. The indicator is composed of four components: industrial confidence, consumer confidence, constructions confidence and retail trade confidence, which are based on different surveys.[3] These four confidence indices are aggregated for the calculation of the overall economic sentiment indicator (1995=100) by using the following weights:

- Industrial confidence indicator 40%
- Consumer confidence indicator 20%
- Construction confidence indicator 20%
- Retail trade confidence indicator 20%.[4]

[1] See Broyer/Savry (2002). Apart from these survey-based indicators, there also exist composite indicators like the Handelsblatt Frühindikator, which, however, comprise components of other surveys as well as real variables like interest rate spreads or exchange rates.

[2] See European Commission: European Economy, Supplement B, No. 8/9-August/September 2001, <http://europa.eu.int/comm/economy_finance>

[3] Source: European Commission <http://europa.eu.int/comm/economy_finance>. The construction of the indicator was changed in October 2001: prior to the change the indicator also comprised a share price index instead of retail trade confidence as well as different weights. For our calculations we use the new indicator values.

[4] The source for industrial, construction and retail trade confidence is the ifo institute. Consumer confidence is obtained from the GfK.

2.2 ifo Business Expectations

Every month the German ifo institute surveys more than 7,000 enterprises from different sectors (excluding the financial sector) on their evaluation of the business situation and their six months ahead expectations.[5] The responses are weighted according to the importance of the industry and aggregated in order to derive the so-called ifo index. While the ifo index comprises both current assessments and expectations, we only include the expectations balance in our analysis since this is the more forward-looking of the components. The indicator is calculated by taking the difference between positive and negative assessments and weighting them according to their branch.

2.3 Purchasing Managers' Index (Reuters/NTC)

The Purchasing Managers' Index (PMI) is compiled monthly for different European countries.[6] Survey participants are senior purchasing executives of manufacturing companies. The survey for Germany started in April 1996 and is divided into manufacturing and service sector surveys. We include the manufacturing indicator in our analysis, which is the most closely watched by financial market participants. The survey results are aggregated to derive an index with a reference value of 50 points (an indicator value above 50 points signals an expansionary economic environment while a value below 50 points indicates a contraction of economic conditions).

2.4 ZEW Indicator of Economic Sentiment

The ZEW Indicator of Economic Sentiment is constructed from the results of the monthly ZEW Financial Market Survey of 350 German financial analysts and institutional investors from banks, insurance companies and large industrial companies which has been conducted since December 1991.[7] The survey participants are asked about their six-month expectations for the German economy. The indicator is constructed as the difference between the percentage share of analysts that are optimistic and the share of analysts that are pessimistic about the German economy in six months.

2.5 Publication Schedule

While all four indicators are published monthly there are significant differences in the publication schedule, i.e. the timing of the actual release of the indicator value. Figure 1 displays the distribution of publication dates for the indicator in month t.

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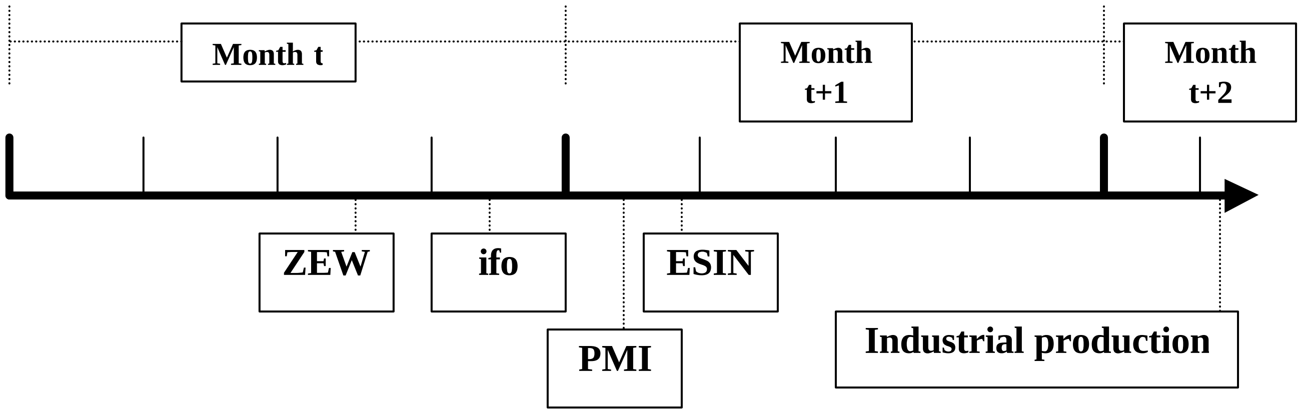
[5] See <www.ifo.de>.

[6] See <www.ntc-research.com>.

[7] See <www.zew.de>.

As can be seen, both the ZEW and ifo indicators are published in the month to the indicator refers to (e.g. the June indicator is released in June).[8] The PMI and ESIN indicators follow in the first week of the next month, i.e. the indicator value for June is published early in July. All four indicators are released well in advance of industrial production for month t which is released in month t+2.

Figure 1: Publication schedule



Note: Publication dates might change over time. The above schedule is an average of publication dates over the time period 2001:6 – 2002:4. Source: newspaper reports.

3 Lead-/Lag-Structures

3.1 Data Selection

The sample range for our data is January 1992 to March 2002 except for the PMI, which starts in April 1996.[9] We use monthly data for all indicators and year-on-year growth rates of German industrial production.

[8] The publication schedule for the ifo indicator changed in January 2002. Prior to this date, the ifo indicator for month t was released in month t+1.

[9] Our starting date is January 1992 because of the availability of the ZEW indicator. The ifo and ESIN indicators are available for a much longer time period.

Figure 2: Sentiment indicators and y-o-y growth rates of industrial production

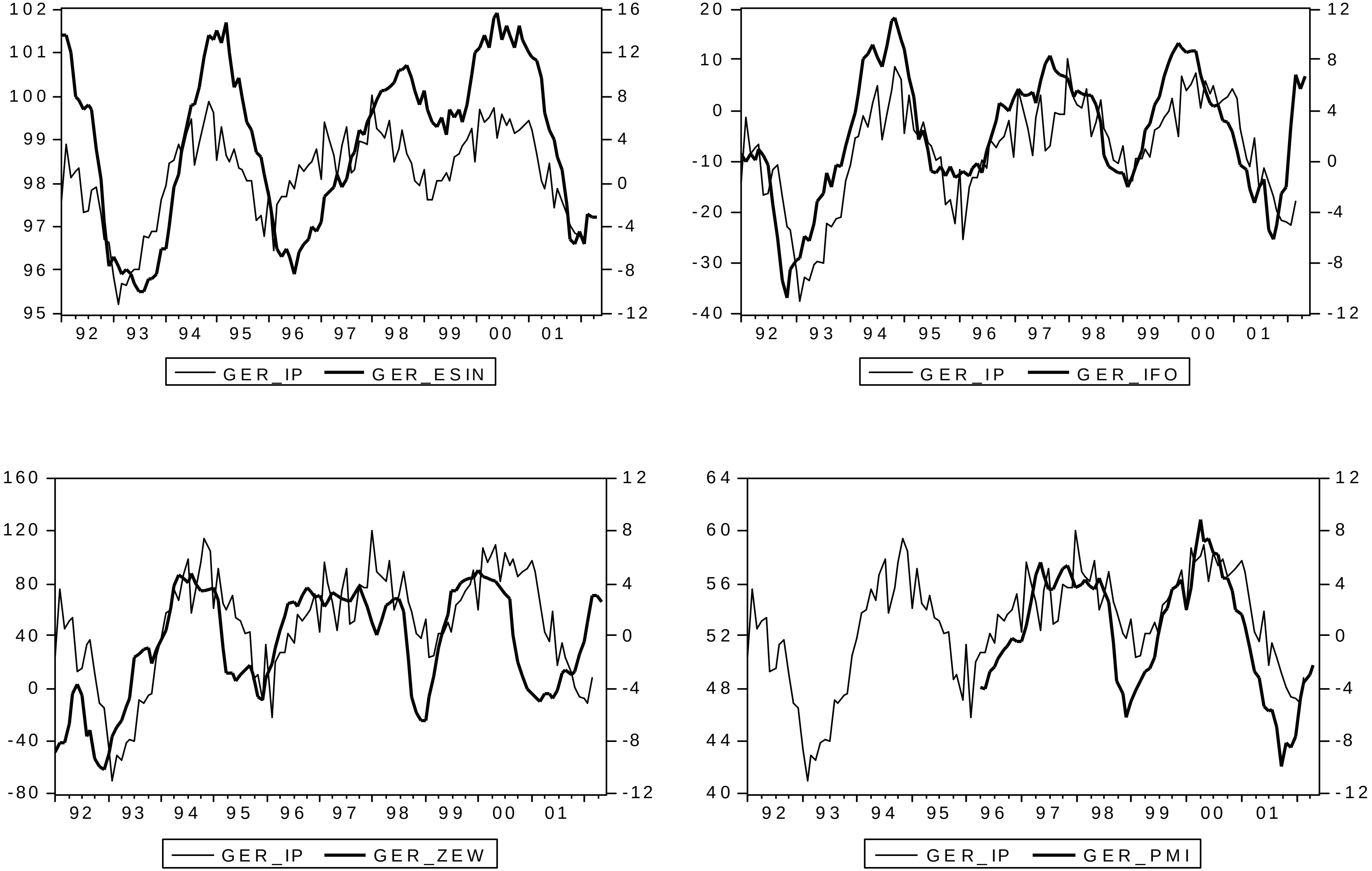


Figure 2 displays the indicators in comparison with the year-on-year growth rate of industrial production. Visual inspection shows that all indicators are correlated with industrial production.

3.2 Cross Correlations

In order to get a first insight into the lead-/lag-structure of the indicators with respect to industrial production growth, we calculate cross-correlations.

Table 1: Cross-correlations between indicators and industrial production

Lag	IFO	ESIN	PMI	ZEW
+4	0.4049	0.7843	0.3938	0.1637
+3	0.5152	**0.7928**	0.5270	0.2776
+2	0.6102	0.7801	0.6445	0.3829
+1	0.6932	0.7657	0.7529	0.4760
0	0.7774	0.7173	0.8315	0.5692
-1	0.8421	0.6510	**0.8493**	0.6524
-2	**0.8785**	0.5537	0.8321	0.7344
-3	0.8730	0.4435	0.7723	0.7853
-4	0.8529	0.3216	0.6858	0.8081
-5	0.7969	0.1945	0.5936	**0.8132**
-6	0.7130	0.0847	0.4674	0.7869

Note: Correlations are displayed in the form Indicator(t-lag) and Industrial production (y-o-y) (t). Bold numbers indicate maximum correlation coefficients for each indicator.

Table 1 shows that all indicators except the ESIN exhibit a lead over industrial production, i.e. correlations between the indicator and the industrial production growth rate increase when the indicator is lagged. The highest correlation coefficients were found for the ifo indicators. The longest lead is found for the ZEW indicator (five months), followed by the ifo indicator (two months) and the PMI (one month). This confirms the findings of Stadler (2001). For the ESIN indicator, correlations start to decrease when the indicator is lagged and increase when industrial production is lagged. The highest correlation coefficient is found for a lag length of 3 for industrial production which suggests that the ESIN is coinciding or even lagging the publication of industrial production.

3.3 Granger Causality Tests

While cross correlations give a first hint at the time structure of the indicators with respect to developments in industrial production they do not necessarily imply causation in the sense of Granger (1969). A more refined analysis to determine the lead of each indicator quantitatively can be performed with Granger causality tests. This test is used to see how much of the current variable Y can be explained by past values of Y and then to see whether adding lagged values of X can improve the explanation.[10] Thus, X is said to Granger-cause Y if the X variable is statistically significant in the equation and therefore improves the forecast of Y. The test equation we use in the following is given by

$$(1) \quad Y_t = a + \sum_i b_i Y_{t-i} + d_j X_{t-j} + e_t, \quad with \;\; j \geq 1$$

If the inclusion of variable X with lag j in the test equation leads to a significant estimate of parameter δ_j then Y is said to be Granger-caused by X_{t-j}.[11] Significance is tested with a t-test.[12] In our case, Y is the year-on-year growth rate of industrial production and X is a leading indicator. At first, the autoregressive lags i of variable Y to be included in the test equation are determined with a univariate model

$$(2) \quad Y_t = a + \sum_i b_i Y_{t-i} + e_t$$

using the Schwartz criterion. Table 2 displays for the industrial production variable the autoregressive lags, which are included in the estimation.[13]

Table 2: Characteristics of the univariate model (equation (2))

	IP
Lags i	1, 2, 12, 13
Coeffiencts b_i (t-statistics)	0,59 (7,34) 0,34 (4,27) -0,47 (-6,15) 0,32 (4,07)
Adj. R^2	0,85

Note: IP=Year-on-year growth rate of industrial production. Sample range January 1992 – March 2002.

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[10] See Granger (1969).

[11] In the traditional Granger causality test, variable X is included with Lags 1 to j *en bloc* and then a subsequent F-test on their significance is performed. However, our question is different: we are more interested in knowing which single time lags are significant in the equation rather than if the variable in general is useful to forecast industrial production. Our approach allows us to identify the single last lag that is significant in the equation.

[12] The t-statistics are heteroskedasticity- and autocorrelation-consistent (computed with the Newey-West (1987) procedure).

[13] All variables were found to be stationary using the KPSS test (see Appendix for details and results).

3.3.1 Causality Between Indicators and Industrial Production

We first apply Granger causality tests to analyze to what extent the different indicators improve the forecast of industrial production. To this end, we add different lags of the indicators to the baseline equation of industrial production and test for their significance. Table 3 displays the coefficients and their significance.

Table 3: Granger causality tests between indicators and industrial production

	Lags j						
	1	2	3	4	5	6	7
IFO	0,12*** (5,87)	0,12*** (4,26)	0,08*** (2,86)	0,10*** (2,88)	0,07* (1,87)	0,04 (1,17)	0,02 (0,58)
ESIN	0,18 (1,39)	0,16 (1,31)	0,17 (1,43)	0,09 (0,64)	0,01 (0,06)	0,01 (0,04)	0,00 (0,01)
PMI	0,33*** (5,97)	0,37*** (5,77)	0,30*** (3,53)	0,27*** (2,83)	0,19* (1,98)	0,14 (1,26)	0,12 (1,06)
ZEW	0,02*** (3,39)	0,02*** (3,44)	0,02*** (3,27)	0,02*** (3,12)	0,02** (2,39)	0,01 (1,59)	0,01 (0,92)

Note: t-statistics in parentheses. Significance level: ***(1%), **(5%), *(10%).

As can be seen in Table 3, all indicators except the ESIN have a lead over industrial production, which supports our previous findings of the cross correlation analysis. This lead extends to five months for IFO, PMI and ZEW (i.e. the fifth lag of the indicators still has explanatory power for the industrial production in time t). The fifth lag of the ZEW indicator is significant at the five percent level while IFO and PMI are significant at the ten percent level. Thus, all three indicators are useful in predicting the future growth rate of German industrial production five months ahead (incorporating the publication lag of industrial production the lead is between six and a half (PMI) and seven months (ZEW)).

3.3.2 Causality Among Indicators

Given that IFO, PMI and ZEW are the most forward-looking indicators with regard to the real economy, we now examine the causality among these three indicators to see if one indicator also helps in forecasting the other indicators. To this end we apply Granger causality tests among the three indicators using the autoregressive lags for each variable as displayed in Table 4. We do not include the ESIN indicator as we found it to be a lagging indicator for the economy in the previous analysis.

Table 4: Characteristics of the univariate model (equation (2))

	IFO	**PMI**	**ZEW**
Lags i	1, 12	1, 10	1, 2, 12
Coeffiencts b_i (t-statistics)	0,91 (37,66) -0,13 (-5.64)	0,94 (29,07) -0,20 (-4,92)	1,46 (18,29) -0,54 (-7,02) -0,04 (-1,87)
Adj. R^2	0,93	0,93	0,95

Note: Sample range January 1992 – March 2002 (except PMI: April 1996 – March 2002).

Table 5 shows that the ZEW indicator significantly leads the ifo indicator by one month (which confirms earlier findings by Hüfner/Schröder (2002)) and the ifo in turn has a one month lead over the PMI.

Table 5: Granger causality tests among indicators

Lags	ZEW → IFO	IFO → ZEW	ZEW → PMI	PMI → ZEW	IFO → PMI	PMI → IFO
1	0,04** (2,45)	0,23 (1,49)	0,01 (0,88)	0,38 (0,91)	0,10** (2,15)	0,01 (0,04)
2	0,02 (1,49)	0,02 (0,14)	-0,01 (-0,51)	-0,21 (-0,56)	0,03 (0,69)	-0,13 (-0,78)
3	0,02 (1,24)	-0,08 (-0,53)	-0,01 (-0,73)	-0,14 (-0,37)	0,04 (0,70)	-0,08 (-0,63)

Note: X → Y denotes a Granger causality test of variable X on variable Y, i.e. whether X helps in the prediction of Y. T-values in parentheses (significance level: **(5%)).

4 Analyzing Forecasting Qualities

While useful in determining the lead-structure of indicators with respect to the year-on-year growth rate of German industrial production, Granger causality tests only refer to in-sample estimates. This chapter complements the previous analysis by presenting a comparison of out-of-sample forecasts of the indicators. Results of both analysis may differ because of instabilities of the model structure over time. As a measure of the forecast quality we compare root mean squared errors (RMSE) and Theil's U values of the indicators at different forecast horizons. As a reference for comparing the forecast accuracy, we use a naive forecast which only includes own lags of the industrial production variable (autoregressive model). Again, we focus on the ifo, PMI and the ZEW indicator since these were found to be the most forward-looking in our previous analysis.

4.1 Forecasting models

We use vector-autoregressive models of the following structure to produce the forecasts:

$$\Delta IP_t = a_1 + \sum_i b_{1i} \Delta IP_{t-i} + \sum_j d_{1j} X_{t-j} + e_t$$

$$X_t = a_2 + \sum_k b_{2k} X_{t-k} + \sum_n d_{2n} \Delta IP_{t-n} + e_t$$

The year-on-year growth rate of industrial production (*DIP*) is explained by its own lags and lags of the sentiment indicator (*X*) and vice versa.[14] The naive reference model for industrial production contains only the lag structure according to Table 2. It has to be noted that this procedure does not aim to find the optimal forecasting model for industrial production but rather to compare the additional value of each indicator for forecasting real economy developments. Before performing forecasts we estimate the model using an estimation sample of 24 months (thus, forecasts start in January 1994 as our whole sample starts in January 1992). As data for the PMI are only available from April 1996 on we present two results: for the whole sample (containing only the ifo and ZEW indicator) and a shortened sample from January 1998 to March 2002 (containing the ifo, ZEW and PMI indicator). We perform rolling out-of-sample forecasts for the 1, 3, 6, 9 and 12 month horizon, i.e. in month t a forecast is produced for t+i with i=1, 3, 6, 9, 12.

[14] The structure of the autoregressive lags is taken from Table 2 and Table 4. The number of lags of the other variable to be included is determined by the Schwartz criterion. In all cases a lag length of one was found to be appropriate.

4.2 Comparing the forecasting performance

Table 6 and Table 7 present the RMSEs for the two different samples which are calculated as follows:

$\text{RMSE} = \sqrt{\frac{1}{n}\sum_i (y_i - \hat{y}_i)^2}$ with $(y_i - \hat{y}_i)$ as the forecast error and n as the number of periods being forecasted. Additionally, we report Theil's U which is computed as

$$\text{Theil's\_U} = \frac{\text{RMSE(Indicator\_Model)}}{\text{RMSE(naive\_Model)}}.$$

A Theil's U < 1 signals that the forecast including the indicator results in a smaller RMSE than the naive model and thus improves the forecast.

For the longer sample (Jan. 1994 – Mar. 2002) both ifo and ZEW exhibit good forecasting qualities. For forecast horizons of up to six months Theil's U is for smaller than one both indicators and thus better than the reference model. However, for the six, nine and 12 month horizon ZEW shows a better forecasting performance with Theil's U of 0,82, 0,77 and 0,78 compared with 0,87, 1,05 and 1,38 for the ifo indicator. The forecasts of the ifo indicator, however, are better for very short horizons of one and three periods.

Table 6: RMSE and Theil's U-values for the period Jan.1994 – March 2002

Forecast horizon	**naive model** RMSE	**Ifo**		**ZEW**	
		RMSE	Theil´s U	RMSE	Theil´s U
1	1,74905	1,64862	0,94	1,72909	0,99
3	2,18459	2,03486	0,93	2,06089	0,94
6	3,28418	2,86779	0,87	2,68560	0,82
9	4,25293	4,46860	1,05	3,29549	0,77
12	4,92158	6,77139	1,38	3,84748	0,78

Table 7 displays the results for the shorter sample (Jan. 1998 – Mar. 2002), which also includes the PMI.[15] It can be seen that only the forecasts produced with the ifo indicator show consistently Theil's U values smaller than one. The ZEW indicator beats the naive model only for the six and nine month horizons while the forecasting performance of the PMI indicator is always worse than the reference model and the models including the ifo and ZEW indicators.

[15] We chose Jan. 1998 as a starting point for the analysis in order to have a sufficiently large sample (April 1996 – December 1997) for the initial estimation of the model including the PMI. Since the data availability for the PMI is comparably short, results have to be interpreted with care.

Table 7: RMSE and Theil's U values for the period Jan.1998 – March 2002

Forecast horizon	**naive model** RMSE	**Ifo**		**ZEW**		**PMI**	
		RMSE	Theil´s U	RMSE	Theil´s U	RMSE	Theil´s U
1	1,46347	1,38534	0,95	1,45762	1,00	1,71608	1,17
3	1,73007	1,63579	0,95	1,82772	1,06	2,45535	1,42
6	2,47203	2,28709	0,93	2,36558	0,96	3,44501	1,39
9	3,11853	2,73458	0,88	3,03807	0,97	3,95722	1,27
12	3,61833	3,19281	0,88	3,62180	1,00	4,21816	1,17

While conclusions on the forecasting ability should be better based on the full sample, as the sample 1998 – Mar. 2002 is rather short, a comparison of Table 6 and Table 7 shows that there is some variability in the results over time.

5 Summary

We have analyzed the forecasting qualities of German leading indicators by focussing on the ifo business expectations, the Economic Sentiment Indicator for Germany of the European Commission, the Purchasing Managers' Index and the ZEW Indicator of Economic Sentiment. Cross correlations indicate that, except for the ESIN, all indicators are leading the year-on-year growth rate of industrial production.

Subsequent Granger causality tests support this view and show that the ifo, PMI and ZEW indicators have explanatory power if they are lagged by up to five months with respect to industrial production. Taking into account the publication lag of industrial production, the three indicators lead real economy developments by about half a year (and the ESIN indicator by about one month). The ZEW indicator is usually the first to be released and has a one-month lead over the ifo expectations indicator which on the other hand has a one-month lead over the PMI.

Out-of-sample forecast evaluations suggest that ifo and ZEW provide the best forecasts for industrial production among the three indicators ifo, PMI and ZEW. While the ZEW indicator performs better than the ifo over a long sample (Jan. 1994 – Mar. 2002) and especially over horizons from six to twelve months, the ifo predicts better at shorter horizons (up to three months) and is superior to the ZEW indicator when a shorter sample (Jan. 1998 – Mar. 2002) is regarded. The PMI exhibits the worst forecasting performance and does not beat a naive reference model at all forecasting horizons.

6 Appendix

Stationarity Tests

We use the KPSS-Test, which tests the null hypothesis of "stationarity" against a unit root alternative.[16] The test uses the regression of the time series to be analyzed (Y_t) against a constant ("stationarity") or a constant and a time trend ("trend stationarity"):

(1) $Y_t = a + ßt + e_t$

Then the stationarity of the residuals of the regression (ε_t) is tested.[17] The test statistics for the two regressions – with a constant only and with a constant and a trend – as well as the chosen lag length are displayed in Table 8.

Table 8: Results of the KPSS-Test

Jan. 1992 – Mar. 2002	Optimal Lag	KPSS with Constant	KPSS with Trend
ESIN	9	0,204	0,063
IFO	9	0,181	0,100
PMI	6	0,197	0,113
ZEW	9	0,287	0,143*
IP	9	0,302	0,096

Notes: Sample Range Jan. 1992 – Mar. 2002 (except for PMI). Significance level: * = 10%.

The result of the KPSS test is that all variables are stationary as the null hypothesis of stationarity could in neither case be rejected in both two possible specifications (with constant/with trend).

[16] See Kwiatkowski et al. (1992).

[17] An essential part of the test statistic is the consistent estimation of the variance of the residual time series. Usually a Bartlett kernel is used to estimate a heteroskedasticity and autocorrelation consistent variance. The KPSS test statistic therefore depends on the choice of the lag length of the Bartlett kernel, that is needed to correct for autocorrelation in the residual term. Hobijn et al. (1998) analyzed different approaches to choose the lag length and concluded that the automatic lag selection procedure developed by Newey and West (1994) improves the performance of the test compared with the original KPSS test. Therefore, we also used this generalized KPSS procedure to test for stationarity.

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