Hüfner, Felix P.; Lahl, David

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David Lahl and Felix Hüfner

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Non-technical Summary

This paper analyzes which factors are driving the ZEW Indicator of Economic Sentiment. Using the results of a poll among survey participants as well as causality tests we identify three groups of influence factors: other sentiment indicators, financial variables and real economy data.

The causality analysis confirms our thesis that financial market experts observe fundamental economic data when building their expectations on economic activity. In every category we found variables which seem to influence the ZEW index, e.g. US consumer confidence, ifo business expectations in the category of other business sentiment indicators, Dax, yield structure and ECB refinancing rate in the category of financial variables and manufacturing orders in the class of fundamental key data.

In a second step these variables are used to estimate out-of-sample forecasts for the ZEW Indicator. We find that a simple model that includes German manufacturing order data, the German yield structure and the US Consumer Confidence indicator as explanatory variables is able to outperform a naive univariate benchmark model as well as the consensus forecast for the ZEW Indicator as published by news agencies.

What Determines the ZEW Indicator?

David Lahl and Felix Hüfner
Centre for European Economic Research (ZEW)

June 2003

Abstract

This paper analyzes which factors are driving the ZEW Indicator of Economic Sentiment. Using the results of a poll among survey participants as well as Granger causality tests we identify three groups of influence factors: other sentiment indicators, financial variables and real economy data. In a second step these factors are used to estimate out-of-sample forecasts for the ZEW Indicator. We find that a simple model that includes German manufacturing order data, the German yield structure and the US Consumer Confidence indicator as explanatory variables is able to outperform a naive univariate benchmark model as well as the consensus forecast for the ZEW Indicator as published by news agencies.

JEL-Classification: E32, E37

Keywords: leading indicators, Germany, zew, forecasting

L 7, 1
P.O.Box 10 34 43
68034 Mannheim
Germany

phone: 0621 / 1235 – 143/-144
fax: 0621 / 1235 - 223
e-mail: lahl@zew.de
huefner@zew.de

1 Introduction

Research about German economic sentiment indicators has become quite popular over the last years. Most of the existing studies focus on the forecasting qualities of different indicators with respect to developments in the business cycle (see e.g. Wolters and Lankes, 1989; Fritsche, 1999; Langmantel, 1999; Fritsche and Stephan, 2000; Stadler, 2001; Broyer and Savry, 2002; Hüfner and Schröder, 2002A, 2002B). These forecasting characteristics of indicators are by now fairly well understood. A question that has not been in the focus of researchers recently is what determines the ups and downs of sentiment indicators, i.e. what factors do the survey participants rely on when filling out the questionnaires.

Knowing more about the influence factors on indicators is important in at least two ways: First, the interpretation of indicator values is facilitated if the underlying rationale of the survey participants is better understood. Second, knowing the determinants of indicator movements helps in forecasting those movements which is becoming increasingly important. Consensus forecasts, extracted from surveys of economists prior to the release of each indicator are providing an important guiding line for financial market participants.

Recently, Rees (2003) developed a model to forecast the ZEW Indicator using the variables DAX, yield structure of interest rates and relationship between ZEW-survey participants who are optimistic and who are neutral. The aim of our study is to extent his study and shed more light on what is driving the ZEW economic sentiment indicator. In our analysis we investigate which economic variables influence the expectations of survey participants. Using Granger causality estimates we determine which of the variables lead the indicator. With the results obtained from this analysis we develop a simple forecasting model for the ZEW Indicator. As out-of-sample forecasts show our model is able to deliver significantly better forecasts than a naive reference model and the consensus forecast produced from a survey among professional economists.

The paper is organized as follows. Chapter two comprises a survey of fundamental economic variables and business sentiment indicators, chapter three presents the Granger causality estimates, chapter four includes the out-of-sample forecast evaluation and chapter five concludes.

2 Survey of the Data

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.[1] 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 state of the German economy in six months (diffusion index).

We include a range of economic variables in order to find out which of them actually lead the ZEW Indicator, i.e. which variables can be used to improve a forecast of the ZEW Indicator. These variables are chosen from a poll where the survey participants were asked directly which factors they take into account when forming their expectations for the German economy.[2] These variables were grouped into three categories: Other sentiment indicators, financial variables and real economy variables. While it is certainly true that a forward-looking indicator should lead real economy variables it might nevertheless be the case that the survey participants are influenced by the publication of real economy statistics in order to verify their past expectations and maybe alter their expectations for the future.

Sentiment indicators include the German ifo business expectations and the German Purchasing Managers' Index as well as the US ISM Purchasing Managers' Index (formerly NAPM) and US Consumer Confidence (Conference Board) in order to capture the influence of foreign variables. Financial variables include the German Dax and the US Dow Jones stock market indices, the yield structure (measured as the difference between the yield on ten-year Bunds and the three-month Euribor), the US$/Euro exchange rate, the main refinancing rate of the European Central Bank and the oil price. Finally, real economy variables comprise the German industrial production, retail sales figures, manufacturing orders and the unemployment ratio.[3] The sample period starts in January 1992 and ends in March 2003.[4]

In interpreting the impact of real economy variables on the ZEW indicator we take into account their publication lag. For example, manufacturing orders for month t are typically released only in month t+2, i.e. with a lag of about six weeks. The same

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

[2] See ZEW Financial Market Report June 2003.

[3] Apart from the ECB interest rate, the US ISM, the ifo expectations, the German PMI and the ZEW Index, all variables are non-stationary (see appendix for the results of KPSS-stationarity tests; we assume non-stationarity if both KPSS-statistics (with constant/with trend) reject the null hypothesis of stationarity) and were consequently included in their first differences, i.e. month-over-month changes. An exemption is the yield structure, which was included in levels based on theoretical considerations.

[4] All data were obtained from Thomson Financial Datastream.

holds true for industrial production numbers and retail sales figures. Unemployment data is released with a one month lag.

3 Granger Causality Tests

In this section we will investigate the relationship between the ZEW Indicator and fourteen economic variables using Granger causality tests. The aim is to analyze the impact of changes in economic variables on the ZEW Indicator.

The Granger (1969) approach is to see first how much of the current y (in this case ZEW Indicator) can be explained by past values of y and then to see whether adding lagged values of x (economic variables) can improve the explanation.[5] 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

$$(1) \qquad Y_t = a + \sum_i \beta_i Y_{t-i} + \delta_j X_{t-j} + \varepsilon_t, \quad with \;\; j \geq 1$$

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}.[6] Significance is tested with a t-test.[7] In our case, Y is the ZEW Indicator and X is an economic variable. At first, the autoregressive lags i of variable Y to be included in the test equation are determined with a univariate model

$$(2) \qquad Y_t = a + \sum_i \beta_i Y_{t-i} + \varepsilon_t$$

using the Schwartz criterion. Table 1 displays for the ZEW Indicator the autoregressive lags, which are included in the estimation.[8]

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[5] See Granger (1969).

[6] 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 the ZEW-indicator. Our approach allows us to identify the single last lag that is significant in the equation.

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

[8] The ZEW indicator was found to be stationary using the KPSS test (see Appendix for details and results).

Table 1: Characteristics of the univariate model (equation (2))

	ZEW
Lags i	1, 2, 11
Coefficients β_i (t-statistics)	1.46 (21.95) -0.54 (-7.77) -0.03 (-1.90)
Adj. R^2	0.95

Note: Sample range January 1992 – April 2003

In the next step we add to the univariate baseline model lags of the economic variables that were described in section 2. Because of publication delays, it might be the case that the first or second lag have no explanatory power. For this reason we include up to three lags in our analysis, which should suffice to take publication lags adequately into account.

3.1 Causality Between the ZEW Indicator and other sentiment indicators

We first apply Granger causality tests to analyze to what extent sentiment indicators, i.e. ifo business expectations (IFO), US Purchasing Managers' Index (US-ISM), German Purchasing Managers' Index (PMI) and US Consumer Confidence (US-Cons) show a lead to the ZEW Indicator. To this end, we add lags of the indicators to the ZEW Indicator baseline equation and test for their significance.

Table 2: Granger causality tests between sentiment indicators and the ZEW indicator

Lags	IFO	PMI	US-ISM	US-Cons
1	0.34** (2.18)	0.58 (1.22)	0.36 (1.43)	0.34*** (3.05)
2	0.04 (0.27)	-0.05 (-0.12)	0.06 (0.27)	0.13 (1.52)
3	-0.12 (-0.79)	-0.26 (-0.83)	0.16 (0.75)	0.003 (0.02)

Note: t-statistics in parentheses. Significance level: ***(1%), **(5%), *(10%). IFO, PMI, US-ISM were found to be stationary and are applied in levels, US-Cons is not stationary, we use it therefore in first differences (PMI starts in April 1996)

As the table shows the first lags of IFO and US-CONS exhibit a significant influence on the ZEW-indicator, whereas the US Purchasing Managers' Index (USISM) and the German Purchasing Managers' Index (PMI) do not show a significant influ

ence. The second and the third lag seem to have no explanatory power and even have the wrong sign in some cases. This confirms the thesis that there is no long-lasting influence of other sentiment indicators on the ZEW Index, but that changes in US Consumer Confidence and Ifo business expectations are observed by financial market experts during survey periods.

3.2 Causality Between the ZEW Indicator and financial market data

In this section we investigate the influence of six financial market variables on the ZEW Indicator that play an important role for German financial analysts including Dow Jones (DOW), Dax (DAX), Euro (EURO), yield structure (YIELDSSTRUC), oil price (OIL), and the main refinancing rate of the ECB as a proxy for the ECB-policy (ECB).

Table 3: Granger causality tests between financial market variables and the ZEW Indicator

Lags	DAX	DOW	EURO	YIELD-STRUC	ECB	OIL
1	0.01** (2.17)	0.01 (1.63)	-26.36 (-0.88)	2.20***(2.92)	-4.35*** (-2.72)	-0.47 (-1.40)
2	0.01** (2.35)	0.01*** (2.7)	-22.82 (-0.84)	2.09***(2.83)	-4.46**(-2.46)	0.06 (0.17)
3	0.01 (1.45)	0.001**(2.5)	-2.92 (-0.09)	1.74** (2.35)	-4.87**(-2.42)	0.38 (0.98)

Note: For Dax, Dow, Euro and oil we used the first differences, yield structure and ECB-interest rate we consider to be stationary, ECB interest rate only starts in April 1999

As Table 3 shows, Dax, yield structure and ECB refinancing rate exhibit a significant influence on the ZEW Index, whereas the Euro exchange rate and oil prices over the whole sample period do not contain information on the future development of the ZEW economic sentiment indicator. The Dow Jones variable exhibits a lead in the second and third lag.

3.3 Causality Between the ZEW Indicator and fundamental data

In the last part of our Granger analysis we investigate the influence of fundamental economic data on the ZEW index. We include popular economic key data that is regularly published by news agencies including manufacturing orders (MO), industrial production (IP), retail sales (RS) and unemployment rate (UNEM). Real fun

damental data are normally only available with delays up to three months. Thus, first lags cannot be observed by financial experts, but the second or third lag should indicate the importance of fundamental data. Only the unemployment rate is available with a one month delay.

Table 4: Granger causality tests between financial markets variables and the ZEW indicator

Lags	MO	IP	RS	UNEM
1	0.15 (0.38)	0.28 (0.69)	0.15 (0.38)	-9.26 (-1.32)
2	1.72*** (3.88)	0.19 (0.36)	-1.06** (-2.35)	6.80 (1.06)
3	-0.11 (-0.26)	0.22 (0.52)	0.34 (0.78)	5.39 (0.77)

Note: For MO, IP, RS and UNEM we used first differences

As already mentioned the second lag of industrial production, manufacturing orders and retail sales should be the one which influences expectations on economic activity. Table 4 shows that manufacturing orders and retail sales exhibit significant coefficients for the second lag in our Granger analysis. The second lag of RS enters the equation with the wrong sign, albeit only at the 5 percent level. Nevertheless, the high significance of manufacturing orders seems to confirm that a rise in manufacturing orders has a positive influence on the ZEW Indicator. Monthly changes in industrial production, however, attract little interest of financial analysts over the whole sample period. The unemployment rate shows the right sign in the first lag but is insignificant. This result does not surprise, since unemployment is usually considered as a lagging variable to economic cycles.

Our Granger analysis confirmed our thesis that financial market experts observe fundamental economic data when building their expectations on economic activity. In every category we found variables which seem to Granger cause the ZEW index, e.g. US consumer confidence, ifo business expectations in the category of other business sentiment indicators, Dax, yield structure and ECB refinancing rate in the category of financial variables and manufacturing orders in the class of fundamental key data.

4 Analyzing Forecasting Qualities

While useful in determining the lead-structure of variables, Granger causality tests only refer to in-sample estimates. This chapter complements the previous analysis

by presenting a comparison of out-of-sample forecasts for the indicator. 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 forecasts. As a benchmark for comparing the forecast accuracy, we use a naive forecast which only includes own lags of the ZEW Indicator (autoregressive baseline model). Again, we focus on all variables which we investigated in the preceding section except for ECB interest rate and PMI indicator as for this variables time-series only over short periods are available. However, the yield structure variable captures the influence of monetary policy.

4.1 Forecasting models

We use an autoregressive model of the following structure to produce the forecasts:

$$ZEW = \alpha + \sum \beta ZEW + \sum \delta X + \varepsilon$$

The ZEW indicator is explained by its own lags and lags of the economic variable (*X*), whereby we use the first lags for the variables IFO, US-ISM, US-Cons, Dax, Dow, Euro, yield structure, oil price and unemployment rate (UNEM) and for the variables industrial production, manufacturing orders and retail sales the second lag because of the publication lag. The naive reference model for the ZEW indicator contains only the lag structure according to Table 1. Before performing forecasts we estimate the model using an estimation sample of 36 months. We perform rolling out-of-sample forecasts for the 1 month-horizon.

4.2 Comparing the forecasting performance

Tables 5-9 present the RMSEs for different samples which are calculated as follows:

$RMSE = \sqrt{\frac{1}{n}\sum_i (y_i - \hat{y}_i)^2}$ 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.

At first we estimate a baseline model using an estimation sample of 36 months. Thus, forecasts start in January 1995 as our whole sample starts in January 1992. Table 5 displays the results of forecasting qualities of the economic variables for the one-month ahead out-of-sample estimation from January 1995 to April 2003. Only three variables e.g. yield structure, manufacturing orders and US-consumer confi

dence exhibit good forecasting qualities. For the one month forecast, Theil's U for each of these variables is smaller than one and thus better than the reference model. For retail sales we also find a Theil's value < 1 but only marginally. Additionally as we know from Granger analysis the retail sales enter the equation with a negative sign what causes some problems for the interpretation of this result. In difference to the Granger test results ifo business expectations and the Dax variable are not able to improve the forecast of the ZEW Indicator.

In a next step we investigate if a combination of the three variables yield structure US Consumer Confidence and manufacturing orders beats the forecast of one single variable. The results presented in table 6 show that combinations indeed yield significantly better forecasts. If we add yield structure, manufacturing orders and US consumer confidence to our reference model we receive the best forecasting model for the period from January 1995 to April 2003 with a Theil's U of 0.93.

To test the stability of the model we present a second forecast for a shorter sample. It might be the case that some variables gained popularity in the last years and should therefore also be integrated in our forecasting model. Furthermore, importance of variables might have varied over time. In table 7 we present the results of a forecast based on the period from January 1999 until April 2003.Before performing the forecasts we estimated again the baseline model using an estimation sample of 84 months instead of 36 months.

Table 7 presents the results of the shorter forecast horizon. Additionally to the yield structure, manufacturing orders and the US-Consumer-Confidence also the US Purchasing manager index shows good forecasting qualities in the out-of-sample forecast. Probably the importance of this indicator increased within the last years. However, as table 8 shows a combined forecast of US-ISM with the other three variables does not improve Theil's U for the shorter horizon.[9]

Other variables like Euro-exchange rate and unemployment rate lead only to Theil's values hardly under 1 and are therefore not considered in a further analysis, even if these results confirm some instability of the model structure over the time. Certainly importance of single economic variables depends to some extent on the actual economic situation. Nevertheless, we found in both samples a relatively stable relation between the variables yield structure, manufacturing orders and US-Consumer confidence and the ZEW Indicator.

[9] For simplicity we only report a comparison of two regimes. Other comparisons confirm the result.

Table 5: RMSE and Theil's U-values for the period Jan.1995 – April 2003

Forecast	RMSE	Theil´s U
Naive Model	8.99001	1.00
IFO	9.05934	1.00771189
US-ISM	9.05438	1.00716017
US-CONS	**8.77393**	**0.97596443**
DAX	9.18785	1.02200665
DOW	9.15459	1.01830699
EURO	9.01944	1.00327363
YIELDSTRUC	**8.88008**	**0.98777198**
OIL	9.06457	1.00829365
MO	**8.63020**	**0.95997669**
IP	9.25984	1.03001000
RS	8.96153	0.99683
UNEM	9.35636	1.04075079

Table 6: Combination of yieldstruc, MO and US-Cons Jan. 1995 – April 2003

	RMSE	Theil´s U
Naive Model	8.99001	1.00
US-CONS / MO	8.40551	0.93498339
US-CONS / YIELDSTRUC	8.68978	0.96660404
MO / YIELDSTRUC	8.54229	0.95019805
MO/ YIELDSTRUC / US-CONS	**8.33946**	**0.92763634**

Table 7: RMSE and Theil's U values for the period Jan.1999 – April 2003

Forecast	RMSE	Theil´s U
Naive Model	8.20428	1.00
IFO	8.28381	1.00969
US-ISM	**8.03572**	**0.97945**
US-CONS	**8.06243**	**0.98271**
DAX	8.31003	1.01289
DOW	8.43190	1.02774
EURO	8.16322	0.99499
YIELDSTRUC	**8.06143**	**0.98259**
OIL	8.20620	1.00023
MO	**7.82133**	**0.95332**
IP	8.33175	1.01554
RS	8.14043	0.99222
UNEM	8.17952	0.99698

Table 8: Combination of yieldstruc, MO, US-Cons and US-ISM 1999:01–2003:04

	RMSE	Theil´s U
Naive Model	8.20428	1.00
US-CONS / MO /US-ISM / YIELDSTRUC	7.50688	0.91500
US-CONS / YIELDSTRUC / MO	**7.50019**	**0.91418**

To compare our results with the forecasts of professional economists who are polled by news agencies prior to the ZEW Indicators' release, we calculate the Theil's U of the consensus forecasts (based on a survey among professional economists) which are published monthly by S&P/MMS and compare it to our simple model. For this purpose we present a third forecast based on the horizon from October 2001 until April 2004, since consensus forecasts for the ZEW index are not available for a longer period.

Table 9: RMSE for 2001:10-2003:04

	RMSE	Theil´s U
Naive Model	10.03969	1.00
CONSENSUS	10.64908	1.06070
US-CONS / YIELDSTRUC / MO	**8.95353**	**0.89181**

Table 9 confirms that our simple model is able to outperform the consensus forecasts of the ZEW Indicator and the naive reference model for the considered period. This result delivers additional evidence that our model performs quite well even if the sample size is too small for definite conclusions.

5 Summary

In this study we investigated the factors that influence the ZEW Indicator of Economic Sentiment, i.e. which factors help in forecasting. Three groups of variables were examined: real economy variables, financial variables and other sentiment indicators. Using Granger tests and out of sample forecasts we found a relatively stable relationship between the variables manufacturing orders, yield structure and US-consumer confidence and the ZEW indicator. Out-of-sample forecasts showed that variables of all three groups improve the forecast of the ZEW Indicator: German manufacturing orders, the German yield structure and the change in the US Consumer Confidence Index. The resulting forecasting model containing all three variables outperforms both a naive univariate benchmark model and the monthly consensus forecast of professional economists. Even if we can not exclude that in different sub-periods other factors are the driving forces of the ZEW Indicator, the explanatory power of our model for the ZEW Indicator of economic sentiment seems to remain constant over time.

An interesting analysis extending our study would be to compare our findings with results for other sentiment indicators. Additionally, it might be worth examining the stability of different influence factors, i.e. whether different variables perform better in certain regimes than in other periods. We leave that for future research.

6 Appendix

Stationarity Tests

We use the KPSS-Test, which tests the null hypothesis of "stationarity" against a unit root alternative.[10] 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"): $Y_t = \alpha + \beta t + \varepsilon_t$

Then the stationarity of the residuals of the regression (ε_t) is tested. 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 10. The result of the KPSS test is that the sentiment indicators, with the exception of the US Consumer Confidence, are stationary variables, while there is strong evidence that the financial and real economy variable series contain unit roots.

Table 10: Results of the KPSS-Test

	Optimal Lag	KPSS with Constant	KPSS with Trend
Sentiment Indicators			
ZEW	9	0.28	0.16**
Ifo expectations	9		
PMI	6	0.29	0.12
US ISM	9	0.22	0.04
US Consumer Conf.	9	0.75***	0.32***
Financial Variables			
US$/Euro	9	1.17***	0.13*
ECB interest rate	5	0.22	0.20**
Inflation	9	0.94***	0.30***
DAX	9	1.04***	0.17**
Dow Jones	9	1.29***	0.21***
Oil price	9	0.63**	0.13*
Yield structure	9	0.36*	0.26***
Real economy variables			
Industrial production	9	1.16***	0.17**
Retail sales	9	1.01***	0.17**
Manufact. Orders	9	1.27***	0.14*
Unemployment rate	9	0.49*	0.29***

Notes: Sample Range Jan. 1992 – Apr. 2003 (except for PMI, ECB). Significance level: ***=1%, **=5%, * = 10%.

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

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