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Faculty of Social Sciences

Institute of Economic Studies

Bachelor Thesis

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Economic Sentiment Indicators in Germany and their Predictive Power for Stock Market

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Prohlášení

Prohlašuji, že jsem bakalářskou práci vypracoval samostatně a použil pouze uvedené prameny a literaturu

V Praze dne podpis studenta

Acknoledgements

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Abstract

German economic sentiment indicators (the Ifo, ZEW, PMI and ESIN) are known to improve predictions of the industrial production in Germany. I try to find theoretical background, why these indicators could possibly lead and improve forecasts of the stock market average DAX 30. Subsequently I test the Granger causality and perform out-of-sample forecasts of the DAX 30 by the Ifo and ZEW indicators. The forecasts are then compared.

Abstrakt

Německé indikátory ekonomického sentimentu (Ifo, ZEW, PMI, ESIN) jsou známy tím, že zlepšují předpovědi průmyslové výroby v Německu. Já se snažím najít teoretické základy, které by vysvětlily, proč by tyto indikátory mohly předbíhat a případně zlepšovat předpovědi vývoje burzovního indexu DAX 30. Následně testuji Grangerovu kauzalitu a vytvořím předpovědi indexu DAX 30 pomocí indikátorů Ifo a ZEW. Předpovědi pak porovnávám.

Contens

1. Introduction

Aim of this bachelor thesis is to investigate the properties of the economic sentiment indicators in Germany. The economic sentiment indicators express the view about economic state in Germany and are closely watched on the stock market and foreign exchange markets. There is evidence that stock market indices in Germany and exchange rate EUR/USD reacts to surprises of certain indicators in the short-term horizon of several minutes.

The key question of the thesis is, whether the economic sentiment indicators are able to predict the german stock market index DAX 30 or at least improve predictions of the DAX 30 development in medium term horizon of few months. I have not found any literature concerning exactly this issue, however Bessler and Opfer (2002) built factor model for sector indices DAFOX and one of the factors was an economic sentiment indicator Ifo business climate.

I have found relatively wide range of literature on the predictive power of the German economic sentiment indicators for the industrial production and the GDP. Broyer and Savry (2002) focused on the GDP prediction and Hüfner and Schröder (2001, 2002) described the indicators' predictive power and accuracy for the industrial production.

My focus was concentrated on theoretical background, since different series are often used in statistical predictions and they are sometimes chosen just to make the best forecast without taking into account their theoretical rationale. Sometimes the statistical significance is revealed, before the theoretical rationale appears, despite that I try to look for theoretical rationale in order to confirm the relevance of the time serie.

I begin with theoretical background of leading indicators and describe the properties these indicators, then I briefly introduce economic surveys. The whole chapter is devoted to description of german economic sentiment indicators that are being subsequently investigated as leading indicators.

Following chapter deals with statistical characteristics of the economic sentiment indicators and their predictive power for the german industrial production as a proxy variable for german real economic development. I use Granger causality test as a statistical tool to determine, whether the sentiment indicators predict the industrial production. The results of my tests are compared with results in working papers that analyzed the indicators and some measure of the german economic development.

When the predictive power of the sentiment indicators for the industrial production is covered, the focus aims at relation between the real economy and stock market returns. Afterwards, a relation of the stock market returns and economic indicators is considered as indirect and if the indicators lead the industrial production by a longer period, than the production lags the stock market, then there is a chance that the indicators could have a predictive power for the stock returns. The Granger causality test is applied here again to find out, whether the indicators predict the stock returns. Some further statistical analysis is performed to better understand the prediction possibilites and relation between the stock returns and sentiment indicators.

2. Leading Indicators and Economic Surveys

2.1. Concept of Leading Indicators

Business cycle indicators have been tracked since the first half of the previous century. During the period of 1919-1922 Harvard Barometer was published and included 13 time series. Time series of leading indicators helped to improve and make predictions of future business cycle development, turning points and potential risks.

Economists look for simiralities and co-movements between a selected indicator and a tracked variable. Oppendländer distinguishes leading, co-moving and lagging indicators. The group of leading indicators is particularly interesting, considering their significant predictive power for the business cycle. Burns and Mitchell, who founded the National Bureau of Economic Research, were the first to use leading indicators in the 1930s. Business cycle, how Burns and Mitchell (1946) defined it, is a fluctuation in overall economic activity and the cyclicality concerns expansion and contraction. However, the time period of expansions and contractions is variable. The leading indicator approach detects stage of business cycle and predicts future economic boom or recession. This approach differs from an econometric model, that follows every fluctuation in economic activity.

The leading indicator approach was initially a pure statistical model without any theoretical background. Why is the theory behind this approach so important, when the forecasts and indications have perfect results? The National Bureau of Economic Reasearch used their time series of indicators to make forecasts and they did not need to study any theoretical background, although they were aware of the theory behind the indicators.

Koopmans (1947) gave underlying argument in favour of theoretical rationalisation in the article Measurement Without Theory. He pointed out that an observed statistical relation or regularity can change over time. The reason for this is evolving behavior pattern. Theoretical understanding helps to analyze the changes in regularities under different circumstances.

Fritsche (1999) summed up the properties of a leading indicator as follows:

1. The leading indicator must have a theoretical rationale.

2. There must be a significant statistical relation between the indicator and an analyzed time serie.

3. The indicator must of course lead the observed time serie and the lead structure must be relatively stable.

2.2. Theoretical Rationale

Leuuw in his paper Toward a Theory of Leading Indicators presents five reasons, why a leading indicator could possibly lead any time serie:

1. Production time – time between the firms' plans about production and the actual realization of the plans

2. Ease of adaptation – short-run flexibility or ability to adapt to different economic activities

3. Market expectations – influence of market players' expectations on real economic activity and production

4. Prime movers – the view that behind the economic fluctuations are initially economic forces trigering downturn or expansion (monetary and fiscal policies)

5. Change-versus-level – the fact that changes in time series turn up or down before levels

2.3. Quantitative vs. Qualitative Indicators

Economic indicators that are used in forecasting can be divided in two groups. First group is called quantitative indicators and the second group is called qualitative indicators.

Both groups of indicators are used together or individually in predictions, but there some differences between them that should be noted.

Quantitative indicators represent exact variables or almost exact with some statistical error. These variables describe some economic activity or measure and express it in numbers. Examples of quantitative indicators are new orders, initial claims for unemployment insurance, average weekly hours of production workers and housing units authorized by building permits.

Qualitative indicators is a non-numerical, but verbal assesment of a certain economic activity. However, qualitative indicators can not be used in econometrical and statistical analysis. Therefore a quantification of these indicators is more useful. Economic surveys convert the qualitative assesments of people to numerical variables.

2.4. Economic Sentiment Surveys

Economic surveys mainly focus on sentiment about future development or hardly measureable past or present unknowns. The sentiment about future is of a high importance, because it represents expectations. The sentiment indicators are widely used as a forecasting tool.

First collections of data were carried out before the Second World War. In 1944 the United States Department of Agriculture conducted survey on consumer sentiment. The answers of respondents were later aggregated. The University of Michigan took over running this survey and now it is known as the Michigan survey. In 1948 the Institut für Wirtschaftsforschung introduced business surveys in Germany. The German Ifo-Institut started with Ifo-Konjunkturtestverfahren in 1950 and collected answers from 10 000 businesses that came from different sectors. Now there is a number of various surveys that asses information from consumers and businesses. The most important institutions (except those already mentioned), conducting consumer and business surveys, are the OECD and the European Commission. In some surveys the polled individuals are financial experts, financial instituions or economists providing another point of view.

Generally economic surveys do not question on precise numbers, but there are several categorical answers to be chosen. Very frequently the answers in sentiment surveys are three-fold: positive, neutral or negative sentiment. This scheme of answers contains less information than precise ones, however precision could lead to “the thruth elicitation problem“ meaning that for example polled company executives would not disclose truthfully precise information about their company because of possible misuse.

2.5. Rationale of Economic Sentiment Surveys for Forecasting

In this chapter quantified economic sentiment surveys in form of an index are considered as a leading indicator. Theoretical rationale is the first condition of leading indicator and therefore the theoretical background of economic sentiment surveys is to be discussed. Consumer, business and analyst sentiment surveys reflect dissimilar views and thus their results are used for slightly different reasons.

The only common aspect of the three types of sentiment surveys is that they represent market expectations and fulfill the third point of Leeuw’s theoretical reason for leading indicators. Nevertheless, the expectations of consumers, managers and analysts do not have to be consistent with each other. Consumer sentiment in surveys quantifies the willingness of consumers to spend in future, it aggregates their view of the most probable future consumption as a part of GDP.

Business surveys of economic sentiment contain information not only about expectations of future economic development, but also internal production plans of a certain business and adaptibility to anticipated changes in economy. Thus, business surveys could be rationalized by the Leeuw’s first three theoretical reasons for leading indicators (production time, ease of adaptation and market expectations – see above).

Economic sentiment surveys of analysts collect the views of experts from financial insitutions, the analysts have experience with forecasting and have access to non-public information. The perspective of analysts is wider than the view of business managers that follow the development of economic environment in connection with their bussines.

3. Economic Sentiment Indicators in Germany

Broyer, Savry (2002) and Hüfner, Schröder (2002) consider four German indicators of economic sentiment: Economic Sentiment Indicator (ESIN) by the European Commission; Ifo Business Expectations by Ifo institute, Purchasing Managers' Index by Reuters/NTC and ZEW Indicator of Economic Sentiment. I found another sentiment indicator called Sentix[1], nevertheless I am not going to use it in my analysis, because it is relative young indicator (started in February, 2001) to make stronger conclusions about its performance.

In the following paragraphs I am going to discuss the properties of these sentiment indicators.

3.1. Ifo Business Expectation Index

Business survey by the Ifo institute polls more than 7 000 managers and executives from German companies involved in manufacturing, construction, wholesaling and retailing. The only financial sector is exluded. The Ifo institute started to make surveys in 1949.

There are three indices: business situation, business climate and business expectations that are calculated by the institute. The Business Situation Index aggregates ex post answers concerning the current situation in the economy and the Business Expectations Index reflects ex ante view of the economic situation in 6 months. The questions in both indices are three-fold: good, neutral or bad (in case of expectations: improve, no change or worsen). The index is then calculated as a difference between percentual positive and negative answers. For example 70 % of the answers were positive, 20 % negative and 10 % neutral, than the index is 70 – 20 = 50.

The Business Climate Index comprises information from the previous two indices. The formula for the Business Climate Index is as follows[2]:

$$\text{Business Climate} = \sqrt{(\text{situation} + 200)(\text{expectations} + 200)} - 200$$

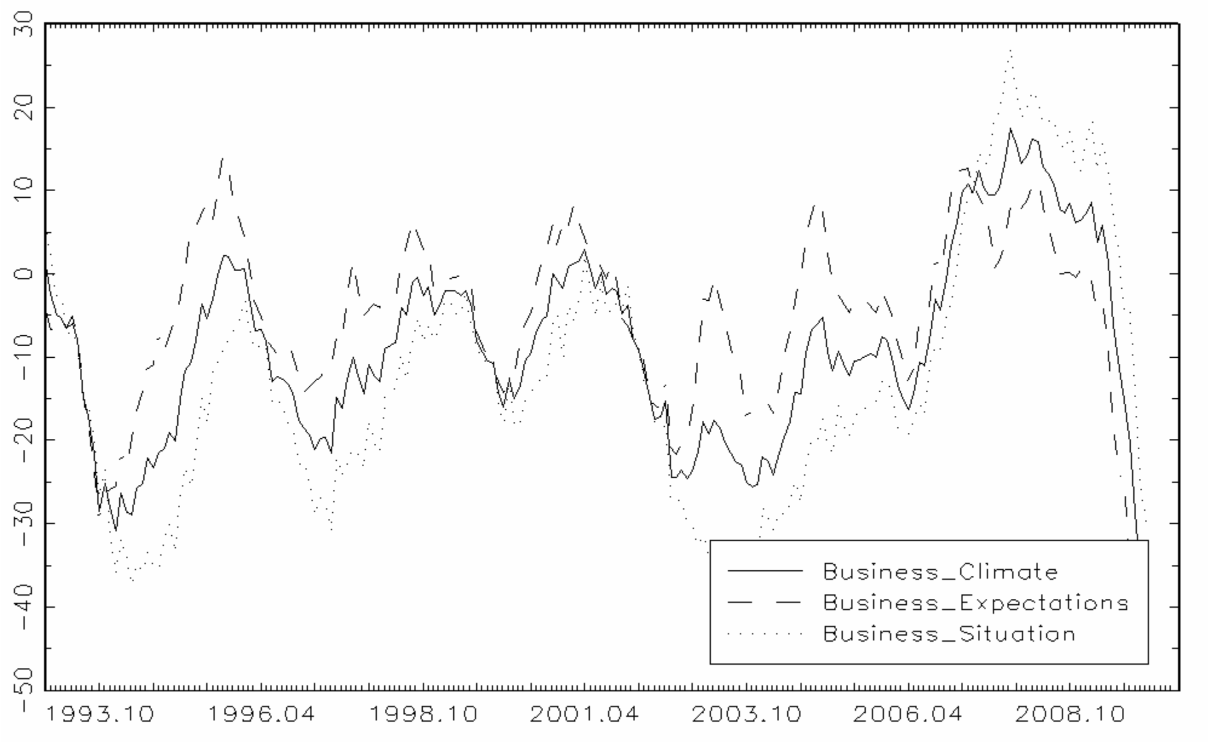
1 http://www.sentix.de/

2 http://www.ifo.de/

For my further analysis I choose the Ifo Business Expectations Index, because it is the most forward – looking index by the Ifo Institute as it is demonstrated in Chart 1. Peaks and troughs in the Ifo Business Expectations precede peaks and troughs in the Ifo Business Situation and in the Ifo Business Climate.

Chart 1:

Ifo indices



Source: http://www.ifo.de

3.2. ZEW Indicator of Economic Sentiment

ZEW Indicator of Economic sentiment is a monthly index that questions 350 financial analysts on their 6-months view of german economic development. The analysts are also asked about their expectations for Eurozone, Japan, Great Britain and the U.S., but my focus is the data for the german economy. ZEW began publishing the index in December 1991. The index represents difference between positive and negative answers on three-fold questions as the Ifo indices.

3.3. Purchasing Managers' Index

The Purchasing Managers' Index (abbr. PMI) is constructed for different countries in Europe, Asia and America.

The PMI surveys monthly two sectors separately: manufacturing and services. The manufacturing index is going to be used as Hüfner, Schröder (2002) did.

The manufacturing index for german economy started in April 1996 and is conducted by the Reuters agency and German association of purchasing and logistics managers. The index reflects answers of 400 members of the association – purchasing senior executives.

The indices are calculated as weighted average of three-fold answers (improve, no change, worsen in comparison with). The responses relate to a change in the economic environment in comparison with the previous. The answers are weighed by the size of the responding company. The average value of the index 50 points means no change, the index above 50 points indicates expansion and under 50 points signalizes recessionary environment.

The manufacturing index is composed of several subindices[1]:

Table 1:

Composition of the PMI manufacturing index

Subindicator	Weighs
New Orders Index	30%
Output Index	25%
Employment Index	20%
Suppliers' Delivery Times Index	15%
Stocks of Purchases Index	10%

The survey questions for the subindices are as follows[2]:

New Orders Index – "Please compare the level of new orders received this month with that of one month ago."

Output Index – "Please compare your production/output this month with the situation one month ago."

Employment Index – "Please compare the level of employment at your unit this month with the situation one month ago."

1,2 Source: http://www.markiteconomics.com

Suppliers' Delivery Times Index - “Please compare your suppliers' delivery times (volume weighted) this month with the situation one month ago. “
Stocks of Purchases Index - “Please compare your stocks of purchases (in units) this month with the situation one month ago. “

3.4. ESIN

The Economic Sentiment Indicator (ESIN) is conducted by the European Commission for the countries in the EU and the EU as a whole. The difference with the above mentioned indicators is that it aggregates business and consumer sentiment. The composition of the indicator is as follows[1]:

Table 2:

Composition of the Economic Sentiment Indicator

Subindicator	Weight
Industrial confidence indicator	40%
Service confidence indicator	30%
Consumer confidence indicator	20%
Retail trade confidence indicator	5%
Construction confidence indicator	5%

The industrial confidence indicator is composed of questions on current order books, stock of products and three-month outlook for production. The service survey asks on business development in the past three months and future three months. Consumers are questioned about financial situation, savings, general economic situation and employment in future 12 months time. The retail trade confidence indicator contains information about past and future business development (3-month horizon) and current volume of stocks. The construction confidence indicator is based on information about order books and development of employment over next three months.

1 Source: http://europa.eu

All the answers except those in the consumer survey are three-fold: improve/increase/more than sufficient; unchanged/sufficient; worsen/decrease/less than sufficient. The answers in the consumer survey are six-fold (i.e. increase sharply/++, increase slightly/+, remain the same/0, fall slightly/-, fall sharply/--, don't know). The subindices are calculated as a difference between positive and negative answers. In case of the consumer survey the formula of the index is:

$$B = (PP + \tfrac{1}{2}P) - (\tfrac{1}{2}M + MM),$$

where PP denotes increase sharply, P increase slightly, M decrease slightly and MM decrease sharply.

4. Economic Sentiment Indicators and Real Economy

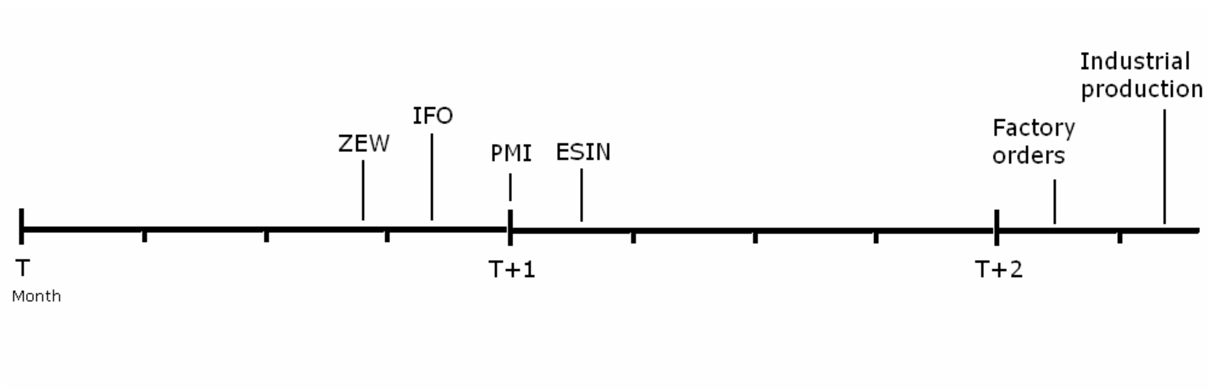
4.1. Publication of the Indicators

In this section I focus on the four indicators and their lead or lag structure as against the real economy in Germany. GDP is usually used as a reference statistics of the real economy, nevertheless GDP is published only once a quarter unlike the indicators. Therefore a monthly published industrial production or factory orders could be used, I use industrial production for the analysis.

The sentiment indicators in Germany are made public at least month before industrial production and factory orders. The publication schedule is shown in Figure 1:

Figure 1:

Publication schedule for month T



Source: Hüfner, Schröder (2002)

4.2. Data Characteristics

In following analysis of the indicators, their leading structure in relation with industrial production and predictive power I use data beginning with the year 1991, because of a structural change in german economy, when Germany was reunified. PMI manufacturing index started to be published in April 1996, nevertheless I use a serie that started in April 1999, because time serie for the whole period was not available. Data for industrial production originate from Deutsche Bundesbank and they are adjusted to yearly growth rates (starting in 1992). The reason for using yearly growth rates and not monthly growth rates of industrial production is that it delivers better results in statistical analysis, because monthly growth rates fluctuate and the movements can not be explained by the sentiment indicators. Some of the indicators are constructed to give information about a following period of 6 months, thus the yearly growth rates of industrial production perform better in statistical analysis. I plot each indicator against the production growth rates to get a first insight of a lead structure.

Chart 2

Ifo and production growth rate (indexed by mean 100)

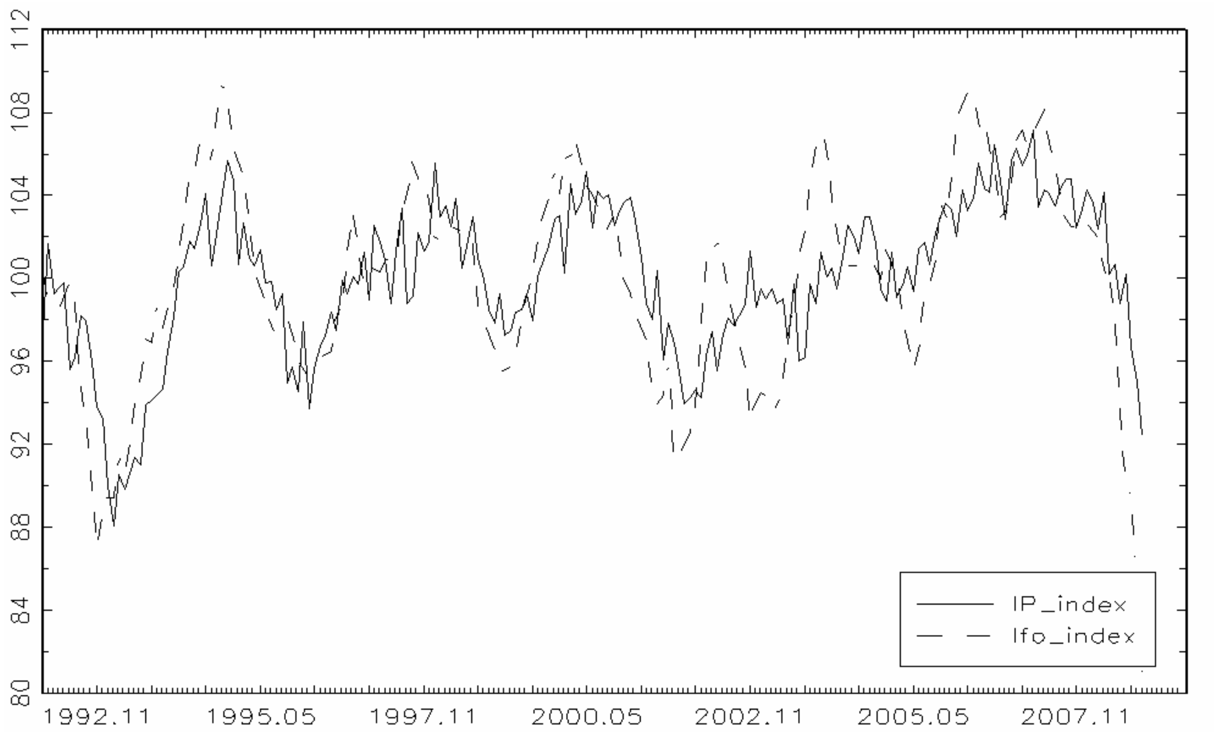


Chart 3

ZEW and production growth rate (indexed by mean 100)

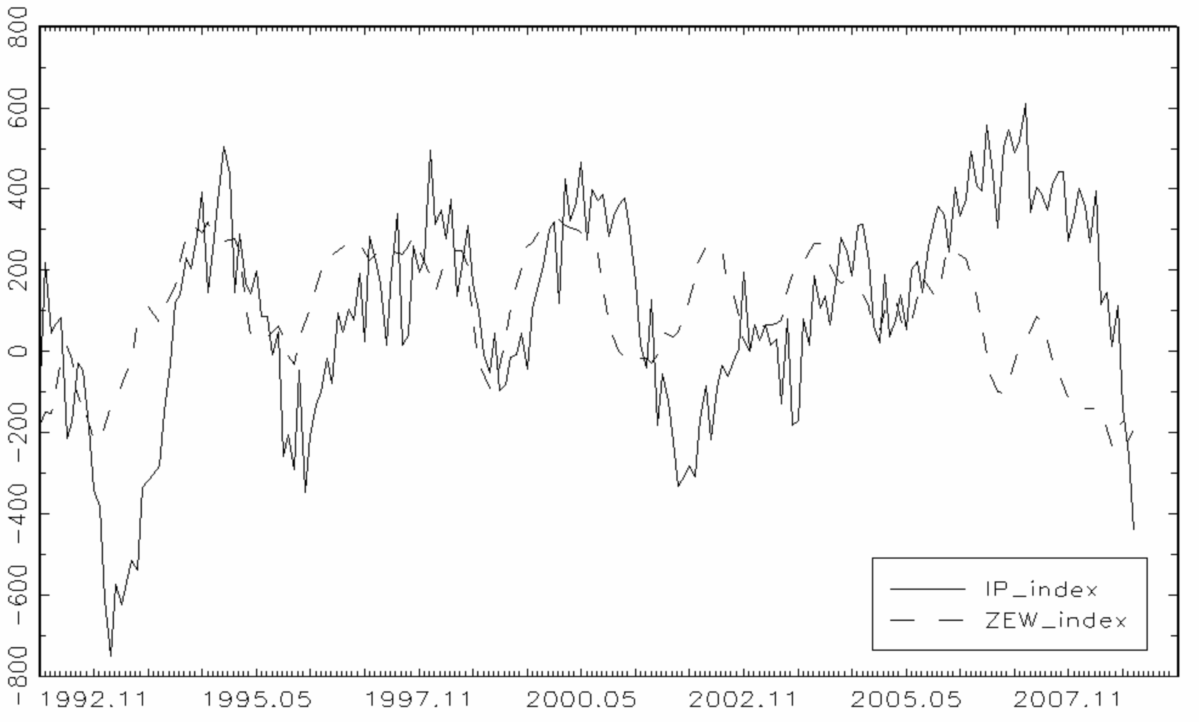
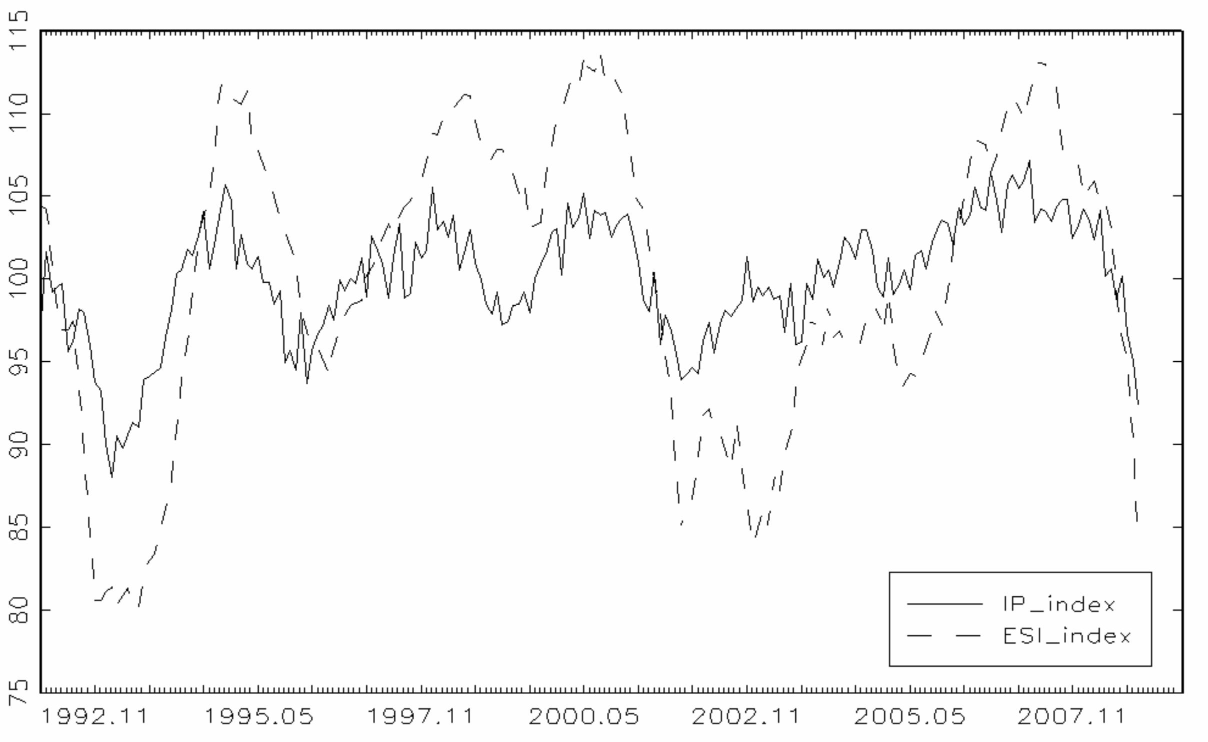


Chart 4

PMI and production growth rate (indexed by mean 100)

Chart 5

ESI and production growth rate (indexed by mean 100)



(Sources: see Internet references and data sources)

The graphical representation shows co-moving or even leading structure of the sentiment indicators. According to results in graphs it seems that the best performing indicator would be the ZEW Indicator of Economic Sentiment. Ifo business expectations could also have a certain lead over the yearly growth rate of industrial production. However, for deeper understanding further analysis is done.

4.3. Stationarity of the Data

I test stationarity of data time series in order to avoid "a spurious regression" in following analysis. The spurious regression means that the independent variable does not have to explain the dependent variable despite that the response variable is strongly correlated with a explanatory variable. There are two stationarity tests commonly used in statistics:
1) Augmented Dickey-Fuller (ADF) test and 2) KPSS test, I apply both tests.

Table 3

T- statistics of the Augmented Dickey-Fuller and KPSS test

	ADF	KPSS
Ifo	-3,915718	0,056027
ZEW	-3,593592	0,280765
PMI	-0,676336	0,294131
ESIN	-2,191990	0,081943
IP	-2,168806	0,486953

IP is the yearly growth rate of industrial production, ADF is the Augmented Dickey Fuller test using Schwarz criterion to determine number of lags, KPSS test was calculated by Barlett kernel using Newey-West bandwith.

Critical values of the ADF and KPSS statistics are:

Table 4

Critical values of the ADF and KPSS statistics

Significance	ADF	KPSS
1%	-3,460884	0,739000
5%	-2,874868	0,463000
10%	-2,573951	0,347000

The conclusion of stationarity tests is that all the series are stationary at significance level of 5 % using the KPSS test except growth rates of industrial production with significance of 1 %. The stationarity does not hold under the Augmented Dickey Fuller test at significance level of 10 % for the PMI, ESIN index and yearly growth rates of industrial production. The results are not unambigous, however the graphical representation shows no trend in the time series. The ADF test often under-rejects the null hypothesis of an unit root, therefore I consider only the results of the KPSS, as Hüfner, Schröder (2002) did. For further analysis I assume the time series are stationary.

4.4. Cross-Correlations

Analysis of the indicators begins with cross-correlations of yearly growth rates of industrial production and the indicators:

Table 3:

Cross-correlations between the yearly growth rate of industrial production and sentiment indicators

Lead	**Ifo**	**ZEW**	**PMI**	**ESIN**
-6	0,198868	-0,246196	0,262986	0,640474
-5	0,288804	-0,175002	0,308145	0,689199
-4	0,362387	-0,099352	0,344457	0,716640
-3	0,447622	-0,008046	0,392221	0,742835
-2	0,538121	0,091505	0,444773	0,756824
-1	0,630753	0,192875	0,513332	0,769718
0	0,732466	0,300009	0,593957	0,785367
1	0,760835	0,372679	0,561517	0,746359
2	0,757407	0,439654	0,532411	0,693765
3	0,738972	0,486886	0,501810	0,629508
4	0,715228	0,533630	0,485991	0,561727
5	0,671307	0,556847	0,489703	0,483607
6	0,610292	0,555445	0,443469	0,408879
7	0,552708	0,543435	0,410511	0,332283
8	0,496129	0,526119	0,396723	0,260688
9	0,420568	0,499397	0,383286	0,179939
10	0,341428	0,461775	0,363084	0,108556
11	0,254845	0,410023	0,337958	0,033326
12	0,172965	0,356371	0,310557	-0,036772

The highest correlation has been recorded between the ESIN and yearly growth rate of industrial production, nevertheless there has not been recorded a leading structure, since the highest correlation coefficient is found in time 0. The PMI and ESIN indices are co-moving indicators according to cross-correlation analysis.

The Ifo and ZEW indicator obviously lead the yearly growth rates of industrial production. The Ifo indicator has the highest correlation with a time lead of 1 and 2 months and the ZEW index with a time lead of 5 and 6 months. However, the Ifo correlation with the growth rates of production outperforms the correlation of the ZEW index with a time lead of 5 and 6 months, the break-even point of these two indices lies between the 7th and 8th month. This could imply that if both indicators lead the industrial production and were useful for prediction of production than the Ifo index would be preferably used in forecasts for shorter period and the ZEW index would perform better for more remote periods.

4.5. Granger Causality

Cross-correlation provided first statistical information about the lead structure of the sentiment indicators and growth rates of industrial production. Now I focus on the predictive power and causality in the sense of Granger causality.

Granger (1969) proposed a definition of causality in time series that can be tested by statistical methods. Granger suggested that a serie X causes a serie Y, if a variance of prediction based on all known information from past is lower than a variance of prediction based on all past information except past information in the serie X. All past information is then determined by past values of Y, what is a simplification that could lead to a false confirmation of causal relation. False confirmation of causality occurs, when there is some other force behind causing both series. However, in the case of sentiment indicators and industrial production I do not try to find economic forces in behind, I look for a indicator that leads and improves predictions of the industrial production.

Formal equation of Granger causality test is as follows:

$$Y_t = \alpha + \sum_{i=1}^{k} \beta i Y_{t-i} + \sum_{j=1}^{k} \gamma_j X_{t-j} + \varepsilon_t \quad (1)$$

In the equation (1) X causes Y, if all γ_j for $j = 1,\ldots,k$ are jointly significant.

Hüfner, Schröder (2001, 2002) modified equation (1) and used in their regression only one independent variable X with lag j and tested for hypothesis that X_{t-j} causes Y_t in the Granger causality sense. Equation (2) includes the modification:

$$Y_t = \alpha + \sum_{i=1}^{k} \beta i Y_{t-i} + \gamma_j X_{t-j} + \varepsilon_t \quad (2)$$

Theoretical background for testing, whether the economic sentiment indicators cause the growth rates of industrial production in the Granger causality sense, is now covered.

I use Akaike information criterium and exclusion test with Wald statistics to determine the maximal order of autoregression and significicant lags of the production growth rate in the equation (3):

(3) $$Y_t = \alpha + \sum_{i=1}^{k} \beta i Y_{t-i} + \varepsilon_t$$

The resulting significant lags are 1, 2, 12, 13 and R^2 in ordinary least square regression only with the significant lags is 84,6 %.

The Granger causality test is carried out according the equation (2) with results of t-statistics in the table 4. The null hypothesis is that a certain economic indicator with lag j (X_{t-j}) causes the growth rate of industrial production (Y_t). I use the Newey-West estimator for calculation of t-statistics because of heteroscedascity and autocorrelation.

Table 4

Granger causality test of the economic sentiment indicators and growth rates of industrial production

Lag	**Ifo**	**ZEW**	**PMI**	**ESIN**
1	5,466695***	3,155584***	4,916737***	2,852169***
2	4,326155***	2,959373***	2,543582**	2,152133**
3	3,797001***	2,761518***	0,811575	1,143782
4	3,414892***	2,632452***	0,211209	0,532422
5	2,470873**	2,462065**	-0,02645	-0,241539
6	0,542783	2,297077**	-0,793473	-0,591130
7	-0,089525	1,709384*	-0,696396	-1,285138
8	-0,460188	0,953989	-0,575155	-1,360265

Significance level: *** 1% ** 5 % * 10 %

The results of the test in the table 4 provide information about the lead structure of each indicator. The lead structure is consistent with the construction of the indicators. The Ifo and ZEW surveys ask the participants about six month horizon and the Granger test revealed that the Ifo index is signicant with maximal five month lead and the ZEW with seven month lead (at the significance level of 10 %). The PMI and ESIN has the maximal lead of 2 months consistent with the fact that the survey questions mostly concern the present conditions and future of three months.

4.6. Literature on the Sentiment Indicators and Industrial Production

Hüfner, Schröder (2002) used the same four indicators with data until 2002. Their results in comparison with mine showed that the ESIN index with a lead is not significant in explaining the industrial production and lags three periods using the cross-correlation. In my analysis the ESIN is co-moving indicator according to the cross-correlation and the indicator with lags one and two months is significant in the Granger causality test.

What is more important, Hüfner, Schröder (2002) investigated the Granger causality among the indicators or in other words they were testing, whether any of the indicators could predict any other indicator (using only the Ifo, PMI and ZEW). Their result was that the ZEW had one period lead over the Ifo and the PMI. Hüfner, Schröder (2001) compared forecasting qualities of vector autoregressive model with the Ifo and ZEW by root mean square error and Theil's U and concluded that over the period of 1994-2002 the Ifo performed better for forecast horizon of 1 month and the ZEW had lower root mean square error using the horizon of 3, 6, 9 and 12 months.

Hüfner, Schröder (2001) proved for the period January, 1994 – September, 2000 that it was helpful to combine forecasts of industrial production by the Ifo and ZEW with horizon of 3 and 6 months. For this purpose they used an encompassing test.

Savry, Broyer (2002) argued that neither the industrial production nor the factory orders explain the development of overall german real activity, therefore they use the quarterly GDP growth rates as an explained variable. However, they concluded the sentiment indicators perform better in forecasting the manufacturing sector.

5. Economic Sentiment Indicators, Real Economy and Stock Market

5.1. Stock Market

The stock market is closely followed by various market players ranging from households, professional investors, businesses to government and central bankers. The stock market is believed to reflect economic conditions of a certain country, it is viewed as a leading indicator of real economy measured by GDP or industrial production. However, there is evidence of stock market failures as a leading indicator. The most cited example is the year 1987 in the U.S., when the stock market indices plunged, although the GDP was growing until 1990s.

Traditional asset pricing theories describe the stock market by market expectations of foreseeable future. Market expectations include human factor and errors incurred by expectation inaccuracies of future development.

Advantage of the stock market in comparison with the GDP and industrial production is that it reacts to fundamental changes very quickly and there is some relation with the future through the expectations. The GDP is released quarterly, the industrial production every month and they reflect past economic development. Additional disadvantage of the GDP and industrial production is the delay caused by that the figures has to be collected, calculated and released. However, the GDP and industrial production are precise figures that include only negligible discrepancies.

The fact that the real economy and the stock market are related leads to a question, what is the direction of causal relation. Chen, Roll and Ross (1986) answered this question by saying: "No satisfactory theory would argue that the relation between financial markets and the macroeconomy is entirely in one direction." Real economy influences systemic risk that is being priced in stocks. Stock prices development determine consumption and investment.

5.2. Stock Pricing

According to basic asset pricing models the stock prices are calculated as discounted future free cash flows. For simplicity I consider the dividend discount model, where free cash flows are represented by dividends:

(4) $$P_0 = \sum_{i=1}^{T} \frac{CF_i}{k^i}$$

; where P_0 is a stock price, CF_i is an expected cash flow/dividend in time i and k is a discount factor.

Future cash flows are the main channel between the stock prices and real economic activity. Nevertheless, the asset pricing formula does not reveal clearly the causal direction, because the future cash flows are influenced by the future economic activity and cash flow deterioration can contribute to economic decline. In the following chapter I decribe theories on relation between stock returns and investment.

5.3. Stock Returns and Investment

This section is based on Morck, Shleifer and Vishny (1990).

Passive Informant Hypothesis

The first theory is called the passive informant hypothesis. This theory asserts that managers are not influenced by the stock market in their investment decisions, therefore the real activity is underlying factor determining the cash flows and subsequently the stock returns. The stock returns do not affect the real activity measured by the investment.

The passive informant hypothesis assummes that the managers have more information than the stock market includes. This theory is more relevant for stock return of a single company than for the whole stock market index.

Active Informant Hypothesis

The active informant hypothesis extends the previous theory by that the managers find useful information in the stock market. The stock market reflects expectations about future economic development and the managers utilize it when making investments.

The theory is then divided into two subhypothesis based on, whether the stock market predicts the investment accurately or not. The stock market includes imprecise expectations about economy, thus Morck, Shleifer and Vishny distinguish between the faulty informant and accurate informant hypothesis. The faulty informant hypothesis leads to investment decision with a bias that translate to overinvestment or underinvestment. The accurate informant hypothesis considers the stock market as an accurate predictor of economy.

The accurate informant theory applies to aggregate indices of the market or industries.

Financing Hypothesis

The financing hypothesis asserts that the stock market determines the cost of capital for a company. Firms have limited possibility to raise debt to finance investment projects, thus the price of equity plays a key role in investment decisions. When investor sentiment allows for overvalued or undervalued stocks, then the equity financing is either cheap or expensive. Companies that maximize profits look for the opportunity to expand investment with lower cost of capital in order to improve profitability. This hypothesis is based on Tobin's q theory that compares market value of the company and replacement cost of capital.

Stock Market Pressure Hypothesis

The stock market pressure hypothesis focuses on effects of undervalued company on investment constraints. The danger of being fired or taken over forces the manangers to be more conservative. New profitable projects with long horizon are rejected and intiated projects are disinvested. The managers accept only opportunities with quick return.

Although the stock market and the real economy are related in both directions according to the previous theories, I assume that the future economic development is reflected in stock market development and separate only the one-way causality. I follow the approach of Chen, Roll and Ross (1986).

5.4. Empirical Evidence on Stock Market and Output Correlation

Fama (1990) tested relation between production growth and stock returns on U.S. data from 1953 to 1987. He regressed the stock returns on the future production growth and found out that R^2 reached 43 %. The most important conclusion was that R^2 rises with increasing period of stock returns and production growth, thus regressing monthly stock returns on monthly production growth delivers lower R^2 than regression with yearly returns and production growth. However, Fama noticed that with increasing period R^2 does not approach 100 % and the variation in the production growth can explain only partially variation in stock returns.

Chen, Roll and Ross (1987) built multifactor model to describe stock returns and used rather the yearly production growth than the monthly growth. They found out that the industrial production and other macroeconomic variables are significant in explaining stock returns. Chen, Roll and Ross admit that lagged stock returns predict macroeconomic variables and therefore they use lagged returns to determine the expected returns.

Mauro (2000) compared regression results of real GDP growth on its lagged values and lagged stock returns for advanced and emerging economies. Mauro tried to separate countries with strong relation between output growth and stock returns and identified following factors that determine the strength of the relation: market capitalization, origin of legal system (English/non-French or other) and number of public offerings. According to Mauro's regressions the link between output growth and stock returns is strong in the U.S. and Great Britain, however in Germany the link is weak.

5.5. Cross-correlation of Stock Returns and Production Growth Rates

I run a simple cross-correlation of stock returns and the growth rates of industrial production in Germany to get a picture about the strength of relation between the two series. The production growth rates are the same as I used above. The stock returns is a monthly serie of yearly stock market growth rates and as a stock market proxy variable I choose DAX 30. The stock market index DAX 30 is observed at the close of last day in a certain month.

At first, the new serie stock returns have to be tested for stationarity. The Augmented Dickey Fuller test does not reject unit root at 10 % significance level, although the KPSS test does not reject the stationarity at 10 % significance level. I consider the serie stationary assuming that the KPSS test is more reliable than the Augmented Dickey Fuller test, because it might overeject the stationarity.

After confirming the stationarity the cross-correlation is performed:

Table 5

Cross-correlation between the DAX 30 stock returns and production growth rate

Lag	Cross-correlation
9	0,392005
8	0,440414
7	0,480665
6	0,507919
5	0,524312
4	0,525171
3	0,512676
2	0,491362
1	0,453811
0	0,422385
-1	0,334696

Cross-correlation revealed that the stock return lead the production growth rate by 4 or 5 months. The lag structure of the production growth rate in relation with the stock returns provides information about lead structure of the economic sentiment indicators over the stock returns. On the basis of the cross-correlation results the PMI and ESIN indices can be excluded from analysis of predictive power for stock market, because these indices are co-moving with the industrial production and only two month lags of the indices are significant for the production growth prediction.

5.6. Economic Sentiment Indicators and Stock Returns

Heathcotte and Apilado (1974) proposed a simple idea. They chose NBER's indicators that lead the real economy by longer period than the real economy lags the stock market to predict stock returns. However, the idea justifies the usage of the indicators only from the statistical point of view.

Theoretical rationale for the relation between economic sentiment indicators and stock returns is indirect. Economic sentiment indicators help to predict industrial production beacause of the reasons that were proposed by Leuuw (see chapter Theoretical rationale). And future development of production influences future cash flows that determine the stock returns. This indirect relation can be expressed by two regressions (5) and (6):

(5) $$Y_t = \alpha + \sum_{i=1}^{n} \beta i \, I_{t-i} + \varepsilon_t$$

, where Y is the yearly production growth, I is the value of a certain indicator and ε is an error term.

(6) $$R_t = \gamma + \sum_{j=1}^{k} \delta_j \, Y_{t+j} + \eta_t$$

, where R is the yearly stock return, Y is the yearly production growth and η is an error term. When the yearly production growth in equation (6) is substituted with the expression of the production growth in equation (5), the result is a equation, where stock returns depend only on the values of indicator:

(7) $$R_t = \mu + \sum_{l=-n+1}^{k-1} \theta_j \, I_{t+l} + \nu_t$$

There are three drawbacks that are needed to be considered in this specific case of Germany when applying the indirect relation.

At first, the relation between the production growth and stock returns in equtation (6) could be weak and the future production growth does not have to be the only explanatory variable for the stock returns. The R^2 from regression of the stock returns on the future production growth in Germany is 31,8 %.

At second, the error term in the equation (7) is higher than the error term in the equation (6). Thus the indicator explains lower part of stock returns variation in comparison with the future production growth.

At third, the stock returns in the equation (7) are expressed as linear combination of future and past values of the indicator. In order to analyse the predictive power of the indicator for the stock returns, I consider only past values of the indicator, because it has to have a leading structure. By omitting the future values of the indicator in the regression the explanatory variables lose part of variation and this could decrease the regression quality.

5.7. Analysis of Sentiment Indicators Lead Structure over Stock Returns

Firstly, the sentiment indicator series are plotted against the yearly DAX 30 returns.

Chart 6

Yearly DAX 30 returns and Ifo business expectations

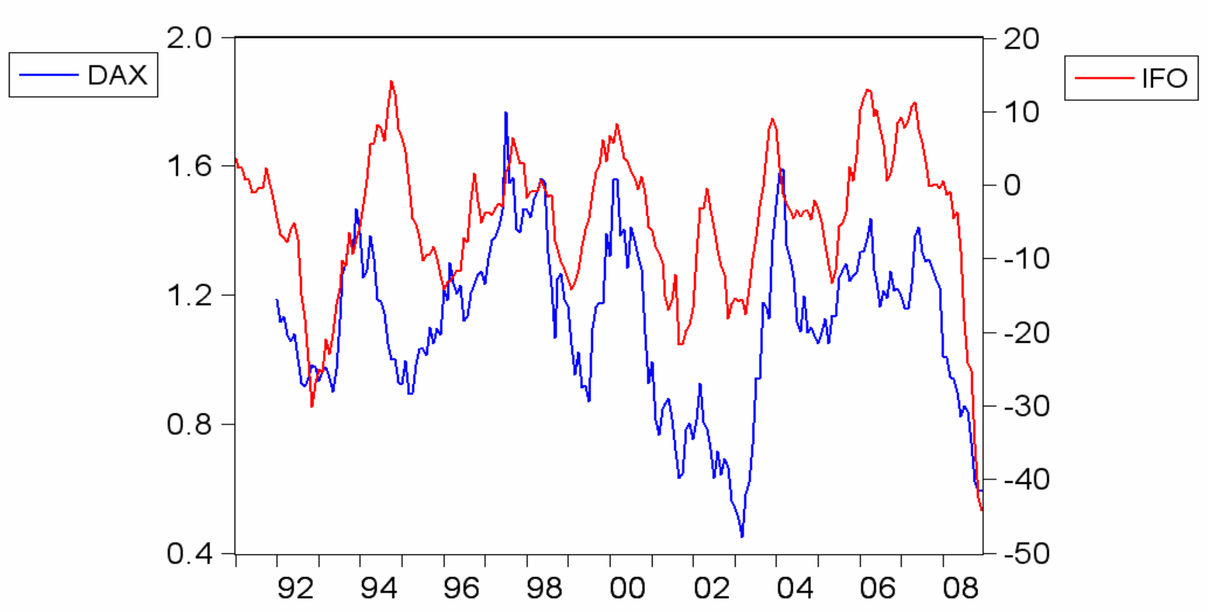
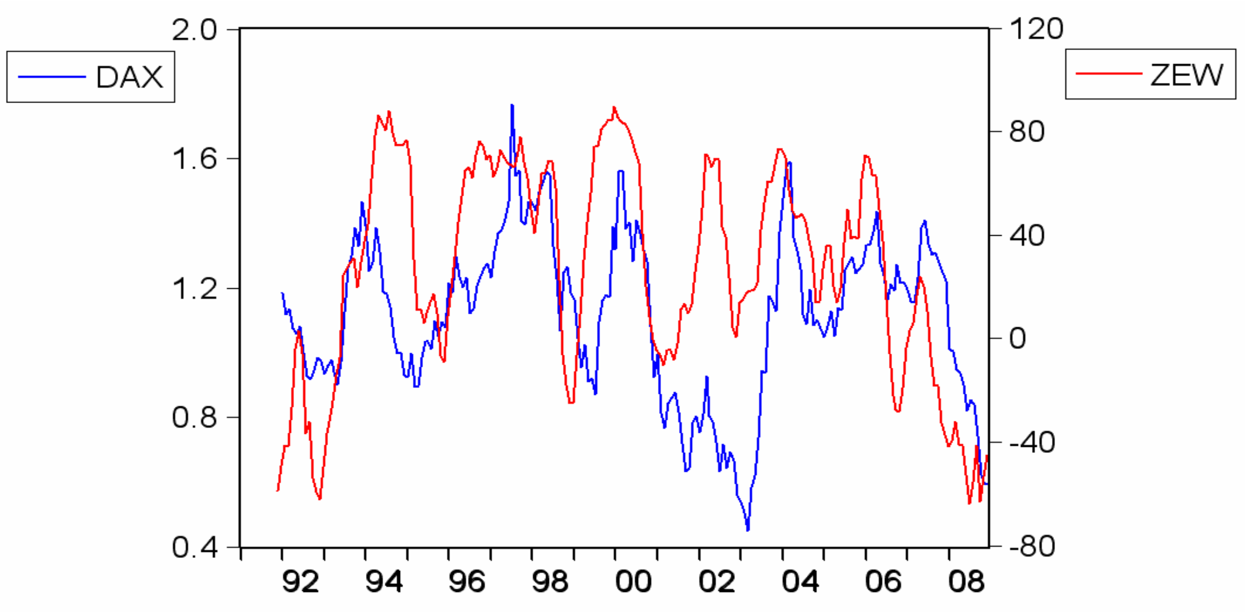


Chart 7

Yearly DAX 30 returns and ZEW Indicator of Economic Sentiment



Both charts 6 and 7 show that the indicators are not considerably leading or lagging, they are more or less co-moving. The ZEW and also the Ifo indicator clearly lead the DAX returns in period 2007-2009, although the ZEW and Ifo peaks in 1994 are both lagging the DAX. Chart 2 and 3 reveal that the Ifo and ZEW lead period in relation with the industrial production growth has narrowed in 1994.

Next step is cross-correlation analysis:

Table 6

Cross-correlation between the stock returns and sentiment indicators

Lead	Ifo	ZEW
-4	0,478011	0,210474
-3	0,526869	0,277252
-2	0,570198	0,334920
-1	0,599161	0,394019
0	0,609327	0,437418
1	0,557628	0,448226
2	0,495999	0,445942
3	0,431065	0,431742

According to cross-correlation analysis the Ifo index is co-moving with the DAX returns and the ZEW has a time lead of one month over the DAX. The correlation values are surprisingly high, especially the Ifo index has a higher correlation coefficient than the production growth does (table 5).

Subsequently, the Granger causality test is performed to find out, whether the Ifo or ZEW with a time lead over the DAX returns improve the DAX autoregressive model. The DAX autoregression model is estimated and the significant lags 1,12 and 13 are result of lag length optimalization using the Akaike information criterium and the Wald test that excludes insignificant lags. The Granger causality from the equation 2 is estimated by the OLS using the White estimator because of heteroscedascity:

Table 7

Granger causality test of the economic sentiment indicators and stock returns

Lag	**Ifo**	**ZEW**
0	2.731521***	2,419459**
1	1,503246	1,678854*
2	0,89917	1,458724
3	0,013544	1,07752
4	-0,663275	0,783803

Significance level: *** 1% ** 5 % * 10 %

I included test of indicators that does not lag the DAX returns, because the indicators are published before the end of month (see Figure 1) and the DAX values are observed at the last day of month. The Granger causality test shows that the Ifo indicator is not significantly leading and the ZEW is weakly significant with one month lead. The series with no lag are very significant and thus the indicators appear to be more or less co-moving with the DAX returns.

Why is the significance of the ZEW with one month lead so low and the Ifo does not improve the DAX predicion at all (considering the leading time series) despite that the charts show leading patterns in some parts of the time frame?

5.8. Stability of the Ifo and ZEW in relation with the DAX Returns

Charts 6 and 7 comparing the Ifo and ZEW with the DAX returns raised suspicion that in the certain part of the observed time frame the indicators clearly lead the DAX and in the other period the indicators are lagging and do not have a predictive power. The indicators probably do not lead the DAX in the first half of the time frame and in the second half they have a significant lead according to the charts. I divide the time period January/1992 - December/2008 into two subperiods January/1992 - June/2000 and July/2000 - December/2008 and test the Granger causality as in table 7 (also using the White estimator) separately for each subperiod:

Table 8

Granger causality test of the indicators and stock returns: 1/1992-6/2000

Lag	**Ifo**	**ZEW**
0	0,651444	1,079613
1	0,122743	0,790583
2	0,227884	1,218448
3	0,140648	1,463527
4	0,070183	1,372103

Significance level: *** 1% ** 5 % * 10 %

Table 9

Granger causality test of the indicators and stock returns: 7/2000-12/2008

Lag	**Ifo**	**ZEW**
0	3,297772***	2,549782**
1	2,416862**	1,714499*
2	1,668385*	1,047248
3	0,612014	0,274367
4	-0,40759	0,051737

Significance level: *** 1% ** 5 % * 10 %

The Ifo and ZEW indicaors are useless for predictions of the DAX returns in the first subperiod January/1992 - June/2000, however in the second period July/2000 - December/2008 the Ifo significance substantially increased for no lag, one month lag and even for the two month lag. The ZEW significance in the second subperiod does not substantially vary from the significance using the whole period.

I test for a coefficient stability of the Ifo and ZEW variables in two regressions:

1. the DAX returns regressed on the DAX returns with lags 1, 12 and 13 and the indicator (ZEW or Ifo) with one month lag

2. the DAX returns regressed on the DAX returns with lags 1, 12 and 13 and the indicator (ZEW or Ifo) with no lag and with one month lag

I use the Wald statistic and not the Chow breakpoint statistic to test the coefficient stability, because the Chow test assummes that the variances of disturbances in both subperiods are the same and it is not true in this case, since the regression has heteroscedastic disturbances:

(8) $$W = (b_1 - b_2)^T (V_1 + V_2)^{-1} (b_1 - b_2)$$

, where b_1 and b_2 are the estimates of the regression coefficients in the subperiod 1 and 2, V_1 and V_2 are covariance matrices of the regression coefficients in the subperiods and ^{T} is a transposition. The Wald statistic has an χ^2 asymptotic distribution with degrees of freedom equal to the number of the estimated regression coefficients. The null hypothesis of the Wald test is that there are no breakpoints and the regression coefficients are stable over the whole sample period.

In order to test the coefficient stability of the sentiment indicators I have to specify a breakpoint that divides the two subperiods. For this purpose the Wald statistic is maximized on the sample trimmed by 15 % observations from the beginning and the end of the serie. The resulting breakpoint for the regression 1. and 2. with the Ifo index is December/1998. The breakpoint for the regression 1. with the ZEW indicator is September/1996 and for the regression 2. August/1996.

Now the Wald test with estimated breakpoints is performed. The Wald statistic in the regression 1. with the Ifo is 12,01 and in the regression 2 the statistic is 10,76, therefore the coefficients of the Ifo are not stable in both cases at the significance level of 1 %. The Wald statistic in the regression 1. with the ZEW indicator is 3,30 and in the regression 2 the statistic for the two coefficients is 5,77; thus the particular coefficients are stable in both regressions at 5 % significance level.

Why is the Ifo index unstable in relation with the stock market returns and the ZEW is not? Is the instability caused by methodological adaptation of the Ifo index to the german reunification, because the Ifo was published only for the west Germany before the year 1990 (the ZEW started to be published in December 1991)? Could this transition period in the Ifo last until 1998 or have the expetations of significantly improved after the year 1998?

5.9. Forecast Accuracy

In this section I focus on an out-of-sample forecast accuracy that can differ from in-sample analysis. For this purpose vector autoregression is employed. Vector autoregression of the DAX returns and the economic sentiment indicator is then compared with autoregression of the DAX returns. The vector regression is defined by two equations (9) as follows:

(9)
$$R_t = \alpha + \sum_{i=1}^{n} \beta_i R_{t-i} + \sum_{j=1}^{n} \gamma_j I_{t-j} + \varepsilon_t$$

$$I_t = \delta + \sum_{k=1}^{n} \theta_k I_{t-k} + \sum_{l=1}^{n} \varphi_l R_{t-l} + \nu_t$$

, where R are the DAX returns, I is a value of sentiment indicator (either the ZEW or Ifo).

Number of lags n in the vector autoregressions has to be determined. Two lags minimize the Akaike, Schwarz and Hannah-Quinn criteria in the vector autoregression of the stock returns and ZEW. The vector autoregression of the DAX returns and Ifo with two lags minimizes only the Schwarz and Hannah-Quinn criteria, the Akaike crriterion is minimal using higher order of vector autoregression. The Autoregression of the DAX returns was defined in chapter 5.7. I use 2 lags for the three regressions, although the DAX autoregression has the lowest Akaike, Schwarz and Hannah-Quinn criteria, when 13 lags are included.

The out-of-sample forecast accuracy of the three models is compared on the basis of root mean square error (RMSE) and Theil's U. Theil's U is defined as RMSE of vector autoregression forecast divided by RMSE of the DAX autoregression forecast (considered as a naive forecast). The forecasts are performed for n steps ahead (n is ranging from 1 to 8). Forecast n steps ahead is a estimate of a prediction for time t+n taking into account information in time t. Forecasts 1,2,3,…,n-1 are calculated at first in order to make prediction n step ahead.

Table 10

Out-of-sample forecast comparison for the period 4/1995-12/2008

number of steps	**AR(2)**	**VAR(2) - ZEW**		**VAR(2) - Ifo**	
ahead - n	RMSE	RMSE	Theil's U	RMSE	Theil's U
1	0,094444	0,093164	98,64%	0,095329	100,94%
2	0,131435	0,128680	97,90%	0,134249	102,14%
3	0,167212	0,163826	97,97%	0,170647	102,05%
4	0,204959	0,197503	96,36%	0,201546	98,33%
5	0,231856	0,222211	95,84%	0,221159	95,39%
6	0,257856	0,257180	99,74%	0,244043	94,64%
7	0,305816	0,315165	103,06%	0,275500	90,09%
8	0,347510	0,407632	117,30%	0,312332	89,88%
9	0,407668	0,612255	150,18%	0,392374	96,25%
10	0,502647	0,923030	183,63%	0,478687	95,23%
11	0,582067	1,526784	262,30%	0,675192	116,00%
12	0,740258	2,491676	336,60%	0,949130	128,22%

AR(2) stands for the DAX autoregression, VAR(2) – ZEW is the vector autoregression of the DAX returns and the ZEW and VAR(2) – Ifo is the vector autoregression of the DAX returns and the Ifo. The vector autoregression of the DAX and ZEW forecasts the DAX returns with the best precision for lower number of months according to RMSE comparison. The Theil's U for the ZEW vector autoregression is the lowest for five month ahead forecast. On the other hand the vector regression of the Ifo and DAX reached significantly lower Theil's U for eight month ahead forecast and outperforms the other two forecasts in the horizon of four to nine months. Can we draw conclusion that one forecast is significantly more accurate from the statistical point of view than any other based only on comparison of RMSE?

Diebold and Mariano (1995) described a statistic that asymptotically tests, whether there is a difference between RMSE of two n step ahead forecasts. However, Harvey, Leybourne and Newbold (1995) made a correction to the Diebold and Mariano statistic dealing with problem of over-sizing with increasing number of steps ahead in forecast. The null hypothesis of the test is no difference between RMSE of two forecasts, the Diebold and

Mariano statistic has asymptotically Student's t distribution and is described in the Appendix. I apply this test to recognize, whether the vector autoregressions predict the DAX returns more accurately than the DAX autoregression.

Table 11

Modified Diebold and Mariano test

number of steps ahead - n	AR(2) vs. VAR(2) - ZEW	AR(2) vs. VAR(2) - Ifo
1	-0,374023	1,010382
2	-0,344884	1,095550
3	-0,232040	1,003455
4	-0,412699	-0,704039
5	-0,428426	-1,615730
6	-0,025606	-1,580675
7	0,369859	-2,087362**
8	1,649915	-1,948095*
9	3,710982***	-0,785223
10	3,939469***	-0,692848
11	4,189374***	1,754234*
12	4,510982***	2,456090**

Significance level: *** 1% ** 5 % * 10 %

Table 11 revealed that the ZEW indicator did not predict the DAX returns with significantly lower RMSE in comparison with the autoregression of the DAX. The significant t-values in the AR(2) vs. VAR(2) – ZEW column prove that the forecast by the DAX autoregression has lower RMSE than by the ZEW vector autoregression. The RMSE of the forecast with 7 and 8 steps ahead by the Ifo vector autoregression is statistically lower than the RMSE of the forecast by the autoregression and the prediction for 11 and 12 steps ahead by the DAX autoregression has lower RMSE than by the Ifo vector autoregression according to the Modified Diebold and Mariano test.

6. Conclusion

Recapitulating the whole idea of the bachelor thesis, I start with theoretical background of leading indicators and economic surveys. The economic sentiment indicators in Germany are briefly introduced and described. Then I test the significance of the indicators for predicting the german industrial production. The results of the Granger causality test are very similar with the results of Hüfner and Schröder (2002), who performed the test for the period of Janury 1992 – March 2002 except the PMI index that started to be published in April 1996. I test the data for the Granger causality in the period of January 1992 – December 2008 except the PMI index starting in April 1999 and conclude that the Ifo index leads the industrial production even by 5 months, the ZEW index by 7 months and the ESIN and PMI lead the production by 2 months. The results of Hüfner and Schröder differ only in that they did not find the ESIN indicator with a lead significantly Granger causing the industrial production.

I continue with description of the stock market and refer to literature proving that the stock returns are influenced by the macroeconomic conditions. The industrial production is considered as one of the measures of macroeconomic conditions, therefore I proceed with indirect relation between the economic sentiment indicators and stock returns. After checking the cross-correlation between the production growth and stock market returns (using the index DAX 30 as a proxy) I dismiss the PMI and ESIN for further analysis, because they are leading the production growth only by 2 months and the production growth is lagging the stock returns by 4 months according to the cross-correlation.

The analysis of the relation between the Ifo and ZEW indices and the stock returns begins with the Granger causality test. The ZEW is weakly significant in predicting the stock returns over the whole period of January 1992 – December 2008 and the Ifo index is insignificant. However, deeper look into graphs reveals that in the first half of the period the indicators are probably lagging the stock returns and in the second half of the period the indicators are leading. Wald statistic confirmed the instability of regression coefficients only in case of model with lagged stock returns and lagged Ifo values, nevertheless the Granger causality test for the first half of the period shows that both indicators are insignificant in predicting the stock returns and in the second half of the period the Ifo becomes significant and t-values of the ZEW increase in the Granger causality test.

The last part of the bachelor thesis is devoted to testing the out-of-sample forecasting accuracy. I build two vector autoregression models of each indicator and the stock returns. Then I compare forecasts accuracy of the two vector autoregressions with prediction accuracy of the stock returns autoregression that is considered as naive forecast. According to root mean square error of the forecasts the ZEW indicator predicts the stock returns better than the sole lagged DAX values for horizon of 1 to 6 months and the Ifo forecasts more accurately for horizon of 4 to 10 months. After applying Modified Diebold and Mariano test for the difference between root mean square errors of two forecasts, I conclude that only the forecast by the Ifo indicator has significantly lower root mean square error for horizon of 7 and 8 months.

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- http://www.markiteconomics.com
- http://www.zew.de – the ZEW index

A. Appendix

A.1. Modified Diebold and Mariano Test

Let us have two n step ahead forecasts $\left\{y^1_{t+n|t}\right\}_{t=1}^{T}$ and $\left\{y^2_{t+n|t}\right\}_{t=1}^{T}$ and corresponding errors $\left\{e^1_{t+n|t}\right\}_{t=1}^{T}$ and $\left\{e^2_{t+n|t}\right\}_{t=1}^{T}$ that are defined as a difference between the forecast and an original serie $\left\{y_t\right\}_{t=1}^{T}$. Then we define a loss function $L\left(y_{t+h};\hat{y}^i_{t+h|t}\right)$; i = 1, 2. The loss function squares the difference between the original serie and the i-th forecast, therefore it the loss function can be re-written as $L\left(\hat{e}^i_{t+h|t}\right)$; i = 1, 2. The null hypothesis of the Diebold Mariano test is H$_0$: $E\left[L\left(\hat{e}^1_{t+h|t}\right)\right] = E\left[L\left(\hat{e}^2_{t+h|t}\right)\right]$

against alternative H$_1$: $E\left[L\left(\hat{e}^1_{t+h|t}\right)\right] \neq E\left[L\left(\hat{e}^2_{t+h|t}\right)\right]$.

A statistic $\left\{d_t\right\}_{t=1}^{T}$ defined as difference between $L\left(\hat{e}^1_{t+h|t}\right)$ and $L\left(\hat{e}^2_{t+h|t}\right)$ equals to zero under the null hypothesis and the mean value of the statistic $\bar{d}$ has asymptotically normal distribution: $\sqrt{T}\left(\bar{d}-\mu\right) \rightarrow N\left(0;\omega^2\right)$, when the serie of loss function differences is covariance stationary and a short memory process. Diebold and Mariano proposed following asymptotical variance estimator: $\hat{\omega}^2 = T^{-1}\left(\gamma_0 + 2\sum_{k=1}^{n-1}\gamma_k\right)$, where T is number of observations, n is number of steps ahead in forecast, γ_k is k-th autocovariance and the estimator of the k-th autocovariance is $\hat{\gamma}_k = T^{-1}\sum_{t=k+1}^{m}\left(d_t-\bar{d}\right)\left(d_{t-k}-\bar{d}\right)$. Harvey, Leybourne and Newbold sugested a modified test statistic: $S_2 = \left(\frac{T+1-2n+T^{-1}n(n-1)}{T}\right)^{1/2} S_1$, where S$_2$ is the Harvey, Leybourne and Newbold test statistic; S$_1$ is the Diebold and Mariano statistic; T is number of observations and n is number of steps ahead in forecast. The Harvey, Leybourne and Newbold test statistic has the Student's t distribution with T-1 degrees of freedom.

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Akademický rok 2008/2009

TEZE BAKALÁŘSKÉ PRÁCE

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Garant studijního programu Vám dle zákona č. 111/1998 Sb. o vysokých školách a Studijního a zkušebního řádu UK v Praze určuje následující bakalářskou práci

Předpokládaný název BP:

The business cycle indicators in Germany and their predictive power for the stock market

Charakteristika tématu, současný stav poznání, případné zvláštní metody zpracování tématu:

Some of the economic sentiment indicators in Germany appear to forecast business cycle in Germany very well (Hüfner/Schröder – 2002). My question would be, whether these indicators could also help to forecast the development on the stock exhange. The aim of the bachelor theses will be to provide a theoretical background for a possible relation in the movements of the economic sentiment indicators and the stock market, the link between the stock market and these indicators should be the real economy. I have not found any literature concerning exactly this issue and therefore the theoretical background will be important.
My expectation is that there is some relationship between the sentiment indicators and the development on the stock market, but this relationship is too weak to make conclusion about the stock market solely on the basis of the indicators. Hence, I will try to use the indicator (one of them, that has the strongest predictive power) in connection with one or a set of stock market preindicators (i.e. interest rates development) and I will try to find out, if the sentiment indicator can somehow improve a predictive power of the system of the stock market preindicators.

Struktura BP:

Seznam základních pramenů a odborné literatury:

Reilly, Fank K.;Brown, Keith C. (2003): Investment analysis and portfolio management, South-Western/Thomson Learning

Tsay, Ruey S. (2005): Analysis of financial time series, Hoboken, NJ : Wiley-Interscience

Hüfner, Felix P.; Schröder, Michael (2002): Forecasting Economic Activity in Germany – How Useful are Sentiment Indicators?, ZEW – Centre for European Economic Research

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