

Döpke, Jörg

**Working Paper — Digitized Version**

## Leading indicators for Euroland's business cycle

Kiel Working Paper, No. 886

**Provided in Cooperation with:**

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

*Suggested Citation:* Döpke, Jörg (1998) : Leading indicators for Euroland's business cycle, Kiel Working Paper, No. 886, Kiel Institute of World Economics (IfW), Kiel

This Version is available at:

<https://hdl.handle.net/10419/46875>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Kieler Arbeitspapiere

# Kiel Working Papers

Kiel Working Paper No. 886

## **Leading Indicators for Euroland's Business Cycle**

by

Jörg Döpke



Institut für Weltwirtschaft an der Universität Kiel  
The Kiel Institute of World Economics

ISSN 0342 - 0787

Kiel Institute of World Economics  
Düsternbrooker Weg 120, D-24105 Kiel

Kiel Working Paper No. 886

**Leading Indicators for Euroland's  
Business Cycle**

by

Jörg Döpke

86575A

October 1998

The author himself, not the Kiel Institute of World Economics, is responsible for the contents and distribution of Kiel Working Papers. Since the series involves manuscripts in a preliminary form, interested readers are requested to direct criticisms and suggestions directly to the author and to clear quotations with him.

Dr. Jörg Döpke  
Kiel Institute of World Economics  
Düsternbrooker Weg 120  
D- 24105 Kiel  
Phone: (0)49-431-8814-261  
Fax: (0)49-431-8814-525  
Email: j.doepke@ifw.uni-kiel.de

## **Abstract**

The paper investigates a set of possible leading indicators for Euroland's business cycle using aggregated quarterly data. The theoretical plausibility, the behavior at business cycle turning points and the mean leads are analyzed. Furthermore, evidence from cross-correlations and Granger-causality tests is presented. Taking all evidence together, real monetary aggregates, nominal interest rates and the interest rate spread are recommended as leading indicators, whereas survey data on order inflow and production expectations are the best coincident indicators.

**Keywords:** Business Cycle, Leading Indicator, European Monetary Union

**JEL-Classification:** E32

## Contents

1. Introduction .....	1
2. Measuring the Business Cycle and Dating the Turning Points .....	1
3. The Time Series Under Investigation .....	3
4. Evidence from Cross Correlations .....	7
5. Testing on Granger-Non-Causality .....	17
6. Out-of-sample Performance .....	19
7. Conclusion .....	22
Appendix: Sources and Methods of Aggregation .....	23
References .....	25

### Tables

Table 1: Summary Descriptive Statistics and Information for the Possible Leading Indicators .....	6
Table 2: Cross Correlations Based on Changes Over Previous Year .....	13
Table 3: Cross Correlations Based Trend Deviations .....	14
Table 4: Cross Correlations Based on Changes Over Previous Quarter .....	15
Table 5: Test on Granger-Non-Causality for Selected Leading Indicator Variables .....	18
Table 6: Out-of-sample-Performance of Indicators .....	21

### Figures

Figure 1: Outputgap in Euroland .....	2
Figure 2: Turning point Analysis: Monetary Aggregates .....	8
Figure 3: Turning Point Analysis: Interest rates .....	9
Figure 4: Turning Point Analysis: Exchange Rates and Raw Material Prices .....	10
Figure 5: Turning Point Analysis: Leading indicator, Survey Data and Share Prices .....	11
Figure 6: Survey Data and Sentiment Indicators .....	12

## 1. Introduction<sup>1</sup>

After the start of EMU, there will be an increasing need to forecast Euroland's business cycle. Hence, some leading indicators would be useful. This paper investigates the indicator properties of a set of selected time series. Therefore, aggregated data for Euroland are used.

## 2. Measuring the Business Cycle and Dating the Turning Points

To evaluate any indicator one has to define and measure the reference cycle. Hence, it has to be decided, whether to use real GDP as a reference variable or - as is often done in the literature - production in industry or manufacturing. Although the industrial sectors are the most cyclical sectors according to a number of studies, here real GDP is chosen because a broader defined time series is likely to be less sensitive to varying sector definitions and to data revisions within the member countries. Furthermore, it has been argued that the results of an evaluation of business cycle variables might depend crucially on the method of detrending (Fabova 1998, Tichy 1994). To produce results which are robust to changes in the data transformation the analysis will be done for first differences, changes over previous year and deviations from trend, respectively. Concerning the latter, deviations from a Hodrick-Prescott-filter-trend are used. The smoothing parameter is set to the "industrial standard" for quarterly data, i.e. 1600.

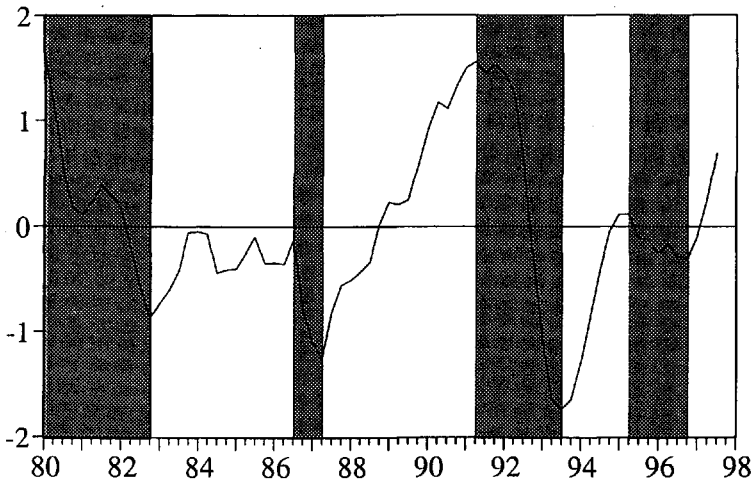
Figure 1 allows a first preliminary look at the business cycle in Euroland as measured by deviations from a Hodrick-Prescott-filter-trend. The recession in 1982 looks a little bit less pronounced than in some single countries. The main reason is the French economic experiment which led to a diverging development during this time. We have a minor downswing beginning in 1986. Compared to the 1982 recession it looks quite deep. But since it is much shorter than

---

<sup>1</sup> Thanks to K.-J. Gem, J. Gottschalk, E. Langfeldt, J. Scheide, H. Strauß and M. Schlie who provided helpful comments on an earlier draft of this paper and to R. Schmidt, who has estimated the labor market variables for Euroland. O. Dieckmann, European Commission Brussels, kindly provided some of the data used in this paper. I am still responsible for all remaining errors.

the downswing to the trough in 1982, one might count it as a growth recession rather than a full recession. In the early nineties a pronounced boom occurred. It looks quite impressive in the Euroland data, because the European country already in a downswing at that time - the UK - is not part of the monetary union. The following recession was particularly strong. Both the movement from peak to trough, and the negative size of the outputgap appear to be very large. This might be due to the special situation in Germany where the unification produced a pronounced boom and delays the recession as compared to the rest of Euroland. The expansion in the course of 1994 came to an early end in the growth recession of 1995.

Figure 1: Outputgap in Euroland



Shaded areas show periods of business cycle downturns.

### 3. The Time Series Under Investigation

In the following several possible leading indicators are discussed. The time series under investigation are:

- Narrow money supply (M1), both nominal and real.
- Broad money supply (M3 for most countries), both nominal and real.
- Short-term interest rates, both nominal and real.
- Long-term interest rates, both nominal and real.
- Interest rate spread.
- the Exchange rate of the ECU vs. the dollar, nominal.
- the real external value of the ECU vs. the currencies of 19 important trading partner countries (see Strauß, 1998 for details.)
- OECD leading indicator for OECD-Europe.<sup>2</sup>
- Future expected production (survey data).
- Order inflow (survey data).
- Stock prices.
- The HWWA-Index of raw material prices
- The economic sentiment indicator for Euroland provided by the European Commission.
- The consumer confidence indicator for Euroland provided by the European Commission.
- The industrial sentiment indicator for Euroland provided by the European Commission.<sup>3</sup>

Of course, this list is far from being complete. For example, short-term workers or the hours worked in an economy have shown some good indicator properties in some studies. This as well as other times series are not available on the European level. However, even in the construction of the time series mentioned above the lack of data is a serious problem. The time series are not

---

<sup>2</sup> The OECD indicator is a weighted average of the leading indicators for individual countries. For detailed information on the system of leading indicators provided by the OECD compare: <http://www.oecd.org/std/li2.htm>.

<sup>3</sup> For detailed information compare:  
<http://europa.eu.int/en/comm/eurostat/serven/part3/euroind/eurl1.htm>



available yet on the European level. This investigation is based on country data prepared by the OECD. (see Köhler 1997 for more detailed information on the availability and methodological concepts of these indicators). The aggregation method is explained in more detailed form in the appendix. Generally, the monetary aggregates and real GDP are converted into a single currency using the current ECU central rate and then simply summed up. All other variables are weighted averages using the 1997 ratio of the country's relative to Euroland's GDP as a weight. Table 1 contains descriptive statistics for all series under investigation.

It is often stated that the use of leading indicators is "measurement without theory", but it can be justified from economic theory, at least to some extent (see de Leeuw 1992, Klein 1997 for a detailed discussion). For example, monetary variables can be justified in the context of any model in which the stance of monetary policy is of importance for the business cycle, such as almost any monetarist or Keynesian theory of the business cycle. This will not hold for real business cycle models, at least for the first generation models of this kind. This is not the place to discuss whether these models make sense or not. But they are definitely in some kind of outsider position within the scientific community. Hence, the existence of this research tradition is no reason to rule out any time series a priori. This does not mean that supply shocks cannot play a central role in the generation of output fluctuations. As far as the oil price shocks are concerned, probably all economists would agree on a major role of supply side disturbances. Therefore, a price index of raw materials is also evaluated.

Survey data can easily be justified by any expectation orientated business cycles theory. Again, this does hold for most of neo-classical and Keynesian theories, although the first group of theories would imply a particular importance of expectations concerning the course of monetary policy or future inflation. However, such data are not available on a comparable basis for the Euroland-countries. Therefore, the focus here is on surveys concerning the expected change in industrial production and on stock prices which might reflect expectations on future profits and sales.

Some variables might have a lead relative to the cycle due to more technical reasons. For example, if some factors of production are fixed or quasi-fixed in

the short run, the more flexible factors are likely to lead the reference cycle. Moreover, it often takes for the results of agent's decision making to be seen in the statistical measure of the cycle. This might stem from the necessary time to build or from shipment, for example. Therefore, the order inflow is likely to be a leading indicator.

To justify the use of a composite leading indicator one has to accept additional assumptions. Not only should the individual time series included in the composite indicator make economic sense and show some lead, but also the combination of forecasts raises some difficult questions (see Diebold 1998: 339 ff.). However, experiences with composite indicators in the US and in Germany are encouraging, therefore, the OECD composite indicator for Europe is taken into account as well as the sentiment indicator provided by the European Commission.

Important practical properties of a leading indicator are the publication lag and the frequency and significance of data revisions. Table 1 gives some snapshot information on the publication lag, e.g. the time period for which data are available in the OECD Main Economic Indicators. Due to the large number of countries and the fact that virtually all variables are seasonally adjusted one also has to take into account that with every new observation the whole time series will change, at least to some extent. Table 1 also provides some information concerning the indicator's volatility<sup>4</sup> with respect to the volatility of the reference cycle. A good indicator should show a volatility in the neighborhood of the volatility of the time series to be predicted. However, evidently there are a lot of variables with substantially higher volatility than the trend deviations of real GDP.

---

<sup>4</sup> Volatility is measured as the standard deviation of a HP(1600) filtered time series relative to the standard deviation of HP(1600)-filtered real GDP. If this ratio equals 1, both variables have the same volatility. Note that this is not the case for time series, which fluctuate around zero (survey data) or for which HP-filtering does not seem to be meaningful (interest rates).

Table 1: Summary Descriptive Statistics and Information for the Possible Leading Indicators

Time Series	Dimension	Publication Lag	Mean	Standard deviation	Relative volatility
Narrow money supply, nominal	Bill. ECU/Euro, yoy	4 month	7.04	1.99	1.26
Narrow money supply, real	Bill. ECU/Euro in 1990 Prices, yoy	4 month	2.43	2.75	1.87
Broad money supply, nominal	Bill. ECU/Euro, yoy	4 month	7.08	2.22	0.77
Broad money supply, real	Bill. ECU/Euro in 1990 Prices, yoy	4 month	2.37	2.01	1.17
Short-term interest rates <sup>a</sup>	p.c.	2 month	9.41	2.88	3.30
Short-term interest rates, real <sup>a</sup>	p.c.	2 month	4.54	1.26	1.44
Long-term interest rates <sup>a</sup>	p.c.	2 month	10.09	2.28	2.61
Long-term interest rate, real <sup>a</sup>	p.c.	2 month	5.16	0.91	1.05
Interest rate spread <sup>a</sup>	percentage points	2 month	0.54	0.98	1.12
Euro(ECU)/\$-exchange rate	ECU/\$, yoy	2 month	2.21	13.20	9.36
Real external value of the ECU	Index 1990=100,yoy	2 month	-0.30	6.56	4.64
OECD-leading indicator Europe	Index 1990=100,yoy	2 month	2.11	2.82	2.01
Survey: production expectations	Survey balance	2 month	1.21	9.27	10.62
Survey: order inflow <sup>a</sup>	Survey balance	2 month	-16.00	15.93	18.24
HWWA-raw-material price index	Index 1975=100,yoy	2 month	-1.53	15.76	15.03
Share prices	Index 1990=100,yoy	2 month	13.45	18.94	13.56
Economic sentiment indicator	Index 1990=100	3 month	101.4	2.56	2.92
Consumer confidence	Survey balance	3 month	-12.27	7.55	8.62
Industrial confidence	SurveyBalance	3 month	-7.73	9.34	10.66

Relative volatility is the standard deviation of the time series relative to the standard deviation of the Eu11 output gap. Source OECD. Eurostat. Own calculations and estimations.

## 4. Evidence from Cross Correlations

In this section, the lead of different indicators is examined. Figures 2 to 6 show the development of the investigated indicators at turning points of the reference cycle. To keep the paper short, not all transformations of the variables are presented. Instead, the trend deviations from HP-trend define the reference cycle. In figure 2 this cycle is compared with the trend deviations of the monetary aggregates. It turns out that it takes a good deal of additional judgment to fix the turning point of the indicator time series and thus to determine the lead or lag. However, it seems quite clear that all these series are indeed leading the cycle. The lead of the nominal money supply looks shorter than the lead of the real variables, while the first one is obviously more stable than the latter. Turning to interest rates (figure 3) it proves to be particularly difficult to find clear-cut turning points for the variables. Consequently, this series are not likely to provide much information about the cycle. However, at least the nominal variables display some kind of lead and may therefore be useful.

Next, simple cross correlation coefficients of the variables with respect to the reference cycle are calculated. The absolute value of this correlation coefficient indicates, whether the series lead or lag the cycle.<sup>5</sup> The results are given in tables 2 to 4.

In table 2 the reference cycle and most of the indicator variables are defined by the change over previous year. The most striking result is that real short term interest rates are hardly significant correlated with real GDP. This does hold for the short-term and - to a smaller extent - also for the long-term real interest rates. Moreover, if there is any correlation, it indicates that real interest rates are

---

<sup>5</sup> However, it is not clear when to call a correlation „strong“ or „weak“ in this context. On one hand, Serletis and Krause (1996) present a classification scheme based on a statistical testing framework. Given the numbers of observations here, one would call two series strongly correlated (probability: 0,05) , if  $0.23 \leq |\rho(i)| \leq 1.0$ , weakly correlated if  $0.10 \leq |\rho(i)| < 0.23$  (probability: 0,10) and uncorrelated if  $0 \leq |\rho(i)| < 0.1$ . On the other hand, for example Jacobs et. al. (1997) call a correlation strong, if  $|\rho(i)| > 0.55$ . However, this convention is ad hoc and does not follow from any statistical reasoning.

Figure 2: Turning Point Analysis: Monetary Aggregates

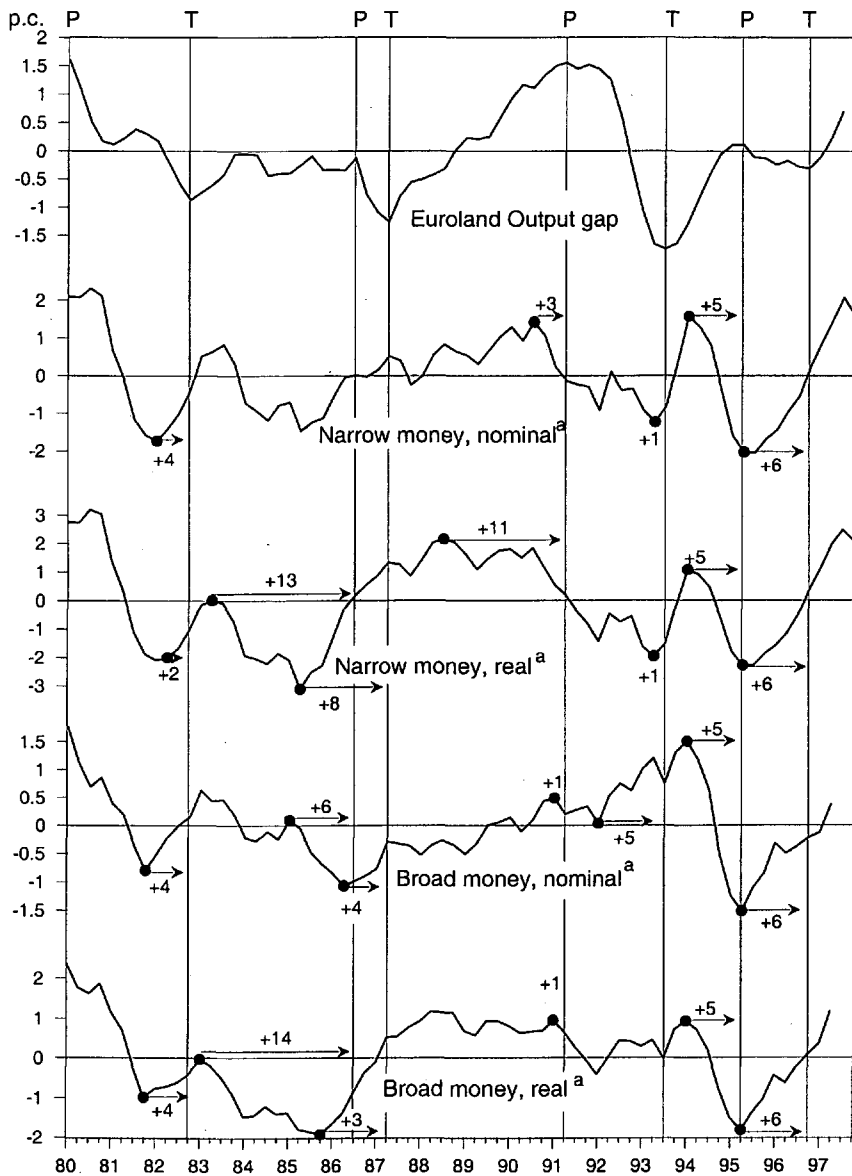


Figure 3: Turning Point Analysis: Interest rates

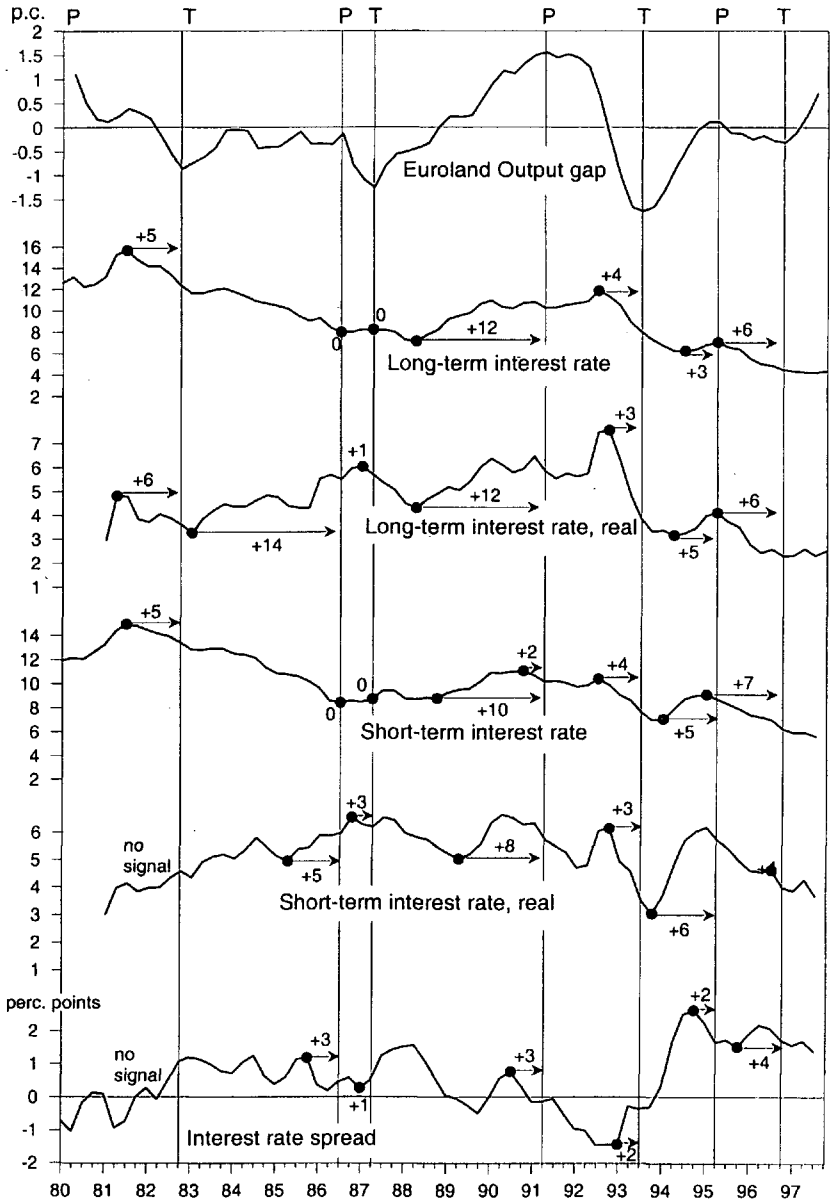


Figure 4: Turning Point Analysis: Exchange Rates and Raw Material Prices

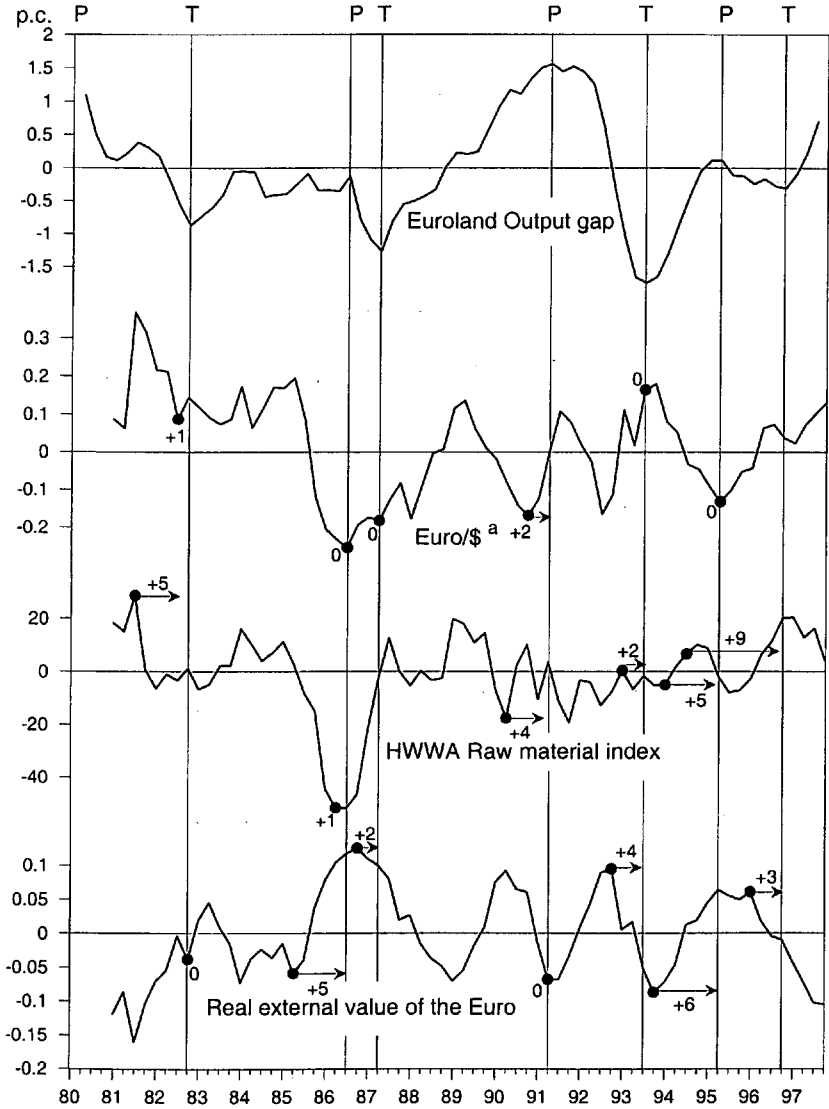


Figure 5: Turning Point Analysis: Leading indicator, Survey Data and Share Prices

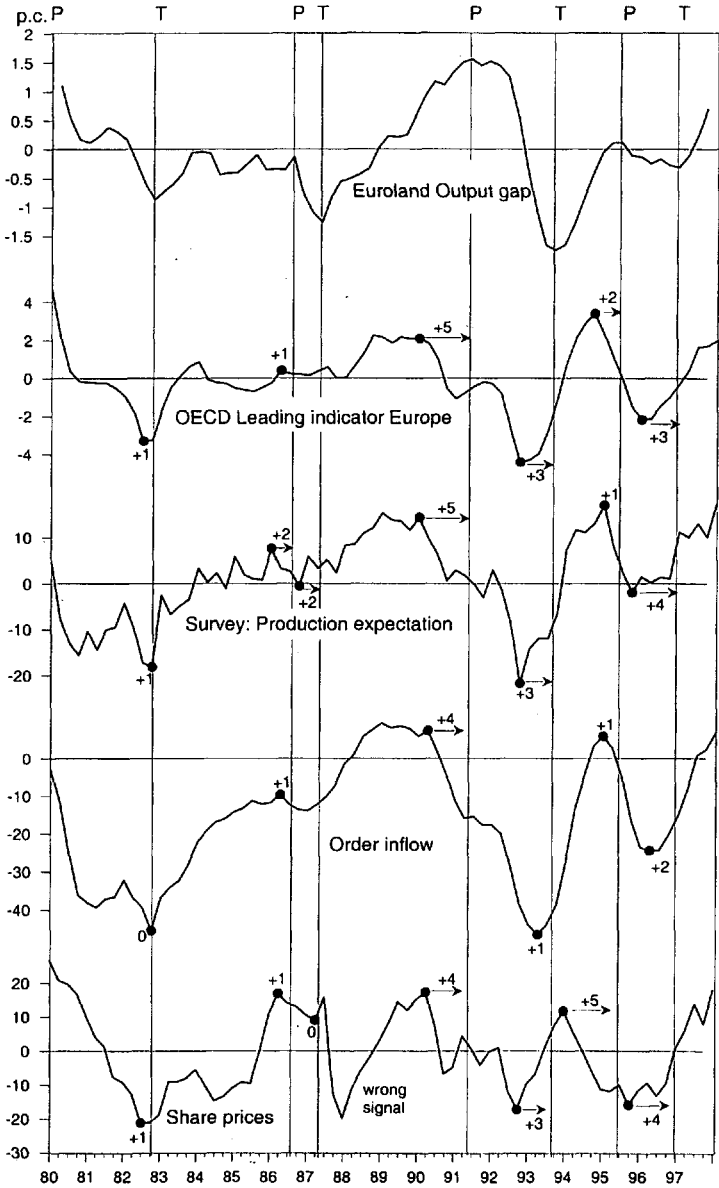




Figure 6: Survey Data and Sentiment Indicators

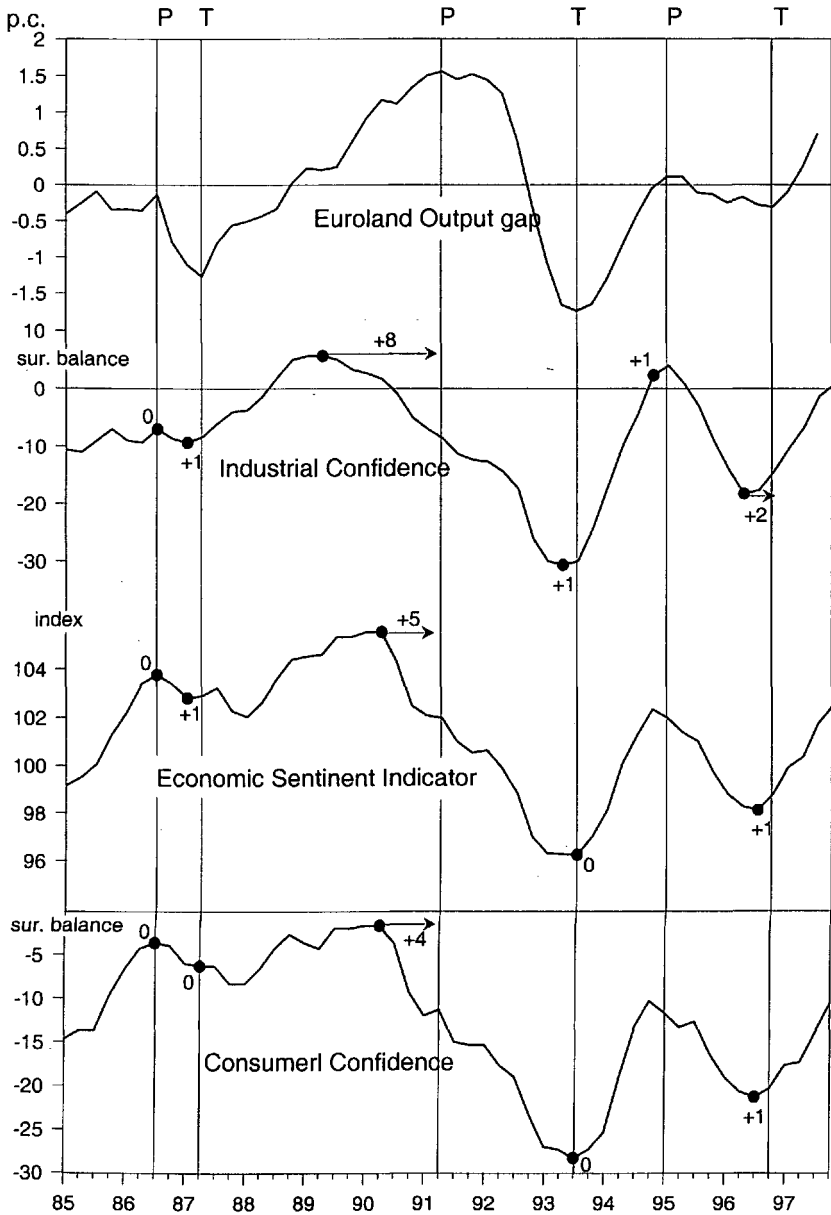


Table 2: Cross Correlations Based on Changes over Previous Year

Time Series	Leads / Lags (Quarters)											
	t-12	t-8	t-7	t-6	t-5	t-4	t-3	t-2	t-1	t	t+1	t+4
Narrow money supply, nominal	0.24	0.27	0.30	0.33	0.35	0.36*	0.33	0.27	0.15	-0.02	-0.13	-0.29
Narrow money supply, real	0.21	0.37	0.45	0.51	0.55	0.56*	0.54	0.50	0.42	0.34	0.23	0.00
Broad money supply, nominal	0.15	0.14	0.15	0.16	0.18	0.18*	0.15	0.09	0.02	-0.08	-0.09	0.05
Broad money supply, real	0.21	0.39	0.48	0.56	0.61	0.62*	0.58	0.51	0.44	0.40	0.33	0.34
Short-term interest rates <sup>a</sup>	-0.09	-0.15	-0.22	-0.29	-0.35	-0.38*	-0.38	-0.36	-0.32	-0.30	-0.21	0.02
Short-term interest rates, real <sup>a</sup>	-0.09	0.08	0.08	0.04	-0.04	-0.10	-0.10	-0.07	0.03	0.18	0.28	0.51*
Long-term interest rates <sup>a</sup>	-0.05	-0.15	-0.21	-0.27	-0.30	-0.31*	-0.30	-0.27	-0.22	-0.21	-0.15	-0.10
Long-term interest rate, real <sup>a</sup>	-0.01	0.20	0.24	0.25	0.23	0.23	0.25	0.31	0.45	0.60	0.62*	0.42
Interest rate spread <sup>a</sup>	0.12	0.08	0.11	0.17	0.27	0.33	0.36	0.38*	0.37	0.32	0.21	0.29 <sup>13</sup>
Euro(ECU)/\$-exchange rate	-0.06	-0.26	-0.26	-0.24	-0.20	-0.17	-0.17	-0.19	-0.26	-0.36	-0.43*	-0.28
Real external value of the ECU	0.01	0.36	0.36*	0.30	0.20	0.10	0.04	0.02	0.05	0.16	0.23	0.26
OECD-leading indicator Europe	0.18	0.20	0.18	0.16	0.19	0.27	0.38	0.47	0.48	0.39	0.10	-0.53*
Survey: production expectations <sup>a</sup>	-0.04	0.07	0.14	0.19	0.27	0.40	0.56	0.69	0.79	0.81*	0.70	0.17
Survey: order inflow <sup>a</sup>	-0.11	0.11	0.16	0.21	0.27	0.37	0.50	0.65	0.79	0.89*	0.86	0.42
HWVA-raw-material price index	-0.21*	-0.25	-0.22	-0.14	-0.06	0.01	0.09	0.11	0.03	-0.03	-0.05	-0.07
Share prices	0.15	0.22	0.25*	0.23	0.23	0.24	0.25	0.28	0.21	0.11	-0.03	-0.20
Economic sentiment indicator <sup>ab</sup>	-0.16	0.10	0.15	0.18	0.24	0.35	0.50	0.65	0.77	0.85*	0.84	0.62
Consumer Confidence <sup>ab</sup>	-0.05	0.22	0.25	0.26	0.29	0.36	0.48	0.61	0.73	0.82	0.83*	0.62
Industrial Confidence <sup>ab</sup>	-0.12	0.04	0.06	0.10	0.17	0.31	0.48	0.66	0.82	0.90*	0.86	0.30

a The time series is considered in levels. b 1985 - 1997 \* denotes maximum absolute value of correlation coefficient. Source: Own calculations.

Beschäftigung in Volkswirtschaft  
 2011/12

Table 3: Cross Correlations Based Trend Deviations

Time Series	Leads / Lags (Quarters)											
	t-12	t-8	t-7	t-6	t-5	t-4	t-3	t-2	t-1	t	t+1	t+4
Narrow money supply, nominal	0.06	0.21	0.31	0.39	0.44	0.45	0.43	0.37	0.38	0.18	0.02	-0.15
Narrow money supply, real	0.26	0.40	0.47	0.51	0.53*	0.52	0.48	0.40	0.30	0.21	0.06	-0.17
Broad money supply, nominal	-0.27	-0.20	-0.10	-0.00	0.07	0.08	0.06	0.02	-0.03	-0.04	-0.05	0.31*
Broad money supply, real	0.20	0.32	0.39	0.45	0.48*	0.46	0.40	0.31	0.22	0.16	0.10	0.13
Short-term interest rates <sup>a</sup>	-0.36	-0.22	-0.20	-0.18	-0.14	-0.10	-0.03	0.06	0.16	0.27	0.36	0.43*
Short-term interest rates, real <sup>a</sup>	-0.05	0.05	0.06	0.03	-0.01	-0.01	0.01	0.10	0.22	0.33	0.47	0.47*
Long-term interest rates <sup>a</sup>	-0.36*	-0.22	-0.18	-0.15	-0.10	-0.04	0.02	0.09	0.16	0.22	0.27	0.21
Long-term interest rate, real <sup>a</sup>	0.08	0.21	0.23	0.22	0.20	0.19	0.18	0.18	0.22	0.23	0.25*	-0.08
Interest rate spread <sup>a</sup>	0.16	0.15	0.15	0.16	0.18	0.18	0.13	0.03	-0.10	-0.26	-0.38	-0.72*
Euro(ECU)/\$-exchange rate	-0.31*	-0.25	-0.20	-0.13	-0.07	-0.04	-0.01	-0.01	-0.04	-0.08	-0.16	-0.03
Real external value of the ECU	0.18	0.27*	0.23	0.16	0.08	-0.01	-0.07	-0.12	-0.12	-0.08	0.03	0.05
OECD-leading indicator Europe	0.19	0.36	0.36	0.37	0.40	0.45	0.49	0.50*	0.43	0.28	0.00	-0.50
Survey: production expectations	0.27	0.43	0.41	0.41	0.41	0.42	0.43	0.41	0.33	0.17	-0.06	-0.56*
Survey: order inflow <sup>a</sup>	0.25	0.48	0.49	0.49	0.49	0.49	0.50*	0.50	0.46	0.36	0.17	-0.45
HWVA-raw-material price index	-0.45*	-0.17	-0.07	0.04	0.15	0.25	0.34	0.37	0.34	0.29	0.25	0.11
Share prices	0.04	0.13	0.17	0.22	0.25	0.26	0.27*	0.27	0.25	0.20	0.08	-0.04
Economic sentiment indicator <sup>a,b</sup>	0.17	0.48	0.51	0.51	0.52	0.53	0.54*	0.54	0.50	0.41	0.25	-0.33
Consumer confidence	0.22	0.44	0.45*	0.44	0.43	0.42	0.43	0.44	0.41	0.34	0.22	-0.32
Industrial confidence	0.21	0.48	0.44	0.50	0.42	0.55	0.58*	0.58	0.53	0.41	0.21	-0.53

a The time series is considered in levels. \* denotes maximum absolute value of correlation coefficient. Source: Own calculations.

Table 4: Cross Correlations Based on Changes over Previous Quarter

Time Series	Leads / Lags (Quarters)											
	t-12	t-8	t-7	t-6	t-5	t-4	t-3	t-2	t-1	t	t+1	t+4
Narrow money supply, nominal	0.03	0.08	0.14	0.19	0.09	0.16	0.11	0.19*	0.11	-0.12	-0.13	-0.12
Narrow money supply, real	0.05	0.18	0.28	0.28	0.24	0.27	0.29*	0.29	0.25	0.14	0.10	0.05
Broad money supply, nominal	-0.01	0.02	0.07	0.06	0.09	0.10	0.02	0.07	0.01	-0.12	-0.17*	0.05
Broad money supply, real	0.03	0.18	0.31	0.26	0.34	0.32	0.31	0.27	0.25	0.22	0.08	0.26
Short-term interest rates <sup>a</sup>	-0.05	-0.09	-0.12	-0.13	-0.17	-0.20	-0.24	-0.28*	-0.27	-0.27	-0.23	-0.09
Short-term interest rates, real <sup>a</sup>	-0.11	-0.03	0.04	0.07	0.02	-0.03	-0.04	-0.12	-0.09	-0.03	-0.00	0.30*
Long-term interest rates <sup>a</sup>	-0.02	-0.08	-0.10	-0.14	-0.17	-0.19	-0.21	-0.23*	-0.22	-0.21	-0.17	0.13
Long-term interest rate, real <sup>a</sup>	0.03	0.03	0.13	0.14	0.12	0.13	0.14	0.09	0.09	0.21	0.23	0.31*
Interest rate spread <sup>a</sup>	0.15	0.10	0.10	0.06	0.10	0.15	0.21	0.27	0.25	0.29*	0.25	-0.05
Euro(ECU)/\$-exchange rate	0.04	-0.20	-0.08	-0.03	-0.05	-0.15*	-0.04	-0.03	-0.09	-0.17	-0.06	-0.08
Real external value of the ECU	-0.03	0.26	0.11	0.09	0.05	0.00	0.06	-0.06	-0.08	0.07	0.05	0.12*
OECD-leading indicator Europe	0.05	0.07	0.13	0.24	0.02	0.12	0.17	0.32	0.36	0.37*	0.10	0.25
Survey: production expectations <sup>a</sup>	-0.08	0.06	0.11	0.10	0.10	0.14	0.19	0.25	0.44	0.53	0.54*	0.30
Survey: order inflow <sup>a</sup>	-0.08	0.05	0.08	0.09	0.10	0.13	0.16	0.22	0.33	0.44	0.53*	0.44
HWWA-raw-material price index	0.13	-0.13	-0.16	0.02	-0.06	-0.08	0.07	0.24*	-0.11	-0.08	0.05	-0.03
Share prices	0.08	-0.01	0.15	0.16*	0.09	-0.00	0.09	0.29*	0.13	0.06	0.07	0.05
Economic sentiment indicator	-0.15	0.01	0.05	0.08	0.06	0.11	0.14	0.23	0.33	0.45	0.52*	0.43
Consumer Confidence	-0.08	0.08	0.11	0.15	0.13	0.14	0.15	0.23	0.32	0.41	0.47*	0.44
Industrial Confidence	-0.12	0.03	0.03	0.02	0.01	0.05	0.13	0.21	0.33	0.47	0.57*	0.38

a The time series is considered in levels. \* denotes maximum absolute value of correlation coefficient. Source: Own calculations.

lagging rather than leading. To make things worse, the sign of the variables is almost consistently wrong: High real interest rates correlate positively with high GDP growth rates rather than negatively, as most people would expect. One might argue that this result is due to the very problematic assumption of a single European interest rate or the specific method to calculate it. However, both the much better results of nominal interest rates and the interest rate spread indicate, that this might not be the crucial point. Instead, one has to accept that a theoretically appealing concept like the "real" interest rate is not so easy to implement empirically and therefore no good indicator. As already mentioned nominal interest rates perform better. Their cross correlations show some lead, although the correlations are generally weak. The lead is about 4 quarters both for long-term and short-term interest rates. The interest rate spread also shows a weak correlation with the expected sign, but the lead is only 2 quarters. The ECU/\$ exchange rate shows no significant lead, but some small lag to the change of real GDP. The real external value of the ECU exhibits some significant correlation and also some lead, but the correlations have not the expected sign. The OECD leading indicator is indeed leading, but the lead is very short (1 quarter).<sup>6</sup> One should mention that this composite indicator is constructed not for Euroland but for OECD-Europe. Thus, a much stronger correlation would have been a surprise. The examined series from survey data show the strongest correlation of all time series under investigation, but are almost coincident. However, given the publication lag of European data, they might be very useful, despite the fact that they do not lead. Finally, the share prices show no clear-cut lag or lead. The indicators provided by the European commission show a high correlation, but are coincident rather than leading. The consumer confidence show even some lag of one quarter.

In table 3 the cross correlation's using trend deviations are presented. There are some minor differences as compared to the results presented in table 2. Generally, the correlation coefficients are lower than in the case of year to year changes. On the other hand, the identified turning points do not vary by very much. However, there are some exceptions. Broad nominal money supply

---

<sup>6</sup> The maximum absolute value of the cross correlation coefficient occurs at  $t+4$ . However, it shows a negative sign at this time point. Therefore, this indicates the pro-cyclical behavior of the indicator as it has to be expected.

shows no lead any more, but a significant lag. The interest rate spread looks less appealing compared to the calculations based on year on year changes. The indicators provided by the European Commission show some lead to this reference cycle.

Table 4 defines the reference cycle in a third manner. Here, changes over previous quarters are used. It turns out, that the correlation become very weak in general. Obviously, there are no indicators which can predict the volatile and sometimes erratic changes over previous quarters. However, looking at the comparison of indicators, the relative quality does not change by very much.

## 5. Testing on Granger-Non-Causality

In this section it is reported upon tests on Granger-non-causality of the time series under investigation for real GDP. Granger-causality as a tool for economic research can be questioned for good reasons. For example (see Salazar et al. 1996) the purchase of anti-freeze is very likely to be "Granger-causal" for the winter, because normally people will buy it before the winter starts. Of course, the causality in any meaningful economic sense is going just in the other direction. However, this problem is not relevant when leading indicators are under investigation. Here a simple "post hoc ergo propter hoc" reasoning is in place and indeed the purchase of anti-freeze is a leading indicator for winter. Using a simple F-test, it is analyzed, whether the lagged values of the indicator series provide any additional information as compared to the autoregressive process of the series to predict. Before doing this, the question arises how to take care of possible unit roots in the time series. Generally, one should take into account a possible cointegration relationship between the time series in applying a test on Granger-non-causality. In some cases, the variables are assumed to be stationary (the result of survey data, real interest rates). Otherwise they have been made stationary by calculating the change over previous year.

Table 5 gives the results of the tests. Broadly speaking, one can separate the possible leading indicators into four groups. The first one contains variables that are not useful as indicators at all, because they do not Granger-cause real

Table 5: Test on Granger-Non-Causality for Selected Leading Indicator Variables

Time Series	Transformation of Time Series	Lag Length of VAR	Value of Schwarz Criteria	F-Value: Times Series does Granger-cause real GDP	F-Value: Real GDP does Granger-cause times series
Narrow money supply, nominal	YoY	2	-13.40	3.40**	1.00
Narrow money supply, real	YoY	3	-13.26	4.16**	0.01
Broad money supply, nominal	YoY	1	-14.19	1.20	0.48
Broad money supply, real	YoY	1	-14.00	4.32**	0.85
Short-term interest rates <sup>a</sup>	Level	2	-5.45	2.55*	6.61**
Short-term interest rates, real <sup>a</sup>	Level	2	-5.31	1.91	5.88***
Long-term interest rates <sup>a</sup>	Level	2	-5.70	3.38**	0.58
Long-term interest rate, real <sup>a</sup>	Level	1	-5.51	0.87	5.07**
Interest rate spread <sup>a</sup>	Level	2	-5.62	1.56	2.27
Euro(ECU)/\$-exchange rate	YoY	1	-8.88	0.31	4.08**
Real external value of the ECU	YoY	1	-10.48	2.17	1.85
OECD-leading indicator Europe	YoY	2	-12.93	10.08***	21.53***
Survey: production expectations	Level	1	-1.00	20.25***	0.74
Survey: order inflow <sup>a</sup>	Level	2	1.67	12.32***	2.20
HWWA-raw-material price index	YoY	1	-8.34	0.75	0.13
Share prices	YoY	1	-8.41	4.51**	2.87*
Economic sentiment indicator	Level	2	-4.92	8.25***	2.18
Consumer Confidence	Level	2	-2.47	4.48**	1.64
Industrial confidence	Level	2	-2.72	12.55***	1.97

YoY denotes change over previous year. \* (\*\*, \*\*\*) denotes. that the null hypothesis is rejected at a 10 (5, 1) percent level.

GDP, but real GDP Granger-causes them. The ECU/\$-exchange rate and the real short-term interest rate belong to this group. A second group consists of variables without any Granger-causality in either direction, namely, the nominal broad money supply, the interest rate spread, the real external value of the ECU and the HWWA raw material price index. The third group comprises variables with a feedback relation to real GDP. These variables Granger-cause real GDP, but the opposite hypothesis can also not be rejected. This result does hold for the nominal short term interest rate, the survey data on order inflow and the share prices. The last group consists of variables that are good indicators as far as Granger-causality is concerned, i.e. the series do Granger-cause real GDP without feedback. These variables are the narrow money supply (nominal and real), the nominal long-term interest rate, the OECD-leading indicator and the survey on production expectations.

## 6. Out-of-sample Performance

In the above, only the in-sample properties of the leading indicators have been investigated. However, for usefulness of a leading indicator the out-of-sample performance is crucial. To investigate this, a procedure is applied that consists of the following steps (see Davis and Fagan: 706, Salazar et al.: 11 ff). First, a univariate representation for the year on year change of (log) real GDP ( $X$ ), is estimated, which is assumed to be stationary :

$$(1) \quad \Delta \ln X_t = \alpha_0 + \alpha_1 \Delta \ln X_{t-1} + \dots + \alpha_n \Delta \ln X_{t-n} + u_t$$

The lag length  $n$  of this autoregressive process is determined by the minimum Schwarz criterion. This results in a lag length of 5 quarters. Then, a bivariate representation (e.g. a VAR) including both real GDP and the indicator variable is run (the lag length is set to 5):



$$\begin{aligned}
 \Delta \ln X_t &= \alpha_0 + \alpha_1 \Delta \ln X_{t-1} + \dots + \alpha_n \Delta \ln X_{t-m} + \\
 &+ \beta_1 I_{t-1} + \beta_2 I_{t-2} + \dots + \beta_m I_{t-m} + u_t \\
 (2) \quad \Delta \ln I_t &= \gamma_0 + \gamma_1 \Delta \ln X_{t-1} + \dots + \gamma_n \Delta \ln X_{t-m} + \\
 &+ \delta_1 I_{t-1} + \delta_2 I_{t-2} + \dots + \delta_m I_{t-m} + u_t
 \end{aligned}$$

Next, this VAR and the univariate equation for real GDP are used to compute out-of-sample forecasts for the next four quarters, respectively. Finally, the forecast of this VAR is compared to the forecast of the simple autoregressive process using a Theil inequality coefficient:

$$(3) \quad \text{Theil} = \frac{\text{RMSE}^{\text{VAR}}}{\text{RMSE}^{\text{autoregressive}}}$$

where RMSE denotes the root mean square error of the forecast. If this coefficient is below 1 the use of the indicator variable improves the forecast, if it is above 1 the forecast is even worse than the projection from a simple autoregressive process. Table 6 shows the main results of this procedure for the years 1990 to 1997. The findings raise doubts whether a simple leading indicator approach is sufficient for a good forecast. In many cases the forecast gets less accurate when the indicator variable is used. In some years, none of the variables improves the forecast.

A good indicator variable should show a constant lead to the time series to predict. Hence, a test on parameter stability is carried out. Davis and Fagan (1997) apply the test procedure of Andrews (1993). Looking at the very short time series here, only very simple approaches can be used. We run the first equation of the VAR above as a single equation model. Then, a standard Chow test for a structural break in the middle of the sample (1989 I) is applied. The results are also given in table 6. As it turns out there is some evidence for a good deal of indicators, that their relationship to the business cycles has changed over the investigation period.

Table 6: Out-of-sample-Performance of Indicators

Time Series	Theil Coef. 1990	Theil Coef. 1991	Theil Coef. 1992	Theil Coef. 1993	Theil Coef. 1994	Theil Coef. 1995	Theil Coef. 1996	Theil Coef. 1997	Test on structural break (F-Value)
Narrow money supply, nominal	1.23	0.41	0.30	0.55	1.97	0.82	3.56	1.19	1.25
Narrow money supply, real	2.22	0.46	0.63	1.13	0.45	0.84	1.09	0.69	0.82
Broad money supply, nominal	1.38	0.77	0.08	0.87	2.92	0.59	6.37	1.32	2.77**
Broad money supply, real	2.38	0.61	0.97	1.12	1.14	0.84	5.88	1.05	1.92*
Short-term interest rates <sup>a</sup>	1.05	0.38	0.99	0.83	0.28	2.44	4.01	0.66	2.20**
Short-term interest rates, real <sup>a</sup>	1.11	1.21	1.04	0.54	0.49	1.79	4.20	0.81	0.94
Long-term interest rates <sup>a</sup>	1.01	0.33	1.09	0.69	0.18	0.99	2.54	0.63	1.98*
Long-term interest rate, real <sup>a</sup>	3.29	1.22	1.05	1.07	0.72	0.70	1.23	1.33	2.02*
Interest rate spread <sup>a</sup>	3.28	0.89	0.54	0.54	1.72	4.03	2.84	0.98	0.72
Euro(ECU)/\$-exchange rate	1.62	1.14	1.01	1.08	0.91	1.20	1.48	1.05	1.29
Real external value of the ECU	2.05	1.31	0.96	1.19	0.80	0.73	1.44	0.77	1.63
OECD-leading indicator Europe	1.29	0.39	0.78	0.63	0.72	2.56	2.21	0.98	0.72
Survey: production expectations	1.06	0.80	0.77	0.40	0.44	3.40	3.97	0.91	1.34
Survey: order inflow <sup>a</sup>	1.04	1.19	0.62	0.55	0.14	3.40	2.16	0.84	2.83**
HWWA-raw-raterial price index	1.36	1.15	0.87	0.94	0.92	1.44	1.83	0.84	0.74
Share prices	1.20	0.98	0.82	0.81	1.00	1.51	2.40	0.82	1.08
Economic sentiment indicator	0.73	2.34	0.91	0.78	0.35	0.60	6.69	1.10	1.61
Consumer confidence	0.78	2.74	0.66	0.96	1.30	2.02	5.26	1.30	1.82
Industrial confidence	2.89	0.90	0.85	0.43	0.94	2.93	3.53	1.01	2.34**

See Text for details. \* (\*\*, \*\*\*) denotes that the null hypothesis of parameter constancy is rejected at the 10 (5,1) percent level.

## 7. Conclusion

Aggregate monetary aggregates for Euroland are reasonable leading indicators for Euroland's business cycle - despite the big problems in aggregating the time series from the national statistics. All monetary variables have some predictive power, which is shown by test on Granger-non-causality and the calculation of cross-correlation coefficients. Hence, the judgment of the current stance of monetary policy can refer to the current behavior of this aggregate time series compared to the past. According to the turning point analysis the real money supply M1 is the best indicator, whereas the out of sample forecast analysis gives the nominal short-term interest rate the first place. Survey data and sentiment indicators seem to be more or less coincident, but with a very high correlation. The out-of-sample tests show that the leading indicator approach has some serious shortcomings. None of the time series provides additional information for every year under investigation. Hence, leading indicators should be used in addition to a full economic analysis rather than a substitute for it.

## Appendix: Sources and Methods of Aggregation

The time series defining the reference cycle is real GDP. Since the series is not available from an official data supplier as a long time series yet we have to construct it. From 1991 to the present the official Eurostat data are used. Concerning the time before the series is estimated using data provided by the OECD (Source: Quarterly National Accounts or OECD, Main Economic Indicators). If necessary, the data are rebased to constant prices of 1990 (or to an index 1990 = 100) and seasonally adjusted with the Census X-11 procedure. Then the times series measured in local currencies are converted into a single currency using the actual ECU-central rate. Then real GDP is calculated by summing up the real GDP of all the individual countries for which quarterly data are available. The German series are adjusted, if necessary, for the effect of German unification. At last the result is multiplied with a chain factor, so that its level matches the level of the official Eurostat's data in 1990. This implies the assumption, that the changes in real GDP of the countries without quarterly data (e.g. Belgium, Ireland, partly Portugal and Austria) are the same as in the rest of Euroland. This assumption makes a little error in the data. However, it should be relatively small, since the rest of Euroland stands for 88 p.c. of overall real GDP in 1997.

The procedure of aggregating of EMU monetary aggregates is basically the same as described above: individual countries' monetary aggregates are converted at actual ECU-central rates and added up.

Index variables are aggregated in the following way (OECD 1997): The indices are based on 1990 = 100. Then the share of national GDP in EU11, calculated with current ECU-central-rates, is used to weight the national indices. For example, the EU11 consumer prices before 1995 are given by:

$$(1) \quad P_t^{EU-11} = \sum_{i=1}^{11} P_t^i \frac{GDP_t^i}{GDP_t^{EU-11}}$$

whereas  $P_t^i$  denotes the CPI of member country  $i$ . After 1995, the official HCPI is used (see Döpke et al. 1998b: 5 for details). Concerning monetary variables and interest rates the variables are aggregated as follows: If money supply is

expressed in a single currency it can simply be summed up. However, it is quite unclear how to do so. Here the money supply is converted in the single currency using current ECU-central rates. Concerning interest rates, there are competing approaches in the literature (see Wesche 1998: 39 for a survey). Some authors argue, that the eurodollar interest rate is the correct choice. They have to assume, however, that the interest rates across Europe are more or less parallel. This was obviously not the case. Therefore, the majority of the researchers have used weighted averages. The weights used here are given by a country's real GDP relative to the European real GDP.<sup>7</sup>

Additional to the time series mentioned so far, some of the indicators provided by the European Commission are used. Unfortunately, they are available only for the period after 1985 for Euroland. The consumer confidence indicator is the arithmetic average of the answers (balances) to the four questions on the financial situation of households and general economic situation (past and future) together with that on the advisability of making major purchases. The industrial confidence indicator is the arithmetic average of the answers (balances) to the questions on production expectations, order-books and stocks (the latter with inverted sign). The economic sentiment indicator is a composite measure in which the industrial confidence indicator and the consumer confidence indicator are given equal weight, while the construction confidence indicator and the share-price index are attributed half the weight of each of the other two (Source: European Commission business and consumer surveys, published in European Economy, Supplement B).

---

<sup>7</sup> The literature considers a wide range of other possibilities (see Wesche (1998 Funke (1997), Brunia (1994)), namely, nominal GDP shares, the ECU weights using constant or actual exchange rates, respectively. Given the interest in predicting real GDP, the real GDP-shares seem to be a natural choice..

## References

- Brunia, N. (1994). A Data Set for a Macroeconometric Model of the EC; The Conversion and Aggregation of Domestic Money Values. CCSO Series No. 21. Groningen.
- Davis, E.P., and G. Fagan (1997). Are Financial Spreads useful Indicators of Future Inflation and Output Growth in EU Countries? *Journal of Applied Economics* 12: 701 - 714.
- de Leeuw, F. (1992). Toward a Theory of Leading Indicators. In: K. Lahhri and G.H. Moore (eds.), *Leading Economic Indicators*. New York: 15-56.
- Diebold, F.X., and G.D. Rudebusch (1989). Scoring the Leading Indicators. *Journal of Business* 62: 369 - 391.
- Diebold, F.X. (1998). *Elements of Forecasting*. Cincinnati.
- Döpke, J., J.W. Krämer, and E. Langfeldt (1994). Konjunkturelle Frühindikatoren in Deutschland. *Konjunkturpolitik* 40: 135-154.
- European Commission (1997). The Joint Harmonised EU Programme of Business and Consumer Surveys. *European Economy* No. 6.
- Funke, N. (1997). Predicting Recessions: Some Evidence for Germany. *Weltwirtschaftliches Archiv* 131(1): 90 - 102.
- Hendry, D.F. (1997). The Econometrics of Macroeconomic Forecasting. *The Economic Journal* 107: 1330 - 1358.
- Jacobs, J., R. Salomons and E. Sterken (1997). The CCSO composite leading indicator of the Netherlands: construction, forecasts and comparison. CCSO Series No. 31. Groningen.
- Klein, P.A. (1997). The Theoretical Basis of Cyclical Indicators, in: K.H. Oppenländer (ed.), *Business Cycle Indicators*. Aldershot: 35 - 48.
- Köhler, A.G. (1997). Selected International Composite Indicators, in: K.H. Oppenländer (ed.), *Business Cycle Indicators*. Aldershot: 101-112.
- Niemera, M.P., and P.A. Klein (1994). *Forecasting Financial and Economic Cycles*. New York.

- OECD (1997). Main Economic Indicators. Paris.
- Salazar, E., R. Smith, M. Weale and S. Wright (1996). Leading Indicators. Paper for the Meeting on OECD Leading Indicators, available at <http://www.oecd.org/>
- Santero, T., and N. Westerland (1996). Confidence Indicators and their relationship to Changes in Economic Activity. OECD Working Paper No. 160. Paris.
- Serletis, A., and D. Krause (1996). Nominal Stylised Facts of U.S. Business Cycles. Review Federal Reserve Bank of St. Louis: 49- 54.
- Strauß, H. (1998). Euroland's Trade with the Rest of the World: An SNA -based Estimation. Kiel Working Paper, forthcoming.
- Wesche, K. (1998). Die Geldnachfrage in Europa. Heidelberg.
- Zarnowitz, V. (1992). Business Cycles - Theory, History, Indicators and Forecasting. Chicago London.