Prediction Qualities of the Ifo Indicators on a Temporal Disaggregated German GDP

Christian Seiler

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Abstract

This paper compares the German Gross Domestic Product between 1991 and 2008 with the Ifo business indicators. Because GDP is published quarterly but the Ifo indicators monthly, the most analyses compare these variables by merging the indicators to quarterly data. In this paper an alternative way is shown: GDP will be disaggregated with ECOTRIM, a software package from Eurostat, to get monthly data. Furthermore, a spline-based disaggregation approach is discussed. The results of the analyses demonstrate a high connection between the disaggregated GDP and the Ifo indicators.

JEL Code: E3.
Keywords: Temporal disaggregation, indicators, Gross Domestic Product, splines.

Christian Seiler
Ifo Institute for Economic Research
at the University of Munich
Poschingerstr. 5
81679 Munich, Germany
Phone: +49(0)89/9224-1248
seiler@ifo.de

Contents

1 Introduction and motivation

A great variety of papers about the qualities of the Ifo indicators and their connection to the German economic cycle exists in the literature; for recent years see for example Fritsche (1999), Kunkel (2003) and Abberger and Nierhaus (2007). In these analyses the Ifo indicators, which are published monthly, will be aggregated to quarterly data to compare them with German GDP, as it is released quarterly. Other analyses, such as Hott et al. (2004), use *industrial production* as a reference series to enable a monthly comparison.

To overcome the restriction of creating quarterly indices (and probably losing information), the comparison will be considered from another perspective. In this paper GDP will be disaggregated to monthly data. This approach bears a risk because information is created and not measured. However, even an aggregation of an indicator leads to distortions. The advantage of disaggregation is obvious and simple because more data points can be used for the analysis, and the statements about the indicators can be created more specifically.

Section 2 gives a brief overview of the data set and different disaggregation methods. Also a spline-based approach will be discussed in this section. In section 3 the three most important Ifo indicators are compared with GDP

growth rates. Section 4 summarizes the results of this paper and gives an outlook.

2 Disaggregation of GDP

2.1 The data set

In this analysis German GDP adjusted for price to the basis year 2000, similar to Kunkel (2003)[1], is used. GDP for reunified Germany is available since the first quarter of 1991 and is published by the Federal Statistical Office of Germany. The values before 1991 are excluded from the analysis because they only exist for West Germany, so they range from 1/1991 to 6/2008. Since GDP is a cumulative value, the method of disaggregation must fulfill the condition

$$GDP_i = GDP_{(i,1)} + GDP_{(i,2)} + GDP_{(i,3)} \tag{1}$$

with $GDP_{(i,1)}, \ldots, GDP_{(i,3)}$ as the appropriate monthly GDPs of quarter i. Condition (1) characterizes German GDP as a *flow series*.

2.2 Disaggregation methods

In the literature many different approaches for temporal disaggregation are found. According to Di Fonzo (2003) most approaches can be classified into

[1]Note that Kunkel (2003) uses German GDP adjusted for price to the basis year 1995.

methods using related indicators and those not using them. Approaches without such indicators are purely mathematical methods to create a smooth path for the unobserved series. First methods based on minimizing squared first or second differences of the high-frequency series were discussed by Boot et al. (1967); Lisman and Sandee (1964) proposed a set of weights that could be used to generate high-freqeuncy data. Recent approaches, as in Wei and Stram (1990) use an ARIMA-based illustration of the time series. In contrast to these approaches the literature about methods using related indicators is much larger. These methods calculate the unobserved series using the information of a related indicator with target frequency. First approaches have been formulated by Denton (1971), Ginsburgh (1973) and Chow and Lin (1971). ARIMA-based approaches with related indicators are discussed in Guerrero (1990) and Wei and Stram (1990); for example.

2.3 Disaggregation with ECOTRIM

For disaggregation of GDP the software tool ECOTRIM Version 1.01[2] from Eurostat is used. ECOTRIM includes unvariate as well as multivariate methods with optional including of related indicators to disaggregate a time series; see Barcellan and Buono (2002) for further details. In this paper disaggregation approaches without a related indicator, i.e. purely mathematical

[2]ECOTRIM can be downloaded via
http://circa.europa.eu/Public/irc/dsis/ecotrim/library

methods, are used. The first applied method[3] was introduced by Boot et al. (1967). First of all, the monthly values will be set to 1/3 of the quarterly value. Then the squared first

$$\sum_{i=2}^{n}(x_i - x_{i-1})^2$$

or second

$$\sum_{i=2}^{n}(\Delta x_i - \Delta x_{i-1})^2$$

order differences between two successive months x_i and x_{i-1} with $\Delta x_i = x_{i+1} - x_i$ will be minimized. The minimization of the differences causes the course of the quarterly values to be adjusted. Boot et al. (1967) apply their approach to annual data, but the methodical transfer from "annual to quarterly" to "quarterly to monthly" is trivial and provided by ECOTRIM. Both techniques fulfill condition (1) analogous for annual data.

2.4 An approach with spline-based weights

As in Lisman and Sandee (1964) a flow series can also be disaggregated by creating a set of weights, e.g. with 1/3 of the quarterly value for the monthly

[3]Denton's (1971) method for flow series without using realted indicators is also provided by ECOTRIM. This approach will not be discussed in this paper, because for $h = 1$ the results are the same as FD and similar for bigger values of h.

data. As mentioned in Jacobs (1994), this method is a very naive way of disaggregation. Generally, a continuous density function $f_{(i-1,i]}(t)$ on each intervall $(i-1, i]$ for distributing the i-th GDP can be defined. With setting $c_{(i,j)}$ as the lower cutpoint of $GDP_{(i,j)}$ the weights are defined as

$$w_{(i,j)} = \int_{c_{(i,j)}}^{c_{(i,j+1)}} f_{(i-1,i]}(t).$$

In this paper the cutpoints are set to $i-1$, $i-1+\frac{1}{3}$, $i-1+\frac{2}{3}$ and i, so that the $c_{(i,j)}$ are equidistant. The reason is that the months have nearly the same length.

To estimate the shape of each density function $f_{(i-1,i]}(t)$, the time series will be interpolated and the form of the appropriate piece $s_{(i-1,i]}(t), i-1 < t < i$, of the interpolated spline function $s(t)$ is used. For interpolation, cubic splines as descibed in Forsythe et al. (1977) are used. The cubic splines have different advantages over other interpolation methods, e.g. polynomial interpolation. Polynomial splines are highly oscillating when the degree of the polynom rises. Piecewise linear interpolation is also possible, but the supposed "smoothed" run of GDP isn't illustrated very well. For general information about interpolation methodsl; see Stoer and Bulirsch (2002).

To use the spline pieces for the shape of the density function it must be secured that $f_{(i-1,i]}(t)$ is a real density function with $\int_{i-1}^{i} f_{(i-1,i]}(t) = 1$. There-

fore the spline piece $s_{(i-1,i]}(t)$ cannot be used directly and must divided by its own integral, respectively

$$f_{(i-1,i]}(t) = \frac{s_{(i-1,i]}(t)}{\int_{i-1}^{i} s_{(i-1,i]}(t)}. \tag{2}$$

The resulting monthly GDPs are displayed in figure 1. As you can see, the calculated values between FD and SD, do not differentiate very largely, except on the borders. The spline-based method generates values that differ more than the other two methods.

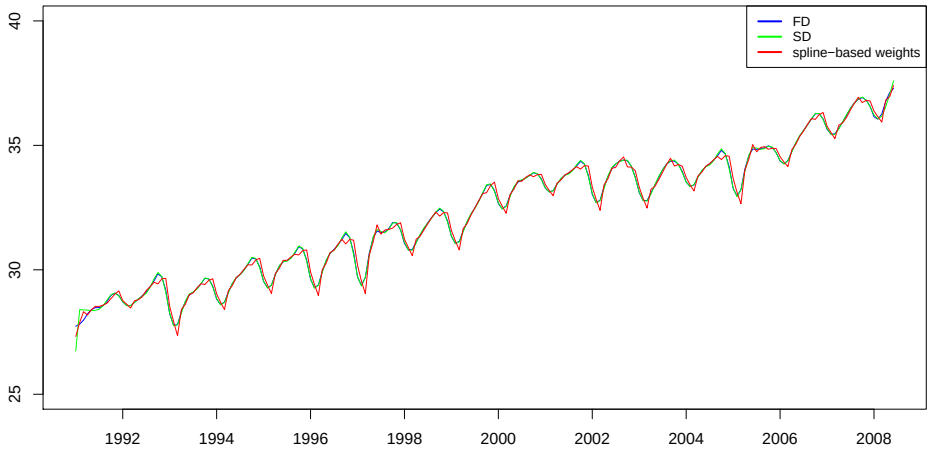

Figure 1: disaggregated GDP

3 Comparison

The Ifo indicators, especially the *Business Climate Index* (BCI), are widely observed in Germany and foreign countries. The Ifo BCI is the indexed geometric mean of the balances[4] of the *Business Assessment* (BA) and the balances of the *Business Expectations* (BE), or to be more precise:

$$BCI = 100 \cdot \frac{\sqrt{(BA + 200) \cdot (BE + 200)}}{BC_{2000}}$$

with BC_{2000} as the average balances of the year 2000. The subindicators BAI and BEI are constructed by adding 200 to the balances and indexing them to the basis year 2000. The Ifo BAI measures the assessment of the *actual business situation* of the companies whereas the Ifo BEI measures the *expected* assessment of the companies for the next six months. Both indicators will be explained in detail, in section 3.2 and 3.3. The indicators are constructed to measure the cyclical development of economic performance in Germany. For this reason the main target of the indicators is to detect the *growth rate* of German GDP. The Federal Statistical Office of Germany calculates the growth rates of GDP based on the quarter of the previous year. Analogous to this approach the growth rates with a basis in the previous years' month are calculated.

To enable a comparison with analyses from a quarterly perspective, the cor-

[4]The balances are constructed by subtracting the negative reponses from the positive.

relations of the indicators with the quarterly growth rates were calculated and listed in Table 4. The results of Kunkel (2003) cannot be used directly for the comparison, because, although only drawing a small distinction, he calculates with balances and not with the indicators and his data range from 1/1991 to 4/2002. The comparison with the quarterly values will be discussed in the corresponding section.

3.1 Comparison with the Ifo Business Climate Index

Contrasting the Ifo BCI with the monthly GDP growth rates, Figure 2 shows a high congruence between the two series. The BCI seems to run concur-

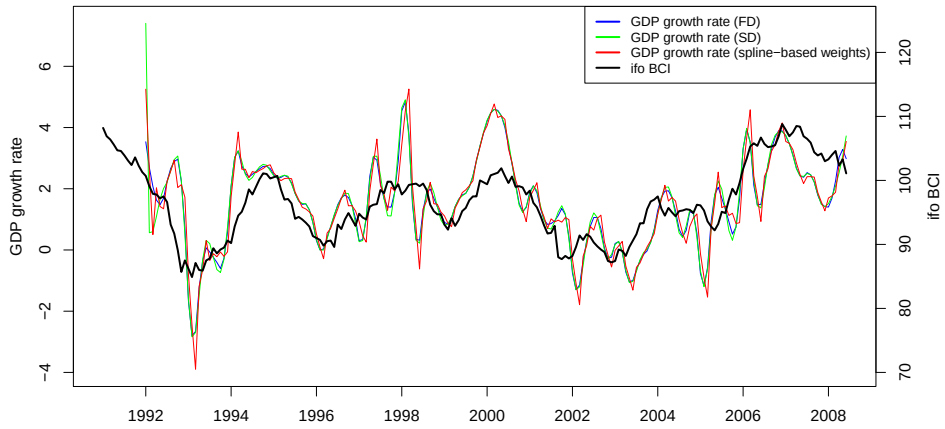

Figure 2: GDP growth rates and Ifo BCI

rently with or slightly leads GDP. The cross correlation function in Figure 3 supports the visually assumed connection. The highest correlation for all three methods can be found at lag 0, so the BCI runs concurrent with GDP.

These correlations are also nearly equal for all three methods; see Table 1. It is remarkable that the correlation, for FD as well as for SD and the spline-based method, until lead 7 is always higher than the correlation to the corresponding month. The indicator seems to have a closer connection to the future than to the past. It should be noted that the absolute correlations for the SD method are almost everywhere lower than those for the FD method.

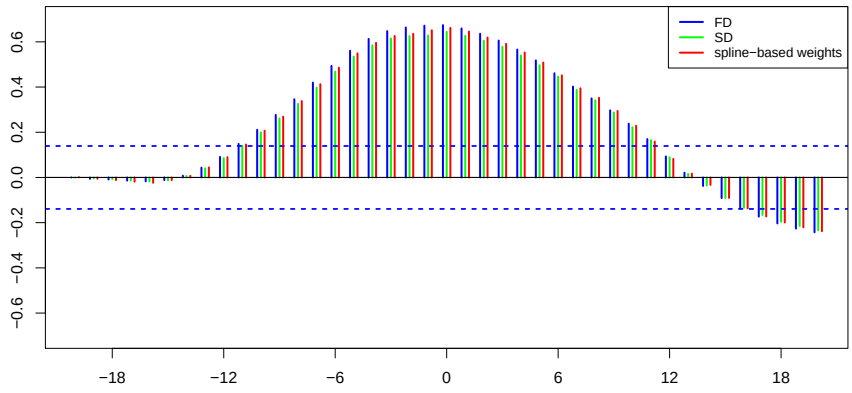

Figure 3: Cross correlation between GDP growth rates and Ifo BCI

Calculating the quarterly cross correlations, the analysis shows that the highest correlation is measured at lag 0, but the correlation is somewhat higher; see Table 4. So even from this perspective the indicator can be classified as concurrent. Note that the results of lead 1 to 3, for example, in the monthly perspective are not exactly like the results of lead 1 in the quarterly perspective, because the correlation depends on the position of the month in the

quarter.

3.2 Comparison with the Ifo Business Assessment Index

For the constructing of the BAI, the companies are asked if their actual business situation in this month is good, satisfactory or poor. Interviews and regression analyses show that the growth of exchange, the number of employed and/or a combination of these variables affects the business situation; see Oppenländer and Poser (1989).

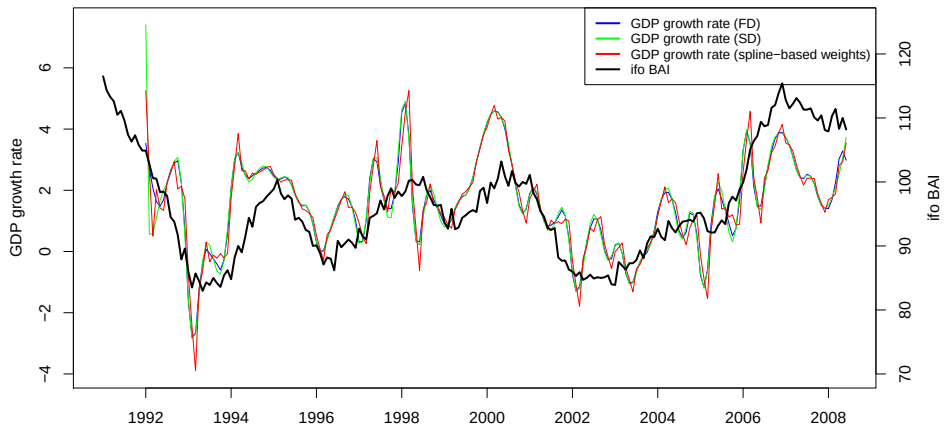

Figure 4: GDP growth rates and Ifo BAI

The BAI is displayed in Figure 4. Visually the indicator seems to run concurrent, especially after 2001. The cross correlation function in Figure 5

supports the assumption. The highest correlation is measured at lag 0 for the spline-based method and at lag 1 for FD and SD; see Table 2. Until 15 months the "lead-correlation" is always higher than the corresponding "lag-correlation". This results support the conception that the BAI has a higher connection to the past than to the future.

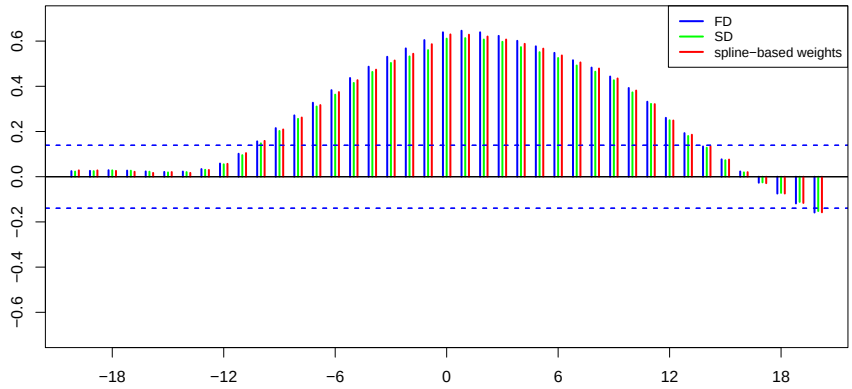

Figure 5: Cross correlation between GDP growth rates and Ifo BAI

In the quarterly analyses the BAI has the highest correlation at lag 0 and would be classified as a concurrent indicator in this perspective. Although no lag-structure could be measured, the "lag-correlations" up to 5 quarters are ever higher; see Table 4.

3.3 Comparison with the Ifo Business Expectation Index

The questions for BEI are similarly constructed to those of the BAI. The companies are asked if their business situation *in the next six months* will be good, satisfactory or poor. This question is directed to the future and marked by high uncertainness.

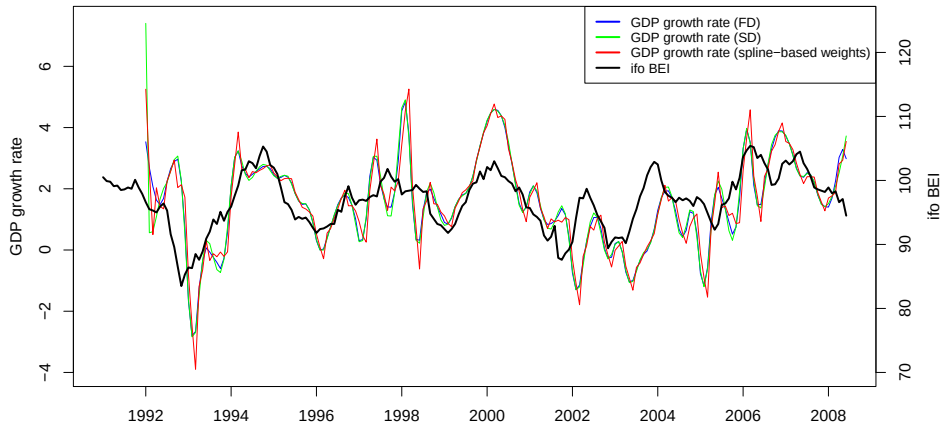

Figure 6: GDP growth rates and Ifo BEI

Figure 6 shows the BEI and the monthly GDP growth rates. A clear forerunning of the indicator can be detected, especially in the periods of 1992 to 1994 and 2002 to 2004. The cross correlation function displayed in Figure 7 supports this visually assumed connection. The highest correlation for all three methods is measured at lead 3. This can be interpreted such, that the

"real" economic change arrives at the companies 3 months after their estimation of the prospective situation at most, which is exactly the middle of the estimated period. This result is quite remarkable, because, as mentioned above, the question includes a high level of uncertainty.

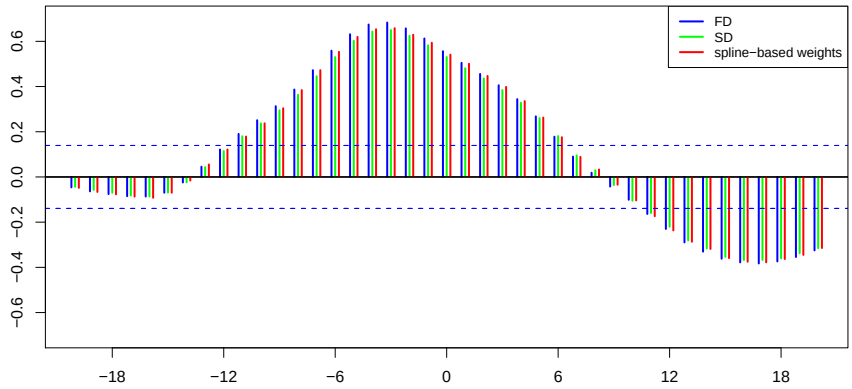

Figure 7: Cross correlation between GDP growth rates and Ifo BEI

Also from the quarterly perspective a lead structure of the BEI can be measured; see Table 4. The highest correlation is detected at lag 1, which is overall the highest measured correlation in the analyses of this paper.

4 Summary and outlook

The analysis in this paper show that there is a close connection between the Ifo indicators and disaggregated German GDP. The highest correlation of all three indicators is around 0.65, which is a high value for a latent variable like the economic performance. The BCI as well as its components, the BAI and the BEI, have a high correlation with the monthly GDP growth rate and confirm the results of several analyses from a quarterly perspective. Especially the results for the BEI show that the construction of the question about the prospective business assessment measures is correct. Also the BAI, which has a closer connection to past than to the future, confirms the idea that the companies react to the economic situation directly or with a slight delay.

Additionally, the analysis shows that the results depend only marginally on the chosen method of disaggregation, and, that the correlations with SD are lower than those with FD. It should be noted that analyses that exclude the values of 1992 lead to higher correlations. The values before 1992 are some what critical because on the one hand the disaggregation methods produce very different values at the beginning of the time series and on the other hand the values of the indicators shortly after reunification are afflicted with a slightly higher degree of uncertainty.

The analyses also show that the disaggregation method with spline-based

weights presented here leads to reasonable and similar results as with the FD and the SD method. In a next step the influence of the diverse interpolation methods should be analysed, embedding them into a mathematical theory. Moreover, for example by using simluation studies, it should be investigated whether this method may yield better results than the other methods.

A Correlation tables

	FD		SD		spline	
	lead	lag	lead	lag	lead	lag
0	0.674	0.674	0.644	0.644	0.662	0.662
1	0.672	0.659	0.628	0.627	0.651	0.646
2	0.663	0.636	0.625	0.605	0.635	0.619
3	0.648	0.606	0.615	0.578	0.626	0.591
4	0.613	0.566	0.584	0.540	0.596	0.553
5	0.561	0.518	0.534	0.497	0.549	0.508
6	0.494	0.461	0.468	0.446	0.486	0.452
7	0.420	0.402	0.397	0.388	0.412	0.394
8	0.346	0.350	0.326	0.341	0.338	0.352
9	0.277	0.297	0.260	0.288	0.269	0.294
10	0.211	0.238	0.199	0.222	0.207	0.229
11	0.149	0.170	0.140	0.165	0.146	0.159
12	0.091	0.093	0.086	0.089	0.090	0.082
13	0.043	0.021	0.041	0.015	0.044	0.017
14	0.008	-0.038	0.006	-0.036	0.007	-0.033
15	-0.012	-0.091	-0.013	-0.090	-0.012	-0.091
16	-0.017	-0.136	-0.018	-0.134	-0.024	-0.137
17	-0.014	-0.173	-0.013	-0.166	-0.019	-0.173
18	-0.009	-0.204	-0.007	-0.196	-0.012	-0.199
19	-0.006	-0.226	-0.004	-0.214	-0.006	-0.221
20	0.000	-0.243	0.000	-0.234	0.002	-0.238

Table 1: Correlations between GDP growth rates and the BCI

	FD		SD		spline	
	lead	lag	lead	lag	lead	lag
0	0.639	0.639	0.611	0.611	0.630	0.630
1	0.604	0.646	0.560	0.613	0.586	0.628
2	0.568	0.639	0.532	0.607	0.544	0.620
3	0.531	0.623	0.503	0.597	0.514	0.607
4	0.487	0.601	0.463	0.573	0.474	0.588
5	0.437	0.577	0.415	0.551	0.427	0.567
6	0.383	0.548	0.363	0.525	0.375	0.536
7	0.327	0.515	0.311	0.492	0.317	0.506
8	0.271	0.483	0.256	0.465	0.262	0.479
9	0.215	0.443	0.202	0.427	0.209	0.435
10	0.156	0.392	0.148	0.373	0.158	0.381
11	0.102	0.332	0.095	0.322	0.104	0.321
12	0.058	0.261	0.055	0.250	0.057	0.249
13	0.034	0.193	0.031	0.180	0.030	0.186
14	0.023	0.134	0.020	0.129	0.017	0.134
15	0.021	0.077	0.019	0.073	0.021	0.076
16	0.023	0.023	0.022	0.019	0.017	0.020
17	0.027	-0.027	0.027	-0.025	0.022	-0.029
18	0.029	-0.075	0.028	-0.072	0.026	-0.074
19	0.026	-0.118	0.025	-0.111	0.028	-0.116
20	0.025	-0.158	0.023	-0.152	0.028	-0.158

Table 2: Correlations between GDP growth rates and the BAI

	FD		SD		spline	
	lead	lag	lead	lag	lead	lag
0	0.556	0.556	0.531	0.531	0.541	0.541
1	0.613	0.505	0.582	0.481	0.594	0.501
2	0.657	0.456	0.624	0.436	0.629	0.447
3	0.683	0.406	0.650	0.385	0.658	0.398
4	0.674	0.344	0.643	0.328	0.653	0.336
5	0.631	0.268	0.602	0.260	0.620	0.263
6	0.559	0.178	0.530	0.181	0.554	0.176
7	0.472	0.090	0.446	0.095	0.472	0.089
8	0.387	0.019	0.363	0.029	0.384	0.033
9	0.313	-0.043	0.294	-0.036	0.304	-0.034
10	0.251	-0.101	0.237	-0.105	0.237	-0.104
11	0.191	-0.164	0.180	-0.160	0.179	-0.174
12	0.121	-0.230	0.115	-0.220	0.121	-0.237
13	0.045	-0.290	0.043	-0.281	0.055	-0.287
14	-0.025	-0.331	-0.024	-0.316	-0.016	-0.319
15	-0.070	-0.362	-0.069	-0.353	-0.070	-0.359
16	-0.087	-0.378	-0.086	-0.368	-0.092	-0.375
17	-0.085	-0.383	-0.082	-0.367	-0.087	-0.378
18	-0.076	-0.374	-0.070	-0.360	-0.077	-0.363
19	-0.064	-0.354	-0.057	-0.337	-0.066	-0.345
20	-0.046	-0.325	-0.044	-0.315	-0.048	-0.314

Table 3: Correlations between GDP growth rates and the BEI

	BCI		BAI		BEI	
	lead	lag	lead	lag	lead	lag
0	0.696	0.696	0.658	0.658	0.582	0.582
1	0.666	0.624	0.548	0.639	0.703	0.427
2	0.509	0.478	0.396	0.566	0.579	0.189
3	0.292	0.305	0.227	0.454	0.332	-0.044
4	0.101	0.098	0.067	0.270	0.135	-0.241
5	0.001	-0.086	0.032	0.085	-0.059	-0.369
6	0.000	-0.205	0.038	-0.073	-0.072	-0.384
7	0.012	-0.250	0.033	-0.189	-0.033	-0.293
8	0.063	-0.199	0.079	-0.220	0.013	-0.102

Table 4: Correlations between quarterly GDP growth rates and the Ifo indicators

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