

Abberger, Klaus

**Working Paper**

## Qualitative Business Surveys and the Assessment of Employment: A Case Study for Germany

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# Working Papers

## Qualitative Business Surveys and the Assessment of Employment A Case Study for Germany

Klaus Abberger

Ifo Working Paper No. 11

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# Qualitative Business Surveys and the Assessment of Employment A Case Study for Germany

## Abstract

Business tendency surveys are a commonly accepted instrument for the assessment of the current business cycle course. Most of these surveys rely on qualitative questions about the current situation of the firms and about their expectations for the next months. This paper analyzes whether qualitative questions about employment expectations are useful to assess actual employment changes. In Germany the Ifo Institute is specialized on business surveys. The German Ifo data are investigated using three different approaches: Smoothing techniques help to date turning points in the course of the series. Error correction models are used to analyze the general lead/lag relations and Probit models are used to estimate a threshold for the survey based indicator which helps to differentiate between an increase and a decrease in employment. All three methods indicate that the employment expectations form a leading indicator of actual employment changes.

JEL Code: C2, C4.

Keywords: Business tendency surveys, employment, employment expectations, turning points, Granger-causality, error correction models.

Klaus Abberger  
Ifo Institute for Economic Research  
at the University of Munich  
Poschingerstr. 5  
81679 Munich, Germany  
Phone: +49(0)89/9224-1266  
abberger@ifo.de

# 1 Introduction

For the analysis of the economic course fast available indicators of business cycle relevant variables are needed. A possible procedure to get early signals about the business cycle course is the execution of companies surveys. In Germany the Ifo Institute has specialized in business surveys. About 7000 firms are asked monthly about their assessment of the current business situation and about their expectations for the coming months. Among others, questions about total order quantity, price expectations and inventory investment are asked. This article is concerned with the results of a question about the employment expectations for the next three months. For the question three possible answers are provided: The number of employed persons will increase, remain approximately the same or decrease. Balances from the answers “increase” and “decrease” are calculated and used as an indicator for actual employment. For a comprehensive description of the Ifo surveys see Goldrian (2004).

This article uses the balances of the survey results from the Ifo institute and examines, whether the course of the actual employment can be analyzed with these data. The statistical offices try to assess the actual monthly amount of employed persons with expensive proceedings. These numbers are used here as reference data. It is examined, whether the survey data yield a fast available and perhaps leading indicator.

At the moment, companies from the four sectors manufacturing, construction, wholesale and retail are asked monthly. The survey results for the four sectors are weighted together to an employment expectation index of trade and industry. Although the service sector is not yet included, the suitability of the index is analyzed in respect to overall employment. Services is indeed a very important sector and the Ifo Institute is working on a service panel, but the data are preliminary at the moment and hence not included in the present investigations of the employment expectations. Nevertheless, employment in all sectors is used as reference time series. It is intended to use the survey based index to get signals about the future course of employment changes. It is not the aim to forecast the absolute amount of employed persons.

The statistical instruments used for the evaluation of the business tendency survey based indicator consists of nonparametric regression methods, error correction models and Probit models. But before these methods can be used the data have to be prepared. This is done in the next section. In the following three sections the above mentioned methods are applied. The last section summarizes the results.

## 2 Data preparation

Ifo Employment Expectations time series are available for the four sectors manufacturing, construction, wholesale and retail. Monthly time series ranging from January 1995 to Mai 2004 are used in this study. The sectoral results are weighted together according to the number of employed persons stated by the national accounting in 2000. The used weights are:

Manufacturing: 0.51

Construction: 0.17

Wholesale: 0.11

Retail: 0.21.

The reference data on employment are provided by the Federal Statistical Office Germany ([www.destatis.de](http://www.destatis.de)). The office publishes monthly employment estimates as part of national accounts. The data are published about 70 days after the end of the corresponding month. But even then the values are subjected to revisions. For detailed descriptions and a comprehensive definition of employed persons see the above mentioned web page. Since the surveys focus on changes in employment, not the absolute amount of employed persons but the yearly differences in employment are suitable reference data. Figure 1 shows the the survey based indicator along with the reference employment series which is rate of change of employed persons to last years month in percent.

Visual inspection of the graphs judge the attempt to use the qualitative survey results as an indicator for the course of actual employment changes. The general course of the two time series is very similar although the amplitudes

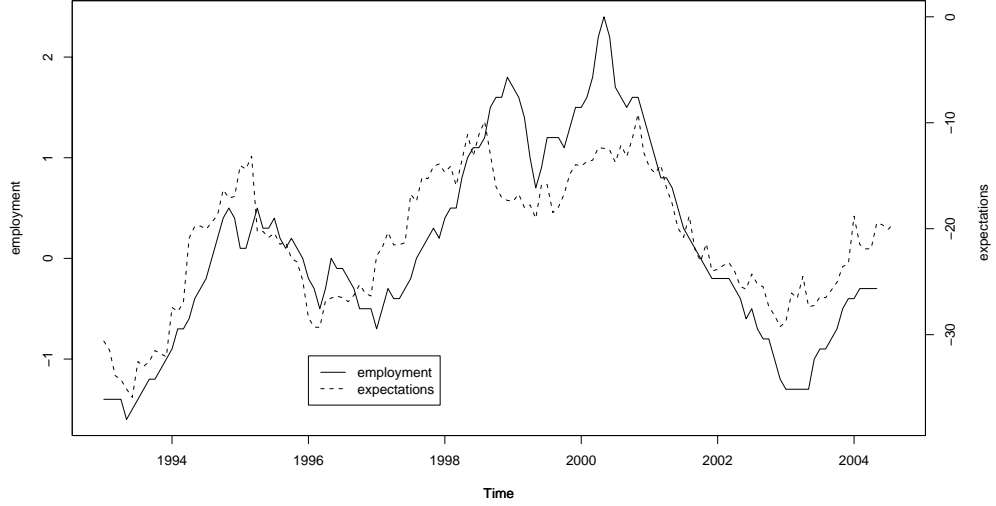


Figure 1: Reference employment series (rate of change of employed persons to last years month) and Ifo Employment Expectations (January 1995-Mai 2004)

are not always equally pronounced. The expectations seem to give reasonable results about turning points in employment changes.

One important remark about the employment expectations has to be made: Before July 1997 the question about employment was asked in the manufacturing sector only quarterly. In the remaining three sectors the question was asked monthly during the whole time period under consideration. To get an end-to-end monthly series for manufacturing, state space methods are used to estimate the missing values.

A structural time series model called local linear trend model is given by (see e.g. Durbin, Koopman, 2001)

$$y_t = \mu_t + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma_\epsilon^2), \quad (1)$$

$$\mu_{t+1} = \mu_t + \nu_t + \xi_t, \quad \xi_t \sim N(0, \sigma_\xi^2), \quad (2)$$

$$\nu_{t+1} = \nu_t + \zeta_t, \quad \zeta_t \sim N(0, \sigma_\zeta^2). \quad (3)$$

$y_t$ ,  $t = 1, \dots, n$ , is the observed time series. Equations (2) and (3) are so called state equations. If  $\xi_t = \zeta_t \equiv 0$  then the trend is exactly linear and the model reduces to the deterministic linear trend plus noise model. With  $\sigma_\xi^2 > 0$  and  $\sigma_\zeta^2 > 0$  the model allows the trend and the slope to vary over time. The model can be estimated with the Kalman filter technique. With  $\sigma_\epsilon^2 \equiv 0$  the filter is used to extrapolate the part of the time series which is obtained quarterly to a monthly time series. This modified time series for manufacturing is then used for the composition of the overall indicator.

### 3 Smoothing and analysis of turning points

Survey based indicators are frequently used to assess the future course of the economic activity. Evidences for accelerations, deceleration or turning points are searched. Such statements refer actually to the slope of the examined time series. E.g. a change point occurs when the first derivative changes its sign. A nonparametric estimation method which is suitable to get slope estimates is local polynomial regression. See Fan and Gijbels (1996) for a monograph about this method. Nonparametric methods benefit from only weak model assumptions they require. Abberger (2004) used this method for detecting turning points in the Ifo business climate.

Consider the equidistant design nonparametric regression model

$$Y_i = g(t_i) + \epsilon_i, \quad (4)$$

where  $t_i = (i - 0.5)/n$ ,  $i = 1, 2, \dots, n$ ,  $g : [0, 1] \rightarrow R$  is a smooth function and  $\epsilon_i$  is the innovation process with mean 0 and common variance  $\sigma^2$ .

Assume that  $g$  is at least  $(p + 1)$ -times differentiable at a point  $t_0$ . Then  $g(t)$  can be approximated locally by a polynomial of order  $p$ :

$$g(t) = g(t_0) + g'(t_0)(t - t_0) + \dots + g^{(p)}(t_0)(t - t_0)^p/p! + R_p \quad (5)$$

for  $t$  in a neighborhood of  $t_0$ , where  $R_p$  is a remainder term. Given  $n$  observations  $Y_1, \dots, Y_n$  an estimator of  $g^{(v)}$  ( $v \leq p$ ) can be obtained by solving the

locally weighted least squares problem

$$Q = \sum_{i=1}^n \left\{ Y_i - \sum_{j=0}^p \beta_j (t_i - t_0)^j \right\}^2 K \left( \frac{t_i - t_0}{h} \right) \Rightarrow \min, \quad (6)$$

where  $h$  is the so called bandwidth and  $K$  is a kernel function (a symmetric density having compact support  $[-1, 1]$ ). Let  $\hat{\beta} = (\hat{\beta}_0, \hat{\beta}_1, \dots, \hat{\beta}_p)^T$  be the solutions of (3), then  $v! \hat{\beta}_v$  estimates  $g^{(v)}(t_0)$ ,  $v = 1, \dots, p$ .

In this article  $p = 2$  and a Gaussian kernel is used for the estimation of the first derivative, which is a common approach. There remains the choice of a bandwidth  $h$  which is always a crucial point in nonparametric regression. For data based bandwidth choice Abberger (2004) has used a so called "plug-in" algorithm which goes back to Gerard and Schucany (1997). This procedure which is completely data driven, is applied to the two employment series under consideration in this article.

The estimation results are shown in Figure 2. Remind that estimates for the slopes are shown and that a turning point in the original series is indicated when the slope estimates cross the zero line.

The results seem to be appealing. The first turning point of the reference series is indicated by the expectation series with a lead of 4 months. The second one is signaled with a lead of 3 months. Then the survey results indicate a weakness which is not as pronounced in the reference series. This is also recognizable in the original data in Figure 1. There is a sharp decrease in 1999 and after that a pronounced increase in the reference series. In the expectations this increase is not as strong. The following turning point in the reference series is signalled by the expectations with a lag of 3 months. The last turning point is indicated with a lead of 2 months by the expectations. All in all the qualitative survey result seem to be very suitable to get an early indicator of the general course of employment changes. In addition one should take into account that the survey data are available very fast. So they also have a publication lead.



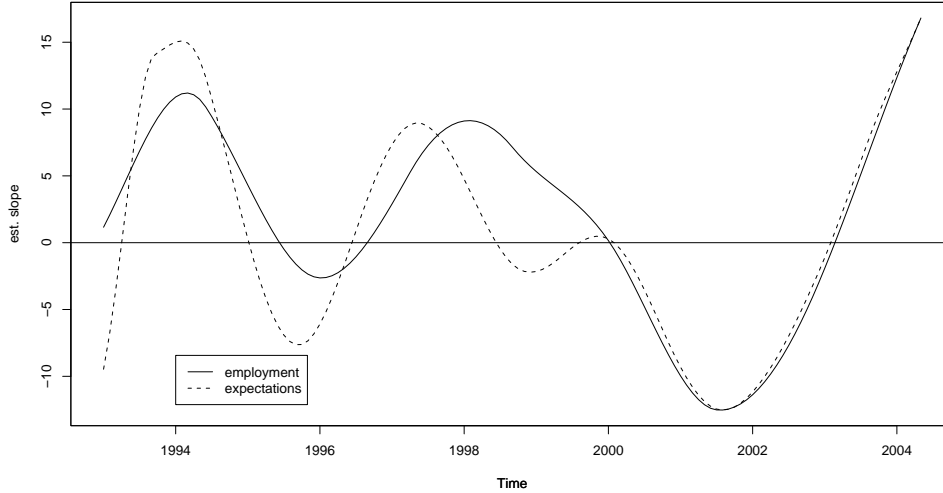


Figure 2: Slope estimates for reference employment and Ifo Employment Expectations

## 4 Error correction models

In this section not only the turning points but the general relations of the expectation series and the appropriate reference series of employment are examined. If the two time series under consideration are both stationary, a traditional concept for analyzing the time series is testing for Granger-causality. The stationarity of the individual series must therefore be examined in a first step. Integrated series can be tested for cointegration. If the series are integrated of order one and are not cointegrated, the usual Granger-causality test can be applied to the first differences of the time series. If the series are cointegrated error correction models can be applied (Granger, 1988). These kind of models incorporate an expression for the deviation of the common equilibrium of the variables under consideration. However, it should be taken into account that error correction model are also often used to analyze stationary series. For a motivation of error correction models see e.g. Banerjee et al. (1993). A discussion of the near-integrated case is contained in De Boef and Grantano (1999). The interrelation between error correction models and causality test is treated in Granger (1988).

## 4.1 Univariate time series characteristics

Before the relations between the bivariate time series are examined, the univariate features must be analyzed. Figure 3 shows the autocorrelations of the reference series. There is a very slowly decay of the autocorrelations noticeable. This is an indication that the examined time series may be integrated. Calculation and inspection of the periodogram would also point to a possible nonstationarity because the periodograms of both series exhibit large values at the lowest frequencies. Another indication for integration of order one is the fact, that the variance of the differenced series is smaller than the one of the original series. Calculating the variance for the second differences yields again a higher value. Although not a proof, this is an further indication for integration of order one (see Mills, 1999, p. 63).

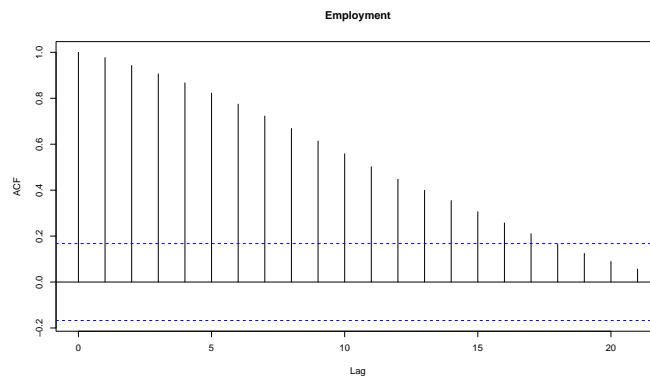


Figure 3: Estimated autocorrelation function for reference employment

Table 1 contains p-values for various unit root test. The augmented Dickey-Fuller test (ADF test) including only a constant and including a linear trend is calculated. The the lag-length is chosen with two alternative information criteria, once with AIC and once with SIC. Another test used here is the Phillips-Perron test (PP test). Both of these test have stationarity as alternative hypothesis. Contrary to this the Kwiatkowski, Phillips, Schmidt, and Shin test (KPSS test) has stationarity as Null hypothesis.

The test results do not coincide completely. The ADF test with a constant and autoregressive order chosen by AIC rejects the Null hypothesis. But all

p-values for		Reference	Expectations
ADF test (AIC)	const.	0.1813	0.031
	linear	0.5057	0.1134
ADF test (SIC)	const.	0.3317	0.2770
	linear	0.7297	0.6390
PP test	const.	0.3736	0.2591
	linear	0.8026	0.6163
KPSS test	const.	***	***
	linear	***	***

Table 1: p-values for various unit root test for reference and expectations time series (for the KPSS test p-values are only indicated by: 0: p-value > 0.1, \*: p-value < 0.1, \*\*: p-value < 0.05, \*\*\*: p-value < 0.01)

other ADF tests and the PP test do not reject the Null hypothesis. The KPSS tests clearly reject the Null hypothesis of stationarity. These tests on unit roots are disputable, see e.g. Maddala and Kim (1998) for a critical discussion. Nevertheless the above results indicate that the use of error correction models seems to be advantageous. These class of models can be used for integrated time series which are cointegrated. On the other hand these models are also used to analyze the relationships of stationary time series. Tests for the first differences of the data under investigation show that there are no unit roots anymore. Hence the time series are at most integrated of order one.

## 4.2 Bivariate models

For time series which are integrated of the same order it is possible to test for cointegration. The Phillips-Ouliaris test (PO test), the Johansen trace test and the Saikkonen and Lütkepohl test, which is described in Lütkepohl et al. (2004), are used to test for cointegration between the expectations and the reference employment. The p-value for the PO test is 0.04114. The p-values for the other tests are contained in Table 2. Since the two series do not have an apparent linear trend only a constant is added to the test equation. Also the number of lags of both variables in the test equation has to be chosen. The information criteria AIC and SIC both indicate that two

Test	No. of lags in VAR	Null hypothesis	p-value
Johanson trace test	1	r=0	0.0101
		r=1	0.4922
	2	r=0	0.2195
		r=1	0.3744
Saikkonen, Lütkepohl	1	r=0	0.0010
		r=1	0.7652
	2	r=0	0.0780
		r=1	0.6625

Table 2: P-values for cointegration tests

lags are appropriate. In the table, r denotes the cointegration rank. The tests are considered sequentially. If r=0 cannot be rejected, a VAR process in the first differences may be appropriate. At the other end, if both Null hypotheses can be rejected, a levels VAR process could be considered for the subsequent analysis. If only r=0 is rejected, a model with a cointegration relation should be applied (see Lütkepohl et al., 2004).

The results of the various cointegration test are mixed. There seem to be indications for cointegration but the results are not clear cut. Overall the tests for unit roots and for cointegration show that testing Granger-causality in an standard VAR model is not recommendable. Therefore error correction models are used to analyze the relation between the two considered time series further. Subsequently a procedure discussed by Lütkepohl et al. (2004) for testing Granger-causality of I(1) processes with unsure cointegration properties is applied.

For the bivariate process  $\{y_t, x_t\}$  the error correction model (ECM) is

$$\Delta y_t = \alpha + \gamma z_{t-1} + \text{lagged } (\Delta x_t, \Delta y_t) + \epsilon_t, \quad (7)$$

with  $z_t = y_t - \beta x_t$  and  $\Delta x_t = x_t - x_{t-1}, \Delta y_t = y_t - y_{t-1}$ . When  $y_t^* = \beta x_t$  the term  $z_t$  represents the the value of disequilibrium. If there exists such an equilibrium this discrepancy, or error, should be a useful explanatory variable for the next direction of movement of  $y_t$ . The bivariate ECM model relate the change in in one variable ( $\Delta y_t$ ) to past equilibrium errors, as well as to

$z_{t-1}$	-0.037 (0.009)	0.08 (0.004)	-	-
$\Delta x_{t-1}$	0.016 (0.034)	0.016 (0.029)	-	-
$\Delta x_{t-2}$	0.002 (0.774)	-	-	-
$\Delta y_{t-1}$	0.399 (<0.001)	0.365 (<0.001)	0.48 (<0.001)	0.43 (<0.001)
$\Delta y_{t-2}$	-0.097 (0.254)	-	0.128 (0.151)	-
$R^2$	0.3089	0.3012	0.1993	0.1858
$adj R^2$	0.2804	0.2841	0.1863	0.1793
AIC	-3.997	-4.001	-3.87	-3.86
SIC	-3.844	-3.91	-3.812	-3.834

Table 3: ECM and AR model estimation results (p-values in brackets)

past changes in both variables.

Table 3 contains the OLS estimation results for ECM models with lags of changes in each,  $x$  and  $y$  and for comparison results for two AR models of differences in  $y$  alone. In this table  $x$  denotes the Ifo employment expectations and  $y$  stands for the reference employment data. The last two columns of Table 3 contain the estimation results for an AR(2) and an AR(1) model. Larger models are excluded because the information criteria do not support them. Comparing the remaining two AR models leads to the conclusion that an AR(1) is satisfactory.

The first two columns of the table contain the results for estimated ECM models. Also in this case the smaller model with one lag in  $\Delta x$  and one lag in  $\Delta y$  seems sufficient. The significance of  $\Delta x_{t-1}$  shows that the employment expectations are in fact helpful for assessing employment. Looking at  $R^2$  and  $adj R^2$  indicates a noticeable improvement from 0.1858 to 0.3012 resp. from 0.1793 to 0.2841.

Another strategy for testing causality is presented in Lütkepohl et al. (2004) and Dolado, Lütkepohl (1996). Testing for Granger-causality is usually done in a VAR framework. Tests for zero restrictions on VAR coefficients are applied. Unfortunately, these tests may have nonstandard asymptotic properties if the VAR contains I(1) variables. Dolado and Lütkepohl (1996) showed that simply overfitting the VAR order and ignoring the extra parameters in testing for Granger-causality overcomes the problems associated with standard

tests - at least if asymptotic properties are of interest. This procedure can even be used if the cointegration properties of the system are unknown.

In the present application an ECM model with one lag in the differences seems appropriate, which corresponds to a VAR(2) model for the levels. The Null hypothesis that the expectations do not Granger-cause the reference series is rejected with a p-value of 0.0006 on basis of a F-test with an overfitted VAR(3) model. Therefore the conclusion that the employment expectations help to improve forecasts of actual employment changes is justified.

## 5 Probit analysis

The previous two sections analyzed the turning points and the general course of the two time series under consideration and indicated a leading behavior of the expectation series before the reference employment series. A further interesting point in this manner would be the question, whether there is a threshold for the employment expectations which can be used to differentiate between a decrease and an increase in actual employment. As one can see in Figure 1 the expectation series is not centered around zero. One reason for that is that there might be a systematic bias in the series. In the present case the respondents tend to be pessimistic. This bias is often called the dolor component. On the other hand it has to be taken into account, that the aim of this paper is to assess the overall employment with survey results of only four sectors, namely manufacturing, construction, wholesale and retail. This is only a fraction of the sectors which are relevant for assessing total employment. But it could be possible to estimate a threshold from the available data which differentiates between an increase and a decrease in employment. To achieve this, Probit models are estimated.

For the Probit analysis the signs of the reference data are used as dependent variable. Instead of using the amount of the yearly difference in employment only the values +1 for a positive amount and -1 for a negative number is utilized. As independent variable the usual expectations are used. Only one lag of the expectations at a time is included in the regression model. That

Probit	Lag					
	0	1	2	3	4	5
<i>Intercept</i>	2.79	2.82	2.79	2.77	2.75	2.69
<i>Expectations<sub>t-lead</sub></i>	0.13	0.14	0.13	0.13	0.13	0.13
AIC	236.74	222.14	220.98	218.78	218.14	227.84
est. threshold	-20.68	-20.81	-20.9	-21.00	-21.08	-21.17

Table 4: Probit estimation results

means the probability of a positive sign is

$$Pr(sign(y_t) = 1|x_{t-lag}) = F(\alpha + \beta x_{t-lag}), \quad (8)$$

where Pr stands for probability and F is a distribution function. By using a Probit this distribution function is assumed to be a Gaussian one.

Table 4 contains the estimation results for different lags of the expectation series. Using AIC the regressions with lag 3 and lag 4 give the best results. The corresponding threshold is the value where the probability in (8) is estimated to be equal to 0.5. For both lags the estimated threshold is about -21.0.

To compare the employment expectations and the reference series again, from the expectation series the value -21 is subtracted and both series are divided by their standard deviations. The standardized series are shown in Figure 4. Visually the two series fit together a little better now than in the first figure with the raw data. It is also confirmed that a change in the sign of the reference series is indicated by standardized expectation series with a lead of about 3 or 4 months on average.

## 6 Summary

The aim of this paper is to analyze whether the results of qualitative business surveys are useful to assess monthly changes in the amount of employed people in a economy. Available German data of the Ifo Institute are used

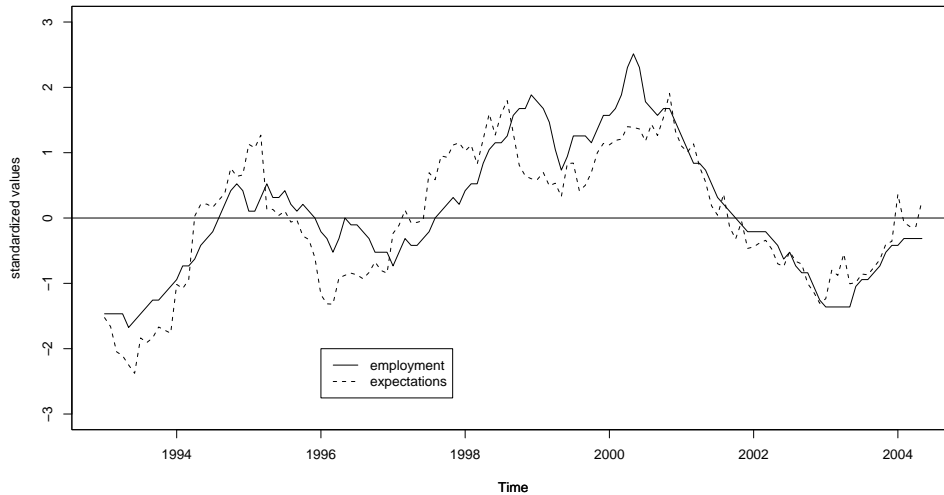


Figure 4: Standardized reference employment and Ifo Employment Expectations series

and compared with German employment data published by the German Federal Statistical Office. Longer time series of survey results are available for the sectors manufacturing, construction, wholesale and retail. For the service sector there does not yet exist such a time series of business tendency survey results. But when for the business cycle mainly relevant sectors are covered, it should be at least possible to assess the course of actual employment.

In this paper three different approaches are used to analyze the data. All methods indicate that the survey results are very useful to assess actual employment changes and they show that the survey based indicator leads the actual employment between two and four months. Despite this the survey data are available in the last week of the corresponding month whereas the reference data of the Statistical Office are on average published 70 day after end of month. In sum this shows that the survey results are useful for assessing employment changes and that they may also be a useful component in building more complex econometric models.



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