The *Service Sentiment Indicator* — A Business Climate Indicator for the German Business–Related Services Sector

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Summary: No other area of the German economy has developed so emphatically in the past ten years as that of business–related services. Regardless their growing importance, business–related services still play only a minor role in official statistics. Above all, official statistics do not provide up–to–date information on the state of the business cycle of this sector. In a situation where such quantitative information is lacking, data obtained from business surveys give important guidelines to the state of this part of the economy. In this paper we show how a reliable compounded business climate indicator for business–related services can be constructed from both business survey and national accounts data.

1 Introduction

In past years, hardly any another sector of the German economy industry has developed as dynamically as the service sector. The structural change from manufacturing to services has deepened in the last decade. Moreover, structures are not only altering amongst the economic sectors, but also within the service sector itself. Business–related services are gaining in importance, whereas traditional services, such as retail and wholesale trade, are losing their importance.

The strong growth of the service sector and especially that of business–related services has led to a heightened attentiveness as far as the public, the media and politics are concerned. In official statistics, however, business–related services plays a rather subordinate role. As far as these official statistics are concerned, around 80 separate statistics are available in total, covering varying characteristics such as the number of businesses, firms and employees, yet a systematic recording of services is missing.[1] As a result, it is not astonishing that no exact reports can be released which constitute the overall economic importance of the business–related services sector. Even the Federal Statistical Office has at its disposal almost no up–to–data and precise information on this sector.[2] This lack of data has recently been criticized by Hax (1998) and the Council of Economic Advisors (Sachverständigenrat, 1998).

To compensate for the lack of up-to- date data for business–related services, the Center for European Economic Research (ZEW) has carried out a quarterly business survey in this sector in cooperation with Germany's largest credit rating agency CREDITREFORM since June 1994.

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[1]Link (1996) refers to the usability of official statistics for the service sector in great detail.

[2]The Federal Statistical Office calculates the Gross National Product for the sector "services not noted elsewhere — among them are business–related services — on the basis of the value–added statistics which are available yearly with a delay of 18 months and the employment statistics, which are processed quarterly with delays of from six to seven months.

Since there is little information on business–related services available in official statistics, the ZEW/CREDITREFORM business survey has in some ways gained similar importance as the well known business surveys of the ifo institute at Munich which were developed after World War II to modernize and supplement the official statistics and which have been the only available source of information on the state of the economy for a long time (Strigel, 1997).
A further advantage of the ZEW/CREDITREFORM survey is that the results can already be publicized within one and a half to two weeks after the end of the data collection period. According to Oppenländer (1997), this quick data procession is an important reason as to why survey data should at least bear equal importance as quantitative data.

In this paper, we show the construction of the *Service Sentiment Indicator*, a business climate index which was first released in the second quarter of 1998 and which is gaining increasing recognition in the media, among financial institution and in economic policy.

2 The ZEW/CREDITREFORM business survey

The definition of business–related services is controversially discussed in literature. To our knowledge, no clear–cut and generally accepted definition exists. We follow the convention proposed by Hass (1995), Klodt et al. (1997) and Strambach (1995), who define business–related services by enumeration of certain sectors. In this paper, the following sectors are defined as business–related services (WZ93 code in the second column of the table):[3]

Sector	**WZ '93**
Computer services	72100, 72201–02, 72301–04, 72601–02, 72400
Legal & book–keeping activities	74123, 74127, 74121–22
Business management	74131–32, 74141–42
Architectural activities	74201–04
Technical testing & planning	74205–09, 74301–04
Advertising	74844, 74401–02
Vehicle renting	71100, 71210
Machine renting	45500, 71320, 71330
Cargo handling & storing	63121, 63403, 63401
Waste & refuse disposal	90001–90007

According to Hass (1995), business–related services represent an important link between the secondary and tertiary sectors. They support the quality and distribution of products. Furthermore, in literature it is presumed that business–related services ease the way to innovation, as is indicated in Licht et al. (1997). Additionally, as Steil (1997) points out, business–related services exhibit a well above–average firm foundation rate. In the last ten years, business–related services profited from distinct outsourcing–activities of

[3]The WZ93 code is a classification system which was developed by the German Federal Statistical Office in accordance with the European standard NACE, Rev. 1. The aim of this code is to be able to classify every firm with regard to its main economic activity.

the manufacturing sector. This can be partly lead back to its close relationship with the production sector. Some authors such as Audretsch and Yamawaki (1991), Hass (1995) and Lichtblau et al. (1996) use Input-Output tables to show that the relationship between services — here, particularly the business–related services — and the industry is in no way substitutive, as Fourastié (1950) amongst others had stated. The relationship between both areas is instead complementary.

The ZEW sends out a single–sided questionnaire every three months to about 4000 firms belonging to the ten economic sectors. The survey is constructed as a panel. It is a stratified random sample, stratified with respect to the ten sectors, regional affiliation (East/West Germany) and five size classes (two for East, three for West Germany). Details on the survey design and on the way expansion factors are constructed are given in Kaiser et al. (1999).
The data collection period starts three weeks prior to the end of a quarter. The questionnaires are mostly sent back to the ZEW by fax. After two weeks, those firms who still have not replied are sent a reminder. Altogether, the response rate amounts to about 30 per cent. As a thankyou for filling out the questionnaire, the participating firms receive a four page report. In addition, they can call up further information over the internet.[4]
The questionnaire is divided up into two parts. In the first part, firms are asked to indicate on a three–point Likert scale whether their sales, prices, demand, profits and number of employees have, in the respective previous quarter, either increased, stayed the same, or decreased. Moreover, they are supposed to give an assessment for the coming quarter. The second part of the survey is dedicated to present–day economic and political issues.[5] The following lines are exclusively concerned with the first part of the survey.

3 Dimensions of the business–related services sector

Out of the 80 single statistics which the Federal Statistical Office makes available, four are potentially able to report on growth and overall economic importance of business–related services. These are: (1) the Mikrozensus,[6] (2) the value–added statistic,[7] (3) the four–annual cost–structure statistic,[8] and (4) the employment statistic.[9] Although all four statistics are not primarily constructed for the recording of the service sector, they can be used as secondary statistics. In general there is the problem that all four statistics are only available with considerable delays and are therefore only partly suitable for economic observation. Another problem is the fact that the four statistics are not really comparable, since they are based on different levels of investigation. The Mikrozensus is a household survey, the value–added statistic collects data on the firm level and both the four–annual cost–structure and the value–added statistic are based on plant–level data.

[4]The internet address is: `http://www.zew.de/aktuell/branchenreport/wb-BreportStart.html`.

[5]On request we are happy to send a copy of the questionnaire.

[6]The Mikrozensus is an annual household survey conducted by the Federal Statistical Office.

[7]The value–added statistic is collected and processed by the Federal Statistical Office.

[8]The four–annual cost–structure statistic should not be mixed up with the quarterly cost–structure statistics in the construction and manufacturing sector.

[9]The employment statistic is collected by the Federal Labor Office and is processed by the Institute for Labor Research (IAB).

Services can therefore be described either in terms of a functional or a sectoral perspective. In the functional approach, activities performed by individuals stand in the foreground. This facilitates the contemplation of service activities in all sectors, including the producing sector. If the analysis is based on sector level, every company is categorized into a certain sector according to its main economic activity. This classification scheme forms the basis of the economy branch system WZ93. In contrast to the sectoral approach, the data material available for the functional analysis is sketchy and based on household surveys. Also, databases which integrate the sectoral and the functional perspective are rare and are associated with high costs.

Due to these reasons, the sectoral perspective forms the basis of this section. The WZ93-Code is used on a three–digit–level since all the included statistics — except for the value–added statistic — are coded on the WZ93 three–digit level. As a result, a detailed ordering of the branches such as in the ZEW/CREDITREFORM survey is not possible.

Aside from the problems which we have dealt with up until now, the recorded secondary statistics differ considerably over the course of time, with regard to their periodicity and up–to–dateness.

In their ZEW–report for the Federal Ministry of Science and Research on the innovative activities of the service sector, Ebling et al. (1999) have researched the four databases mentioned above in order to describe growth and dimensions of the service sector.

According to Ebling et al. (1999, Table 2–2), the number of firms in the entire service sector increased by 3.1 percentage points between 1994 and 1996. Computer services experienced the largest growth rates in this time period. They grew by 17.7 percent. Growth rates of technical services (architecture, technical advice and planning) were at 11.9 percent; those of the transportation sector at 17 percent and those of the heterogeneous segment of other business–related services at 3.9 percent. In comparison, the number of firms in the manufacturing sector decreased by 8.7 percent. The entire service sector constitutes 85.9 percent of the total number of firms in Germany. The share of software, transport and technical services is 15.3 percent. Table 1 gives an overview of the number of firms in the service sector.

Table 1: Number of firms and growth in business–related services

	1994 total	1994 in %	1996 total	1996 in %	change in%
Services	372,762	100	384,411	100	3.1
of it:					
— Wholesale trade	42,789	11.5	40,062	10.4	-6.4
— Retail trade	128,070	34.4	127,568	33.2	-0.4
— Cargo handling & storing	47,463	12.7	55,529	14.4	17.0
— Banks, insurance	7,313	2.0	7,033	1.8	-3.8
— Software	9,059	2.4	10,659	2.8	17.7
— Technical services	1,822	0.5	2,039	0.5	11.9
— other business–related services	136,246	36.6	141,521	36.8	3.9
Manufacturing	68,331		62,843		-8.7

It has to be stressed at this point that all figures presented in this section are based on a three–digit classification scheme whereas the ZEW/CREDITREFORM business survey is based on a five–digit code.
Ebling et al. (1999, Table 2-2) also calculate employment growth rates mainly based on data sources provided by the IAB. Table 2 displays employment growth rates of business–related services, entire services, and manufacturing industries. The figures in Table 2 are indexed with 1982 serving as the basis year. Since the IAB data do not follow the WZ '93 classification scheme, figures on some sectors, e.g. software, cannot be reported. It turns out that technical services and other business–related services account for very high growth rates. This growth in business–related services is of course also due to increased outsourcing activities of the manufacturing sector. However, regardless of the reasons for the growth dynamics of business–related services, Table 1 and Table 2 show that business–related services play an increasingly important role in the German economy, leading to a demand for an up–to–date indicator on the state of this sector's economic situation.

Table 2: Employment growth index for business–related services (1982=100 %)

Sector	**1982**	**1991**	**1996**
Manufacturing	100	107	89
Services	100	122	129
of it:			
— Wholesale trade	100	123	128
— Retail trade	100	117	119
— Banks/insurances	100	119	122
— Technical services	100	155	165
— other business–related services	100	157	189

4 Construction of the Service Sentiment Indicator

4.1 A three–stage approach

In this section we describe how we constructed the SSI in a three–stage approach. The SSI is a compounded indicator which consists of both survey and national accounts data. As

Kaiser (1998) has shown, the ZEW/CREDITREFORM business survey data are quite responsive to political events implying that such events may influence the response patterns of the survey participants. In order to dampen these impacts, we decided to additionally use national accounts data in the construction of the indicator. In this respect, our approach is comparable to that of Kranendonk and Jansen (1997) who construct a leading indicator for The Netherlands.
The construction of the SSI therefore proceeds in three steps. In the first step, we construct a partial indicator based on the ZEW/CREDITREFORM business survey data. This partial indicator is mixed in with national accounts data, namely with the gross value added (GVA) in "services not listed elsewhere". The ten business–related services segments investigated in the ZEW/CREDITREFORM business survey are among this more broadly defined sector. There are no better up–to–date data than the GVA in "services not listed elsewhere" available on a quarterly basis. The national accounts data are published by the German Institute for Economic Research (DIW), Berlin, quarterly with a lag of one quarter. Hence, the current GVA in "services not listed elsewhere" has to be forecasted for the current quarter before being merged with the partial indicator from the ZEW/CREDITREFORM business survey. In the third step, we attach weights to each of the two partial indicators in order to obtain one single compounded indicator.

4.2 The partial indicator based on the survey data

As a pre–step to the construction of the indicator, the individual responses of the participating firms have to be aggregated. As is usual for this kind of data, we use sales (demand, employment, profits) balances. Balances denote the share of firms reporting increased sales minus the share of firms reporting decreased sales.[10]
In the ZEW/CREDITREFORM business survey, both realized changes in sales and expectations for the next quarter are asked for. In order to merge both pieces of information, we proceed analogously to the ifo–business climate indicator. Our aggregates index for sales (likewise for the other variables) is:

$$UI \;=\; \Big((\text{Sales judgement}+200) \;\cdot\; (\text{Sales sales expectation}+200)\Big)^{1/2} \;-\; 200, \qquad (1)$$

where UI denotes the sales index. Equation (1) is the geometric mean of sales expectations and sales judgements. In order to avoid negative values in the square root, 200 is added. The time series used for the calculation of UI are seasonally adjusted with an approach described in appendix A. The aggregated indices for the other variables are constructed using the same procedure.
In the following, we use first differences of the aggregated indices since even survey data may have non–stationary components at times (Entorf and Kavalkakis, 1992).
How can the information contained in the aggregated indices of the four variables be condensed to a single indicator? In principle, one can attach arbitrary weights to the individual variables. However, particularly in the present case, the variables in question a highly correlated with one another, as becomes apparent from Table 3.

[10]The price variables are left out here since, as Entorf (1993) has shown for the ifo data, price variables are often not very reliable in business surveys.

Table 3: Correlations between the first differences of the aggregated indices of the survey variables

	Sales	Profits	Demand	Employment
Sales	1.0000			
Profits	0.7532	1.0000		
Demand	0.8012	0.6581	1.0000	
Employment	0.4554	0.5396	0.6016	1.0000

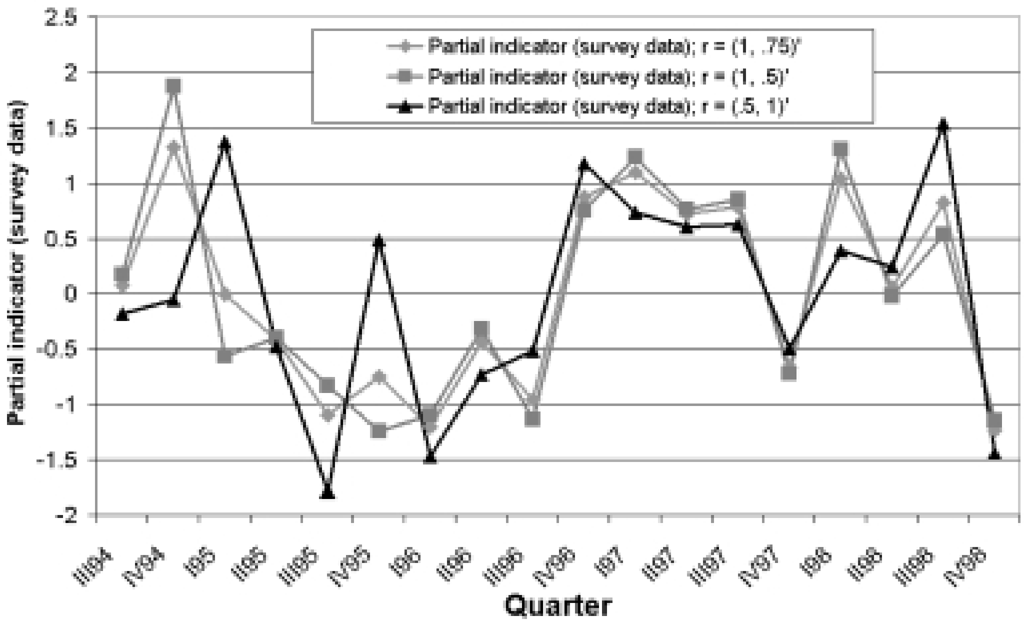
The construction of the partial indicator from the ZEW/CREDITREFORM business survey therefore follows Rao's (1971) proposal which was successfully implemented in the construction of the G–Mind (Szczesny et al., 1997). Rao proposes a regression–like approach to determine the weights used in a business climate indicator. Rao's suggestion is to transform the variables in question — in our case the aggregated sales, demand, profit, and employment indices — into variables with mean 0 and variance 1. The variance–covariance matrix $(X'X)^{-1}$ is then identical to the correlation matrix. If an appropriate proportionality vector r is defined, it can be shown that the weights of the individual components can be uniquely defined. Rao's approach leads to correlation–adjusted weights for the survey variables.

As a consequence of the high correlation of the survey variables, Rao's correlation–adjusted weights may become negative — an occurrence which is economically implausible. Therefore, we decided to consider the sales and employment variables only since these exhibit the weakest correlation with one another.

We define the proportionality vector as $r = (1,\ .75)'$ since sales is the more important variable from a firm's perspective. After adjustment for correlation and normalization, the final weights for the two components of the partial indicator of the survey data are 0.6909 for the sales variable and 0.3091 for the employment variable. These weights have an immediate interpretation: The first difference of the aggregated sales variables have a weight of 69.09 percent whereas the employment variables' weight is 30.91 percent.

Since the proportionality vector r is arbitrarily defined, we conducted a sensitivity analysis where we tried alternative combinations of the elements in r. Figure 1 plots the different partial indicators yield from alternative weighting of the sales and employment variables against a time axis. It turns out that the partial indicator calculated from the survey data is quite robust against different weighting schemes. Major differences only arise if the employment variable receive twice the value in r as the sales variables.

Figure 1: Attaching alternative weighting schemes to the partial indicator from the survey data: A sensitivity analysis



The figure compares different weighting schemes with one another. $r = (1, .75)'$ *means that the weight of the sales variable is 100 percent into the partial indicator from the survey data and that the weight of the employment variable is 75 percent, and so forth.*

4.3 The national accounts component of the SSI

We now turn to the second component of the indicator which is based on quarterly data of the national accounting system. Due to the lack of properly defined data for the business related service sector we are restricted to using the real value added data of the subaggregate "services not listed elsewhere" as a proxy. The data are seasonally unadjusted and are published with a delay of one quarter by DIW. The fact that the national accounts data are published with a lag of one quarter makes it necessary to find an econometric model enabling us to forecast the current gross value added of "services not listed elsewhere".

Since the ZEW/CREDITREFORM business survey is conducted for the entire of Germany, we also use the German gross value added data instead of West German data only. This restricts the sample period from 1992/I to 1998/III, implying that a maximum of 27 observations are available.

Figure 2 shows the growth rates of gross value added — in constant prices — for East and West Germany separately. From the second half of 1991 until the end of 1992 growth rates were extraordinarily high in East Germany as a result of the reconstruction of the economy. These unusual growth rates are not related to any business cycle movements. For the indicator to measure business cycle phenomenon correctly we shorten the investigation period to 1993/I to 1998/III. Starting in 1993/I, Figure 2 shows that the data cover roughly one business cycle, beginning with the recession in 1993, moving to a moderate recovery period up to 1996/II and finally to a down swing phase thereafter, which was especially pronounced for East Germany.

We model the first differences of gross value added. The reason for doing so is that levels are not very informative with respect to business cycle movements, whereas changes in the series, captured by taking first differences, provide information about the direction of the economic activities in this sector. Furthermore, by taking first differences we eliminate the nonstationary component in the series which represents the long term component in the series. Following Oppenländer (1996, p. 27), typical leading indicators for a business cycle are changes in inventory, order activities, survey data on expected business cycle developments, the number of building permits and the like. To proceed one step further in the construction of the second component of the indicator we selected several time series from the Federal Statistical Office which we think could be useful in predicting the development of the gross value added of the sector "services not mentioned elsewhere". In addition we used several capacity utilization rate time series for certain subsectors of the industry published by the ifo-Institute, Munich. In a first step we looked at the cross correlations between the selected series and the gross value added in order to determine the lead structure of the series. After the preselection of the explanatory variables we ran several multiple regressions by adding and/or dropping variables from the list of the preselected data.

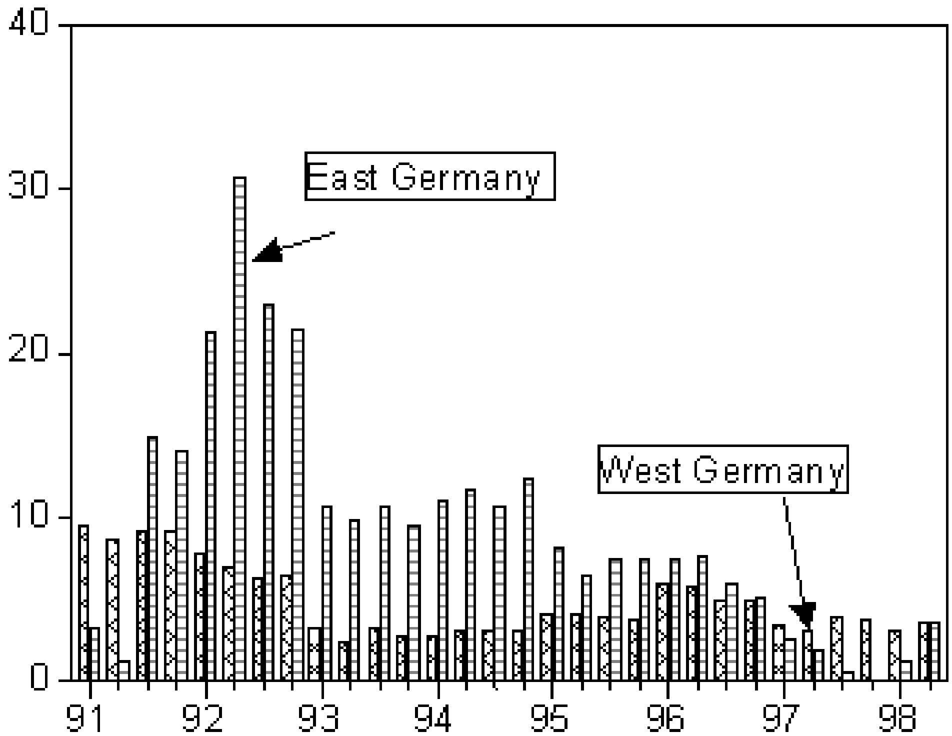
Among the list of variables selected are sales in several industrial sectors, several producer prices, production indices for the whole economy as well as for different sectors and different goods (investment goods, durable consumption goods, nondurable consumption goods), building allowances, various business climate indices, and data taken from the ZEW Financial Market Report (Szczesny et al., 1997). If necessary, variables were seasonally adjusted and transformed into stationary series before entering the regression. Besides indicators for Germany we further distinguished between data for West Germany as well as for East Germany.

The regression we think is best suited to predict gross value added is

$$\begin{array}{rcccccc} \Delta y_t & = & \underset{(8.015)}{53.37+} & \underset{(8.443)}{0.101\, bce_{t-1}-} & \underset{(7.840)}{0.555\, cap_t+} & \underset{(4.266)}{0.176\, cab_{t-4}} & \\ & - & \underset{(4.228)}{0.265\, cabg_{t-4}+} & \underset{(3.535)}{0.059\, ord_{t-1}+} & u_t- & \underset{(2.078)}{0.534\, u_{t-1},} & \end{array} \qquad (2)$$

where Δ is the first difference operator, y is the gross value added of services not mentioned elsewhere in constant prices, *bc* is the ifo business climate index for the West German economy, cap is the industrial capacity utilization rate, *cabg* is capacity utilization in the consumption goods industry, and *ord* are the back orders in the investment goods producing sector. In addition the regression equation includes a first order autoregressive structure in the error term u_t to account for persistence in the series. The adjusted R^2 of equation (2) is 0.738, the Durbin Watson test statistic is 2.488, the sum of squared errors is 0.266, and the number of observations is 20.

Figure 2: Annual growth rates in "Services not listed elswhere" for East and West Germany



The figure displays annual growth rates of the national accounts subaggregate "services not listed elsewhere" in East and West Germany.

The equation explains for about 74 % of the variation in gross value added growth, and all coefficients are statistically different from zero at the usual significance levels, as can be seen from t–values printed in parenthesis below the estimated coefficients. The residuals of the equation are white noise although the Durbin Watson statistics gives a vague hint towards negative serial correlation. However, due to the low number of observations, the value of the Durbin Watson statistic is below the critical values for the usual significance levels.

Apart from the capacity utilization rate in the industrial sector, all explanatory variables enter the regression lagged one to four quarters. The contemporaneous capacity utilization rate does not destroy the forecasting properties of the equation because, in general, actual data for this series are available earlier than the national accounts data. A growing order activity in the investment goods producing sector as well as a more optimistic view towards the future development of the business cycle lead to a better growth performance in the sector "services not listed elsewhere".

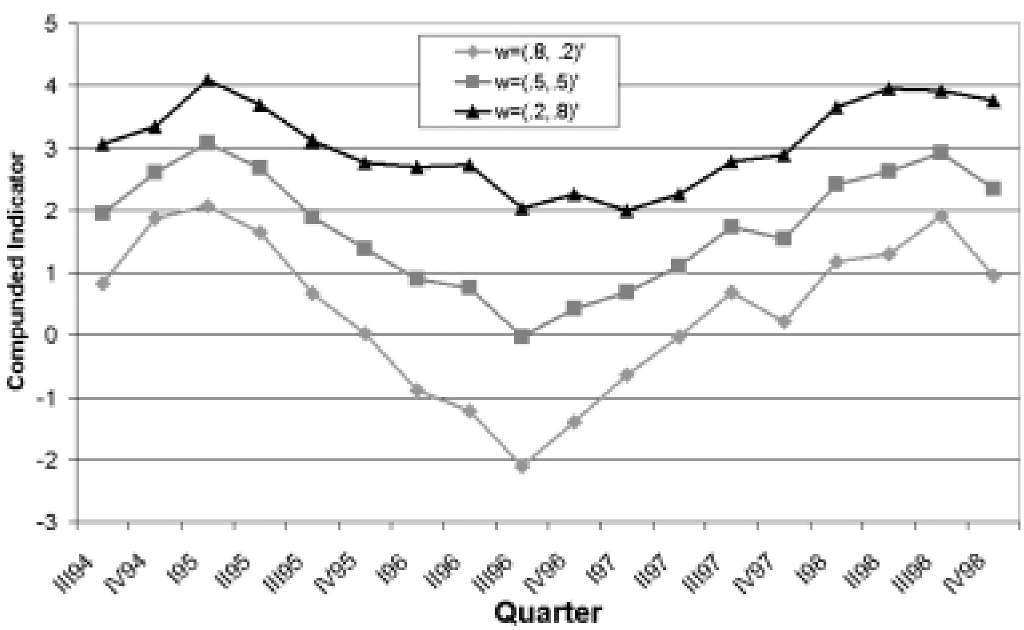
It should be noted that none of the East German data entered the regressions in a statistically significant way. For this reason we decided to take German data instead of West

German data in all those cases where the explanatory power of the variables was nearly identical.
The forecasted values obtained from equation (2) and the partial indicator discussed in section 4.2 enter the final compounded Service Sentiment Indicator. The weighting schemes between the two partial indicators are discussed in the following section.

4.4 Merging both partial indicators

In the third step of the SSI–construction, both components are merged into one single indicator. The weighting scheme between the partial indicator from the survey and from the national accounts data is .8 for the survey part and .2 for the national accounts part, $w = (.8, .2)'$. These weights were chosen since they guarantee a smooth course of the indicator for the time period under investigation. Figure 3 shows a sensitivity analysis of the weights attached to the partial indicators. Both partial indicators are measured in first differences so we decided to cumulate the compounded indicator's values.
From looking at Figure 3 it is evident that the *shapes* of the curves are very similar while the levels differ considerably. The level, however, is not informative in a business–cycle analysis context. Thus, our indicator is quite robust against alternative weighting schemes.

Figure 3: Attaching alternative weighting schemes to the compounded indicator: A sensitivity analysis



The figure compares different weighting schemes with one another. $w = (.8, .2)'$ means that the weight of the partial indicator of the business survey is 80 percent and that the weight of the national accounts partial indicator is 20 percent.

One major difficulty concerning of the indicator we have developed so far is its interpretation. It mixes first differences of aggregated survey data with first differences of national accounts data so that the compounded indicator's dimension is undetermined. Therefore, we decided to put the indicator's value on an ordinal scale which starts from zero. The maximum remains undetermined since the time series are too short to cover an entire business cycle. The ordinal indicator takes on the value 1 (2, 3, ...) if the compounded cumulated indicator's value is less than -3 (between -3 and -2.9, between -2.9 and -2.8, and so forth in .1–steps).

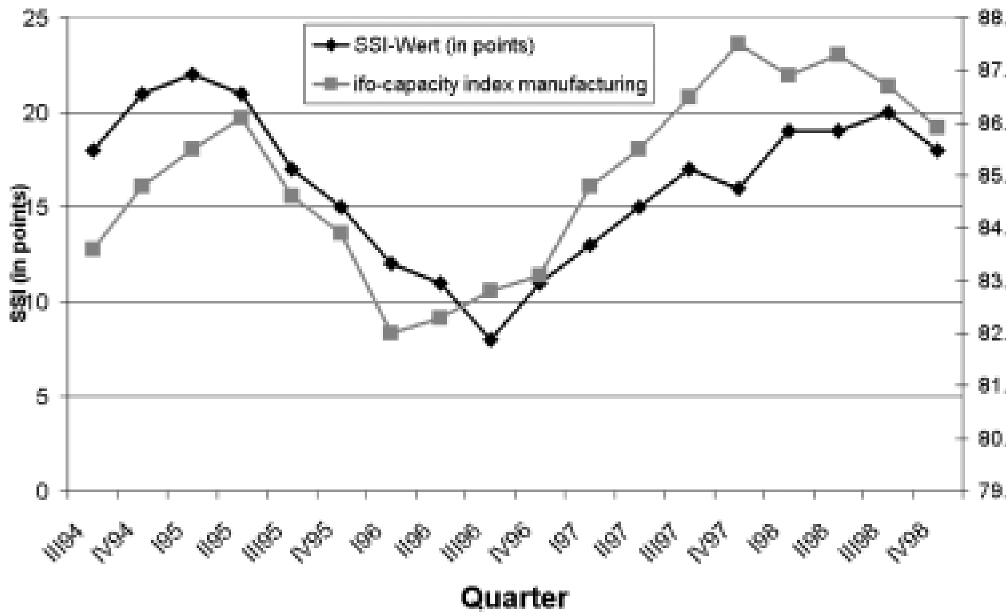
An upward direction of the final indicator, the *SSI*, reflects an expansion period whereas an downward directed indicator reflects a recessive period. If there are no changes, the situation in the business–related services sector remains unchanged — note that all variables used in the indicator's construction were seasonally adjusted and hence the indicator is also seasonally adjusted. As long as the indicator has not passed through a complete business cycle, it can reflect neither overheating nor recessive tendencies. As soon as sufficient data points are available, we will be able to attach bands to the indicator.

4.5 In search of a reference indicator

A final step in the construction of business climate indicators is usually to compare it to some reference time series. However, as we have already discussed in detail, there is no such time series available for business–related services despite the national accounts data which were included in the indicator's construction and thus cannot be used.

In order to give at least a hint with regard to the indicator's performance, we have plotted the SSI against a number of time series related to manufacturing industries. Business–related services are closely connected to manufacturing industries meaning that the development of the manufacturing sector should influence business–related services with or without a lag. Figure 4 displays the relationship between the SSI and the ifo capacity utilization index of commodities. Both time series show roughly the same pattern, and it seems as if there is no lead/lag relationship between them. If the ifo capacity utilization index for manufacturing is used, it turns out that the ifo index leads by two quarters until 1996. The lead–relationship then diminishes so that at the margin, there is also neither a lead nor a lag relationship. Similar patterns occur if the SSI is compared to the sales index of manufacturing industries; the net production index of manufacturing industries; investment indices; commodity indices; and consumption indices.

Figure 4: The SSI and the ifo capacity utilization index (commodities)



The figure compares the SSI to the ifo capacity utilization index of commodities.

It is clearly still desirable to compare the SSI to a time series which actually represents the state of the economy in the business–related services sector. As long as no such data are provided by official statistics there is, however, no way to test the indicator against actual outcomes.

5 Summary and conclusion

This paper has shown how a reliable business climate indicator can be constructed even when the data material at hand is weak. To our knowledge, this is the first approach to construct a business climate indicator for business–related services.
The indicator is constructed in three steps. In the first step, data from a business survey in the business–related services sector are condensed into a single (partial) indicator. Since business survey data are often subject to political news and short–time influences, we constructed a compounded indicator. National accounts data on the sector "services not noted elsewhere" were used as a second component of the indicator in a second step. Since these national accounts data are only available with a lag of one quarter, we have to forecast the current value of the national accounts data by use of a linear regression. In a third step, both partial indicators are merged into the *Service Sentiment Indicator*.
A drawback of the insufficient availability of data on the services sector is that a reference time series of our indicator is missing. Therefore, we have conducted several sensitivity analysis at various steps in the construction of the indicator. The indicator proved to be very robust against alternative weighting schemes.

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A Seasonal adjustment of the survey data

One difficulty with the ZEW/CREDITREFORM business survey data is that the time series — especially the sales series — show strong seasonal patterns. Therefore, seasonal adjustment is needed. The classical approaches to seasonal adjustment do not apply here since the time series in question are too short. We thus present a seasonal adjustment method which can be used even for short time series.

If the seasonal patterns are independent of a time trend, the individual components of a time series X_t — time trend T_t, the cyclical component C_t, the seasonal component S_t and an irregular component u_t (where the subscript t denotes the corresponding point in time) — is given by

$$X_t = T_t + C_T + S_t + u_t \tag{3}$$

Alternative approaches using the ZEW/CREDITREFORM business survey data lead to the conclusion that their seasonal patterns are best captured by seasonal dummies. Since it is a quarterly survey, we include three quarterly dummies, S_i $(i = 1, 2, 3)$and a constant term, a. Our regression equation is

$$X_t = b_1 S_1 + b_2 S_2 + b_3 S_3 + b_4 + \epsilon_t, \tag{4}$$

where the b_i's denote the coefficients to be estimated and ϵ_t is an i.i.d. normal distributed error term which includes the irregular components u_t in addition to the cyclical component C_t. From applying an ordinary least squares regression on equation (3), the residuals $\hat{\epsilon}_t$ are obtained by

$$\hat{\epsilon}_t = X_t - \hat{X}_t, \tag{5}$$

where $\hat{X}_t$ denotes the fitted value of X_t. Since $\hat{\epsilon}_T$ not only the error term (which has a mean value of 0 and a constant variance by construction) but also the cyclical component, one additional step needs to be undertaken to yield the seasonally adjusted time series. Since the original time series did not exhibit a time trend, its mean value is added to $\hat{\epsilon}_t$ for all elements of the original time series:

$$\tilde{X}_t = \frac{1}{t}\sum_{t=1}^{T} X_t + \hat{\epsilon}_t, \tag{6}$$

where T is the total number of time periods. $\tilde{X}_t$ denotes the seasonally adjusted time series.

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