

# Sampling, Stratification, Expansion and Results of a Business Survey in the German Business-related Services Sector

by

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**Abstract:** No other area of the German economy has developed so emphatically in the past ten years as has that of business-related services. Regardless of its growing overall economic importance, official statistics fail to provide economic researchers and economic policy with current data on the business-related service sector. In such a situation where quantitative information about certain sectors is lacking, data obtained from business surveys give important information on the state of the economy. The outcome of such surveys crucially depends on the expansion factors attached to the responses of individual firms. In this paper it is shown how a robust method of calculating expansion factors can be obtained using known auxiliary totals from the population. Robust in this sense means that the expanded data of the ZEW/Creditreform business survey are insensitive to changes in the sample design while the non-expanded data are not.

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## **Non-technical summary**

While the business-related service sector has increasingly gained in overall economic importance and media-attention in recent years, official statistics still fail to provide economic policy and economic researchers with current data on the state of this part of the economy. The ZEW/Creditreform business survey in the business-related service sector aims at filling this information gap, at least partially. It has been carried out since the second quarter of 1994 and asks questions on recent sales, profit, price, demand and employment growth.

It is of crucial importance for any kind of business survey to find reliable expansion factors which are used to weight firms participating in a business survey by their individual relative economic importance. The firms participating in the ZEW/Creditreform business survey are weighted by their shares in sales. Such weights are attached first to account for the sample design and second to account for the different implication a large firm reporting, say, decreased sales has on the entire economy than that of a small firm reporting a decrease in sales. If no expansion takes place, small and large firms would be treated equally, and the differences inherent in firm sizes (or, likewise in sectoral or regional affiliation) would not be accounted for. Intuitively, what is done in an expansion is to attach to each firm in a given sample a weight which is proportional to the economic importance the respective firm possess.

This papers shows how a reliable and robust method of calculating expansion factors can be found even if there is little information on the population under consideration.

# 1 Introduction

In recent years, hardly any other sector of the German economy has developed as dynamically as has the service sector. The structural change from manufacturing industries towards services has deepened in the last decade. Even within manufacturing industries a structural change is appearing: firms from the manufacturing sector increasingly offer services such as project consulting, maintenance and repairs. Moreover, structural changes also take place within the service sector. Business-related services are gaining in economic importance while traditional service sectors, such as retail and gross trade, are losing in relative significance.

A main reason for the success of business-related services has been increased outsourcing activities of the manufacturing sector. Tasks not primarily related to the main business field have been transferred to legally independent service firms. However, the strong growth of business-related services has led to a heightened attentiveness as far as the public, the media and politics are concerned. In official statistics, business-related services still play a rather subordinate role. Although around 80 separate statistics are available, covering varying characteristics such as the number of enterprises, firms and employees, a systematic recording of services is missing.<sup>1</sup> This concerns the industrial classification used by the different statistics, the unit of investigation (firm, plant or person) and the periodicity of these statistics. As a result, it is not astonishing that no exact figures can be released which constitute the overall economic importance of business-related services. Even the Federal Statistical Office has only little information on business-related services at its disposal.<sup>2</sup> To compensate for the lack of current data on business-related services, the Centre for European Economic Research (ZEW) has carried out a quarterly business survey for the business-related service sector since June 1994 in collaboration with Germany's largest credit rating agency Creditreform.

Since there is little information on business-related services in official statistics, the ZEW/Creditreform business survey in some ways bears similar importance as the well known ifo-business surveys which were developed after World War II to modernize and supplement official statistics

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<sup>1</sup>Link (1996) refers to the usability of official statistics for the service sector more precisely.

<sup>2</sup>The Federal Statistical Office estimates, for example, the gross value added for business-related services on the basis of a sales tax statistic which is available with a delay of 18 months, and a statistic on the number of employees which is processed quarterly by the Federal Labor Office with a delay of about six to seven months.

(Strigel, 1997). A further advantage of the ZEW/Creditreform survey is that the results can already be published between one and a half to two weeks following the end of the data collection period. As Oppenländer (1997) claims, this up-to-dateness is an important reason why economic survey data should at least be viewed as being equally important as quantitative data.

In recent years, the ZEW/Creditreform business survey has clearly gained in terms of recognition in the media and economic policy. On the basis of this survey, the ‘Service Sector Business Survey’, an economic indicator for business-related services, was developed in 1998 (Kaiser and Buscher, 1999).

The lack of availability of official statistics on business-related services has an immediate effect on the business survey carried out by ZEW and Creditreform: the entire population under consideration as the basis for the sampling frame and the calculation of expansion factors can only be determined with difficulties. In this paper we show how robust — in the sense of robustness with respect to changes in the sample design — expansion factors can be calculated in spite of the problematic data situation.

The following chapter illustrates in short the recording of business-related services in official statistics. Section 3 gives a brief overview of ZEW/Creditreform business survey, motivates the expansion of the survey to the target population and describes the determination of sales in the realized sample. A detailed description of how the total sales of the underlying population is established is given in section 4. Section 5 describes how expansion factors are calculated; this is followed by a brief discussion of the results in section 6. Finally, section 7 gives a brief outlook on further research in the context of the SSBS.

## **2 Recording of business-related services in official statistics**

Auxiliary data from sources outside the survey are needed to highlight growth and importance of business-related services and to derive the expansion factors. Out of the 80 individual official statistics four are potentially applicable for this task. These are: (1) the Mikrozensus, (2) the sales tax statistic, (3) the quarterly cost-structure statistic, and (4) the

employee statistic. The first three statistics are collected by the Federal Statistical Office, the last one is collected by the Institute for Employment Research at Nuremberg. Although all four statistics are not primarily constructed for the recording of the service sector, they can be considered 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 current economic phenomena. It is also problematic that the four statistics are not really comparable since they are based on different levels of investigation. In this respect, the Mikrozensus is a household survey, the sales tax statistic is targeted at the firm level (just like the quarterly cost–structure statistic), and the employee statistic on the plant level.

By collecting the information available on the business–related service sector from the four statistics listed above, we are able to report some figures on growth and economic importance of business–related services.

While total employment has fallen by about about 11 percent in West Germany between 1982 and 1996, the number of employees in the service sector (including services brought about by the state) rose by about 22 per cent, from 10.2 to 12.4 million. Within the service sector the area of business–related services has particularly gained in importance — above all the sectors of business consulting, advertising, rental and waste disposal. In these areas, the number of employees has increased in this period, from merely 1 million to 1.8 million: a rise of 80 per cent.

The business survey of the ZEW and Creditreform aims at providing information on this fast–growing part of the German economy since official data lack this information.

### **3 The ZEW/Creditreform business survey**

#### **3.1 Definition of business-related services**

To our knowledge, no clear and generally–accepted definition of business–related services exists. Its definition is cause for a quite controversial discussion in literature. We follow the convention of Hass (1995), Klodt et al. (1997), Miles (1993) and Strambach (1995), who define business–related services by simple enumeration of certain sectors.

In this paper, the following sectors are defined as business-related services:

<b>Branch</b>	<b>NACE-Rev. I code</b>
Computers and related activities	72100, 72201-02, 72301-04, 72601-02, 72400
Accounting & book-keeping, tax consultancy	74123, 74127, 74121-22
Management Consultancy	74131-32, 74141-42
Architectural activities	74201-04
Engineering activities	74205-09, 74301-04
Advertising	74844, 74401-02
Renting of automobiles & transport equipment	71100, 71210
Renting of other machinery & equipment	45500, 71320, 71330
Cargo handling and storage	63121, 63403, 63401
Sewage & refuse disposal	90001-90007

According to Hass (1995), business-related services represent an important link between the secondary and tertiary sector. They support the quality and distribution of products. Furthermore, it is presumed in literature that the area of business-related services eases the way to innovation, as is indicated in Licht et al. (1997). Additionally, as Steil (1997) points out, business-related services show a foundation rate which is clearly above-average. 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 manufacturing is in no way substitutive, as Fourastié (1950), amongst others, had stated. The relationship between both areas is complementary instead.

### 3.2 The business survey

ZEW and Creditreform send out a single page questionnaire every three months to about 3,500 firms belonging to the ten sectors listed above. The survey is constructed as a panel data set. It is a stratified random sample, stratified with respect to the ten sectors, five size classes (two for East and three for West Germany), as well as with respect to regional affiliation (East/West Germany). The stratified target population thus consists of 50 cells. A sample questionnaire, the questionnaire of the fourth quarter of 1999 is printed in on the last page of this paper.

A sample refreshment takes place on an annual basis. Firms which have

not taken part in the survey for more than six times in a row are removed from the panel. First survey results of the pilot study and a description of the original sample survey can be found in Saebetzki (1994). Current survey results are released in the media and in ZEW publications.<sup>3</sup>

The ZEW/Creditreform business survey starts three weeks prior to the end of a quarter. Questionnaires and a personal letter to the prospective survey respondent are sent out by mail. The questionnaires are mostly returned to the ZEW by fax. After two weeks, those firms who have not replied are sent a reminder. Altogether, the response rate amounts to about 30 percent (see Tables 1 and 4). As a thank you for filling out the questionnaire, the participating firms receive an analysis in the form of a four page report containing the main findings of the survey. In addition, they can draw further information over the internet.

The questionnaire is divided into two parts. In the first part the firms are requested to indicate, on a three point Likert scale, whether their sales, prices, demand, returns and number of employees have, in the respective previous quarter, either decreased, stayed the same, or increased. Moreover, they are supposed to give an assessment for the forthcoming quarter. The second part of the survey is dedicated to present-day economic and political issues. Issues cover on-the-job-training, wage negotiation and dispersion of general wage agreements (Kaiser and Pfeiffer 2000, Kaiser and Pohlmeier 2000), innovation and demand for heterogeneous labor (Kaiser, 1998) and adjustment to demand fluctuations (Kaiser and Pfeiffer, 2000) and the introduction of the Euro and export propensity (Kaiser and Stirböck, 1999).<sup>4</sup> Although expansion factors are applied to both the first and the second part of the survey, the following discussion focuses on the business cycle part of the survey.

### **3.3 Why attach expansion factors?**

The main issue of the ZEW/Creditreform business survey is to monitor the development of business-related services in Germany. Since comparability of the realized sample population cannot be guaranteed because firms often

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<sup>3</sup>The ZEW offers to send current survey results to an interested public. Send an email to [konjunkturumfrage@zew.de](mailto:konjunkturumfrage@zew.de) to receive copies.

<sup>4</sup>In a related study, Kaiser (1998a) analyzes the impact of political events on answering patterns in business surveys.

do not respond as it was expected when the sample was drawn, weighting of the realized sample assures comparability to the target population — at least concerning some known auxiliary totals (Hidioglou et al. 1995).

First, the structure of the realized sample data with regard to the three stratification variables (sector, size, region) is determined by the frame population and the sample design. Since no official business register is available in Germany, the sample is drawn from the “MARKUS” firm data base made available to the ZEW by the Creditreform. It is a CD–Rom containing information on the entire set of firms found in the registers of Creditreform. Besides the industrial classification code and number of employees, the data base contains firm sales, firm addresses and, in most cases, a contact person. As far as possible, newly–founded enterprises are recorded into this frame. Though this data base does not actually cover the entire population of firms in Germany, the MARKUS data base is the most complete sampling frame available for Germany (Licht and Stahl, 1995). However, East German firms and large firms are over–represented in the MARKUS data base. In the sample design, this fact is not adjusted for for two reasons: East German firms develop very heterogeneously and sales is concentrated on large firms.

The second factor determining the structure of the realized sample is the response mechanisms, i.e. the firm’s ‘decision’ to answer the questionnaire. It is widely known from other business surveys that the probability of participating in a mail survey is influenced by several factors (Paxson et al. 1995). In the ZEW/Creditreform business survey, different response probabilities show up in the given strata. The response rate does not differ greatly across West and East German firms, with the related figures being 24 and 28 percent, respectively. It differs, however, across the individual sectors.

The smallest response rate is seen amongst computer activities, where it is 25.1 percent. The highest response rate, at 37.2 percent, is in the sewage & refuse disposal sector.<sup>5</sup> Table 1 displays the response rate of the SSBS in the third quarter of 1999 (22nd wave).

These factors — biased sample population, sample design and response mechanism — require expansion of the realized sample.

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<sup>5</sup>These figures relate to the 22nd wave of the survey (III. quarter of 1999).



**Table 1:** Response rate across sectors, firm size and regional affiliation (22nd wave, 3rd quarter 1999)

	West Germany			East Germany		
	1–19	20–59	>59	1–24	> 24	
Computer activities	20.0	17.1	27.3	35.7	46.7	25.1
Accounting, book-keeping	25.3	25.4	54.8	43.2	15.4	29.5
Management consulting	28.7	36.8	24.3	37.0	20.8	29.2
Architectural act.	24.1	30.2	32.0	34.1	45.5	27.8
Engineering act.	25.9	41.7	34.2	41.5	61.4	37.3
Advertising	23.3	25.0	25.6	31.6	33.3	25.5
Renting of automobiles	22.5	31.8	42.1	19.4	30.0	25.5
Renting of machinery	19.4	27.9	41.7	38.2	28.6	27.0
Cargo handling	18.0	24.1	24.8	38.5	47.1	26.5
Sewage & refuse disposal	18.2	31.0	43.2	34.9	36.4	30.2
	22.6	27.7	31.2	35.9	40.7	28.3

### 3.4 Sales figures of the participating firms

Turnover figures are not asked for in the questionnaire. These figures are gathered from the aforementioned MARKUS firm data base. The MARKUS data base does not reveal the sales figures for all of the participating firms.<sup>6</sup> The missing values must therefore be estimated.

The most important input factor in the production of services is labor. If output is approximated by sales, the number of employees stands in direct proportion to the size of sales. We therefore explain sales by the number of employees in a regression and replace the missing sales values with the estimated values. The information which has been collected in the MARKUS data base contains the number of employees for almost all of the firms in our sample. Since, apart from the number of employees, sectoral and regional effects may also influence sales figures, these variables are also taken into account for the estimation.

The data collected in the MARKUS data base identify around 78,395 firms in the business-related service sector.<sup>7</sup> For 75,793 (97 percent) firms (of which about 9,974 are from East Germany), the MARKUS data contain

<sup>6</sup>The MARKUS-data base only contains sales figures for around 98 percent of the firms. (Base: 22nd wave (III. Quarter of 1999) and MARKUS from August 1999.)

<sup>7</sup>Referring to the MARKUS data of August 1999.

both sales figures and the number of employees. These data form the basis for estimating the missing sales values by means of a median regression.<sup>8</sup> The estimations were carried out separately for East and West Germany and the ten sectors.

Finally, it has to be pointed out that our regression results in few cases lead to estimated sales figures which appear to be unreasonable, since they are either ‘too small’, negative, or ‘too large’. In these cases, a separate way of estimating the missing sales data is chosen. The sales figures of the firms are estimated via the average sales per employee. In addition, the mean sales per employee ( $U_{prom}$ ) is calculated individually for the ten sectors and East and West Germany. In order to avoid the situation where a large bias occurs through a firm having extremely large or small sales, those firms which have sales per employee of either more than 1 million DM or less than 100,000 DM are not taken into account. If the sales per employee of firm  $i$  is below 20,000 DM or above 1 million DM, then the sales of this firm ( $U_i$ ) is replaced with  $U_i = U_{prom} * m_i$ , whereby for  $U_{prom}$ , the corresponding mean of the sales per employee is chosen with respect to sectoral affiliation and with respect to the firm either being in East or West Germany. The variable  $m_i$  denotes the number of employees of firm  $i$ .

In the majority of cases, estimating the sales by way of the regression suffices. Only for firms with up to seven employees does it lead to negative sales in the individual sectors or rather, as is the case in the above comments, to sales per employee which are regarded as being too small.<sup>9</sup>

## 4 Determination of the survey population

### 4.1 Stratification

Calculating expansion factors requires a description of the target population to which the realized sample is expanded. Since sales is the variable which is looked at most in economic analysis, weighting factors have to be found such that the total weighted sales of the realized sample equals the

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<sup>8</sup>Because of outlier problems, a median regression was preferred over an OLS regression.

<sup>9</sup>In the 22nd wave for example, only three firms which had only five employees were affected by this correction. Out of the ‘large’ firms, none of them were affected by the sales correction introduced here.

total population sales.

Distinctions between East and West Germany, the ten sectors listed above, as well as between different size classes have to be made when information on total sales is gathered. The basic information on total sales of the business-related service sector is obtained from the sales tax statistic, which is the only information available at the disaggregated sectoral level used in the ZEW/Creditreform business survey. This basic information does not distinguish between size classes and is available on a biennial basis until 1996 and on an annual basis from 1996 onwards. The statistic is published with a delay of about 18 months. In the sales tax statistic, every company which has more than 25,000 DM of taxable sales per year is recorded. The Federal Statistical Office publishes these data at a five-digit classification level.

The original sample of the ZEW/Creditreform business survey, which was drawn in spring 1994, was stratified into ten sectors, East and West Germany, and six size classes (1–49, 50–99 and more than 100 employees). Table 2 shows how the firms in the sample were distributed according to old size class definition and relative to the absolute number of firms in West and East Germany in the sample, respectively. Table 2 clearly indicates that the old size definition leads to very thinly occupied cells for the largest size classes. The cell occupation of the largest size class is even thinner in East Germany.

**Table 2:** Sample population across cells relative to the total number of firms in East and West Germany according to the old size definition (22nd wave, 3rd quarter 1999)

	West Germany				East Germany			
	1-49	50-99	> 99	total	1-49	50-99	> 99	total
Computer activities	6.4	2.3	3.1	11.7	8.9	0.5	1.4	10.9
Accounting, book-keeping	9.2	1.1	1.0	11.3	6.5	0.0	0.5	7.0
Management consulting	6.4	1.8	2.8	11.0	5.0	1.0	0.5	6.4
Architectural act.	5.6	0.3	0.2	6.1	4.8	1.1	0.3	6.2
Engineering act.	8.6	1.8	2.4	12.8	14.4	3.5	1.0	18.8
Advertising	7.4	1.8	2.0	11.2	5.8	0.8	0.2	6.7
Renting of automobiles	5.4	0.4	0.3	6.1	6.4	0.6	0.2	7.2
Renting of machinery	6.3	1.0	1.0	8.3	7.0	1.0	0.3	8.3
Cargo handling	6.1	2.3	2.9	11.3	8.3	2.9	1.6	12.8
Sewage & refuse disposal	6.7	1.5	2.0	10.2	10.5	2.6	2.6	15.7
total	68.0	14.1	17.9	100.0	77.6	13.9	8.5	100.0

**Table 3:** Sample population across cells relative to the total number of firms in East and West Germany according to the new size definition (22nd wave, 3rd quarter 1999)

	West Germany				East Germany		
	1-19	20-59	> 59	total	1-24	> 24	total
Computer activities	4.3	2.5	4.8	11.7	6.1	4.8	10.9
Accounting, book-keeping	5.0	4.6	1.7	11.3	5.1	1.9	7.0
Management consulting	4.0	2.6	4.3	11.0	3.4	3.0	6.4
Architectural act.	4.4	1.3	0.5	6.1	3.5	2.7	6.2
Engineering act.	6.7	2.2	3.9	12.8	10.7	8.1	18.8
Advertising	4.2	3.8	3.2	11.2	4.3	2.4	6.7
Renting of automobiles	4.1	1.5	0.5	6.1	5.1	2.1	7.2
Renting of machinery	4.0	2.7	1.6	8.3	5.0	3.4	8.3
Cargo handling	3.9	2.8	4.6	11.3	4.6	8.1	12.8
Sewage & refuse disposal	4.2	2.7	3.2	10.2	7.0	8.6	15.7
total	44.9	26.7	28.4	100.0	54.8	45.2	100.0

In order to guarantee an almost equal distribution of firms across the size cells, we thus introduce a new system of dividing up everything. It is now layered according to ten branches, three size classes for West Germany (1-19, 20-59 and 60 or more employees) and two categories for East Germany (1-24 and more than 25 employees). This is done to ensure that ‘small’ firms are considered sufficiently in the sales expansion. A further categorization of large firms (60 or more employees in West Germany, 25 or more in East Germany) does not appear necessary. Table 3 redisplay Table 2 with the new size class definition applied.

In each of the cells containing the target population of the ZEW/ Credit-reform business survey, the sales of each responding cell firm is expanded onto the total cell sales. The sales figures obtained from data from the sales tax statistic have to be divided up into the 50 subpopulations which are determined by affiliation to East or West Germany, five size classes and ten sectors.

In Table 4, we display the number of participants and the number of firms which were sent a questionnaire between the second quarter of 1994 and the third quarter of 1999. This is to give the reader a reference on how many firms actually take part in the survey.

**Table 4:** Number of survey participants

Quarter	# of participants	# of firms invited	response rate (in %)
II94	690	3333	20.7
III94	762	3330	22.9
IV94	780	3132	24.9
I95	553	1190	46.5
II95	822	2001	41.1
III95	729	1943	37.5
IV95	708	1919	36.9
I96	730	1895	38.5
II96	741	1872	39.6
III96	674	1842	36.6
IV96	623	1830	34.0
I97	588	1816	32.4
II97	1061	4191	25.3
III97	1010	4159	24.3
IV97	1001	4103	24.4
I98	937	4047	23.2
II98	977	3984	24.5
III98	924	3936	23.5
IV98	1093	3781	28.9
I99	994	3740	26.6
II99	1127	3707	30.4
III99	1038	3687	28.2

## 4.2 Separation of total sales onto the subpopulations

Since the Federal Statistical Office separated the sales tax data into East and West Germany only up until 1994, categorization of sales into the two regions for the subsequent years is problematic. For 1996 and the years

following, we must determine sales of each region from the figures for the whole of Germany. We therefore assume constancy over time in the share of East and West German firms in total sales of each of the business-related service sectors. The total sales of each of the ten sectors is thus split up between East and West Germany according to the 1994 shares. This method can be justified by the fact that the share of sales which was allotted to East and West Germany in 1992 and 1994 remained fairly constant in the individual sectors. The largest shift amongst sales shares was seen in management consultancy. There, the West German share rose from 84.5 percent to 91.9 percent between 1992 and 1994. In general, the share of sales of West Germany in 1992 deviates from the mean sales share of 1994 by two percent at the most. For the shift of sales share in the individual sectors from East to West Germany (or vice versa), there is no tendency.

The distribution of sales varies considerably across the ten sectors being considered. The shares of East and West German firms for the other sectors are located somewhere between these two extremes. Beneath the overproportional content of East German firms in the sample, these sector-specific differences in the distribution of sales across West and East Germany make it necessary to split up total sales into East and West Germany separately for every sector.

Due to the publication lag and the bienniality of the sales tax statistic, further preparatory work must be done with regard to setting up the stratified target population. Turnover figures for 1998 are established through extrapolation of the growth rate from 1994 to 1996 for the ten sectors separately. Turnover figures for the years between the official recordings, i.e. 1995 and 1997, are established by interpolation.

As a basis for splitting up the target population into different size classes, the MARKUS data are used once again. Since these data contain employment figures for almost all firms, splitting up the total sales of the target population taken from the sales tax data into different size classes is done by calculating the shares of each size class and splitting up total sales by these shares for each stratum of the population.

In order to avoid a bias in favor of the large size class category, firms with more than 1000 employees were not considered — that was 0.15 percent of the total number of firms (according to the MARKUS data of August 1997).

## 5 Calculation of expansion factors

Attaching expansion factors to firm data implies accounting for the overall economic relevance of, for example, a large firm compared to a small firm. While for a large and a small firm the percentage decline of sales may be the same, e.g. 10 percent, the absolute decrease for, say, the large firm may be 1 million DM and for the small firm only 1,000 DM. The share of answers from the 22nd wave of the ZEW/Creditreform business survey (III. quarter of 1999) clarifies this issue. Without expansion, a total of 35.2 percent of business-related services revealed that they had experienced increased sales in relation to the II. quarter of 1999. For 44.9 percent of the firms, the sales stayed the same and for 19.9 percent, sales figures declined. If sales expansion factors are applied using the method which is described in this section, then a different picture arises. In that case, 42 percent of the firms claim to have increased sales, 38.7 percent report unchanged sales figures, and 19.3 per cent claim to have a decrease in sales. Formulated more precisely with respect to sales: 42 percent of total sales are generated by firms which experienced an increase in sales, for 16.4 million DM (39 million DM  $\cdot$  0.42), an increase in sales occurred.

In this section we formally describe the way expansion factors are calculated. Let  $U_{i,j}$  denote the sales of company  $i$  from cell  $j$ , with  $i \in \{1, \dots, n_j\}$ , whereby  $n_j$  represents the number of firms of each cell in our realized sample. Subsequently,  $n = \sum_{j=1}^{50} n_j$  is the sum of firms in our sample survey.  $U_j = \sum_{i=1}^{n_j} U_{i,j}$  is the sales in our sample which is gained in one cell. Furthermore, let  $G_j$  represent the sales which is gained in one cell of the target population and  $G$  the sales of the target population.

The expansion is to be carried out over individual cells. This leads to cell-specific expansion factors  $H_j^A$  and the following equation:

$$G_j = \sum_{i=1}^{n_j} H_j^A U_{i,j} \quad \text{or} \quad H_j^A = \frac{G_j}{U_j} \quad \forall j \in (1, \dots, 50)$$

If this cell factor  $H_j^A$  is multiplied by the sales of the company, then the individual expansion factor  $H_{i,j}^A$  for company  $i$  arises as follows:

$$H_{i,j}^A = U_{i,j} H_j^A$$

$$\text{or} \quad H_{i,j}^A = U_{i,j} \frac{G_j}{U_j} \quad \forall i \in 1, \dots, n_j \wedge \forall j \in 1, \dots, 50.$$

## 5.1 Outliers

Below it is explained, how one deals with firms which emerge from the expansion as ‘special cases’. These firms are only taken into account in the calculations as one occasion (Lee 1995). That means the factor  $H_{ij}^A$  is set to  $U_{ij}$  for the  $i$ th firm of cell  $j$  firm classified as an outlier. The following types of firms are considered as outliers: (1) firms with large sales or (2) firms with large sales per employee, both relative to the sales figures in the corresponding cell. Naturally, this action influences the calculation of the expansion factors of the remaining firms in every cell that contains a special firm because  $\sum_{i=1}^n H_{ij}^A = G_j$  has to be fulfilled. This is explained in greater detail below. In the case of a sales share which is ‘too high’ in the corresponding cell  $Z_j$  we proceed as follows:<sup>10</sup>

1. Determination of the sales share of an individual firm which would arise from a uniform distribution of the sales figures across all firms in the cell. This share is equal to  $\frac{1}{n_j} \quad \forall j \in \{1, \dots, 50\}$ .
2. Determination of the sales share of an individual firm in the sample. This share is given by  $\frac{U_{i,j}}{U_j} \quad \forall i \in Z_j \wedge \forall j \in \{1, \dots, 50\}$ .
3. If the actual sales share of an individual firm is more than double that of the sales share arising from a uniform distribution of sales across all firms in the cell, this firm is considered as an outlier.

Turnover per employee being ‘too high’ therefore comes about when the sales per employee exceeds 1 million DM. In that instance, the company are treated as outliers. For these firms, the following notation is to be introduced. Let  $ID_j$  represents the number of firms which are in the  $j$ th cell and are special cases. In the 17th wave, 35 of the 972 firms were categorized as ‘special cases’ and were expanded with a factor of 1. This represents 3.6 percent of the total number firms.

Since the special cases are not considered in the expansion, the total sales  $U_j^*$  of the remaining companies in a cell for which the expansion is to be carried out decreases. This is a result of  $U_j^* = \sum_{i \notin ID_j} U_{i,j}$ . Likewise, in order to reduce the corresponding sales figures, total sales of the cell is:  $G_j^* = G_j - \sum_{i \in ID_j} U_{i,j}$ . The expansion is then taken up using  $G_j^*$ . The

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<sup>10</sup>The following explanation therefore always relates to a particular cell, even when it is not explicitly specified.



corrected expansion factor is:

$$H_{i,j}^* = U_{i,j} \frac{G_j^*}{U_j^*} \quad \forall i \notin \mathbb{D}_j$$

Since the special firms are only included in the calculation with their own sales (i.e. without cell factor), the following is obtained:

$$H_{i,j} = U_{i,j} \quad \forall i \in \mathbb{D}_j.$$

## 5.2 Item non-response

Firms taking part in the survey may leave questions unanswered. This is called ‘item non-response’. The value of the corresponding variable then is ‘missing’. The indicator variable  $\mathbb{I}_i^{increased}$  takes the value 1 if company  $i$  has stated that, in comparison to the last quarter, it has recorded increased sales (prices, profits, demand, number of employees). If this is not the case, then  $\mathbb{I}_i^{increased}$  is coded with 0. In analogy, we proceed with the indicator variables  $\mathbb{I}_i^{equal}$  (for unchanged sales) and  $\mathbb{I}_i^{decreased}$  (for decreased sales). If a company  $i$  is in one cell, then:  $\mathbb{I}_i^{increased} + \mathbb{I}_i^{equal} + \mathbb{I}_i^{decreased} \neq 1$ . Let  $M_{j,k}$  be the amount of firms which have a missing value in the  $j$ th cell at the  $k$ th variable. For the affected variable, these firms are not taken into account. Thus, for total sales in the sample which is relevant for the expansion, the following are applied:

$$U_j^{**} = \sum_{i=1}^{n_j} U_{i,j} \quad \forall i \notin (\mathbb{D}_j \cup M_{j,k}).$$

From that, the expansion factors are given by:

$$H_{i,j}^{**} = U_{i,j} \frac{G_j^*}{U_j^{**}} \quad \forall i \notin (\mathbb{D}_j \cup M_{j,k}).$$

If missing values emerge amongst individual firms, then the corresponding expansion factors are set at 0.

To sum up, the following expansion factors  $H_{i,j}$  come about:

$$H_{i,j} = \begin{cases} U_{i,j} \frac{G_j^*}{U_j^{**}} & : i \notin (\mathbb{D}_j \cup M_{j,k}) \\ U_{i,j} & : (i \in \mathbb{D}_j) \wedge (i \notin M_{j,k}) \\ 0 & : i \in M_{j,k}, \end{cases}$$

for the  $i$ th company in the  $j$ th cell.

The expansion for the characteristic ‘increased’ (e.g. sales) of a survey variable is:

$$\sum_{j=1}^{50} \left( \sum_{i=1}^{n_j} H_{i,j} \cdot \mathbb{1}_i^{\text{increased}} \right).$$

## 6 Discussion

For the representation of survey data, balances are often calculated from the individual firm responses. This balance — such as the one obtained from the question related to sales — results from the share of firms which indicated that they recorded increased sales, minus the share of firms which indicated that they recorded decreased sales. If the *non-expanded* balance is positive, then the majority of *participating* firms were able to realize a growth in sales. It can, however, still be possible that the business-related service sector actually witnessed a decrease in sales. This happens, for example, if small firms experienced growth while large firms experienced a decline.

In the ZEW/Creditreform business survey, there has twice been the phenomenon that, without expansion of the sales variables, the sales balance slipped into the negative area, whereas with expansion it never fell into in the negative area. This occurred since before the second quarter of 1997, East German firms were over-represented in the sample. East German firms have shown worse judgements of their economic situation since the end of 1994 than their East German competitors.<sup>11</sup> The expansion corrects for this effect resulting from the sample design. Expanded and non-expanded sales balances are shown in Figure 1.<sup>12</sup>

**Figure 1: sales balances weighted and unweighted**

Since there are no formal tests with which the quality of expansion methods can be checked, an evaluation of our expansion factors turns out to be difficult. A piece of information regarding the robustness of our expansion

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<sup>11</sup>Originally, an over-proportional amount of East German firms were included because little was known about their response behaviour at that time.

<sup>12</sup>It is clear from Figure 1 that the survey data exhibit seasonal fluctuations. A suitable method to resolve this seasonality for a short time series is suggested in Kaiser and Buscher (1999).

factors, however, is given by the effects which changes in the design of the sampling frame have on the outcome of the ZEW/Creditreform business survey. Since the beginning of the ZEW/Creditreform business survey, the number of firms in the sample has increased on two occasions, namely in the second quarter of 1995 (an increase from 1046 to 1807 firms) and in the second quarter of 1997 (an increase from 1755 to 4166 firms). In the second enlargement, the over-proportional representation of East German firms was removed since, in the course of time, the response rate of East German firms proved to be higher than that of their West German counterparts. Figure 2 displays the total number of participants in every wave of the ZEW/Creditreform economic survey and the relationship between the West and East German firms who answered. In the second enlargement, this relationship changed from 1.5 (first quarter of 1997) to 2.9 (second quarter of 1997).

Due to the better sales evaluations of West German firms, it is to be expected that the sample enlargement leads to an unusually large and positive increase of the sales balance. In fact, the unweighted balance increases by 24.1 percent whereas if expansion factors are attached, it does so by only 18.8 percent. Our expansion factors thus seem reasonably good at correcting changes in the sample design.

<b>Figure 2: # of participating firms</b>
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## 7 Summary and further research

In spite of its growing economic importance, the service sector is still insufficiently recorded in official statistics. In situations constituted by a lack of data, business surveys become a very important instrument in observing the economy.

With the example of the ZEW/Creditreform business survey for business-related services, we show how a suitable method of calculating expansion factors can be found even when there is little information on the target population. On the basis of data from sales tax statistics and from a data base provided by a credit rating agency, the target population is set up and stratified into ten sectors, East and West Germany, as well as into five size classes (three for West Germany, two for East Germany). The target population is thus divided up into 50 cells. The responses of the

individual firms are expanded proportionally to their sales share in one of the related 50 cells. A comparison of expanded and non-expanded survey results shows that we have developed a robust method of calculating expansion factors, since the expanded balances do not respond to changes in the sample design as do the non-expanded figures.

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