Discussion Paper No. 01-50

Differences in Response Patterns
in a Mixed Mode –
Online/Paper & Pencil Business Survey

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Abstract: This paper investigates if significant differences exist between online and paper & pencil participants in a quarterly business survey in the German business–related services sector when respondents may freely choose to respond either online or by more conventional methods. It also analyzes the determinants of online participation and studies if item–nonresponse is reduced when respondents participate online. Online respondents, indeed, significantly differ from paper & pencil participants with respect to their ordinal sales and price assessments, with online participants being less optimistic on both counts than their paper & pencil counterparts. These differences are not attributable to observable firm characteristics as far as sales judgements are concerned and they disappear once it is controlled for observable firm heterogeneity in the case of price assessments. Significant differences in the judgement of demand, profit and employment as well as in the expectations concerning sales, prices, demand, profit and employment cannot be found.

Binary probit model estimation results indicate that online participation is not significantly affected by sector affiliation, affiliation to East or West Germany nor information technology endowment. Firms with between 1 and 19 employees are, however, significantly less likely than larger firms to participate online. A significant correlation between online participation and unit–nonresponse does not exist, as a bivariate probit model with sample selection estimation results show. In general, item–nonresponse tends to be higher for online–respondents.

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"Use of WWW for surveys will no doubt begin with establishment surveys because of greater access to the technology."

Clayton and Werking (1998, p. 560)

1   Introduction

The rapid technological development of modern Information and Communication Technologies (ICTs) has induced a marked change in the collection of survey data in recent years. 'Computer Assisted Survey Information Collection' (Couper et al., 1998; Mesenbourg et al., 2000; Nicholls et al., 1997; Weeks, 1992) has gained remarkably in acceptance. Interviewers are supported by laptops and online–access to central computers (Smith et al., 1998), computer assisted telephone interviewing is becoming more and more common (Edwards et al., 1998) and online surveys have been identified as the data collection method of the future (Clayton and Werking, 1998).

Technological progress achieved in the survey business has changed the character of business and household surveys. Equally important are the new methods, which are likely to influence answering patterns, since they change the social interaction between the interviewer and the interviewee, even if a personal interview does not take place. For example, socially undesirable answers such as 'our number of employees decreased in the last period' might be more easily given

if the interviewer only knows a random number assigned to the respondent in the online survey than if the questionnaire is returned by surface mail or fax, having the firms name printed on top of the questionnaire.[1] The implementation of such computer technologies and their effects on unit–nonresponse and item–nonresponse are fairly well documented for the older survey approaches, i.a. in the collected volume edited by Couper et al. (1998).[2] Not much is known, however, about the effects of the introduction of additional online response option — in addition to the opportunity to respond by paper & pencil — to the response patterns in business surveys. As Dillman (2000, p. 232) puts it: "The newness of Internet (e–mail and Web) and interactive voice response surveys means that virtually no research has addressed the potential mode differences that might be associated with these methods."

This paper investigates if differences in response patterns occur if an online re-

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[1]Acquiescence is the second most commonly cited factor influencing survey responses (e.g. Schnell et al., 1995) and is unrelated to question content; it does not matter in business surveys since agree/disagree questions are usually not asked.

[2]Computer Assisted Telephone Interviewing is discussed in some detail by de Leeuw and Nicholls (1996), recent applications of Computer Assisted Personal Interviewing include Fuchs et al. (2000) and Turner et al. (1998), mail–by–disk is described by van Hattum and de Leeuw (1999), optical scanning is examined by Dillman and Miller (1998) as well as Blom and Lyberg (1998), the advantages of audio–enhanced computer–assisted self–interviewing are demonstrated by Schneider and Edwards (2000) and email survey technique is used by Couper et al. (1999) as well as by Schaefer and Dillman (1998). Couper and Nicholls (1998) provide an historical overview on computer assisted survey information collection (CASI).

sponse option is offered to the participants of a business survey in the German business–related services sector, in addition to the more traditional way to fill out the questionnaire by paper & pencil. The empirical analysis is based on data taken from the 'Service Sector Business Survey' (SSBS), a panel data set which is collected quarterly by the Centre for European Economic Research (Zentrum für Europäische Wirtschaftsforschung, ZEW) since summer 1994. It began as a one–page paper & pencil survey which asked for firms' assessment of their past and expected economic development on a three–point Likert scale, ranging from 'improved' over 'unchanged' to 'worsened'. The participating firms used to return the questionnaire either by fax or surface mail.[3] Since the first quarter of 2001, the firms in the SSBS sample also have the additional opportunity to fill out the questionnaire over the Internet, so that the SSBS is collected in a 'mixed mode' since then.[4] A total of 72 (8.5 per cent) out of 847 firms in the realized sample actually made use of the online opportunity.

Although I am presently unaware of any study that deals with differences in response patterns due to alternative response modes in an online/paper & pencil business survey, there is an abundant strand of the survey methodology literature

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[3]I use the term 'firm' throughout the paper although it is in fact a firm representative who fills out the questionnaire (or refuses participation).

[4]Note that the term 'mixed mode survey' is often used for surveys where individuals in a survey sample are multipily contacted by different approaches (e.g. first by mail, then by email). This differs from the notion I use here, where firms may freely choose to respond either by paper & pencil or online.

which is concerned with closely related issues. In that respect, Lynn (1998) compares response patterns of computerized personal interviews (CAPI) and paper & pencil questionnaires and finds a tendency for CAPI–respondents to be more likely to choose extreme categories on three and five point Likert scales. Lynn does not find significant differences in unit–nonresponse. Richter et al. (2001) run LISREL estimates on a small sample of social sciences students who responded to an online/paper & pencil computer literacy survey to show that the two response modes are 'psychometrically equivalent', basically meaning that significant differences in response patterns do not exist. Dillman et al. (1998a) demonstrate that quit rates in an online survey are lower if a 'plain' instead of 'fancy' questionnaire design is used, since fancy design requires longer computer processing time. Tuten et al. (1999, 2000) analyze the use of banner ads in online–only personal surveys. Dillman and Bowker (2001) discuss the success chances of Internet household surveys and give recommendations concerning the way online surveys should be conducted, a point to which I shall return to in Section 2. Bandilla and Hauptmanns (1998), Couper (2000) and Hauptmanns (1999) critically judge the success chances of online household surveys by pointing out the following problems associated with pure online surveys: (i) unknown sampling frame of Internet users, (ii) impossibility of drawing true random samples and (iii) high potential of self–selection since the sample is not actively drawn. The potential advantages of online surveys with respect to the time required to complete a survey are underlined by Barbieri and Romano (1999) as well as by McFadden

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and Winter (2001). McFadden and Winter (2001) also discuss the effects of the 'unfolding brackets' technique on response patterns and find significant anchoring effects. In a comparison of left– and right–justified response boxes in online surveys, Bowker and Dillman (2000) find that left justified response boxes lead to data quality gains if respondents have high computer skills.[5] Typologies of online survey respondents are provided by Bandilla and Bosnjak (2001), Bosjnak (2001), Bosnjak and Bandilla (2000), Bosnjak et al. (2001) and Tuten et al. (1999); these papers, however, do only marginally differ in content. The advantages of a multimode, multicontact strategy in household and business surveys are stressed by Schaefer and Dillman as well as by Dillman et al. (2001). Jamieson (1998) as well as Parent and Jamieson (2000) report positive effects of multimode, multicontact strategies on response rates for business surveys collected by Statistics Canada. The Internet as a means of information and data dissemination for a statistical agency is discussed in Keller et al. (1999), Murphy et al. (2000) and has been the main subject of the 'Quality Conference 2001'.[6] The effect of information technology on data collection and data dissemination

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[5]The advantage of left justified response boxes in the setting of Bowker and Dillman (2000) is that respondents do not need to scroll to the right to tick their answers if the response box is aligned to the right. This problem, however, does not occur in the online version of the SSBS since participants view the entire set of questions, even if respondents operate their screens in an 800×600 pixels mode.

[6]See the Internet at `http://www.q2001.scb.se/` for further details and for a download of paper abstracts.

is dealt with by Bradburn (1999) from a Federal Statistical Agency's Perspective.

This paper (i) displays descriptive statistics on the dispersion of Internet access in the German business–related services sector, (ii) discusses potential technical problems in the implementation of a mixed mode business survey, (iii) analyzes the determinants of online versus paper & pencil survey participation using — since online participation is only observed if firms participate in the SSBS at all — a bivariate probit model with sample selection and (iv) studies if response patterns significantly differ between the two data collection modes. The fourth issue is tackled in two ways. First, simple χ^2 tests are run to check if online respondents give significantly differently answers than paper & pencil respondents. Second, ordered probit models for firms' propensity, to indicate if they have experienced an improved, unchanged or worsened business development, are run. The ordered probit specification includes, besides a dummy variable for the response mode, a set of observable firm characteristics in order to control for difference in the anatomy of online and paper & pencil respondents. If the dummy variable for online participation turns out to be significant, differences in response patterns exist even when it is controlled for observable firm heterogeneity. Finally, the paper investigates if data quality, measured in terms of item–nonresponse, changes if firms participate online.

If the SSBS was conducted online only, this would very likely lead to a coverage error, as the sample included only firms with Internet access. Since the SSBS asks

questions referring to the current and prospective economic development of firms, running a purely online survey might lead to biased results, because firms with Internet access are likely to be better endowed with ICT–equipment than firms without Internet access and are hence able to produce services at lower costs, an aspect which is especially crucial in the business–related services sector.[7] This in turn implies that these might be the firms with a better business development, suggesting that sample selection bias is likely to occur.

These sample selection problems might even occur if firms have the free choice between responding online or by paper & pencil, as it is the case for the SSBS, since (i) the visual appearance of the online and the paper & pencil questionnaires differ and (ii) it is possible that firms which had not responded if there was no online option would now take part in the survey, leading to a potential sample selection bias.[8] In addition, since online surveys are "peopleless and paperless" (Werking 1994, p. 163), introducing an online response option might change the social interaction between the survey respondents and the interviewee: while the paper & pencil questionnaire have the respondent's name printed at the top of the questionnaire, online participants only type in a randomly generated number. The effect of the introduction of an additional online option on response patterns

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[7]Bertschek and Kaiser (2001) find highly significant and positive effects of ICT–investment on labor productivity using SSBS data.

[8]All online participants which were included in earlier samples had, however, taken part in the survey before. Due to sample refreshment, eight online respondents were included in the SSBS sample for the first time.

in an established paper & pencil business survey has, to the best of my knowledge, not yet been investigated in the existing literature. Practitioners often assume that these kinds of measurement and sample selection problems might not occur. They often refer to the fact that firms have the free choice between responding online or by relying on paper & pencil. That this view of the world is not necessarily correct is suggested by the fact that online respondents in the SSBS report a significantly worse sales development even if differences in observable firms characteristics such as sector affiliation, affiliation to East or West Germany, PC–endowment and firm size are taken into account. This indicates that significant mode effects may actually exist in mixed–mode online/paper & pencil business surveys.

Further results are that sector affiliation and affiliation to East or West Germany do not significantly affect the respondents' decision to fill out the questionnaire online.[9] By contrast, small firms are significantly less likely to participate online than large firms. A significant correlation between firms' decision to participate in the SSBS at all and to respond online is cannot be found, implying that the estimates for the online participation decision do not suffer from a sample selection bias. This is shown using a bivariate probit model with sample selection.

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[9]Clearly, this does not imply that *un*observed factors such as general attitude towards new technology adoption do not play an important role here. Given that only cross–sectional and non–panel data are presently available, there is no way to take these unobserved factors into account.

Table 1: The ten sectors included in the SSBS and their industrial classification

Sector	NACE–Rev. I code
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

Finally, item–nonresponse tends to be generally higher if the questionnaires are filled out online.

2 Data

The SSBS is a stratified random sample. The ZEW sends out a single page questionnaire every three months to about 4,000 firms belonging to the ten sectors listed in Table 1. 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.

The structure of the realized sample with regard to the three stratification

variables (sector, size, region) is determined by the frame population and by 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 Creditreform, Germany's largest credit rating agency. 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 firms' sales, addresses and, in most cases, the name of the managing directors. Although this data base does not actually cover the entire population of firms in Germany, small firms are underrepresented, the MARKUS data base is the most complete sampling frame available for Germany (Licht and Stahl, 1995).

The second factor determining the structure of the realized sample is the response mechanism, i.a. firms' '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). Section 3.2 analyzes the effects of observable firm characteristics on the general SSBS–participation and on the decision to respond online in greater detail.

These factors — sample design and response mechanism — require expansion of the realized sample in univariate analyses.[10] The calculation of the expansion

[10]The standard argument against expansion as discussed in some detail by Schnell (1993) for an individual person survey, namely lack of homogeneity of the sample strata, may of course also apply here.

factors is described in greater detail in Kaiser et al. (2000). Appendix A displays figures on sample size, realized sample size and response rates.

A sample refreshment takes place on an annual basis. Firms which have not taken part in the survey more than six times in a row are removed and replaced. Results of the first survey 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.[11]

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 first class mail (postage is paid by the ZEW). By sending the cover letters directly to the managing directors, the ZEW hopes to circumvent gate keepers, clerical staff and assistants who might have the order not to forward survey requests (Paxson et al., 1995; Dillman, 2000, Ch. 10). Changes in the respondents' address can be noted on the SSBS–questionnaire in order to maintain an up–to–date data base. The cover letter promotes the survey as the only source of information on the current state of the economic development in the German business–related services sector and informs the participants that they will receive a four–pages report summarizing the main findings of the survey within the next six weeks. After two weeks, non–particpants receive a reminder,

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[11]The ZEW offers to send current survey results to an interested public. Send an email to `konjunkturumfrage@zew.de` to receive copies. Write to the same address to receive copies of the SSBS data set for scientific use.

although the initial letter does not inform the firms in the sample that they will receive this reminder. The cover letter mentions that the survey participants will also receive the passwords to access the additional information provided on the ZEW Internet sites, a service which is provided since the last quarter of 1998. This service has been used by a total of 213 survey participants since its introduction. Altogether, the response rate amounts to about 30 per cent, a response rate which is well above the average response rate across 183 U.S. business surveys found by Paxson (1992) and which might be due to the shortness of the survey (Dillman et al., 1993).

Firms which participated in the previous quarter receive a different cover letter than those which did not take part. The participants are thanked again for their reply and are urged to participate, while the non–participants receive a letter underlining the importance of the survey.

Roughly 90 per cent of the returned questionnaires used to be sent back to the ZEW by fax, the rest being sent back by surface mail before the online response mode was introduced. After two weeks, those firms which have not replied are sent a reminder. Since the first quarter of 2001 (26th wave of the SSBS), participants also have the opportunity to fill out the question online; 72 of the 847 participants have taken up this opportunity. The comparably low response rate in the first quarter of 2001 (see Appendix A) is mainly due to overly detailed questions on firms investment behavior, ICT usage, skill mix and labor cost, as a small nonresponse analysis among 18 non–participants has shown.

The three main reasons for the ZEW to introduce the additional online participation mode are (i) an improvement of data quality due to the obsolescence of manual data entry, (ii) a cost reduction due to the obsolescence of manual data entry and due to the reduction of mailing costs and (iii) an increase in response rates by offering two instead of just one response mode. The additional online mode might also reduce the time respondents spend with filling out the survey and hence provides incentives to participate, an issue which is stressed by Bandilla and Hauptmanns (1998), Barbieri and Romano (1999), Dillman (1998), Hauptmanns (1999), McFadden and Winter (2001), Schaefer and Dillman (1998) as well as Smith (1999). The possibility of speeding up the data collection process and the possibility of conducting more complex surveys offered by an online response mode (Dillman, Ch. 11, 2001; Smith, 1999) do not readily apply here, since the time schedule of the survey as well as the survey design remain basically unchanged in order to keep the online and the paper & pencil survey as similar as possible.

In addition, the ZEW wished to offer the online survey response mode early in the development of the new technology in order to gain experience with the new media and to indicate its readiness for new technological opportunities. As Kottler (1998) puts it in an online marketing survey context, "Web interviewing has arrived and is established. Embrace it or be left behind".

Lastly, online surveys broaden the variety in questionnaire design by allowing a more dynamic interaction between respondents and interviewers, e.g. with re-

spect to skip patterns instructions, pop–up instructions, shapes and colors; see Dillman (2000, Ch. 11) for more details. Although the more dynamic interaction between respondents and interviewers offers a great potential for survey design (Payrhuber and Schmuk, 2001), the ZEW aimed at keeping the online and the paper & pencil questionnaire as similar as possible ('unimode design'; Dillman, 2000, Ch. 6) in order to avoid differences in response patterns arising from differences in the stimulus, which would be particularly harmful, as it implies a structural break in the time series constructed from the panel data information. Appendix B displays a screenshot of the first set of questions of the online questionnaire, Appendix C displays the entire paper & pencil questionnaire. Both questionnaires correspond to the 28th wave of the SSBS (first quarter of 2001). Empirical evidence on the dispersion of ICT in the business–related services sector is gained from data obtained in the 25th wave of the SSBS which corresponds to the second quarter of 2000. This wave contains information on the use of ICT in the business–related services sector. It was asked if firms (i) have Internet access, (ii) possess their own homepage and (iii) use email. The data also contains information on the share of employees with their own office email account. Table 2 displays descriptive statistics on the use of ICT in the German business–related service sector and in other important sectors of the German economy. The figures for the non business–related service sectors are taken from the ZEW ICT–survey which was collected in 2000 on behalf of the German Ministry of Education and

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Research.[12] Some of the additional sectors overlap with those defined in Table 1. The share of firms with Internet access is generally impressive and indicates that online surveys indeed have great potential for the near future.

The most interesting figures displayed in the context of online business surveys are those related to firms' Internet access and the share of firms with their own homepage. More than 90 per cent of the firms in the business–related services sector have Internet access, implying that almost every firm which took part in 25th wave had the possibility of fillng out the questionnaire online. It may, however, be the case that the person in charge of filling out the questionnaire does not have Internet access. Since the survey is sent to the executive managers, the probability appears to be quite small. While this figure does not distinguish between Internet access via the firms's own server, meaning that an online response is not associated with variable costs, or via a commercial Internet provider, where variable costs arise, the share of 66.1 per cent of firms with an own homepage is much less impressive. It, however, still indicates that at least these 66.1 per cent of the respondents usually do not have to cover variable costs when they participate online.[13] Although the figures related to email use in the German business–related service sector are not of heightened importance in the present context, they nevertheless imply that the German business–related services sec-

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[12]I am indebted to Irene Bertschek and Helmut Fryges for providing me with this data.

[13]It can not be ruled out that firms with an own homepage also have to incur variable costs since some firms may not possess least lines.

tor is a fairly advanced user of electronic communication.

To summarize, the descriptive evidence in Table 2 implies that almost any firm in the German business–related services sector included in the realized SSBS sample can at least potentially fill out the SSBS online. However, filling out the questionnaire online is not associated with variable costs for only two third of the firms. In that respect, Table 2 also supports Clayton and Werking's (1998, p. 546) view that "Using the WWW for surveys, while full of promise, does pose a variety of problems, namely limited penetration and inevitable mixed mode collection for the years to come."

In fact, the 8.5 per cent of online respondents met very well with the ZEW's expectations concerning online participation. Problems with filling out the online survey did not occur during the data collection period.[14]

When the ZEW started the online survey project, it followed the recommendations of Dillman (2000, Ch. 11); Dillman and Bowker (2001); Dillman et al. (1998b) and Schmidt (1997), who describe how an online survey should be conducted.[15] In particular, (i) the web questionnaire provides a welcome screen

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[14] One respondent, who had already sent back the questionnaire by fax, wished to fill out the questionnaire online as well. The server automatically shuts down the online access if a questionnaire is returned by either response mode, so that the respondent did not receive access and hence wondered why he could not access the online questionnaire.

[15] The online survey is set up in close accordance to the quality standards proposed by the 'Arbeitsgemeinschaft deutscher Markt– und Sozialforschungsinstitute' (Society of German Market

Table 2: Dispersion of ICT in the German business–related services sector

Share of firms w/ own homepage		
business–related services		66.1
Share of firms w/ Internet access		
Business–related services*		91.1
Consumer goods		89.7
Chemical products		96.3
Basic products		87.7
Metal manufacturing		88.9
Electrics		98.0
Measurement and control		93.3
Vehicles		95.4
Gross trade		84.6
Retail trade		74.6
Transport		80.6
Banking and insurance		97.1
Software		100.0
Technical services		94.9
Other services		93.0
Share of firms which use email		85.4
Share of employees w/ own email account:	mean:	52.9
	median:	50.0

Table 2 displays descriptive statistics on the use of ICT in the German industries. The superscript * indicates that this information's source is the 25th wave of the SSBS and refers to 967 firms. The other data is taken from the ZEW ICT–survey and refers to 4,411 firms.

which emphasizes the ease of responding and tells respondents how to proceed, (ii) firms in the sampling frame are provided with a PIN number to limit access to the firms in the sample, (iii) shapes or colors were not used at all, (iv) differences in the visual appearance of the questionnaire due to different screen configurations, operating systems, browsers, partial screen display and wrap–around texts do not arise,[16] (v) drop–down boxes are not used, (vi) it is not required that respondents answer all questions before they may proceed, (vii) the questionnaire is presented in a very similar way to the traditional one and (viii) the respondents are informed as to how many of the total number of questions they have already answered. The questions are presented in blocks, and each block is transferred separately to the ZEW–server whenever respondents click "ok" at the end of the block of questions to proceed in the survey. It is hence not required that participants fill out the entire questionnaire. They may also temporarily quit the survey. If respondents reenter the questionnaire, Formicula recovers the answers already given so that respondents can complete the questionnaire. The ZEW decided

and Social Sciences Research Institutions, 2001).

[16]Nichols and Sedivi (1998) report that many participants in a U.S. Bureau of Census business survey had difficulties in accessing the questionnaire since it was programmed in JavaScript, a programming language which is not compatible with many Internet browsers. Kanarek and Sedivi (1999) as well as Clayton and Werking (1998) discuss technical incompatibility problems in the context of online surveys implemented in the U.S. Bureau of Census and the U.S. Bureau of Labor Statistics respectively. Schwarz and Reips (2001) discuss incompatibility problems of JavaScript with popular browsers.

to block questions instead of presenting them step–by–step ('one screen — one item') in order to keep the amount of time required to fill out the questionnaire to a minimum. [17]

In addition, the ZEW made sure that (i) the website is firewall–protected and that (ii) cookies are not required.

However, three differences between the online questionnaire and the paper & pencil questionnaire are noteworthy: Firstly, the online questionnaire asks for the business judgements in the present quarter and, when that part is completed, for the prospects for the coming quarter. In contrast, the paper & pencil questionnaire is constructed so that questions on current and expected development are placed beside one another. Secondly, the online questionnaire contains, beside improved, unchanged or worsened business development, a fourth answering possibility, namely the option 'don't know'. None of the online respondents have, however, used this category. Thirdly, in order to make the questionnaire appear visually more attractive, the online questionnaire comes with a light green background. For the background of the questions, a slightly darker green than for the answers is used in order to ease the readability of the online questionnaire.

When the ZEW launched the online survey project, it aimed at providing a broad

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[17]Gräf (2001) as well as Gräf and Heidingsfelder (1999) suggest presenting each question separately, at least in the case of surveying people. It is probably fair to mention, however, that these authors developed and sell an online questionnaire software tool which only supports question–by–question surveys.

technical platform which is not restricted to the SSBS and can also be used by other surveys conducted by the institution. The online survey tool was named "Formicula" since what it does is design a form, the questionnaire, which is sent back to the ZEW via the Internet. Formicula is a script–language which allows a questionnaire to be laid out and data collection via the Internet to be controlled. It is a module for a web–server and can supervise multiple surveys; its use is only restricted by server capacities. Formicula is programmed in Java, which means it implements the philosophy 'compile once, run everywhere' and is therefore not restricted by the underlying operating system of the web server. Formicula uses a consolidation of different distinct technologies to generate dynamic web contents provided by Sun Microsystems called servlets. As a servlet, Formicula produces a simple HTML–form whenever an online participant accesses the survey's website. The formular is filled out by the respondent and sent back to the servlet which generates a dynamic response according to the guideline of the script. Since the HTML–code used corresponds to the HTML-standard 4.0 there are no specific requirements for the client's browser. A technical documentation of Formicula is provided by Doherr (2001).

Online participants spend on average 300 seconds (or five minutes) filling out the online questionnaire, with a median of 242 seconds.[18] Table 3 displays means and quantiles of the time distribution. Since it is unknown how much time it takes to

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[18]These figures are not corrected for item–nonresponse. However, all online participants filled out the entire questionnaire (sometimes leaving out individual questions).

Table 3: Time (in seconds) spent to fill out the online questionnaire

Minimum	10 %	50 %	90 %	Maximum	Mean	Std. err.
116	144	242	505	1477	300.439	208.7755

Table 3 descriptive statistics on the time online particpants spend to fill out the questionnaire.

fill out and fax or mail back the paper & pencil questionnaire, it is impossible to assess if online participation is time–saving.[19] In addition, the figures displayed in Table 3 are not adjusted for item–nonresponse.

3   Empirical investigation

The plan of the empirical investigation of sample selection bias and measurement error is as follows: Subsection 3.1 studies if online and paper & pencil respondents differ with respect to past survey participation. Subsection 3.2 tests if there are significant differences between online and paper & pencil participants. Subsection 3.3 tests if there are significant differences in the response patterns of online and paper & pencil participants. Subsection 3.4 investigates if data quality, measured by item–nonresponse, differs between online and paper & pencil participants.

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[19]Fuchs et al. (2000) compare the time participants in a household survey spend in completing a CAPI interview and a paper & pencil questionnaire and find that CAPI takes slightly longer.

3.1 Previous survey experience of the online participants

One important success factor of any survey is the establishment of trust between the interviewer and the interviewee, as stressed by Dillman (2000, Ch. 6). Trust potentially is even more important for online than for paper & pencil survey since the information contained in online responses might be potentially even easier disseminate than in any other survey mode. It could therefore be expected that online respondents have participated in the SSBS more often than paper & pencil respondents. Since the SSBS has witnessed several sample refreshments and one sample enlargement (see Appendix A), firms in the sample have had unequal chances to participate in the SSBS survey. Table 4 therefore also displays, beside the number of participations, descriptive statistics on the number of times a firm was included in the sample and the ratio of the number of participations and the number of inclusions in the sample. The latter variable is an indicator of attitude towards the survey, as large values indicate a high individual response rate. The figures are displayed separately for paper & pencil and online participants and correspond to the participants of the 28th wave. Figure 1 displays Table 4 by using the corresponding boxplots of the three indicators for past survey experience.

Mean and median survey participation tend to be slightly larger for paper & pencil respondents than for online participants. Paper & pencil participants also tend to be included more often in the sample than online respondents. Indeed, a

Table 4: Descriptive statistics on past SSBS–participation

| | | Quantiles | | | | | |
	Min.	10 %	50 %	90 %	Max.	Mean	Std. err.
# of participations							
paper & pencil	0	1.0	9.0	25	27	11.0	8.7
online	0	0.0	5.5	23	27	8.6	8.2
# of inclusions in the sample							
paper & pencil	1	1.0	15.0	27	27	14.8	9.3
online	1	1.0	9.0	27	27	12.4	8.7
Ratio							
paper & pencil	0	0.2	0.7	1	1	0.7	0.3
online	0	0.0	0.7	1	1	0.6	0.3

Table 4 displays descriptive statistics on past survey participation behavior of the respondents to the 28th SSBS–wave. The figures correspond to 775 paper & pencil participants and to 72 online respondents.

two–sample Wilcoxon rank–sum test cannot accept the identity of the medians between the two treatment groups, with the respective marginal significance levels being 0.026 and 0.0437 percent respectively. Rank–sum tests are conducted here since they are distribution–free, an issue which is important here with regard to the boxplots, since the variables are not symmetrically distributed, let alone normally distributed as required for t testing. The identity of the medians cannot be rejected for the ratio of participation and inclusions in the sample by a rank–sum test (p–value 0.1169).

To summarize, the descriptive evidence on past survey experience indicates that online respondents have less experience with the SSBS than paper & pencil participants. It hence appears as if firms which (i) took part in the SSBS more often and (ii) were more often included in the sample are reluctant to switch to the

Figure 1: Boxplots for the variables representing past SSBS–experience
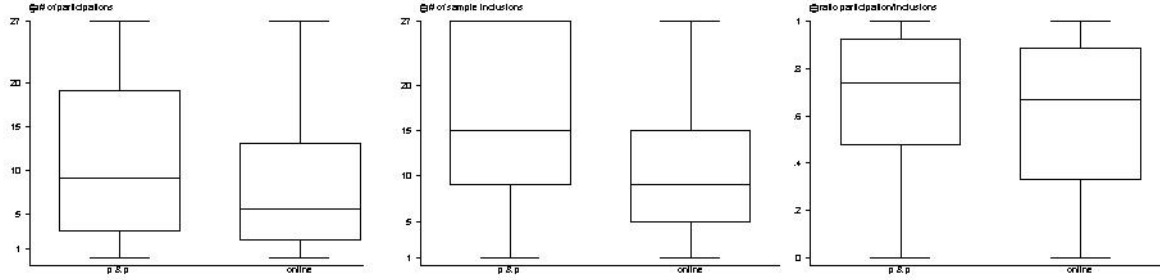
online response mode, probably because they had good experiences with the traditional paper & pencil response mode. The insignificant differences with respect to the median ratio of the number of times a firm participated to the number of inclusions in the sample indicate that attitude towards the SSBS does not differ between the two response modes.

3.2 The determinants of online participation

A straightforward starting point in the investigation of potential sample selection bias is the analysis of the determinants of online versus paper & pencil participation. In this section, I test whether observable firm characteristics have significant effects on the choice of response mode. Before, however, firms choose their response mode, they first decide whether or not to take part in the survey at all. The econometric model applied here takes the first–stage participation decision into account by estimating a bivariate probit model with sample selection. Figure 2 visualizes the two–step decision process: the online participation decision

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Figure 2: Two–step decision process of general survey participation and response mode
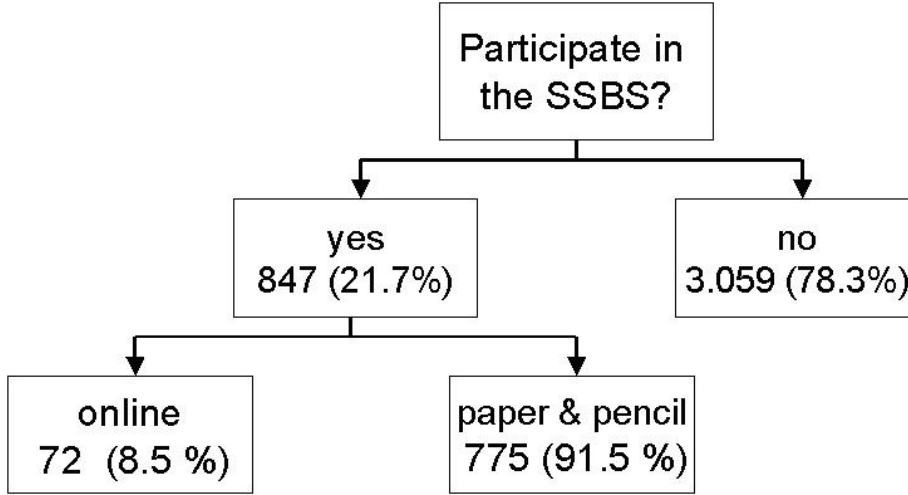
reached in the second stage is only observed if firms decided to participate in the survey in the first stage.

The baseline idea of the bivariate probit model with sample selection is to jointly estimate a firm's decision to participate in the SSBS and its decision concerning the response mode, the latter decision only being observed if the firm takes part in the survey. The interdependence between the two decisions is incorporated in the correlation of the error terms corresponding to the two binary probit equations. If the correlation coefficient is insignificantly different from zero, the latent variables corresponding to the two decisions are uncorrelated and the parameters can be consistently and efficiently estimated by separate binary probit models.[20] If it is significantly different from zero and separate estimations were run, inconsistent parameter estimates are obtained for the probit model for on-

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[20]Note that an insignificant correlation does not imply that the two decisions are independent.

line participation. Technical details on the bivariate probit model with sample selection are presented in Greene (1995, Ch. 22.3).[21]

The following observable firm characteristics are assumed to determine firms' decision to participate and to respond online: (i) a set of nine sector dummy variables with waste and waste water removal as the base category, (ii) a dummy variable for East German firms, (iii) two size class dummies (between 1 and 19 employees and between 20 and 59 employees with the category between more than 59 being the comparison group) and (iv) previous experience with SSBS participation. The specification takes past survey experience into account by including the the ratio of the number of past survey to the number of inclusions in the sample and the total number of past surveys in which the firm participated. Past survey participation is included linearly and as a squared term in the online equation and as two dummy variables (zero past participations and between one and six participations, with more than six participations as baseline category) in the general participation equation.[22]

The estimation of a bivariate probit model with sample selection shows that the error terms of the two binary probit equations are insignificantly correlated with one another (p–value 0.1181; the Wald–test statistic is the square of the

[21]I use Limdep7.0 (Greene 1995) to run the estimation.

[22]The number of inclusions in the sample might also matter in both decisions. It is, however, highly correlated with the number of participations (correlation coefficient 0.8416, p–value 0.000), so that the number of inclusions is left out in the estimations.

t–value corresponding to the correlation parameter). This implies that a firm's choice concerning the response mode is uncorrelated with its initial decision to participate. Separate estimation of the parameters yields consistent and efficient parameter estimates for the online decision. Since imposing the restriction that the error terms of the two equations are uncorrelated leads to efficiency gains, I run two separate binary probit models for general survey participation and survey response mode. Estimation results for the separate estimations are displayed in Table 5, while the results for the bivariate probit model with sample selection are moved to Appendix D.

The decision to participate in the SSBS is not well explained by observable firm characteristics such as sector affiliation, affiliation to East or West Germany and firm size. The related coefficients are both separately and jointly insignificantly different from zero.[23] Indeed, joint insignificance of all coefficients except the constant term and the 'experience' parameters cannot be rejected. Evidence for nonresponse bias as a result of differences in sector affiliation, affiliation to East or West Germany and firm size is hence not given.

Unsurprisingly, survey experience is an important determinant of survey participation. There is an inverse U–shaped effect of the number of past surveys in which a firm participated on the probability of taking part in the 28th survey

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[23]The dummy variable corresponding to Machine rental is significant at the nine percent marginal significance level only. With regard to the sample size, significance levels smaller than five percent should be regarded as insignificant here.

wave as well. The maximum probability is reached at a number of 27.7 past participations, which is outside the observed number of past participations and simply implies that those firm which have always taken part in survey are most likely to participate in the 28th wave as well. The ratio of actual to possible participation also highly significantly and positively affects participations in the current survey. If the ratio is interpreted as firms' attitude towards the survey, this indicates that firms with a positive attitude are more likely to respond than firms with a negative attitude.

The decision to participate in the 28th wave of the SSBS online is not well explained in general. The entire specification is significant at the 4 percent marginal significance level only.[24] It turns out, however, that firms with between one and 19 employees are significantly less likely to respond online than firms with more than 59 employees. Firms from the software sector are weakly significantly more likely to reply online than firms from the waste and waste water removal sector. Both significant effects might be due to differences in PC endowments: smaller firms and non–software firms might be less well equipped with PCs than large firms and firm from the software sector.[25] Running an otherwise identical binary probit model for online participation including the number of PCs per employee, however, shows that (i) PC–density does not significantly affect online participa-

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[24]Note that pseudo R^2s are transformation of the restricted and unrestricted log–likelihood functions only. They are displayed for completeness.

[25]Note that the presence of Internet access perfectly predicts online participation.

tion (likelihood–ratio test statistic: 0.8398, p–value: 0.3595), (ii) the weak significance of the software sector dummy disappears and (iii) the high significance of the dummy variable for firms with between one and 19 employees remains. The latter result indicates that online participants significantly differ from paper & pencil respondents with respect to firm size even if it is controlled for PC endowment. This implies that differences in the responses to the questionnaire might be attributable to differences in firm size. In fact, using SSBS data, Kaiser and Spitz (2000) demonstrate in a quantification context that small firms come to significantly worse judgements e.g. of their sales development than large firms.

3.3 Differences in response patterns

The most important issue investigated in this paper is the question of whether there are significant differences in the response patterns between online and paper & pencil participants. This topic is even more important in panel data surveys, where time series are constructed from the individual survey waves and the analyst is interested in changes across time. If there are significant differences in the response patterns when an additional online option is offered after the survey has been running for a while, a comparison across time is severely hampered. Table 6 presents the results of χ^2 tests for identity of the response patterns in the answers to the first part of the SSBS questionnaire. It turns out that there are significant

Table 5: Binary probit model estimation results for the probability of survey participation and online participantion

	Survey part.		Online part.	
	Coeff.	Std. err.	Coeff.	Std. err.
Sector affiliation dummies				
Software	0.0166	0.1091	0.4393*	0.2469
Tax consultancy	0.1031	0.1132	-0.0122	0.2836
Management consultancy	0.0148	0.1130	0.3424	0.2581
Architecture	0.0023	0.1128	-0.0290	0.2984
Technical planning	0.0900	0.1112	0.1743	0.2565
Advertising	-0.1089	0.1150	-0.1621	0.3095
Vehicle rental	-0.0438	0.1301	-0.5050	0.4465
Machine rental	0.1964*	0.1158	-0.0004	0.2796
Transport	-0.0864	0.1115	0.0689	0.2722
East Germany	0.0522	0.0685	-0.0049	0.1670
Firm size dummies				
1–19 employees	0.0244	0.0732	-0.4874***	0.1717
20–59 employees	0.1175	0.0785	-0.1818	0.1781
Survey experience				
Ratio	1.6255***	0.1023	-0.1278	0.2669
# of previous part.	0.0719***	0.0132	-0.0264	0.0318
(# of previous part.)^2	-0.0013***	0.0005	0.0004	0.0011
Constant	-1.8275***	0.1001	-0.9371***	0.2455
Wald tests for joint significance				
	Test stat.	p–value	Test stat.	p–value
Entire specification	975.90	0.0000	26.22	0.0357
Spec. w/o experience terms	15.12	0.2348	21.11	0.0489
Sector dummies	10.32	0.3248	10.87	0.2846
Size class dummies	3.08	0.2139	8.83	0.0121
Participation	81.64	0.0000	2.54	0.2802
pseudo R^2	0.2907		0.0575	
# of obs.	3906		847	

Table 5 displays binary probit model estimation results for the probability of (i) participation in the SSBS and (ii) replying online instead of taking part by paper & pencil. The asterisks *** and * denote significance at the one and ten percent significance level respectively. The abbreviation 'part.' is shorthand for participation.

differences in the response patterns in sales and price judgements only. Paper & pencil participants are more optimistic in both cases. This contradicts my initial guess that the economically more healthier firms participate online.

One way to check if these differences in responses are due to observable firm characteristics is to control for these effects by estimating an ordered probit model for firms' propensity to indicate worsened, unchanged or increased business developments using sector dummies and firm size dummies, as well as a dummy variable for East Germany, as explanatory variables. If the differences in response patterns between online and paper & pencil respondents are due to differences in observable firm characteristics — for example due to differences in firm size between online and paper & pencil respondents as suggested in the previous subsection —, a dummy variable for online participation in such an ordered probit estimation should turn out to be significantly different from zero.

Table 7 displays the coefficient estimates of the dummy variable for online participation. The table does not display the estimation results for the sector dummies, the firm size dummies and the dummy variable for East German firms for the sake of brevity. The three answering categories are ordered as follows: 'worsened', 'unchanged', 'improved', so that a positive coefficient indicates positive effects on the probability of choosing the 'improved' category. The initial univariate evidence from Table 6 is replicated in the multivariate setting as well: online participants are more likely to have indicated worse judgements concerning sales than paper & pencil respondents. The formerly significant difference of

Table 6: Results of χ^2–tests in response patterns

		Share of firms indicating		# of parti–	Test	
	'up'	'no change'	'down'	cipants	statistic	p–value
Sales						
Online participants	30.5	41.7	27.8	773		
Paper & pencil	23.2	34.8	42.0	69	6.286	0.043
Sales expectation						
Online participants	41.7	47.2	11.1	765		
Paper & pencil	48.5	38.2	13.2	68	2.017	0.365
Price						
Online participants	16.0	69.3	14.8	771		
Paper & pencil	5.7	84.3	10.0	70	7.532	0.023
Price expectation						
Online participants	9.0	78.0	12.9	765		
Paper & pencil	5.7	87.1	7.1	70	3.207	0.201
Demand						
Online participants	31.4	46.1	22.5	764		
Paper & pencil	27.5	46.4	26.1	69	0.662	0.718
Demand expectation						
Online participants	37.9	48.9	13.2	759		
Paper & pencil	34.8	56.5	8.7	69	1.905	0.386
Profit						
Online participants	23.1	46.3	30.6	766		
Paper & pencil	20.3	42.0	37.7	69	1.510	0.470
Profit expectation						
Online participants	30.4	51.5	18.2	760		
Paper & pencil	39.4	45.5	15.2	66	2.315	0.314
Employment						
Online participants	22.0	57.9	20.1	768		
Paper & pencil	27.9	48.5	23.5	68	2.318	0.314
Employment expectation						
Online participants	24.6	60.4	14.9	763		
Paper & pencil	30.3	54.6	15.2	66	1.128	0.569

Table 6 displays χ^2–tests of identity in the response shares.

Table 7: Coefficient estimates for ordered probit estimation results for firms' propensity to report a worsened, unchanged or improved business development (in that order; results for online–dummy only)

	Coeff.	p–val.	p–value entire specification
Sales	-0.3931	0.007	0.000
Sales expectation	-0.0116	0.938	0.000
Price	-0.0850	0.576	0.000
Price expectation	0.1163	0.478	0.000
Profit	-0.2421	0.091	0.000
Profit expectation	0.1055	0.474	0.000
Demand	-0.1923	0.181	0.000
Demand expectation	-0.0644	0.657	0.000
Employment	0.0001	0.999	0.000
Employment expectation	-0.0045	0.976	0.000

Table 7 displays ordered probit model estimation results for the effects of online participation on firms' ordinal judgements and expectations concerning their current and future business development. The specification also includes a set of nine dummy variables for sector affiliation and a dummy variable for East German firms. 'p–value entire specification' denotes the marginal significance level of a Wald test for joint insignificance of the parameters except the constant term.

online participation related to price judgements disappears, however. These two results imply that differences in the response patterns to the sales question might indeed be attributable to observable firm heterogeneity, while the differences in the answers to the price question can be explained by observable differences in firm characteristics.

Differences in response patterns arising from differences in observable firm characteristics can generally be easily corrected by appropriate weighting. If differences in responses arise from differences in unobservable firm characteristics, weighting does not help here, since firms obviously cannot be weighted according to something unobservable. At least for the sales question, differences in responses appear to be due to different appearances of the questionnaire.

It is difficult to actually trace the reason for the differences in response patterns, especially since differences arise in sales and price judgement responses only. The fact that the sales and price questions are the very first to be asked in the online questionnaire might help to explain why there are differences in the response patterns. One way to study whether the response differences are actually due to the ordering of the questions is to randomly assign the questions to the respondents, as suggested by Vogt (1999), who, however is merely concerned with the effect of question order in homogeneous sets of questions and primacy/recency effects. The ordering could be tracked, and later analyzed if responses differ depending upon it. This issue, however, has to be left for further research, especially with regard to the fact that there are presently only 72 online respondents.

3.4 Effects on item–nonresponse

Many studies have demonstrated that CASI usually improves data quality, at least as far as the older and more established computerized survey techniques are concerned (Nicholls et al., 1997; de Leeuw and Collins, 1997; Ramos et al., 1998). It is, however, not yet known if online surveys provide better quality data than paper & pencil surveys. This subsection investigates if differences in data quality exist.

The questions concerning the changes in total sales, prices, demand, profit and employment of the first part of the SSBS questionnaire are usually answered by almost all participants of the survey. These questions are relatively simple to answer since they are repeated on a three point ordinal scale and only require the respondents' own subjective judgement. However, χ^2 tests of identity of the shares of item–nonresponses in the first part of the survey indicates that, except for the questions concerning price and demand expectations, each of these questions are answered by relatively fewer online participants than by paper & pencil respondents. This result is somewhat in contrast to Schaefer and Dillman (1998), who find lower item–nonresponse for email respondents than for paper & pencil survey participants. Test results for the questions on business development are displayed in the upper panel of Table 8, while test results related to the questions on apprenticeship training, general training, PC–intensity, total sales, total labor

costs, gross investment and ICT–investment are displayed in the lower panel. As the latter set of questions is more difficult to answer, at least if participants take the task seriously — answering these questions requires the provision of numbers instead of qualitative assessments —, it is unsurprising that item–nonresponse is a more severe problem in the second part of the SSBS questionnaire.

The figures displayed in the upper panel of Table 8 suggest that there are differences in item–nonresponse related to the first part of the questionnaire. This is also supported by a χ^2 test for identity of the distribution of the total number of missing values between the two response modes (p–value 0.000).[26]

These differences could potentially be due to secrecy problems in the online survey. Respondents might be reluctant to reveal information on their current and expected state of their businesses. That view is contradicted by the usually insignificant differences in item–nonresponse in the much more confidential issues such as investment, labor costs and sales. As mentioned earlier, the design of the online questionnaire is very similar to that of the paper & pencil one. 'Direct' effects arising from the visual appearance on the screen or on the paper questionnaire cannot be ruled out, however.

With respect to the tests for identity in item non–response corresponding to the second part of the questionnaire, the general conclusion is that there are no such significant differences.

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[26]I use a χ^2 test since the total number of missing values appears to be a discrete rather than a continuous variable, e.g. 87.5 percent of the online respondents and 93.7 percent of the paper & pencil respondents do not have any missing item in the first part of the SSBS–questionnaire.

To summarize, significant differences in the magnitude of item–nonresponse are only found for the questions related to past and future business development, with item–nonrespone being larger for online–respondents. The reason for these differences is unclear, however. The fact that item–nonresponse related to the much more confidential issues such as total sales, investment and labor costs does not significantly differ between the response modes suggests that secrecy issues do not have an effect on item–nonresponse in the online survey.

Table 8: Results of χ^2–tests in item–nonresponse

	# of missing responses	Share of missing responses	Test statistic	p–value
Sales			17.15	0.0000
Online participants	3	4.17		
Paper & pencil	2	0.26		
Sales expectation			7.37	0.0070
Online participants	4	5.56		
Paper & pencil	10	1.29		
Price			4.79	0.0290
Online participants	4	5.56		
Paper & pencil	2	0.26		
Price expectation			1.04	0.3070
Online participants	2	2.78		
Paper & pencil	10	1.29		
Demand				
Online participants	11	15.28	3.06	0.0800
Paper & pencil	3	0.39		
Demand expectation			1.33	0.2490
Online participants	3	4.17		
Paper & pencil	16	2.06		
Profit			4.26	0.0390
Online participants	3	4.17		
Paper & pencil	9	1.16		
Profit expectation			11.15	0.0010
Online participants	6	8.33		
Paper & pencil	15	1.94		
Employment			11.12	0.0010
Online participants	4	5.56		
Paper & pencil	7	0.90		
Employment expectation			14.58	0.0000
Online participants	6	8.33		
Paper & pencil	12	1.55		

— over —

	# of missing responses	Share of missing responses	Test statistic	p–value
PCs per employee			0.08	0.7810
Online participants	3	4.17		
Paper & pencil	38	4.90		
Total sales			0.57	0.4510
Online participants	9	12.50		
Paper & pencil	123	15.87		
Total labor costs			0.23	0.6300
Online participants	16	22.22		
Paper & pencil	192	24.77		
Gross investment			3.07	0.0800
Online participants	13	18.06		
Paper & pencil	214	27.61		
ICT–investment			1.18	0.2780
Online participants	11	15.28		
Paper & pencil	160	20.65		

Table 8 displays χ^2–tests of identity in item–nonresponse between the two answering modes. A total of 775 firms answered by paper & pencil, 72 answered online.

4 Conclusions

This paper studies if significant differences in the answering patterns exist between online and paper & pencil respondents to a quarterly business survey conducted in the German business–related services sector since the second quarter of 1997. Before an additional online response option was offered in the first quarter of 2001, survey participants returned the one–sided questionnaire either by fax or surface mail. Firms were allowed to freely choose between online and paper & pencil participation. A total of 72 (8.5 per cent) out of 847 participating firms

used the online reply mode.

It turns out that small firms reply online significantly less often than large firms and that firms from the software sector fill out the online questionnaire significantly more often. The first effect disappears if it is controlled for firms' PC–endowment, the second effect remains even in this case. Past survey experience and affiliation to East Germany does not have a significant effect on online participation. Estimation results obtained from running a bivariate probit model with sample selection — online response is only observed if firms answer the questionnaire at all — indicate that there is an insignificant correlation between the general decision to take part in the survey and to reply online.

Tests for identity of the distribution of answers to firms' ordinal assessment of their past and future business development show that online respondents differ with respect to their assessment of past sales and price developments. Online respondent submit worse evaluations in both cases. These differences are not attributable to differences in the characteristics of online and paper & pencil respondents in case of the sales question, as ordered probit estimation results imply. The differences in the answering patterns to the price question disappears, however. It is difficult to explain why the differences in answering patterns to the sales question remain even after controlling for observable firm heterogeneity. They may be caused by the fact that the sales question is the very first in the online questionnaire. A random ordering of the online questions could help to assess if the ordering of question can explain differences in response patterns.

Finally, it is shown that item–nonresponse is more widespread among online survey participants than among paper & pencil respondents, a difference which is not attributable to secrecy problems. It could be that respondents are not used to the online technology, so that the differences in item–nonresponse may disappear in future survey waves.

The inspection of the logfiles of the online response mode is left for further research. Their analysis might also help to understand survey participants' response behavior.

Appendix A Sample sizes, realized sample sizes and response rates

Quarter	Wave No.	Sample	Realized Sample	Response rate (in %)
I/2001	28	3958	874	22.1
IV/2000*	27	4042	1164	28.8
IIII/2000	26	3852	1062	27.6
II/2000	25	3908	999	25.6
I/2000	24	3963	984	24.8
IV/1999*	23	4072	1146	28.1
III/1999	22	3687	1063	28.8
II/1999	21	3707	1152	31.1
I/1999	20	3740	1019	27.2
IV/1998	19	3781	1118	29.6
III/1998*	18	3936	949	24.1
II/1998	17	3990	1008	25.3
I/1998	16	4047	958	23.7
IV/1997	15	4103	998	24.3
III/1997	14	4159	1010	24.3
II/1997⋆	13	4191	1061	25.3
I/1997	12	1817	589	32.4
IV/1996	11	1831	624	34.1
III/1996	10	1842	676	36.7
II/1996	9	1873	742	39.6
I/1996	8	1897	731	38.5
IV/1995	7	1920	709	36.9
III/1995	6	1944	731	37.6
II/1995	5	2002	823	41.1
I/1995	4	1191	554	46.5
IV/1994	3	3145	793	25.2
III/1994	2	3330	762	22.9
II/1994	1	3334	692	20.8

Appendix A displays figures on sample sizes, realized sample sizes and response rates across the past SSBS–waves. The superscripts ⋆ and ∗ denote sample enlargements and sample refreshments respectively.

Appendix B First set of the online questionnaire questions

Konjunkturumfrage - Microsoft Internet Explorer von Lycos Europe

Konjunktur (Fragen 1 bis 5 von 22)
Beantworten Sie Bitte die folgenden Fragen für ihr Hauptgeschäftsfeld.
Wir fragen Sie zuerst nach der Entwicklung **im laufenden Quartal (April bis Juni 2001)** gegenüber dem Vorquartal.

[1] Ist der Umsatz Ihres Unternehmens...
○ gestiegen   ○ gleich geblieben   ○ gesunken   ○ unbekannt

Um wie viel Prozent ca.?
[   ] Prozent   ☐ keine Angabe

[2] Sind Ihre Preise...
○ gestiegen   ○ gleich geblieben   ○ gesunken   ○ unbekannt

[3] Hat sich Ihre Ertragslage...
○ verbessert   ○ nicht verändert   ○ verschlechtert   ○ unbekannt

[4] Ist die Nachfrage nach Ihren Dienstleistungen...
○ gestiegen   ○ gleich geblieben   ○ gesunken   ○ unbekannt

[5] Ist ihr Personalbestand...
○ gestiegen   ○ gleich geblieben   ○ gesunken   ○ unbekannt

[OK]

Appendix C Paper & pencil questionnaire

*Bitte senden Sie den ausgefüllten Fragebogen bis **Freitag, 23. März 2001, an Fax-Nr. 0621/1235-333** oder -170 (oder per Post, Gebühr zahlt Empfänger) zurück an das Zentrum für Europäische Wirtschaftsforschung (ZEW)*

ZEW / CREDITREFORM – KONJUNKTURUMFRAGE

ZEW
Konjunkturumfrage
Postfach 10 34 43
68034 Mannheim

Beantworten Sie bitte die folgenden Fragen für Ihr Hauptgeschäftsfeld. Wir fragen Sie zuerst nach der Entwicklung *im laufenden Quartal (Januar bis März 2001)* gegenüber dem Vorquartal. Dann beantworten Sie bitte die gleiche Frage für die voraussichtliche Entwicklung *im kommenden Quartal (April bis Juni 2001).*

Ist der Umsatz Ihres Unternehmens...
❏ gestiegen   ❏ gleich geblieben   ❏ gesunken

Wird der Umsatz Ihres Unternehmens...
❏ steigen   ❏ gleich bleiben   ❏ sinken

Um wie viel Prozent ca.?
_____ Prozent   ❏ keine Angabe

Um wie viel Prozent ca.?
_____ Prozent   ❏ keine Angabe

Sind Ihre Preise...
❏ gestiegen   ❏ gleich geblieben   ❏ gesunken

Werden Ihre Preise...
❏ steigen   ❏ gleich bleiben   ❏ sinken

Hat sich Ihre Ertragslage...
❏ verbessert   ❏ nicht verändert   ❏ verschlechtert

Wird sich Ihre Ertragslage...
❏ verbessern   ❏ nicht verändern   ❏ verschlechtern

Ist die Nachfrage nach Ihren Dienstleistungen...
❏ gestiegen   ❏ gleich geblieben   ❏ gesunken

Wird die Nachfrage nach Ihren Dienstleistungen...
❏ steigen   ❏ gleich bleiben   ❏ sinken

Ist Ihr Personalbestand...
❏ gestiegen   ❏ gleich geblieben   ❏ gesunken

Wird Ihr Personalbestand...
❏ steigen   ❏ gleich bleiben   ❏ sinken

Bildet Ihr Unternehmen in einem oder mehreren anerkannten Ausbildungsberufen aus?
❏ ja   ❏ nein

Wie viele Auszubildende und Vollbeschäftigte hatte Ihr Unternehmen im vergangenen Jahr ca.?
Anzahl: _____ Auszubildende
Anzahl: _____ Vollzeitbeschäftigte

Ist die Anzahl Ihrer Auszubildenden in den vergangenen drei Jahren…
❏ gestiegen   ❏ gleich geblieben   ❏ gesunken

Wird sich die Anzahl Ihrer Auszubildenden in den kommenden drei Jahren voraussichtlich...
❏ erhöhen   ❏ nicht verändern   ❏ verringern

Falls Sie in 1999 Auszubildende eingestellt haben: Hatten Sie Schwierigkeiten, geeignete Bewerber zu finden?
❏ ja   ❏ nein   ❏ keine Azubis eingestellt

Besteht in Ihrem Unternehmen über die Erstausbildung hinaus Weiterbildungs- bzw. Fortbildungsbedarf?
❏ begleitend zur beruflichen Erstausbildung
❏ unmittelbar im Anschluss an die berufliche Erstausbildung
❏ später, nachdem Berufserfahrung gesammelt wurde
❏ nein

Zielen Weiterbildungsmaßnahmen eher auf...
❏ Erweiterung der Erstausbildung
❏ Eintritt in ein neues Tätigkeitsfeld
❏ Sowohl als auch
❏ Sonstiges: _____

Wie viele Mitarbeiter hatte Ihr Unternehmen in folgenden Mitarbeitergruppen im Jahresdurchschnitt 2000 ca.?

Mitarbeiter mit Fachhochschul- (FH-) oder Uni-Abschluss in naturwiss.-techn. Fächern ...... _____

Mitarbeiter mit FH- oder Uni-Abschluss in wirtschafts-, sozial- oder geisteswiss. Fächern.. _____

Mitarbeiter mit Fachschulabschluss .... _____

Mitarbeiter mit Berufsabschluss .... _____

Mitarbeiter ohne abgeschlossene Berufsausbildung .... _____

Wie viel Prozent der Arbeitsplätze sind in Ihrem Unternehmen mit einem PC ausgestattet?
ca. _____ Prozent

Wie hoch war Ihr Umsatz in 2000 ca.?
in Tsd. DM: _____

Wie hoch waren Ihre Personalkosten in 2000 ca.?
in Tsd. DM: _____
in Prozent des Umsatzes: _____

Wie hoch waren Ihre Bruttoinvestitionen (Bruttozugänge zu Sachanlagen und Gebäuden) 2000 ca.?
in Tsd. DM: _____

Wie hoch waren Ihre Investitionen für Informationstechnologien (Computerhardware, Software, Telekommunikation) 2000 ca.?
in Tsd. DM: _____

Appendix D: Bivariate probit with sample selection estimation results for the probability of survey participation and online participantion

	Survey part.		Online part.	
	Coeff.	Std. err.	Coeff.	Std. err.
Sector affiliation dummies				
Software	0.0346	0.1086	0.3493	0.2385
Tax consultancy	0.1103	0.1161	0.0247	0.2500
Management consultancy	0.0219	0.1106	0.2684	0.2393
Architecture	0.0077	0.1137	-0.0186	0.2796
Technical planning	0.1339	0.1080	0.1686	0.2499
Advertising	-0.0696	0.1167	-0.2201	0.2925
Vehicle rental	-0.0096	0.1339	-0.5096	0.4248
Machine rental	0.2144*	0.1162	0.0580	0.2411
Transport	-0.0541	0.1136	-0.0244	0.2574
bf East Germany	0.0703	0.0682	0.0302	0.1727
Firm size dummies				
1–19 employees	0.0037	0.0732	-0.3932**	0.1844
20–59 employees	0.1190	0.0800	-0.0943	0.1839
Survey experience				
Ratio	1.8970***	0.1170	0.7180	0.4904
# of previous participations	—	—	0.0202	0.0405
(# of previous participations)^2	—	—	-0.0010	0.0014
0 participations	-0.4614***	0.1107	—	—
1–6 participations	-0.5663***	0.0666	—	—
Constant	-1.2856***	0.1255	-2.2494***	0.5898
Correlation coeff.	0.7476	0.4783	—	—
Wald tests for significant correlation				
	Test stat.	*p*–**value**	**Test stat.**	*p*–**value**
Correlation coeff.	2.4430	0.1181	—	—
# of obs.	3906			

Appendix D displays bivariate probit estimation results for the probability of (i) participating in the SSBS and (ii) of replying online instead of taking part by paper & pencil. The asterisks ***, ** and * indicate significance at the ten, five and one per cent significance level respectively.

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