

Sources of Measurement Errors in Business Surveys

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Abstract

Measurement errors are commonly ascribed to four sources: the respondent, the interviewer, the instrument (the survey questionnaire), and the mode of data collection. The unique characteristics of business population and business surveys affect the survey response process and contribute to the occurrence of specific measurement errors. Several authors have already exposed the need for an additional source of measurement errors in business surveys: the records or the information system or, even more broadly, the organization. Although this addition considerably improves the usefulness of the categorization, some sources of measurement errors still lack. This paper proposes an extension of the existing categorization in order to cover all known sources of measurement errors in business surveys and elaborates on its implications for detection, reduction and prevention of measurement errors in business surveys.

Keywords: business participants, business setting, survey characteristics, survey staff

1. Introduction

Measurement errors in business surveys receive much more attention nowadays than in the past. Still, the categorization of sources responsible for their occurrence does not reflect specific errors encountered in these surveys. This paper first defines measurement errors and presents existing categorizations of their sources, and then develops an integral categorization to address all known sources of measurement errors in business surveys based on previous and own research.

1.1 Definition of Measurement Error

A measurement error is defined as "a deviation" of the observed survey value from the true value (Groves 1991, p. 2) or as "a difference" (Hansen, Hurwitz, Marks and Mauldin 1951, p. 152) or "a discrepancy" (Sukhatme and Sukhatme 1970, p. 381) between them. Lessler and Kalsbeek (1992, pp. 242-243) noted that the term "difference" might not be the most suitable one because of its allusion to mathematical difference which is not applicable to variables measuring properties on nominal and ordinal scales.

The definitions implicitly acknowledge the existence of a true value. Nevertheless, the existence of a true value is not always taken for granted (Kruskal 1991). It surfaces as a questionable concept particularly in the measurement of attitudes and other psychological attributes (Groves 1991, p. 22). Lessler and Kalsbeek (1992, pp. 242-244) also noted that the true value may be either treated as independent of the survey conditions or operationalized with regard to particular survey specifications.

In practice, the true values are usually tied to particular survey conditions. Groves et al. (2004, pp. 49-54) defined measurement errors as the observational gap between the ideal measurement and the response obtained. Biemer and Lyberg (2003, pp. 38-43) simply described measurement errors as those that occur at the time of data collection.

It has to be noted that the definitions here apply to an individual unit of analysis even though they may be also applied to an estimate. In this latter case, the measurement error includes all sampling as well as nonsampling errors (Bureau of the Census, no date, p. 48, in Federal Committee on Statistical Methodology 1978).

1.2 Sources of Measurement Errors in Surveys of Individuals and Households

Measurement errors are generally ascribed to four principal design features of the measurement process (e.g. Groves 1989, p. 11):

- the interviewer;
- the respondent;
- the instrument (the survey questionnaire); and
- the mode of data collection.

Interviewers may cause measurement errors in the administration of the questionnaire by rewording questions, accentuating certain words, skipping questions, recording wrong answers or using different probes but they may also affect the respondent's behavior with their own demographic and socioeconomic characteristics (Groves 1989, p. 359).

Respondents make measurement errors during the response process. They may not have the necessary information; they may misinterpret the question, fail to recall the relevant information, make erroneous inferences, choose an inappropriate response option, edit the response, etc. (Tourangeau, Rips and Rasinski, 2000, p. 8).

Measurement errors arising from questions included in survey questionnaires depend on the words making up the questions, the structure of the questions, and the order or context of the questions (Groves 1989, p. 449). In addition, the questionnaire design along with its nonverbal language may contribute to the occurrence of measurement errors (Jenkins and Dillman 1997). Therefore, it is possible to list specialists for questionnaire content and design as sources of measurement errors as far as they are involved in the questionnaire design and evaluation processes (Esposito 2003).

Finally, the mode of data collection influences the interactions between the interviewers, respondents, and instruments, e.g. face-to-face and telephone methods of applying the survey instrument differ considerably from self-administration. Different modes may use different channels of communication as well as survey procedures such as refusal conversion rules, and interviewer selection and training procedures (Groves 1989, p. 503).

1.3 Sources of Measurement Errors in Business Surveys

In business surveys, the records (Ponikowski and Meily 1989), the information system (Biemer and Fecso 1995; Biemer and Lyberg, 2003) or the organization (O'Brien 2000) are added as additional error sources. It is typical in business surveys that the respondent cannot answer survey questions by merely relying on memory and has to look up the business records in order to acquire relevant data about the organization. The recorded data may be inaccurate, outdated, incomplete, difficult to access or simply unavailable for the unit of observation. So the information system with its contents, organization and accessibility considerably affects the response accuracy.

More broadly speaking, the organization may be treated as the fifth source of measurement error (O'Brien 2000). In such a case, the information system is still included as a source of measurement error because it pertains to the organization but other important aspects that influence a respondent's behavior in the survey response process are covered as

well, e.g. the organizational policy on surveys or the internal organizational structure.

Two definitions of a respondent also point to their different role in business surveys, which is "to locate the source of the information and to provide it" (Goldenberg, Butani and Phipps 1993, p. 290) or "to supply the requested information, either by accessing the business' information system or by relying on personal or other knowledge" (Biemer and Fecso 1995, p. 258).

Another categorization defines the task, the information system and the respondent as sources of measurement errors but it only applies to establishment surveys conducted by mail (Goldenberg, Butani and Phipps 1993).

Although these approaches are valuable an empirical study showed that some sources of measurement errors still lack in these categorizations.

2. Empirical Study

The findings are based on a qualitative study of 28 businesses of different size included in the Quarterly Survey of Trade (QST) conducted by the Statistical Office of the Republic of Slovenia (SORS). This business survey uses an eight-page questionnaire accompanied by a separate six-page instruction booklet and a booklet with an excerpt of the standard activity classification. One of the mailings also included a leaflet on survey results and their use.

The QST is a mandatory recurring survey conducted by a governmental organization. Data collection is self-administered and conducted by mail. Nonresponding businesses receive up to three reminders. Telephone calls may be made to persistent nonresponding businesses and businesses providing missing or highly inconsistent data.

The aim of this study was to perform a detailed examination of the actual response process in a business survey with a special emphasis on the respondent's perspective. As a preliminary step to the fieldwork, interviews with the survey staff were carried out in order to acquire information on the conduct of the survey, its development over time as well as problems encountered in the past.

The initial contact with an enterprise was established with the person indicated as a contact person on an earlier questionnaire if available. In a telephone conversation this information was verified or the respondent-to-be was identified. On-site visits were

arranged around two consecutive deadlines for questionnaire completion. One researcher carried out the organization of the field work and the field work itself. The implementation was challenging because it was difficult to get participation and organize the visits right after the questionnaire was completed. Most of the contacted people were already familiar with the survey and only some of them were new to it.

Refusals to cooperation were mainly due to the work overload during the period when the respondents intended to complete the questionnaire. In some cases the on-site visits were not organized the same day or the day after the questionnaire's completion because of the respondents' other business engagements, sick leaves, holidays or weekends, etc. A short time lag though does not seem to be so damaging for remembering a frequently repeated and well-documented process.

Qualitative research interviews were carried out with people who filled out the questionnaire. In some cases the interview was also conducted with people providing data for the questionnaire. In addition, the process of filling out was observed at least partially in eight cases; the extent of observation mainly depended on the amount of data retrieved before the visit.

3. Results

The empirical study showed that sources of measurement errors in business surveys are numerous and not completely covered by existing categories. Identified categories and their relations to existing ones are summarized in Figure 1.

Existing sources	Relations	Identified sources
Respondent	<i>Extension</i>	Business participants
Records/Information system/Organization	<i>Reallocation</i>	Organizational context/ Business setting
Interviewers	<i>Extension</i>	Survey staff
Survey questionnaire/ Survey instrument	<i>Change in focus</i>	Survey instrument
Mode of data collection	<i>Extension</i>	Survey characteristics

Figure 1: Redefined Sources of Measurement Errors in Business Surveys

The results of this empirical study are presented according to identified sources of measurement errors. It has to be considered, however, that these sources are often linked so that their interactions actually cause measurement errors.

3.1 Business Participants

The QST questionnaire collects different types of data, i.e. accounting, commercial, personnel, and store data, which suggests that more than one person may be involved in the response process especially in larger businesses. During the on-site visits, four main patterns with regard to the roles and number of people involved in the response process could be discerned:

- a single person who carried out the whole response process autonomously;
- two people, of whom one is a superior;
- more than two people within the business; and
- people in an accountancy firm and in the business.

The roles of these people in the response process were very different. The person appointed to fill out the entire questionnaire or a major part thereof had a central role in the response process. The person in a superior position typically entered the response process at the end when the questionnaire was already completed so the signature was often sought for the sake of formality. It has to be acknowledged, however, that the role of people in a superior position could be more noticeable and influencing for the first questionnaire's completion.

When more than two people within the same business were involved in the response process, it usually meant that one person answered the majority of the questions and that the others either supplied some data or were in a superior position. In some cases, the people were not employed in the business for which they completed the QST questionnaire; they were employed in an accountancy firm which provided services to several businesses, or worked for that single business on a contractual basis.

In addition, the QST editing staff explained that the same person could be responsible for more than one survey especially in larger businesses ("one person for statistics"). This often meant that the contact person only filled out the questionnaire with the data received from someone else.

The involvement of more than one person in the response process raises the question of the manner in which the survey instrument is transferred from one person to another and the communication that accompanies it. Several approaches were noticed in the study. Some people delivered both the questionnaire and the instruction booklet to the colleagues providing data for some questions; however, they did so only for the first time or occasionally or if they noticed changes. Others supplied the colleagues only with a

copy of the questionnaire or a copied page of the questionnaire. Some people simply emailed excerpted questions or communicated their own interpretation of the questions.

Considering the differences in roles and a differential exposure to the survey instrument, it is impossible to label all the people involved in the response process as respondents. Respondents are the most prominent – yet, only one – group of people occupied with the survey task in the business. Other groups include response coordinators, data providers, authorities, and gatekeepers or boundary spanning units, and they may all be a source of measurement errors in business surveys although their impact varies considerably.

3.2 Organizational Context or Business Setting

The survey instrument is delivered to an established business setting with a given organizational structure, processes, people, and culture. The fulfillment of a survey request necessitates the provision of information on the business. The information, however, is dispersed across the organization due to the division of labor, establishment of branch plants, subsidiaries, etc. (Tomaskovic-Devey, Leiter and Thompson 1994, p. 441). It resides in business records and people's minds, which constitute a business information system.

The study examined business information systems and pointed to factors which may influence the business effort in identifying, accessing, transforming, and transmitting the information sought from its location to the survey instrument. As expected, larger businesses had more sophisticated information systems and more qualified staff although this assured neither a proportionately higher effort nor less measurement errors compared to smaller ones.

Interestingly, businesses with foreign ownership had tough requirements for internal reporting which resulted in the up-to-dateness of accounting records. In fact, those businesses which brought all activities of record formation to bear on the fulfillment of prompt internal reporting appeared to have special respect for data and their quality. On the other hand, some businesses seemed to use data only to fulfill the legal requirements of bookkeeping, payment of taxes and contributions, etc.

Therefore, the kind of business setting influenced the response process and the occurrence of measurement errors well beyond the mere "technical issue" concerning the availability of data.

3.3 Survey Staff

The QST is a self-administered mail survey and therefore does not employ interviewers. The study showed that the absence of interviewers did not result in the absence of impact from other survey staff.

The initiative for the contact between the business and the QST staff could come from any of them. Most people involved in the response process did not initiate the communication with the SORS. Exceptions represented those who wanted, for instance, to get explanations during the first questionnaire's completion, to find an acceptable solution when data were unavailable, to communicate an error discovered after returning the questionnaire, to arrange the postponement of the deadline, etc. The QST staff mainly communicated with the business because they did not receive the completed questionnaire, because some data were inconsistent or missing, etc.

It turned out that the majority of the interviewed people in the study had already had some contacts with the QST or other SORS staff. Despite their rareness or uniqueness, these contacts generally produced a memorable experience. In fact, the respondents could provide the reason of the contact and some elaborated on the outcome as well as the associated feelings. Their accounts were particularly comprehensive when they described problem-solving procedures concerning demanding QST questions or a stringent deadline.

Support from the QST staff usually contributed to the prevention or reduction of measurement errors. Sometimes, however, a respondent deliberately or inadvertently made a measurement error and referred to instructions from the QST staff for having done so.

In all the abovementioned cases, the SORS staff had a direct impact on the (non)occurrence of measurement errors. In addition, the contacts with the SORS staff also affected the business participants' attitudes to the survey task, which may have had an impact on their motivation for performing the survey task well.

3.4 Survey Instrument

The study confirmed the importance of a good survey instrument in self-administered surveys. It revealed known issues with business survey questions, e.g. use of jargon, mixing professional expressions and colloquial language, demanding breakdowns, unclear question intent, separated questions and instructions, lack of instructions, etc. It showed some deficiencies in the questionnaire design, e.g. inconsistent titles and numbering system, inconsistent use of color,

insufficient transparency of the questionnaire structure, etc. This sometimes contributed to or caused measurement errors, including misclassification errors, and errors of omission and commission.

The QST instrument, however, consists of other materials besides the QST questionnaire. The study indicated that the use of the two appended booklets in the response process was quite modest. This proved detrimental in some cases because the booklets contained information essential for provision of accurate answers. Surprisingly, the booklets were judged useful – but often only for other people and other uses, e.g. the instruction booklet for less qualified personnel and the classification booklet for registration purposes.

In addition, the leaflet on survey results was never explicitly mentioned by the respondents although a couple of them declared getting something from the SORS occasionally. Although the lack of the leaflet's impact on the response process seemed not to have caused any measurement errors, this may have been a lost opportunity for improving the motivation for accurate questionnaire's completion through more positive attitudes to the survey task.

3.5 Survey Characteristics

3.5.1 Mode of Data Collection

The QST is a typical mail survey based on a self-administered paper questionnaire. This mode of data collection does not foresee any direct contact with the SORS besides through the survey instrument if the response process proceeds without any problems and produces a timely and accurate response. Such a mode of data collection accommodated data retrieval, which was often lengthy and/or involved more than one person in the QST, but placed a greater weight on the performance of the survey instrument and a larger burden on business respondents.

In the presence of problems in the response process, respondents could contact the QST staff by phone or email but few actually decided to do this. Many explained that they had been especially perplexed during the first completion of the questionnaire when the survey instrument had not provided answers to all emerging questions. The same was observed in those cases where a person was new to the survey. The lack of contact with the QST staff thus contributed to the measurement errors and the negative experience with the completion of the questionnaire.

3.5.2 Recurrence of the Response Process

The mode of data collection, however, was not the only survey characteristic which influenced the response process of the QST and the resulting measurement errors. The repeated administrations of the QST to the same business shaped this process considerably (for more details see Bavdaž 2006). Using the steps of the complete response process model by Willimack and Nichols (2001), it was observed that record formation, respondent selection, priorities assessment, and data release became less relevant or not relevant at all with recurrence while the cognitive processes were characterized by routine.

In particular, the record formation generally remained the same, the survey task was typically performed by previously designated respondents and its scheduling appeared to be relatively stable. The changes usually originated in the business environment, e.g. due to the introduction of a new system of record formation, changes in the respondent's workplace, changes in reporting deadlines, etc.

Many respondents in the study admitted they did not read the whole questionnaire, let alone the instructions, for a repeated questionnaire's completion. The same phenomenon was also observed. After they gave the questionnaire a swift scan for any changes they plunged into the retrieval processes based on the previously completed questionnaire or other working papers and supporting notes. The comprehension step was thus performed superficially and referred more to understanding previous questionnaire completion than to understanding survey requests. The retrieval procedures followed the previously established course and exhibited learning-curve effects. The respondent's judgment clung to the initial approach which was unlikely to change because previous reporting was satisfactory and for continuity reasons. The recurrence also affected the data release by loosening up the respondent's supervision.

To summarize, although the recurrence eased the response burden it also created many opportunities for perpetuating old measurement errors or making new ones.

3.5.3 Legal Requirements

In mandatory business surveys the response process is somewhat forced and this may have an impact on the accuracy of reported data. The response to the QST is mandatory which means that nonresponse, a late response as well as an inaccurate response may all be sanctioned. The SORS was only partially successful in

using its legal basis in the case of the QST since less than half of the businesses returned the QST questionnaire before the dispatching of the first mail reminder. Nevertheless, the final response rates were high, i.e. constantly above 90 %.

Although the editing rates were not estimated the SORS's editing staff reckoned that a third of the QST questionnaires required some sort of treatment or intervention, mainly because of incomplete and inaccurate data. The key businesses and those with major errors and deviations were summoned by telephone to provide explanations or correct the data, and they generally did so. The on-site visits, however, revealed some respondents' approaches leading to inaccurate answers which were not discovered and followed up by the SORS. A couple of respondents also mentioned that only a law requiring standard reporting would guarantee adequate records with precise data to support the questionnaire's completion. The respondents actually made use of estimates when precise figures were ungenerable, when they were generable with substantial effort, and when they were not readily retrievable. Occasionally they also ignored some questions or breakdowns even if they were applicable.

In the QST, enforcing a response was therefore less problematic than enforcing a timely and accurate response. It also appeared that a reduction of nonresponse errors was quite easily converted into an increase in measurement errors.

4. Discussion

The empirical study showed that the response to a business survey may be complex due to the presence of a number of people and the interplay of personal characteristics, organizational features, and survey design. The present discussion first addresses the sources of measurement errors on the business side and then continues with those which pertain to the survey although this division is to some extent arbitrary considering the many interaction between sources of measurement errors.

4.1 Business and its Participants in Survey Response

The literature on survey methodology recognizes that the organization with its information system may figure as a source of measurement errors in business surveys besides the respondent. The organization, however, consists of people and already includes the respondent. In order to avoid this duplication, it is better to speak about business participants on one hand

and organizational context or business setting on the other.

The key to this division lies in activeness and participation. Business participants are active in the response process while the business setting is formed of passive others who stay in the background. Although they both influence the survey response process, the effects in the return direction are differential, noticeable in the case of business participants, and negligible, if any – at least in the short-term, in the case of the business setting.

It can then be concluded that the business setting embraces all people whose activities remain unaffected by the survey request. Nevertheless, their activities may be very important for the outcome of the response process. First of all, there is the management, the policies they adopt, the strategies they pursue, the values they have, the staff they employ, the evidence and knowledge they require, etc. Most often, policies on survey participation are mentioned in the literature which is understandable in the case of nonmandatory business surveys. For mandatory business surveys, however, other issues may be far more relevant, e.g. the importance of evidence-based decision making, attitude to governmental reporting, etc.

In surveys of individuals and households, it is usually so evident who a respondent is that special definitions are neither necessary nor provided. The two available definitions for business surveys focus on the provision of requested information as well as on the applied mechanism (the acts of locating and retrieving). None of them establishes the criteria which would separate respondents from mere data providers. For instance, it is not unambiguous whether a person who receives a survey request through another person still qualifies as a respondent or not; or whether a person who delegates all retrieval tasks to other colleagues but writes the data down on the questionnaire form qualifies as a respondent or not; or what exactly constitutes the act of providing or supplying information.

In order to tackle these issues, it is proposed that a respondent to a business survey is someone who provides data with the particular purpose of answering a survey question. The provision of data is a necessary qualification for being a respondent, while contact with the survey instrument is a sufficient condition and differentiates a mere data creator or data provider from a respondent. The provision of data means recalling data from one's memory, retrieving data from the business records or collecting data from other people who recall the data from memory and/or retrieve them from the business records.

The contact with the survey instrument has to be sufficient to allow the person to autonomously identify the elements which are essential for comprehending the survey question and for a judgment of the response adequacy. It may be claimed that exposure to a specific survey question as given in the questionnaire is the minimal contact which still qualifies a person as a survey respondent. More exposure bears the greater effect of the survey instrument on to the person exposed.

This suggests that the survey instrument is irrelevant for some people involved in the process because they are never faced with it. In this case, the survey instrument has to perform proficiently for the exposed respondent so that they are adequately equipped for further data collection within the business. If the survey instrument does not communicate all the necessary elements of the question to this respondent, this failure is likely to produce a measurement error in the collected items. When the people who provide data to the respondent have the chance of getting in touch with at least some part of the survey instrument, they also get the chance to detect critical information themselves and influence the data adequacy. In addition to searching the best respondent, the statistical organizations should therefore investigate how to convince the recipient of a survey instrument to deliver it to a better respondent and how to identify them as well as how to adapt the questionnaire for inappropriate respondents.

4.2 Survey-Related Categories

Three sources of measurement errors are related to the survey itself and are under direct control of the survey organization: the survey instrument, the survey staff and the survey characteristics.

In business surveys, the survey instrument rarely consists of a survey questionnaire only. Advance and accompanying letters, booklets containing instructions and codes as well as various feedback forms all serve as a survey instrument and have to be taken into account. The study results indicate a modest use of the appended materials, which is consistent with previous findings (e.g. O'Brien, Fisher, Goldenberg and Rosen 2001). Nonuse of the entire instrument when its use is expected may be a source of measurement errors so as the use of the instrument when this instrument fails to communicate the necessary or correct information. This implies efforts should be directed to the improvement of the survey instrument and its usage.

Data collection in business surveys is prevalently self-administered. In this case, staff at the survey

organization do not perform typical interviewer's tasks. Questionnaire administration staff carry out nonresponse follow-up and editing, helpdesk staff and subject specialists may be available for consultation, etc. The survey staff therefore get occasionally in contact with people in businesses (cf. Sudman, Willimack, Nichols and Mesenbourg 2000, pp. 330-331). Previous research used them as a source of information on potential measurement errors (Rowlands, Eldridge and Williams 2002; Giesen and Hak 2005). However, they should also be viewed as a potential source of these errors despite the delicacy of this issue. As a consequence, appropriate training should be organized for all survey staff, not only for interviewers.

The mode of data collection is a recognized source of measurement errors in surveys. Business surveys, however, may have at least two other characteristics which contribute to the occurrence of measurement errors, namely their recurring and mandatory character. The first participation of a business or a person in a self-administered recurring business survey calls for intensive and extensive support and control of the statistical organization because it sets the standards and thus determines the quality of all subsequent completions of the questionnaire. This is also important for the enforcement of legal requirements when they exist.

There is one controversy with regard to legal requirements and their impact on the measurement errors. On one hand, the businesses are required by law to provide accurate data to the statistical organizations. But on the other hand, the statistical organizations usually concede the use of estimates when precise data are unavailable. This concession is legitimate since good population estimates may put up with good estimates at the business level. However, it calls for some rules or a guidance on what constitutes a good estimate and how much measurement error is still acceptable. The lack of such information may then serve as an excuse for making measurement errors and providing bad data to the statistical organization.

5. Conclusion

The paper proposed an extension and partially different grouping of sources of measurement errors in business surveys. The new categorization conceptually systematizes these sources. It may prove as a useful tool to address all potential sources of measurement errors in a particular business survey as well as to synthesize research findings across surveys. It has to be noted, though, that since the research underlying these findings is qualitative it is important that it is

evaluated with further qualitative and quantitative research on specific sources of measurement errors in business surveys as well as on their interactions.

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