CONTROL AND MEASUREMENT OF NONRESPONSE ERROR IN ESTABLISHMENT SURVEYS

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INTRODUCTION

Nonresponse error results from a failure to collect complete information on all units in the selected sample. Nonresponse produces error in survey estimates in two ways. First, the decrease in sample size or in the amount of information collected in response to a particular question results in larger standard errors. Second, and perhaps more important, a bias is introduced to the extent that nonrespondents differ from respondents within a selected sample.

Sampling from business establishments presents nonresponse problems somewhat different from those experienced in household surveys. This paper is tailored to illustrate nonresponse error in establishment surveys. Sources of error are discussed, controls used to combat nonresponse are outlined, and measurements used to represent nonresponse error are presented. A summary profile of the state of error techniques in use at selected government agencies is displayed.

An excellent reference on survey nonresponse error is Madow et al. (1983) especially Volume 1, which presents a comprehensive discussion on the subject.

SOURCES OF NONRESPONSE ERROR

There are three primary sources of nonresponse and they can be represented as a hierarchy. First, a sampled company may not be contacted, in which case the establishment does not have an opportunity to respond. This is referred to as a noncontact. Second, a sampled unit that is contacted may fail to respond. This represents unit nonresponse. Third, the unit may respond to the questionnaire incompletely. This level is referred to as item nonresponse.

Noncontacts

When an attempted contact of a selected survey unit results in a failure to contact or when no contact is attempted, the nonresponse is classified as noncontact. One failure to contact that could occur in establishment surveys results from seasonal closings (for example, in the vacation and leisure industry, with seashore resorts closing during the winter and ski resorts and ski equipment shops closing for the summer--and the food processing industry, which is affected both by seasonality and disturbances in the weather).

An attempted contact may also fail because of a temporary closing due to a strike or work stoppage, a possible event in industries with strong and radical labor unions.

Attempted contacts may not succeed due to a failure to locate the company. The firm may have moved or changed telephone number, or an incorrect address may have been inserted on the universe file. In the case of mail surveys, the survey form might be sent to the wrong location, the form misplaced prior to mailing, or lost during the mailing process.

Nonattempted contacts may result from negligence or sabotage on the part of the interviewer or in the mailing operation. Also, there may not be enough time in the collection period to reach all sampled units. The end result is that the sampled company is never contacted in the first place.

Unit Nonresponse

Once the sampled company is contacted, lack of any response to the questionnaire is classified as unit nonresponse. It is simply the failure of a contacted company to respond. Here again, certain sources of unit nonresponse are common to establishment surveys. For example, the survey form may never reach the appropriate division or contact person. This is most likely for large conglomerates with many divisions in diverse locations. The headquarters of a large corporation might be in a different city, or even a different State, than the production divisions.

Another source of unit nonresponse is when the sampled company is participating in too many surveys. This is especially true among the largest establishments, which because of their size may be included in every survey of their industry. Smaller companies, although not as likely to be involved in numerous surveys, may also have trouble finding the time to respond due to limited staff and resources.

Excessive costs of retrieving data is another reason for unit nonresponse among establishments. For example, a survey might ask for a particular disaggregation from company files that would require creating a new program to assemble the data. Another problem is that a company may have complex file structures that do not lend themselves to easy retrieval of the data in the form that the survey requests.

In other cases, the data requested may not be relevant, or the contact person decides it is not relevant to the company and tosses out the form. Also, unit nonresponse results from units being unwilling to cooperate; some companies might have a blanket policy of not responding to voluntary surveys or confidentiality of the data could be an issue.

Item Nonresponse

Item nonresponse is the failure of a responding company to answer a particular question. As with unit nonresponse, excessive costs are a primary cause of item nonresponse. Respondents might answer those questions that can be answered easily and skip over those requiring expensive data retrieval and manipulation.

Item nonresponse may also arise from technical difficulties. For example, some data may not be available during the survey period due to the ongoing development of a computer system to retrieve and assemble the information. Other times data may be unavailable due to systems processing problems at the time of the survey. Of course if the problems are widespread the result may be unit nonresponse.

Sometimes item nonresponse may reflect deficiencies in the questionnaire. Surveys that request too much data are apt to yield many partial returns. Questionnaires that are complicated, look cluttered or have ambiguous questions or unclear instructions have increased probability of item nonresponse (or even unit nonresponse). Sensitive questions or queries in areas the company regards as confidential may also be omitted.

Another source of item nonresponse may be the fault of the interviewer who does not follow the instructions provided or may either purposely (for example, because of time constraints) or accidentally omit questions.

CONTROL OF NONRESPONSE ERROR

Noncontact

First, to reduce noncontact of sampling units, controls can be instituted to ensure a strong effort to produce a successful first wave of contact and persistent followup procedures in the event of initial failure. In the case of mail surveys, mailing lists should be carefully checked to obtain accurate addresses. Annual or quinquennial benchmark surveys may require extensive research to update and verify mailing lists. Establishing process and quality control procedures on the mailing operation can further ensure that all survey forms are mailed and then received by sample units.

For interview surveys, interviewers who are convinced of the importance of the data collection effort will make a strong effort to reach all sampling units. Good interviewer training is necessary to achieve low noncontact rates.

Unit Nonresponse

The distributions of companies in many establishment surveys are highly skewed. For example, the distribution of finance companies stratified by total dollar receivables at the 1985 benchmark survey was:

Size ($ millions)	No. of Companies	Loans ($ billions)
Under 5	1288	0.8
5 and under 25	161	1.9
25 and under 100	96	5.5
100 and under 500	115	25.3
500 & over	78	270.6

Given such a frame, it is clear that in a survey of finance companies response from large companies is crucial to produce good estimates. Thus the followup of large companies who are not responding is very important. Followup techniques may take the form of reminder cards, periodic telephone calls, or re-interviews.

Advance notification that the company has been selected for a statistical survey may encourage a response. For example, a letter informing the company of the objectives and uses of the survey along with a cordial request for their cooperation in order to make the program a success. Concerns about confidentiality can be allayed at this point. A personal visit or telephone call by a member of the survey staff to important establishments may also be effective.

Another good front-end or initiation technique for promoting cooperation is to offer the company a copy of the statistical release or published survey results if they agree to participate.

The use of special reporting arrangements may encourage large companies to respond. Large companies that are vital to the survey because of their large holdings of key survey variables may appreciate special treatment. For example, suppose a survey is conducted out of Washington, D.C., but the data collection is done through district reporting centers. It may be beneficial to offer large companies direct communication with headquarters or central office clearance. This not only allows them more time to prepare the data, but eliminates an intermediate step in the event that problems occur with the reported data.

For surveys that collect detailed information, large firms may have thousands of observations, whereas small firms may have only a handful. Special arrangements to encourage the cooperation of the large firms may include allowing them to submit data on magnetic tape, floppy discs, or according to a specially arranged format.

Special care and treatment may also be necessary to produce a good response from the smallest sampling units. Unless the survey is short and simple, small companies that respond may face a disproportionate cost due to their limited resources. Responding to a complex survey, whether done manually by internal staff or by hiring outside programmers (possibly requiring the purchase of more sophisticated data processing equipment) may be a significant financial burden.

Another control technique for increasing the response rate among small establishments is sample rotation. A company participates in the survey panel for an agreed-upon length of time and is then replaced by another company having similar characteristics.

Survey designs where adherence to a strict probability selection is important may need to be changed from time to time because of a shifting population, perhaps due to growth or geographical relocations. This requires a redesign with assignment of new probabilities of selection to population units. Maximizing the overlap across survey designs may be desirable in order to provide stable, comparable data series. Additionally, sizable investments may have been made by both respondents and agency in order to collect the data. There are a number of techniques available, including the use of certainty selection and the use of conditional probabilities based on the previous design. Two references giving techniques for changing from an initial set of probabilities to a new set are Keyfitz (1951) and Kish (1965).

Item Nonresponse

Once the selected company committs to participation, the final step is to ensure that it answers all survey items. An important part in reducing item nonresponse is played by the prior knowledge of the data storage structures of establishments in the sampling frame. Acquiring this knowledge may require a pilot test or presurvey questionnaire. This could ask for such things as how the requested data are stored, if the response will be manual or computerized, if data can be disaggregated, or if the data can be retrieved and assembled in the form desired. Then using the results of the pilot test, the survey questionnaire can be tailored to fit the recordkeeping practices and abnormalities of the surveyed population.

Item nonresponse followup and callbacks aid converting partial returns into full response. Training of interviewers or data editing clerks in the importance of survey data and being cordial to respondents in their followup requests is important. Additional patience may be required in collecting items from establishments due to the many tiers of personnel. A circuitous path may be encountered before a correct contact is made. The use of nonresponse measures can also be helpful in followup procedures. For example, item nonresponse and item coverage rates flag key items that need callbacks.

The design of the questionnaire is another factor in controlling item nonresponse. Since poorly organized survey forms, poorly illustrated questionnaire skip patterns, and excessively long questionnaires are known to increase item nonresponse, a clear unambiguous survey form that can be completed in a reasonable amount of time is beneficial.

MEASUREMENT OF NONRESPONSE ERROR

Various measures of nonresponse error can be assembled at the data processing stage of a survey. There are both direct and indirect measures and indicators that can be used to assess the effect of nonresponse on the survey. Direct measures produce estimates of the bias in survey estimates due to nonresponse. Indirect measures do not provide an actual estimate of the bias, but do give some indication of the possible existence of nonresponse bias and its seriousness.

Indirect Techniques

The unit response rate is frequently used as an indirect measure of nonresponse. Easy to compute, it is the ratio of the number of responding eligible units to the number of eligible units in the sample. The unit nonresponse rate is of course the complement of the unit response rate. During the data processing stage of the survey, this measure provides a useful warning sign of the extent of the nonresponse problem. Later, when survey estimates are available, these rates provide indicators of nonresponse bias.

In establishment surveys, a better analysis of the nonresponse problem can be obtained by tabulating unit response rates by size of institution. For example, a 95 percent overall response rate is not as good as it appears if only one of the 10 largest companies responded. The tabulation of unit response rates by interviewer or geographical area may also identify problems with the data collection effort.

Item response rates are indirect measures of nonresponse on a micro level. They are calculated as the number of eligible units responding to an item divided by the number of eligible responding units. These rates provide an early indication of nonresponse and may be helpful if shown by size of industry, interviewer, geographic area, or some other stratified variable.

The item coverage rate may be more useful than the item response rate in establishment surveys. Defined as the ratio of the total of a significant variable (for example, income, acreage, total deposits) for eligible responding units to the total for all eligible units in the sample, it is a meaningful measure of nonresponse in establishment surveys where a relatively small number of firms have a disproportionately large share of the market.

The refusal rate, measured as the number of eligible units that refuse to participate divided by the number of eligible sample units, provides indirect information about the willingness to respond among the population of companies. This could say something about the difficulty of the questionnaire, the unit contact and reception process, or the ability of the interviewer. Improved information results from the rate being tabulated by interviewer, collection district, State, or other entity.

Knowing the reason for either unit or item nonresponse is helpful toward obtaining future reductions in the nonresponse rates. This understanding can build a data base to correct flaws in the design. For example, the corporation does not wish to participate because it views the data as confidential, or the company does not maintain the detail in its recordkeeping to fully respond.

Nonresponse adjustment is typically carried out using data obtained from one interview period. In the case of a panel survey, data collected across interview periods may be used to evaluate the nonresponse adjustment procedure. This longitudinal data may also be useful in developing models for or refining the nonresponse adjustment procedure.

Direct Techniques

A direct measure of nonresponse bias is obtained by collecting some of the survey data or covariate data for nonrespondents from another source, such as from a census or from administrative records. Comparisons with respondent census data by various subgroups yield differences which make possible the construction of correction factors to adjust for nonresponse. The characteristics of most establishment populations make the formation of subgroups important in determining differences between respondents and nonrespondents, for example, large companies versus small ones.

Another way of deriving a direct measure of nonresponse bias is to draw a sample of nonrespondents and conduct an intensive followup to collect the data. Estimates of the nonresponse population are constructed from this sample and compared to those based on the respondent sample. Differences between the two estimates are a measure of the nonresponse bias.

SUMMARY PROFILE AND CHARTS

Respondents to the government agency questionnaire reported data on control procedures and measurements used to contain and assess nonresponse error. The collected data are shown in the form of bar charts. Bar charts 1 and 2 show the summary data on control procedures. Each bar consists of three segments: the percentage of surveys that use the procedure on a regular basis, the percentage that use it on an irregular basis, and the percentage of surveys for which the procedure is not applicable. The complement of the bar is the percentage that does not use the procedure.

Noncontact Controls

In surveys where a mailing operation is involved, the use of control procedures to verify the accuracy of the mailing operation is routinely done at government agencies as indicated in Chart 1.

Unit Nonresponse Controls

The unit nonresponse controls shown in Chart 1 are front-end methods since they deal with initiation and special introductory arrangements. It appears that a reasonably strong effort is put forth to encourage participation by giving advance notification of the companies' selection for the survey, providing a publication of survey results and providing a convenient environment of special arrangements for transmitting the data. The more costly act of personal visitation shows less use.

Ongoing controls for maintaining low unit nonresponse rates are shown in Chart 2. Frequent use is made of unit nonresponse followup and intensive efforts at establishments considered critical to the success of the survey.

Item Nonresponse Controls

The last two bars in Chart 2 relate to item nonresponse.

Data keeping practices pilot test is a front-end technique used in about half the applicable government surveys. The second bar shows that strong use is made of item nonresponse followup.

Indirect and Direct Measurement Techniques

Bar Charts 3 and 4 show two bars for each measurement technique. The first bar is divided into three parts: the percentage of surveys that use the technique on a regular basis, the percentage that use it on an irregular basis, and the percentage not applicable. The second bar is also divided in three: the percentage of surveys that use the measure only within the agency (internal), the percentage of surveys that publish the measure, and the percentage not applicable. The complement of the bar is the percentage of surveys that do not use the measurement technique.

Among the indirect measures perhaps the most striking result is the difference between the use and the publication of the measure. Also, there does not appear to be a strong effort to document the reason for the nonresponse. The two direct measures surveyed, linking to administrative data and a followup sample of nonrespondents, see limited use at government agencies.

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Chart 1
CONTROL PROCEDURES
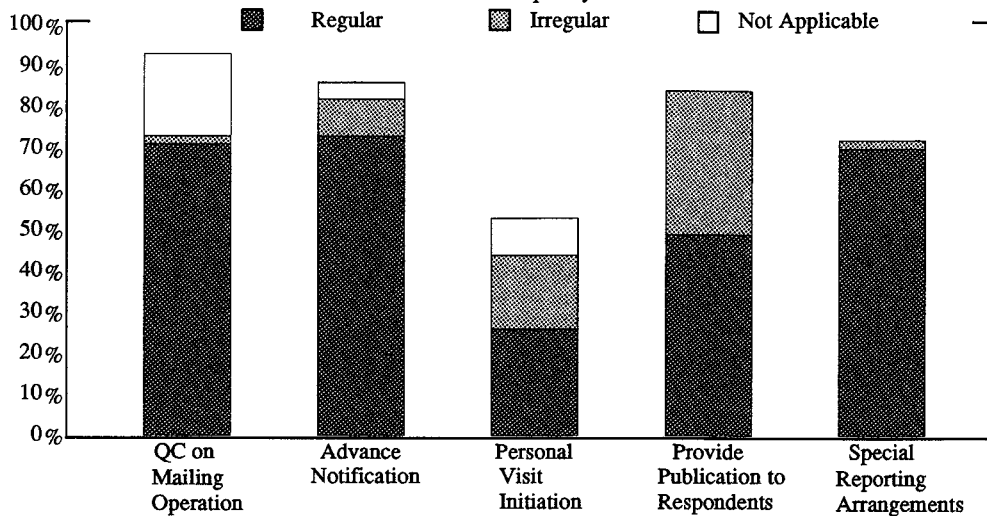Extent and Frequency of Use

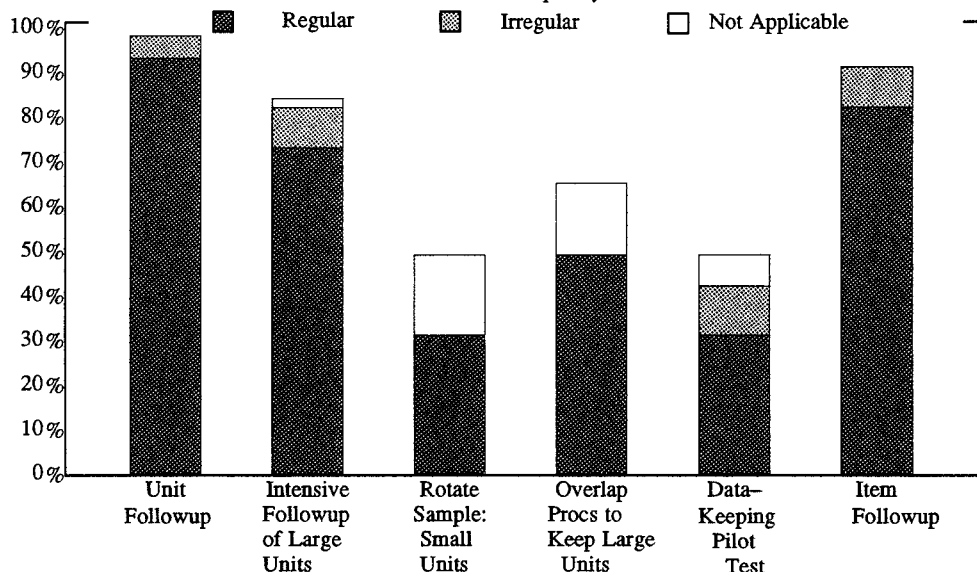Chart 2
CONTROL PROCEDURES
Extent and Frequency of Use

Chart 3
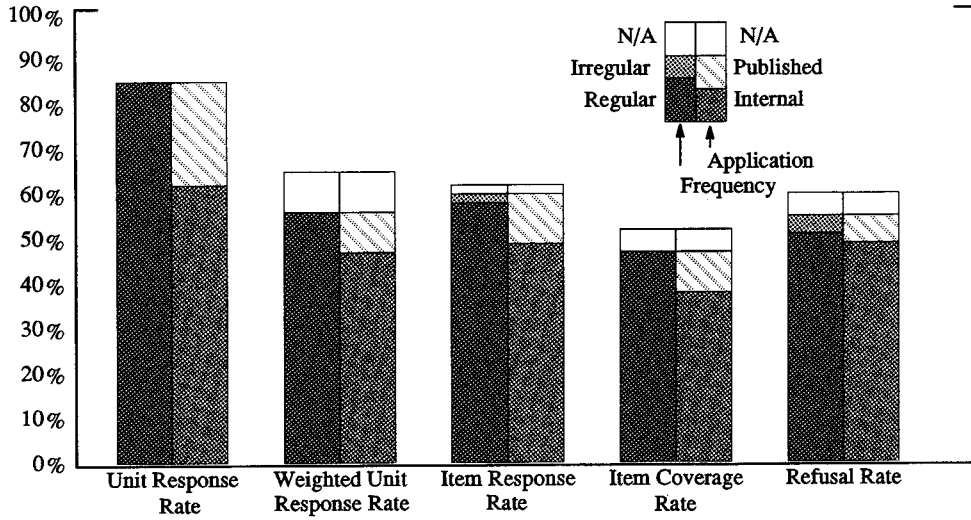INDIRECT MEASUREMENT TECHNIQUES
Frequency and Application of Use

Chart 4
MORE MEASUREMENT TECHNIQUES
Frequency and Application of Use