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Telephone presurveys, self-selection, and non-response bias to mail and Internet surveys in economic research

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A telephone presurvey is used in conjunction with mail and Internet follow-up surveys to assess self-selection and item nonresponse bias. Findings suggest that self-selection is present, but item nonresponse bias is limited. The Internet version exhibited no item nonresponse bias.

I. INTRODUCTION

A lack of secondary data to answer specific research questions has prompted economists to increasingly use direct mail, telephone, Internet and other types of surveys to obtain important information. The literature is replete with survey examples across all major subdisciplines, with a major concentration in the areas of marketing and environmental economics. While useful in answering many questions, there are inherent limitations and problems associated with surveys (Dillman, 1978).

Surveys are costly to conduct, and their limitations are generally inversely related to expenses associated with the type of survey. For example, direct mail surveys are popular because of their relatively low cost, but are also associated with lower quality results. The results of personal interview surveys are higher quality but are often exorbitantly expensive.

A primary concern with direct mail surveys (assuming that they are properly designed) is nonresponse bias, which arises when the characteristics of the respondents are systematically different from the characteristics of the nonrespondents. This arises, for example, when the response rates from one income group are significantly different than response rates in other income groups. Nonresponse bias leads to results that misrepresent the targeted population.

Multiple 'wave' mailings and telephone and postcard follow-ups to mail surveys are among the many methods used to increase response rates and mitigate nonresponse bias (Dillman, 1978; Pennings *et al.*, 2002). However, responses are frequently clustered, and increasing response rates does not necessarily lead to a more representative sample (Hite, 1998). While there is some evidence that these procedures are effective in improving response rates, they provide little information about the existence of nonresponse bias. There are methods for testing for nonresponse bias, but all are relatively *ad hoc* or depend on 'expert' judgments about possible nonresponse bias.

Nonresponse bias, by its very nature, is difficult to identify. The characteristics of nonrespondents are typically not observed. In such cases, direct testing for nonresponse bias is impossible and it is difficult to draw conclusions about the efficacy of remedial measures in mitigating nonresponse bias. Whitehead *et al.* (1993) use a telephone presurvey to collect basic data on potential respondents to a follow-up mail survey. The information collected in the telephone presurvey is used to examine nonresponse bias in the follow-up mail survey.

The results of Whitehead *et al.* (1993) are extended to examine differences in potential nonresponse bias to different types of survey media—Internet versus mail. Internet surveys have the distinct advantage of being relatively

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low cost and can be administered rapidly. However, there are two major concerns regarding Internet surveys: first, not everyone has Internet access and Internet users may not be representative of the target population; and second, some respondents may not be comfortable transmitting personal information over the Internet. These concerns fuel a perception that Internet surveys may, in fact, be more susceptible to nonresponse bias.

Results are presented from a survey of American households using a telephone presurvey to gather basic data about potential respondents. The presurvey was followed by mail and Internet surveys to the pool of respondents indicating a willingness to participate in a follow-up survey. A split sample design is employed in which the follow-up survey can be responded to by mail only, by Internet only or by either mail or Internet at the respondents discretion. The telephone presurvey was used to establish demographic characteristics of the sample. With the demographic characteristics of potential respondents and nonrespondents to the follow-up mail or Internet surveys there is a rare opportunity to *directly* examine nonresponse bias.

The objectives of this paper are two-fold. First, to examine the issue of self-selection bias related to those willing to participate in a follow-up survey. That is, are there distinguishing characteristics between those who agree and do not agree to participate in the follow-up survey? These results provide evidence of whether people self-select into the sample pool. Second, to examine whether there are systematic differences in characteristics between respondents and nonrespondents to the follow-up survey overall and within each survey elicitation method (mail, Internet, or combination).

II. SURVEY METHODS

A National Water Quality telephone presurvey was conducted in February–March 2002 by the Social Sciences

Research Center telephone bank at Mississippi State University (the initial components of this research were developed by Hite *et al.* (2002)). The purpose of the survey was to assess awareness and concern about Gulf of Mexico marine hypoxia and willingness to pay for methods to reduce the size of the hypoxic zone as well as to collect basic sociodemographic data on the respondents. Question design and wording was pretested using focus groups in Columbus, Ohio. Respondents were contacted using random digit dialling procedures, and household members over the age of 18 with the most recent birthday were asked to participate in the phone survey. After screening for qualified respondents, the response rate to the telephone survey was approximately 95%, resulting in 3412 responses. At the completion of the phone interview, respondents were asked if they would be willing to participate in a follow-up survey sent by mail. Those agreeing to the follow-up were randomly divided into three groups: one group received a mail survey to only be returned by mail, one group received a mail survey but were also given a web address where answers could be submitted via the Internet, and one group received a letter directing them to a web page where the questionnaire was administered on-line.

III. SELF-SELECTION BIAS

First it is examined whether individuals select into a follow-up survey.¹ Of the 3412 completed telephone presurveys, 56% agreed to participate in the follow-up survey, while 44% refused.² Self-selection bias was examined using four key demographic variables: income, education, age, and gender – as well as a simple willingness to pay (WTP) for reduction in the size of the hypoxic zone. Table 1 provides the summary statistics and results for tests of differences in means between respondents and nonrespondents. Income is significantly different between those agreeing to participate in the follow-up and those refusing. There are

Table 1. Means and tests for differences in means between those agreeing and those not agreeing to participate in a follow-up survey

Characteristic	Agree	Refused	T-statistic
Income (US\$)	54 653 (1595) ^a	51 019 (883)	3.31*
Education (years)	14.48 (1900)	14.49 (1512)	−0.12
Age (years)	44.84 (1900)	45.44 (1512)	−0.99
Gender (proportion male)	0.55 (1900)	0.57 (1512)	−1.07
Willingness to pay (US\$)	28.12 (1900)	19.86 (1512)	−11.19*

Notes: ^aNumbers in parentheses are number of observations. *Statistically significant at the 0.05 level assuming equal variances.

¹ It is important to note that self-selection bias in answering the phone survey is not being tested. This test only represents potential self-selection bias in the follow-up survey.
² Agreement to participate in the follow-up survey did not guarantee that the individuals would actually respond.

no significant differences in the other variables. Given the topical nature of the survey (environmental concerns) it is not surprising that higher income individuals agree to a follow-up survey more than lower income individuals. Nevertheless, results show that selection bias based solely on simple demographics is limited, consistent with the findings of Whitehead *et al.* (2002).

Perhaps more importantly, the average WTP for those agreeing to participate in the follow-up was significantly higher than those not agreeing to the follow-up.³ This suggests that those with higher WTP systematically self-select into the follow-up sample. The self-selection mechanism may be more complicated than simple demographics can detect. It could be argued that the WTP selection effect is a direct result of the positive correlation between income and WTP. Regression results indicate that after controlling for income, WTP is still significantly higher for those that participate in the follow-up survey than those that do not.

IV. NON-RESPONSE BIAS

The nonresponse bias to the follow-up survey is now considered. Here, the focus is on unit nonresponse; that is, those who returned their survey versus those who did not. Unit nonresponse bias can be directly tested using the demographic characteristics of all potential respondents collected in the telephone presurvey. Table 2 examines aggregate nonresponse bias across all three follow-up survey types. On average, follow-up respondents are significantly older than nonrespondents. Other characteristics are not significantly different.

Table 3 breaks the results down by follow-up survey type. Only age in the combined mail–internet option survey show strong signs of unit nonresponse ($\alpha = 0.05$). Income and age in the mail-only survey and education in the mail–Internet option survey exhibited unit nonresponse at a lesser significance level ($\alpha = 0.10$). Interestingly, the Internet-only version of the survey exhibited no signs of unit nonresponse.

Table 2. Means and T-test results for nonresponse bias across all survey types in follow-up survey

Characteristic	Respondents	Nonrespondents	T-statistic
Income (US\$)	55 866 (537) ^a	53 945 (1055)	1.40
Education (years)	14.49 (630)	14.47 (1265)	0.12
Age (years)	46.63 (630)	43.94 (1265)	3.55*
Gender (proportion male)	0.55 (630)	0.56 (1265)	−0.43

Notes: ^aNumbers in parentheses are number of observations. *Statistically significant at the 0.05 level assuming equal variances.

Table 3. Means and T-test results for nonresponse bias across specific survey types in follow-up survey

Characteristic	Respondents	Nonrespondents	T-statistic
Mail only survey			
Income (US\$)	56 818 (242) ^a	54 067 (378)	1.29
Education (years)	14.49 (630)	14.47 (1265)	0.12
Age (years)	45.76 (285)	44.27 (449)	1.26
Gender (proportion male)	0.56 (285)	0.56 (449)	0.00
Mail–Internet option survey			
Income (US\$)	55 041 (243)	54 020 (370)	0.48
Education (years)	14.34 (280)	14.60 (453)	−1.26
Age (years)	47.96 (280)	43.70 (453)	3.64*
Gender (proportion male)	0.51 (280)	0.54 (453)	−0.73
Internet only survey			
Income (US\$)	55 288 (52)	53 705 (307)	0.40
Education (years)	14.42 (65)	14.41 (363)	0.01
Age (years)	44.75 (65)	43.84 (363)	0.43
Gender (proportion male)	0.63 (65)	0.57 (363)	0.87

Notes: ^aNumbers in parentheses are number of observations. *Statistically significant at the 0.05 level assuming equal variances.

³ The median WTP value for those agreeing was US\$23, while the median WTP for those not agreeing was US\$15, indicating that the midpoints of the distribution were also different as well.

V. CONCLUSIONS

This paper extends Whitehead *et al.* (2002) by examining potential unit nonresponse across elicitation methods. Two conclusions are significant. First, prior research findings that, without requisite correction, self-selection bias could lead to upward bias in WTP estimates are confirmed (Messonnier *et al.*, 2000; Whitehead *et al.*, 2002). Second, nonresponse bias across different survey elicitation method was examined. The results suggest that despite significantly lower response rates there appears to be no evidence that use of the Internet results in a significantly greater likelihood of unit nonresponse bias when compared to mail surveys. This outcome is useful for researchers wishing to strike a balance between survey costs, response rates, and unit nonresponse biases.

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