

## Comparison of Data Obtained by Telephone versus Personal Visit Response in the U.S. Consumer Expenditures Survey

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### Abstract<sup>1</sup>

Although the Consumer Expenditures Quarterly Survey (CEQ) was designed to collect data from households by personal visit, about 42 percent of the households provide their expenditures data over the telephone. Recently, the CEQ began recording the mode of data collection, allowing the first analysis of the mode's impact on expenditures data. Currently, we know little about why interviewers and households choose the telephone for response. In this paper, we examine the geographic, economic, and demographic characteristics associated with telephone respondents in order to compare the data collected by telephone against the data collected by personal visit. White, non-Hispanic, highly-educated people that own their homes are responding to the CEQ survey by telephone at the highest rates. We model expenditures data and observe the coefficient for the dummy mode variable along with other predictors of expenditures. Regression models show the effect of the mode of data collection on total expenditures to be negligible, although telephone respondents tend to refuse income questions and phone data are allocated and imputed at significantly higher rates than personal visit responses.

**Keywords:** Mode, Telephone, Expenditures

### 1. The U.S. Consumer Expenditure Program

The Consumer Expenditure Survey program provides continuous information on the expenditures of American consumers for use in a variety of economic research and in support of revisions to the Consumer Price Index. The Bureau of Labor Statistics (BLS) sponsors the collection of expenditures in two separate surveys. First, the Consumer Expenditures Diary is designed to collect small, detailed expenditures that would be difficult for respondents to recall during an interview. Second, the Consumer Expenditures

Quarterly (CEQ) survey is designed to collect less frequent, more expensive, memorable purchases. Interviewers from the Census Bureau collect the data for both surveys. Results from the two surveys are integrated<sup>2</sup> to create published expenditures data. The data analysis described in this paper use data from only the CEQ survey.

The Census Bureau conducts about 40,000 CEQ interviews across the nation each year. Each selected household<sup>3</sup> is interviewed five times over one year. The Wave 1 interview is primarily a bounding interview to assist recall, and data from this interview do not contribute to expenditures estimates. Waves 2-5 of the survey ask respondents about larger expenditures, such as furniture, automobile, and vacation expenses. The survey is administered by computer assisted personal interviewing (CAPI), either in person or over the telephone (not centralized). An average CEQ interview takes approximately one hour to complete.

## 2. About the Analysis

### 2.1 Data

With the introduction of the CAPI instrument in April, 2003, the CEQ began tracking the mode of data collection. This is the first analysis assessing the impact of CEQ mode on expenditures data quality. Data for this analysis come from the period April, 2003 to March, 2004. The sample size is 32,193 households (covers Waves 2-5 only).

<sup>2</sup> For each expenditure category where both surveys can potentially estimate the same quantity (e.g., expenditures for lamps), the estimate with the lowest mean square error is used for that category (i.e., CEQ and Diary data are never combined to estimate an expenditure category).

<sup>3</sup> The CEQ collects data from consumer units, which include people living in a household related by blood or marriage, or unrelated people that share household expenditures. Each household consists of one or more consumer units. For most housing units, the household and consumer unit are the same. For this paper, we use the terms interchangeably.

<sup>1</sup> The author thanks William Mockovak, Karen Goldenberg, David Swanson, John Dixon, and Brian Meekins of the BLS for helpful comments. Any opinions expressed in this paper are those of the author and do not constitute policy of the Bureau of Labor Statistics or BAE Systems Information Technology.

## 2.2 Focus on Measurement Error

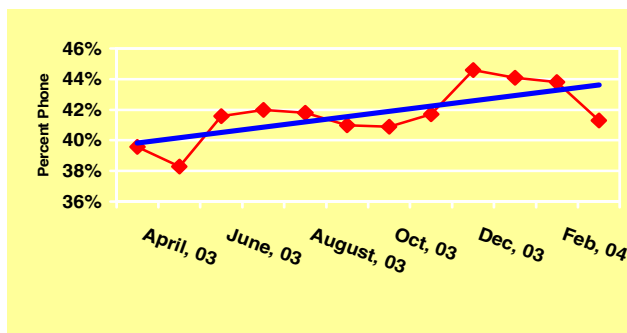
The focus of this paper is to examine how mode affects measurement errors in the CEQ. If data from this study came from a dual frame design that included separate sample designs for a personal visit and telephone data collection, we would be interested in mode differences due to sampling, coverage, nonresponse, and measurement. However, all CEQ respondents come from the same survey design. For example, we cannot create a separate response rate for each mode because the same respondent may be contacted multiple times by personal visit and telephone to gain contact. Therefore, measurement errors due to mode are the only error type of interest.

## 2.3 CEQ Mode

The CEQ was designed as a personal visit survey. Researchers have suggested that long, burdensome interviews like the CEQ are ill-suited for the telephone (Lyberg, 1988). Collins (1988) reports that it's a commonly held view in the U.K. that long interviews are not viable over the phone. Consequently, BLS researchers have generally felt that CEQ telephone interviews should only be used to avoid a refusal. However, empirical results linking mode problems with interview length are difficult to find.

Figure 1 shows the proportion of completed CEQ interviews conducted by telephone from April, 2003 through March, 2004. The fitted linear trend line (in blue) suggests that the percentage of CEQ phone interviews is likely stable or increasing. However, because the available data about mode cover only one year, it is difficult to separate the trend from the seasonality in the percentage of CEQ interviews collected by phone.

**Figure 1. Trends in CEQ Telephone Interviews**



## 2.4 Compensating for Non-Random Mode

When comparing CEQ data quality by mode, the major limitation is that the assignment of households to mode is not random. Although the survey is designed for personal visit data collection, interviewers can accept telephone response if this is the only means to complete the interview. When households (or interviewers) control the selection of mode, we must attempt to compensate for these differences in respondents to isolate the effect of the mode on expenditures.

In an attempt to remove the selection bias and make the mode data comparable, we use a two-stage modeling process. In the first stage, we fit a logistic model<sup>4</sup> where the dependent variable is the survey mode, and the independent variables are characteristics related to the respondent (age, race, home ownership, and income, etc.) and characteristics related to the data collection (interviewer, regional office, etc.). The logistic model identifies variables that may affect which mode of data collection is used. In the second stage, we fit a set of linear models where the dependent variables are expenditures (e.g., total expenditures, vehicle expenditures, etc.), and the independent variables include all significant variables from the first stage logistic regression (e.g., interviewer code, etc.), along with variables hypothesized to relate to consumer spending. With this modeling process, we attempt to control for characteristics related to both expenditures and mode.

## 3. Who Responds by Telephone

From the logistic model, we found that households responding to the CEQ by telephone do not resemble a random sample from the CEQ frame. Phone respondents are more likely to be white, non-Hispanic, highly-educated, and own their homes. They also have income that is 20 percent higher than personal visit households.

In Table 1, we show the most significant coefficients from the logistic model<sup>5</sup> where the dependent variable is mode of interview. We have sorted the chi-square statistics for a subset<sup>6</sup> of coefficients in descending order. Although all of the coefficients are highly

<sup>4</sup> Logistic regression models are commonly used when the dependent variable is binary and can be expressed as a probability.

<sup>5</sup> For the logistic model, the percent of concordant pairs was about 80 percent and the P-Value of the Hosmer Lemeshow goodness of fit statistic is 0.27, showing adequate model fit.

<sup>6</sup> Additional variables are final weight, wave, race, education, gender, ethnicity, age, age<sup>2</sup>, family size, frame, poverty rate, urban/rural, month of interview, region, income, degree of urbanicity, and public housing. Interactions include wave\*month and education\*race.

significant ( $p < .001$ )<sup>7</sup>, two of the three coefficients that most influence mode are due to the interviewer and the Census Bureau regional office<sup>8</sup> (RO). These two characteristics are associated with the data collection agency, and not the respondent. During interviewer focus groups in 2004, a group of about 25 interviewers nearly unanimously stated that “they only conduct CEQ interviews by telephone at the respondent’s request”. The data from the logistic model place doubt on the interviewers’ claim.

**Table 1. Predictors of Telephone Interview**

Variable	Wald $\chi^2$ (Millions)	P Value
Interviewer	62.1	< .001
State	7.2	< .001
Census Regional Office	2.2	< .001
Month of Interview	1.4	< .001
Tenure (owner, renter)	1.0	< .001
Number of Wage Earners	0.5	< .001
Refusal Conversion	0.5	< .001

To further examine the dominant impact of the interviewer on mode selection, we calculated the percentage of CEQ interviews conducted by phone for each interviewer. Figure 2 shows the number of interviewers that conduct fewer than 20 percent of their CEQ interviews by phone, between 20 and 40 percent, etc.

**Figure 2. Percent Phone for CEQ Interviewers**

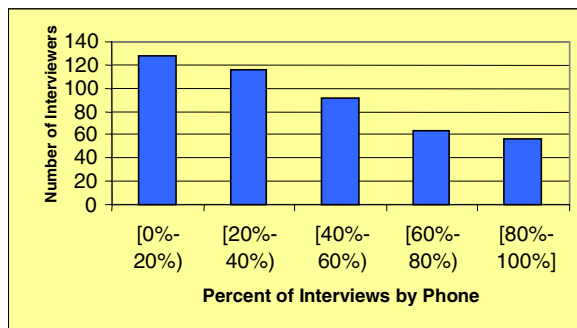


Figure 2 shows that a large number of interviewers are deviating greatly from the 42 percent national average.

<sup>7</sup> The Wald Chi Square statistics shown are generated by SAS Proc Logistic. However, each household can appear in the survey between one and four times during the April, 2003 – March, 2004 time period. We used Proc Genmod to account for the repeated measures in the dataset. Also, we embedded the Genmod regression in a SAS macro that runs the regression 44 times using the BRR replicate weights for the CEQ survey. This more proper treatment of the sampling variance did not change the substantive results.

<sup>8</sup> The Census Bureau’s field staff is managed by 12 regional offices (RO). Because each RO operates fairly independently, this variable is important for capturing differences in management philosophies.

Of the 455 CEQ interviewers<sup>9</sup> in this analysis, 128 conducted fewer than 20 percent of their CEQ interviews over the phone. Conversely, 56 interviewers conducted over 80 percent of their interviews by phone. A priori, we expected a roughly normal distribution around the 42 percent mean phone rate. Figure 2 shows a distribution that’s far from normal.

Although interviewer’s caseloads vary greatly by home ownership rates, respondent income, and other correlates of CEQ mode, the phone rates seem to deviate too far from the mean value of 42 percent. If respondents were truly requesting the phone interviews, it seems unlikely that one interviewer could work over 100 cases during a year and never do a phone interview, and another interviewer would have over 100 cases where 95 percent of the respondents request a phone interview. The data suggest that interviewer behaviour is influencing the mode of data collection.

**4. Data Quality by Mode**

Data collected by consumer expenditures surveys are widely believed to underestimate actual spending (Garner et al., 2003; Silberstein, 1988). There was concern that CEQ telephone data would exacerbate this bias, by having lower average household spending than personal visit data. Some explanations could be that interviewers (and respondents) may rush through a phone interview, or that respondents pay less attention to the task during a phone interview. Table 2 shows data for total expenditures, income, and survey length by mode.

**Table 2. Data Analysis by Mode of Interview**

Mode of Data Collection	Annualized Total Expenditures (Median)	Annual Income (Median)	Interview Length in Minutes (Median)
Personal Visit (n=18,769)	\$ 29,056	\$ 35,000	68
Telephone (n=13,424)	\$ 29,224	\$ 42,000	53

<sup>9</sup> We removed interviewers who conducted fewer than 11 CEQ interviews during the year to reduce the unimportant prevalence of these interviewers in the tails of the Figure 2 distribution. For example, an interviewer conducting 3 CEQ interviews during the year may be very likely to be 100 percent phone or 100 percent personal visit.

Table 2 shows that telephone and personal visit respondents both report about \$29,000 in annual median expenditures. In fact, distributions of total expenditures for the two modes are nearly identical, including mean, quartiles, variance, skewness, and kurtosis (data not shown). If the CEQ mode were randomly assigned to respondents, Table 2 alone would argue strongly that CEQ data obtained by telephone are comparable with personal visit data. However, we have said the mode is not random, and therefore we need to account for covariates affecting both the mode of data collection and expenditures. (Table 1 shows a subset of these variables.)

The rightmost column of Table 2 shows that CEQ personal visit interviews are about 25 percent longer than telephone interviews (68 minutes compared with 53 minutes). The CEQ CAPI instrument records the interviewing time for each of the survey’s 23 sections. Every section of the interview is longer when the mode is personal visit, ranging from about 20 percent longer for some sections to a high of about 80 percent longer for Section 6 (appliances) and Section 18 (trips).

Although expenditures and length of interview are positively correlated ( $\rho=.14$ ), this does not necessarily mean that longer interviews produce better (higher) expenditures data. It is more likely that the causal relationship between expenditures and interview length is that reporting large numbers of expenditures increases the length of the CEQ, and not because longer interviews, perhaps because of thoughtful response, cause the respondent to report more expenditures. However, this is a conjecture by the author, and the interpretation of this correlation is subjective.

**4.1 Expenditures Regression Models**

In Stage 1 we showed that the interviewer and Census RO, along with characteristics of the respond influence the mode of data collection. Now in Stage 2 we will show how these variables relate to reported expenditures. In the Stage 2 models, we include all significant predictors of mode from Stage 1, along with other variables theorized as relating to expenditures<sup>10</sup>. Table 3 shows a subset of the 20 plus main-effects and interaction coefficients in the model ( $R^2=.38$ )<sup>11</sup>. A point of interest in this table is that the

<sup>10</sup> Variables not shown in Table 3 include final weight, wave, gender, ethnicity, age, age<sup>2</sup>, family size, frame, poverty rate, urban/rural, month of interview, region, regional office, income, degree of urbanicity, public housing, and interviewer code. Interactions include mode interacted with tenure, race, education, information book, record use, wave, and regional office.

<sup>11</sup> A more appropriate model that uses log transformations for both income and expenditures has  $R^2$  of .46. The effects of the coefficients are very similar, and I show the model in Table 3 for simplicity.

coefficients that relate to the respondent (top set of variables) are generally significant, while the coefficients representing controllable aspects of the survey design are generally not significant (bottom set of variables). Of course, this is desirable from a surveying perspective. These coefficients indicate that expenditure levels reported by a household are due to unique characteristics of that household, and reports of those expenditures are not heavily influenced by characteristics of the data collection.

The characteristic of the data collection we were most interested in here is the mode variable (telephone). The coefficient ‘telephone’ is one of the few coefficients in the model that fails to reach statistical significance. Further, the coefficient is positive (phone expenditures are higher), indicating that the probability is likely quite low that personal visit data produce significantly higher expenditures. This suggests that the CEQ mode has minimal impact on reported CEQ expenditures.

**Table 3. Predictors of Expenditures**

Variable	Coefficient	P Value
<b>Income</b>	.07	< .01
<b>Number of Earners</b>	1,179	< .01
<b>Home Owner</b>	865	< .01
<b>White</b>	498	.02
<b>Lowest Education</b>	-1559	< .01
<b>Telephone</b>	661	.15
<b>Records</b>	295	< .01
<b>Used Visual Aid</b> (Information Book, section 4.4)	96	.27
<b>Refusal Conversion</b>	-556	.18

**4.2 Phone Coefficients for Components of Expenditures**

Table 3 above shows a regression model where the dependent variable is total household expenditures. Although the mode is not significant in this model, it is possible that mode affects reported spending differently for different types of expenditures. For example, phone response may work well for reporting housing expenditures because respondents may know their mortgage payments. However, telephone respondents may underreport small appliances because they don’t have access to the visual aids (see Section 4.4) that assist with the recall of these expenditures. To check for this possibility, we ran a set of regressions where the dependent variable is each of the expense categories shown in column 1 of Table 4.

**Table 4. Estimated Mode Effect for Expenditure Categories**

Type of Expenditure	Estimated Phone Coefficient	P Value
Alcohol	-8	.51
Tobacco	23	.06
Housing	540	<.01
Apparel	16	.67
Transportation	200	.47
Health	66	.19
Entertainment	25	.79
Personal Insurance	4	.97

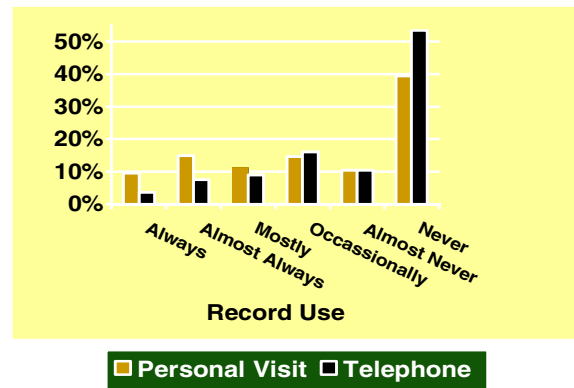
Table 4 shows that coefficients for most components of expenditures are statistically insignificant. We expected to see social desirability effects in the top two rows of Table 4 (alcohol and tobacco spending). As the theory goes, the reduced social contact when the mode is phone may allow respondents to more readily admit spending for these less healthy habits. However, the coefficient for alcohol is insignificant, and substantively has an unexpected sign. For tobacco, we may see increased reporting when the mode is phone, as the difference approaches statistical significance ( $p=.06$ ). Alcohol and tobacco spending show mixed results for the social desirability hypothesis.

**4.3 The Effect of Record Use on Expenditures Data**

The CEQ is recognized as a long, cognitively burdensome interview. The respondent is asked to remember all major purchases over the last three months for all household members. Researchers have recognized the difficult demands of the survey, and certain questions ask the respondents to use records (utility bills, etc.) to increase the accuracy of reported expenditures. However, for most sections of the survey, the CAPI instrument does not prompt the interviewer to request record use. Following the interview, the interviewer codes how often she perceives that the respondent used records. They assign one of six codes on an ordinal scale from ‘Always’ to ‘Never’, as shown in Figure 3.

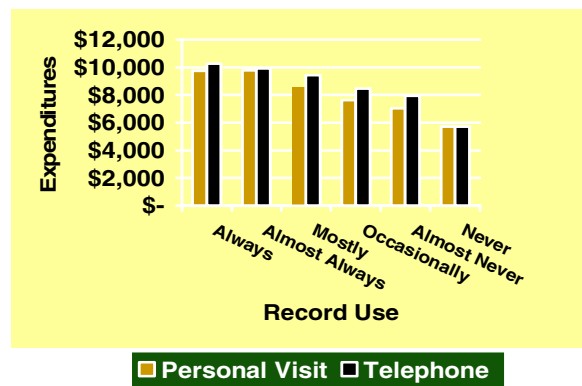
This figure shows that overall record use in the CEQ is low, but households responding by personal visit use records at much higher rates than households responding by telephone. However, it is unclear how interviewers assess how often respondents are consulting records when the mode is phone. Therefore, it is possible that measurement error on the record use question may affect the results shown in Figures 3 and 4.

**Figure 3. Respondent Use of Records (by Mode)**



Using the ‘more is better’ premise that is generally accepted when analyzing expenditure surveys, Figure 4 shows that record use is associated with reports of more expenditures. We hypothesized that the CEQ cannot be completed accurately without the use of records, and the data from Figure 4 support this assertion. Because use of records varies by household type and composition, we analyzed the effect of record use in our multivariate model. Table 3 (Section 4.1) shows the coefficient for record use as \$295. This says that as we move across the six categories from ‘never use records’ to ‘always use records’ expenditures are about \$1,500 higher ( $5 \times \$295$ , or 20 percent of total reported spending), after controlling for income and other variables. During interviewer training, we should stress this important effect of record use to Census Bureau interviewers.

**Figure 4. The Effect of Record Use on Reported Expenditures**



Interestingly, Figure 4 also shows that respondents report higher expenditures by telephone, after controlling for each category of record use. Although phone respondents use records less frequently, record use also seems to effectively stimulate expenditure reporting when the mode is phone. There is no reason why phone respondents cannot use records at the same



rate as personal visit respondents. It's possible that effective interviewer training could reduce the discrepancy in record use shown in Figure 3, and increase record use for both modes of data collection.

#### 4.4 The Effect of the CEQ Information Book

The CEQ survey has a visual aid called the information book, which shows examples of types of expenditures. Recall of events usually improves if a respondent has appropriate cues (Bradburn, 1987). The information book should assist the respondent by allowing the respondent to use recognition, in addition to recall, to report expenditures. For instance, Section 8 of the CEQ asks whether the household purchased any furniture, infant's equipment or outdoor equipment. For this question, the information book lists about 50 examples of applicable expenditure types (e.g., sofas, coffee table, and mattresses). The information book serves as a cue that can 'jog' the memory of the respondent, perhaps resulting in reported expenditures that otherwise may be omitted.

The main problem with the information book is persuading interviewers and respondents to use the book. Currently, fewer than 60 percent of personal visit respondents used the information book, as coded by the interviewer.<sup>12</sup> For telephone respondents, CEQ interviewers do not carry extra copies of the information book to leave with respondents. Consequently telephone respondents have no access to the visual aid. Table 3 (Section 4.1) shows that the information book likely has a small, positive impact on total expenditures, although the coefficient does not reach statistical significance (p=.27). Why is the effect of the information book smaller than we expected? Lack of use is likely the main culprit. Even when interviewers check that the information book was used, it is not clear how often, and how respondents are using the information book. Is the respondent using the information book for the entire CEQ interview, or simply accepting the book and glancing at it once? We need to learn more about interviewers' current use of the information book, and emphasize its proper use during interviewer training.

### 5. Problems with the Telephone Data

Although the phone data do not seem to negatively impact expenditures, we did find two problems with the phone data: the collection of income, and a need for more data adjustments.

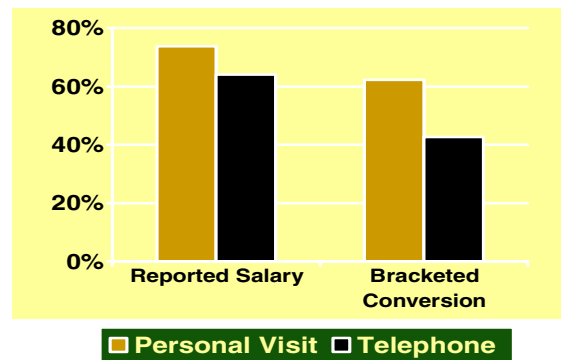
<sup>12</sup> After completion of the CEQ, the interviewer answers "Yes or No" to the following question, "Was the information book used during the interview?"

### 5.1 Income Data

During the 2<sup>nd</sup> and 5<sup>th</sup> CEQ interviews, we ask the respondent to report components of income (e.g., dividend income) for each adult in the household. Income is regarded as one of the most difficult items to obtain in household surveys, but even more difficult when the mode is telephone. Kormendi (1988) writes that "a long series of studies have shown that it is especially difficult to obtain answers to income questions in telephone interviews." Our analysis of CEQ income collection supports this literature.

For this analysis, we focus on the reporting of one specific component of income, salary. First, interviewers ask the respondent to report the salary of each eligible household member. If a respondent either refuses or cannot estimate the salary for a household member, interviewers ask them to place the respondent's income into a bracket (e.g., \$0-\$4,999, \$5,000 - \$9,999, etc.). Figure 5 shows that more telephone respondents fail to answer both the initial and the bracketed income question when compared with personal visit cases.

Figure 5. Effect of Mode on Income Reporting



As Figure 5 shows, we successfully collect salary data for about 75 percent of personal visit respondents, compared with 65 percent of telephone respondents (first set of bars). In addition, for personal visit respondents that fail to report salary, we obtain a bracketed estimate of income about 60 percent of the time. For telephone income refusals, we only obtain bracketed income about 40 percent of the time (second set of bars). Therefore, both salary questions perform worse when the mode is telephone.

For persons not reporting salary in Figure 5, 63 percent said they don't know the salary while 37 percent refused the income question (data not shown). Although the refusal percentage is fairly high, this somewhat supports the idea that nonresponse (to income) is due more to lack of knowledge than an unwillingness to answer (Kormendi, 1988). However,

the proportion refusing when the mode is telephone is 45 percent, compared with 29 percent for personal visit. It is unclear whether respondents feel less comfortable answering the income question by phone, or simply feel more comfortable indicating they are refusing the income question when the mode is phone. It is likely that many of the ‘Don’t Knows’ for both modes may be tacit refusals.

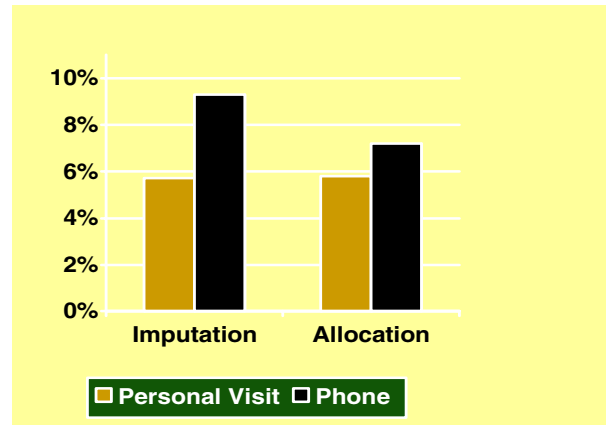
Respondents may only feel comfortable providing answers to sensitive questions when they trust the survey organization (Dillman, 1978). This may be an advantage for personal visit collection of income. Based on this, we hypothesized that respondents who completed Wave 1 of the CEQ by personal visit and Wave 2 by telephone would report income at higher rates than respondents completing both of Waves 1 and 2 by telephone. The CEQ data supported this hypothesis (data not shown), but the phone cases that were previously interviewed in person still had higher income item nonresponse than the personal visit cases.

**5.2 Data Adjustment by Mode**

For this analysis of CEQ data, we consider two types of data adjustment, imputation and allocation. We define an imputation as occurring when a respondent recalls a purchase (e.g., purchased a watch), but cannot recall the cost of the watch. For this situation, BLS imputes the cost of the watch. We define an allocation as occurring when a respondent reports an expenditure amount (e.g., spent \$200 on clothing), but cannot recall the detailed purchases (e.g., bought one shirt and two pair of shoes).

CEQ imputations and allocations can be thought of as forms of item nonresponse. Generally, item nonresponse rates are lower when the mode is face to face (de Leeuw, 1988). The CEQ data agree with the prior literature. Figure 6 shows that both imputation and allocation rates are higher when the mode is telephone. For example, about six percent of the dollars reported in the CEQ come from imputations when the mode is personal visit. For phone data, the imputation rate is about 50 percent greater (9 percent compared with 6 percent). We need to investigate reasons for these discrepancies. One hypothesis is that the lack of record use (Section 4.3) negatively impacts respondents’ knowledge of their purchases.

Figure 6. Data Adjustment by Mode



**6. Conclusions**

Census Bureau interviewers are using the telephone as the primary means of CEQ data collection for about 42 percent of their cases. Logistic regression results suggest that interviewers, rather than respondents, have the largest impact on whether the CEQ is completed by phone or by personal visit. Another major influence on the mode of data collection is the Census Bureau Regional Office; this implies that management’s actions, or perhaps tacit consent, contribute to the proportion of CEQ interviews collected by telephone.

The CEQ expenditures data obtained by telephone are very similar to the data obtained by personal visit. Generally, comparisons of data from personal visit and telephone surveys have found very minor measurement errors due to mode (Lyberg, 1988). Our findings from this CEQ mode comparison support this literature. Regression models show that expenditures data, including models for components of expenditures (e.g., apparel) are very similar by mode. For most regression models, the mode variable is one of the few insignificant variables in the model. Therefore, the CEQ mode of data collection seems to have an almost negligible effect on CEQ measurement errors related to reported expenditures.

However, we did see two problems in the telephone data. First, respondents are more likely to refuse the income question when interviewed by phone. This refusal occurred for both the initial salary question, and the bracketed salary question designed to reduce income refusals. Second, respondents are providing fewer details about their purchases, either omitting the cost of reported expenditures or providing insufficient details about purchases made during a shopping trip. This leads to higher imputation and allocation rates in the phone data.

## 7. Future Research

First, one option may be to observe and behaviour code a small set of CEQ telephone interviews. This observation could help determine whether the administration of CEQ questions by phone creates problems for either the interviewer or the respondent. BLS will combine results from this observation with expert review of the CEQ to determine whether we should change some questions when the mode is phone.

Second, the major limitation of this analysis is the non-random assignment of households to mode. We are experimenting with propensity score models to more appropriately handle the problem of mode selection bias.

Finally, because it is impossible to guarantee that we have removed mode selection bias through any statistical model, introducing a randomized mode experiment into the CEQ could be a future option. Within a randomized experiment, we could make more direct comparisons across the two modes to assess measurement error and data quality. However, it is possible respondents may self-select mode within the experiment. If we used production data for this experiment, interviewers would conduct interviews using other than the assigned mode if respondents requested a specific mode. For instance, if an interviewer contacted an assigned personal visit case by telephone to set up an appointment, and the respondent said that they have time to complete the CEQ right now, the interviewer would conduct the interview. If enough respondents select a mode other than the assigned mode, we will have a dataset with the same challenges we tried to adjust for in this paper.

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