

## CE Data Quality Report (Prototype)

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### Overview

The Consumer Expenditure Survey (CE) has historically provided some limited metrics for data users to evaluate the overall quality of output provided in its products.

Published tables provide standard errors, the public-use microdata user guide provides response rates, and the public-use microdata datasets provide all the variables and flags necessary for users to create his or her own quality measures. There has long been a recognition for the need for more comprehensive data quality metrics that are timely and routinely updated, accessible to data users from a single source. However, there is also recognition of the high cost in terms of resources and commitment to identifying appropriate metrics and establishing the information base necessary to routinely produce reports on survey data quality. In order for this effort to be sustainable, the benefits from it must be relevant and useful to survey operations and data users.

This report is the first in a series of iterations towards a single reference source on a comprehensive set of CE data quality metrics that are timely and routinely updated for the Consumer Expenditure Quarterly Interview Survey (CEQ) and the Consumer Expenditure Diary Survey (CED). The initial measures presented in this first report were based on already currently collected data and producible with limited resources. The decision to release the first report with only a very limited set of measures was based on the recognition of the benefits of “learning-by-doing” –

providing CE with insight as to what resources might be needed to produce such a product routinely. As a better understanding of the infrastructure needed for creating measures of data quality in the CE develops, more metrics will be produced.

### How to read this report

The following section (Data Quality Measures) includes a summary table of all the metrics annual percentage changes. Each subsequent section of this document relates to a specific data quality measure or group of measures. The first part of each of these sections describes the current trends for the measure(s) followed by a graph over time. General definitions and a guide for interpreting the different measures are included after the graph(s). Detailed definitions and descriptions of the data used can be found in the [Appendix](#).

### Data Quality Measures

The measures reported in this report for the years 2009 through 2013 are:

[CE Response and Nonresponse Rates](#)

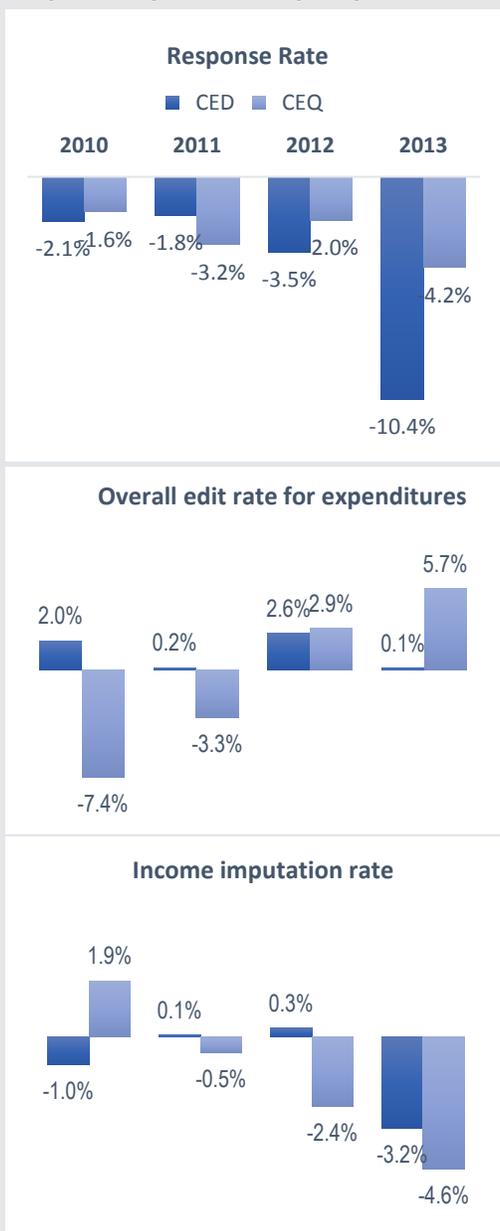
[Expenditure edit rates](#)

[Income imputation rates](#)

The annual rates for these measures appear in Table 1, and their annual percentage change are shown in the Figure 1. The annual rates of these measures and further details about the measures are reported in the sections that follow. The charts in the sections that follow are based on the

annual rates in Table 1. All rates presented in the report are produced using unweighted data.

**Figure 1. Annual percentage change from the previous year of data quality measures**



**Table 1. Annual rates of data quality measures (unweighted)**

Data Quality Measure	2009	2010	2011	2012	2013
	<i>Percent</i>				
Response Rate					
CEQ	75.0	73.8	71.4	70.0	67.1
CED	73.0	71.5	70.2	67.8	60.8
Overall edit rate for expenditure reports					
CEQ	16.2	16.6	16.6	17.0	17.0
CED	27.6	25.6	24.7	25.5	26.9
Imputation rate for expenditure reports					
CEQ	6.8	7.1	7.3	7.5	8.1
CED	na	na	na	na	na
Allocation rate for expenditure reports					
CEQ	8.6	8.7	8.5	8.8	8.2
CED	27.4	25.4	24.5	25.3	26.7
Overall imputation rate for income reports					
CEQ	48.0	47.5	47.5	47.7	46.2
CED	52.7	53.7	53.4	52.1	49.8

## CE Response and Nonresponse

### CE Interview Survey (CEQ)

[Response rates](#) steadily fell from 75.0 percent in 2009 to 67.1 percent in 2013 (Figure 2), with the largest annual percentage change of -4.2 percent occurring in 2013. A portion of the recent decline in 2013 is the result of the shutdown of the Federal Government which occurred in October 2013.<sup>1</sup>

Refusal rates rose from 17.1 percent in 2009 to 21.2 percent in 2013, with smaller increase in noncontact rates of 4.5 percent to 5.8 percent, respectively. The [reclassification rate](#) of interviews to unit nonresponse remained consistently negligible throughout this period.

### CE Diary Survey (CED)

CED response rates mirrored the same declining trend as the CEQ, and were consistently lower. The CED response rate fell from 67.6 percent in 2009 to 56.2 percent in 2013 (Figure 2), with the largest annual percentage change of -10.4 percent occurring in 2013. The CED was also affected by the shutdown of the Federal Government, which can account for a portion of the decline in the response rate. CED refusal rates also trended upwards but were consistently lower than those for the CEQ, rising from 11.1 percent in 2009 to 12.8 percent in 2013. CED noncontact rates ranged from 4.7 percent to 6.0 percent within the period. The nonresponse reclassification rate is higher in the CED than the CEQ but fairly consistent, ranging from 4.7 percent to 6 percent.

### Explanation and Interpretation

Figure 2. Annual final disposition rates (unweighted)



<sup>1</sup> Note that September's rates were affected by the shutdown as well because interviewers were not able to go out and collect data or Diaries that were started in September, but ran into October.

Response and nonresponse rates are measures of cooperation levels in a survey. Since not all eligible sample units will be available or agree to participate in the survey, there will be some nonresponse to the survey request. Characteristics of nonrespondents may differ from respondents and they may have different responses to the survey questions, so that their omission from the survey may result in bias in the estimates produced from the survey. While weighting adjustments may reduce bias, the effectiveness of this approach depends on the availability and quality of variables used in the weighting so that concerns about bias persist. So in general, higher response rates (and lower nonresponse rates) are preferred.

The unit of observation for the CE is the Consumer Unit (CU), so response and nonresponse rates are computed at the CU level. Among eligible CUs, nonresponse occurs when the interviewer is unable to contact an eligible member of the CU, or when the contacted CU member refuses. The Census Bureau categorizes eligible CUs who do not respond to the survey as *Types A nonresponse*. Reasons for Type A nonresponse include the following: the interviewer finds no one at home despite repeated visits, all eligible members are away during the interview period, or eligible members refuse for any reason.

In addition to the Type A nonresponse described above, there is a minimal expenditure edit check performed at BLS (CE) after Census delivers the data that could change an interviewer-coded “completed interview” (or respondent) to “nonrespondent”; this type of edit is referred to as the *nonresponse reclassification*. The edit uses a subset of respondent characteristics to highlight CUs that were highly suspect to have under-reported expenditures for manual review; reclassification to unit nonresponse occurs when there is adequate justification of under-reporting in the data that would adversely impact the quality of the final survey estimates. Since this edit increases the number of unit nonresponses, a lower reclassification rate is preferred.

In addition, the nonresponse reclassification rates may also be viewed as an indicator of the potential for nonresponse bias because the minimal expenditure edit (which triggers reclassification) converts these ‘respondents’ to nonrespondents. If those reclassified as nonrespondents are systematically different from respondents, nonresponse bias will result. From this perspective also, a lower reclassification rate is preferred. Ideally, other indicators that attempt to measure nonresponse bias should be considered in conjunction with this reclassification rate when evaluating nonresponse bias.

This reclassification is conducted in both the Interview and Diary surveys; however, cases in the Interview survey account for less than 0.2 percent for all cases and are excluded in for the CEQ in Figure 2.

Although the CE Interview Survey comprises five waves of data collected from the same CU, and two waves for the CE Diary Survey, longitudinal response rates are not currently computed for either CE survey. The CE treats each wave of data collected as independent from each other in the production of official survey estimates, and consequently, response and

nonresponse rates are computed for each wave independently; these rates are depicted in the graphs above.<sup>2</sup>

**Summary:** Everything else equal, higher response rates are more desirable for minimizing potential nonresponse bias for surveys if respondents are representative of the target population. The trend of declining response rates continued in 2013 for both the CEQ and the CED, emphasizing the need to better understand if and how differences between respondents and nonrespondents affect nonresponse bias of key survey estimates.

### Definitions

- Eligible Sample (denominator for all rates): the total number of eligible consumer units for the period.
- Response rate (AAPOR definition RR2): the total number of completed and partial interviews (interviews that provide data for use in the production tables) for the period, divided by the eligible sample.
- Refusal rate (AAPOR definition REF3): the total number of nonresponse units due to refusals (for various reasons such as time, language or health problems) and insufficiently completed interviews for the period, divided by the eligible sample.
- Noncontact rate (1- AAPOR definition CON3): the total number of nonresponse units due to inability to contact any sample unit member for the period, divided by the eligible sample.
- Nonresponse reclassification rate: the total number of consumer units for the period who had been classified as interviews at the close of the data collection period but were subsequently reclassified as nonresponse based on a review of their total expenditures and other information, divided by the eligible sample.

Details on the exact calculations of the rates can be found in Appendix A.

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<sup>2</sup> For the CE Interview Survey, Wave 1 is treated as a bounding interview, and is excluded in the response and nonresponse rates presented in the graphs.

## **CE Expenditure Edit Rates (Imputation and Allocation)**

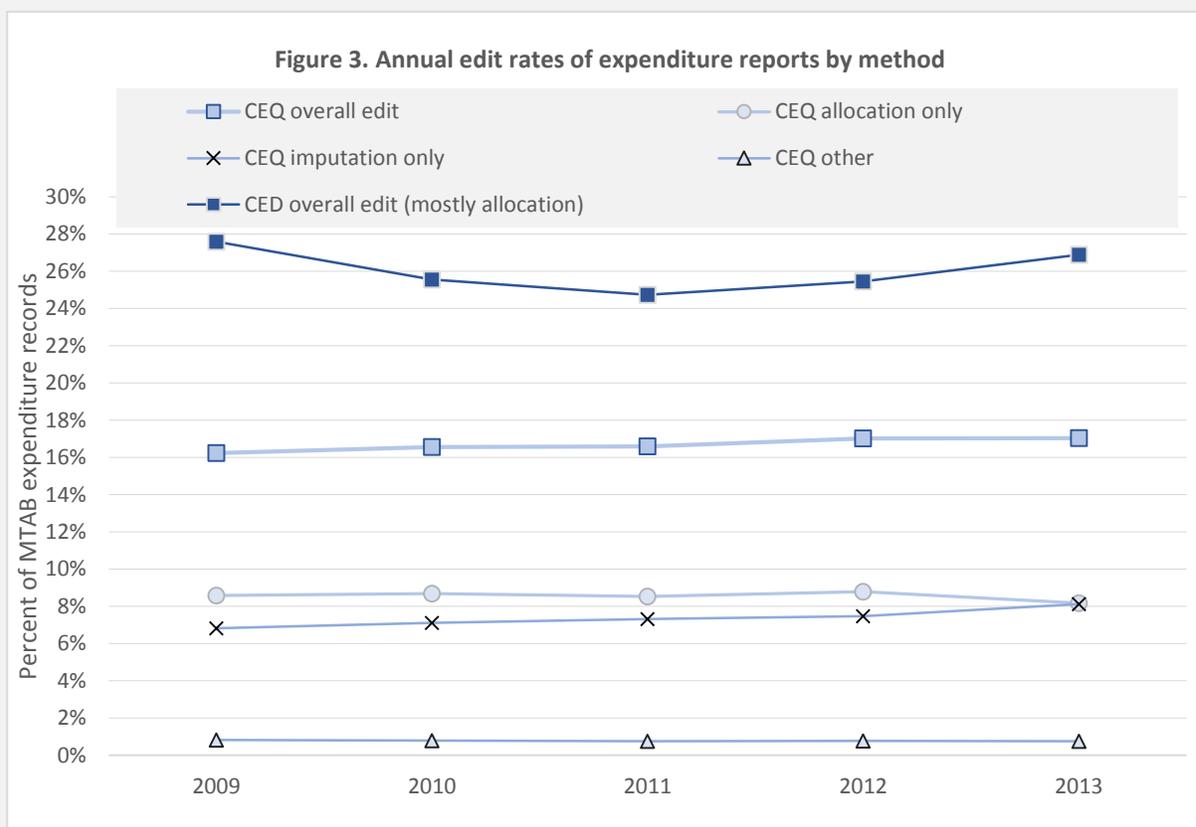
Imputation and allocation are two major types of data edit routines to improve expenditure and income estimates derived from the Interview and Diary Surveys. In addition to the overall expenditure data edit rate, imputation rate and allocation rate are separately reported for income and expenditures. The figure shown in this section is based on Table 1.

### *CE Interview Survey (CEQ)*

The increase in the overall proportion of edited expenditure reports between 2009 and 2013 was small (16.2 percent to 17.0 percent, respectively), with a larger increase in imputation rates from 6.8 percent in 2009 to 8.1 percent in 2013 (Figure 3). The trends of imputation rates varied dependent on the expenditure category. Expenditure categories with the most apparent trends in increasing imputation rates between 2009 and 2013 included vehicle purchases, leased vehicles, telephone expenses, and trips and vacations. Only two categories had a clear trend of decreasing imputation rates: construction and repairs for jobs not started and disposal of owned properties. Allocation rates were largely steady around 8.6 percent, then falling to 8.2 percent in 2013.

### *CE Diary Survey (CED)*

The overall edit rate declined between 2009 and 2011 from 27.6 percent to 24.7 percent, but increased to 26.9 percent in 2013 (Figure 3). Allocation is the primary form of edit performed on CED expenditures, and the overall edit rate largely reflects allocation rates.



### Explanation and Interpretation

At the completion of an interview, data from the interviewer's laptop are transmitted to the Census Master Control System. The Census Bureau's Demographics Surveys Division preforms some preliminary processing and reformatting of the data before transmitting the data to BLS on a monthly basis; names and addresses of respondents are not transmitted. At BLS, a series of automated and manual edits are applied to data in order to make data consistent, fill in missing information, and correct errors in the collected data. (For more description about the data collection and processing for the CE surveys, see <http://www.bls.gov/opub/hom/pdf/homch16.pdf>.)

Edits are defined as any changes in the data made during processing that require judgment or assumptions (whether model based or manually adjusted by the analyst). Imputation and allocation are two major types of data edit routines to improve estimates derived from the Interview and Diary Surveys.

- *Data imputation* routines currently account for missing or invalid entries and address most expenditure and income fields, excluding assets.
- *Allocation* routines are applied, when respondents provide insufficient detail to meet tabulation requirements. For example, if a respondent provides a non-itemized overall expenditure report for the category of fuels and utilities, that overall amount will be

allocated to the target items mentioned by the respondent (such as natural gas and electricity).

In addition to allocation and imputation, data are reviewed and manually edited as needed by BLS economists based on the economist's research and expert judgment.

**Summary:** The higher imputation rate of expenditure reports was coupled with a lower allocation rate for the CEQ in 2013 (8.6 percentage change, and -6.9 percentage change, respectively, between 2013 and 2012; see Table 1) causing the overall edit rate to be stable between the two years. Higher imputation rates reflect higher item nonresponse, which is not desirable. However, imputation based on sound methodology improves the completeness of the data to produce survey estimates.

In contrast to the CEQ, the allocation rate of CED expenditures rose – it was 5.7 percent higher in 2013 relative to 2012. The higher allocation rate of CED expenditures indicate that respondents are not providing the required item detail in their diary reports.

Income imputation rates fell in both the CEQ and CED in 2013 (by -3.2 percent, and -4.6 percent, respectively).

## CE Income Imputation Rates

### CE Interview Survey (CEQ).

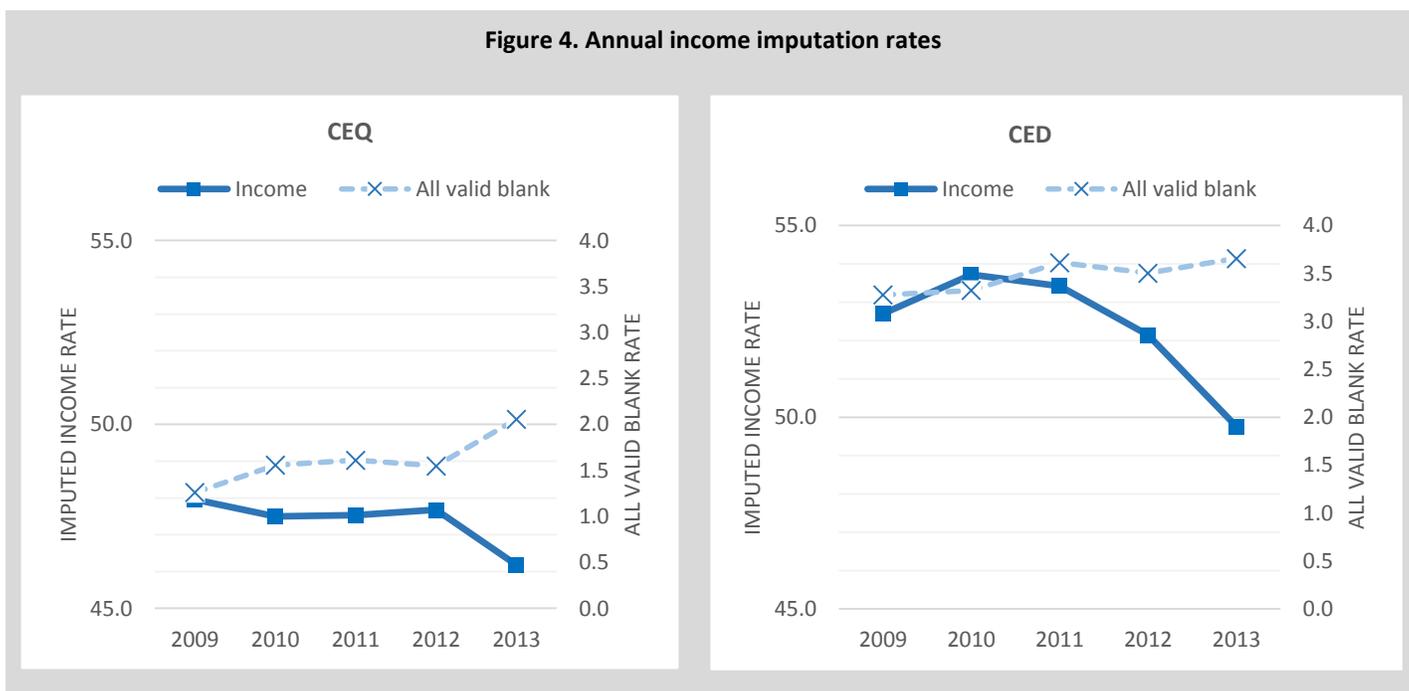
The proportion of consumer units' whose total income before tax included *any* imputed sources of income continued a declining trend from 48 percent to 46.2 percent between 2009 and 2013 (Figure 4, left panel). However, the imputation rate of zero-reported income to a positive value increased from 1.3 percent to 2.1 percent over this period. This edit is referred to as "All valid blank" conversion. It occurs when a CU reports that they received no income, but the BLS imputes that some income was received.

### CE Diary Survey (CED).

As in the CEQ, the proportion of imputed income in the CED also declined between 2009 and 2013, from 52.7 to 49.8 percent (Figure 4, right panel). The imputation rate of zero-reported income to a positive value ("All valid blank" conversion) was relatively steady around 3 percent across this span of 5 years.

NOTE: Drop off in income imputation rates for both surveys. In 2013, substantial revisions were made to the income section: some questions were merged together or split into new questions. The change in questionnaire is the likely cause of the larger change in income imputation rates for both CEQ and CED surveys in 2013.

Figure 4. Annual income imputation rates



## Appendix A. Detailed Metric Definitions

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In appendix A, we present the details of all proposed metrics for the data quality measures used in the report. These include the response rates, refusal rates, noncontact rates, reclassification rates, and editing rates for expenditures and income).

### 1. Response and nonresponse rates

In order to calculate the response and non-response rates, we use data sets that are not fully processed by BLS. These data sets are used because the fully processed data excludes non-response cases. The datasets used include good interviews and type A non-interviews. Following the model of the production tables, each wave of data is treated independently for the CE quarterly interview survey (CEQ) and each weekly diary will be treated independently for the CE Diary survey (CED).

#### **Eligible Sample** (denominator for all rates):

The total number of good interviews and interviews due to non-response, non-contact, or other eligible households. This excludes any address that was sampled and ineligible (for example, an abolished household at a sampled address or a commercial business at a sampled address).

#### **CEQ:**

Count of all unique CUs in data file. Includes the following interview OUTCOME codes<sup>3</sup>.

- 201 Completed interview
- 203 Transmit, no more follow-up possible (Through Section 20 complete)
- 215 Insufficient partial (TYPE A NONINTERVIEW)
- 216 No one home, unable to contact (TYPE A NONINTERVIEW)
- 217 Temporarily absent (TYPE A NONINTERVIEW)
- 219 Other (TYPE A NONINTERVIEW)
- 321 Refused, Hostile respondent (TYPE A NONINTERVIEW)
- 322 Refused, Time related excuses (TYPE A NONINTERVIEW)
- 323 Refused, Language problems (TYPE A NONINTERVIEW)
- 324 Refused, Other (TYPE A NONINTERVIEW)

#### **CED:**

Count of all unique CUs in data file. Includes the following diary PICKCODE (pick up) codes.

- 201 Interview
- 216 Type A - No home(unable to contact)

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<sup>3</sup> Codes for the OUTCOME variable are also available the public use microdata paradata file, FPAR. The OUTCOME codes have the same values and definitions as shown in Appendix A. The file FPAR has been available since the 2009 data release.

- 217 Interview - Temporarily Absent(counted as Type B noninterview for Census, in scope for BLS)
- 219 Type A - Other - Specify
- 321 Type A - Refused, Hostile respondent
- 322 Type A - Refused, Time-related excuses
- 323 Type A - Refused, Language problems
- 324 Type A - Refused, Other - Specify
- 325 Type A - Diary Placed Too Late
- 326 Type A - Blank Diary, majority of items recalled without receipts(counted as Type B noninterview for Census)

#### **A.1.a: Response Rate (AAPOR definition RR2)**

Defined as total number of good and partial interviews (interviews that provide data for use in the production tables), divided by the eligible sample.

#### **CEQ:**

OUTCOME =

201 Completed interview

203 Transmit, no more follow-up possible (Through Section 20 complete)

#### **CED:**

PICKCODE =

201 Interview

217 Interview - Temporarily Absent(counted as Type B noninterview for Census, in scope for BLS)<sup>4</sup>

#### **A.1.b: Refusal Rate (AAPOR definition REF3)**

Defined as total number of type A non-interviews that were refused or started, but not completed, divided by the eligible sample. Refused interviews includes refusals due to time, language problems, and other types of refusals.

#### **CEQ:**

OUTCOME =

215 Insufficient partial (TYPE A NONINTERVIEW)

321 Refused, Hostile respondent (TYPE A NONINTERVIEW)

322 Refused, Time related excuses (TYPE A NONINTERVIEW)

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<sup>4</sup> Expenditures made while on trips are out of scope for CED, so temporarily absent cases are counted as having had no in-scope expenditures (zero expenditures) during the diary week for the CE published tables. For collection purposes, these cases are treated as Type B Noninterviews in the CED. For OMB reporting purposes these cases are treated as Type A Noninterviews.

323 Refused, Language problems (TYPE A NONINTERVIEW)

324 Refused, Other (TYPE A NONINTERVIEW)

**CED:**

PICKCODE =

321 Type A - Refused, Hostile respondent

322 Type A - Refused, Time-related excuses

323 Type A - Refused, Language problems

324 Type A - Refused, Other - Specify

**A.1.c: Noncontact Rate**

Defined as total number of type A non-interviews that were due to non-contact, divided by the eligible sample.

**CEQ:**

OUTCOME =

216 No one home, unable to contact (TYPE A NONINTERVIEW)

217 Temporarily absent (TYPE A NONINTERVIEW)

**CED:**

PICKCODE =

216 Type A - No home(unable to contact)

### A.1.d: Reclassification of interview to unit nonresponse (Minimal Expenditure Rates)

Defined as the total number of interviews that were changed from completed to a Type A non-interview based on a review of total expenditures and other information about the CU, divided by the eligible sample.

#### CEQ

OUTCOME =

219 Other (TYPE A NONINTERVIEW)

TYPEASP = "Minexpn"

#### CED

INTRVIEW =

- 5 Diaries with zero items reported in both weeks of the survey OR Diaries with zero items reported and the diary from the other diary week is a Type A, B, or C non-interview
- 6 Diaries with zero items reported and the diary from the other diary week has > 10 items reported in FDB with the total cost of these items being <= \$50 OR Diaries with zero items reported and the diary from the other diary week has <= 10 items reported in FDB with the total cost of these items being <= \$50 and the CU does not live in a rural area or a college dormitory and no members of the CU were away during the reference period
- 7 Diaries where there is one person in the CU and the total amount spent on food (at home and away from home) is <= \$5 in the current week and <= \$15 in the other diary week, and the number of items reported for non-food items in the current week is < 4 or the total cost of items reported for non-food items in the current week is < \$30
- 8 Diaries where there are 2 or 3 members in the CU the total amount spent on food (at home and away from home) is <= \$10 in the current week and <= \$20 in the other diary week and the number of items reported of non-food items in the current week is < 4 or the total cost of non-food items reported in n the current week is < \$30
- 9 Diaries where there are four or more CU members and CU the total amount spent on food (at home and away from home) is <= \$20 in the current week and <= \$30 in the other diary week and the number of items reported of non-food items in the current week is < 4 or the total cost of non-food items reported in n the current week is < \$30

## 2. Expenditure Edit Rates

Expenditure edit rates are calculated using processed CE data (data that are used to produce the published tables) for each collection period. Following the model of the production tables, each wave of data is treated independently for the CE quarterly interview survey (CEQ) and each weekly diary will be treated independently for the Diary survey (CED).

#### CEQ:

Interview expenditure edits are calculated using the interview monthly tabulation file (MTAB). The "cost flag" (COST\_) is used to identify if an expenditure was edited and what type of edit was done (imputation, allocation, combination, other). In addition, the "allocation number" is

used to determine whether the resulting estimated has been allocated. The different types of edits (or non-edits) will be identified by the following flags. Note: These definitions may be further refined as the metrics are developed.

CEQ MTAB Flag value	Flag Description	Edit group	Edit Subgroup
0	All of the source fields were flagged either as 0 (No Census adjustment) or -300 output from screens selected for microfilm review/no change or -400 output from screens; but not selected for microfilm review (no change)	Unedited	NA
1	One of the source fields was flagged by Census (source flag >0)	Unedited	NA
2	Manually updated (expenditure flag = -100) Changed in superfix (not a valid data adjustment source record field [-500]) Changed in superfix (is a valid data adjustment source record field [-600]) (Note: All of the following flags (3-9 & Q-S) indicate the source field was data adjusted by BLS. The two digit numbers in the parenthesis are the trailing digits of the source field flag, and indicate the method(s) of adjustment named after the parenthesis.)	Edited	Other
3	(-01 through -10) IMPUTATION	Edited	Imputed
4	(-12 through -19) ALLOCATION	Edited	Allocated
5	(-20 through -27) IMPUTATION and ALLOCATION	Edited	Combination
6	(-30 through -32) COMPUTATION only	Unedited	NA
7	(-35 through -43) COMPUTATION and IMPUTATION	Edited	Imputed
8	(-45 through -52) COMPUTATION and ALLOCATION	Edited	Allocated
9	(-53 through -68) COMPUTATION, IMPUTATION and ALLOCATION	Edited	Combination
Q	(-70 through -74,-75,-76) MANUAL IMPUTATION	Edited	Imputed
R	(-78 through -85,-86,-87,-88) MANUAL ALLOCATION	Edited	Allocated
S	(-90) SECTION 18 SPECIAL PROCESSING	Edited	Other

Of note, for both surveys, the number of targets selected for an allocation will affect the adjustment rates (the total number of items that are allocated will add to both the numerator and the denominator).

#### CEC:

Diary expenditure edit rate is calculated using the expenditure files from diary. The “cost flag” (COST\_) is used to identify if an expenditure was edited. In addition, the “allocation number” is used to determine whether the resulting estimate had been allocated. An expenditure record will be considered unedited if it has one of the following flags:

CEC EES Flag Value	Description	Explanation
'0'	Default - no change to data	No adjustments were made during processing.

'3'	Reviewed, no update; default adjustment status	The value was reviewed during processing, but no adjustments were made.
'11'	Sales Tax, Preliminary edits, or Minimal expenditure reclassification edit	Sales tax is a calculation applied to the data and will be treated as unedited for these rates.
'15'	Phase 1 Confirmed. Operator/Error Resolution Overrides (confirms value)	This flag is carried from the CAPI instrument and is present when a Field Representative suppresses a prompt to check the value (confirming the reported value). No changes are made to the data.
'16'	Phase 1 Changed. Error Resolution Changes value	This flag is carried from the CAPI instrument and is present when a Field Representative updates a value after prompted to check the value. Though the data is changed, it is assumed that it is edited based on the respondent's input and not considered as edited during processing.

All other flags indicate some type of adjustment during processing and are considered edited for the rate. An allocation rate is also produced using the allocation number of a given item (ALCNO). Any allocation number not equal to '000' is an allocated value. It is important to note that the values that are allocated are included in the editing rate; however, these values may also have been edited in some other way during the processing. It is not possible to delineate other edits from the current data available.

### Income Imputation Rates

The CE implemented multiple imputations of income data, starting with the publication of 2004 data. Prior to that, only income data collected from complete income reporters were published. However, even complete income reporters may not have provided information on all sources of income for which they reported receipt. With the collection of bracketed income data starting in 2001, this problem was reduced but not eliminated. One limitation was that bracketed data only provided a range in which income falls, rather than a precise value for that income. In contrast, imputation allows income values to be estimated when they are not reported. In multiple imputations, several estimates are made for the same consumer unit, and the average of these estimates is published.

Income data from the Diary Survey are processed in the same way as in the Interview Survey.

Imputation rates for income will be calculated based on the processed CE data (data that are used to produce the published tables) for each collection period. Following the model of the production tables, each wave of data will be treated independently for the CE quarterly interview survey (CEQ) and each weekly diary are treated independently for the Diary survey (CED). Imputation rates are calculated for final income before taxes. The income is counted as imputed if any of its summed components were imputed during processing. This will be

identified using the imputation indicator flag. Any value of the flag not equal to '100' is considered imputed.

#### Imputation Flag values

Flag Value	Description
100	No imputation. This would be the case only if NONE of the variables that are summed to get the summary variables is imputed.
2nn	Imputation due to invalid blanks only. This would be the case if there are no bracketed responses, and at least one value is imputed because of invalid blanks.
3nn	Imputation due to brackets only. This would be the case if there are no invalid blanks, and there is at least 1 bracketed response
4nn	Imputation due to invalid blanks AND bracketing
5nn	Imputation due to conversion of valid blanks to invalid blanks. (Occurs only when initial values for all sources of income for the consumer unit and each member are valid blanks.)

Additionally, an all valid blank conversion rate is calculated indicating the percent of instances that were converted from all valid non-responses (i.e., the respondent replied that the CU did not receive income from any source) to invalid non-responses that were subsequently imputed during processing. This will be based on the indicator flag with a value of '500' or above.