

The impact of income imputation in the Consumer Expenditure Survey

With the release of 2004 data from the Consumer Expenditure Survey, the Bureau of Labor Statistics began implementing imputation for missing responses to questions about income; imputation has brought CE estimates closer to CPS estimates, but significant disparities remain between the estimates for many of the smaller components

Bill Passero

From 1980, the year the Consumer Expenditure Survey (CE) became a continuous survey, until 2004, no procedures were employed to produce estimates for sources of income that respondents acknowledged receiving, but for which they did not provide values. However, the release of 2004 data marked the introduction of imputation for missing income responses. With a number of years of imputed income data now available, it is possible to evaluate how well BLS imputation routines are working. The purpose of this article is to assess the impact and efficacy of imputation by comparing pre- and postimputation estimates of CE-reported income with estimates from the Current Population Survey (CPS), a large-scale household survey that has employed imputation for many years in the course of producing its income estimates.

In the next section, after a brief discussion of the background and history of income imputation in the CE, the methodology for comparing CE and CPS income estimates is presented. Then the timing of income data collection in the two surveys is examined. Timing is important because

it affects the construction of matching periods for comparison. The discussion then proceeds to detail the structure and content of the income questions asked in each survey's respective collection instrument.

Following the latter discussion, the next section of the article is dedicated to a comparative analysis of aggregate income estimates from the CE and CPS. The common income categories that can be created from the two surveys are detailed, and three alternative estimates of CE income are described. These estimates are then measured against CPS estimates. The analytical portion of this section is devoted to examining both levels and ratios of CE and CPS aggregates, for total income and by income category. The final section of the article briefly summarizes the results of the analysis and notes the direction that future refinements in the collection and imputation of income in the CE are likely to take.

Background

The CE produces comprehensive expenditure data reflecting the buying habits of U.S. families. Because it is vital that the soundness and consistency of these data be maintained, the

Bill Passero is a senior economist in the Branch of Information and Analysis, Office of Prices and Living Conditions, Bureau of Labor Statistics. E-mail: passero.bill@bls.gov

BLS conducts regular, thorough comparisons of CE data with expenditure data from other sources, such as the Personal Consumption Expenditures (PCE) component of the National Income and Product Accounts produced by the Bureau of Economic Analysis.¹ But a unique feature of the CE which makes it particularly useful is that, as a household survey, it also collects demographic and socioeconomic characteristics of participants that can be associated with the expenditures they make.

Among these characteristics is family income, one of the most important demographic determinants of consumer spending. Household surveys intent on collecting data on family income, either as their primary interest or as supplementary to their primary interest, often encounter the issue of nonresponse because of the sensitive nature of income data. Respondents frequently feel uncomfortable answering questions about their income or may believe that such questions are an invasion of their personal privacy.

Survey managers have resorted to various methods developed by the statistics community for imputing values to substitute for missing responses. These methods make certain assumptions about the distribution of missing values and the relationship of nonresponse to socioeconomic characteristics of the sample population. To the extent that the procedures violate the mechanisms leading to nonresponse, the resulting imputed values will lead to biased and inconsistent results when used for analytical purposes.

CE managers have become particularly sensitive to these concerns because sampled consumer units² report expenditure data that are expected a priori to be highly correlated with income. Consequently, from 1972 to 2003 the CE did not impute for missing income, and CE data releases instead identified sample households as either “complete” or “incomplete” income respondents.³

Given the unique requirements that any income imputation procedure would have to satisfy, CE and Census Bureau staff began a systematic search for an appropriate method. Geoffrey Paulin and David Ferraro laid out theoretical and practical issues that would have to be resolved before a method could be selected.⁴ Two general methods for performing imputations merited evaluation. Hot-decking was the technique employed by large-scale surveys such as the CPS. This technique imputes missing income values in the sample with values reported by persons in families with a similar set of demographic and socioeconomic characteristics, predetermined to be relevant to the level of income. Paulin and Ferraro eliminated hot-decking as a method for the CE because of the small sample size of that survey.

The second class of methods examined was model-based imputation, which draws on the work of Roderick Little and Donald Rubin.⁵ Each of these methods consists of two parts. The first part involves the creation of a statistical model to predict income values, while the second part is concerned with producing error terms to add to the predicted values, thereby preserving the variance of the distribution.

To employ a model-based imputation method appropriately, the response mechanism by which the missing income responses came into being had to be determined first. Little and Rubin laid out three mechanisms. In the first, the missing income responses occur completely at random and are not correlated with any characteristics of the respondents. In the second, the missing responses are correlated with characteristics of the respondents, excluding income. In the final method, the missing responses are correlated with both characteristics of the respondents and the level of income.

In addition, two operational modeling questions had to be answered: first, would income imputation be done at the consumer unit level or at the individual member level within each consumer unit? and second, would imputation be done for total income or for each of the component items of total income?

After researching these questions, Paulin and Ferraro concluded that the second response mechanism, wherein nonresponse is correlated with respondent characteristics only, would be tested first. This testing would then be aimed toward (1) imputation at the consumer unit level, which would avoid complications introduced by interactions involving work decisions between members, and (2) individual components of income, which would provide more information for researchers and allow for differences in model specification and parameter estimates between items.

Finally, Paulin and Ferraro addressed the question of whether expenditures were useful in predicting income and, therefore, should be included in modeling. Testing also would confirm retrospectively whether past reluctance to impute with methods that did not account for expenditures was justified. Paulin and Ferraro found that both total expenditures and expenditures for selected sub-aggregations of items demonstrated predictive power.

While research continued into the appropriate method for imputing income in the CE, changes were made in the collection instruments in 2001 to improve the reporting of income. Bracketing questions were added to the survey to follow the initial questions. The bracketing questions asked for the amount received for each source of income a

respondent indicated that the consumer unit had received. Thus, if a respondent initially refused to report his or her income or did not know the amount received, the bracketing questions probed to determine whether the respondent would select a range that best reflected the amount received. The responses to the bracketing questions added a layer of complexity to the task of choosing an imputation method.

Once the research was completed, it was determined that the method chosen for the CE would be a regression-based procedure that would preserve both means and variances for each source of income. The process would produce five imputed values for each missing observation. The first step would be to run a regression to obtain coefficients to use in creating imputed values. Random noise would then be added to each coefficient, and the resulting “shocked” coefficient used to estimate an imputed value. Additional noise would be added to the estimated values to ensure that consumer units with similar demographic characteristics would not receive similar imputed incomes. After the five imputed values were created for each missing value, an estimate representing the mean of those five values would be calculated. Reported specific values would be retained as is. If a respondent reported a certain bracket within which his or her income fell, the imputed values would have to fall within the range defined for that bracket.

In a small number of instances, a consumer unit might report not receiving income from any source. In such an extremely unlikely situation, the income imputation procedure would be run with an additional step: a logistic regression based on the characteristics of the consumer unit, such as whether he or she was retired or was a student, would be run first to impute a receipt status (yes or no) for each source of income. For those sources of income that a consumer unit was imputed to have received, the model would be run to produce imputed income values.

Data collection

The introduction of imputed income in data released from the 2004 CE permits the same kind of comparisons between the CE and other sources that have been made in the past for expenditure items. In fact, by comparing the CE income estimates with those from another established source of income data over a period covering pre- and postimputation years, one can measure both the impact of imputation on the relationship of aggregate CE income to the independent source and the efficacy and quality of the imputation method in producing those estimates. For

this study, CE income data are compared with similar data from the CPS for the 2002–06 period.

Comparisons of mean or aggregate pretax income between the CE and the CPS have been a staple feature of BLS publications for almost 20 years.⁶ Almost all these published comparisons were based on CE data before imputation and CPS data that included imputed values. Income estimates for the CE are from its Interview Survey component, while the Annual Social and Economic Supplement (ASEC) is the source of CPS income data for comparison in this study.

The difference in timing of the collection of income data between the CE and the CPS poses challenges in constructing matching periods for comparison purposes. The Interview Survey is designed to collect one year’s worth of expenditure data from sample units. This is done through five interviews, the first interview for bounding purposes only and the remaining four interviews conducted at 3-month intervals, thereby collecting expenditure data for 12 months. The Interview Survey uses a rotating design whereby sample units are introduced every month (replacing other units that have completed their participation in the survey.) Income data are collected during the second and fifth interviews, covering the 12 months prior to the month of the current interview. Thus, a consumer unit undergoing the second interview in June 2007 would report wage income received from June 2006 through May 2007.

The ASEC is conducted annually in March, although a limited number of eligible households are interviewed in February and April. The survey collects data on the previous calendar year’s income from all sources. Thus, households completing the ASEC in March 2007 report income for the 2006 calendar year. Conducting the ASEC in March is believed to provide better income data, because most households would either be in the process of completing or have just completed preparing tax returns and therefore would be more likely to remember income sources and amounts.

Although the structure and wording of income questions are similar in the CE and the CPS, there are major differences that can affect the estimates. In the CE, the respondent is asked to report the amount received from earned income, Social Security, Railroad Retirement, and Supplemental Security Income individually for each consumer unit member aged 14 years and older. For each of the remaining sources of income, the respondent reports the amount received by the consumer unit as a whole. In comparison, in the ASEC the respondent is directed to report individually the amount received for each source

of income by each household member 15 years or older. Regarding income reference periods, the CE respondent is asked about the amount received over the last 12 months for each source of income, with the exception of Social Security and Railroad Retirement income, for which the respondent reports the amount of the last payment received. If the respondent either refuses to answer or does not know the amount received for any of these sources, he or she is shown a card with ranges or brackets of income and then is asked to report which bracket best reflects the amount received. In the ASEC, respondents are asked to report the amount received over the calendar year. If they find that a year is too big a time span over which they can exercise recall, they are allowed to report for shorter periods. The periodicity of their response is asked if necessary.

Sources of income

With respect to the contents of the income questions, and using the CE questions as a basis for comparison, one readily sees that it is natural to consider earned income first, because it is by far the largest contributor to total income. The questionnaire in the Interview Survey asks the amount each eligible member of the consumer unit received in wages and salaries (including commissions, tips, allowances, Armed Forces pay, severance pay, teaching fellowships, and the like) for all jobs. The Interview Survey also collects data in a separate question on income or losses after expenses from each consumer unit member's unincorporated non-farm business, partnership, or professional practice, as well as income or losses from the consumer unit's own farm. The ASEC asks for earnings, including tips, bonuses, overtime pay, and commissions, from the employer for whom the member worked longest during the calendar year. Such earnings can be wage and salary income, net income (or loss) from nonfarm self-employment, or net income (or loss) from farm self-employment. Three followup questions probe for earnings from other employers, other nonfarm businesses, and other farms. Severance pay and military allotments are included in earnings, and questions on these topics are asked in combination with questions on other miscellaneous sources of income after the questions for all other specific income categories have been asked.

The CE probes for amounts of Social Security and Railroad Retirement income received. These amounts include survivor and disability insurance payments, as well as retirement benefits. The ASEC asks separate questions about Social Security income and Railroad Retirement income. Data on Social Security income are obtained

from a question on payments received by the household member directly or on behalf of children under age 19 in the household. Data on Railroad Retirement income are collected in questions covering three broad categories of income for which an individual may be eligible under the program: pension or retirement income, survivor benefits, and income related to a health condition or disability.

Supplemental Security Income (SSI) is one of the few sources of income for which the CE and ASEC questions are essentially the same. Both surveys ask for the amount of SSI received from all government sources. Questions collecting data on interest income in the CE and ASEC also are quite similar. The only difference is in the potential sources of interest income referenced in the questions. The Interview Survey probes for interest from bank accounts, money market funds, certificates of deposit, or bonds, whereas the ASEC uses three questions that specifically screen for whether any members of the household have received any interest from money market funds, interest-earning checking accounts, savings accounts, cashed savings bonds, treasury notes, individual retirement accounts (IRAs), certificates of deposit, or other investments that pay interest.

In one of its questions, the CE queries respondents for amounts of regular income from dividends, trusts, estates, or royalties. The types of income cited in this question also are found in a number of places in the ASEC questionnaire. One question is specifically directed toward dividends from stocks and mutual funds. Data on receipts from estates or trusts are collected in two places. The first is as a source of survivor benefits, the second as a class of property income. Data on net royalty income also are collected in the latter question.

Data on pension and annuity income, whether due to retirement, due to disability, or as a survivor, are collected through one question in the CE Interview Survey. Sources specified for such income are private companies, the military, government, IRAs, and Keogh plans. As mentioned earlier with regard to Railroad Retirement income, the ASEC inquires about retirement and pension income, survivor benefits, and disability income in separate questions. The question about retirement and pension income refers to all such income from a previous employer or union, or any other type of retirement income from sources other than Social Security or veterans' benefits. With the exception of retirement income from Railroad Retirement, the income data collected here conceptually match CE counterpart data.

The ASEC query on survivor benefits also mentions widows' pensions, insurance annuities, and other survivor

benefits (other than Social Security or veterans' benefits). Income from survivor pensions from private companies; unions; Federal, State, and local governments; and the military are reported here. The ASEC questions concerning income related to a health condition or disability identify many of the same sources that are listed for survivor benefits, such as companies, unions, government at all levels, and the military. Finally, though not explicitly stated in the question, income received from foreign government pensions is offered as an example of one of the types of income the miscellaneous income question at the end of the ASEC is designed to capture.

Unemployment compensation and supplemental unemployment compensation are other sources of income cited in the CE Interview Survey questionnaire. The ASEC poses three separate questions on unemployment compensation. One asks for the amount of State or Federal unemployment compensation, the second probes for income from supplemental unemployment benefits, and the third focuses on union unemployment or strike benefits.

The CE asks respondents to combine income received from worker's compensation or veteran's benefits, including the GI bill, but excluding military retirement benefits, in one report. Worker's compensation is surveyed in a distinct question in the ASEC, but the question also covers any other payments made as a result of a job-related injury or illness. Worker's compensation benefits, including benefits for black lung disease, also are reported in the aforementioned ASEC questions on survivor benefits and disability income. The receipt of veterans' benefit payments warrants its own question in the ASEC, but not in the CE.

Another question in the CE Interview instrument pertains to income received as public assistance or welfare. In 2002, the questionnaire used Aid to Families with Dependent Children and grants from Job Corps as examples of such assistance. In subsequent years, the questionnaire was revised to refer specifically to cash assistance from any State or local government welfare program, such as Temporary Assistance to Needy Families, or short-term emergency help. The main question that seeks this information in the ASEC probes for cash assistance received from a State or county welfare program (with the name of a representative State program added as an example), either directly or on behalf of children in the household. The miscellaneous-income question at the end of the ASEC lists welfare, emergency assistance, and other short-term cash assistance as examples of the types of income to be reported.

Two questions in the CE Interview Survey instrument

cover any net income or loss from any type of rental of rooms or living units. The first question is directed toward collecting data on net income or loss from roomers or boarders; the second focuses on ascertaining data on net income or loss received from other rental units. The property income question in the ASEC, which was heretofore mentioned as a source for trust/estate and royalty income, also seeks information on net income or loss from rental property and receipts from roomers and boarders.

Child support payments not received as a lump sum are an additional component of income found in the CE Interview Survey. A similar question appears in the ASEC.

The CE Interview Survey questionnaire asks about regular income from alimony or other sources, such as income from persons outside the consumer unit. The ASEC splits these sources between two questions, the first referring to alimony payments, the second to regular financial assistance from friends or relatives not living in the household.

Finally, the CE Interview Survey poses a catchall question seeking information about "other" money income. Among the sources from which this other money might have been received, the question lists cash scholarships and fellowships, stipends not based on working, and the care of foster children. All other income from a source not specified in previous questions is to be reported here. The ASEC contains a question requesting information on educational assistance for tuition, fees, books, or living expenses, including Pell Grants. Listed in this question as sources of educational assistance are scholarships and grants, as well as employers, friends, and relatives living outside the household. Assistance from any of these sources could be reported in a number of places in the CE. To the extent that a student is receiving regular payments, such payments would be reported as regular income from sources outside the consumer unit. If the assistance is earmarked for a particular educational expense, such as tuition, it could be reported in the educational expenses section of the CE as an expenditure for which reimbursement is received. The miscellaneous-income question at the end of the ASEC encompasses payment for caring for a foster child, as well as any other money income not already covered by earlier questions.

The ASEC is designed to cover the civilian noninstitutional population, plus those military personnel who live with at least one other civilian adult, on or off base. The CE also is designed to represent the civilian noninstitutional population, plus a portion of the institutional population: residents of boarding houses; those living in student or worker housing facilities, such as college dormitories;

staff units in hospitals or in homes for the aged, infirm, or needy; and those residing in permanent living quarters in hotels, motels, or mobile home parks. Nursing home residents are excluded, as are military personnel living on base. Off-base military personnel are included.

Comparison of CE and CPS income

Sources and timeframes. ASEC income data used in this article are derived from an unpublished Census table titled “In-House Table 8. Income Allocation by Income Source,” which the CPS produces annually for its internal use. For each source of income, the table shows the number of persons 15 years and older (in thousands) who receive income from that source and the mean amount of income they receive. Both those directly reporting income and those for which allocation is done are covered. In Census parlance, allocation is the equivalent of imputation in the CE. The means and numbers of persons reporting each source of income are multiplied together to obtain aggregate income.

The income categories shown here are the most detailed that can be constructed from the types of income provided in table 8 from the ASEC and the income Universal Classification Codes from the CE.⁷ Total aggregate income is composed of the following categories: wage and salary income; net nonfarm self-employment income; net farm self-employment income; unemployment compensation; workers’ compensation (including compensation for black lung disease) and veterans’ benefits; Social Security and Railroad Retirement income; Supplemental Security Income; public assistance; pensions and annuities; interest; dividends, rents, royalties, and estates and trusts; child support; and accident and temporary insurance, educational assistance, alimony, financial assistance, and other income not elsewhere classified.

As noted earlier, annual estimates of income for the CPS match the calendar year, while the annual estimates of income for the CE Interview Survey cover the year prior to the month of interview. Thus, a major issue in comparing CE and CPS income estimates is determining how to select consumer units for inclusion in the analysis. After due consideration, three estimators of CE income were chosen.

The first replicates the method used for producing income estimates in the CE-CPS income comparison tables (and the reference tables) that appear in CE publications.⁸ Recall that the CE Interview Survey collects expenditure data for the 3 months prior to the interview month; annual income reported by consumer units in their second

or fifth interview is adjusted to fit the same period. In practice, this means dividing the annual amount by 12, thus creating a monthly amount, and then assigning that amount to each of the 3 months covered by the interview. For example, if a consumer unit reports \$600 of interest income at its second interview in March 2006, this process will assign \$50 ($\$600 \div 12$) to each of the months from December 2005 through February 2006, the reference period for the interview. Second-interview income is carried forward through the third and fourth interviews before the income data are collected again at the fifth interview. Thus, at its third interview in June 2006, the aforementioned consumer unit would have \$50 of interest income assigned to each of March, April, and May of 2006. The annual CE estimate for any calendar year will be calculated from all income assigned to that year.

Compared with the CPS estimate, the estimate created by this method uses a significant amount of income reported from an earlier period. With 2006 as an example, the first month whose interviews would be used in the CE estimate is February. One-twelfth of the income reported in that interview would be assigned to January. However, the 12-month reference period for reporting would run from February 2005 through January 2006, meaning that 11 months of the reference period would have been outside the calendar year of interest. April 2006 would be the first month in which one-twelfth of the annual income reported would be allocated to a 3-month reference period in which each month would be in 2006 (January–March). Yet the recall period for income in the April 2006 interviews is April 2005–March 2006, a full 9 months of which still are outside the year of interest.

In fact, the only month whose interviews would span a recall period matching the ASEC calendar year is January of the *next* year. (For calendar-year 2006, interviews conducted in January 2007 would have an annual reference period from January 2006 to December 2006.) This fact forms the basis for the second method of creating CE estimates for comparison with CPS income estimates: only the second and fifth interviews conducted in January of the next year are used to construct the estimate. Although using such interviews would exactly match the period covered by the ASEC, the number of interviews is very small—about one-sixth of the number of interviews conducted in any one quarter. This small number of interviews would be detrimental to the statistical reliability of the estimate, potentially leading to wide annual swings in it, particularly for some of the more thinly reported categories of income.

Because of the conceptual attractiveness of the sec-

ond method in matching the ASEC timeframe, the third method for creating CE estimates essentially expands on the second method. Centering on January interviews, this method adds the second and fifth interviews conducted between October of the previous year and April of the current year, or 3 months before and after January, to expand the number of interviews used in creating the estimate. As a result, one-seventh of the interviews report income earned in the year matching the calendar year. The earliest 12-month period, reported by one-seventh of the interviews, would run from October 1 of the previous year to September 30 of the current year; similarly, another one-seventh of the interviews would cover the latest 12-month period, from April 1 of the current year through March 31 of the next year.

In all three methods, weighting adjustments are made to ensure that the aggregate estimates are representative of the entire population. The adjustments start with the fact that sample units in the CE Interview Survey are assigned population weights such that the sum of the weights for consumer units interviewed in a calendar quarter will equal one national population. Thus, for any month, the sum of the weights of interviewed units will be approximately one-third of the national population and the sum of the weights of units undergoing a particular interview—the second, third, fourth, or fifth—during that month will approximate one-twelfth of the national population.

To obtain a population-weighted estimate of CE income by the first method is straightforward because of the way annual income is mapped to the reference months of each interview. For example, all income assigned to March 2006 would originate in interviews conducted from April through June of 2006. The weights assigned to consumer units interviewed during those 3 months would approximate one national population. Thus, one can calculate a nationally representative estimate of March 2006 income by applying the weights to the income reported. This procedure can be extended to each month of a calendar year, and then a weighted annual estimate for each year can be derived by summing the monthly estimates.

The weighting adjustment for the second method of estimating CE income also is fairly simple and is expanded to apply to the third method. The second method uses the second and fifth interviews in January of a survey year. These interviews represent approximately one-sixth of the interviews conducted in the first quarter of the year; thus, their weights are multiplied by 6 to produce a weighted national estimate. In the third method, the weights for the second and fifth interviews taken over the 7 months from October to April would represent about one-and-

one-sixth times the national population. Rather than deflate them all equally, it was decided that the weights for units undergoing their second and fifth interviews in the outlying months of October and April would be cut by one-half. This decision would be simple to implement and would assign greater weight to interviews conducted in months closer to the central month of January.

Results. The impact of imputation in the CE can be seen in table 1, which shows aggregate incomes, total and by source, from the CE and CPS, along with the ratio of CE-to-CPS estimates for the years 2002–06. The CE did not impute for income nonresponse in the first 2 years of this period, so the estimates are based on all reported income, regardless of whether the consumer unit was considered a complete or incomplete income respondent.

Imputation significantly raises CE aggregate income, bringing it into near comparability with CPS estimates. On average, imputation adds about 20 percentage points to the CE/CPS ratio. For the preimputation period of 2002–03, the mean CE/CPS ratio for total aggregate income, taking into account each method for estimating CE income, is about 0.75. The average ratio for the postimputation period of 2004–06 rises to about 0.95.

This increase in the ratio for aggregate income is driven largely by the increase in wage and salary income after imputation in the CE. Wage and salary income accounts for about 80 percent of total CE income and 77 percent of total CPS income over the 2002–06 period. Before imputation, CE aggregate income averages about \$1,650 billion less than CPS aggregate income, with CE wage and salary income trailing CPS wage and salary income by about \$1,123 billion. The CE/CPS ratio for wage and salary income averages about 0.78. After imputation, the gaps between aggregate income and wage and salary income in the CE and CPS narrow to an average of about \$462 billion and \$179 billion, respectively. Wage and salary income for the CE almost matches the CPS estimate, with an average ratio of about 0.97.

Social Security and Railroad Retirement income is the next-largest component of total income in the CE and CPS. The story here is similar to the one for wage and salary income. The mean 2002–03 CE/CPS ratio is somewhat more than 0.80, while the 2004–06 ratio increases to slightly more than 0.95.

Imputation in the CE has a larger impact on the CE/CPS ratio for nonfarm self-employment income, the third-largest contributor to total income, than for any other component of income. In fact, the ratio almost doubles after imputation, going from about 0.63 to a bit more than

Table 1. Aggregate pretax income and ratios for Current Population Survey (CPS) and for three alternative measures for Consumer Expenditure Survey (CE), by total and source of income, 2002–06

[In billions of dollars]

Year and survey	Total		Wage and salary		Nonfarm self-employment		Farm self-employment		Unemployment compensation	
	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio
2002										
CPS.....	\$6,515.7	...	\$5,078.4	...	\$302.6	...	\$20.4	...	\$37.9	...
CE, reference year 2002	4,629.0	71.0	3,736.3	73.6	197.8	65.4	14.9	72.8	14.7	38.7
CE, January 2003	4,858.1	74.6	3,880.9	76.4	204.3	67.5	4.2	20.3	13.2	34.8
CE, October 2002–April 2003	4,838.7	74.3	3,890.2	76.6	198.6	65.6	18.5	90.7	20.1	53.0
2003										
CPS.....	6,707.2	...	5,157.1	...	331.6	...	28.0	...	36.9	...
CE, reference year 2003	5,007.9	74.7	4,042.1	78.4	194.6	58.7	15.8	56.3	18.8	51.0
CE, January 2004	5,328.2	79.4	4,295.7	83.3	210.7	63.5	8.2	29.1	20.6	55.8
CE, October 2003–April 2004	5,109.5	76.2	4,125.7	80.0	194.3	58.6	14.8	53.0	20.0	54.1
2004										
CPS.....	6,939.6	...	5,346.6	...	321.7	...	29.0	...	25.0	...
CE, reference year 2004	6,322.2	91.1	5,021.3	93.9	338.4	105.2	22.6	77.8	18.6	74.3
CE, January 2005	6,689.9	96.4	5,119.7	95.8	566.6	176.1	15.7	54.0	22.4	89.5
CE, October 2004–April 2005	6,636.6	95.6	5,206.3	97.4	435.1	135.2	11.3	38.9	16.4	65.4
2005										
CPS.....	7,352.4	...	5,630.6	...	366.5	...	37.3	...	22.3	...
CE, reference year 2005	6,872.5	93.5	5,432.6	96.5	430.1	117.4	12.5	33.7	13.1	58.8
CE, January 2006	6,872.1	93.5	5,394.3	95.8	558.5	152.4	20.1	53.9	9.9	44.4
CE, October 2005–April 2006	6,940.3	94.4	5,522.8	98.1	423.4	115.5	10.6	28.5	11.6	52.1
2006										
CPS.....	7,800.6	...	5,967.4	...	407.7	...	31.7	...	20.7	...
CE, reference year 2006	7,170.8	91.9	5,718.6	95.8	414.0	101.5	14.7	46.5	12.8	61.9
CE, January 2007	7,332.3	94.0	5,994.1	100.4	445.0	109.1	13.1	41.5	16.0	77.3
CE, October 2006–April 2007	7,286.8	93.4	5,815.2	97.5	380.1	93.2	26.7	84.3	11.0	53.5
	Workers' compensation (including compensation for black lung disease) and veterans' benefits		Social Security and Railroad Retirement		Supplemental Security Income		Public assistance		Pensions and annuities	
	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio
2002										
CPS.....	36.4	...	389.8	...	25.9	...	6.0	...	262.5	...
CE, reference year 2002	7.7	20.4	312.9	80.3	23.3	90.0	4.1	67.8	178.7	68.1
CE, January 2003	6.5	17.2	299.1	76.7	19.5	75.2	4.2	69.6	217.4	82.8
CE, October 2002–April 2003	7.1	18.7	315.9	81.0	20.8	80.3	4.6	76.6	203.4	77.5
2003										
CPS.....	36.1	...	410.1	...	28.0	...	7.1	...	276.3	...
CE, reference year 2003	8.0	22.2	325.4	79.3	19.1	68.2	4.1	57.4	226.3	81.9
CE, January 2004	8.1	22.5	343.8	83.8	14.6	52.0	2.6	36.9	252.6	91.5
CE, October 2003–April 2004	9.9	27.3	334.7	81.6	15.5	55.4	3.9	55.7	231.8	83.9
2004										
CPS.....	39.9	...	431.8	...	30.6	...	5.8	...	291.9	...
CE, reference year 2004	8.9	22.4	400.0	92.6	20.8	67.9	4.7	82.1	280.1	96.0
CE, January 2005	11.6	29.0	431.0	99.8	13.4	43.8	5.6	97.5	300.0	102.8
CE, October 2004–April 2005	8.9	22.4	411.4	95.3	18.9	61.9	5.0	87.4	316.3	108.3
2005										
CPS.....	43.9	...	449.2	...	31.1	...	6.6	...	310.3	...
CE, reference year 2005	10.8	24.5	431.0	96.0	25.0	80.4	5.2	78.7	290.4	93.6
CE, January 2006	7.5	17.1	441.1	98.2	25.9	83.3	4.9	74.8	268.1	86.4
CE, October 2005–April 2006	10.3	23.4	441.9	98.4	26.4	84.7	5.5	83.8	291.1	93.8

Table 1. Continued—Aggregate pretax income and ratios for Current Population Survey (CPS) and for three alternative measures for Consumer Expenditure Survey (CE), by total and source of income, 2002–06

[In billions of dollars]

Year and survey	Workers' compensation (including compensation for black lung disease) and veterans' benefits		Social Security and Railroad Retirement		Supplemental Security Income		Public assistance		Pensions and annuities	
	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio
2006										
CPS.....	\$41.6	...	\$471.5	...	\$31.6	...	\$5.6	...	\$314.9	...
CE, reference year 2006	11.8	28.4	446.0	94.6	23.6	74.6	5.2	92.9	283.5	90.0
CE, January 2007	8.4	20.1	409.1	86.8	26.6	84.1	4.9	87.9	213.6	67.8
CE, October 2006–April 2007	13.5	32.4	452.2	95.9	25.9	81.8	5.0	90.2	302.6	96.1
	Interest		Dividends, rents, royalties, and estates and trusts		Child support		Accident and temporary insurance, educational assistance, alimony, financial assistance, and other income not elsewhere classified			
	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio	Aggregate	CE/CPS ratio
2002										
CPS.....	145.4	...	119.7	...	24.0	...	66.7	...	...	...
CE, reference year 2002	36.9	25.4	50.3	42.1	13.3	55.3	38.1	57.2	...	...
CE, January 2003	39.8	27.4	48.9	40.9	13.3	55.3	107.0	160.5	...	...
CE, October 2002–April 2003	41.7	28.7	57.3	47.8	14.3	59.6	46.3	69.5	...	...
2003										
CPS.....	148.3	...	152.4	...	25.1	...	70.0	...	...	...
CE, reference year 2003	47.9	32.3	60.7	39.8	17.1	67.9	28.0	40.0	...	...
CE, January 2004	38.2	25.7	63.2	41.5	21.5	85.4	48.5	69.2	...	...
CE, October 2003–April 2004	43.4	29.2	65.6	43.0	16.9	67.4	32.9	47.0	...	...
2004										
CPS.....	163.2	...	157.0	...	27.0	...	70.2	...	...	...
CE, reference year 2004	59.0	36.2	85.3	54.3	19.2	71.1	43.1	61.4	...	...
CE, January 2005	59.0	36.1	50.6	32.2	21.7	80.5	72.6	103.5	...	...
CE, October 2004–April 2005	49.8	30.5	81.0	51.6	21.0	77.7	55.2	78.6	...	...
2005										
CPS.....	186.9	...	169.8	...	26.0	...	72.0	...	...	...
CE, reference year 2005	61.9	33.1	99.9	58.8	19.2	73.8	40.7	56.5	...	...
CE, January 2006	37.6	20.1	45.1	26.6	17.0	65.4	41.9	58.1	...	...
CE, October 2005–April 2006	61.3	32.8	71.9	42.3	19.6	75.4	43.9	60.9	...	...
2006										
CPS.....	229.2	...	186.7	...	25.4	...	66.6	...	...	...
CE, reference year 2006	69.7	30.4	106.9	57.3	22.6	88.9	41.4	62.1	...	...
CE, January 2007	66.8	29.1	80.1	42.9	18.1	71.3	36.6	55.0	...	...
CE, October 2006–April 2007	85.7	37.4	109.5	58.6	21.3	84.0	38.0	57.0	...	...

1.22, making nonfarm self-employment income the only source of income for which the CE estimate is, on average, higher than the CPS estimate.

At about 4 percent of the total, pension and annuity income is the next-largest component of total income. After imputation, the CE/CPS ratio for pension and annuity income rises by an amount that is almost equivalent to that for Social Security and Railroad Retirement income.

For 2002–03, the ratio averages just under 0.81, increasing to slightly under 0.93 for 2004–06.

None of the nine remaining income components represents as much as 2 percent of total income reported in the CE. For the CPS, however, two categories—interest income; and income from dividends, rents, royalties, and estates and trusts—each make up more than 2 percent of total income. Hence, the CE/CPS ratios for these items are

fairly low, and, historically, they have been among the lowest in the published tables. In addition, interest income is one of the few components whose CE/CPS ratio does not increase appreciably after imputation: on average, the aggregate preimputation interest income estimate in the CE is about 28 percent of the CPS estimate, while, after imputation, the estimate increases about 3.5 percentage points, to just under 32 percent of the CPS estimate.

Imputation does not have a marked impact on the CE/CPS ratio for income from dividends, rents, royalties, and estates and trusts either, although the initial level of the ratio is higher than that for interest income. The ratio for 2002–03 averages midway between 0.42 and 0.43, and increases to an average of just over 0.47 after imputation.

Each of the remaining seven sources of income accounts for less than 1 percent of total income in each of the CE and the CPS. Thus, any change in the CE/CPS ratio after imputation has a tiny impact on overall aggregate income between the two surveys. In addition, the number of consumer units in the CE reporting income from these sources is often very low, particularly for the method of creating CE estimates from the second and fifth interviews from January of the next year. Hence, outlying values have a disproportionate impact on the calculated estimates.

Of the seven components still outstanding, two actually show a drop in the average ratio between 2002–03 and 2004–06. The first of these is farm self-employment income, for which the CE-CPS ratio drops almost 3 percentage points, from slightly under 54 percent to 51 percent. The other component is an amalgam of individual income sources from each survey that could be combined into the category of accident and temporary insurance, educational assistance, alimony, financial assistance, and other income not elsewhere classified. The CE/CPS ratio for this component shows an even larger change between pre- and postimputation periods, dropping from an average of about 0.74 to approximately 0.66. For both of these components, and more strikingly for the latter, the wide swings in the CE estimates across years in the second and third estimation methods are due to infrequent reports of such income, a factor that offers an explanation for the drop in the ratio.

Examining the five remaining sources of income reveals, on the one hand, that the mean CE/CPS ratio for unemployment compensation rises significantly after imputation. The CE estimate for 2002–03 averages almost 48 percent of the CPS estimate. For the 3-year period after imputation is introduced, the CE estimate rises to an average of more than 64 percent of the CPS estimate. On the other hand, for income from workers' compensa-

tion (including compensation for black lung disease) and veterans' benefits, the ratio of CE to CPS income changes very little after imputation, moving from about 0.22 to more than 0.24.

SSI is another income component for which the average ratio remains relatively stable subsequent to imputation. At a mean of about 70 percent of the CPS estimate in 2002–03, the CE estimate for SSI is the fifth highest among the components with respect to the CPS. Adding imputed SSI income to that reported by consumer units increases the CE estimate only to an average of somewhat under 74 percent of the CPS estimate during 2004–06. By contrast, child support income, a marginally smaller component of total income than SSI, exhibits a large increase in the CE/CPS ratio after imputation: the ratio averages slightly more than 0.65 for 2002–03, after which it rises to an average of well over 0.76 over the 3-year period that followed. The final and smallest source of total income, public assistance, displays the largest rise in the CE/CPS ratio after imputation began. The CE estimate averages under 61 percent of the CPS estimate in the 2 years prior to imputation, rising over the next 3 years to an average of slightly more than 86 percent of the CPS estimate, a greater-than-25-percentage-point increase.

The role of imputation

The preceding examination of the change in the ratio of CE income to CPS income after CE income estimates are augmented by imputation shows only part of the picture with respect to the impact of imputation on the relationship between the two measures. This section investigates more closely the magnitude of imputation as it affects the final aggregate estimates for total income and for each source of income in the CE and the CPS over the 2004–06 period when imputation is done for both surveys.

Table 2 shows the percentage of CE and CPS aggregate income, both total and by source, accounted for by imputation for the 3 years during which it has been used in the CE. An examination of total income shows that about 37 percent of the CE aggregate is attributable to imputation, compared with about 33 percent in the CPS. On average, the percentage of imputed income in the CE has risen each year since the inception of imputation, while the percentage has remained stable in the CPS. Even though the CPS aggregates are larger than the CE aggregates and the difference between the aggregates has risen from approximately \$400 billion in 2004 to about \$530 billion in 2006, the dollar amounts imputed in the CE are uniformly larger than the amounts imputed in the

Table 2. Aggregate pretax income and percent distribution, total and by reported and allocated status, by source of income, Current Population Survey (CPS) and three alternative measures of Consumer Expenditure Survey (CE), 2004–06

[In billions of dollars]

Year, category of income, and survey	Total	Reported	Percent reported	Allocated	Percent allocated
2004					
Total aggregate income:					
CPS.....	\$6,939.6	\$4,603.6	66.3	\$2,336.0	33.7
CE, reference year 2004	6,322.2	3,944.6	62.4	2,377.5	37.6
CE, January 2005	6,689.9	4,318.1	64.5	2,371.7	35.5
CE, October 2004–April 2005	6,636.6	4,274.2	64.4	2,362.3	35.6
Wage and salary:					
CPS.....	5,346.6	3,672.9	68.7	1,673.8	31.3
CE, reference year 2004	5,021.3	3,084.1	61.4	1,937.3	38.6
CE, January 2005	5,119.7	3,251.8	63.5	1,868.0	36.5
CE, October 2004–April 2005	5,206.3	3,331.5	64.0	1,874.8	36.0
Nonfarm self-employment:					
CPS.....	321.7	183.5	57.0	138.3	43.0
CE, reference year 2004	338.4	145.2	42.9	193.3	57.1
CE, January 2005	566.6	261.2	46.1	305.4	53.9
CE, October 2004–April 2005	435.1	179.9	41.3	255.2	58.7
Farm self-employment:					
CPS.....	29.0	12.7	43.9	16.3	56.1
CE, reference year 2004	22.6	8.1	35.9	14.5	64.1
CE, January 2005	15.7	7.5	48.1	8.1	51.9
CE, October 2004–April 2005	11.3	4.1	36.7	7.2	63.3
Unemployment compensation:					
CPS.....	25.0	18.7	74.8	6.3	25.2
CE, reference year 2004	18.6	15.0	80.7	3.6	19.3
CE, January 2005	22.4	13.4	59.9	9.0	40.1
CE, October 2004–April 2005	16.4	13.0	79.5	3.3	20.5
Workers' compensation (including compensation for black lung disease) and veterans' benefits:					
CPS.....	39.9	27.6	69.3	12.2	30.6
CE, reference year 2004	8.9	6.6	73.5	2.4	26.5
CE, January 2005	11.6	10.6	92.1	.9	7.9
CE, October 2004–April 2005	8.9	7.1	79.9	1.8	20.1
Social Security and Railroad Retirement:					
CPS.....	431.8	283.1	65.6	148.6	34.4
CE, reference year 2004	400.0	312.4	78.1	87.7	21.9
CE, January 2005	431.0	349.6	81.1	81.4	18.9
CE, October 2004–April 2005	411.4	329.9	80.2	81.5	19.8
Supplemental Security Income:					
CPS.....	30.6	21.8	71.2	8.8	28.7
CE, reference year 2004	20.8	16.9	81.6	3.8	18.4
CE, January 2005	13.4	12.0	89.7	1.4	10.3
CE, October 2004–April 2005	18.9	15.5	82.1	3.4	17.9
Public assistance:					
CPS.....	5.8	4.0	70.4	1.7	29.6
CE, reference year 2004	4.7	3.7	77.4	1.1	22.6
CE, January 2005	5.6	4.6	81.4	1.0	18.6
CE, October 2004–April 2005	5.0	3.8	74.7	1.3	25.3

Table 2. Continued—Aggregate pretax income and percent distribution, total and by reported and allocated status, by source of income, Current Population Survey (CPS) and three alternative measures of Consumer Expenditure Survey (CE), 2004–06

[In billions of dollars]

Year, category of income, and survey	Total	Reported	Percent reported	Allocated	Percent allocated
Pensions and annuities:					
CPS.....	\$291.9	\$193.6	66.3	\$98.4	33.7
CE, reference year 2004	280.1	221.4	79.0	58.7	21.0
CE, January 2005	300.0	256.9	85.6	43.1	14.4
CE, October 2004–April 2005	316.3	254.5	80.5	61.8	19.5
Interest:					
CPS.....	163.2	41.3	25.3	121.8	74.7
CE, reference year 2004	59.0	27.8	47.0	31.3	53.0
CE, January 2005	59.0	38.8	65.9	20.1	34.1
CE, October 2004–April 2005	49.8	24.7	49.7	25.0	50.3
Dividends, rents, royalties, and estates and trusts:					
CPS.....	157.0	81.8	52.1	75.3	47.9
CE, reference year 2004	85.3	53.7	62.9	31.6	37.1
CE, January 2005	50.6	34.4	67.9	16.3	32.1
CE, October 2004–April 2005	81.0	48.6	60.0	32.4	40.0
Child support:					
CPS.....	27.0	19.5	72.3	7.5	27.7
CE, reference year 2004	19.2	16.7	86.8	2.5	13.2
CE, January 2005	21.7	19.1	87.9	2.6	12.1
CE, October 2004–April 2005	21.0	18.9	89.9	2.1	10.1
Accident and temporary insurance, educational assistance, alimony, financial assistance, and other					
CPS.....	70.2	43.0	61.3	27.1	38.7
CE, reference year 2004	43.1	33.3	77.3	9.8	22.7
CE, January 2005	72.6	58.1	80.0	14.5	20.0
CE, October 2004–April 2005	55.2	42.6	77.1	12.6	22.9
2005					
Total aggregate:					
CPS.....	7,352.2	5,026.8	68.4	2,325.7	31.6
CE, reference year 2005	6,872.5	4,322.3	62.9	2,550.1	37.1
CE, January 2006	6,872.1	4,332.7	63.0	2,539.4	37.0
CE, October 2005–April 2006	6,940.3	4,405.6	63.5	2,534.6	36.5
Wage and salary:					
CPS	5,630.6	4,002.1	71.1	1,628.4	28.9
CE, reference year 2005	5,432.6	3,376.8	62.2	2,055.8	37.8
CE, January 2006	5,394.3	3,400.0	63.0	1,994.5	37.0
CE, October 2005–April 2006	5,522.8	3,493.0	63.2	2,029.8	36.8
Nonfarm self-employment:					
CPS.....	366.5	216.4	59.1	150.1	41.0
CE, reference year 2005	430.1	187.7	43.6	242.4	56.4
CE, January 2006	558.5	229.6	41.1	328.9	58.9
CE, October 2005–April 2006	423.4	181.0	42.8	242.3	57.2
Farm self-employment:					
CPS.....	37.3	13.7	36.7	23.6	63.3
CE, reference year 2005	12.5	2.2	17.7	10.3	82.3
CE, January 2006	20.1	12.1	60.1	8.0	39.9
CE, October 2005–April 2006	10.6	6.2	57.9	4.5	42.1
Unemployment compensation:					
CPS.....	22.3	17.0	76.2	5.3	23.8
CE, reference year 2005	13.1	11.1	84.6	2.0	15.4
CE, January 2006	9.9	6.5	65.7	3.4	34.3
CE, October 2005–April 2006	11.6	9.4	80.6	2.3	19.4

Table 2. Continued—Aggregate pretax income and percent distribution, total and by reported and allocated status, by source of income, Current Population Survey (CPS) and three alternative measures of Consumer Expenditure Survey (CE), 2004–06

[In billions of dollars]

Year, category of income, and survey	Total	Reported	Percent reported	Allocated	Percent allocated
Workers' compensation (including compensation for black lung disease) and veterans' benefits:					
CPS.....	\$43.9	\$30.3	69.0	\$13.6	31.1
CE, reference year 2005	10.8	8.4	77.8	2.4	22.2
CE, January 2006	7.5	7.5	99.4	(¹)	.6
CE, October 2005–April 2006	10.3	7.6	74.2	2.6	25.8
Social Security and Railroad Retirement:					
CPS.....	449.2	301.8	67.2	147.5	32.8
CE, reference year 2005	431.0	341.0	79.1	90.1	20.9
CE, January 2006	441.1	351.8	79.8	89.3	20.2
CE, October 2005–April 2006	441.9	340.3	77.0	101.6	23.0
Supplemental Security Income:					
CPS.....	31.1	22.7	73.1	8.4	26.9
CE, reference year 2005	25.0	20.5	81.8	4.5	18.2
CE, January 2006	25.9	23.5	90.5	2.5	9.5
CE, October 2005–April 2006	26.4	20.5	77.6	5.9	22.4
Public assistance:					
CPS.....	6.6	5.0	76.4	1.6	23.6
CE, reference year 2005	5.2	4.2	80.4	1.0	19.6
CE, January 2006	4.9	4.2	84.1	.8	15.9
CE, October 2005–April 2006	5.5	4.5	81.7	1.0	18.3
Pensions and annuities:					
CPS.....	310.3	211.4	68.1	98.8	31.9
CE, reference year 2005	290.4	229.5	79.0	60.9	21.0
CE, January 2006	268.1	223.2	83.2	44.9	16.8
CE, October 2005–April 2006	291.1	224.9	77.3	66.2	22.7
Interest:					
CPS.....	186.9	54.8	29.3	132.1	70.7
CE, reference year 2005	61.9	29.6	47.8	32.4	52.2
CE, January 2006	37.6	12.7	33.6	25.0	66.4
CE, October 2005–April 2006	61.3	26.1	42.7	35.1	57.3
Dividends, rents, royalties, and estates and trusts:					
CPS.....	169.8	87.3	51.4	82.5	48.6
CE, reference year 2005	99.9	63.7	63.8	36.2	36.2
CE, January 2006	45.1	22.3	49.5	22.8	50.5
CE, October 2005–April 2006	71.9	45.7	63.6	26.2	36.4
Child support:					
CPS.....	26.0	19.5	75.0	6.5	25.0
CE, reference year 2005	19.2	17.7	92.0	1.5	8.0
CE, January 2006	17.0	14.8	87.0	2.2	13.0
CE, October 2005–April 2006	19.6	17.7	90.4	1.9	9.6
Accident and temporary insurance, educational assistance, alimony, financial assistance, and other					
CPS.....	72.0	44.7	62.0	27.3	38.0
CE, reference year 2005	40.7	30.0	73.9	10.6	26.1
CE, January 2006	41.9	24.8	59.2	17.1	40.8
CE, October 2005–April 2006	43.9	28.7	65.3	15.3	34.7

See note at end of table.

Table 2. Continued—Aggregate pretax income and percent distribution, total and by reported and allocated status, by source of income, Current Population Survey (CPS) and three alternative measures of Consumer Expenditure Survey (CE), 2004–06

[In billions of dollars]

Year, category of income, and survey	Total	Reported	Percent reported	Allocated	Percent allocated
2006					
Total aggregate income:					
CPS.....	\$7,800.6	\$5,226.9	67.0	\$2,573.7	33.0
CE, reference year 2006	7,170.8	4,354.7	60.7	2,816.2	39.3
CE, January 2007	7,332.3	4,435.1	60.5	2,897.3	39.5
CE, October 2006–April 2007	7,286.8	4,492.4	61.7	2,794.4	38.3
Wage and salary income:					
CPS.....	5,967.4	4,163.5	69.8	1,803.9	30.2
CE, reference year 2006	5,718.6	3,447.2	60.3	2,271.5	39.7
CE, January 2007	5,994.1	3,685.0	61.5	2,309.1	38.5
CE, October 2006–April 2007	5,815.2	3,566.6	61.3	2,248.7	38.7
Nonfarm self-employment:					
CPS.....	407.7	227.3	55.7	180.4	44.2
CE, reference year 2006	414.0	144.9	35.0	269.1	65.0
CE, January 2007	445.0	109.7	24.7	335.3	75.3
CE, October 2006–April 2007	380.1	132.8	34.9	247.3	65.1
Farm self-employment:					
CPS.....	31.7	15.6	49.1	16.2	51.0
CE, reference year 2006	14.7	5.1	34.3	9.7	65.7
CE, January 2007	13.1	2.8	21.4	10.3	78.6
CE, October 2006–April 2007	26.7	17.5	65.6	9.2	34.4
Unemployment compensation:					
CPS.....	20.7	15.4	74.6	5.2	25.4
CE, reference year 2006	12.8	9.5	74.2	3.3	25.8
CE, January 2007	16.0	10.5	65.7	5.5	34.3
CE, October 2006–April 2007	11.0	8.2	74.4	2.8	25.6
Workers' compensation (including compensation for black lung disease) and veterans' benefits:					
CPS.....	41.6	28.7	69.0	12.9	31.0
CE, reference year 2006	11.8	8.4	71.4	3.4	28.6
CE, January 2007	8.4	4.7	55.6	3.7	44.4
CE, October 2006–April 2007	13.5	10.4	77.1	3.1	22.9
Social Security and Railroad Retirement:					
CPS.....	471.5	312.7	66.3	158.8	33.7
CE, reference year 2006	446.0	345.5	77.5	100.6	22.5
CE, January 2007	409.1	309.2	75.6	99.9	24.4
CE, October 2006–April 2007	452.2	349.9	77.4	102.3	22.6
Supplemental Security Income:					
CPS.....	31.6	23.7	74.8	8.0	25.2
CE, reference year 2006	23.6	18.9	80.0	4.7	20.0
CE, January 2007	26.6	22.5	84.6	4.1	15.4
CE, October 2006–April 2007	25.9	21.2	82.1	4.6	17.9
Public assistance:					
CPS.....	5.6	4.1	74.5	1.4	25.5
CE, reference year 2006	5.2	4.1	78.9	1.1	21.1
CE, January 2007	4.9	2.8	56.7	2.1	43.3
CE, October 2006–April 2007	5.0	3.8	75.4	1.2	24.6
Pensions and annuities:					
CPS.....	314.9	212.0	67.3	102.9	32.7
CE, reference year 2006	283.5	221.1	78.0	62.4	22.0
CE, January 2007	213.6	160.8	75.3	52.9	24.7
CE, October 2006–April 2007	302.6	228.1	75.4	74.5	24.6

Table 2. Continued—Aggregate pretax income and percent distribution, total and by reported and allocated status, by source of income, Current Population Survey (CPS) and three alternative measures of Consumer Expenditure Survey (CE), 2004–06

[In billions of dollars]

Year, category of income, and survey	Total	Reported	Percent reported	Allocated	Percent allocated
Interest:					
CPS.....	\$229.2	\$67.0	29.2	\$162.1	70.7
CE, reference year 2006	69.7	31.0	44.5	38.7	55.5
CE, January 2007	66.8	26.9	40.3	39.9	59.7
CE, October 2006–April 2007	85.7	40.8	47.6	44.9	52.4
Dividends, rents, royalties, and estates and trusts:					
CPS.....	186.7	94.8	50.8	91.9	49.2
CE, reference year 2006	106.9	71.1	66.5	35.8	33.5
CE, January 2007	80.1	57.3	71.6	22.8	28.4
CE, October 2006–April 2007	109.5	67.6	61.7	41.9	38.3
Child support:					
CPS.....	25.4	18.2	71.6	7.2	28.5
CE, reference year 2006	22.6	20.4	90.6	2.1	9.4
CE, January 2007	18.1	15.7	86.6	2.4	13.4
CE, October 2006–April 2007	21.3	19.3	90.6	2.0	9.4
Accident and temporary insurance, educational assistance, alimony, financial assistance and other					
CPS.....	66.6	43.8	65.8	22.8	34.2
CE, reference year 2006	41.4	27.5	66.6	13.8	33.4
CE, January 2007	36.6	27.3	74.7	9.3	25.3
CE, October 2006–April 2007	38.0	26.2	68.9	11.8	31.1

¹ Less than 0.1.

CPS and the difference in imputed aggregate income has risen from about \$35 billion in 2004 to around \$260 billion in 2006.

As noted earlier, wage and salary income is the predominant component of total income, so the contribution of imputation to aggregate wages and salaries essentially matched the contribution to total income. Imputation is a bigger factor in the CE estimates than the CPS estimates, in terms of both the percentage of the estimate and the actual dollar value. In 2004, 37.0 percent of CE wages and salaries are a result of imputation, and the percentage rises to 37.2 percent in 2005 and 39.0 percent in 2006. Over the same 3 years, imputation accounts for about 30.1 percent of CPS wages and salaries. Wages and salaries imputed in the CE exceed those imputed in the CPS by about \$220 billion for 2004, rising to about \$475 billion in 2006.

The two components of total income representing retirement income show remarkably similar patterns with respect to the effect of imputation, both internally and in relation to the CPS. Though starting from a lower level, the average percentage of imputed income represented in the CE estimates for Social Security and Railroad Retirement income and for income from pensions and annuities

increases each year from 2004 to 2006. For the former component, the percentage goes from 20.2 percent to 23.2 percent; for the latter component, it rises from 18.3 percent to 23.8 percent. Nonresponse appears to have been less of an issue for the CE than for the CPS, because the CPS is seen to have imputed, on average, 33.6 percent of Social Security and Railroad Retirement income and 32.8 percent of pensions and annuities over the 3-year span. With one exception, the income directly reported by respondents is \$30 billion to \$55 billion more for Social Security and \$10 billion to \$60 billion more for pensions and annuities in the CE than in the CPS.

More than one-half of the CE estimates for nonfarm self-employment income are derived from imputation. As with the sources of income mentioned in the previous two paragraphs, the average percentage of imputed income rises each year, but there is a sizable 11-percentage-point increase, from 57.5 percent to 68.5 percent, between 2005 and 2006. Imputation in the CPS averages 42.7 percent over the 3-year period. The amount imputed in the CE estimates is significantly greater than the amount imputed in the CPS each year, although, seemingly paradoxically, the average difference is smallest, at just over \$103 billion,

in 2006, the year in which imputed income makes up the largest proportion of the CE estimate.

Interest income and, to a lesser degree, income from dividends, rents, royalties, and estates and trusts show wildly different response patterns between the CE and the CPS. The percentage of imputed income incorporated into the CE estimates for interest income has varied from 45.8 percent in 2004, to 58.6 percent in 2005, to 55.9 percent in 2006. The change in the percentage from year to year is attributable to swings in the percentage of income imputed in the CE estimate that is derived from January interviews only. The CPS derives an average of 72.0 percent of its annual estimates from imputation, and the actual dollar amounts imputed dwarf the amounts of imputed interest income in the CE by \$100 billion to \$120 billion.

The average percentage of imputed income for CE dividends, rents, royalties, and estates and trusts over the 2004–06 period peaks in 2005 at 41.0 percent and then drops the next year to 33.4 percent, the lowest of all 3 years. In 2004, imputed income makes up 36.4 percent of this category. CPS estimates for dividends, rents, royalties, and estates and trusts are composed of a higher percentage of imputed income—on average, about 48.6 percent—than is any CE estimate produced for the same period, with one exception: the 2005 CE estimate based on January 2006 interviews. In actual dollar amounts, the CPS uniformly imputes much higher amounts than does the CE, regardless of the way CE income is measured: on average, \$83.2 billion dollars are imputed annually in the CPS, compared with \$29.6 billion in the CE.

Turning to the two components whose CE/CPS ratios fall after imputation is instituted reveals that the first—farm self-employment income—shows average percentages of CE imputed income rivaling the levels for nonfarm self-employment income. For both 2004 and 2006, almost 60 percent of CE farm self-employment income originates as a result of imputation, slightly more than the 54.8 percent of the farm self-employment income estimate imputed in 2005. The CPS imputes about \$10 billion more of farm self-employment income than the CE imputes annually, although, as a percentage of the total, the CE and the CPS imputations differ by less than 2 percentage points (58.0 percent and 56.8 percent, respectively).

Imputation constitutes a much smaller proportion of CE income for the second category: accident and temporary insurance, educational assistance, alimony, financial assistance, and other income not elsewhere classified. The average percentage of imputed income for this category ranges from 21.9 percent in 2004 to 33.9 percent in 2005.

The amount of income imputed by the CPS for the same category averages twice as much (\$25.7 billion compared with \$12.8 billion) as the amount imputed in the CE across all of the years examined. As a proportion of the total, imputed income makes up 37 percent in the CPS and 28.6 percent in the CE.

Over the 2004–06 period, the annual average percentages of income imputed for unemployment compensation in the CE are fairly low and stable: 26.6 percent in 2004, 23.0 percent in 2005, and 28.6 percent in 2006. However, a closer examination of the imputation percentages for each method of selecting CE observations shows that imputation is much more prevalent when January interviews alone are used, adding up to 6 percentage points to the average. Overall, the percentages imputed in the CE and the CPS are similar, differing from about 1 to 3 percentage points across the years studied.

For the category of workers' compensation (including compensation for black lung disease) and veterans' benefits, tracking the average percentages imputed in the CE is somewhat misleading. In 2004 and 2005, the average percentages of income imputed are 18.2 percent and 16.2 percent, respectively. The average percentage almost doubles in 2006, to 32.0 percent. These results are due almost solely to the relative paucity of imputation in estimates based on January interviews. In 2005, barely any income from this source—0.6 percent—is imputed for January 2006 interviews. For the estimate based on interviews during the period from October 2005 to April 2006, the percentage imputed is 25.8 percent, and for the estimate based on the publication methodology, 22.2 percent results from imputation. In 2004, the situation is similar, though not so extreme. The respective percentages imputed are 26.5 percent (publication method), 20.1 percent (October 2004–April 2005), and 7.9 percent (January 2005). A complete reversal of this pattern occurs in 2006, with the percentage imputed for January 2007 interviews leaping to 44.4 percent while the percentages for the publication method and the October 2006–April 2007 interviews are 28.6 percent and 22.9 percent, respectively, comparable to the rates posted in the earlier 2 years. Imputation in the CPS accounts for about 30.9 percent of such income, compared with 24.4 percent of income derived for the latter two methods in the CE.

On average, the percentages of SSI imputed in the CE are the second lowest of any component of total income. Although imputed income makes up an increasing share of the total each year of the period examined, the overall rise is small, going from 15.5 percent in 2004 to 17.8 percent in 2006. CPS percentages of imputed income are

about 10 points higher than those in the CE (26.9 percent, compared with 16.7 percent), with actual dollar values imputed running more than twice as high as the CE's (\$8.4 billion, compared with \$3.9 billion).

Imputation in the CE for income from public assistance shows the interyear variability exhibited by other components, such as accident and temporary insurance, educational assistance, alimony, financial assistance, and other income not elsewhere classified, as well as interest income. The average percentage imputed swings from 22.2 percent in 2004, down to 17.9 percent in 2005, and then up to 29.7 percent in 2006. As with these other sources, the variability in the case of income from public assistance can be traced to changes in percentages imputed for January interviews. The percentage of income resulting from imputation in the CPS is greater than that of the CE for the first 2 years of the period, but lower than the CE's estimate for the final year.

The final component of total income, child support, shows both the lowest and most consistent average percentages of imputed income as a share of the total of any component of income in the CE. In 2005, only 10.2 percent of child support income—the lowest average percentage of the three years examined—is obtained via imputation. The highest percentage, only about 1.6 percentage points greater than the lowest, is 11.8 percent of the total, registered in 2004. The CPS imputes a much higher percentage of child support over the period, an average of 27.1 percent, more than 3 times as much, on average, in dollar terms: \$7.1 billion, as opposed to \$2.1 billion.

WITH THE RELEASE OF 2004 DATA from the Consumer Expenditure Survey (CE), the BLS began implementing imputation for missing responses to income questions. The multistage procedure produced multiple imputed values for each missing observation. To assess how well

these imputation routines performed, estimates of aggregate income based on both reported and imputed values were compared with estimates calculated from the Current Population Survey (CPS) for the years 2002–06. This period covered the 2 years prior to the introduction of imputation and the 3 years following.

Because of methodological differences between the CE and the CPS, three alternative measures of CE income were derived for comparison with the CPS. On average, prior to imputation CE estimates for total money income before taxes were about 75 percent of the CPS aggregate. After imputation, CE estimates rose to about 95 percent of the CPS estimate. An examination of individual sources of income reveals that, in general, imputation has brought CE estimates closer to CPS estimates, although significant disparities remain between the estimates for many of the smaller components. On the basis of these results, further refinements to the CE income questions and imputation procedures are expected.

The analysis presented in this article has used the Annual Social and Economic Supplement (ASEC) of the CPS as a benchmark to which CE Interview Survey aggregates are compared. The Census Bureau, in its turn, evaluates the quality of ASEC estimates through comparison studies with other independent sources of income. In a similar vein, Daniel Weinberg has cited studies comparing CPS income data with national and State income data from the Bureau of Economic Analysis, with income data from the Census Bureau's Survey of Income and Program Participation, and with earnings data from the Internal Revenue Service.⁹ Also, Bruce Webster has compared median household income and earnings estimates for 2004 and 2005 from the American Community Survey with CPS data.¹⁰ Comparing CE income estimates with these alternative sources, in addition to continuing work with the CPS, offers further avenues for analyzing the quality of CE income data. □

Notes

ACKNOWLEDGMENT: Thanks go to Carmen DeNovas-Walt and Edward Welniak of the Income Surveys Branch of the U.S. Census Bureau for providing the CPS income data and reviewing the manuscript of this article.

¹ For a comprehensive review and analysis of comparisons between CE and PCE expenditure estimates, see Thesia I. Garner, George Janini, William Passero, Laura Paszkiewicz, and Mark Vendemia, "The CE and the PCE: a comparison," *Monthly Labor Review*, September 2006, pp. 20–46.

² A consumer unit consists of (1) all members of a particular household who are related by blood, marriage, adoption, or some other legal arrangement; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more

persons living together who use their incomes to make joint expenditure decisions. Financial independence is determined by spending behavior with regard to the three major expense categories: housing, food, and other living expenses. To be considered financially independent, the respondent must be financially responsible for at least two of the three major expenditure categories, either entirely or in part.

³ See Thesia I. Garner and Laura Blanciforti, "Household Income Reporting: An Analysis of U. S. Consumer Expenditure Survey Data," *Journal of Official Statistics*, March 1994, pp. 69–91, for more details.

⁴ Geoffrey D. Paulin and David L. Ferraro, "Imputing income in the Consumer Expenditure Survey," *Monthly Labor Review*, December 1994, pp. 23–31.

⁵ Roderick J. A. Little and Donald B. Rubin, *Statistical Analysis with Missing Data* (New York, John Wiley and Sons, 1987), cited in Paulin and

Income Imputation

Ferraro, "Imputing Income."

⁶ See *Consumer Expenditure Survey, 1987*, Bulletin 2354 (Bureau of Labor Statistics, June 1990), text tables 6 and 7; *Consumer Expenditure Survey, 1990–91*, Bulletin 2425 (Bureau of Labor Statistics, September 1993), text tables 8 and 9; *Consumer Expenditure Survey, 1992–93*, Bulletin 2462 (Bureau of Labor Statistics, September 1995), text tables 6 and 7; *Consumer Expenditure Survey, 1994–95*, Bulletin 2492 (Bureau of Labor Statistics, December 1997), text tables 10 and 11; *Consumer Expenditure Survey, 1996–97*, Report 935 (Bureau of Labor Statistics, September 1999), text tables 8 and 9; *Consumer Expenditure Survey, 1998–99*, Report 955 (Bureau of Labor Statistics, November 2001), text tables 20 and 21; and *Consumer Expenditure Survey, 2002–2003*, Report 990 (Bureau of Labor Statistics, March 2006), text tables 3–6.

⁷ Universal Classification Codes are six-digit codes that identify expenditure, income, and selected demographic variables at the most detailed level for use in CE data dissemination and CPI pricing activities.

⁸ *Ibid.*

⁹ Daniel H. Weinberg, "Income data quality issues in the CPS," *Monthly Labor Review*, June 2006, pp. 38–45.

¹⁰ Bruce H. Webster, Jr., "Evaluation of Median Income and Earnings Estimates: A Comparison of the American Community Survey and the Current Population Survey" (U.S. Census Bureau), March 12, 2007, on the Internet at www.census.gov/acs/www/Downloads/Evaluation_of_Income_Estimates31207.doc (visited Mar. 9, 2009).