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The Validity of Consumption Data
Are the Consumer Expenditure Interview and Diary Surveys Informative?

Adam Bee, Bruce D. Meyer, and James X. Sullivan

7.1 Introduction

The Consumer Expenditure (CE) Survey is a vital data source. Assessing and improving the quality of the CE is a major policy and research issue for several reasons. The CE is the source of weights for the Consumer Price Index (CPI), which is used to index for inflation income tax brackets, government transfer payments such as Social Security benefits, private labor contracts, and other economic variables. The CE is also the only comprehensive source of consumption information on the US population.[1] The survey is used by government agencies for several purposes and has been extensively used by outside researchers. The CE data have been used to address a long list of research issues that would be difficult or impossible to address with another source. The survey has been available in some form for almost a century, and in its current form for over thirty years. This long history allows researchers to examine changes over a long time period.

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1. There are recent efforts to gather comprehensive but less detailed expenditure data as part of other surveys (see, e.g., Hurd and Rohwedder 2011; Li et al. 2010). An interesting aspect of these papers, given the focus of the current paper, is that these efforts assess the quality of their data by comparing it to that of the CE.

Many previous studies have compared the CE to other data sources. Some of these comparisons report alarming patterns. Several authors have pointed out that the weight on housing is much higher in the CPI than in the personal consumption expenditure (PCE) deflator. Bosworth (2010) argues that the housing weight is about twice as large in the CPI as the PCE because of uneven underreporting in the CE. Other authors have emphasized that the ratio of CE expenditures to PCE expenditures has declined from about 0.8 to just above 0.6 in recent decades (Attanasio, Battistin, and Leicester 2006). It is important to recognize that these earlier studies often compare expenditures that are noncomparable.

There are important gaps in our knowledge from these comparisons. A key gap is that comparisons of CE aggregates to national income account data are generally done with the integrated data that are a confusing amalgam of the two components of the CE: the interview survey and the diary survey. Researchers generally use one or the other of these components, so the benchmarking of the amalgam cannot be applied to the data that are typically used by researchers. A better understanding of the quality of spending data in each of these surveys will also inform efforts to redesign the CE, as the Bureau of Labor Statistics (BLS) is in the midst of a multiyear redesign of the surveys. The first reason given for the CE redesign in the BLS planning documents is underreporting of expenditures (Bureau of Labor Statistics 2010). To evaluate the separate components of the survey, it is necessary to compare them separately to outside sources.

In this chapter we examine comparisons of CE data to micro- and macrodata from other sources. We examine the quality of reported expenditures, which can be roughly thought of as outlays, as well as parts of consumption, which can be thought of as a flow of resources used, including the flow of resources from the ownership of durables. The rental equivalent of owner-occupied housing, while not part of expenditures, is used to determine the CPI weights and is an appropriate measure of housing consumption. In the case of vehicles, an expenditures measure would include purchases, but consumption should be based on a flow of resources consumed, which depends on the number and value of vehicles. These durable measures are crucial in calculating consumption, but their reporting has not been extensively validated. Keeping in mind that mean squared error is equal to bias squared plus variance, we also examine the variance of the data and the frequency of reports of no spending. Last, we examine the representativeness of the interview survey along a number of dimensions, including income.

We begin by examining ratios of CE aggregate data to national income account data, looking separately at the interview survey and diary survey. We rely on information from the BLS and the Bureau of Economic Analysis as to which expenditure categories are most comparable and we focus on these. We find that most of the largest categories of consumption are mea-

sured well in the interview survey, as the ratio to PCE data is close to one and has not declined appreciably over time. These categories include new vehicles, food and beverages at home, rent and utilities, the rental equivalent of owner-occupied housing, gasoline and other energy goods, and communication. Several other large categories are reported at a low rate or have seen the ratio to the PCE decline over time. These categories include food away from home, furniture and furnishings, clothing, gambling, and alcohol. There are no large diary survey categories that are both measured well and reported at a higher rate than in the interview survey. Overall, the categories of expenditures that are not reported well tend to be those that involve many small and irregular purchases. These poorly reported categories also tend to be private goods (clothing), ones that one may not want to reveal that one buys (alcohol, tobacco), and certain luxuries (alcohol, food away from home). Large salient purchases like automobiles, and regular purchases like rent, utilities, and groceries, seem to be well reported. We find that the number and value of cars compare closely to outside sources, and the time pattern of home values closely follows other data.

We also present evidence on the precision of interview and diary survey data. Coefficients of variation are noticeably higher in the diary survey than in the interview survey. Diary respondents are much more likely to report zero spending for a consumption category, and a high and increasing fraction of respondents report zero for all categories. For example, 11.9 percent of 2010 diary survey respondents report zero spending for an entire week, up from 4.5 percent in 1991.

We then compare the demographic characteristics and the income distribution reported in the CE and the Current Population Survey (CPS). The results suggest that the CE interview sample is fairly representative along many dimensions. However, Sabelhaus et al. (chapter 8, this volume) provides strong evidence of underrepresentation at the top of the income distribution and underreporting of income and expenditures at the top. They find that low-income households are well represented. The underrepresentation of high-income households and their disproportionate underreporting of expenditures means that the aggregate reporting rates relative to the PCE emphasized in the paper likely understate the underreporting problem for high-income households, but overstate the problem for low-income households.

These results have implications for the use of existing CE data and for the redesign of the CE survey. The importance of the underreporting of expenditures in the CE will depend on the purpose for which the data are used. Uses of the data that rely on aggregates are likely biased. Our results suggest the CPI is biased because the differential underreporting means that the weights do not accurately reflect consumers' purchases. However, a simple comparison of PCE and CPI weights overstates the potential bias in consumer prices because much of the PCE is not intended to be captured by the

CPI. Given evidence that the CE may be more likely to miss spending near the top of the distribution, underreporting is less of a concern for analyses that do not rely on spending at the top, such as measures of consumption poverty or median consumption. And, the high and fairly constant reporting rates for large categories of consumption in the interview survey suggest that, for some purposes, researchers can rely on these categories to address some of the concerns about underreporting.

The outline of the remainder of the chapter is as follows: In section 7.2 we describe the interview and diary components of the CE. Section 7.3 summarizes past work comparing the CE to other sources. In section 7.4 we provide our comparisons of the separate interview and diary surveys to national income account personal consumption expenditure data. In section 7.5 we provide comparisons of CE data on the ownership and value of durable goods to those from other sources. In section 7.6 we examine the precision of the data and the frequency of no reported expenditures in the interview and diary surveys. In section 7.7 we consider the representativeness of the CE survey. We discuss the implications of our results for uses of the CE survey and for survey redesign in section 7.8, and conclude in section 7.9.

7.2 The Consumer Expenditure Survey

The Consumer Expenditure survey is a national survey designed to represent the noninstitutionalized civilian population of the United States. The survey has two parts: the interview survey and the diary survey. Both components are based on the same sampling frame, but they have different questionnaires that are administered to different samples. We examine the data from both of these surveys.

The interview survey took its current form in 1980, though it began much earlier. It includes about 5,000 families each quarter between 1980 and 1998 and about 7,500 families thereafter. It is a recall survey that collects information from families (or consumer units) about their expenditures for the previous three months. The survey is a rotating panel—about 20 percent of the sample is replaced each quarter. Consumer units remain in the sample for up to five interviews—an initial bounding interview, followed by four quarterly interviews. The bounding interview collects information on demographic characteristics and ownership of major durables. Data from the bounding interview are not publicly available. The next four interviews collect detailed expenditure information in addition to demographic, employment, and income data. The interviews are generally done in person, though phone interviews have become more common in recent years. Starting in 2003, interviewers used a Computer Assisted Personal Interview (CAPI) instrument. The interview lasts sixty minutes on average.

The diary survey collects consumer unit spending through direct recordkeeping. On a daily expense record, consumer units are asked to self-report

spending for up to two consecutive one-week periods. This recordkeeping format is designed to capture spending on small, infrequent purchases that may be missed in a recall survey. The diary survey also includes a questionnaire that collects information on household characteristics. This questionnaire is administered by an interviewer. Since 2004, a CAPI instrument has been used for this interview. The diary survey includes about 5,000 households annually. See US Bureau of Labor Statistics (2012) for more details.

Not all types of spending are collected in both surveys (US Bureau of Labor Statistics 2012). For example, the interview survey does not collect spending on housekeeping supplies, personal care products, and nonprescription drugs, while the diary survey does not capture overnight trips expenses or credit and installment plan payments. The diary survey also does not collect information on the rental equivalent value of owned homes, which is a major component of any total consumption measure, is one of the largest PCE categories, and is weighted very heavily in calculations of the CPI. While the diary survey is designed to capture other types of spending, in practice many important categories, such as new vehicle purchases, are rarely reported.

The diary and interview surveys are also designed for different purposes (US Bureau of Labor Statistics 2012). The interview survey is designed to capture relatively large expenditures and those that occur regularly such as rent or mortgage payments. The diary survey, on the other hand, is designed to capture smaller spending categories and those purchased more frequently. Often the level of detail is much greater in the diary survey. For example, in the 2010 survey, the diary survey has more than one hundred detailed subcategories that fall under the classification of food at home, while the interview survey has only one spending classification for food at home.

7.3 Earlier Consumer Expenditure Survey Comparisons

The CE data have been compared to data from many sources, but the most extensive and heavily cited comparisons are to the personal consumption expenditure (PCE) data from the National Income and Product Accounts (NIPA). Past research (Gieseman 1987; Slesnick 1992; Branch 1994; Garner et al. 2006; Garner, McClelland, and Passero 2009; Attanasio, Battistin, and Leicester 2006; Meyer and Sullivan 2011b) has emphasized a discrepancy between CE and PCE data. In comparing the CE to the PCE data, it is important to recognize conceptual incompatibilities between these data sources.[2] Slesnick (1992), when comparing CE data from 1960–1961 through 1989, concluded that "approximately one-half of the difference between aggregate expenditures reported in the CEX surveys and the NIPA

2. See Deaton and Kozel (2005) for discussion of noncomparabilities between survey and national income account data for expenditures.

can be accounted for through definitional differences" (593-94). Similarly the General Accounting Office (1996), in their summary of a Bureau of Economic Analysis comparison of the differences in 1992, reported that "more than half was traceable to definitional differences."

A key conceptual difference between PCE and CE spending is that the CE measures out-of-pocket spending by households, while the PCE definition is wider, including purchases made on behalf of households by institutions such as employer-paid insurance or free financial services, and purchases made by nonprofits. The magnitude of this difference in how spending is defined has increased over time. McCully (2011) reported that in 2009 nearly 30 percent of the PCE was not intended to be captured by the CE, up from just over 7 percent in 1959. In 2009, these differences include imputations such as those for owner-occupied housing and financial services (but excluding purchases by nonprofit institutions serving households and employer contributions for group health insurance) that account for over 10 percent of the PCE. In-kind social benefits account for almost another 10 percent. Employer contributions for group health insurance and workers' compensation account for over 6 percent, while life insurance and pension fund expenses and final consumption expenditures of nonprofits represent almost 4 percent. Another important difference between the PCE and CE is that the CE is not intended to capture purchases by those abroad, on military bases, and in institutions.

It is also important to note that the PCE aggregates do not necessarily reflect true total spending. The PCE numbers are the product of a great deal of estimation and imputation that is subject to error.[3] One indicator of the potential error in the PCE is the magnitude of the revisions that are made from time to time (Gieseman 1987; Slesnick 1992). An indication of this is the 2009 revisions to the PCE that substantially revised past estimates of several categories. Notably, food at home, one of the largest categories, decreased by over 5 percent after the 2009 revision.[4]

One of the first evaluations of the current CE is Gieseman (1987), who reports CE comparisons to the PCE for 1980–1984.[5] He reports separate comparisons of interview survey and diary survey estimates, though the diary estimates are only for food. In these early years, published tabulations

3. The PCE estimates come from business records reported on the economic censuses and other Census Bureau surveys. These business surveys are subject to a number of sources of error and are adjusted using input-output tables to add imports and subtract sales that do not go to domestic households. These totals are then balanced to control totals for incomes earned, retail sales, and other benchmark data.

4. The 2008 value for food at home was 741,189 (in millions of USD) prior to revision and 669,441 after, but the new definition excludes pet food. A comparable prerevision number excluding pet food is 707,553. The drop from 707,553 to 669,441 is 5.4 percent. Thank you to Clinton McCully for clarifying this revision.

5. Comparisons of expenditure survey data to national income accounts data go back at least to Houthakker and Taylor (1970).

separate interview and diary data, while published data for later years are integrated.[6] Consequently, subsequent comparisons of CE to PCE almost exclusively rely on the integrated data that combine interview survey and diary survey data.[7] Gieseman found that the CE reports were close to the PCE for rent, fuel and utilities, telephone services, furniture, transportation, and personal care services. On the other hand, substantially lower reporting of food, household furnishings, alcohol, tobacco, clothing, and entertainment were apparent back in 1980–1984. In separate interview survey and diary survey comparisons for food at home, he found that the CE/PCE ratios for the interview survey exceeded that for the diary survey by 10 to 20 percentage points, but were still below 1. For the much smaller category, food away from home, the diary survey ratios exceeded the interview survey ratios by about 20 percentage points, but again were considerably below 1. The current patterns have strong similarities to these from thirty years ago.

Garner et al. (2006) report a long historical series of comparisons for the integrated data that begins in 1984 and goes up through 2002. Some categories are reported well. Rent, utilities, etc. and utilities, fuels, and related are reported at a high and stable rate over time relative to the PCE. Telephone services, vehicle purchases, and gasoline and motor oil are reported at a high rate that has declined somewhat over time. Food at home relative to the PCE is about 0.70, but has remained stable over time. The many remaining categories of expenditures have low and generally falling rates of reporting relative to the PCE, though some small categories such as footwear and vehicle rentals show increases.

The authors ultimately argue that this historical series can be replaced by a better series that focuses on categories that are the most comparable. "A more detailed description of the categories of items from the CE and the PCE is utilized than was used when the historical comparison methodology was developed. Consequently, more comparable product categories are constructed and are included in the final aggregates and ratios used in the new comparison of the two sets of estimates" (22). The authors note that aggregates from the two sources tend to be more different for noncomparable categories. The new series is reported for every five years from 1992 to 2002 in Garner et al. (2006), and updated and extended annually through 2007 in Garner, McClelland, and Passero (2009).

When this new BLS methodology on categories that are comparable between the CE and the PCE is used, and when the PCE aggregates are adjusted to reflect differences in population coverage between the two sources, the ratio of CE to PCE is fairly high, but still has tended to fall

6. In cases where the expenditure category is available in both surveys, the BLS selects the source for the integrated data that is viewed as most reliable. See Steinberg et al. (2010) and Creech and Steinberg (2011).

7. Exceptions include Meyer and Sullivan (2010; 2011b).

over time. The ratio for 1992 and 1997 is 0.88, while in 2002 it is 0.84 and has fallen to 0.81 by 2007 (Garner, McClelland, and Passero 2009). The share of the PCE that is comparable to the CE has also tended to fall somewhat over time, dropping from 0.57 in 1992 to 0.52 in 2007. A much larger share of the CE is comparable to the PCE, slightly over 70 percent in all years.

For nine of the larger expenditure categories, Meyer and Sullivan (2010, 2011b) report limited comparisons over time for the interview survey only. They find that for most of these major categories reporting rates are high and stable.

Some research has sharply overstated the discrepancy by comparing non-comparable categories of CE and NIPA consumption and ignoring definitional differences. In addition, almost all comparisons are based on the integrated data that combine CE diary and CE interview data, so the results are not applicable to either the CE interview data or diary data alone, as they are typically used in research. Some authors have argued that despite the incompatibilities between the CE and PCE, in the absence of definitional changes one would expect the differences between the series to be relatively constant (Attanasio, Battistin, and Leicester 2006). This conclusion is not at all obvious; one might still expect a gradual widening of the difference between the sources given their rapidly growing incompatibility as reported in McCully (2011).

There have been comparisons of the CE to many other sources. Most are summarized on the BLS comparisons web page.[8] These comparisons include utilities compared to the Residential Energy Consumption Survey (RECS), rent and utilities compared to that reported in the American Housing Survey (AHS), food at home compared to trade publications *Supermarket Business* and *Progressive Grocer*, health expenditures compared to the National Health Expenditure Accounts (NHEA) and the Medical Expenditure Panel Survey (MEPS). With the exception of health expenditures, the comparisons generally suggest that the CE does a fairly good job of reporting these types of expenditures. However, except for health expenditures, these comparisons are to categories for which the comparisons to the PCE have indicated high and roughly stable reporting, though the reporting of food at home is at a lower rate, especially in the diary survey. See Garner, McClelland, and Passero (2009) or Branch (1994) for summaries.

7.4 Separate Interview and Diary Survey Comparisons to National Income Accounts

For the purposes of assessing CE survey quality, it is important to examine the interview and diary surveys separately. Differences in spending across these two data sources provide evidence on how best to collect

8. http://www.bls.gov/cex/cecomparison.htm.

spending data. For some important categories there are large differences between the mean reported values in the interview and diary surveys. For example, between 1998 and 2003, average spending on food at home in the CE interview survey exceeded the average from the CE diary survey by more than 20 percent.[9]

Recognizing that not all noncomparabilities can be removed, we examine the ratio of CE interview and diary survey values weighted by population to corresponding categories of PCE data for select PCE categories.[10] We have followed the approach of Garner et al. (2006), Garner, McClelland, and Passero (2009), and Passero (2011) who select categories in the PCE and CE that are most comparable based on "concepts and comprehensiveness." These comparable categories are 56 percent of the PCE in 2010. To align each CE spending subcategory with the comparable PCE category, we have heavily relied on a concordance supplied to us by the BLS. The data appendix in Bee, Meyer, and Sullivan (2012) notes the cases where expenditure subcategories are not available in either the interview or diary survey, and appendix table 1 in that paper provides our concordance of Universal Classification Codes (UCCs) in the diary and interview survey for each of these comparable PCE categories. In tables 7.1 and 7.2, we report CE/PCE ratios for categories of expenditures for which we can define reasonably comparable CE and PCE categories for either the interview or the diary survey alone.[11] Table 7.1 summarizes the findings for the largest categories in 2010. Table 7.2 reports the results for forty-six comparable categories for 1986 and 2010. Additional years are available in appendix table 2 of Bee, Meyer, and Sullivan (2012).

Among the ten largest categories in table 7.1 (combining the BLS subcategories of clothing into one so that it is large enough to be in the top ten), six are reported at a high rate in the interview survey and that rate has been roughly constant over time. These well-measured categories are the imputed rent on owner-occupied nonfarm housing, rent and utilities, food and nonalcoholic beverages purchased for off-premises consumption (food at home), gasoline and other energy goods, communication, and new motor vehicles. These six categories are all among the eight largest. In 2010,

9. The fact that food at home from the interview survey compares more favorably to PCE numbers than does food at home from the CE diary survey does not necessarily imply that the former is reported more accurately. For example, the CE interview survey numbers may include nonfood items purchased at a grocery store. Battistin (2003) argues that the higher reporting of food at home for the recall questions in the interview component is due to overreporting, but as Browning, Crossley, and Weber (2003) state, this is open to question. We stick to the presumption that more is better, as the CE is almost always below the PCE and this criteria is largely used by the BLS in selecting which source, interview or diary, is preferred for a particular expenditure category (see Creech and Steinberg 2011).

10. We do not correct for differences in population coverage. Such corrections have averaged 2 to 3 percentage points in past analyses (Garner et al. 2006; Garner, McClelland, and Passero 2009).

11. A larger set of categories can be examined, of course, with the union of the interview and diary data.

Table 7.1 CE-PCE comparisons for ten large categories, 2010 (in millions of dollars)

PCE category	PCE	DS/PCE	IS/PCE
Imputed rental of owner-occupied nonfarm housing	1,203,053		1.065
Rent and utilities	668,759	0.797	0.946
Food and nonalc. beverages purchased for off-premises consumption (food at home)	659,382	0.656	0.862
Purchased meals and beverages (food away from home)	533,078	0.508	0.528
Gasoline and other energy goods	354,117	0.725	0.779
Clothing	256,672	0.487	0.317
Communication	223,385	0.686	0.800
New motor vehicles	178,464		0.961
Furniture and furnishings	140,960	0.433	0.439
Alcoholic beverages purchased for off-premises consumption	106,649	0.253	0.220

Notes: The PCE category name for food at home is "food and nonalcoholic beverages purchased for off-premises consumption." The PCE category name for food away from home is "purchased meals and beverages." DS = Diary Survey; IS = Interview Survey.

the ratio of interview survey to PCE exceeds 0.94 for imputed rent, rent and utilities, and new motor vehicles. It exceeds 0.80 for food at home and communication and is just below 0.80 for gasoline and other energy goods. The 2010 ratios for both the interview and diary surveys are just over 0.50 for purchased meals and beverages (food away from home) and close to 0.43 for furniture and furnishings. For clothing and alcohol, the interview survey ratios are both low and below the diary survey ratios, which are below half themselves.

While the diary survey is designed to capture most types of spending, in practice many categories are missed, including some of the largest categories. For example, no spending on new trucks, pick-ups, vans, or jeeps is captured in the diary survey between 2007 and 2010. For this reason, we do not report a diary survey/PCE ratio for new motor vehicles in table 7.1. The diary survey/PCE ratio for imputed rental of owner-occupied nonfarm housing (the largest PCE category we examine) is also missing because the diary survey does not collect information on the rental equivalent of owned homes.

Looking at the full forty-six categories reported in table 7.2, among the remaining categories outside the top ten in size, only six in the interview and five in the diary survey have a ratio of at least 0.80 in 2010. The largest of these categories reported well in the interview survey are motor vehicle accessories and parts, household maintenance, and cable and satellite television and radio services. In the diary survey, household cleaning products and cable and satellite television and radio services are reported well in 2010, though the historical pattern for both exhibits substantial variation (also see appendix table 2 of Bee, Meyer, and Sullivan [2012]). The remaining

Table 7.2 **Aggregate Consumer Expenditure (CE) interview and diary survey and personal consumption expenditures (PCE), 1986 and 2010 (in millions of dollars)**

	2010					1986				
PCE category	PCE	CE DS	CE IS	DS/PCE	IS/PCE	PCE	CE DS	CE IS	DS/PCE	IS/PCE
Total durables, nondurables, and services										
Total	9,965,306					2,841,379				
Comparable items (no. of categories differ for interview and diary survey)		2,315,529	3,998,836	0.57	0.74		900,434	1,502,609	0.66	0.85
Durable goods										
Total durable goods	1,085,484					421,440				
Comparable durable goods (no. of categories differ for IS and DS)		184,531	376,802	0.38	0.53		83,907	293,296	0.47	0.88
New motor vehicles	178,464		171,450		0.96	134,047		154,574		1.15
Motor vehicle accessories and parts	26,558		23,474		0.88	11,446		7,065		0.62
Furniture and furnishings	140,960	61,010	61,859	0.43	0.44	59,392	26,928	45,494	0.45	0.77
Household appliances	40,536	27,323	30,034	0.67	0.74	21,243	10,689	17,644	0.50	0.83
Glassware, tableware, and household utensils	41,545	11,822	3,402	0.28	0.08	15,142	5,653	2,983	0.37	0.20
Televisions	37,407	11,730	14,379	0.31	0.38	11,635	3,772	6,741	0.32	0.58
Audio equipment	19,019	5,703	3,086	0.30	0.16	7,247	2,480	10,290	0.34	1.42
Recording media	33,077	6,892	4,985	0.21	0.15	10,429	2,923	3,246	0.28	0.31
Photographic equipment	2,844	3,860	2,937	1.36	1.03	2,997	1,488	1,812	0.50	0.60
Sporting equipment, supplies, guns, and ammunition	53,258	12,733	16,422	0.24	0.31	13,147	6,329	7,420	0.48	0.56
Bicycles and accessories	4,257	2,338	1,868	0.55	0.44	2,114	978	1,195	0.46	0.57
Pleasure boats	9,779		6,960		0.71	4,828		4,909		1.02
Other recreational vehicles	9,580		5,245		0.55	5,446		7,235		1.33
Recreational books	30,412	4,079	5,582	0.13	0.18	7,771	3,104	4,127	0.40	0.53
Musical instruments	4,939	1,845	1,848	0.37	0.37	1,606	271	2,586	0.17	1.61
Jewelry and watches	61,485	26,774	14,320	0.44	0.23	24,333	13,354	11,329	0.55	0.47
Telephone and facsimile equipment	13,991	3,941	4,126	0.28	0.29	1,256	1,286	1,089	1.02	0.87
Nondurable goods										
Total nondurable goods	2,301,517					774,189				
Comparable nondurable goods (no. of categories differ for IS and DS)		1,008,380	1,018,800	0.60	0.70		424,127	437,329	0.66	0.77
Food and nonalc. beverages purchased for off-premises consumption	659,382	432,541	568,134	0.66	0.86	273,849	184,751	217,242	0.67	0.79

Alcoholic beverages purchased for off-premises consumption	106,649	27,016	23,452	0.25	0.22	41,670	13,899	14,252	0.33	0.34
Women's and girls' clothing	161,192	80,450	49,737	0.50	0.31	77,933	49,664	43,353	0.64	0.56
Men's and boys' clothing	95,480	44,532	31,585	0.47	0.33	44,884	30,115	26,207	0.67	0.58
Clothing materials	4,203	1,227	687	0.29	0.16	3,057	652	1,059	0.21	0.35
Shoes and other footwear	59,334	36,679	17,896	0.62	0.30	24,464	15,689	11,896	0.64	0.49
Gasoline and other energy goods	354,117	256,573	275,691	0.72	0.78	91,191	76,406	96,671	0.84	1.06
Pets and related products	50,068	28,401		0.57		10,021	6,914		0.69	
Household cleaning products	41,287	47,597		1.15		18,156	16,993		0.94	
Household paper products	40,325	12,502		0.31		11,295	4,087		0.36	
Household linens	24,288	10,767	7,070	0.44	0.29	11,020	6,102	4,077	0.55	0.37
Sewing items	1,213	1,038	1,154	0.86	0.95	574	1,224	1,030	2.13	1.79
Tobacco	94,357	29,057	43,395	0.31	0.46	32,157	17,631	21,543	0.55	0.67
Services—household consumption expenditures										
Total services	6,578,305					1,645,750				
Comparable services (no. of categories differ for IS and DS)		1,122,618	2,603,234	0.60	0.83		392,400	771,984	0.72	0.92
Rent and utilities	668,759	533,202	632,560	0.80	0.95	225,758	187,547	217,782	0.83	0.96
Imputed rental of owner-occupied nonfarm housing	1,203,053		1,281,521		1.07	304,497		340,934		
Other motor vehicle services	58,612		33,654		0.57	9,552		7,701		0.81
Cable and satellite television and radio services	79,524	64,014	77,063	0.80	0.97	10,533	4,966	10,032	0.47	0.95
Photo processing	2,388	1,456	1,383		0.58	4,110	1,558	2,265	0.38	0.55
Photo studios	7,089	2,009	2,527	0.28	0.36	3,381	709		0.21	
Gambling	99,578	9,517	6,288	0.10	0.06	15,516	3,458		0.22	
Veterinary and other services for pets	25,669	19,101	17,401	0.74	0.68	3,660	2,909	3,578	0.79	0.98
Purchased meals and beverages	533,078	270,810	281,323	0.51	0.53	161,472	116,882	104,439	0.72	0.65
Communication	223,385	153,300	178,771	0.69	0.80	55,600	41,837	44,260	0.75	0.80
Legal services	96,788	6,573	15,590	0.07	0.16	27,348	2,858	7,155	0.10	0.26
Accounting and other business services	27,745	15,921	7,934	0.57	0.29	3,729	11,137	3,192	2.99	0.86
Funeral and burial services	19,048	1,365	11,442	0.07	0.60	7,091	1,270	5,824	0.18	0.82
Repair and hire of footwear	457	416	187		0.41	449	296	351	0.66	0.78
Child care	30,309	9,270	9,629	0.31	0.32	7,983	8,081	7,126	1.01	0.89
Household maintenance	55,216	35,664	45,961	0.65	0.83	20,539	8,892	17,347	0.43	0.84

Notes: Data are from the Consumer Expenditure interview and diary surveys and the US Bureau of Economic Analysis. Reported categories are only those where the CE and PCE are most comparable. Comparable categories follows Passero (2011). The PCE numbers are from table 2.4.5U. Personal consumption expenditures by type of product, accessed on November 21, 2011.

categories that are reported poorly in both surveys with ratios below one-half include glassware, tableware, and household utensils, and sporting equipment. Gambling and alcohol are especially badly reported with ratios below 0.20 and 0.33, respectively, in both surveys in most years.

While the ratios for selected years are shown in table 7.2, the patterns for the ten largest categories of expenditures can be more easily seen in a series of figures. We discuss the categories in order of their size beginning with the largest. Figure 7.1A reports the ratio of CE-to-PCE imputed rent from 1984 onward[12] and new motor vehicles from 1980 onward.[13] These two large categories are available for the interview survey, but not the diary survey.[14] Both categories compare favorably to the PCE—they have ratios near one that have not declined appreciably over time. The imputed rental of owner-occupied nonfarm housing in the interview survey typically exceeds the PCE equivalent by about 10 percent, slightly more so in the most recent years. While some analyses of CE-to-PCE aggregates omit housing because the ratio exceeds one (Sabelhaus et al., chapter 8, this volume), we include it because selecting only those categories with low ratios would necessarily bias the overall picture. The CE/PCE ratio for new motor vehicles is overall very close to one, approximately 1.05 in the 1980s, approximately 0.97 in the 1990s, and right around one in the first decade of the twenty-first century.

Figure 7.1B reports diary and interview comparisons for rent and utilities. In the interview survey the CE/PCE ratio is just below 1, averaging around 0.95, while the diary survey ratio is about 10 percentage points lower. Food at home in the interview and diary surveys is reported in figure 7.1C. Interview food at home has a ratio just under 0.90 in nearly all years except the period from 1981 to 1987, when a different wording of the food at home question was employed.[15] The diary survey ratio is about 20 percentage points lower at 0.70. Food away from home is reported in figure 7.1D. This category has a low ratio in both surveys and one that has declined since the 1980s. The diary survey ratio is also about 10 percentage points higher than the interview survey ratio, although the two surveys give similar numbers following

12. Information on the rental equivalent of the home is not available in the interview survey in 1980 and 1981.

13. For the surveys administered in the fourth quarter of 1981 through the fourth quarter of 1983, the CE sampling frame only covered urban areas. For this reason, we exclude data from the 1982 and 1983 surveys. In addition, the 1981 estimates we report are not entirely nationally representative, because part of this spending comes from the fourth quarter of the 1981 survey and the first quarter of the 1982 survey.

14. The diary survey does collect data on new vehicle purchases, but we do not report ratios for this category for the diary survey because these data appear to capture a small share of purchases. See the discussion in the data appendix in Bee, Meyer, and Sullivan (2012) for more details.

15. The effect of this change in wording has been known for a long time (see Gieseman 1987). During 1980–1981, the interview survey asked usual weekly expenditure on food over the past three months, while from 1982–1987 spending on food over the previous month was asked. In 1988, the survey returned to the earlier question. Because the January to March 1982 surveys collected data for part of 1981, the change in questionnaire is partly reflected in the 1981 totals.

a change in the wording of the food away question in the interview survey in 2007.[16] The ratio for the diary survey is biased downward somewhat because the diary survey does not collect data on food away from home spending that occurs during out-of-town trips. The interview survey does collect these data; in 2010 spending on food during out-of-town trips was about 6 percent of the PCE aggregate for food away. Ratios for spending on gasoline and other energy goods are displayed in figure 7.1E. The ratio is nearly always above 0.80 in the interview survey and about 5 to 10 percentage points lower in the diary survey. The interview survey ratio did fall over the 1980s. Clothing is shown in figure 7.1F, combining the categories of women's and girls' clothing, men's and boys' clothing, and shoes and footwear. This category is the first one that is reported poorly. The reporting ratio has declined from about 0.60 to less than one-half for the diary survey, with the interview survey consistently lower. The ratio for communication is shown in figure 7.1G. The interview survey shows a ratio of about 0.80 for most years, though there is a dip to nearly 0.70 for much of the 1990s and early in the twenty-first century. The diary survey ratio has been 5 to 10 percentage points lower since about 1996. Furniture and furnishings in figure 7.1H is badly reported with a ratio in the interview survey that falls over time from about 0.75 to 0.45. The ratio for this category is more variable in the diary survey, at about 0.50 in the early years, high in the middle years, and then near the interview survey numbers in the most recent years. Alcoholic beverages purchased for off-premises consumption in figure 7.1I is a very badly reported category, with both interview and diary survey ratios that drop from 0.33 to just over 0.20.

The overall pattern indicates much better reporting in the interview survey than the diary survey. Household cleaning products is the only category among the forty-six we report where the diary survey reports expenditures at a higher rate than the interview survey and reports them well, that is, at a high absolute rate that has not declined appreciably over time. This fairly small category has a ratio of 1.15 in 2010 in the diary survey and has not declined appreciably in the past twenty years. On the other hand, there are many categories of expenditures, in particular most of the largest ones, that are reported at a higher rate in the interview survey and have maintained high and roughly stable rates.

This finding of higher reporting in an interview survey is consistent with other evidence. There is a long history of papers that have noted the presence of "diary fatigue," meaning that respondents tire of completing the diary and omit purchases. Evidence of this pattern in the CE diary survey that is frequently cited is the fact that reported expenditures fall noticeably in the second diary week (US Bureau of Labor Statistics 1983; Silberstein and Scott 1991; Stephens 2003). See Crossley and Winter (chapter 1, this

16. Starting with the second quarter of 2007, the question on food away from home changed from a query about usual monthly spending to usual weekly spending. This change resulted in a noticeable increase in reported food away spending.

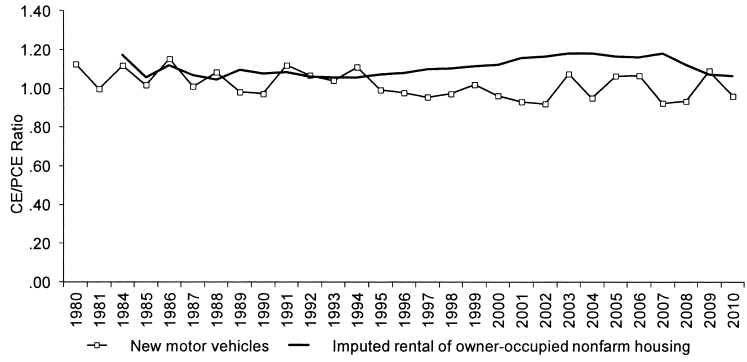

Fig. 7.1A Comparisons of CE interview aggregates to PCE aggregates, new motor vehicles and imputed rent

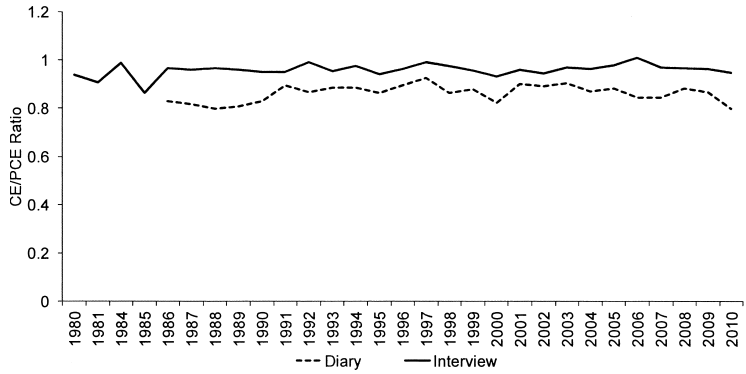

Fig. 7.1B Comparisons of CE diary and CE interview aggregates to PCE aggregates, rent and utilities

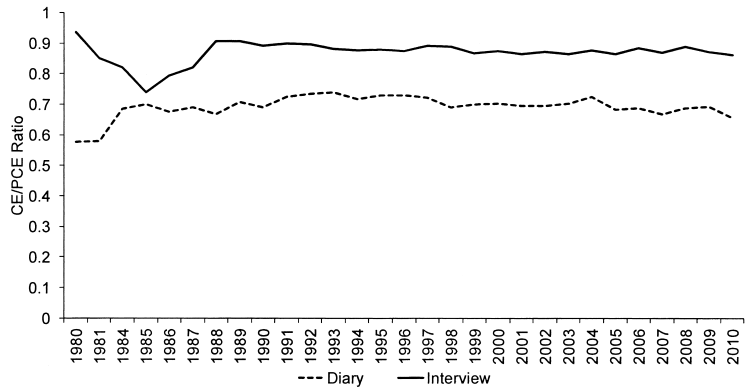

Fig. 7.1C Comparisons of CE diary and CE interview aggregates to PCE aggregates, food at home

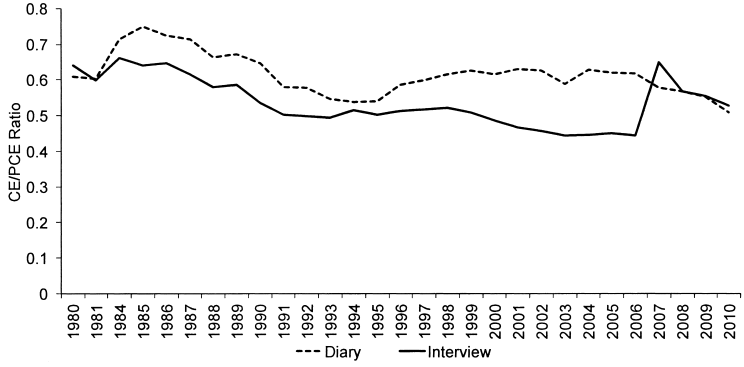

Fig. 7.1D Comparisons of CE diary and CE interview aggregates to PCE aggregates, food away from home

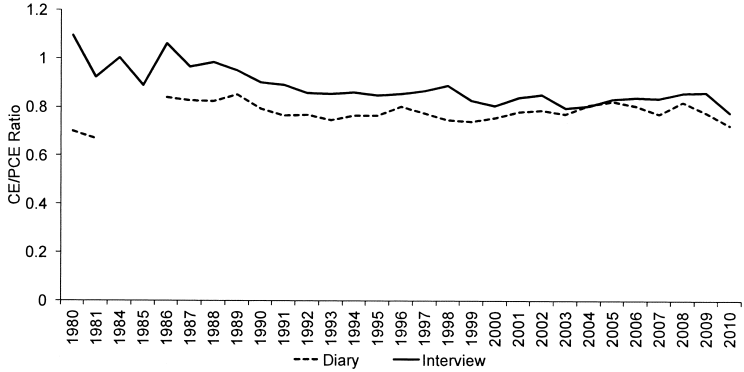

Fig. 7.1E Comparisons of CE diary and CE interview aggregates to PCE aggregates, gasoline and other energy goods

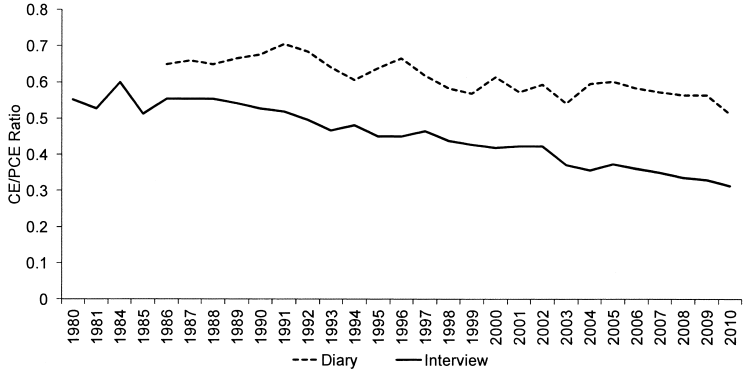

Fig. 7.1F Comparisons of CE diary and CE interview aggregates to PCE aggregates, clothing and shoes

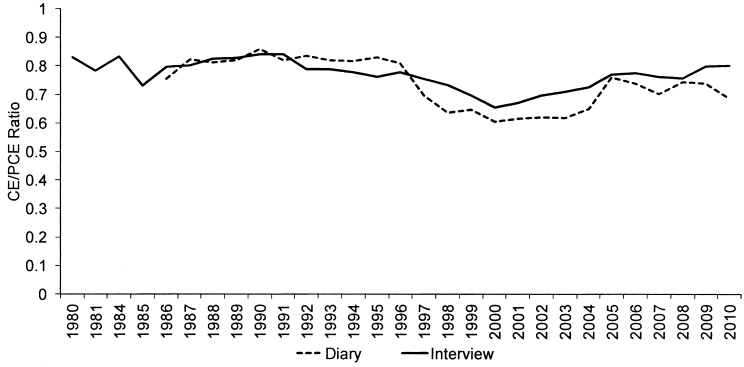

Fig. 7.1G Comparisons of CE diary and CE interview aggregates to PCE aggregates, communication

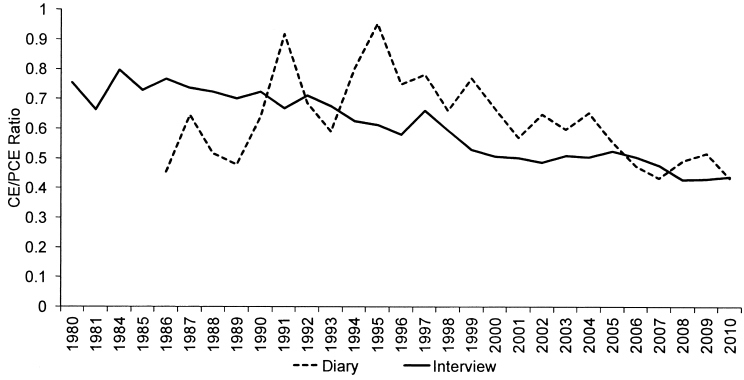

Fig. 7.1H Comparisons of CE diary and CE interview aggregates to PCE aggregates, furniture and furnishings

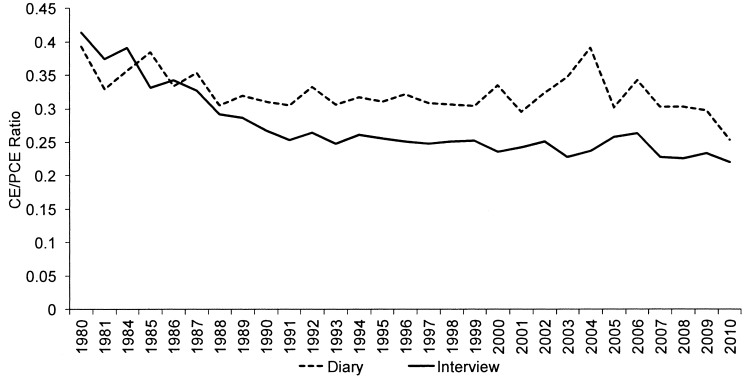

Fig. 7.1I Comparisons of CE diary and CE interview aggregates to PCE aggregates, alcoholic beverages

volume) for a nice discussion of diary fatigue and other problems with collecting expenditure data with a diary.

This pattern of lower reporting in diary surveys than interview surveys is also evident in other North American data. Statistics Canada conducted in parallel two versions of the Canadian Survey of Household Spending in 2009. One version was a twelve-month recall interview survey, while the second was the redesigned survey that gathers spending on many items through two-week diaries. The interview spending on average exceeds the diary spending for comparable categories by 9 percent for frequent expenses and 14 percent for less frequent expenses (Dubreuil et al. 2011). The authors believe the difference between the modes is not due to other features of the survey that changed, such as the elimination of balance editing. For example, balance editing tends to affect income and savings rather than expenditures. Possible reasons that this difference might arise are that insufficient motivation may lead diary respondents to omit many items to reduce the burden of the process. Consistent with this hypothesis, the Canadian Food Expenditure Survey (Ahmed, Brzozowski, and Crossley 2010) finds that the second diary week tends to have lower reported expenditures (by 11 percent) than the first, as respondents tire of the process. A recall measure from this same survey has food expenditures 14 percent higher than the two-week diary average.

In principle an attentive, motivated respondent could report better data in a diary than in a recall survey, but the evidence shows that the typical respondent does not fit this profile. The diary task also requires respondent effort at many distinct times during the two weeks, whereas an interview survey requires a single short (albeit taxing) interview. These results suggest that the presence of an interviewer may be helpful in coaxing greater compliance with the survey.

The categories of expenditures that are not reported well tend to be those that involve many small and irregular purchases. These poorly reported categories also tend to be private goods (clothing), ones that one may not want to reveal that one buys (alcohol, tobacco), and certain luxuries (alcohol, food away from home). Large salient purchases (like automobiles), and regular purchases like rent, utilities, and groceries, seem to be well reported. These patterns have been largely evident since the 1980s or even earlier. However, over the past three decades there has been a slow decline in the quality of reporting of many of the mostly smaller categories of expenditures in both the interview survey and the diary survey.

7.5 Durables in the CE

Reporting ownership of houses and vehicles is very different from reporting the small, discretionary purchases that seem to be badly reported in the CE. We begin by examining how the reported stock of cars matches that from other sources. This information does not enter expenditures, but enters consumption when we calculate a value of the services of owned cars. In

table 7.3, we compare reported car and truck ownership in the interview survey to administrative data on motor vehicle registrations.

These comparisons are complicated by a number of issues. First, the CE is intended to capture only vehicles owned by households, but the registration data include commercial and publicly owned vehicles including farm trucks. We were able to obtain an estimate of the number of two types of commercial vehicles, taxis and rental cars, for four states. The taxi share ranged from 0.04 percent (Arizona in 2003) to 0.68 percent (New York in 1998). The rental car share ranged from 0.30 percent (Mississippi in 2004) to 1.54 percent (Arizona in 1998). We do not have an easy way to estimate the prevalence of corporate cars and other commercial vehicles.

Second, the registration data include leased vehicles and motor homes that are not included in the CE survey numbers. We were able to obtain estimates of the motor home shares for seven states. The share of motor homes ranged from 0.3 percent (Maine in 2007) to 1.8 percent (Oregon in 2000). The total number of leased cars and trucks in the CE survey for 2002 was 6.96 million, or about 3.75 percent of all cars and trucks. These first two complications imply that we understate the share of vehicles owned by households that are reported in the CE. Third, our survey count of vehicles will not include those that have been disposed of by the household, but have not been reported as disposed to the state or have not had their registrations expire. Conversely, registrations will not include vehicles that have not been registered. This issue, which is likely less important, could bias the measure of reporting either up or down. Fourth, prior to 1985, personal passenger vans, minivans, and utility vehicles were included in automobile registrations, while subsequently they were included in trucks. For this reason, we generally report comparisons for cars and trucks combined so that we have a consistent concept over time.

Bearing these caveats in mind, ratios of cars and trucks in the CE to those in the administrative records are reported in the bottom line of table 7.3. The ratios are consistently well above 0.80. Given that a large share of cars and trucks are commercially owned as the numbers in the previous paragraph suggest, these numbers indicate a very high reporting rate. In similar comparisons (appendix table 3 of Bee, Meyer, and Sullivan 2012), we find that the total number of reported trucks owned in the CE lines up closely with data from the Vehicle Inventory and Use Survey (VIUS)—all of the ratios of CE counts to VIUS counts are slightly over one.

We have also verified that the purchase price of vehicles in the CE interview survey is reported fairly well. Purchase prices are directly part of expenditures and also are used to determine the rental value of car ownership, which enters flow consumption. We validate the reported purchase price of new and used vehicles in the interview survey by comparing the reported values to published values in National Automobile Dealers Association (NADA) bluebook guides. For a sample of one hundred cars with a reported purchase price in each of the years 1990 and 2000, we compare the reported

Table 7.3 **Comparison of vehicle ownership in the CE interview survey to motor vehicle registrations, 1972–2010 (in millions)**

	1972	1973	1980	1987	1990	1992	1995	1997	2000	2002	2003	2004	2005	2006	2007	2008	2009
Automobiles																	
CE survey	89.6	80.6	105.8	120.7	121.6	120.7	121.2	116.6	113.7	116.2	118.3	114.4	106.8	106.6	107.7	108.3	108.3
State motor vehicle registrations	96.6	101.4	120.7	130.0	132.2	125.1	126.9	128.4	132.2	134.6	134.3	135.0	135.2	134.0	134.5	135.6	133.4
Ratio	0.928	0.795	0.876	0.928	0.920	0.965	0.955	0.908	0.860	0.863	0.881	0.848	0.790	0.795	0.801	0.798	0.812
Trucks																	
CE survey	10.1	9.9	25.8	33.2	39.3	42.5	52.1	56.1	63.5	69.6	74.1	86.2	87.6	89.0	90.4	91.8	92.4
State motor vehicle registrations	20.3	22.2	32.3	45.7	53.1	61.6	70.8	75.3	85.0	90.8	92.8	97.9	101.6	105.7	108.2	108.0	108.3
Ratio	0.498	0.447	0.801	0.727	0.740	0.690	0.736	0.744	0.747	0.766	0.798	0.881	0.862	0.842	0.835	0.850	0.853
Automobiles & trucks																	
CE survey	99.7	90.5	131.7	153.9	160.9	163.2	173.2	172.7	177.1	185.7	192.4	200.7	194.4	195.6	198.1	200.1	200.7
State motor vehicle registrations	116.8	123.6	153.0	175.7	185.3	186.7	197.7	203.8	217.3	225.5	227.2	232.9	236.8	239.7	242.7	243.6	241.7
Ratio	0.854	0.732	0.860	0.876	0.869	0.874	0.876	0.847	0.815	0.824	0.847	0.862	0.821	0.816	0.816	0.821	0.830

Notes: Motor vehicle registrations are from the US Federal Highway Administration, Highway Statistics. Registration numbers include all commercial cars and trucks. In 1980, personal passenger vans, passenger minivans, and utility-type vehicles are included in automobile registrations. Starting in 1990 these vehicles are no longer included in automobiles, but are included in trucks.

Table 7.4 **Correlation of reported vehicle purchase price in the CE interview survey to NADA values**

Survey year	1990	2000
Cars owned 6 months or less	0.956	0.912
Cars owned 12 months or less	0.937	0.790
Cars owned 24 months or less	0.879	0.779

Notes: For each of the survey years reported, we compute the correlation between the reported purchase price of a random sample of vehicles from the CE interview survey and the value of these vehicles reported in the NADA guides. Values from NADA guides were identified based on make, model, year, number of cylinders, and number of doors for each vehicle. For each survey year, we select a random sample of one hundred new and used vehicles with a reported purchase price from the CE interview survey.

vehicle values in the interview survey to bluebook data. We match these cars from the interview survey to a bluebook price based on the reported make, model, year, and number of doors for each car. We report the correlations in table 7.4. The comparisons are probably most relevant for cars that have been recently purchased. For those that have been owned six months or less the correlations are very high, 0.956 and 0.912 in 1990 and 2000, respectively. This is especially impressive given that there are many characteristics of cars that are not reported in the CE or cannot be matched to bluebook features.

Some past work has found that respondents seem to report home values fairly accurately in household surveys (Kiel and Zabel 1999; Bucks and Pence 2006). We have compared the reported rental equivalent of homes to the reported house values. The rental equivalent and home value are highly correlated, at around 0.6 in a typical year. The ratio of the rental equivalent to home value has been fairly stable, though it declined appreciably in the middle of the first decade of the twenty-first century, as one might expect during a period of rising home prices. To see whether the general pattern over time in reported home values in the CE is sensible, we plotted in figure 7.2 the average home value reported in the CE interview survey compared to the Case-Shiller house price index. The average CE rental equivalent has the same qualitative time pattern as the Case-Shiller index, but it rises faster over time. The Case-Shiller index holds housing characteristics fixed, while the CE average does not. Because many characteristics of houses are improving over time such as square footage, presence of air conditioning, and other home amenities (see Meyer and Sullivan 2011a), the CE rise should be more pronounced, which is what is evident in figure 7.2.

7.6 Precision and the Frequency of Reported Purchases in the Interview and Diary Data

We next examine the precision of expenditure reports from the interview and diary surveys. The precision of these estimates is of interest for several

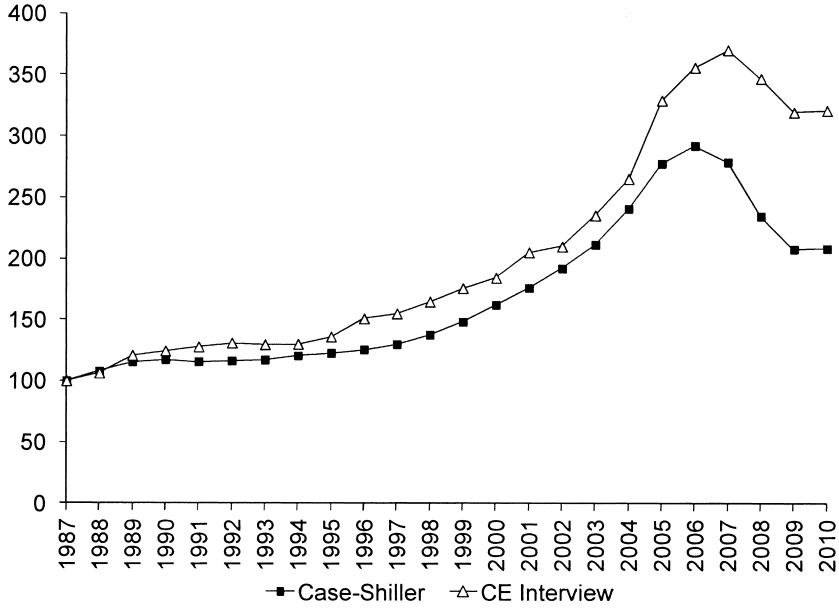

Fig. 7.2 Reported value of the home (CE interview) compared to Case-Shiller annual housing price indices (base year = 1987)

Note: The CE data exclude the following states because they are not included in the Case-Shiller index: AL, AK, ID, IN, ME, MS, MT, SC, SD, WV, and WI. In addition, the following states are excluded because of limited state information in the CE data: DE, GA, MD, and MN.

reasons. First, the precision of the consumer unit reports determines the precision of statistics calculated from the data. Second, by comparing the precision of the interview and diary components of the survey, one can determine how many diary responses are needed to obtain the same precision as one interview response. This point is important in choosing between interview and diary forms of survey administration and the appropriate sample sizes. Third, the dispersion of the various components of expenditures is informative if either of the CE survey components is going to be used to estimate distributional characteristics of expenditures, as when one is using the CE to assess inequality or poverty or in calculating percentiles for use in setting poverty thresholds as is done with the new Supplemental Poverty Measure.

To assess the precision of the CE, we examine the same forty-six categories of expenditures from table 7.2 that align closely with the PCE. We use these categories because we have verified their consistency over time. For thirty-five of these categories we have comparable data for both the interview and diary surveys. In table 7.5 we report the coefficient of variation (CV) of the quarterly interview reports and the weekly diary reports

Table 7.5 **Coefficient of variation by spending category, Consumer Expenditure (CE) interview and diary survey, 1987–2010**

	2010			1991			1987		
PCE category	CE DS	CE IS	DS/IS	CE DS	CE IS	DS/IS	CE DS	CE IS	DS/IS
Durable goods									
New motor vehicles		12.34			9.01			9.93	
Motor vehicle accessories and parts		4.68			4.71			5.60	
Furniture and furnishings	14.67	10.37	1.42	14.25	5.61	2.54	15.39	5.42	2.84
Household appliances	19.05	8.58	2.22	18.62	4.82	3.86	19.03	4.55	4.18
Glassware, tableware, and household utensils	6.32	8.59	0.74	20.61	5.60	3.68	9.10	7.25	1.26
Televisions	17.32	8.84	1.96	33.39	8.15	4.10	30.89	8.55	3.61
Audio equipment	16.32	10.06	1.62	22.91	6.16	3.72	18.98	5.52	3.44
Recording media	9.40	5.99	1.57	7.78	3.80	2.05	8.59	4.85	1.77
Photographic equipment	26.27	11.81	2.22	29.77	16.00	1.86	34.23	16.82	2.04
Sporting equipment, supplies, guns, and ammunition	14.03	8.84	1.59	13.33	7.64	1.75	13.86	6.26	2.21
Bicycles and accessories	29.65	17.68	1.68	35.49	14.19	2.50	33.73	10.79	3.13
Pleasure boats		80.78			51.70			30.23	
Other recreational vehicles		55.97			47.25			26.92	
Recreational books	8.91	6.20	1.44	6.89	4.52	1.52	9.41	7.21	1.31
Musical instruments	47.55	23.02	2.07	45.03	22.51	2.00	36.32	27.38	1.33
Jewelry and watches	35.99	12.43	2.90	17.01	8.22	2.07	18.41	8.81	2.09
Telephone and facsimile equipment	19.26	8.57	2.25	18.11	6.51	2.78	14.63	7.63	1.92
Nondurable goods									
Food and nonalc. bev. purchased for off-premises consumption	1.81	0.93	1.93	1.72	1.62	1.06	1.92	1.48	1.30
Alcoholic beverages purchased for off-premises consumption	4.46	4.45	1.00	4.51	4.51	1.00	3.97	3.59	1.10
Women's and girls' clothing	4.79	3.69	1.30	5.26	2.52	2.08	3.74	3.50	1.07
Men's and boys' clothing	5.31	4.78	1.11	4.34	2.84	1.53	5.06	3.27	1.54
Clothing materials	12.39	17.96	0.69	17.92	10.66	1.68	11.60	7.41	1.57
Shoes and other footwear	5.06	3.10	1.63	3.62	3.15	1.15	5.85	2.84	2.06
Gasoline and other energy goods	2.19	1.73	1.27	2.37	1.98	1.20	2.84	1.83	1.55
Pets and related products	6.56			5.68			5.22		
Household cleaning products	3.60			2.86			3.75		
Household paper products	3.37			2.96			2.85		

Household linens	6.18	4.93	1.26	7.66	5.57	1.37	7.08	4.62	1.53
Sewing items	30.73	15.88	1.93	28.75	9.10	3.16	13.69	12.21	1.12
Tobacco	6.04	5.48	1.10	3.75	3.10	1.21	3.23	3.34	0.97
Services—household consumption expenditures									
Rent and utilities	3.80	2.20	1.72	3.44	1.67	2.05	4.07	1.46	2.78
Imputed rental of owner-occupied nonfarm housing		2.08			2.86			2.76	
Other motor vehicle services		7.52			9.98			8.09	
Cable and satellite television and radio services	4.14	1.63	2.54	5.82	3.36	1.73	6.48	3.29	1.97
Photo processing	13.81	9.22	1.50	11.62	5.30	2.19	14.18	4.54	3.12
Photo studios	23.57	14.34	1.64	20.98			18.01		
Gambling	43.18	17.33	2.49	10.69			12.69		
Veterinary and other services for pets	10.70	6.75	1.59	9.43	8.52	1.11	13.67	5.79	2.36
Purchased meals and beverages	2.12	2.45	0.87	1.97	2.45	0.81	3.53	2.75	1.28
Communication	2.63	1.52	1.73	2.72	1.90	1.43	4.67	1.91	2.45
Legal services	27.21	16.41	1.66	34.45	18.46	1.87	33.79	25.15	1.34
Accounting and other business services	31.94	9.99	3.20	22.34	9.16	2.44	17.46	15.04	1.16
Funeral and burial services	38.27	17.24	2.22	77.21	15.64	4.94	60.41	16.71	3.61
Repair and hire of footwear	29.79	21.05	1.42	19.89	9.66	2.06	17.92	7.18	2.49
Child care	16.46	19.28	0.85	8.34	9.64	0.87	9.94	9.25	1.07
Household maintenance	12.13	5.52	2.20	9.13	5.94	1.54	13.35	6.82	1.96
Weighted mean (all categories)	7.07	4.32	1.63	6.30	3.67	1.72	6.71	3.75	1.79
Weighted mean (comparable categories only)	6.18	3.92	1.58	6.24	3.44	1.82	6.62	3.67	1.80
Median ratio			1.63			1.86			1.92

Notes: Data are from the Consumer Expenditure interview and diary surveys. Spending categories are the same as those reported in table 7.2. The unit of observation is a consumer unit-quarter for the interview survey and a consumer unit-week for the diary survey. The coefficient of variation is the ratio of the standard error of the mean to the mean times the square root of the sample size, where the standard error is calculated using the balanced repeated replication procedure recommend by the BLS for variance estimation in the CE survey.

for these categories of expenditures.[17] CVs for additional years are reported in appendix table 4 of Bee, Meyer, and Sullivan 2012. We focus on comparisons of quarters to weeks since a substantial share of respondents to both surveys do not complete the entire four quarters or two weeks. For example, typically about 10 percent of consumer units only respond for one of the diary weeks. For a given year table 7.5 reports the diary CV, the interview CV, and the ratio of diary to interview. Several patterns are apparent. First, the diary CVs tend to be much larger than those for the interview survey. In 2010, the weighted average of the CVs across comparable categories is 1.58 times as large in the diary survey as in the interview survey. We expect the interview survey to be more precise because it captures thirteen weeks of expenditures, as compared to just one week for the diary survey. If we make the extreme and implausible assumptions of no error in either survey, that weekly observations are independent, and simple random sampling, we would expect a ratio of CVs equal to the square root of 13 or 3.6.

Second, the diary/interview ratios vary sharply across expenditure categories. For 2010, the diary CV is over three times that of the interview CV for accounting and other business services, but the diary CV is slightly lower than the interview CV in the case of glassware, tableware, and household utensils. The ratios vary considerably, even for some of the largest categories of expenditures. For food and nonalcoholic beverages purchased for off-premises consumption (food at home) the diary CV is nearly twice as large as the interview CV, but it is smaller than the interview CV for purchased meals and beverages (food away from home).

Third, there are also noticeable changes in the CVs over time. For the diary survey, the weighted average for comparable categories falls slightly throughout the period. For the interview survey, the weighted average falls between 1987 and 1991 and then rises between 1991 and 2010. The CVs for the largest categories—food at home, purchased meals and beverages, gasoline and other energy products, rent and utilities, and imputed rent—in the interview survey tend to rise between 1987 and 1991 and then fall between 1991 and 2010, although the CV for rent and utilities rises throughout this period and the CV for purchased meals and beverages falls between 1987 and 1991. All of these categories except food away were reported at a high rate in the interview survey relative to the PCE, and these rates did not decline much

17. We calculate the CV as the square root of the sample size times the standard error of the mean divided by the mean. The standard error is calculated following the Balanced Repeated Replications (BRR) procedure used by the BLS to calculated standard errors for official CE tables. This BRR procedure is used to account for the CE survey's multistage sample selection process. (See http://www.census.gov/srd/papers/pdf/rr93–6.pdf for details on this procedure.) The CVs that we report are about 10 percent larger than those estimated, assuming simple random sampling design for the diary survey, and about 40 percent larger for the interview survey. We report CVs for 1987 instead of 1986 (the first year that data are available for most spending categories) because a complete set of replicate weights is not available in the public use version of the 1986 interview survey.

over time. Looking at these same categories for the diary survey (except for imputed rent, which is not available) the CVs tend to fall between 1987 and 1991, and then rise between 1991 and 2010, except for gasoline and other energy products, which falls throughout this period.

To understand what is behind these differences in the coefficients of variation across expenditure categories, surveys, and time, we look at the share of respondents who report no expenditures in a given category. It is first important to note that a substantial share of diary respondents indicate that they had no expenditures at all in a given week, and this share has been sharply increasing over time. As recently as 1991 the share of valid respondents for whom at least one of the week's expenditures was zero was 4.5 percent, but it reached 11.9 percent in 2010 (appendix table 5 of Bee, Meyer, and Sullivan 2012). In 2010, 9.4 percent of diary weeks have zero reported expenditures for the entire week. There are three reasons why a family in the diary survey would have zero expenditures for an entire week. First, the family may be on a trip for the entire week and the diary survey explicitly does not capture spending on trips. About three-quarters of the families with zero spending for an entire week in the 2010 diary survey fall into this group. Second, the family may truly have zero spending for that week, and third, the family may fail to report actual spending that occurred during the interview week. As we explain in section 7.8, regardless of the reason, the prevalence of zero expenditures, and more generally the greater dispersion of spending in the diary, has important implications for certain uses of the diary data.

In table 7.6, we report the share of reports that are zero for the forty-six categories of expenditures that we have previously considered. For each year, we report the share of zeros in the diary survey, the interview survey, and the difference between the surveys. (See appendix table 6 of Bee, Meyer, and Sullivan [2012] for additional years.) Looking at the thirty-five categories of expenditures available for both interview and diary surveys, twenty-four of the diary survey categories are zero more than 90 percent of the time, while fourteen of these same categories in the interview survey are zero for 90 percent or more of the consumer units. In 2010, 72 percent of diary survey respondents reported no spending on rent and utilities, as compared to 2 percent of interview survey respondents. Clearly these higher rates of zero reports are one reason for the higher CVs for the diary survey. The rate of reports of zero has also been rising for both surveys. Between 1986 and 2010 the majority of diary survey categories saw increases in the share of zeros. While not as pronounced, the rise in zeros is also apparent in the Interview Survey.

These results on CVs and frequency of period without any purchases have several implications for distributional analyses. In particular, the greater dispersion of weekly expenditures than quarterly expenditures, the extent to which this varies across expenditure categories and time, and the changing frequency of purchases suggest that the use of diary data to examine

Table 7.6 **Fraction of consumer units with zero spending by spending category, Consumer Expenditure (CE) interview and diary survey, 1986–2010**

	2010			1991			1986		
PCE category	CE DS	CE IS	DS-IS	CE DS	CE IS	DS-IS	CE DS	CE IS	DS-IS
Durable goods									
New motor vehicles		0.988			0.980			0.970	
Motor vehicle accessories and parts		0.806			0.875			0.874	
Furniture and furnishings	0.902	0.777	0.126	0.880	0.688	0.192	0.901	0.667	0.233
Household appliances	0.961	0.816	0.146	0.968	0.799	0.169	0.971	0.783	0.189
Glassware, tableware, and household utensils	0.889	0.895	-0.007	0.892	0.867	0.025	0.901	0.846	0.055
Televisions	0.997	0.957	0.040	0.998	0.959	0.039	0.997	0.950	0.046
Audio equipment	0.987	0.968	0.019	0.991	0.777	0.213	0.989	0.750	0.239
Recording media	0.954	0.811	0.142	0.942	0.703	0.239	0.963	0.768	0.194
Photographic equipment	0.994	0.976	0.018	0.995	0.976	0.019	0.996	0.969	0.026
Sporting equipment, supplies, guns, and ammunition	0.961	0.827	0.134	0.948	0.767	0.181	0.955	0.773	0.183
Bicycles and accessories	0.995	0.983	0.013	0.995	0.974	0.021	0.995	0.975	0.020
Pleasure boats		0.998			0.996			0.996	
Other recreational vehicles		0.999			0.997			0.996	
Recreational books	0.964	0.817	0.148	0.944	0.715	0.229	0.944	0.716	0.228
Musical instruments	0.996	0.987	0.010	0.995	0.977	0.018	0.996	0.975	0.021
Jewelry and watches	0.958	0.894	0.065	0.940	0.799	0.140	0.947	0.779	0.168
Telephone and facsimile equipment	0.989	0.934	0.055	0.981	0.938	0.042	0.993	0.951	0.042
Nondurable goods									
Food and nonalc. bev. purchased for off-premises consumption	0.189	0.012	0.177	0.090	0.008	0.082	0.117	0.009	0.108
Alcoholic beverages purchased for off-premises consumption	0.854	0.674	0.181	0.810	0.635	0.175	0.763	0.572	0.191
Women's and girls' clothing	0.795	0.531	0.264	0.722	0.377	0.345	0.734	0.347	0.387
Men's and boys' clothing	0.862	0.623	0.239	0.827	0.502	0.325	0.836	0.479	0.357
Clothing materials	0.983	0.972	0.011	0.963	0.916	0.047	0.966	0.901	0.065
Shoes and other footwear	0.890	0.674	0.216	0.887	0.538	0.349	0.891	0.503	0.388
Gasoline and other energy goods	0.362	0.095	0.267	0.319	0.109	0.210	0.300	0.113	0.187
Pets and related products	0.812			0.784			0.810		
Household cleaning products	0.591			0.495			0.517		
Household paper products	0.765			0.624			0.658		

Household linens	0.927	0.823	0.104	0.928	0.818	0.110	0.937	0.795	0.141
Sewing items	0.990	0.965	0.024	0.976	0.929	0.046	0.978	0.916	0.062
Tobacco	0.858	0.792	0.067	0.735	0.661	0.074	0.662	0.588	0.074
Services—household consumption expenditures									
Rent and utilities	0.720	0.024	0.696	0.629	0.028	0.601	0.708	0.034	0.673
Imputed rental of owner-occupied nonfarm housing		0.341			0.368			0.381	
Other motor vehicle services		0.750			0.748			0.737	
Cable and satellite television and radio services	0.895	0.253	0.641	0.916	0.474	0.442	0.956	0.579	0.377
Photo processing	0.985	0.931	0.054	0.973	0.745	0.229	0.974	0.747	0.227
Photo studios	0.994	0.977	0.018	0.991			0.993		
Gambling	0.955	0.898	0.057	0.935			0.948		
Veterinary and other services for pets	0.978	0.859	0.119	0.980	0.865	0.115	0.987	0.867	0.120
Purchased meals and beverages	0.304	0.194	0.110	0.254	0.166	0.088	0.246	0.162	0.084
Communication	0.729	0.055	0.674	0.701	0.050	0.652	0.676	0.061	0.615
Legal services	0.997	0.974	0.023	0.997	0.962	0.035	0.997	0.957	0.041
Accounting and other business services	0.980	0.944	0.036	0.971	0.932	0.040	0.978	0.933	0.045
Funeral and burial services	0.999	0.987	0.012	0.998	0.944	0.054	0.998	0.960	0.039
Repair and hire of footwear	0.997	0.990	0.007	0.994	0.947	0.047	0.993	0.937	0.056
Child care	0.990	0.974	0.016	0.966	0.942	0.024	0.953	0.931	0.022
Household maintenance	0.955	0.714	0.240	0.939	0.725	0.214	0.951	0.720	0.230
Mean difference			0.133			0.161			0.169
Median difference			0.065			0.110			0.120

Notes: Data are from the Consumer Expenditure interview and diary surveys. Spending categories are the same as those reported in table 7.2. The unit of observation is a consumer unit-quarter for the interview survey and a consumer unit-week for the diary survey.

poverty or inequality is problematic. We discuss these implications in more detail in section 7.8.

7.7 Representativeness of the CE

There are concerns that the CE misses certain types of households. The main method used in past studies that have assessed the bias due to unit nonresponse in the CE is comparisons of respondents contacted through more intensive methods to the remainder of respondents (Chopova et al. 2008; King et al. 2009). These studies suggest little bias. However, these analyses are not without their drawbacks, as those contacted through more intensive efforts may not be representative of those who are never contacted at all or are unwilling to respond.

To directly examine the representativeness of the CE, we compare the distribution of household characteristics in the CE to those in the Current Population Survey (CPS).[18] While the distribution of characteristics in the CPS does not necessarily reflect the true distribution in the US population, the CPS is a large survey (about 100,000 households annually in recent years) that is relied upon for many official statistics. Our results indicate that the characteristics of those in the CE line up quite closely with those of CPS respondents. These results do not necessarily confirm that the CE is representative of the US population. Rather, they indicate that any concerns about representativeness in the CE are shared with the CPS.

In addition to a base weight to account for sampling probabilities, the CE has two stages of poststratification adjustment to weights. The first stage is a "noninterview" adjustment based on region of country, household tenure (owner or renter), consumer unit size, and race of the reference person. The second stage is a "calibration factor" that accounts for frame undercoverage by adjusting the weights to twenty-four "known" population counts for region, race, tenure, age, and urban/rural status. Thus, we do not focus on these characteristics of households.

We report a number of demographic characteristics of the interview survey respondents for the years 1980–2010, as well as corresponding CPS values in appendix table 7 of Bee, Meyer, and Sullivan (2012). We examine characteristics at the individual level, rather than at the level of the family or household to facilitate comparability. The educational attainment distributions match quite closely, though the CE has slightly greater representation of those without a high school degree and this tendency has increased slightly over time. Marital status, weeks and hours worked, and age match very closely, though the CE has somewhat fewer young children. The share

18. For these comparisons we use the Annual Social and Economic Supplement, formerly called the Annual Demographic File or the March CPS.

that owns a home matches very closely, but that should not be surprising given that housing tenure is used to weight the CE data.

One of the principal concerns about unit nonresponse is that the CE may disproportionately miss households with either high or low income. Sabelhaus et al. (chapter 8, this volume) examine the representativeness of the CE interview survey by income. They match CE respondent and nonrespondent households to income at the zip-code level. They find that there is a small underrepresentation of those from the top four or five percentiles of zip-code-level income and no underrepresentation (maybe a slight overrepresentation) at the bottom of the zip-code-level income percentiles. Much more important quantitatively, they find that the income reported in the survey, either because high-income people are missing or because income is underreported at the top, is much lower than that from other sources such as the Survey of Consumer Finances and tax records. Furthermore, reported spending relative to income is very low at the top.

This evidence suggests that much of the underreporting of expenditures occurs at the very top of the income distribution, implying that the aggregate underreporting statistics emphasized in this paper likely overstate the weakness of the CE for a typical household. If much of the underreporting is due to high-income households understating spending, then spending by the vast majority of consumers is better than the averages that the aggregate numbers indicate. These results combined with those in the current chapter have several implications for various uses of the data that we discuss below.

7.8 Implications for Uses of the Current CE and for Redesign of the Survey

The results in this chapter have implications for the uses of existing CE data. Underreporting of expenditures is a first-order problem, particularly because it differs substantially across spending categories. In addition to the level of underreporting, the changes in the extent of underreporting over time have also varied across type of good. The result of these patterns is that uses of the data that rely on aggregates are likely biased. In particular, the CPI is biased since the differential underreporting means that the weights do not accurately reflect consumers' purchases. For example, as mentioned earlier, one of the principal concerns about the CE is that it causes too much weight is be put on housing in the CPI. The changes in the relative reporting of different types of good means that changes in the CPI are likely biased as well.

Fortunately, the quantitative importance of this problem may not be as severe as it first seems. A simple comparison of PCE and CPI weights overstates the potential bias in consumer prices because, as noted above, much of the PCE is not intended to be captured by the CPI. There is also research that has directly examined using PCE weights in a consumer price index (Blair chapter 2, this volume), finding only a modest bias that goes in different directions depending

on how the index is constructed. It should also be noted that much of the bias may come from the plutocratic (dollar weighted as opposed to person weighted) nature of the CPI. While dollar weighting is appropriate when deflating national accounts, for many purposes of the CPI, such as indexing tax parameters and government benefits, person weighting may be more appropriate. Much of the aggregate underreporting in the CE appears to come from underreporting by high-income households who are underrepresented in the survey to begin with. While overall, the sample appears fairly representative, the dollar-weighted nature of the CPI weights means that potentially missing a small share of households that account for a large share of expenditures could significantly bias the total expenditure-based weights.

The results also indicate that certain categories of expenditures are well measured, on average, especially in the interview survey, and have not seen their reporting deteriorate. For researchers, emphasizing well-measured components may be a successful strategy to reduce bias when relying on the CE. For example, Meyer and Sullivan (2012) examine consumption poverty using "core consumption," which is based on well-measured spending categories from the interview survey: food at home, rent plus utilities, transportation, gasoline, the value of owner-occupied housing, rental assistance, and the value of owned vehicles. An important advantage of the interview survey relative to the diary survey is that the former has many more large, well-measured categories of expenditures.

One could reasonably estimate total expenditures or consumption from these well-measured categories, relying on the constancy of the relationship between these categories and total spending as measured in the 1980s, when these categories in the CE were more comparable to the PCE. For example, see Meyer and Sullivan (2010). Such a procedure will give a consistent series over time, but is unlikely to deliver an unbiased measure of the level of consumption because of underreporting that was present in the 1980s. Alternatively, scaling up total expenditures using CE/PCE ratios for all categories would be suspect given that so much of the CE is not comparable to the PCE. Methods that use CE data recognizing the nature of underreporting need to be further developed and validated.

Some uses of the CE survey rely on the distribution of expenditures. Examples include the construction of poverty thresholds for the new Supplemental Poverty Measure, and the calculation of poverty rates and inequality measures. For most of these uses, the representativeness of the CE through most of the income distribution and the concentration of underreporting among the highest income households is largely favorable for the use of the CE interview survey. Conversely, the data are ill-suited for examining the highest income households. As a corollary, analyses of inequality using CE data should focus on statistics that are not heavily dependent on spending by the top few percentiles of the distribution such as 90/10 ratios rather than variances, Gini coefficients, or spending shares at top percentiles.

The interview survey is the more appropriate data source for studies of consumption inequality or other distributional analyses. The goal of distributional analyses is typically to measure consumption rather than expenditures. Consumption differs from expenditures because one pays infrequently for goods and services that one is continuously consuming like rent and utilities. Durable goods like cars are purchased very infrequently, but their services are received over a long period of time. Even much food is in cans or boxes that may be purchased at a very different time from when it is consumed. To closely approximate consumption, average spending over a long period of time is needed. The much higher variability of weekly expenditures than quarterly expenditures is an indication of the greater deviation of weekly expenditures from consumption. The higher observed variability of weekly expenditures than quarterly expenditures could be the result of greater true variance or greater variance. Neither higher true variability nor measurement error is helpful in approximating longer-term consumption.

One might think that even though one or two weeks of expenditures are not ideal for measuring the longer-term distribution of expenditures or consumption, they have a simple, maybe even time-constant, relationship to longer-term distributions. However, such a relationship is unlikely for several reasons. Because distributional measures such as percentiles, poverty measures, and variances inherently depend on dispersion, the differing dispersion in the diary survey spending relative to longer-term spending, the differing relative dispersion across expenditure categories, and the changes in the relative dispersion over time mean that both levels and changes in distributional measures based on weekly diary data are biased. Previous studies have assumed a constant relationship between the weekly and quarterly data in order to infer longer-term distributional patterns or have not addressed the issue of the relationship between two weeks of expenditures and longer-term measures of consumption (Attanasio, Battistin, and Ichimura 2007; Attanasio, Battistin, and Padula 2012). The changing dispersion of the weekly data relative to the quarterly data for many categories indicates that this assumption is not valid. Furthermore, because aggregate spending is the sum of spending in different categories, the relationship between a given percentile in the weekly data and that of longer-term expenditures will change as spending shifts between categories with different degrees of dispersion. That the distribution of weekly expenditures differs in complicated and changing ways from the distribution of longer-term expenditures suggests there is no simple, time-invariant way to convert one to the other.

That nearly 10 percent of diary survey respondents report no spending at all in a week is also problematic. As discussed above, a family might report zero expenditures for an entire week because they are on a trip for the entire week, they have zero spending for that week, or they fail to report actual spending. However, even if these zero reports of spending are accurate, such spending is unlikely to reflect consumption accurately. The large fraction of

families with zero total spending suggests that any inequality measure that depends heavily on spending at low percentiles will be misleading.

The results also have implications for the redesign of the CE survey. In deciding which type of survey, interview or diary, to emphasize in the future it is important to recognize how the current versions perform. The interview survey does well at recording many large categories of expenditures, but does poorly at others. The diary survey does better than the interview survey for some categories, particularly some small categories that the interview captures poorly, but rarely does the diary survey do well on both an absolute basis and compared to the interview survey. These results are also consistent with the evidence on diary and interview reporting from the Canadian Survey of Household Spending as well as the Canadian Food Expenditure Survey. Diary reporting seems to capture less spending than is obtained through an interview.

The greater dispersion in the diary survey means that larger sample sizes are required to obtain the same level of precision as in the interview survey. For categories of expenditures that can be compared across the two surveys, the weighted average of the coefficients of variation in the diary survey is 58 percent greater than that of the interview survey in 2010. In terms of precision, this result indicates that about 2.5 independent weekly diary survey observations approximately equal one quarterly interview survey observation.

7.9 Conclusions

In this chapter we examine the quality of consumption data in the CE interview and diary surveys. While some categories of spending are significantly underreported, our results indicate that the interview survey, in particular, does quite well in terms of a high and roughly constant share of expenditures relative to the national accounts for some of the largest components of consumption. These components include imputed rent on owner-occupied housing, rent and utilities, food at home, gasoline and other energy goods, new motor vehicles, and to a lesser extent, communication. The interview survey does poorly for food away from home, clothing, furniture and furnishings, and alcoholic beverages. Our results are less encouraging for the diary survey, which does poorly overall. There is no major category for which the diary survey has both a higher ratio to the PCE than the interview survey and the ratio is high and stable. We also find that the number and value of cars in the interview survey compares closely to outside sources, and the time pattern of home values closely follows other data.

Overall, the categories of expenditures that are not reported well tend to be those that involve many small and irregular purchases. These poorly reported categories also tend to be private goods (clothing), ones that one may not want to reveal that one buys (alcohol, tobacco), and certain luxu-

ries (alcohol, food away from home). Large salient purchases like automobiles, and regular purchases like rent, utilities, and groceries, seem to be well reported.

While the evidence on the relative bias of the interview and diary data is compelling, the evidence on precision of the data also favors the interview survey. Coefficients of variation are noticeably higher in the diary survey than in the interview survey. We also find that diary survey respondents are much more likely to report zero spending for a consumption category. In 2010, 72 percent of diary survey respondents reported no spending on rent and utilities, as compared to 2 percent of interview survey respondents. The rate of reports of zero has been rising for both surveys. For the diary survey, we also find a high and increasing fraction of respondents reporting zero for all categories; 11.9 percent of 2010 diary survey respondents report zero spending for an entire week, up from 4.5 percent in 1991.

The CE interview sample appears to be representative along many dimensions. However, Sabelhaus et al. (chapter 8, this volume) provides strong evidence of underrepresentation at the top of the income distribution and underreporting of income and expenditures at the top. They find that low-income households are well represented. The underrepresentation of high-income households and their disproportionate underreporting of expenditures means that the aggregate reporting rates relative to the PCE emphasized in the chapter likely understate the underreporting problem for high-income households, but overstate the problem for low-income households.

These results have implications for the use of existing CE data and for the redesign of the CE survey. The importance of the underreporting of expenditures in the CE will depend on the purpose for which the data are used. Uses of the data that rely on aggregates are likely biased. Our results suggest the CPI is biased because the differential underreporting means that the weights do not accurately reflect consumers' purchases. However, we discuss several reasons why this problem might not be as worrisome as it first appears.

The evidence that the CE appears to miss spending near the top of the distribution implies that underreporting is less of a concern for analyses that do not rely on spending at the top, such as measures of consumption poverty or median consumption. And, the high and fairly constant reporting rates for large categories of consumption in the interview survey suggest that, for some purposes, researchers can rely on these categories to address some of the concerns about underreporting.

The greater dispersion of spending in the diary survey data has important implication for distributional analyses. The high and increasing fraction of zero reported spending suggests that the use of diary survey data to assess inequality trends and other distributional outcomes is likely to lead to biased and misleading results. Also, the larger coefficients of variation in the diary

survey suggest that larger sample sizes are required for the diary survey to obtain the same information as in the interview survey. Furthermore, diary data may not be appropriate to capture the longer-term distribution of expenditures needed to measure consumption for distributional analyses.

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