# Sources of Error in Survey and Administrative Data: The Importance of Reporting Procedures

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July 14, 2011

*Abstract:* With national statistical agencies devoting considerable attention to administrative data, analyses of the quality of administrative data and reasons for differences between administrative data and survey data are greatly needed. This paper explores the problem of differences between administrative and survey data using as an example the monthly employment figures gathered from U.S. business establishments. A large share of the difference between administrative and survey estimates of employment and employment change is due to reporting differences. Analysis of two matched samples reveals that reporting differences are related to imputation in the administrative data, differences in the timing of data collection, and differences in the reporting procedures used by establishments. The results provide direction for improvements in reporting procedures and the basis for a conceptual model of reporting differences. More generally, the paper demonstrates that both administrative data and survey data may contain errors and identifies practical ways to assess data quality.

*Key words:* Measurement error; data collection; time series; seasonality.

*Acknowledgments:* I am grateful to Jason Faberman, Julie Gershunskaya, Anne Polivka, and James Spletzer for useful comments and helpful discussions. This paper has benefitted from comments of seminar participants at the American Economic Association meetings and the Society of Government Economists conference. I thank Greg Erkens, Kristin Fairman, Larry Huff, Steve Kroll, Chris Manning, Polly Phipps, and Michele Walker for assistance with data. The views expressed in this paper are solely those of the author and do not reflect the views of the U.S. Bureau of Labor Statistics.

## 1. Introduction

Administrative data offer several advantages over survey data, including larger sample size, lower cost, and lower respondent burden. As a result, national statistical agencies are trying to make better use of administrative data (Eurostat 2003; Prevost and Leggieri 1999). Administrative data also have some disadvantages, including inappropriate constructs, matching problems, and other measurement issues. As a result, analyses of the quality of administrative data and reasons for differences between administrative data and survey data are greatly needed.

This paper explores the problem of differences between administrative and survey data using as an example the monthly employment figures gathered from U.S. business establishments. The administrative data come from the Quarterly Census of Employment and Wages (QCEW), which is based on mandatory quarterly Unemployment Insurance (UI) reports. The survey data come from the Current Employment Statistics (CES) survey. Statistics based on these sets of data are produced by the U.S. Bureau of Labor Statistics (BLS) and used extensively by economists, policymakers, researchers, financial analysts, and government agencies as indicators of current economic conditions and as measures of labor-market activity.

Researchers and practitioners have taken several approaches to the comparison of administrative and survey data. The most common approach is to assume that the administrative data represent the truth. If this assumption is valid, differences between survey and administrative data at the micro level represent measurement errors in the survey data. As a result, this approach uses administrative data to determine the validity of survey data and to aid in identifying adjustments that may improve survey-based estimates (Bound and Krueger 1991; Kreuter, Muller, and Trappmann 2010; Pischke 1995).

The assumption that the administrative data are correct is convenient, but for several reasons it may not be appropriate. Administrative data may contain measurement error because of problems with matching individual observations across multiple sources (Kapteyn and Ypma 2007), because of reporting errors (Abowd and Stinson 2011), because the construct behind a particular measure in administrative data differs from the construct that analysts require (Davies and Fisher 2008; Johnson and Moore 2008), or for other reasons.

Whether the administrative data can be assumed to be correct depends, of course, on the particular data source and proposed statistical use. In this paper, I assume that both the administrative data and survey data may contain measurement error. I take this approach because the two sources of U.S. monthly employment data analyzed here are collected in fundamentally different ways, involving differences in timing, records sources, and respondents. As a result, although both the QCEW and CES collect monthly employment data from an establishment using the same definition, the differences in reporting procedures may affect the extent to which respondents adhere to this definition.

This paper aims to identify several sources of error (including measurement error) in the employment data from the QCEW and CES and to identify sources of differences between QCEW and CES estimates. Related goals include providing recommendations to reduce the magnitude of differences between QCEW and CES estimates and providing guidance for comparisons of administrative and survey data in other contexts. Reducing differences between QCEW and CES estimates is important because these differences contribute to revisions to CES estimates that are related to the annual process of aligning the sample-based estimates to universe counts derived from the QCEW.

The next section of the paper presents background information on the QCEW and CES and compares the respective estimates at the aggregate level. Section 3 decomposes the difference in aggregate estimates into four sources, including reporting differences. The paper then explores, in Section 4, differences in reporting at the micro level by examining two matched samples of CES-QCEW data, using regression analysis to identify factors that are related to reporting differences between CES and QCEW. Section 5 presents some practical implications of the comparative analysis. The concluding section summarizes the main findings and discusses future challenges regarding the quality of administrative data and comparisons between survey and administrative data.

## 2. Background on QCEW and CES

### *2.1. QCEW Data*

The QCEW is a quarterly census of all U.S. business establishments subject to UI taxes, covering approximately 9 million establishments nationwide. Each quarter, businesses are required submit quarterly contribution reports, either electronically or by mail, to state agencies responsible for administering UI programs. In their quarterly reports, businesses report the total wages paid to covered workers during the quarter (which is the tax base) and employment for each of the three months in the quarter. Monthly employment is defined as the number of covered employees who worked or received pay during the pay period that includes the 12th day of the month.

State agencies transmit the microdata to BLS, and QCEW estimates of employment and wages are released approximately 7 months after the end of each quarter. Owing to the universal coverage of the QCEW data, QCEW estimates are produced at a fine level of detail by geography and industry. In cases where employers submit a quarterly report but do not provide

employment data for all 3 months (a form of item nonresponse), the QCEW program imputes the employment data using historical QCEW data for the particular establishment. For the private sector in 2008, QCEW imputations represented about 5 percent of units and 3 percent of employment. The QCEW serves as the sampling frame for the CES and other BLS establishment-based surveys.

*2.2 CES Data*

The CES survey is a large-scale, nationwide establishment survey. Each month it collects data on employment, hours, and earnings from a sample of nonagricultural establishments. The CES sample currently includes about 140,000 businesses and government agencies nationwide that together represent approximately 440,000 individual worksites and about 30 percent of employment in the survey universe. Employment is defined in the CES as the number of employees who worked or received pay during the pay period that includes the 12th day of the month—the same reference period as the QCEW.

CES data are collected using computer-assisted telephone interviews (CATI) and various self-reporting modes, including touchtone data entry, direct electronic file transmission, the Internet, mail, and fax. With direct electronic transmission, large firms provide data on all of their establishments that are participating in the CES to a central collection facility. Firms that report their CES data in this way usually also report their QCEW data to the same facility, though not necessarily at the same time.

Approximately 40,000 new sample units are enrolled in the CES sample each year. New units generally report using CATI for a number of months and are then converted to one of the automated methods if they are willing to use them. The sample rotation plan allows most firms to report for 4 years and then be rotated out of the sample for a similar period. The sample

design is a stratified, simple random sample of worksites, clustered by UI account number. The sample strata are based on state, industry, and employment-size class. The sampling frame and the CES sample are updated annually with current data from the QCEW.

CES estimates are released approximately 3 weeks after the reference period. This set of estimates is considered preliminary because some establishments do not respond by the primary deadline for data receipts. In order to incorporate additional sample received after this deadline, each sample-based estimate undergoes two monthly revisions before being finalized.

### *2.3 CES Estimation Procedures*

Once a year, in March, the CES obtains a total employment figure (or "benchmark") for each estimating cell (defined by industry) from universe employment counts derived mainly from the QCEW. The CES estimate for March is determined by this benchmark, and employment estimates for subsequent months are computed using a ratio derived from CES respondents who provided data in both the current month and the previous month. The numerator of this ratio is the weighted employment in the current month for all such respondents in the estimating cell, and the denominator is the weighted employment in the previous month for these respondents. The employment estimate for a given month is computed by multiplying this ratio by the estimate for the prior month and then adding an estimate of residual net birth-death employment.

The birth-death factor helps account for the failure of the CES sample to capture employment changes due to business births and deaths (Mueller 2006). Although these changes are not captured, the death-related employment losses tend to offset the birth-related employment gains. As a result, what is needed is an estimate of the difference between birth-related

employment gains and death-related employment losses. This factor is estimated using a time-series model based on historical QCEW data.

When new benchmark figures are determined, CES estimates for the previous 21 months are subject to revision. Benchmark revisions can have adverse effects on users of CES data. Many users have made business or policy decisions based on the initial estimates, and they must reconsider these decisions in light of the revised data. Benchmark revisions are typically on the order of 0.1 to 0.2 percent of total nonfarm employment, but revisions for two recent years have been relatively large (0.6 percent for March 2006 and -0.7 percent for March 2009).

The magnitude of benchmark revisions is determined largely by differences between CES and QCEW in over-the-year employment growth. BLS has considered converting benchmarking from an annual process to a quarterly process. Whether such a change would reduce the absolute value of total revisions depends in large part on differences in seasonal patterns between CES and QCEW (Battista, Manning, and Robertson 2009). At issue is the difference between the CES and QCEW measures of employment change at monthly and quarterly frequencies.

### *2.4 Comparing QCEW and CES Estimates at the Aggregate Level*

To give a sense of how QCEW and CES compare at the aggregate level, I compare the respective estimates of total employment using monthly data from March 2003 to March 2007. This period covers four "benchmark years"—13-month periods that run from March of one year to March of the following year. At the beginning of each benchmark year, the QCEW and CES estimates are identical because CES estimates are benchmarked as of March. The CES estimates presented here are the final sample-based estimates for that month; they are not adjusted to reflect benchmarking in later years. The estimates refer to total private nonfarm employment, and they are not seasonally adjusted.

As shown in Figure 1, the seasonality of employment is quantitatively important and consistent over time in both series. The seasonal pattern consists of large increases during the second and fourth quarters, a large decrease during the first quarter, and essentially no change during the third quarter. This seasonal pattern exists for other macroeconomic quantity variables (such as output), though the seasonal movements are smaller in employment than in output (Barsky and Miron 1989). Seasonal movements are thought to be caused by holiday spending, weather, summer vacations, and the opening and closing of schools (Barsky and Miron 1989; Miron 1996; Rydzewski, Deming, and Rones 1993).

Figure 2 plots the difference between the QCEW and CES estimates for each month. Over this period the difference between the estimates was as large as 1 million. In each 13-month period, the difference was largest in December. From September through January, there is a consistent pattern across the years in the difference between the estimates. The difference decreased from September to October, increased from October to December (as QCEW increased while CES was roughly constant on average), and decreased from December to January (as both QCEW and CES decreased but QCEW decreased by more).

Users of these data are typically more interested in the magnitude and direction of employment change over time than the level of employment at a particular point in time. Table 1 shows the average percentage change in employment from month to month. The period with the largest difference in growth rates between QCEW and CES is December to January. QCEW employment fell by 2.62 percent on average, while CES employment fell by 2 percent. The series also show large differences from November to December, with QCEW employment rising by 0.37 percent and CES employment falling by 0.09 percent.

The end of the year also stands out when viewing the data on a quarterly basis (using the estimates for the third month of each quarter). QCEW estimates showed a greater buildup of employment at the end of the calendar year and a larger drop of employment moving into the following year. This pattern of differences in growth rates explains why switching from an annual benchmarking process to a quarterly one would increase the absolute value of total revisions (Battista, Manning, and Robertson 2009). Over the first three quarterly periods (covering March–December) shown in Table 1, QCEW grew faster than CES. But in the other period (December–March), QCEW grew less than CES. With annual benchmarking these changes offset to some extent, but with quarterly benchmarking they would not.

## 3. Sources of Error in QCEW and CES

### *3.1 Error Sources in Administrative and Survey Data*

Much attention has been paid by researchers and practitioners to sources of error in surveys. The total survey error paradigm (Groves, Fowler, Couper, Lepkowski, Singer, and Tourangeau 2009) identifies multiple sources of error in surveys: measurement error, processing error, coverage error, sampling error, nonresponse error, and adjustment error. Administrative data may also have some of these errors. Although administrative data do not typically involve coverage error or sampling error, these data may contain measurement error, processing error, nonresponse error, and adjustment error. Nonresponse error may exist in administrative data due to missing data. Imputation aims to reduce nonresponse error, but imputation procedures may create adjustment error.

Measurement error may exist in administrative data for a variety of reasons. First, there may be problems with individual identifiers that prevent complete matching of individual observations across multiple sources of administrative data, such as one source for demographic

information and another source for incomes (Kapteyn and Ypma 2007). Second, the construct of a particular item in administrative data may be somewhat different than what is desired for a statistical use. For example, administrative data from tax authorities provide a measure of taxable income, but a more comprehensive measure of income (including nontaxable income, for instance) may be desired. A related issue is that individuals and businesses may understate their taxable income in order to reduce their tax liabilities; as a result, taxable income observed in administrative data may differ from "true" income and income reported in surveys (Abowd and Stinson 2011, Johnson and Moore 2005).

### *3.2 Error Sources in QCEW and CES*

Both the QCEW and CES are subject to measurement error. The two data sources share the same definition of employment: the number of employees who worked or received pay during the pay period that includes the 12th day of the month. When reporting their data, employers may introduce errors by deviating from this definition. For instance, they may include in their employment counts workers who were on layoff or on unpaid leave for the entire pay period. Or they may include in their counts all employees who worked any time during the month, rather than limiting their count to those who worked during the pay period that includes the 12th.

These reasons apply equally, at least in principle, to the QCEW and CES. There is an additional reason to suspect measurement error in monthly employment data in the QCEW: data for all three months of a quarter are reported simultaneously. This raises the possibility of a seam effect: that month-to-month changes in employment are larger for the seam months (across quarters) than for adjacent months off the seam (within a quarter). Seam effects are common in panel surveys that interview respondents every three or four months but ask respondents to

provide data for each month within the reference period (e.g., Kalton and Miller 1991; Rips, Conrad, and Fricker 2003). In part due to concern about seam effects, BLS publications from the database of longitudinal QCEW data use employment in the third month of a quarter but do not use employment for the first and second months (Pivetz, Searson, and Spletzer 2001).

Errors may also arise in the QCEW and CES due to nonresponse. The nonresponse error in the CES is typical of surveys: when some of the sampled units do not respond to the survey, it increases the variance of the estimates. In addition, if nonrespondents are systematically different than respondents, nonresponse will contribute bias to the employment estimates (Dixon and Tucker 2010). The average CES response rate by the final deadline for sample-based estimates from March 2003 to March 2008 was about 55 percent (Huff and Gershunskaya 2009). In the QCEW, item nonresponse occurs when employers submit a quarterly contribution report but do not provide employment counts for all three months. In these cases, the employment data are imputed, and the imputed values may differ from the true values. As a result, errors related to nonresponse in the QCEW are manifest as adjustment errors.

Sampling error and coverage error are present for the CES but not the QCEW. Sampling error exists because estimates are based on only part of the sample frame; because the CES is a probability sample, sampling error contributes only to the variance of the estimates. Coverage error exists in the CES because its sample is drawn only once a year and therefore does not capture employment changes resulting from business births (openings) and deaths (closings) in real time. The estimation procedure used to adjust CES estimates for births and deaths reduces coverage error but does not eliminate it. The QCEW has no coverage error because it captures births and deaths within its normal reporting time frame.

*3.3 Decomposition of Differences in Employment and Employment Growth*

I now develop a decomposition of the difference between QCEW and CES estimates of employment. The decomposition is useful for identifying some sources of error in the CES and for identifying the reasons for QCEW-CES differences in employment and employment growth. As a result, the findings from the decomposition can guide program improvements and identify ways for BLS to reduce differences between QCEW and CES estimates. The decomposition builds on the approach used in Gershunskaya, Eltinge, and Huff (2002) and Huff and Gershunskaya (2009). The fundamental insight is that because the QCEW serves as the sampling frame for the CES, CES-type estimates can be constructed for the CES frame and sample using employment values from the QCEW.

Inputs for the decomposition are six research series of estimates of total private nonfarm employment (not seasonally adjusted) for each month from March 2003 to March 2007. The first series is the usual QCEW estimate, $\hat{E}^{QCEW}$. The other five series are CES-type estimates, computed using CES sampling weights and the CES estimation procedure; the series vary in the sample used to compute the estimates, the employment values used for that sample, and whether the birth-death adjustment factors are used. In the notation used for these series, the superscript indicates the set of establishments used to compute the estimates ("r" for CES respondents, "s" for CES sample, or "f" for CES frame). The first subscript indicates the source of the employment values used to construct the estimate ("Q" for QCEW or "C" for CES). The second subscript indicates whether the birth-death adjustment factors are used ("y" for yes or "n" for no).

$\hat{E}^{r}_{C,y}$ is the usual CES estimate; it is based on CES respondents, uses CES employment values, and uses the birth-death adjustment. $\hat{E}^{r}_{Q,n}$ and $\hat{E}^{r}_{C,n}$ are also based on CES respondents

but do not use the birth-death adjustment; $\hat{E}^{r}_{Q,n}$ uses QCEW employment values and $\hat{E}^{r}_{C,n}$ uses CES employment values. The final two series are based on either the CES sample ($\hat{E}^{s}_{Q,n}$) or the CES frame ($\hat{E}^{f}_{Q,n}$); these series use QCEW employment values but not the birth-death adjustment.

The difference between the QCEW and CES estimates for a given month can be decomposed into four components:

$$\hat{E}^{QCEW} - \hat{E}^{r}_{C,y} = \left[\left(\hat{E}^{QCEW} - \hat{E}^{f}_{Q,n}\right) - \left(\hat{E}^{r}_{C,y} - \hat{E}^{r}_{C,n}\right)\right] + \left(\hat{E}^{f}_{Q,n} - \hat{E}^{s}_{Q,n}\right) + \left(\hat{E}^{s}_{Q,n} - \hat{E}^{r}_{Q,n}\right) + \left(\hat{E}^{r}_{Q,n} - \hat{E}^{r}_{C,n}\right). \quad (1)$$

The term in brackets consists of two parts. The first part, $\hat{E}^{QCEW} - \hat{E}^{f}_{Q,n}$, reflects the coverage of the CES frame (which is fixed at the time the CES sample is drawn) relative to the QCEW universe (which is dynamic). The second part, $\hat{E}^{r}_{C,y} - \hat{E}^{r}_{C,n}$, reflects the cumulative birth-death adjustment (from the most recent benchmark to the current month) that is made to correct for the lack of coverage of births and deaths in the CES; this part can be taken as an estimate of the first part. The difference between these parts represents coverage error in the CES.

The second term on the right side of equation (1), $\hat{E}^{f}_{Q,n} - \hat{E}^{s}_{Q,n}$, represents CES sampling error. The third term, $\hat{E}^{s}_{Q,n} - \hat{E}^{r}_{Q,n}$, represents CES nonresponse error. The fourth term, $\hat{E}^{r}_{Q,n} - \hat{E}^{r}_{C,n}$, reflects reporting differences between QCEW and CES among CES respondents. Reporting differences at the micro level can arise because of differences in the QCEW and CES definitions of employment (due to employment not covered by UI) or because establishments report different employment values to QCEW and CES even though the definitions are identical. Differences may occur, for instance, in the source records, reference period, the particular types

of workers an establishment includes or excludes in the counts, and the person who completes the forms.

An important caveat is that, under this approach, reporting differences can also reflect issues in linking CES and QCEW data at the establishment level. Such linking is required to create estimates using QCEW employment values for establishments in the CES sampling frame. The linking was based on an exact match using state, UI account number, and reporting-unit number (an establishment identifier for account numbers with multiple establishments). The linking process is difficult because of mergers, acquisitions, and the opening of new establishments and because firms may combine employment information for multiple establishments in their reports for the CES and QCEW. Imperfect linking undoubtedly contributes to the overall difference between CES and QCEW as measured using this approach, but the magnitude of this contribution is uncertain. It is likely that linking issues contribute primarily to reporting differences, but they may also contribute to the measures of CES coverage error and CES nonresponse error.

In order to simplify the expressions in later steps, it is useful to rewrite equation (1) as

$$Q_t - C_t = CV_t + SE_t + NR_t + RP_t, \tag{2}$$

where $Q_t$ and $C_t$ are the QCEW and CES estimates for month $t$, $CV_t$ is coverage error, $SE_t$ is sampling error, $NR_t$ is nonresponse error, and $RP_t$ is reporting differences between QCEW and CES. The shares of the overall difference between QCEW and CES estimates of employment for a given month can be obtained by dividing each term in equation (2) by $Q_t - C_t$:

$$1 = \frac{CV_t}{Q_t - C_t} + \frac{SE_t}{Q_t - C_t} + \frac{NR_t}{Q_t - C_t} + \frac{RP_t}{Q_t - C_t}. \tag{3}$$

Beyond the difference in QCEW and CES employment levels, also of interest is the difference between QCEW and CES measures of employment growth over time. The difference between monthly employment growth in the QCEW and the CES is

$$\Delta Q_t - \Delta C_t = (Q_t - Q_{t-1}) - (C_t - C_{t-1}), \text{ or}$$

$$\Delta Q_t - \Delta C_t = (Q_t - C_t) - (Q_{t-1} - C_{t-1}), \text{ or substituting from equation (2)}$$

$$\Delta Q_t - \Delta C_t = \Delta CV_t + \Delta SE_t + \Delta NR_t + \Delta RP_t. \quad (4)$$

The shares of the difference in employment growth between QCEW and CES for a pair of consecutive months can be obtained by dividing each term in equation (4) by $\Delta Q_t - \Delta C_t$:

$$1 = \frac{\Delta CV_t}{\Delta Q_t - \Delta C_t} + \frac{\Delta SE_t}{\Delta Q_t - \Delta C_t} + \frac{\Delta NR_t}{\Delta Q_t - \Delta C_t} + \frac{\Delta RP_t}{\Delta Q_t - \Delta C_t}. \quad (5)$$

Table 2 contains the results of these decompositions. For the decomposition of the difference in employment levels, I first compute shares for each month during the period and then compute a weighted average of the shares across months, weighting by the absolute value of the difference in each month, $|Q_t - C_t|$. I follow a similar procedure for the decomposition of differences in employment growth at monthly and quarterly frequencies, except that the weight used in averaging the shares across periods is the absolute value of the difference in employment growth over each period, $|\Delta Q_t - \Delta C_t|$. In each case, the weight is the total amount to be explained.

The most important sources of the difference in employment levels between QCEW and CES are coverage error (59 percent) and reporting differences (48 percent). Sampling error accounts for 10 percent of the difference and nonresponse accounts for -17 percent. (A given share is positive if the relevant numerator and denominator have the same sign; the share is negative if the numerator and denominator have the opposite sign.) The importance of coverage

error suggests that improvements to the CES birth-death procedures would reduce differences between CES and QCEW estimates of monthly employment.

Regarding the differences in monthly employment growth between QCEW and CES, 75 percent are due to reporting differences, 10 percent to nonresponse error, 10 percent to coverage error, and 4 percent to sampling error. On a quarterly basis, the share of differences in employment growth that is due to reporting differences (27 percent) is much lower than on a monthly basis. The largest shares of the differences in growth at a quarterly frequency are due to coverage error (41 percent) and nonresponse error (32 percent). That the portion due to reporting differences is lower at the quarterly frequency might arise from seam effects in the QCEW because the quarterly changes are constructed using data from only the third month of each quarter. In the next section, I examine seam effects directly using matched QCEW-CES microdata.

A main finding from the decomposition is that reporting differences between QCEW and CES are responsible for a large share of both the difference in employment at a point in time and the difference in employment change from month to month. As a result, I focus on reporting differences in the next section.

## 4. Reporting Differences between CES and QCEW

This section focuses on differences between CES and QCEW in the reported data on the level of employment and the change in employment. Specifically, I am interested in identifying factors that are related to such differences. I consider a variety of factors including (1) establishment characteristics such as pay frequency; (2) aspects related to how the data are collected and processed by BLS; and (3) the procedures used by businesses to compile

employment data for the two programs. The analysis is based on two samples of matched QCEW-CES microdata.

*4.1 Influence of Establishment Characteristics, Imputation, and Timing of Data Collection*

The first dataset used to analyze reporting differences is a large sample of CES respondents matched to their QCEW data. The sample was constructed by taking all CES respondents from January 2006 to March 2007 and attempting to match them to their QCEW data for that period. Of the 367,155 respondents in the private, nonfarm sector, an exact match (based on state, UI account number, and reporting-unit number) was obtained for 242,110 respondents. Data for some multi-establishment firms could not be matched because the establishment-level information was consolidated into an aggregate report for one or both programs and the level of aggregation was not the same in the QCEW and CES. However, the CES respondents in the matched and unmatched samples are broadly similar in terms of average employment, the distribution by employment-size class, and the distribution by industry.

The dataset for the matched sample provides information on employment at establishment $i$ in month $t$ according to the QCEW ($Q_{it}$) and the CES ($C_{it}$). The reported employment data are compared in terms of the absolute value of the difference in employment in month $t$ ($|Q_{it} - C_{it}|$) and the absolute value of the difference in employment change from month $t'$ to month $t$ ($|\Delta Q_{it} - \Delta C_{it}|$, where $\Delta Q_{it} = Q_{it} - Q_{it'}$ and $\Delta C_{it} = C_{it} - C_{it'}$). Linear regressions are estimated in which the dependent variable is either (1) the difference in employment in a given month, (2) the difference in employment change over consecutive months, or (3) the difference in employment change over a quarter (using data for the third month of consecutive quarters).

The regressions comparing employment levels are estimated using data from March 2006 to February 2007, and those comparing employment change are estimated using data from March 2006 to March 2007. The sample used for each regression is constructed by pooling information across the multiple periods relevant for the dependent variable. The explanatory variables of interest are whether QCEW data are imputed, pay frequency, the method by which CES data are collected, and the timing of the CES report. The remaining explanatory variables are establishment size (using indicator variables based on 7 size categories), industry (13 categories), geographical division (9 categories), and whether the establishment is part of a multi-establishment firm. The information on QCEW imputation and CES collection/timing are specific to the time period of the dependent variable.[1] Coefficient estimates for these regressions are reported in Table 3.

In general, the regression results indicate that factors related to employment differences at a point in time are also related to differences in employment change. In particular, imputation in the QCEW is strongly associated with both larger differences between QCEW and CES employment at a point in time and larger differences in employment change on a monthly or quarterly basis. For example, when QCEW data are imputed, the difference between QCEW and CES employment in a given month is 6.3 workers greater than when QCEW data are not imputed.

All else equal, establishments with weekly payrolls exhibit CES-QCEW differences that are larger than those for establishments with less-frequent payrolls (bi-weekly or semi-monthly).

[1] When the dependent variable refers to employment change over a monthly or quarterly period, the imputation variable for the period is an indicator for QCEW employment being imputed in either month $t'$ or month $t$. The closing code (which identifies the timing of the CES report) for the period is defined as the greater of the codes in month $t'$ and month $t$. If the collection method is the same in the beginning and ending months, the collection method for the period is defined as this common method; otherwise the method for the period is a residual category labeled "mixed."

A potential explanation for this pattern is that establishments with weekly payrolls are more likely to use different reference periods for QCEW and CES. With a weekly payroll, an establishment has at least four pay periods in a given month. With a semi-monthly payroll, by contrast, there is only two pay periods in each month and therefore a greater likelihood that establishments will use the same reference period for QCEW and CES.

Differences between QCEW and CES are also associated with the timing of the receipt of CES data for a given reference month. A majority of the survey responses (about 75 percent for this sample) are received by the primary deadline for data receipts, which is the last Friday of the reference month and referred to as "first closing." Second closing is three weeks after first closing, and third closing (the final deadline for sample-based estimates) is three weeks after second closing. All else equal, establishments reporting by first closing have smaller differences (in both employment levels and employment change) than establishments reporting later. This pattern might reflect differences in the underlying characteristics of establishments that report before or after first closing, such as how organized their record-keeping is or the complexity of their operations.

The method by which CES data are collected is predictive of QCEW-CES differences in employment and employment change. Compared to CATI, differences are somewhat smaller for touchtone data entry and much smaller for electronic file transmission. The estimated coefficients on the method variables could represent causal effects of method, but because methods are not randomly assigned these coefficients could also reflect the underlying characteristics of establishments that use each method.

Another potential reason for reporting differences in the CES and QCEW microdata on monthly employment is differences in the timing of data collection. While CES data are

collected monthly, QCEW data are collected quarterly. To test for seam effects, I compute the absolute value of the percentage change in employment over each pair of consecutive months from January 2006 to January 2007. Then I average these changes across establishments separately for month pairs that are across quarters and those that are within a quarter.

These averages are reported in Table 4 separately by establishment-size class. For the QCEW, the variation in monthly employment is larger across quarters than within a quarter. For the CES, by contrast, the variation across quarters is about the same as the variation within a quarter. Examined another way, the variation in monthly employment across quarters is larger in the QCEW than in the CES. These patterns are all consistent with seam effects in the QCEW.

### *4.2 Influence of Reporting Procedures*

To examine the influence on QCEW-CES reporting differences of characteristics related to how establishments derive the employment counts for the QCEW and CES, I use data collected from a response analysis survey (RAS) that was conducted by phone in 2008. A sample of CES respondents was contacted to gather information about the methods and sources used to compile employment data for the two reports. Since the early 1980s, BLS has used the RAS method to investigate data quality in establishment surveys (Goldenberg, Butani, and Phipps 1993). For a RAS, a respondent is contacted after survey completion and is asked a series of standardized questions on record-keeping practices, records availability and use, understanding of survey instructions and definitions, discrepancies between survey definitions and answers, and other data-quality issues (Phipps, Butani, and Chun 1995).

The sample for this RAS was not designed to be representative of all CES respondents. The RAS targeted respondents that exhibited specific types of reporting differences based on previously reported data for January 2006–March 2007. The types of differences are based on

measures of employment change over various periods of time, as specified by the groups that are defined in Appendix Table 1. For example, the first group identifies establishments that exhibited differences between QCEW and CES in employment change from December to January. The proportion of the sample allocated to each group was based on the perceived importance of each group to overall QCEW-CES differences. Although an establishment could fall into more than one group, for sampling purposes each establishment was assigned to a single group based on an order of precedence. A small control group was created to represent establishments whose monthly QCEW and CES employment data were identical during this period. The analysis reported here is based on unweighted data.

The sample consisted of 3,002 actively reporting establishments of various sizes and industries. In order for an establishment to be eligible for sampling, its QCEW data must have been reported (not imputed) for all months from January 2006 to March 2007. A handful of industries were excluded from the sample frame because of scope differences between QCEW and CES or because of potential complications with collecting RAS data: educational services, government, hospitals, and professional employer organizations. In addition, establishments that used direct electronic transmission to report their CES data were excluded because they had been promised exclusive contact through the central collection facility.

The RAS questionnaire was divided into two sections with similar questions: one section focused on the monthly CES report, the other on the Quarterly Contribution Report (QCR)—the tax form that is the source of QCEW data. Initial contact was made with the CES respondent of record, who was then asked to complete the CES section. If the CES respondent was also familiar with the QCR, he or she was also asked the questions regarding the QCR. If another person at the establishment was responsible for the QCR, the interviewer contacted that

individual and attempted to complete the QCR section. If an outside organization (such as an accounting firm or payroll processor) was responsible for the QCR, the interviewer did not contact that organization.

Among the sampled establishments, 63 percent answered one or both parts of the questionnaire, while 27 percent refused to answer either part. Interviewers were unable to reach the remaining 10 percent. Nonresponse was relatively high for the QCR section, which limits the number of cases for which comparisons can be made between the procedures used to compile QCEW and CES data. A major factor in this nonresponse was that an outside organization was responsible for preparing the QCR figures. Among establishments that completed one or both parts of the questionnaire, 56 percent completed only the CES section, 44 percent completed both sections, and less than 1 percent completed only the QCR section.

Some of the procedures used to compile QCEW and CES data are compared in Table 5. The sample of respondents used for a given comparison is establishments that provided information on the procedures used for both programs. Establishments were more likely to use an incorrect reference period for QCEW (48 percent) than for CES (15 percent). The correct reference period is the pay period of the 12th day of the month. Incorrect reference periods recorded in the RAS interviews include the entire month (the most common response) and a pay period other than the one including the 12th. Respondents were asked if their employment counts represented a count of checks issued rather than the number of persons receiving pay; roughly the same proportion of respondents (10 to 12 percent) used a count of checks for deriving QCEW and CES employment.

RAS interviewers presented respondents with an extensive list of 20 employee types, asking if the establishment had each type and, if so, whether that type was included in the CES or

QCR employment figures. The list included such types as employees working in locations outside the state (should be excluded), trainees (included), employees on leave without pay (excluded), and employees on layoff or strike (excluded if they are away for the entire pay period). According to the responses, nearly half of respondents reported incorrectly including/excluding at least one type in their employment counts for both QCEW and CES.

The final set of variables in Table 5 relates to the data sources that an establishment uses to complete the CES and QCR reports, who prepared the reports, whether there were any changes to the data sources, and record clean-up procedures such as purging of employee records. In a relatively small share (8 percent) of these establishments, a different data source (such as payroll, memory, or a count of time cards) was used for the two reports. By contrast, in over half (59 percent) of these establishments, different people prepared the two reports. Taken together, the summary statistics in Table 5 support the view that employment data from both QCEW and CES involve measurement error, but the types and magnitude of errors are different in each source.

The next step in my analysis of the RAS data is to relate differences in procedures to differences between the QCEW and CES data reported by establishments. I estimate a set of regression models of the form: $\Pr(G_{ij} = 1) = \alpha + \beta R_i + \theta Z_i + \varepsilon_{ij}$, where $G_{ij}$ is an indicator for establishment $i$ being in group $j$ (see Appendix Table 1 for group definitions) and $R_i$ is a variable constructed from the RAS responses. $Z_i$ is a vector of control variables, including establishment size, industry, and an indicator for being part of a multi-establishment firm. Models are estimated as linear probability models for each group and RAS variable. Estimates of $\beta$ are reported in Table 6. If $j$ is the control group, then $R$ contributes to reporting differences between QCEW and CES if $\beta < 0$. Conversely, if $j$ is any other group, then $R$ contributes to reporting

differences if $\beta > 0$. For many of the RAS variables used in the regressions, $R$ is an indicator for whether an establishment follows a different procedure for QCEW than for CES.

The first set of variables in Table 6 relates to the number and timing of payrolls. The regression results provide some evidence that having multiple payrolls is associated with reporting differences. Compared to establishments with a single payroll, those with multiple payrolls (for example, one payroll for hourly workers and another payroll for salaried workers) are 11.1 percentage points more likely to exhibit a different over-the-year change from March to March and 3.9 percentage points less likely to be in the control group. A potential explanation for this pattern is that with multiple payrolls, it is possible for an establishment to use one set of payrolls for the CES report and another set for the QCR report—leading to reporting differences.

For establishments with a single payroll, there is also some evidence that pay frequency is associated with reporting differences. All else equal, those with monthly payrolls are 8.7 percentage points more likely than those with weekly payrolls to be in the control group. This pattern is related to differences in the reference period used for CES and QCEW. Establishments with a monthly payroll have only one pay period to choose from and therefore use the correct pay period for both reports. By contrast, 43 percent of establishments with a weekly payroll use a different pay period for constructing the QCEW and CES counts.

This interpretation assumes that differences in the reference period used for QCEW and CES are related to reporting differences—a relationship that is demonstrated by the regression results. For example, establishments using a different reference period are 7 percentage points more likely than establishments using the same reference period to exhibit a different over-the-month change from December to January. In addition, using a count of checks for one program but not the other is associated with reporting differences. Differences in check counting are

associated with an increase of 6.6 percentage points in the probability of being in the June-December-January group and a decrease of 5 percentage points in the probability of being in the control group.

Inconsistent treatment of certain employee types also contributes to reporting differences. All else equal, establishments that treated employee types incorrectly for one program but not the other are 8.4 percentage points more likely to be in the December-January group and 4.4 percentage points less likely to be in the control group than establishments following the same procedure for both programs. For reference period, check counting, and employee types, the qualitative pattern is similar: establishments that use different procedures for QCEW and CES have larger reporting differences.

That pattern also holds regarding the people who prepare the reports. All else equal, establishments for which different people prepare the CES and QCR reports are less likely to be in the control group, more likely to have QCEW (but not CES) showing a stair-step pattern, and more likely for CES (but not QCEW) employment to be constant within a quarter. Using a different data source for the CES and QCR reports is not associated with reporting differences. However, if the QCR data source doesn't have monthly counts, it is much more likely that QCEW (but not CES) employment is constant within a quarter. This implies that data sources contribute to seam effects in the QCEW.

## 5. Discussion

### *5.1 Toward a Conceptual Model of Reporting Differences*

The empirical results in the previous section suggest that micro-level reporting differences between QCEW and CES are created by the interaction of the variation over time in

actual (or "true") employment and differences in the procedures used in collecting QCEW and CES data. That relationship is captured by the following equation:

| Differences in reported employment | = | Differences in procedures | × | Variation in actual employment | (6) |
|---|---|---|---|---|---|

In this equation, both factors on the right side have a positive relationship with differences in reported employment. However, if one factor is zero, the other factor has no effect on differences in reported employment. For example, differences in the reference period used will not create differences between the QCEW and CES measures of employment during periods in which actual employment is stable. Analogously, variation over time in actual employment will not create differences between the QCEW and CES measures of employment when establishments follow the same procedures for both programs.

This framework can explain why QCEW-CES differences are noticeably larger for December than other months. According to my analysis of the RAS data, QCEW data are more likely than CES data to be based on a count of employees who worked anytime during the month, rather than the correct reference period of the 12th of the month. By itself, this difference in reporting procedures could contribute to differences between QCEW and CES data in any month. But during months in which employment is changing rapidly, the difference in reference periods should translate into a very large difference in the reported data. This is precisely the case for December due to the expansion of employment during the month for the holiday season.

### *5.2 Reducing Differences between QCEW and CES Estimates*

This analysis points to several ways that BLS can reduce the magnitude of differences in employment between QCEW and CES. Although these differences may be caused by several factors (namely, CES coverage error, CES sampling error, CES nonresponse, and reporting

differences), it makes sense to focus on reporting differences given that these differences are responsible for a large share of the difference between QCEW and CES estimates of both the level of employment and the monthly change in employment. A way to address reporting differences while promoting correct measurement would be to highlight the definition of employment and to emphasize that in most cases the QCEW and CES definitions are identical. The CES program already does this to some extent within the normal framework of respondent contact. CES interviewers mention the QCEW to some respondents during the CES initiation process and discuss definitions with respondents if their first month of CES data differs greatly from their QCEW data. These efforts could be expanded by discussing the QCEW with more respondents during CES initiation or by reconciling CES and QCEW microdata more frequently. Definitions could be highlighted by redesigning the forms and instructions used to collect CES data.

It is not feasible or desirable to discuss reporting differences directly with QCEW respondents on an individual basis, because only a small percentage of the 9 million establishments in the QCEW will ever be solicited for CES and because the QCEW source document is a tax form rather than a survey instrument. Still, BLS periodically reviews state QCR forms and works with states to standardize and improve the wording of key concepts on the forms. In addition, BLS stays in contact with payroll-processing and payroll-software firms to make sure they understand the employment definition on the QCR form and understand that in most cases it is the same as the definition used for CES; these efforts cover QCEW reporting for a very large number of establishments.

Beyond actions targeted to the particular employment values reported by establishments, BLS may be able to reduce differences between the CES and QCEW employment estimates by

reducing the amount of imputation in the QCEW or improving the accuracy of the imputation that is done. Other promising steps include improving response rates in the CES and improving the CES birth-death procedure; BLS already has efforts in place in those areas and has done much work on them in the past (e.g., Cohen, McCarthy, Rosen, and Wiatrowski 2006; Mueller 2006; Rosen, Hertwig, and Gomes 2002).

### *5.3 Quality and Comparability of Administrative and Survey Data*

My analysis of the RAS data highlights the role of reporting procedures in the comparison of survey and administrative data. In the present context, establishments often follow different procedures in reporting their QCEW and CES data, and this contributes to differences in the data reported to the two programs. In other contexts, reporting procedures are likely to differ between survey and administrative data because these types of data are usually collected under different conditions. For example, survey data on individual earnings are collected during telephone or in-person interviews, whereas administrative data are collected from tax authorities based on reports from businesses and individuals. Differences in reporting procedures can take place on a variety of dimensions, including collection mode, the timing of collection relative to the reference period, and the identity of respondents.

The analysis in this paper also demonstrates that the monthly employment data in both the CES and QCEW involve measurement error, but the types and magnitude of errors are different in each source. It is well accepted that survey data are subject to measurement error and other types of error (Groves et al. 2009), but the notion that administrative data may contain errors is not widely recognized. To be sure, in many contexts the quality of administrative data may exceed the quality of survey data. But analysts and statistical agencies should at least

consider the possibility that administrative data may have errors, especially measurement error and adjustment error (related to imputation and other edits).

In this regard, it is useful to ask whether the administrative data measure the construct that is appropriate for the statistic that is being considered and how it compares to the construct in the survey data. If it is the appropriate construct, to what extent is the construct adhered to by respondents? The present analysis has documented that although the tax form that is the basis for the administrative data from the QCEW uses the same reference period as the corresponding survey instrument from the CES, in many cases businesses do not use this reference period when constructing their monthly employment counts for the tax form.

It is often difficult for a statistical agency to completely assess the quality of administrative data because these data are often produced outside the agency, the agency may not have access to the microdata, and the agency may not be able to influence the collection procedures (Eurostat 2003). This paper provides some concrete examples of ways to assess the quality of administrative data. One way is internal consistency checks that explore patterns in the administrative data. The test for seam effects in the QCEW takes this approach by analyzing the monthly change in employment and comparing the average change within a quarter to the average change across quarters.

Another way to assess the quality of administrative data is to match it at the micro level to existing survey data and compare the values of particular variables. Such a comparison will not directly identify errors in the administrative data because survey data may also have errors, but it can be a useful guide. A third way is to conduct a RAS, in which reporting units in the administrative data are asked questions about reporting procedures. Although such surveys are usually used to assess quality of survey data, this paper demonstrates the value of a RAS for

assessing quality of administrative data. A RAS may be done for the administrative data alone or in combination with related survey data, as was done in this case.

## 6. Conclusion

This paper explores the problem of differences between administrative and survey data using as an example the monthly employment figures gathered from U.S. business establishments. The difference between QCEW and CES estimates at the aggregate level can be decomposed into four potential sources: reporting differences, CES nonresponse, CES sampling error, and CES coverage error. The most important sources of the difference in employment levels between QCEW and CES are coverage error and reporting differences. Furthermore, reporting differences are responsible for the largest share of the difference in monthly employment growth between QCEW and CES.

The factors that are related to reporting differences between QCEW and CES are explored using matched microdata. This analysis reveals that imputation in the QCEW is strongly associated with both larger differences between QCEW and CES employment at a point in time and larger differences in employment change on a monthly or quarterly basis. Another factor contributing to reporting differences between the two programs is the timing of data collection: CES data are collected monthly, while QCEW data are collected quarterly. This produces a seam effect in the monthly QCEW data: the variation in monthly employment is larger across quarters than within a quarter.

More generally, the evidence presented in this paper suggests that reporting differences between QCEW and CES are created by the interaction of the variation over time in actual employment and differences in the procedures used by establishments to compile QCEW and CES data. Controlling for size and industry, establishments that follow different procedures

have larger reporting differences. In particular, reporting differences are associated with differences in the reference period used to compute employment, whether certain types of employees are included in the employment count, and having different people prepare the two reports.

Moving forward, there are several challenges to be confronted regarding the quality of administrative data and comparisons between administrative and survey data. When a statistical agency discovers measurement errors in administrative data, what can it do to reduce the extent of such errors? The agency could make changes to the procedures it uses to create statistics from the underlying microdata, such as the procedures related to imputation and data editing. But what if the errors relate to the construct or to the reporting procedures? In that case, the statistical agency must attempt to work with the administrative agency to make changes to the construct or reporting procedures in order to reduce measurement error while maintaining the validity of the administrative data for the administrative agency.

Here there may be a conflict of interest between the two agencies regarding the dual functions of administrative data. It is reasonable to assume that the administrative agency collects the data and processes it to optimize its use in administering programs (such as collecting taxes and paying benefits), but the resulting data may not be entirely appropriate for statistical purposes (Davern, Roemer, and Thomas 2009). Statistical agencies may seek changes in how the administrative data are collected or processed, but the changes must not compromise the administrative function of the data.

Comparing survey and administrative data requires linking records, and the linking process creates a variety of challenges. An exact match requires a common identifier, but in some cases one may not exist. Even with a common identifier, problems may arise due to errors

in the identifiers (Abowd and Vilhuber 2005) or incompatibilities related to, for example, changes in household composition or the dynamics of business ownership (Benedetto, Haltiwanger, Lane, and McKinney 2007). In some contexts, linking requires the consent of individuals to have their data from the two sources linked; this requirement creates concerns about whether the selectivity of consent induces bias into estimates derived from the combination of survey and administrative data (Sakshaug and Kreuter 2011).

When linking is feasible, a challenge arises regarding the method of combining information from survey and administrative data. In many cases the combined dataset will provide two measures of the same item for a set of units (e.g., individuals, businesses), such as the CES and QCEW measures of monthly employment for CES respondents. When one discards the assumption that the administrative data represent the truth, combining the two sources of information to produce the most accurate estimate becomes a complicated problem. One approach is to specify and estimate aspects of the measurement process in the survey and administrative data (Abowd and Stinson 2011; Kapteyn and Ypma 2007).

Despite these challenges, researchers and statistical agencies are likely to continue to improve the use of administrative data for statistical purposes, either in combination with survey data or on its own.

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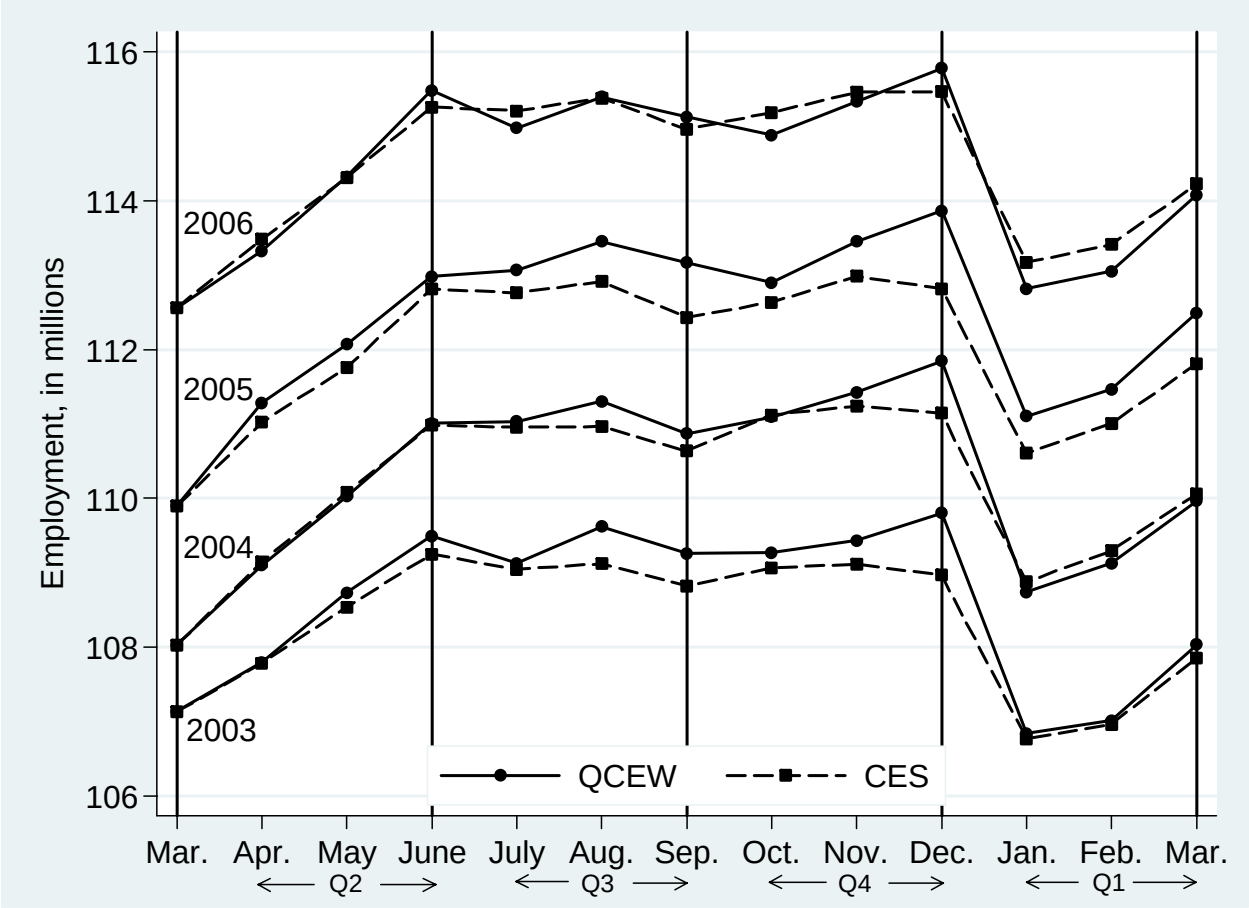
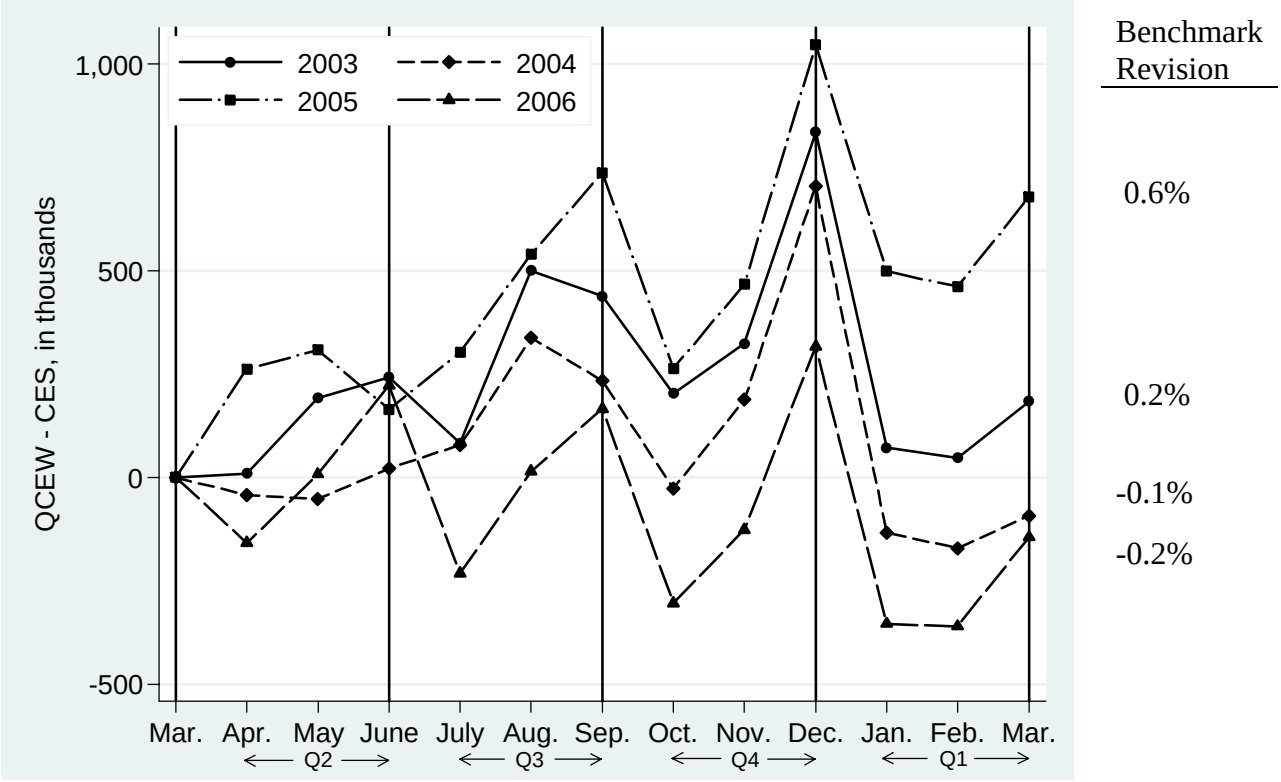
Figure 1. QCEW and CES Employment Estimates, 2003–2006




*Notes:* Employment is total private nonfarm employment. The series start in March of each year from 2003 to 2006 (after the benchmark) and end a year later, in March 2004 to March 2007 (before the benchmark). Vertical lines identify the third month of each quarter.

Figure 2. Difference between QCEW and CES Employment Estimates, 2003–2006




*Notes:* Employment is total private nonfarm employment. The series labels correspond to the year at the beginning of a given 13-month period; for instance, the series labeled "2003" begins in March 2003 (after the benchmark) and ends in March 2004 (before the benchmark). Vertical lines identify the third month of each quarter.

Table 1. Changes in QCEW and CES Employment Estimates, 2003–2006

| Period | Percentage Change | | Difference |
|---|---|---|---|
| | QCEW | CES | |
| Monthly | | | |
| Mar. to Apr. | 0.89 | 0.87 | 0.02 |
| Apr. to May | 0.83 | 0.74 | 0.09 |
| May to June | 0.85 | 0.81 | 0.04 |
| June to July | -0.17 | -0.08 | -0.09 |
| July to Aug. | 0.35 | 0.09 | 0.26 |
| Aug. to Sep. | -0.30 | -0.34 | 0.04 |
| Sep. to Oct. | -0.06 | 0.26 | -0.32 |
| Oct. to Nov. | 0.33 | 0.17 | 0.16 |
| Nov. to Dec. | 0.37 | -0.09 | 0.46 |
| Dec. to Jan. | -2.62 | -2.00 | -0.61 |
| Jan. to Feb. | 0.26 | 0.29 | -0.02 |
| Feb. to Mar. | 0.89 | 0.74 | 0.15 |
| Quarterly | | | |
| Mar. to Jun. | 2.59 | 2.44 | 0.15 |
| Jun. to Sep. | -0.12 | -0.33 | 0.21 |
| Sep. to Dec. | 0.64 | 0.34 | 0.30 |
| Dec. to Mar. | -1.49 | -0.99 | -0.50 |

Table 2. Decomposition of QCEW-CES Differences, 2003–2006

| Source | Levels | Monthly Changes | Quarterly Changes |
|---|---|---|---|
| Coverage Error | 59 | 10 | 41 |
| Sampling Error | 10 | 4 | 0 |
| Nonresponse Error | -17 | 10 | 32 |
| Reporting Differences | 48 | 75 | 27 |

*Note:* Due to rounding, the percentages may not sum to 100 within a column.

Table 3. Reporting Differences and Establishment Characteristics

| | Mean | Levels | Monthly Changes | Quarterly Changes |
|---|---|---|---|---|
| Mean of dependent variable | | 6.38 | 3.15 | 4.50 |
| QCEW data imputed | 0.08 | 6.32** | 2.49** | 4.80** |
| Pay frequency | | | | |
| Weekly | 0.45 | — | — | — |
| Bi-weekly | 0.28 | -3.36** | -2.19** | -2.83** |
| Semi-monthly | 0.24 | -0.95** | -0.85** | -1.00** |
| Monthly | 0.03 | 1.26 | -0.14 | -0.41 |
| CES collection method | | | | |
| CATI[a] | 0.22 | — | — | — |
| Electronic file transmission | 0.36 | -4.45** | -1.81** | -2.78** |
| Touchtone data entry | 0.19 | -0.75** | -0.46** | -0.87** |
| Fax, mail, or Internet | 0.21 | 0.07 | 0.27** | 0.20 |
| Other or mixed | 0.01 | -1.21 | 0.31 | 1.06** |
| CES closing code | | | | |
| 1 (By 1st closing) | 0.75 | — | — | — |
| 2 (Between 1st & 2nd closing) | 0.19 | 1.06** | 0.72** | 0.38** |
| 3 (Between 2nd & 3rd closing) | 0.03 | 2.09** | 1.48** | 2.79** |
| 4 (After 3rd closing) | 0.04 | 0.39 | 1.32** | 1.53** |
| $R^2$ | | 0.093 | 0.05 | 0.07 |
| *N* | | 2,362,616 | 2,297,084 | 726,539 |

[a] Computer-Assisted Telephone Interview.

* $p < .10$; ** $p < .05$.

*Notes:* Regressions also include controls for industry (13 categories), size (7 categories), geographical division (9 categories), and an indicator for being part of a multi-establishment firm. The unit of observation is an establishment in a particular period; the *p* values are computed based on standard errors that account for multiple observations per establishment. The reported means of the explanatory variables are based on the sample used for the "levels" regression.

*Source:* Merged QCEW and CES data for March 2006–March 2007.

Table 4. Testing for Seam Effects in Monthly Employment Data

| | QCEW | | | CES | | | QCEW – CES | |
|---|---|---|---|---|---|---|---|---|
| Size Class | Across | Within | Diff | Across | Within | Diff | Across | Within |
| 1 to 9 | 12.92 | 9.06 | 3.87 | 9.19 | 8.98 | 0.21 | 3.73 | 0.07 |
| 10 to 19 | 10.22 | 7.32 | 2.90 | 7.54 | 7.38 | 0.16 | 2.68 | -0.06 |
| 20 to 49 | 8.67 | 6.52 | 2.15 | 7.10 | 6.84 | 0.26 | 1.57 | -0.32 |
| 50 to 99 | 7.57 | 5.63 | 1.93 | 6.47 | 6.02 | 0.45 | 1.09 | -0.39 |
| 100 to 249 | 5.91 | 4.42 | 1.49 | 5.20 | 4.92 | 0.28 | 0.71 | -0.50 |
| 250 to 499 | 5.14 | 3.81 | 1.33 | 4.64 | 4.34 | 0.30 | 0.50 | -0.53 |
| 500 or more | 4.27 | 2.83 | 1.44 | 3.90 | 3.63 | 0.27 | 0.38 | -0.80 |
| Total | 9.78 | 7.03 | 2.76 | 7.46 | 7.21 | 0.25 | 2.32 | -0.19 |

*Notes:* The numbers in the table are averages of absolute percentage changes of employment in consecutive months. The absolute percentage change is defined as $|x_1 - x_2|/\bar{x}$, where $x_1$ is employment in the first month, $x_2$ is employment in the second month, and $\bar{x} = (x_1 + x_2)/2$. Due to rounding, the differences shown in the table may exactly not equal the difference between the corresponding values. Size class is based on average monthly employment at the establishment between January 2006 and January 2007.

*Source:* Merged QCEW and CES data for January 2006–January 2007.

Table 5. Procedures Used to Compile QCEW and CES Data

| Procedure/characteristic | Percent | N |
|---|---|---|
| Number of payrolls | | 1,835 |
| Single | 85.9 | |
| Multiple | 14.1 | |
| Pay frequency (if single payroll) | | 1,577 |
| Weekly | 39.6 | |
| Bi-weekly | 38.9 | |
| Semi-monthly | 12.2 | |
| Monthly | 1.7 | |
| Missing or other | 7.6 | |
| Reference period | | 691 |
| Incorrect for QCEW | 47.8 | |
| Incorrect for CES | 15.3 | |
| Different for QCEW & CES | 42.3 | |
| Check counting | | 827 |
| Used for QCEW | 10.0 | |
| Used for CES | 12.1 | |
| Different for QCEW & CES | 10.8 | |
| Treatment of employee types | | 711 |
| Incorrect for QCEW | 41.8 | |
| Incorrect for CES | 45.9 | |
| Different for QCEW & CES | 17.9 | |
| People and data sources | | |
| Different data source for QCEW & CES | 8.2 | 803 |
| Different people prepare QCEW & CES | 58.5 | 1,819 |
| Change in QCEW data source | 3.6 | 882 |
| Change in CES data source | 4.3 | 1,777 |
| Purging of employee records | 34.5 | 1,505 |
| QCR data source doesn't have monthly counts | 18.0 | 750 |

*Source:* 2008 CES-QCEW Response Analysis Survey.

Table 6. Reporting Differences and Reporting Procedures

| | Dec.-Jan. | June-Dec.-Jan. | March-March | Oct.-Dec. | Control | QCEW constant within | QCEW constant across | QCEW stair-step | CES constant within | CES constant across | *N* | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean of dependent variable | 0.391 | 0.109 | 0.456 | 0.364 | 0.039 | 0.097 | 0.012 | 0.019 | 0.043 | 0.060 | | |
| Multiple payrolls | 0.040 | 0.034 | 0.111** | -0.012 | -0.039** | -0.002 | -0.007 | 0.005 | 0.006 | 0.014 | 1,835 | 0.141 |
| Weekly payroll | — | — | — | — | — | — | — | — | — | — | | |
| Bi-weekly payroll | -0.027 | -0.011 | -0.010 | 0.008 | -0.012 | -0.030 | 0.006 | -0.001 | 0.003 | -0.004 | 1,577 | 0.389 |
| Semi-monthly payroll | -0.003 | 0.015 | 0.015 | -0.038 | -0.011 | -0.079** | -0.001 | -0.017 | 0.002 | 0.016 | 1,577 | 0.122 |
| Monthly payroll | -0.016 | -0.030 | -0.033 | 0.006 | 0.087** | -0.098 | 0.025 | -0.009 | 0.008 | -0.089* | 1,577 | 0.017 |
| Missing/other payroll | 0.022 | 0.033 | 0.024 | 0.054 | -0.022 | -0.089** | -0.011 | -0.008 | 0.056** | 0.017 | 1,577 | 0.076 |
| Reference periods different | 0.070* | 0.024 | 0.093** | 0.067* | -0.088** | 0.008 | 0.009 | -0.009 | 0.010 | -0.006 | 691 | 0.423 |
| Check counting different | -0.010 | 0.066* | 0.060 | 0.052 | -0.050* | 0.005 | 0.011 | -0.003 | -0.021 | -0.027 | 827 | 0.108 |
| Employee types treated differently | 0.084* | 0.009 | 0.033 | -0.043 | -0.044* | 0.012 | 0.010 | -0.003 | 0.008 | -0.044* | 711 | 0.179 |
| Different data source used for QCEW and CES | 0.028 | 0.016 | 0.084 | -0.047 | -0.045 | -0.011 | -0.013 | 0.005 | 0.032 | 0.001 | 803 | 0.082 |
| QCR data source doesn't have monthly counts | -0.030 | -0.042 | 0.043 | -0.112** | 0.002 | 0.137** | -0.011 | -0.012 | -0.013 | -0.010 | 750 | 0.180 |
| Different people prepare QCEW and CES | 0.010 | 0.006 | -0.027 | 0.014 | -0.032** | 0.016 | -0.001 | 0.015** | 0.017* | 0.004 | 1,819 | 0.585 |
| Change in CES data source | 0.127** | -0.048 | -0.122** | -0.021 | -0.027 | 0.010 | 0.019 | -0.020 | 0.004 | 0.003 | 1,727 | 0.043 |
| Change in QCEW data source | 0.128 | -0.022 | -0.062 | -0.007 | -0.023 | 0.017 | 0.025 | -0.009 | -0.024 | -0.048 | 882 | 0.036 |
| Purging of employee records | -0.009 | -0.024 | 0.029 | 0.017 | -0.018 | 0.005 | -0.014** | 0.000 | 0.002 | -0.009 | 1,505 | 0.345 |

* $p < .10$; ** $p < .05$.

*Notes:* Each cell comes from a separate regression, except for payroll frequency (for which the set of cells covers a single regression). Regressions also include size (6 categories), industry (7 categories), and an indicator for being part of a multi-establishment firm. Sample for pay-frequency regression is establishments with a single payroll. See Appendix Table 1 for definitions of groups labeled in column headings.

*Source:* 2008 CES-QCEW Response Analysis Survey.

Appendix Table 1. Group Definitions for the Response Analysis Survey

| Group | Definition | Sampling Percent |
|---|---|---|
| Dec.-Jan. | Over-the-month change from December 2006 to January 2007 is different in QCEW and CES | 40 |
| June-Dec.-Jan. | Over-the-year buildup (from June to September to December 2006) is larger in QCEW than CES, and the drop from December 2006 to January 2007 is larger in QCEW than CES | 4 |
| March-March | Over-the-year change from March 2006 to March 2007 is different in QCEW and CES | 23 |
| Oct.-Dec. | Over-the-quarter change from October to December 2006 is different in QCEW and CES | 20 |
| Control | QCEW and CES employment data were identical (or nearly identical) for all months between January 2006 and March 2007 | 3.33 |
| QCEW constant within | QCEW data are constant for all 3 months within a quarter while CES data are not; must see this pattern in at least 3 of the 5 quarters. | 4.84[a] |
| QCEW constant across | QCEW data are constant for 2 months across quarters while CES data are not; must see this pattern in at least 3 of the 4 cross-quarter periods. | 4.84[a] |
| QCEW stair-step | QCEW data exhibit stair-step pattern while CES data do not; must see this pattern in at least 3 of the 4 cross-quarter periods. A stair-step pattern is an increase (decrease) in employment over the months of a quarter followed by a decrease (increase) in the first month of the following quarter. | 4.84[a] |
| CES constant within | CES data are constant for all 3 months within a quarter while QCEW data are not; must see this pattern in at least 3 of the 5 quarters. | 4.84[b] |
| CES constant across | CES data are constant for 2 months across quarters while QCEW data are not; must see this pattern in at least 3 of the 4 cross-quarter periods. | 4.84[b] |

[a] The groups "QCEW constant within," "QCEW constant across," and "QCEW stair-step" were combined for sampling purposes, and the combined group was allocated 4.84 percent of the sample.

[b] The groups "CES constant within" and "CES constant across" were combined for sampling purposes, and the combined group was allocated 4.84 percent of the sample.

*Notes:* The definition of each of the first four groups involves computing a change (from month $t'$ to month $t$) in CES employment ($\Delta C = C_t - C_{t'}$), the corresponding change in QCEW employment ($\Delta Q = Q_t - Q_{t'}$), and then computing the absolute value of the difference in these changes ($|\Delta Q - \Delta C|$). An establishment was then considered to be in the group if the difference exceeded a threshold that depended on employment-size class (based on the average of QCEW and CES employment in the base period). These thresholds were: 3 employees for size class 1–9, 7 employees for class 10–49, 10 employees for class 50–99, 15 for class 100–249, and 20 for class 250+.

*Source:* 2008 CES-QCEW Response Analysis Survey