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Abstract

This paper examines seasonal differences in monthly employment figures gathered from two Bureau of Labor Statistics programs. One is the Quarterly Census of Employment and Wages (QCEW), which is based on mandatory quarterly Unemployment Insurance reports; the other is the Current Employment Statistics (CES) survey. Despite using similar definitions of employment, QCEW and CES estimates are often different at micro and aggregate levels, both at a point in time and in seasonal patterns. At the aggregate level, the largest differences in growth rates between QCEW and CES employment occur from November and January. Three-fourths of the differences in monthly employment growth between QCEW and CES is due to reporting differences. Analysis of two matched samples of QCEW-CES micro data reveals that seasonal differences are related to imputation in the QCEW, the number and frequency of payrolls, and differences in the procedures used by establishments to compile QCEW and CES data.

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1. Introduction

Monthly employment data from two Bureau of Labor Statistics (BLS) programs—the Quarterly Census of Employment and Wages (QCEW) and the Current Employment Statistics (CES) survey—are used extensively by economists, policymakers, researchers, financial analysts, and government agencies as indicators of current economic conditions and as measures of labor-market activity. Estimates from the monthly CES survey of business payrolls are among the most visible statistics released by the federal government. CES estimates are released approximately three weeks after the reference period and are a component of the Conference Board's Index of Coincident Economic Indicators. The CES surveys approximately 410,000 individual worksites nationwide that together represent about 30 percent of employment in the survey universe.

The QCEW is a quarterly census of all U.S. business establishments subject to Unemployment Insurance (UI) taxes, covering approximately 9 million establishments nationwide. On their UI tax forms each quarter, establishments report employment for each of the three months in the quarter. QCEW estimates are released 7 to 9 months after the reference period. Although QCEW estimates are less timely than those from the CES, QCEW estimates are available at a finer level of detail in terms of geography and industry. The QCEW serves as the sampling frame for the CES.

Both programs collect monthly employment data from an establishment using the same definition: the number of employees who worked or received pay the pay period that includes the 12th day of the month.[1] Despite this similarity, QCEW and CES estimates are often different at

[1] Although the QCEW and CES definitions of employment are identical for most industries, the definitions differ in an important respect. The QCEW definition refers to workers covered by UI, whereas the CES definition does not require workers to be covered by UI in order to be counted. Some employees in railroads, religious organizations, education, and hospitals are not covered by UI.

micro and aggregate levels, both at a point in time and in seasonal patterns. Such differences are important in relation to the annual process by which the CES re-aligns (or "benchmarks") its estimates of employment to universe employment counts derived mainly from the QCEW.[2] Differences in over-the-year employment growth between the two programs result in benchmark revisions to the CES. Furthermore, the potential effects of converting benchmarking to a quarterly process depend in large part on differences in seasonal patterns between CES and QCEW (Battista, Manning, and Robertson 2009).

When a new benchmark to the CES is announced, estimates for the previous 21 months are subject to revision.[3] 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).

This paper first documents the seasonal differences between QCEW and CES estimates at the aggregate level and decomposes such differences into four sources, including differences in reporting at the micro level. The paper then examines the influence of various establishment characteristics and reporting procedures on seasonal differences using micro data from two matched samples of QCEW and CES data, including a sample from a response analysis survey that asked establishments how they compiled the employment data for QCEW and CES.

Although this paper compares survey and administrative data, it differs from validation studies (e.g., Bound and Krueger 1991; Pischke 1995) in an important respect. Validation

[2] "Employment, Hours, and Earnings from the Establishment Survey," Chapter 2 in *BLS Handbook of Methods*. http://www.bls.gov/opub/hom/pdf/homch2.pdf (accessed September 30, 2009).
[3] For example, with the release of CES data for January 2010, BLS introduced its annual revision of CES estimates of national employment for March 2009. With this benchmark revision, sample-based estimates from April 2008 to December 2009 were subject to revision.

studies typically assume that administrative data represent the truth, and therefore differences between survey and administrative data represent measurement errors in the survey data. In this paper, by contrast, I assume that both administrative and survey data may contain measurement error. This is similar to the approaches taken in Abowd and Stinson (2005) and Kapteyn and Ypma (2007).

2. Seasonal Differences at the Aggregate Level

This section compares QCEW and CES estimates at the aggregate level 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.[4] At the beginning of each benchmark year, the QCEW and CES estimates are identical because CES estimates are benchmarked as of March.[5] The CES estimates presented here are the final (i.e., third closing) sample-based estimates for that month; they are not adjusted to reflect benchmarking in later years. The estimates refer to private nonfarm employment (total and by industry), and they are not seasonally adjusted.[6]

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 in the second and fourth quarters, a large decrease in the first quarter, and essentially no change in the third quarter. This seasonal pattern is present for other macroeconomic quantity variables (such as output), though the seasonal movements are smaller in employment than in output (Barsky and

[4] Data for the 2007 and 2008 benchmark years are also available, but they are not included in this analysis because the start of the recession in December 2007 complicates the graphical presentation of the estimates and their interpretation.

[5] Due to some minor differences in scope between QCEW and CES (e.g., agriculture and private households are in the scope of QCEW but outside the scope of CES), the published estimates are not exactly equal in March. To facilitate a direct comparison of the series, in the data presented here the QCEW estimates have been adjusted to match the scope of the CES.

[6] The government sector is excluded from this analysis because CES selects government units for the sample following a quota method rather than the probability method used for the private sector.

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).[7]

Figure 2 plots the difference between the QCEW and CES estimates for each month. Over this period the difference (QCEW – CES) in any given month was as large as 1 million. In a given 13-month period the difference is largest in December; within a quarter the difference is usually largest in the third month and smallest in the first month. From September to October, the difference decreases. From October to December, the difference grows, as QCEW increases while CES is roughly constant on average. From December to January, the difference decreases, as both QCEW and CES decrease but QCEW decreases by more.

Table 1 sharpens the focus on the magnitude of changes by considering the average percentage change in employment from month to month and at longer frequencies. On a monthly basis, 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. QCEW estimates show 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 seasonal differences 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 grows faster than CES.

[7] The seasonality of employment has declined markedly since 1960 (Rydzewski, Deming, and Rones 1993).

But in the other period (December–March), growth in the QCEW lags behind growth in the CES. With annual benchmarking these changes offset to some extent, but with quarterly benchmarking they would not.

The seasonal differences between QCEW and CES at the aggregate level are present in most industries. For each of 14 industry groups, Figure 3 plots QCEW and CES employment averaged over the four benchmark years 2003–2006. Figure 4 shows the difference between QCEW and CES as a percentage of the average of QCEW and CES. The pattern most consistent across industries is the December-to-January pattern. The most dramatic pattern around December is in retail trade, an industry with strong seasonality due to holiday shopping; in December the difference between QCEW and CES was 2 percent of employment.

The pattern of differences in education and health services is different than in other industries. The difference between QCEW and CES is large from May to September, peaking in August at 2 percent of employment. Both series display a contraction over the summer months, but the contraction is much more pronounced in the CES. Analysis of micro data indicates that the differences for this industry arise from colleges, universities, and professional schools (NAICS 6113). This is likely due to differences in the treatment of student workers at universities. These workers are counted in the CES, and as a result the CES estimate shows a large decline during the summer months, when most students are on break from school. In the QCEW, by contrast, these workers are not counted because they are not covered by UI; as a result, the QCEW estimate displays less variability over the summer.[8]

[8] A related difference between QCEW and CES arises from the treatment of school teachers. During the summer months, when many teachers are not working, CES adjusts the reported data upward to avoid a large drop in the estimates. As a result, CES estimates for state and local government (which is excluded from my analysis) typically show less of a decline in the summer months than do the corresponding QCEW estimates.

3. Sources of Seasonal Differences

There are several potential reasons why QCEW and CES have different seasonal patterns. One class of reasons relates to how the figures are compiled and reported by establishments. Because QCEW and CES data are derived from separate forms that establishments complete at different times, establishments often follow different methods for compiling employment figures for the two programs. For instance, differences may occur 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.

Differences may also arise from non-response and imputation. The QCEW program imputes employment data for establishments that do not report for a given quarter. For the private sector in 2008, QCEW imputations represented about 5 percent of units and 3 percent of employment. CES does not impute for non-response but instead uses data from respondents to estimate the percentage growth rate of employment. However, CES non-response can lead to differences between CES and QCEW because non-response creates the possibility that CES respondents do not accurately reflect the CES sample, which is drawn to represent the QCEW universe (Dixon and Tucker 2010). The average CES response rate by the final deadline (i.e., third closing) from March 2003 to March 2008 was about 55 percent (Huff and Gershunskaya 2009).

QCEW and CES also have different ways of handling business births (openings) and deaths (closings). Because it is tied to quarterly tax filings, QCEW captures these events within its normal reporting time frame, meaning that this information is available at a lag of 7 to 9 months. CES does not observe these events in real time because its sample is drawn only once a year. As a result, CES uses an estimation procedure with two components (Mueller 2006). The

first component excludes employment losses due to business deaths from sample-based estimation in order to offset the missing employment gains from business births. The second component is an ARIMA time-series model designed to estimate the residual net birth-death employment not accounted for by the first component.

I develop a decomposition to quantify the relative contribution of these various potential sources of seasonal differences between QCEW and CES employment estimates.[9] Inputs for the decomposition are six research series of monthly employment estimates from March 2003 to March 2007. The series vary in the sample used to compute the estimates, the employment data used for that sample, and whether the birth-death adjustment factors are used. The six series (X_1 through X_6) are defined as follows:

- X_1 uses CES respondents and QCEW data but not the birth-death adjustment.
- X_2 uses the entire CES sample and QCEW data but not the birth-death adjustment.
- X_3 uses CES respondents and CES data but not the birth-death adjustment.
- X_4 uses CES respondents, CES data, and the birth-death adjustment.
- X_5 is the QCEW estimate.
- X_6 uses the CES frame and QCEW data but not the birth-death adjustment.

The difference between the published QCEW and CES estimates for a given month, $T_t \equiv X_5 - X_4$, can be decomposed into four parts:

$$X_5 - X_4 = [(X_5 - X_6) - (X_4 - X_3)] + (X_6 - X_2) + (X_2 - X_1) + (X_1 - X_3). \quad (1)$$

The term in brackets consists of two parts. The first part, $X_5 - X_6$, 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, $X_4 - X_3$, reflects the cumulative birth-death adjustment

[9] This decomposition was inspired by the approach taken in Huff and Gershunskaya (2009).

(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 $X_5 - X_6$. The difference between these two parts contributes to QCEW-CES differences at a given point in time. Denote the term in brackets as $BD_t \equiv (X_5 - X_6) - (X_4 - X_3)$.

The second term on the right side of equation (1), $SE_t \equiv (X_6 - X_2)$, reflects CES sampling error: even if CES obtained responses from the entire sample, the CES estimate would differ from the frame because it is a sample. The third term, $NR_t \equiv (X_2 - X_1)$, reflects the pattern of CES non-response—for example, differences between the employment growth of CES respondents and the overall CES sample (respondents and non-respondents). The fourth term, $RP_t \equiv (X_1 - X_3)$, 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.

Reporting differences (as measured with this approach) can also reflect problems in linking CES and QCEW data at the establishment level. Such linking is required to create series such as X_1, for which QCEW employment is substituted for the CES employment reported by CES respondents. 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/or 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 CES-QCEW differences due to coverage/birth-death and CES non-response.

The relative contribution of the four components to the overall difference between QCEW and CES can be obtained by taking differences of equation (1) between month t and month t':

$$T_t - T_{t'} = (BD_t - BD_{t'}) + (SE_t - SE_{t'}) + (NR_t - NR_{t'}) + (RP_t - RP_{t'}).^{10} \quad (2)$$

Dividing each term in equation (2) by $T_t - T_{t'}$ gives:

$$1 = \frac{BD_t - BD_{t'}}{T_t - T_{t'}} + \frac{SE_t - SE_{t'}}{T_t - T_{t'}} + \frac{NR_t - NR_{t'}}{T_t - T_{t'}} + \frac{RP_t - RP_{t'}}{T_t - T_{t'}}. \quad (3)$$

Each ratio on the right side of equation (3) is the share of $T_t - T_{t'}$ that is "explained by" the given component. This ratio is positive if the numerator and denominator have the same sign (i.e., the underlying components move in the same direction); the ratio is negative if the numerator and denominator have the opposite sign.

I implement this decomposition using monthly data on X_1 through X_6 from March 2003 to March 2007; these data cover the four benchmark years from 2003 to 2006. At the monthly frequency, I first compute the percentages for each pair of consecutive months, separately for each year. Then I compute a weighted average of the percentages across years separately for each pair of consecutive months, weighting by the absolute value of the overall monthly change for the pair in that year, $|T_t - T_{t'}|$. Finally, to aggregate the percentages across periods (consecutive months) I take a weighted average where the weight for each period is the average across years of $|T_t - T_{t'}|$. The result is four percentages, one for each component, that sum to

[10] $T_t - T_{t'}$ is the monthly change in the difference between QCEW and CES employment. It is also the difference between employment growth in the QCEW and employment growth in the CES. To see this, define QCEW employment in month t as $Q_t \equiv X_5$ and CES employment as $C_t \equiv X_4$. Then, because $T_t = Q_t - C_t$, it follows that $T_t - T_{t'} = (Q_t - C_t) - (Q_{t'} - C_{t'}) = (Q_t - Q_{t'}) - (C_t - C_{t'})$.

100. I also apply this procedure to examine changes over other frequencies (quarterly, semi-annual, and annual).

The results of the decomposition for total private nonfarm employment are shown in Table 2. Regarding the differences in monthly employment growth between QCEW and CES, 75 percent is due to reporting differences, 10 percent to CES non-response, 10 percent to coverage/birth-death, and 4 percent to CES sampling error. As a result, improving the birth-death procedures used for the CES and increasing CES response rates could each reduce seasonal differences. Given that reporting differences account for a large share of the total difference, I focus on reporting differences in the subsequent sections of the paper.

Examining the results for each monthly period, in each of the four periods with the largest monthly difference in growth rates between QCEW and CES, the portion due to reporting differences is 50 percent or more. In particular, the portion due to reporting differences is 76 percent for the December-to-January period and 69 percent for the November-to-December period.

On a quarterly basis, the portion due to reporting differences (27 percent) is much lower than on a monthly basis. A larger portion of the change at a quarterly frequency is due to coverage/birth-death (41 percent) and CES non-response (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. Seam effects might arise in the QCEW because establishments report data for all three months of a quarter at the same time (Pivetz, Searson, and Spletzer 2001). In the next section, I present evidence on seam effects using matched QCEW-CES micro data.

Table 3 presents decomposition results separately by industry. In most industries, reporting differences account for a majority of the overall differences at the monthly frequency. A notable exception is retail trade, for which only 16 percent of the overall differences are due to reporting differences; the source with the largest share is CES non-response, at 53 percent. By contrast, for education and health services reporting differences account for nearly all of the overall differences between CES and QCEW. This finding is consistent with the pattern of seasonal differences in this industry being driven by differing treatment of student workers at universities (as discussed at the end of Section 2).

4. Seasonal Differences and Establishment Characteristics

This section considers the influence of various establishment characteristics on seasonal differences between CES and QCEW. The analysis is based on a large sample of CES respondents matched to their QCEW data. These data also provide the opportunity to examine other differences in reporting between CES and QCEW data, including seam effects.

The sample used in this section was constructed by taking the universe of CES respondents in private, nonfarm establishments for January 2006 to March 2007 and matching them to their QCEW data for that period.[11] The sample contains 242,110 establishments. I measure seasonal differences for this analysis using the difference between employment growth in QCEW and CES over a given period. Specifically, I construct the changes in employment for each establishment using data from the QCEW (ΔQ) and CES (ΔC). Then I construct the absolute value of the difference in the changes: $Diff = |\Delta Q - \Delta C|$.

This difference is constructed for each relevant period at monthly, quarterly, semi-annual, and annual frequencies from March 2006 to March 2007. For each frequency I estimate a linear

[11] The data could not be matched for some establishments. In particular, data for some multi-establishment firms could not be matched because QCEW employment was reported at the firm level but CES employment was reported at the establishment level.

regression in which *Diff* is a function of establishment characteristics. The sample used for each regression is constructed by pooling information across the multiple periods for that frequency (e.g., March to April for monthly). The establishment characteristics are size, industry, whether QCEW data are imputed, length of pay period, the method by which CES data are collected, the timing of the CES report, Census division, 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.[12] Coefficient estimates for these regressions are reported in Table 4.

The regression results indicate that, all else equal, differences in growth between QCEW and CES are larger in professional and business services, information, leisure and hospitality, education and health services, and construction. In addition, imputation in the QCEW is strongly associated with seasonal differences.[13] For example, the monthly regression indicates that the difference between QCEW and CES employment growth is 2.5 workers greater when QCEW data are imputed than when they are reported. In this dataset, 9 percent of the monthly changes involve QCEW imputation for the beginning or ending month.

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

[12] The imputation variable for the period is an indicator for QCEW employment being imputed in either the beginning month or the ending month. The closing code (which identifies the timing of the CES report) for the period is defined as the greater of the codes in the beginning and ending months. If the collection method is the same in the beginning and ending months, then the collection method for the period is defined as this common method; otherwise the method for the period is a residual category labeled "mixed."

[13] Imputation in the QCEW is typically based on an establishment's historical QCEW data, but CES employment can be used in special cases. Less than 2 percent of imputed cases involve CES as the source.

only two pay periods in each month and therefore a greater likelihood that establishments will use the same reference period for QCEW and CES.

CES responses for a given reference month are received by BLS in waves. A majority of the data (about 75 percent for this sample) are reported by the primary deadline for data receipts, which is the last Friday of the reference month and referred to as "first closing." All else equal, establishments reporting by first closing have smaller seasonal differences than establishments reporting later.[14] 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.

Seasonal differences are also associated with the method by which CES data are collected. Compared to Computer-Assisted Telephone Interview (CATI), seasonal differences are somewhat smaller for Touchtone Data Entry (a self-reporting method using a telephone keypad) and much smaller for Electronic Data Interchange (EDI). EDI is a centralized system to which large firms provide data on all of their establishments that are participating in the CES (Clayton, Searson, and Manning 2000). Firms that report their CES data via EDI usually also use EDI to report their QCEW data.[15] 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

[14] Data received by first closing are used in the preliminary estimates that are published approximately three weeks after the reference period. In order to incorporate additional sample received after the primary deadline, each estimate undergoes two monthly revisions before being finalized. Second closing is three weeks after first closing, and third closing is three weeks after second closing. Therefore, for any given reference month, second-closing estimates are published one month after first-closing estimates, and third-closing estimates are published two months after first-closing estimates.

[15] Some EDI reporters submit a single report that is used first for CES and then later for QCEW; for these reporters there should be no differences. Other EDI reporters submit their CES and QCEW data in separate reports.

method. New units are typically assigned first to CATI and later moved to other collection methods if they are willing to use them.[16]

Beyond seasonal differences, other types of reporting differences between QCEW and CES employment can be explored using this sample of matched data. Some users of monthly QCEW data are concerned about the possibility of seam effects because data for all three months of a quarter are reported simultaneously.[17] The seam effect in this context is that month-to-month changes in employment tend to be larger for the seam months (across quarters) than for adjacent months off the seam (within a given quarter).[18] If seam effects exist in the QCEW, they would contribute to reporting differences between CES and QCEW.

To test for seam effects, I compute the absolute percentage change in employment over each pair of consecutive months from January 2006 to January 2007.[19] 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 5. 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. Furthermore, the variation in monthly employment across quarters is larger in the QCEW than in the CES, and the variation within a quarter is smaller in the QCEW than in the CES. These results are all consistent with seam effects in the QCEW.

[16] When I split the CATI respondents into regular CATI (new units) and permanent CATI (experienced units) and re-estimated the models, I found no significant differences in the dependent variable between regular and permanent CATI.

[17] In part due to concern about seam effects, BLS publications from the database of longitudinal QCEW data use employment in the third month of the quarter but do not use employment for the first and second months (Pivetz, Searson, and Spletzer 2001).

[18] 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).

[19] The absolute percentage change is computed as $|x_2 - x_1|/(\frac{x_1+x_2}{2})$, where x_1 is employment in the first month and x_2 is employment in the second month.

5. Seasonal Differences and Reporting Procedures

The previous section examined the influence on QCEW-CES differences of establishment characteristics that are regularly maintained by one or both programs. This section explores the influence of establishment characteristics that are not regularly collected and difficult to measure—characteristics related to how establishments derive the employment counts for the QCEW and CES. Data on such characteristics was obtained from a response analysis survey (RAS) that was conducted 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).[20] For a RAS, a respondent is contacted after survey completion, usually by telephone, 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).

Seasonal differences between QCEW and CES were captured in the sample design of this RAS using groups defined by specific types of reporting differences based on data from January 2006 to March 2007.[21] The groups, which are defined in Appendix Table 1, were developed to target specific types of reporting differences that have been identified through past research and analysis. The sample consisted of 3,002 actively reporting establishments of various sizes and industries. The proportion of the sample allocated to each group was based on the perceived importance of each group to overall QCEW-CES differences. A small control group was created

[20] RAS studies on CES-QCEW differences were conducted in 1994 (Werking, Clayton, and Rosen 1995) and 2001. A pilot for the 2008 RAS was conducted in 2007 (Applebaum, Fairman, Groen, and Phipps 2008).
[21] In order for an establishment to be eligible for sampling, its QCEW data must have been reported (not imputed) from January 2006 to March 2007, and it must have reported to the CES from October 2006 to March 2007.

to represent establishments whose QCEW and CES employment data were identical (or nearly identical) for all months (during this period) in which the establishment participated in the CES.

A handful of industries were excluded from the sample frame because of scope differences between QCEW and CES or because of potential complications with collection of the RAS data: professional employer organizations (NAICS 561330), educational services (NAICS 61), hospitals (NAICS 622), and all government units. Establishments that reported their data via EDI were excluded because they had been promised exclusive contact through the EDI Center.[22] The sample chosen for interview consisted of 3,002 establishments.

The RAS questionnaire was designed to gather information on a variety of topics, including payrolls, data sources, reporting procedures, record keeping, reference period, the types of employees included in employment counts, and possible reasons the QCEW and CES employment counts may differ. The 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 of the RAS. If an outside organization (such as an accounting firm or payroll processor) was responsible for the QCR, in most cases the interviewer did not contact that organization.[23]

[22] These restrictions produced a sample frame of 49,746 establishments, including 6,031 that qualified for the control group and 9,474 that qualified for another group. Among these 15,505 establishments, observations with the same phone number on record with the CES were deleted to avoid contacting the same person more than once, leaving 10,228 establishments available for sampling. These establishments were sampled randomly, while respecting the targeted proportions for the groups, to achieve a sample of 3,002.

[23] Interviewers did not contact payroll processors. However, if the outside organization was an accountant or corporate office, interviewers asked the respondent for permission to contact them and ask about the preparation of

The RAS was conducted by phone from January to June 2008 and achieved an overall response rate of 71 percent. Approximately 63 percent of the sampled establishments answered one or both parts of the questionnaire, while 8 percent declined to participate in the formal questionnaire but did agree to answer a single question on reasons for differences in the employment counts. About 19 percent refused to answer any questions. Interviewers were unable to reach the remaining 10 percent of the sample.

Non-response was relatively high for the QCR section. For 34 percent of the responding establishments, an outside organization was responsible for preparing the QCR figures. This resulted in a smaller number of completed questions for the QCR section and higher item non-response for the QCR questions, which limits the number of cases for which comparisons can be made between the procedures used to compile QCEW and CES data. Of 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 6. 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 the QCEW (48 percent) than for the CES (15 percent). The correct reference period is a count of employees who worked during the pay period of the 12th. Incorrect reference periods recorded in the RAS interviews include a cumulative monthly count (the most common response) and a count of employees who worked during a pay period other

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the QCR. Most respondents who used accountants declined permission because of the prospects of being charged by the accountant.

than the one including the 12th.[24] 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 includes 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 the QCEW and CES.

The final set of variables in Table 6 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. When different people prepare the two reports, differences in the procedures used for check counting and employee types are more prevalent than when the same person prepares the reports.[25]

[24] Problems with the understanding of and adherence to the pay period of the 12th as the reference period have been found in many employer studies (e.g., Goldenberg and Phillips 2000) and involve several BLS programs, not just QCEW and CES.

[25] Among establishments for which different people prepare the two reports, 17.9 percent used check counting for one program but not the other, compared to 8.4 percent of establishments for which one person prepared both reports. For employee types, these percentages are 28.3 percent (different people) and 13.5 percent (same person).

These summary statistics support the view that employment data from both the QCEW and CES involve measurement error, but the types and magnitude of errors are different in each source. The next step in the analysis of the RAS data is to relate differences in procedures to differences between the QCEW and CES data reported by establishments. The RAS interviews explored that relationship directly by asking respondents what they thought caused the differences in the two reports. Respondents could give more than one reason; their responses were coded into 25 distinct reasons of 8 types. Also coded was whether a given response referred to the QCEW, the CES, both programs, or neither program. As shown in Table 7, the most common reasons given for differences in reporting related to the reference period used and the treatment of employee types. When respondents reported a reason related to the reference period, they were more likely to identify the reason with the QCEW than the CES. In contrast, when respondents reported a reason related to the treatment of employee types, they were more likely to identify the reason with the CES than the QCEW.

As another way to relate procedures to reporting differences, I estimate a set of regression models of the form: $\Pr(G_{ij} = 1) = \alpha + \beta R_i + \theta Z_i + \varepsilon$, where G_{ij} is an indicator for establishment i being in group j (see Appendix A for group definitions) and R_i is a variable constructed from the RAS responses. The control variables Z_i include 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 β are reported in Table 8. If j is the control group, then R contributes to seasonal differences between QCEW and CES if $\beta < 0$. Conversely, if j is another group, then R contributes to seasonal 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 8 relates to the number and timing of payrolls. The regression results provide some evidence that having multiple payrolls is associated with seasonal differences between QCEW and CES. All else equal, 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 differences in seasonal patterns.

For establishments with a single payroll, there is also some evidence that pay frequency is associated with seasonal 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. In turn, this pattern is caused by 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 seasonal differences in QCEW and CES data—which 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 seasonal differences. Differences in check

counting are associated with an increase of 6.6 percentage points for the June-December-January group and a decrease of 5 percentage points for the control group.

Inconsistent treatment of certain employee types also contributes to seasonal 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 differences in reported employment.

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, QCEW (but not CES) employment is much more likely to be constant within a quarter. This implies that data sources contribute to seam effects in the QCEW.

6. Conceptual Model of Reporting Differences

The empirical results in the previous two sections suggest that seasonal differences in employment between QCEW and CES are created by the interaction of the underlying seasonality of 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	×	Seasonality of employment	(4)

In this equation, both factors on the right side have a positive relationship with differences in reported employment. However, if one factor is zero, then the other factor has no effect on differences in reported employment. For example, differences in the reference period used will not create differences in employment growth during periods in which employment is stable. Analogously, employment seasonality will not create differences in employment growth when establishments follow the same procedures for both programs.

The relationship between differences in procedures and differences in reported employment is documented in the previous section. The role of seasonality is suggested by the pattern of seasonal differences by industry because seasonality varies by industry. However, these patterns could reflect in part differences in procedures. To better isolate the role of seasonality, Figure 5 uses the aggregate estimates of monthly employment (the estimates used in Section 2) by industry to plot the month-to-month change in the average of QCEW and CES employment against the difference between the change measured using QCEW employment and the change measured using CES employment.

Figure 5 has one panel for each month-to-month period; each panel contains 13 data points, one for each industry. On the horizontal axis, the change in the average of QCEW and CES employment is used as a measure of the seasonality of employment. From August to March there is a positive relationship between underlying seasonality and differences in QCEW and CES growth rates. A convenient way to summarize this relationship is to pool the data across periods and estimate a regression of the change in growth rates as a function the growth rate of average employment with controls for period and industry. The estimated coefficient on the

growth rate of average employment is 0.126 with a standard error (adjusted for clustering by industry) of 0.051.[26]

Further evidence on the positive relationship between seasonality and differences in QCEW and CES employment comes from a regression on the establishment micro data for the period March 2006–March 2007:

$$|\Delta Q - \Delta C|_t = \alpha + \beta|\Delta E|_t + \gamma X + \varepsilon, \quad (5)$$

where Q is QCEW employment, C is CES employment, and E is the average of Q and C. Changes are computed in percentage terms from month to month, and the data are pooled across the 12 periods. X is a vector of controls for establishment size, industry, and period. The estimate of β, which measures the relationship between employment change at the establishment level and differences in QCEW and CES growth rates, is 0.214 with a standard error (adjusted for clustering by establishment) of 0.054.[27]

The framework embodied by equation (4) can explain why QCEW-CES differences are noticeably larger for December than other months. According to the RAS results, 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 should contribute to differences in reported data in all months. But during months in which employment is changing rapidly, the difference in reference period should translate into a very large difference in reported data. This is precisely the case for

[26] The qualitative nature of this result is robust to alternative measures of the seasonality of employment. If, instead of the change in the average of QCEW and CES, the change in QCEW is used, the estimated coefficient is 0.108 (SE = 0.049); if the change in CES is used, the estimated coefficient is 0.142 (SE = 0.056).

[27] In equation (5), $|\Delta E|$ serves as a measure of the true (unknown) employment change. The estimate of β is still positive and significant if, instead of $|\Delta E|$, $|\Delta Q|$ or $|\Delta C|$ is used. When $|\Delta Q|$ is used, the estimate of β is 0.389 (SE = 0.079); when $|\Delta C|$ is used, the estimate of β is 0.906 (SE = 0.048).

December (especially in retail trade) due to the expansion of employment during the month for the holiday season.

7. Conclusion

There is a strong seasonal pattern to employment as measured by both the QCEW and CES. However, the seasonal patterns in the employment data from these two BLS programs differ in ways that are quantitatively important and qualitatively consistent over time. At the aggregate level, the largest differences in growth rates between QCEW and CES estimates occur between November and January. QCEW estimates show a greater buildup of employment from October to December and a larger drop of employment from December to January.

The qualitative pattern of aggregate seasonal differences between QCEW and CES exists in most industries, although the magnitude of such differences varies substantially by industry. The pattern most consistent across industries is the December-to-January pattern. Retail trade shows the most dramatic differences in seasonal patterns between QCEW and CES around the end of the year, when employment in that industry peaks due to holiday shopping. Large differences between QCEW and CES exist over the summer months in education and health services; these differences are likely due to differences in the treatment of student workers at universities.

The differences between QCEW and CES estimates at the aggregate level can be decomposed into four potential sources: reporting differences, CES non-response, CES sampling error, and the incomplete coverage of the CES frame for births and deaths of establishments. On a monthly basis, 75 percent of the differences in employment growth between QCEW and CES is due to reporting differences; CES non-response and coverage/birth-death each account for 10 percent of the differences.

Analysis of a large sample of matched CES-QCEW micro data reveals that imputation in the QCEW is strongly related to seasonal differences in employment: the difference between QCEW and CES employment growth is greater when QCEW data are imputed than when they are reported. 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 seasonal differences in employment between QCEW and CES are created by the interaction of the seasonality of 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 seasonal differences in employment. In particular, seasonal 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.

This analysis points to several ways to reduce the magnitude of seasonal differences in employment between QCEW and CES. It makes sense to focus on reporting differences given that these differences are responsible for a large share of the difference in monthly growth rates. 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 and by reconciling CES and QCEW micro data 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 seasonal differences between CES and QCEW by reducing the amount of imputation in the QCEW and/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 (Cohen, McCarthy, Rosen, and Wiatrowski 2006; Rosen, Hertwig, and Gomes 2002).[28]

[28] In February 2011, BLS began updating the net birth-death model component of the CES estimation process more frequently, generating birth-death factors on a quarterly basis instead of annually. See "Introduction of Quarterly Birth/Death Model Updates in the Establishment Survey." http://www.bls.gov/ces/ces_quarterly_birthdeath.pdf (accessed February 8, 2011).

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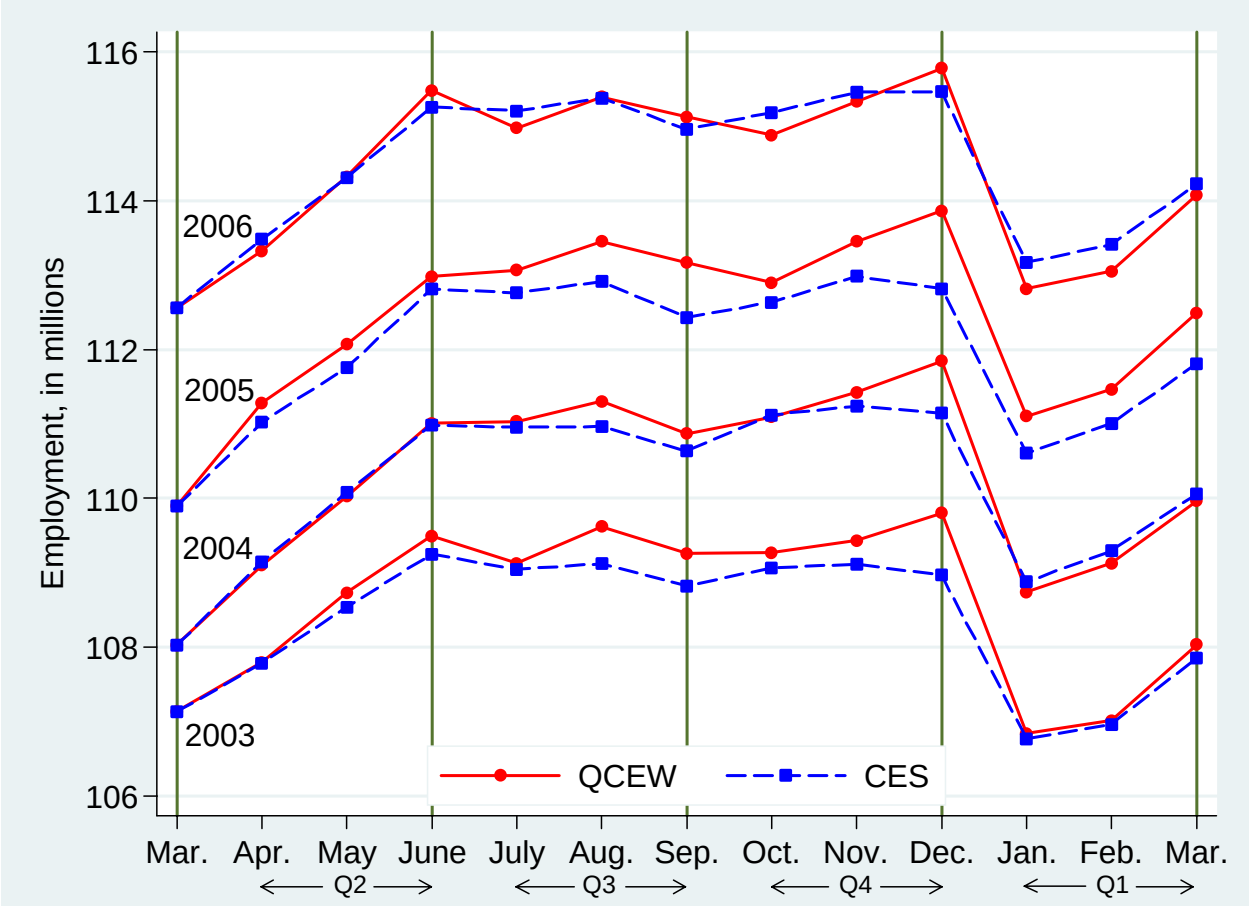
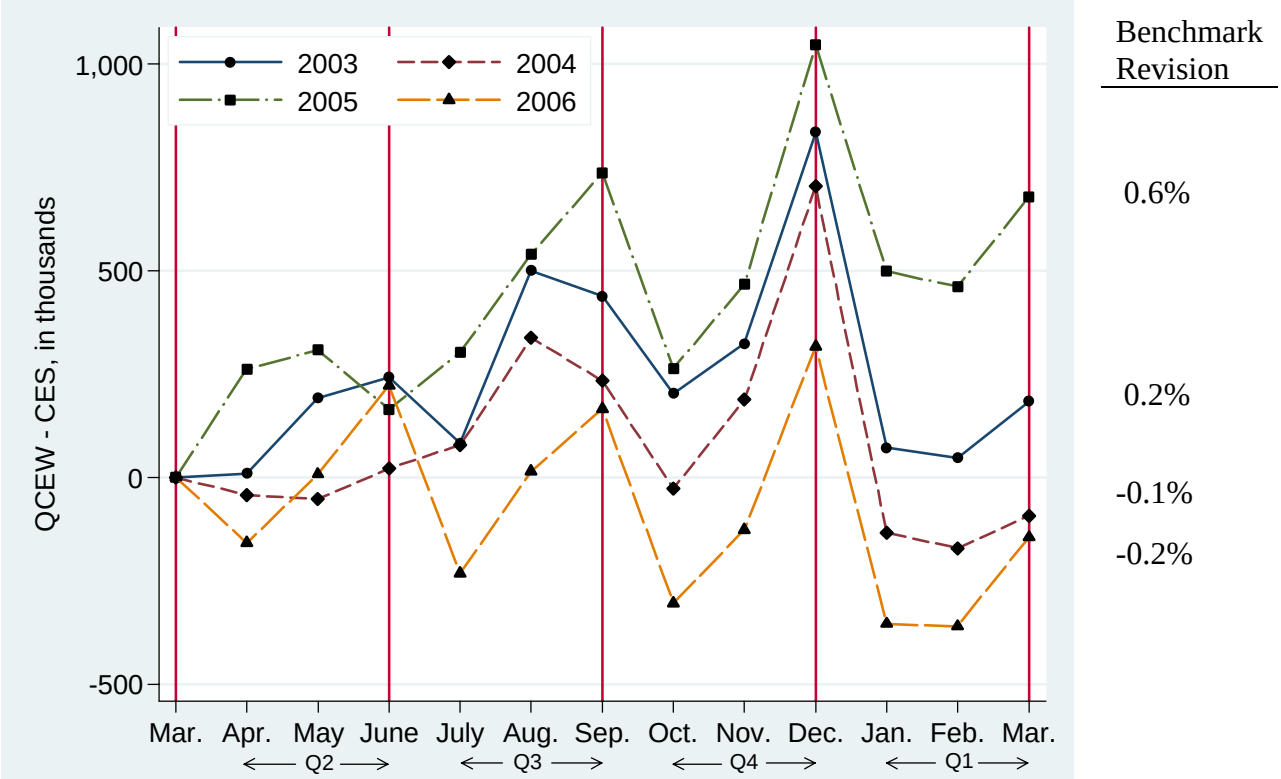
Figure 1. QCEW and CES Employment, 2003–2006



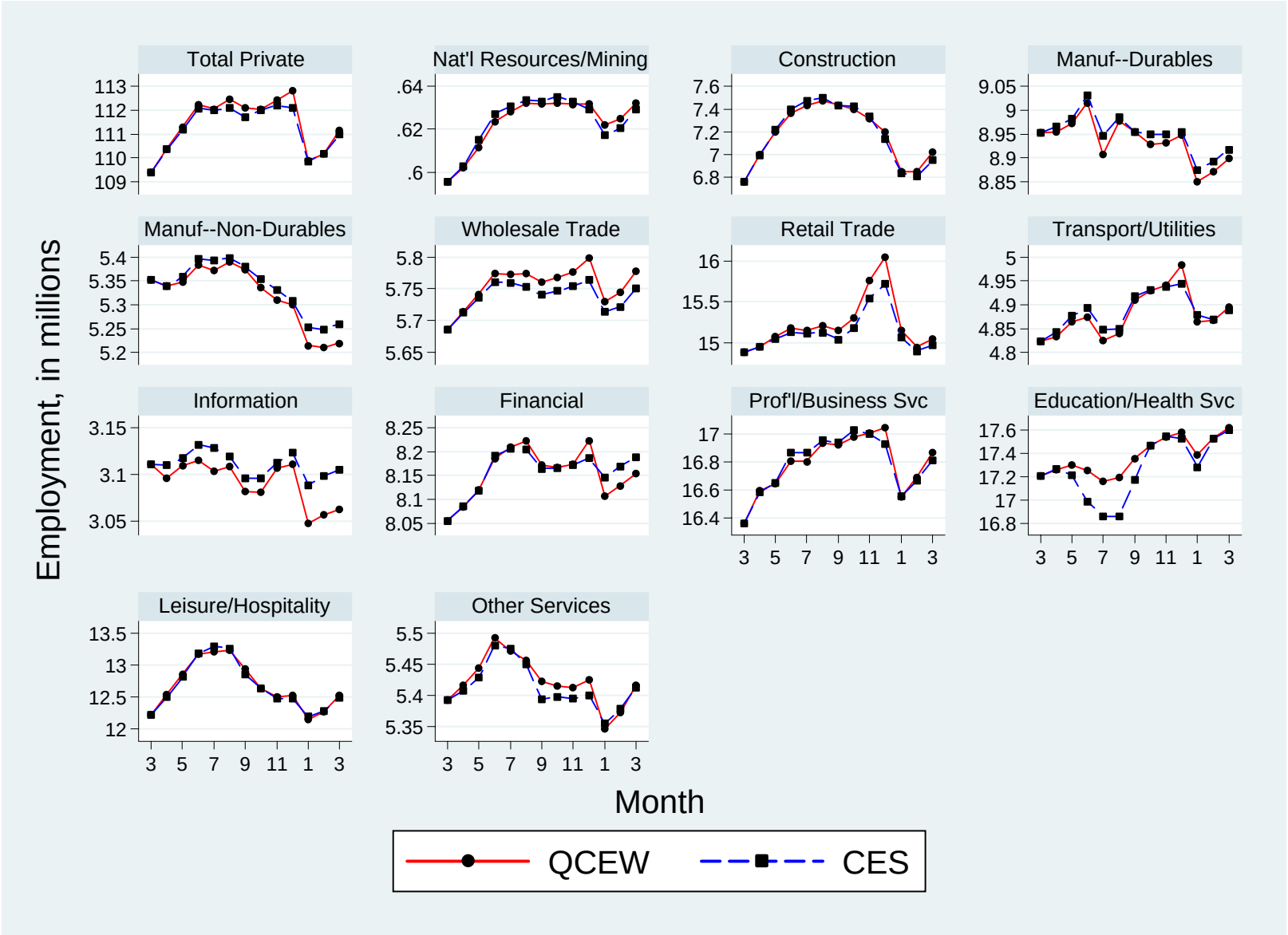
Notes: Employment is total U.S. private nonfarm employment. The series start in March of each year from 2003 to 2006 (after the benchmark) and end a year later, in March 2004 to March 2007 (before the benchmark). Vertical lines identify end of quarters.

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



Notes: Employment is total U.S. 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 end of quarters.

Figure 3. QCEW and CES Employment, by Industry Group, 2003–2006 (annual averages)



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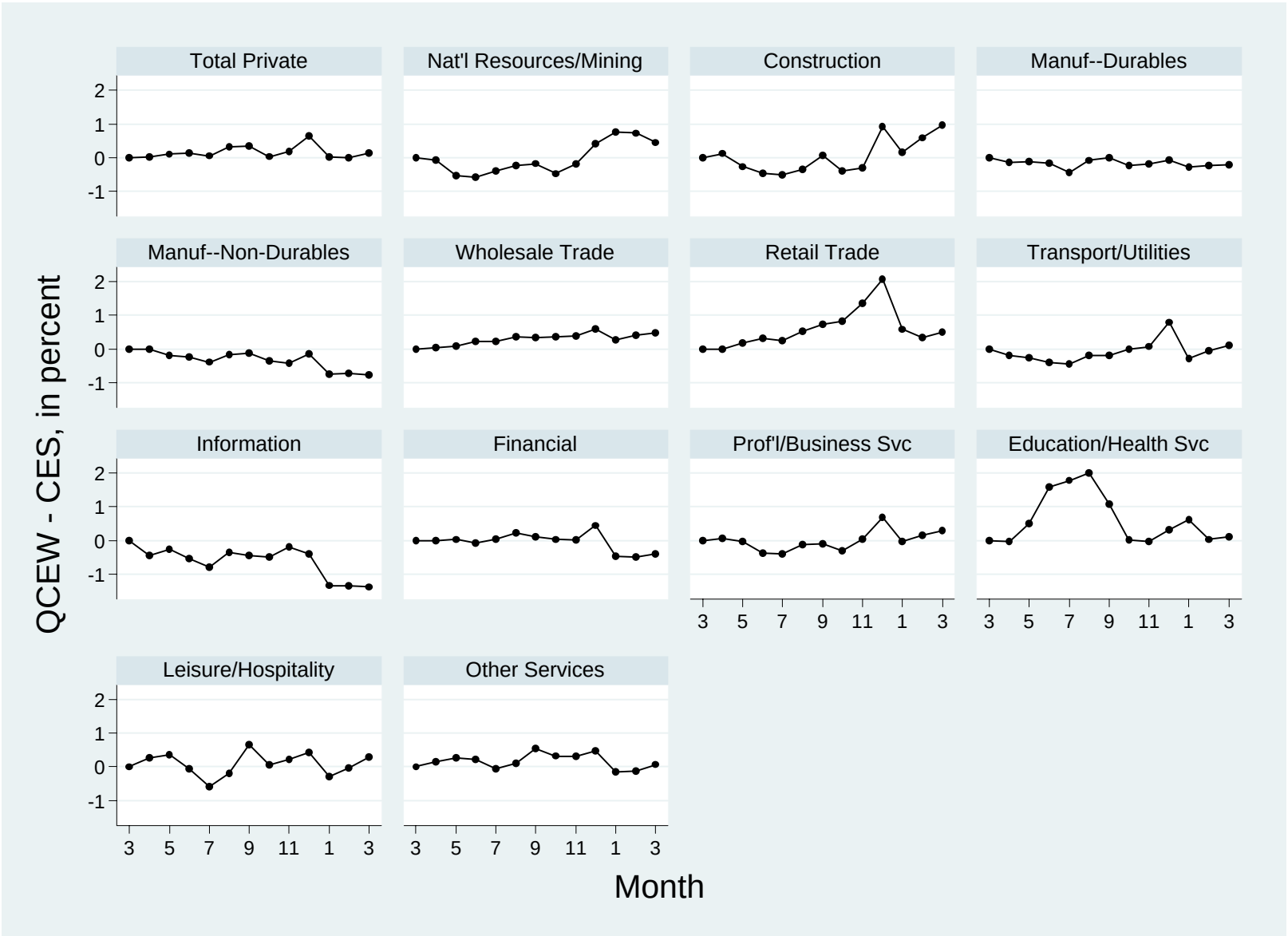

Figure 5. Seasonality and Seasonal Differences: Evidence from Industry Variation, 2003–2006 (annual averages)

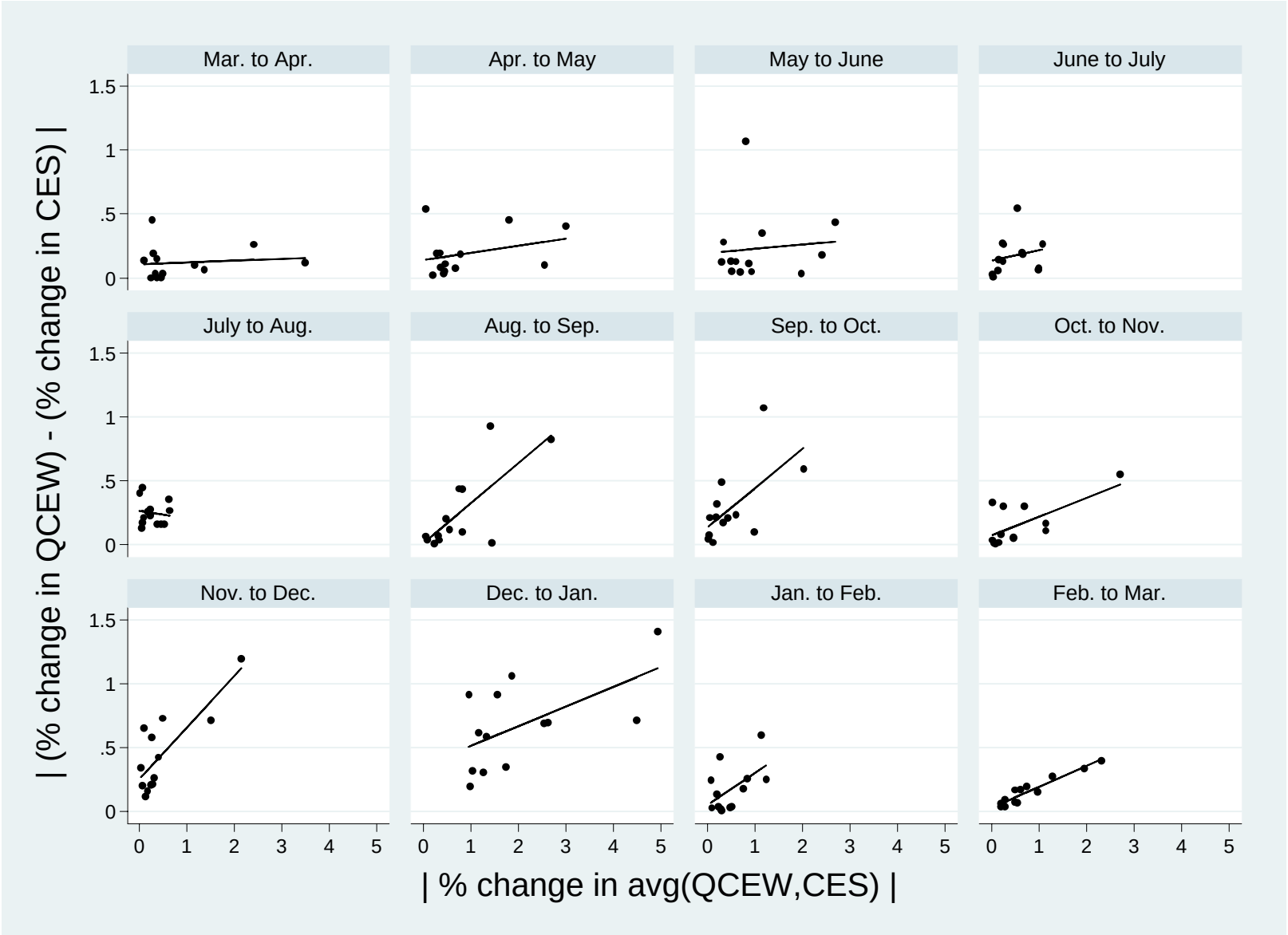

Table 1. Changes in QCEW and CES Employment, 2003–2006

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
Average			**0.19**
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
Average			**0.29**
Semi-Annual			
Mar. to Sep.	2.47	2.11	0.36
Sep. to Mar.	-0.86	-0.65	-0.21
Average			**0.29**
Annual			
Mar. to Mar.	1.59	1.44	0.14

Note: The average differences are based on the absolute value of the differences over the relevant period.

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

Period	Coverage/ Birth-Death	Sampling Error	Non-Response	Reporting Differences
Monthly				
Mar. to Apr.	56	48	-60	57
Apr. to May	12	-14	-32	134
May to Jun.	1	5	-51	146
Jun. to Jul.	40	-19	22	58
Jul. to Aug.	16	7	28	50
Aug. to Sep.	54	-13	48	11
Sep. to Oct.	-27	11	-19	135
Oct. to Nov.	30	-8	79	-2
Nov. to Dec.	7	3	22	69
Dec. to Jan.	6	-1	19	76
Jan. to Feb.	-86	114	-4	76
Feb. to Mar.	12	28	-103	163
Average	**10**	**4**	**10**	**75**
Quarterly				
Mar. to Jun.	82	67	-213	164
Jun. to Sep.	99	-9	24	-13
Sep. to Dec.	48	-10	85	-24
Dec. to Mar.	-1	2	38	61
Average	**41**	**0**	**32**	**27**
Semi-Annual				
Mar. to Sep.	81	-24	-47	90
Sep. to Mar.	-93	23	-50	220
Average	**20**	**-7**	**-48**	**136**
Annual				
Mar. to Mar.	36	44	-14	34

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

Table 3. Decomposition of QCEW-CES Differences by Industry, 2003–2006

	Monthly				Quarterly			
Industry	Cov/ B-D	Samp Error	Non-Resp	Rpt Diffs	Cov/ B-D	Samp Error	Non-Resp	Rpt Diffs
Total Private	10	4	10	75	41	0	32	27
Nat'l Resources/Mining	21	2	2	74	40	20	67	-26
Construction	4	3	11	82	15	10	4	71
Manuf—Durables	-3	11	69	23	-34	3	98	33
Manuf—Non-Durables	3	8	-3	92	1	6	21	72
Wholesale Trade	25	-29	42	62	41	24	-98	133
Retail Trade	30	1	53	16	35	-3	56	11
Transport/Utilities	-11	6	66	40	-14	5	103	6
Information	34	4	32	30	66	11	16	7
Financial	31	-6	1	73	43	10	2	45
Prof'l/Business Svc	22	-6	19	65	39	4	37	19
Education/Health Svc	7	0	0	93	-8	4	9	96
Leisure/Hospitality	17	-7	26	64	29	-3	38	37
Other Services	14	24	3	59	53	42	22	-18
	Semi-Annual				Annual			
Industry	Cov/ B-D	Samp Error	Non-Resp	Rpt Diffs	Cov/ B-D	Samp Error	Non-Resp	Rpt Diffs
Total Private	20	-7	-48	136	36	43	-14	34
Nat'l Resources/Mining	49	27	57	-33	114	5	78	-97
Construction	69	8	38	-16	135	-20	-36	22
Manuf—Durables	-32	58	97	-23	-248	-5	441	-87
Manuf—Non-Durables	19	10	2	69	-37	35	68	34
Wholesale Trade	49	-8	-3	62	44	3	-64	117
Retail Trade	53	0	16	32	153	-10	3	-45
Transport/Utilities	75	-12	4	34	98	-35	-11	47
Information	72	29	-3	2	50	14	51	-16
Financial	48	-24	30	47	-8	2	80	26
Prof'l/Business Svcs	25	13	60	3	-8	32	55	21
Education/Health Svcs	0	3	10	88	15	82	-78	81
Leisure/Hospitality	34	-26	13	79	70	-63	73	19
Other Services	20	23	-1	58	71	129	11	-111

Notes: "Cov/B-D"=Coverage/Birth-Death. "Samp Error"=Sampling Error. "Non-Resp"=Non-Response. "Rpt Diffs"=Reporting Differences. Due to rounding, the percentages may not sum to 100 within a row.

Table 4. Seasonal Differences and Establishment Characteristics

		Frequency			
	Mean	Monthly	Quarterly	Semi-Annual	Annual
Mean of dependent variable		3.16	4.53	5.40	6.31
Industry					
Nat'l Resources/Mining	0.01	0.41	1.98**	2.92**	7.09**
Construction	0.05	0.80**	1.29**	1.41**	1.52**
Manuf—Durables	0.04	0.08	0.31	1.12	2.26
Manuf—Non-Durables	0.02	-0.57*	0.03	0.40	3.04
Wholesale Trade	0.04	0.20	0.21	0.15	0.41*
Retail Trade	0.28	—	—	—	—
Transport/Utilities	0.04	0.16	0.02	-0.30	0.60
Information	0.04	1.35**	2.27**	3.16**	4.04**
Financial	0.12	0.58**	0.98**	1.06**	1.17**
Prof'l/Business Svcs	0.11	1.95**	3.26**	4.04**	4.69**
Education/Health Svcs	0.09	0.78**	1.61**	1.28**	0.21
Leisure/Hospitality	0.11	1.30**	1.84**	1.82**	1.98**
Other Services	0.03	0.70**	1.22**	1.36**	1.86**
QCEW data imputed	0.09	2.52**	4.87**	7.96**	14.28**
Length of pay period					
Weekly	0.44	—	—	—	—
Bi-weekly	0.28	-2.20**	-2.84**	-3.30**	-3.53**
Semi-monthly	0.24	-0.87**	-1.00**	-1.38**	-1.27**
Monthly	0.03	-0.11	-0.42	-1.18	-1.60
CES collection method					
CATI[a]	0.22	—	—	—	—
Electronic Data Interchange	0.36	-1.82**	-2.80**	-3.48**	-3.01**
Touchtone Data Entry	0.19	-0.44**	-0.84**	-1.40**	-1.98**
Fax/Web/Mail	0.21	0.28**	0.27	0.12	1.33*
Mixed	0.02	0.30	1.00**	0.78	1.49**
CES closing code					
1 (By 1st closing)	0.66	—	—	—	—
2 (Between 1st & 2nd closing)	0.24	0.72**	0.39**	1.78**	2.53**
3 (Between 2nd & 3rd closing)	0.05	1.48**	2.75**	2.44**	3.52**
4 (After 3rd closing)	0.05	1.36**	1.52**	2.28**	2.91**
R^2		0.05	0.07	0.08	0.08
N		2,299,358	727,266	345,947	145,465

[a] Computer-Assisted Telephone Interview.

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

Notes: Regressions also include controls for size (7 categories), Census 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 standard errors account for multiple observations per establishment. The reported means of the independent variables are based on the sample used for the monthly regression.

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

Table 5. 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	13.01	9.12	3.89	9.24	9.05	0.19	3.77	0.07
10 to 19	10.27	7.30	2.97	7.54	7.37	0.16	2.73	-0.07
20 to 49	8.63	6.52	2.11	7.07	6.84	0.23	1.56	-0.32
50 to 99	7.63	5.65	1.98	6.50	6.05	0.45	1.13	-0.39
100 to 249	5.89	4.42	1.48	5.20	4.90	0.30	0.69	-0.48
250 to 499	5.13	3.78	1.35	4.61	4.33	0.28	0.52	-0.55
500+	4.21	2.84	1.37	3.91	3.62	0.29	0.30	-0.78
Total	9.82	7.05	2.77	7.48	7.24	0.24	2.34	-0.19

Notes: The numbers in the table are averages of absolute percentage changes of employment in consecutive months. The absolute percentage change is computed as $|x_2 - x_1|/(\frac{x_1+x_2}{2})$, where x_1 is employment in the first month and x_2 is employment in the second month. Due to rounding, the differences shown may exactly not equal the difference between the corresponding values.

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

Table 6. 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/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 7. Respondent Reasons for Employment Differences between CES and QCEW

		Program identified			
Type of Reason	Percent	QCEW only	CES only	QCEW & CES	None
Human error	8.1	19.6	41.3	5.4	33.7
Reference period	30.1	73.3	14.4	4.1	8.2
Automatic reporting	3.0	41.2	20.6	8.8	29.4
Employee types	25.2	7.7	25.3	8.1	59.0
Counting checks	5.4	24.6	49.2	3.3	23.0
Worksite differences	9.2	30.8	37.5	6.7	25.0
Data source or timing	5.9	14.9	40.3	20.9	23.9
Don't know	13.2	9.4	16.1	12.1	62.4

Notes: Sample consists of respondents who answered both QCEW and CES sections of questionnaire. The detailed reasons in each type are as follows, with the most common reason listed first.

- Human error: (1) clerical/posting error, (2) BLS error/change request.
- Reference period: (1) monthly count of all who worked, (2) not reporting the pay period including the 12th of the month, (3) quarterly count of all who worked, (4) cumulative count of employees.
- Automatic reporting: (1) error/changes in payroll software and/or processing firm, (2) switched payroll software and/or processing firm, (3) changes to in-house reporting procedures, (3) clean up of records procedures differ.
- Employee types: (1) different employee types included/excluded in employee counts, (2) inconsistent reporting of seasonal workers, (3) layoffs/ closings, (3) turnover.
- Counting checks: (1) counting of checks rather than employees, (2) counting of bonus checks in December.
- Worksite differences: (1) data includes more than one location, (2) CES and QCEW worksites are linked incorrectly, (3) business structure definition change (e.g., buyouts and mergers).
- Data source or timing: (1) manual (or from memory) count/estimation of all employees, (2) reports are compiled at different times, (3) reports generated from different data sources.
- Don’t know: (1) do not know, (2) respondent was not the contact person at the time.

Source: 2008 CES-QCEW Response Analysis Survey.

Table 8. Seasonal 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
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. Reference category for payroll frequency is weekly. 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. Groups for 2008 CES-QCEW Response Analysis Survey

Group	Definition
Dec.-Jan.	Over-the-month change from December 2006 to January 2007 is different in QCEW and CES
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
March-March	Over-the-year change from March 2006 to March 2007 is different in QCEW and CES
Oct.-Dec.	Over-the-quarter change from October to December 2006 is different in QCEW and CES
Control	QCEW and CES employment data were identical (or nearly identical) for all months between January 2006 and March 2007
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.
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.
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 a graduate increase (decrease) in employment over the quarter followed by a decrease (increase) in the first month of the following quarter.
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.
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.

Notes: The definition of each of the first four groups involves computing a change in CES employment (ΔC), the corresponding change in QCEW employment (ΔQ), 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 (using 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