Business employment dynamics: tabulations by employer size

To measure quarterly employment growth by firm size, using Business Employment Dynamics data, BLS chooses dynamic-sizing as the official methodology

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Business Employment Dynamics (BED) data are becoming a major contributor to our understanding of employment growth and business cycles in the U.S. economy. The Bureau of Labor Statistics BED program generates gross job gains and gross job loss statistics that underlie the quarterly net change in employment. These statistics show, for example, that the net growth of 869,000 jobs in the fourth quarter of 2004 is from the sum of 8.1 million gross job gains from opening and expanding establishments, and 7.2 million gross job losses from contracting and closing establishments.

The new BED data have captured the attention of economists and policymakers across the country, and are high quality, high frequency, relatively timely, and historically consistent. The microdata used to construct the gross job gains and gross job loss statistics are from the Quarterly Census of Employment and Wages (QCEW). It is important to note that the BED data were created with no new data collection efforts and with no new additional respondent burden.

Following the initial release of the BED data in September 2003, the BED data series expanded in May 2004 with the release of industry statistics. BLS then began work on tabulations by size class. The production of size-class statistics is a complex task involving several economic and statistical issues. Although it is trivial to classify a business into a size class in any given quarter, it is difficult to classify a business into a size class for a longitudinal analysis of employment growth. Several different classifications exist, and many of these possible classifications have appealing theoretical and statistical properties. Furthermore, these alternative classification methodologies result in sharply different portraits of employment growth by size class.[1]

This article discusses the alternative statistical methodologies that BLS considered for creating size-class tabulations from the BED data. Our primary focus is to compare and contrast four alternative methodologies: quarterly base-sizing, annual base-sizing, mean-sizing, and dynamic-sizing, and to discuss the evaluation criteria that BLS considered for choosing its official size-class methodology. Although BLS is making the seasonally adjusted data series from all the classification methodologies available for research purposes, one methodology had to be chosen as the official methodology for citation and analysis in the quarterly BED press release. This is analogous to the calculation of the unemployment rate from the Current Population Survey—BLS produces and releases six different unemployment rates {U1, U2, …, U6}, yet refers only to the official unemployment rate, U3, in the text of the monthly employment situation press release.[2] After careful consideration of the four methodologies, BLS chose dynamic-sizing as the official methodology for the BED size-class statistics.

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The economics of employer size

Many BLS employment statistics are for the Nation as a whole, with additional detail provided for industry and geographical breakdowns. The BLS Quarterly Census of Employment and Wages program also produces statistics by employer size. Some interesting aspects about the U.S. economy are evident in these cross-sectional QCEW employer-size statistics.

Empirical findings about employer size. Two of the most interesting empirical findings about the role of employer size in the U.S. economy involve the relationships between employer size and number of employees and between employer size and wages earned. First, although most establishments are small, most people work in mid-sized and large establishments. Table 1, which documents the number of establishments and their employment by size class, shows that 60 percent of establishments have less than 5 employees, and 17 percent of establishments have between 5 and 9 employees.[3] Most establishments in the United States are small: 88 percent of establishments have less than 20 employees, 95 percent of establishments have less than 50 employees, and 98 percent of establishments have less than 100 employees.

Table 1 also shows that employment is more evenly spread through the size class distribution. Only 7 percent of employment is in establishments with less than 5 employees, and 26 percent of employment is in establishments that have less than 20 employees. Although only 0.1 percent of establishments (5,487 establishments) have 1,000 or more employees, 11 percent of employment is in these largest establishments. Similarly, 43 percent of employment is in the 2 percent of establishments that have 100 or more employees, and 57 percent of employment is in the 5 percent of establishments that have 50 or more employees. The data in table 1 clearly show that the majority of U.S. employment is concentrated in a small percentage of all U.S. establishments.

A second empirical finding about the economics of employer size is that workers in large establishments earn more than workers in small establishments. This is seen in chart 1, where the average weekly wages are graphed for each size class.[4] With the exception of the smallest size class (less than 5 employees), weekly wages are monotonically increasing with establishment size. Employees who work in establishments with 5 to 9 employees earn, on average, $585 per week, and employees who work in establishments with 50 to 99 employees earn, on average, $703 per week. Workers employed in the largest establishments—those with 1,000 or more employees, earn on average $1,156 per week.

There is a large literature in economics that attempts to explain why the wages of individuals are positively associated with the size of their employer.[5] Briefly, the evidence from this literature suggests that theories based on compensating differentials; union avoidance; monitoring; and rent sharing accruing from product market power contribute little to explaining the employer-size wage differential. Sorting of workers into establishments is a more likely possibility: analysts have found that firm size coefficients are reduced by roughly one-half when observed labor quality variables are added to a wage regression, and controlling for unobserved labor quality in a longitudinal fixed effects regression further reduces the firm size coefficients. Even so, there remains a significant size effect after controlling for both observed and unobserved labor quality.[6] Recent work using linked employer-employee microdata allows one to evaluate explanations that could not have been analyzed using most analytical databases. This recent research finds that more skilled workers tend to work together, and this matching reduces the employer-size wage premium by approximately 20 percent, yet a large and significant employer-size wage premium still exists and remains unexplained.[7] Although it is an accepted fact that workers in large firms earn more, economists have not yet conclusively answered why this is so.

Who creates the most jobs? One of the most discussed topics about employer size is the question of who creates the most jobs: small businesses or large businesses? Policymakers often cite an important role for small businesses in creating jobs. Data analysts have known for a long time that estimating the number of jobs created by small businesses is extremely sensitive to the statistical methodology used. This was explained by Steven Davis, John Haltiwanger, and Scott Schuh, and was recently confirmed in an article by Cordelia Okolie, using BED microdata.[8] As Okolie shows in table 2 of her article, a quarterly base-sizing methodology credits the smallest size class (firms with 1-4 employees) with net employment growth of more than 900,000 jobs, whereas an end-sizing methodology states that this smallest size class had net employment losses of almost 200,000 jobs. These statistics highlight how alternative methodologies for assigning firms to size classes can result in very different conclusions regarding whether small businesses or large businesses are responsible for the creation of new jobs.

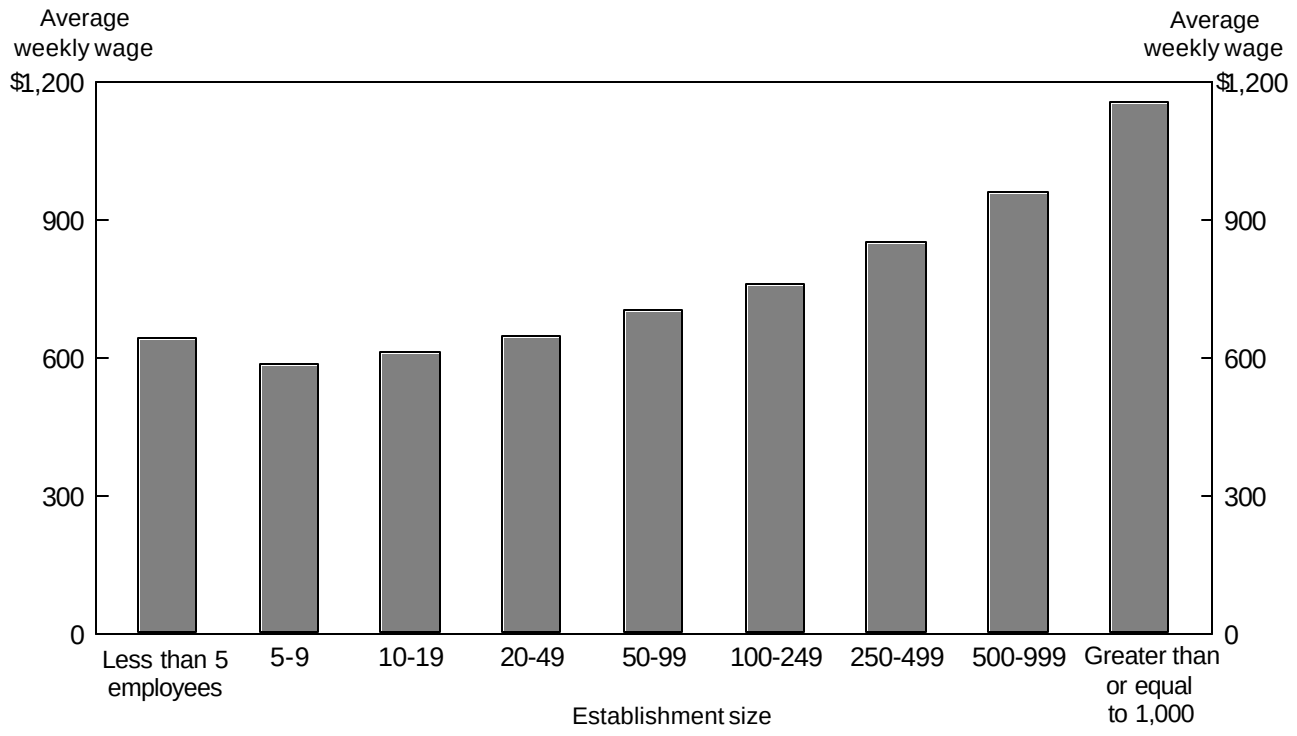
Size class methodologies

An overview of the issues. In her article, Okolie mentions three methodology issues that influence the calculation and interpretation of business employment dynamic statistics by size class. The first is how businesses should be classified into size classes when constructing net and gross job flow statistics. Okolie's analysis showed that this is the most important methodology issue, and further discussion and analysis of this issue is the focus of this article. The second issue

Table 1. Number of establishments and employment, by size class, first quarter 2004, QCEW data

Size class	Number of establishments	Employment	Share of establishments	Employment (in percent)	Cumulative number of establishments (in percent)	Cumulative employment (in percent)
Total	7,933,974	105,583,548	...	...	...	...
Less than 5	4,768,812	7,095,128	60.1	6.7	60.1	6.7
5–9	1,331,834	8,810,097	16.8	8.3	76.9	15.1
10–19	872,241	11,763,253	11.0	11.1	87.9	26.2
20–49	597,662	18,025,655	7.5	17.1	95.4	43.3
50–99	203,030	13,970,194	2.6	13.2	98.0	56.5
100–249	115,598	17,299,058	1.5	16.4	99.4	72.9
250–499	28,856	9,864,934	.4	9.3	99.8	82.2
500–999	10,454	7,090,739	.1	6.7	99.9	89.0
Greater than or equal to 1,000	5,487	11,664,490	.1	11.0	100.0	100.0

Chart 1. Average weekly wage by establishment size, first quarter 2004 QCEW data



involves the appropriate measure to use in the denominator when calculating net and gross job flow rates. Okolie found that this had very small effects on the net employment growth statistics, and this issue is not discussed further in this article. The third issue is whether the establishment or the firm should be the unit of analysis, and this is briefly discussed in the following section.

Firm or establishment? There are valid arguments for choosing either the firm or the establishment as the unit of

analysis for producing BED size class tabulations. On the one hand, if employment changes are the result of decisions made at corporate headquarters, then the firm is the appropriate unit for analyzing the expansion and contraction of businesses. On the other hand, if employment changes are the result of individual establishment decisions based upon local labor market conditions, then the establishment is the appropriate unit to analyze business expansions and contractions. Although the truth obviously lies somewhere between these two extremes—employment changes at individual establishments are affected by both corporate decisions and by local factors—BLS has decided that firm-level data best satisfy user needs for net and gross job flow statistics by size class. This decision was made after consultations with users and with BLS advisory committees, and after a review of how other international statistical agencies produce their longitudinal size-class tabulations. The Employer Identification Number (EIN) is the firm-level identifier used to create the BED size-class statistics. The seasonally adjusted time series of size-class statistics shown later in this article are all firm-level statistics.[9]

The four methodologies under consideration. As mentioned earlier, this article discusses four methodologies for determining employer size class: quarterly base-sizing, annual base-sizing, mean-sizing, and dynamic-sizing. Quarterly base-sizing and mean-sizing were discussed in the Okolie article. Based upon conversations with users and with BLS advisory committees, BLS has determined that the end-sizing methodology discussed by Okolie is not a viable option, and thus end-sizing is not discussed in this article. Annual base-sizing and dynamic-sizing are two methodologies that were introduced for evaluation following the publication of Okolie's article.

There are many ways that firms can be classified into size classes for a longitudinal analysis of employment growth. Employment growth is measured as the change in the size of the firm from one quarter to the next. One possible classification methodology is to use the firm's size in the first of the two quarters; this is called quarterly base-sizing. Mean-sizing is a methodology that classifies the firm based upon the average size of the firm in the previous and the current quarter. A specific example may help illustrate these two methodologies. Assume that a firm grows from 3 employees in June (the second quarter) to 13 employees in September (the third quarter). Using the quarterly base-sizing methodology, the firm had 3 employees in the initial quarter and would be classified in the "1–4" size class category. Using the mean-sizing methodology, the mean of 3 and 13 is 8, and this firm would be classified in the "5–9" size class. The firm's growth of 10 employees would be attributed to the "1–4" size class under quarterly base-sizing, and would be attributed to the "5–9" size class under mean-sizing. This example begins to hint how alternative classification methodologies can have a large impact on how employment growth is attributed to different size classes.

Annual base-sizing is a methodology that classifies a firm based upon its size class in the most recent March (the first quarter of the year, as measured in the BED program). In the example of the previous paragraph, the second to third quarter growth of 10 employees would be attributed to the size class of the firm as it was classified in the first quarter of the year (which is unknown in this simple example). As described in more detail later in this article, annual base-sizing has some appealing statistical properties that remedy some of the perceived faults of the quarterly base-sizing methodology.

Dynamic-sizing is a straightforward measurement methodology that allocates a firm's quarterly employment growth or loss to each respective size class in which the growth or loss occurred. Firms are initially assigned to a size class each quarter based on their employment in the previous quarter, but are re-assigned to a new size class during the quarter when their employment change indicates that a size-class threshold has been crossed. In the example of a firm growing from 3 to 13 employees, the growth of 10 would be allocated as follows: size class "1–4" would be credited with the growth of 1 employee (the growth from 3 to 4), size class "5–9" would be credited with the growth of 5 employees (the growth from 4 to 9), and size class "10–19" would be credited with the growth of 4 employees (the growth from 9 to 13).[10] The methodology of dynamic-sizing—also referred to as momentary-sizing—was initially proposed by Professor Per Davidsson in two research papers in the mid-to-late 1990s.[11]

Dynamic-sizing is based on a measurement process which assumes continuous linear employment growth or loss from one quarter to the next, with the growth or loss allocated into the appropriate size class at the moment it occurred. In the example of a firm growing from 3 employees in June to 13 employees in September, this growth of 10 employees can be linearly modeled as the growth of 1 employee every 9 days (13 weeks from one quarter to the next, 7 days per week, and 10-employee growth over these 91 days). If a firm's employment change could be measured on a daily basis, and if this employment change occurred linearly within the quarter, then the statistics from this measurement process would be equivalent to the statistics from dynamic-sizing with quarterly point-in-time employment data.

Methodology matters—a simple example. The example in the previous paragraphs shows that the four methodologies differ in how they allocate employment growth and loss to employer size classes. We now add one more wrinkle to this

simple example by asking: What happens when employment returns to its original level the following quarter? Specifically, assume that a firm grows from 3 employees in the second quarter to 13 employees in the third quarter, and then declines back to 3 employees in the fourth quarter. Chart 2 presents the third and fourth quarter net employment growth statistics by size class computed under the four methodologies.

The upper left corner of chart 2 shows the net employment growth statistics for this example computed under the quarterly base-sizing methodology. The growth of 10 employees, from 3 to 13, is attributed to the "1–4" size class (classified on the base period employment of 3), and the following quarter's decline of 10 employees, from 13 to 3, is attributed to the "10–19" size class (classified on the base period employment of 13). In this particular example with a quarterly base-sizing methodology, small firms get credit for creating jobs, whereas larger firms get credited for losing jobs.

The middle left panel of chart 2 shows the net employment growth statistics for this example computed under the mean-sizing methodology. The growth of 10 employees and the decline of 10 employees both get credited to the "5–9" size class (because the mean employment level for both the growth from 3 to 13 and the decline from 13 to 3 is 8). The mean-sizing methodology imposes symmetry in this example; the growth and the following decline back to the initial level of employment are allocated to the same size class.

The bottom left corner of chart 2 shows the net employment growth statistics for this example computed under the dynamic-sizing methodology. Similar to the mean-sizing methodology, the dynamic-sizing methodology results in statistics that are symmetrical for the expansion and the following contraction. However, in this example, the dynamic-sizing methodology allocates the jobs gained in the expansion and the jobs lost in the contraction to multiple size-class categories, whereas the mean-sizing methodology allocates all jobs gained and all jobs lost to one size-class category.

The three right panels of chart 2 show the net employment growth statistics for this example computed under the annual base-sizing methodology. Three panels are given because we do not know from this simple example what the employment was in March of the given year. If March employment was 3, then the annual base-sizing methodology allocates all the growth and all the decline to the "1–4" size class category. If March employment was 8 or 13 (two of many possibilities), then the net employment growth and following decline is allocated to the "5–9" or the "10–19" size class, respectively. Similar to mean-sizing and dynamic-sizing, the annual base-sizing statistics are symmetrical for the expansion and the contraction in this specific example.[12]

Transitory and reverting changes

Background. The example in the previous section shows how alternative classification methodologies can allocate net employment growth and decline to different size classes. Furthermore, and crucially important in analyzing which employers create the most jobs, this example also shows how some methodologies, relative to others, can systematically allocate employment growth into smaller size categories while allocating employment decline into larger size categories. This effect is often referred to as regression to the mean bias.[13]

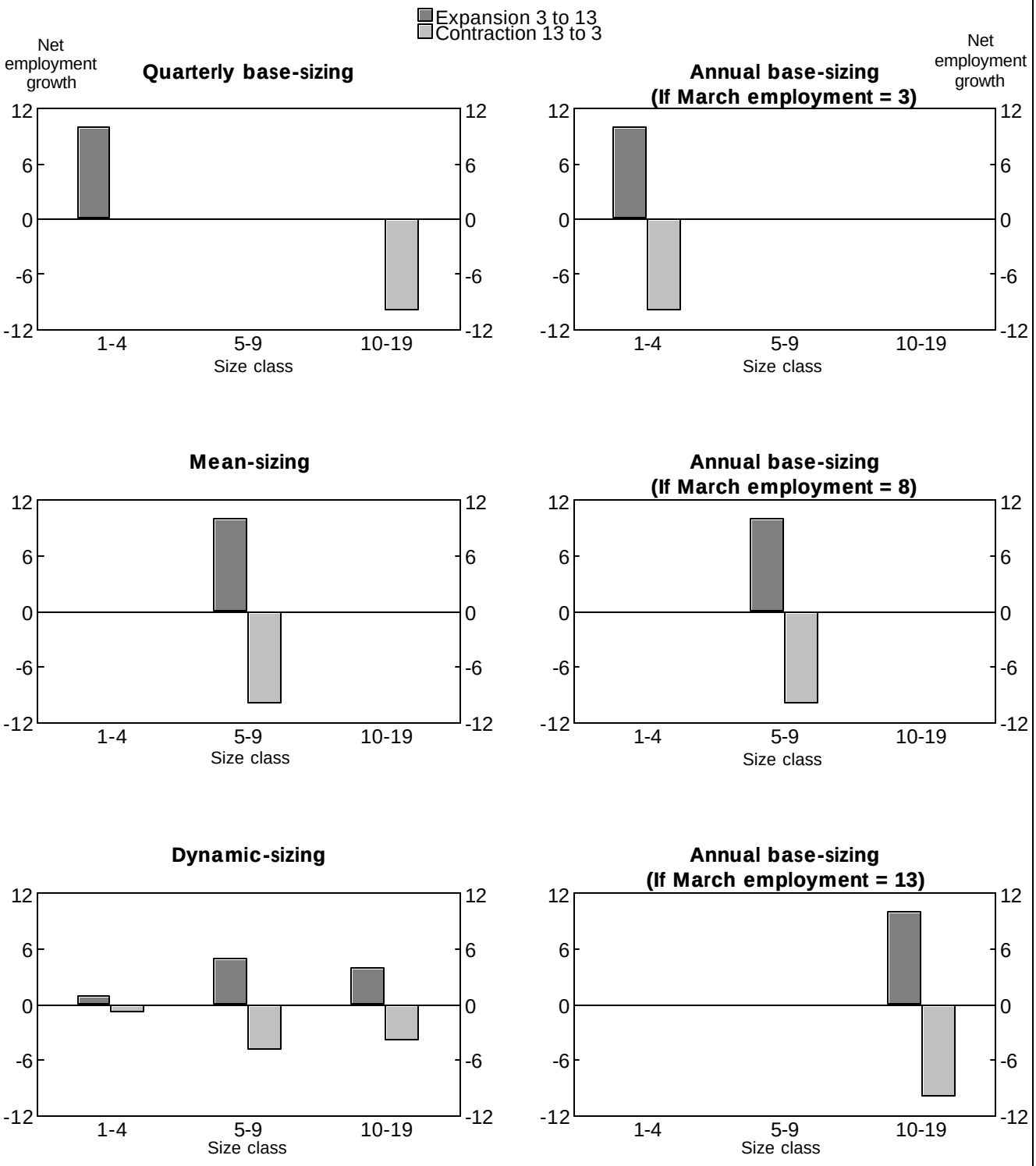
We do not believe that the so-called regression to the mean effects are a bias. The quarterly base-sizing statistics are measuring exactly what they are designed to measure for a quarter, and the fact that these statistics treat growth and decline nonsymmetrically is not a bias. Measuring bias in a statistically rigorous way implies knowing the truth and measuring how an estimator deviates from this truth. We view symmetry as a desirable property for an estimator, but we do not view symmetry as the truth.

In the example used in the previous section, the symmetry (or lack of) in the net employment change estimates calculated under the various methodologies can be traced back to firms that cross a size-class boundary twice within a given time interval. The firm in the example grew out of the "1–4" size class, through the "5–9" size class, and into the "10–19" size class, and then the following quarter it declined out of the "10–19" size class, back through the "5–9" size class, and into the "1–4" size class. Thus, within two quarters, the firm in this example crossed the size class boundary separating the "1–4" and "5–9" categories twice—once in each direction—and also crossed the size class boundary separating the "5–9" and "10–19" categories twice (again, once in each direction).

Seasonality is a major reason why a firm may cross a size-class boundary twice within a given time interval. Many industries have very large and predictable seasonal swings in employment. If we analyze quarterly changes in employment levels over the course of a year, seasonality will lead to transitory and reverting changes in employment. For example, an amusement park in a northern climate may have 75 employees in the summer, yet only have 2 or 3 maintenance employees on the payroll during the winter. This amusement park would cross multiple size class boundaries twice during the course of a year, as it moves out of the "1–4" and into the "50–99" size class in the spring and summer, and then falls out of the "50–99" size class and back into the "1–4" size class in the fall and winter.

There are several other reasons why a firm might cross a size class boundary twice within a given time interval. A transitory and reverting decline in employment (for example,

Chart 2. **Example of net employment growth by size class, four different classification methodologies**



from 5 to 4 and then back to 5) would occur when an employee leaves a firm and it takes time to fill the resulting vacancy. Similarly, a transitory and reverting increase in employment may occur (for example, from 4 to 5 and then back to 4) if a firm hires someone in expectation of a forthcoming retirement. Measurement error is another reason why firms may have transitory and reverting changes in employment. In the example of the previous section, in which the three quarters of employment were {3, 13, 3}, the firm might have mistakenly reported an employment level of 13 in the middle quarter when it meant to report an employment level of 3.

Regardless of the source of the transitory and reverting change in employment, firms that cross a given size-class boundary twice within a given time interval would lead to statistics that show small firms creating jobs and large firms losing jobs when employment growth is classified into size classes with a methodology that does not impose symmetry on employment growth and decline. The questions that we ask in this section are: Whether and to what extent do establishments in the BED microdata exhibit such growth and decline across size-class boundaries? And what effect do these transitory and reverting changes in employment across size-class boundaries have on the net employment growth statistics when tabulated under alternative methodologies?

Empirical analysis. We analyze the incidence and the effect of transitory and reverting changes in employment across size class boundaries using the universe of establishments that have positive employment in the first quarter of 1999 and first quarter of 2000. Our restriction to positive employment in both periods removes births and deaths from our sample, and gives us a balanced panel of establishments that are alive in all five quarters of the analysis. We remove births and deaths because the establishments that are born in the second quarter of 1999 have several quarters to experience transitory and reverting changes in size class, whereas establishments born in the first quarter of 2000, are not able, in our sample, to experience a transitory and reverting change. We believe that focusing on continuous establishments with positive employment in the first quarter of each year is the best sample for simplicity in both the analysis and the interpretation of the data.[14]

The incidence of transitory and reverting changes in size classes in the five quarters starting with the first quarter of 1999 to the first quarter of 2000 is documented in table 2. The first column of table 2 shows that the analysis sample has 5.3 million continuous establishments with an average quarterly employment of more than 100 million jobs.[15] The second column shows that 80.6 percent of these establishments do not cross a given size class boundary twice during the year. The third column shows that 19.3 percent of establishments (1.028 million establishments) make a transitory and reverting change in size class during the year. These establishments represent 15.9 percent of employment in continuous units. The bottom 3 rows of table 2 show that the two unique samples have identical net employment growth rates of 0.6 percent, but the sample of establishments with transitory and reverting changes in size class have gross job gains and gross job loss rates that are more than three times higher than the sample of establishments without transitory and reverting changes in employment. This relatively large amount of gross job gains and gross job losses in the businesses with transitory and reverting changes in size class suggests a strong potential for the quarterly base-sizing methodology to systematically allocate growth and decline to different size-class categories.

The observed transitory and reverting changes in size class can occur many ways. More than three-fourths of these 1.028 million establishments are in the same size class in both the first quarter of 1999 and first quarter of 2000, yet were in a different size class at some point during the second, third, and/or fourth quarters of the year. The other 22 percent of establishments with a transitory and reverting change in size class during the year were either annual expansions or annual contractions, and crossed a given size class boundary twice during the year.[16] For the 1.028 million establishments that have a transitory and reverting change in size class during the year, table 3 lists the 15 most frequent temporal patterns describing which size class they are in during the five quarters—first quarter 1999 through first quarter of 2000. The most frequent pattern, experienced by 37,570 establishments, is starting in size class "1–4" during the first quarter of 1999 expanding into size class "5–9" during the second quarter of 1999, and then declining back into size class "1–4" and remaining there for the following three quarters—third quarter 1999 through first quarter 2000.

For establishments that cross a size class boundary twice during the year, the data in table 3 show that the 11 most frequent patterns are establishments that are in the same size class for four of five quarters, and being in an adjacent size class for only one quarter. This is not suggestive of seasonality, because one would expect a seasonal firm to have increased employment for several quarters during the year. The 14th row of table 3 shows that 16,476 establishments are in size class "1–4" during the first quarter of both 1999 and 2000, and are in size class "5–9" during the other three quarters of the year. These are likely to be seasonal firms, such as small landscaping companies that have more employment in the warmer quarters of the year than in the colder quarters of the year. One additional observation about table 3 is that most frequent temporal patterns involve the smallest two size classes (1–4 and 5–9), which suggests that the largest effects of transitory and reverting changes in size class should be observed for the smallest size classes.

Table 2. Effects of transitory and reverting changes in size class among continuous establishments, Business Employment Dynamics microdata, first quarter 1999 through first quarter 2000

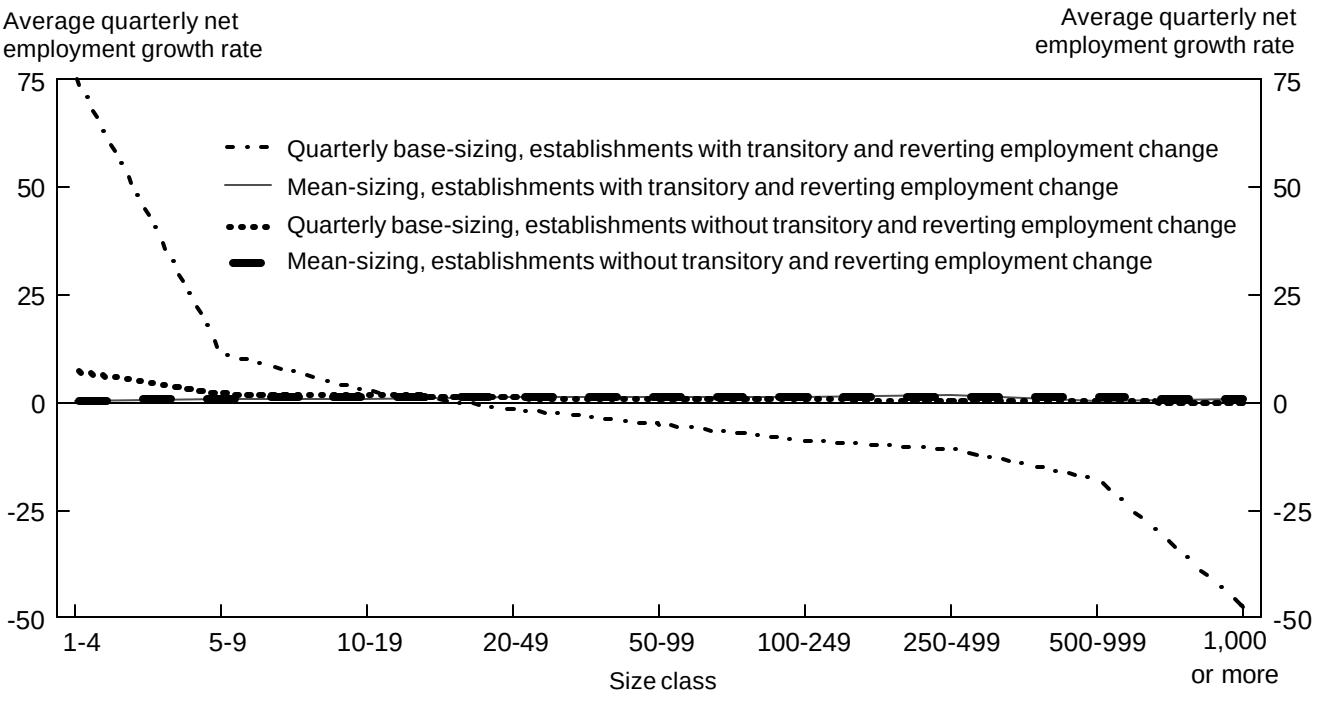
Measure	All establishments	Establishments without a transitory and reverting change in size class	Establishments with a transitory and reverting change in size class
Number of establishments	5,324,506	4,296,241	1,028,265
Share (in percent)	(100.0)	(80.6)	(19.3)
Average quarterly employment	100,633,651	84,582,061	16,051,590
Share (in percent)	(100.0)	(84.0)	(15.9)
Average quarterly employment change	577,869	489,992	87,877
Share (in percent)	(100.0)	(84.7)	(15.2)
Average quarterly gross job gains	6,612,451	4,095,154	2,517,297
Share (in percent)	(100.0)	(61.9)	(38.0)
Average quarterly gross job losses	6,034,582	3,605,162	2,429,420
Share (in percent)	(100.0)	(59.7)	(40.2)
Average quarterly employment change (in percent)	.6	.6	.6
Average quarterly gross job gains (in percent)	6.6	4.8	15.6
Average quarterly gross job losses (in percent)	6.0	4.3	15.0

Table 3. Patterns of transitory and reverting change in size class among continuous establishments, Business Employment Dynamics microdata, first quarter 1999 through first quarter 2000

Pattern	Size class in—					Frequency	Percent
	Quarter I 1999	Quarter II 1999	Quarter III 1999	Quarter IV 1999	Quarter I 2000		
Total	...	...	...	...	...	1,028,265	100.0
1	1–4	5–9	1–4	1–4	1–4	37,570	3.7
2	1–4	1–4	0	1–4	1–4	36,666	3.6
3	1–4	1–4	1–4	0	1–4	36,145	3.5
4	1–4	0	1–4	1–4	1–4	35,307	3.4
5	1–4	1–4	1–4	5–9	1–4	34,698	3.4
6	1–4	1–4	5–9	1–4	1–4	28,049	2.7
7	5–9	5–9	5–9	10–19	5–9	25,970	2.5
8	5–9	10–19	5–9	5–9	5–9	23,210	2.3
9	5–9	5–9	1–4	5–9	5–9	20,536	2.0
10	5–9	5–9	5–9	1–4	5–9	20,508	2.0
11	5–9	1–4	5–9	5–9	5–9	20,387	2.0
12	1–4	5–9	5–9	1–4	1–4	19,589	1.9
13	5–9	5–9	10–19	5–9	5–9	17,651	1.7
14	1–4	5–9	5–9	5–9	1–4	16,476	1.6
15	1–4	1–4	5–9	5–9	1–4	14,469	1.4
Other	...	...	...	...	...	641,034	62.3

The data in chart 3 show the average quarterly net employment growth rate, by size class, first quarter 1999 through first quarter 2000, for establishments with and without a transitory or reverting change, computed under two different classification methodologies—quarterly base-sizing and mean-sizing. Several conclusions from chart 3 warrant mention. The two alternative methodologies result in relatively similar net employment growth rates for the sample of 4.3 million establishments without transitory and reverting changes in employment. However, as expected, the size classification methodology does have a large effect on the net employment growth rates for the sample of 1.028 million establishments that cross a given size class boundary twice during the year. The statistics computed with the quarterly base-sizing methodology show that the smallest establishments in size class "1–4" have a net employment growth rate of 76 per-

Chart 3. **Employment growth for continuous establishments with or without transitory and reverting changes in size class, using two methodologies, first quarter 1999 to first quarter 2000**



SOURCE: Business Employment Dynamics microdata.

cent, and the largest establishments in size class "1,000 or more" have a net employment growth rate of negative 47 percent. This is in contrast to the statistics for the same sample computed with a mean-sizing methodology, which shows net employment growth rates for all size classes between 0 percent and 2 percent.

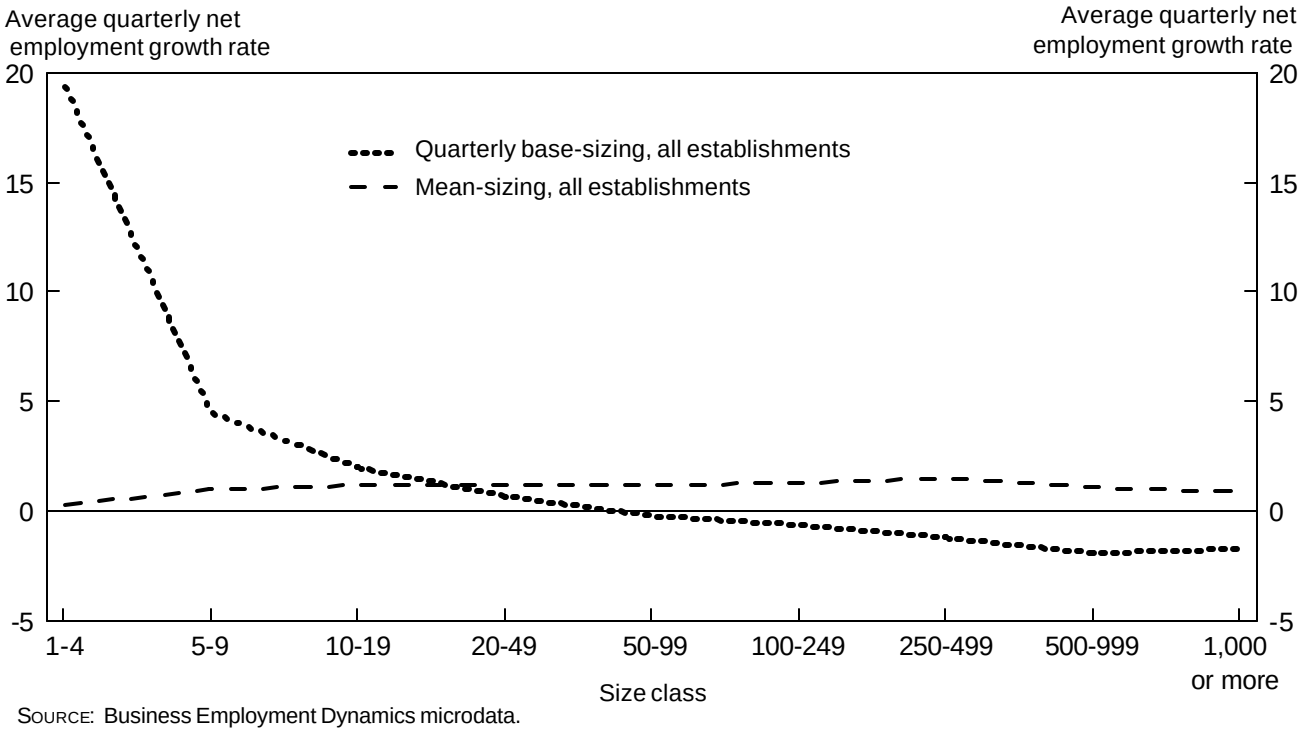
Chart 4 shows the average quarterly net employment growth rates, by size class, for the entire universe of the 5.3 million continuous establishments as computed under the two alternative methodologies. The quarterly base-sizing methodology shows a net employment growth rate that is essentially monotonically declining with size class: the smallest establishments in size class "1–4" have a net growth rate of 19.5 percent, whereas the largest establishments in size class "1,000 or more" have a net growth rate of –1.7 percent. In contrast, the mean-sizing methodology shows a growth rate between 0.3 and 1.5 percent for all size classes. These statistics in chart 4 are similar to the statistics in table 1 of the Okolie article.[17]

In summary, there are three primary findings to be drawn from the empirical analysis in this section. First, 19 percent of continuous establishments in the BED quarterly microdata exhibit transitory and reverting changes across size class during a 1-year period. Second, the net employment growth rates, by size class, for this sample of establishments are extremely different when computed under alternative methodologies. The quarterly base-sizing methodology results in statistics that show the smaller establishments creating jobs and the larger establishments losing jobs, whereas the mean-sizing methodology shows essentially no differences in the net employment growth rate across size classes. And third, the net employment growth rates for the sample of establishments without transitory and reverting changes in size class exhibit relatively little difference when computed under alternative methodologies. What is the interpretation of these findings? Transitory and reverting changes in size class have often been cited as the underlying cause of why different methodologies result in different net employment growth statistics. Our analysis confirms and quantifies this using the BED microdata. This result will play a large role in the evaluation of different methodologies for the official BED size classification methodology.

Evaluation criteria and analysis

BLS considered several evaluation criteria for choosing an official methodology from the four possible size classification methodologies—quarterly base-sizing, annual base-sizing, mean-sizing, and dynamic-sizing. The empirical analysis of the effects of transitory and reverting changes in size

Chart 4. Employment growth for all continuous establishments by size class, using two methodologies, first quarter 1999 to first quarter 2000



SOURCE: Business Employment Dynamics microdata.

class in the previous section points to symmetry as being a critical criterion for the evaluation. The other criteria used for the evaluation are [a] how births are treated by the alternative methodologies, [b] consistency with other BLS classification methods, [c] whether the statistics exhibit additivity across quarters, and [d] whether the methodology is comprehensible to users of the Business Employment Dynamics data.

Symmetry. For firms that cross a size-class boundary twice within a given period of time, the quarterly base-sizing methodology will attribute the firm's growth to the smaller size class below the boundary, and will attribute the firm's job loss to the higher size class above the boundary. The analysis in the previous section showed substantial effects resulting from these transitory and reverting changes in size class. Furthermore, the statistics computed under the quarterly base-sizing methodology in chart 4 indicate that continuous establishments with 50 or more employees did not contribute any net employment growth to the economy during the first quarter 1999–first quarter 2000. Although there is no "truth" upon which to evaluate this, we find it implausible that mid-sized and large-sized establishments did not create (on average) any net new jobs in a high-growth year when the sample of continuous businesses created more than 2.3 million jobs.

BLS has decided that the nonsymmetrical effects resulting from transitory and reverting employment changes across size class boundaries need to be factored out of the Business Employment Dynamics data by employer size class. As such, quarterly base-sizing will not be selected as the official methodology for the Business Employment Dynamics data by employer size. The annual base-sizing, mean-sizing, and dynamic-sizing methodologies all impose symmetry on the net employment growth statistics for firms with transitory and reverting changes in employment across size class boundaries.[18]

Treatment of births. The alternative methodologies differ in how they treat business births. The quarterly and annual base-sizing methodologies both classify firms based upon their size in some previous quarter, but the fact that births do not exist in previous quarters presents a challenge. Two approaches can be used to overcome this problem: a "zero size class" category can be defined for births to reflect their nonexistence in the previous quarter, or the employment associated with firm births can be measured in the current quarter when the births first appear with positive employment. We have found the first option to be intractable—in any given quarter, opening establishments create more than 1.5 million

new jobs, which is higher than the total net employment growth for any quarter. The second option (defining the size class of births based upon their current quarter employment) can be justified as the best measure of the intended size of a birth, but this results in births being treated differently than all other firms in both the quarterly and the annual base-sizing methodologies.

Unlike the quarterly and the annual base-sizing methodologies, mean-sizing treats births in the same manner as it treats continuous units for the purpose of assigning firms to size classes. Under mean-sizing, a firm is defined to a size class based upon the average employment in the current and the previous quarter. For births, the employment in the previous quarter is zero, and for deaths, the employment in the current quarter is zero. Thus, the size class of births is based upon one-half their employment in the current quarter, and the size class of deaths is based upon one-half of their previous quarter employment. This mean-sizing approach for classifying business births and deaths is not intuitively obvious.

The dynamic-sizing methodology appears to handle births and deaths the best. By definition, the movement from 0 to 1 employees and the movement from 1 to 0 employees are both credited to the "1–4" size class. Any birth with 4 or fewer employees in its first quarter of existence will have all employment growth attributed to the "1–4" size class, and any death with 4 or fewer employees in its last quarter will have all employment loss attributed to the "1–4" size class. A birth or death involving 5 or more employees would have 4 jobs gained or lost credited to the "1-4" size class, and the remaining jobs gained or lost would be credited to the "5–9" and higher size classes, as appropriate.

Consistency with other BLS classification methods. In the QCEW program, which is the source data for the BED statistics, a distinction is made between economic code changes and noneconomic code changes. An economic code change occurs when an establishment actually changes its location, industrial activities, and/or sector (for example, Federal, State, local government, or private sector) and that change can be identified in a timely manner and can be reflected in the reference period of the data when it occurred. Noneconomic code changes are much more frequent than economic code changes. Noneconomic code changes occur when the establishment's industrial activity, location, or sector was coded in error, changed gradually from one primary location or activity to another, reflected a structural change to the codes (for example, a change from the 2002 NAICS to the 2007 NAICS codes), or changed but the reference period of the change cannot be determined. Economic code changes are introduced immediately, whereas noneconomic code changes are held until the following first quarter, at which time all changes in classification codes collected through the year are implemented. This methodology is optimal for analyzing the time series of employment changes within industries or geographies within a year's data.

The annual base-sizing methodology proposed for the BED size class statistics is modeled on this statistical methodology that BLS uses for industry and geography classifications. That is, just as changes in industry and geography codes are often held constant through the year, the size class of a firm should also be held constant through the year. However, analyzing employment changes based upon industry or geography is conceptually different than analyzing employment changes based upon firm size, in that the variable of interest (employment change) is directly related to the classification variable (employer size). Whether holding or not holding the size classification of a firm fixed throughout the year is desirable for a continuous quarterly measurement process for the BED size-class data requires a subjective weighting of the strengths and weaknesses inherent in this approach.

Additivity across quarters. One criterion that has been proposed for evaluating the various size classification methodologies is the additivity of size class statistics across quarters. Specifically, do the quarterly net employment growth statistics by size class add up across quarters to the same net employment growth statistics by size class that would be computed from a longer measurement frequency such as an annual March-to-March change?[19] If the employment changes occur within the year, rather than spanning a March when the firm's size class is redefined, the annual base-sizing methodology satisfies the additivity criterion. For example, if a firm grows from 3 to 9 between March and June, grows from 9 to 13 between June and September, and then stays at 13 for the following several quarters, the annual base-sizing methodology would put the 6-job gain from 3 to 9 in the "1–4" size class, and would put the 4-job gain from 9 to 13 in the "1–4" size class. These quarterly changes sum to the annual March to March change of 10 employees credited to the "1–4" size class.

Quarterly base-sizing and mean-sizing do not satisfy the additivity criterion between quarterly and annual measurements. In the example of the previous paragraph, quarterly base-sizing would put the 6-employee gain from 3 to 9 in the "1–4" size class, would put the 4-employee gain from 9 to 13 in the "5–9" size class, but would put the 10-employee annual gain in the "1–4" size class. Mean-sizing would put the 6-employee gain from 3 to 9 in the "5–9" size class, would put the 4-employee gain from 9 to 13 in the "10–19" size class, but would put the 10-employee annual gain from 3 to 13 in the "5–9" size class.

Dynamic-sizing satisfies the additivity criteria. In the specific example, the quarterly gain of 6 employees from 3 to 9 would be classified as 1 job gained in the "1–4" size class

and 5 jobs gained in the "5–9" size class, and the quarterly gain of 4 employees from 9 to 13 would be classified as 4 jobs gained in the "10–19" size class. The annual gain from 3 to 13 would result in the exact same statistics: 1 job gained in the "1–4" size class, 5 jobs gained in the "5–9" size class, and 4 jobs gained in the "10–19" size class.

Comprehensibility. Our final and admittedly subjective evaluation criterion is that of comprehensibility. Users of the BED data by employer size must be able to understand the underlying size classification methodology in order to properly interpret the resulting statistics.

Perhaps the most intuitive classification methodology for an analysis of job growth by size class is quarterly base-sizing, which answers the question: "Where does quarterly job growth originate?" The quarterly base-sizing methodology falls naturally out of a transition matrix which relates how firms move from one size class to another, and quarterly base-sizing has parallels to the way most people calculate percentages. However, due to its problems with transitory and reverting changes across size classes, the quarterly base-sizing method was dismissed earlier when discussing symmetry.

The annual base-sizing methodology has some issues associated with regard to its comprehensibility. When measuring employment growth between the first and second quarters in relation to the firm's size class in the first quarter, the annual base-sizing statistics answer the intuitive question of where does quarterly growth originate. However, the annual base-sizing methodology measures the second to third quarter employment growth by a firm's size class in the first quarter, which unfortunately does not provide a simple answer to the question of where quarterly growth originates in the second quarter. The annual base-sizing methodology is the correct methodology for a cohort analysis—following a well defined set of firms across multiple quarters, but does not provide a continuous methodology for measuring quarterly employment growth by size class.

Our discussions with users and with our advisory groups, as well as our reading of the literature, has resulted in a multitude of reactions regarding the comprehensibility of the mean-sizing methodology. The negative reaction is focused on three premises: firms with large employment changes may be assigned to a size class that is different from the size class defined by either of the quarterly cross-sectional measures of employment; classifying firms into a size class based upon an average is conceptually much different that classifying firms into industries or geographies; and similar employment changes can be treated differently (for example, an expansion from 1 to 7 employees would classify 6 jobs gained in the "1–4" size category, whereas an expansion from 1 to 8 employees would classify 7 jobs gained in the "5–9" size category). These criticisms are said to result in the mean-sizing statistics being difficult to interpret. However, advocates of the mean-sizing approach recommend it as a statistical correction for regression to the mean effects. When pressed further, advocates of mean-sizing cite the economic rationale of mean-sizing being the best available measure of the long-run size of the firm. In any quarter, some firms are expanding and some are contracting, and some of these employment changes are temporary and some are movements along a long run path of growth or decline. In the absence of more information such as previous and future employment levels, the average of the employment levels from the two quarters is the best statistical measure of the firm's long-run employment when only two measures of quarterly employment are available. After extensive discussion with users and amongst ourselves, we have come to the conclusion that mean-sizing would be an acceptable, but certainly not a unanimous first choice of methodologies.

Does dynamic-sizing satisfy the comprehensibility criterion? Dynamic-sizing is a new size classification methodology and, as yet, has not been implemented by other national statistical agencies, nor has it been implemented by either statisticians or economists.[20] The methodology of dynamic-sizing is premised on an underlying model of point-in-time measurement of size-class change from a continuously linear growth process, and has a straightforward measurement methodology along with desirable statistical and economic properties. Because dynamic-sizing is a new methodology, BLS will engage in user education and outreach activities about this methodology, of which this article is a start.

Summary of the evaluation. As discussed in the earlier analysis, annual base-sizing measures where growth originates in a fixed cohort type analysis, whereas dynamic-sizing provides a more current evolving picture of size class growth on a continuous basis. BLS has concluded that dynamic-sizing is an economically and statistically preferred methodology for continuous quarterly measures of employment growth by employer size.

Net employment change

Dynamic-sizing emerged from our evaluation as the preferred methodology for the BED tabulations by firm size. We now turn to the size class statistics from this methodology. We also present, for comparison purposes, the seasonally adjusted time series of size class statistics from the other three methodologies discussed and evaluated in this article.

Description of the data. The quarterly BED data series is constructed from microdata originating from the Quarterly Census of Employment and Wages (QCEW), also known as the ES-202 program. All employers subject to State Unem-

ployment Insurance (UI) laws are required to submit quarterly contribution reports detailing their monthly employment and quarterly wages to the State Employment Security Agencies. BLS also directs the States to conduct two supplemental surveys that are necessary to yield accurate industry and geographical data. The first is the Annual Refiling Survey (ARS), in which nearly 2 million businesses are contacted each year to obtain or update business name, addresses, industry codes, and related contact information. The second is the Multiple Worksite Report (MWR), which collects employment and wages for each establishment in multi-unit firms within the State.

After the microdata are augmented and thoroughly edited by the State Labor Market Information staff, the States submit these data and other business identification information to BLS as part of the Federal-State cooperative QCEW program. The data gathered in the QCEW program are a comprehensive and accurate source of employment and wages, and provide a virtual census (98 percent) of employees on nonfarm payrolls. In the fourth quarter of 2004, the QCEW statistics show an employment level of 131.6 million, with 8.5 million establishments.

The BED statistics are tabulated by linking establishments across quarters. The accuracy of these statistics depends on two primary factors: the quality of the establishment level microdata being reported by businesses to the States, and the record linkage methodology used by BLS to link establishments and firms across quarters. The basic products from the BED program are statistics measuring quarterly net employment change, gross job gains, and gross job losses. The time series of historical statistics starts in the third quarter of 1992.[21]

Net employment growth. Tables 4–7 (pages 16–19) present the second quarter 1993 through fourth quarter 2003 seasonally adjusted time series of net employment growth statistics by firm size, calculated under the four possible size classification methodologies: quarterly base-sizing, annual base-sizing, mean-sizing, and dynamic-sizing. Before discussing the tables, several points need to be mentioned. First, within each table, each separate size-class series was seasonally adjusted, and the seasonally adjusted size-class series were then added to create the seasonally adjusted total series. This standard seasonal adjustment procedure will lead to the total net employment change series varying across the four tables. Second, these data are calculated on a firm-level basis. These are the first time series of firm-level tabulations to be published from the Business Employment Dynamics program.[22] And third, the data in these tables were produced on a research basis, and these data may differ from the published size class data from the BED program for several reasons—the main reason being that the published data include more quarters and thus, the seasonal adjustment factors will be different for the research and the published series.[23]

One striking conclusion evident in tables 4–7 is that the contributions of the various size classes to net employment growth vary across the methodologies. This is most evident in the smallest and largest size classes (which is not surprising given the analysis reported earlier in this article). The quarterly base-sizing methodology shows that firms in the "1–4" size class grew by 499,000 jobs, on average, between the second quarter of 1993 and the fourth quarter of 2003. (See the penultimate row in table 4.) The annual base-sizing methodology shows that firms in the "1–4" size class grew by 263,000 jobs in the average quarter, whereas the corresponding statistic for the dynamic-sizing methodology is a substantially smaller 38,000 jobs in the average quarter. Thus, methodology matters. The BED data indicate that the firms in size class "1–4" account for 10 percent, 67 percent, or 127 percent of average quarterly net employment growth, depending upon methodology. Similarly, firms in the largest size class of "1,000 or more" account for between –20 percent and 30 percent of average quarterly net employment growth, depending upon the methodology used to classify firms into size classes.

The major differences in the data resulting from the alternative methodologies are seen in the "1–4" size class and the "1,000 or more" size class. To visually see this, we graph these data series in charts 5–8 on pages 20–21 (putting all nine size classes in the charts would result in too much clutter). These charts show the substantial variation in the average level of net employment growth in the "1–4" size class (499,000 in chart 5, 38,000 in chart 8).

Conclusion

This article has described the size class statistics in the BLS Business Employment Dynamics program. Four alternative size classification methodologies were evaluated on multiple criteria, and dynamic-sizing was chosen as the best methodology for measuring continuous quarterly employment growth by employer size. The size class statistics presented in this article greatly expand the BED program, and will provide valuable data for BLS users. The analysis and the statistics presented in this article are the first step of a longer research agenda into documenting and understanding the employment dynamics of U.S. businesses. There is discussion in both the academic and the policy communities that size class statistics may be proxying for age: young businesses are often small businesses, and large businesses are often older mature businesses. We, at BLS, are creating a measure of age for all firms in the BED program (not a trivial task), and we hope to present research in the near future that not only documents the relationship of firm size and firm age, but also analyzes their contributions to employment growth.

Table 4. Quarterly net employment growth by firm size, quarterly base–sizing methodology, seasonally adjusted, second quarter 1993 through fourth quarter 2003

[In thousands]

Period	Total	1–4	5–9	10–19	20–49	50–99	100–249	250–499	500–999	1,000 or more
1993										
Quarter II	786	516	124	52	31	7	–18	–19	18	75
Quarter III	896	538	156	93	74	27	17	2	–10	–1
Quarter IV	665	501	128	65	43	6	0	–14	–12	–52
1994										
Quarter I	409	439	92	35	9	–12	–9	–3	–7	–135
Quarter II	1,034	527	131	54	41	21	19	9	5	227
Quarter III	1,207	546	180	116	114	66	49	2	2	132
Quarter IV	531	461	92	51	2	–14	–6	–19	6	–42
1995										
Quarter I	648	481	120	69	31	32	5	–24	–30	–36
Quarter II	426	486	104	28	–28	–27	–40	–65	–1	–31
Quarter III	820	495	121	56	32	8	6	–17	0	119
Quarter IV	407	494	114	33	7	–17	–44	–34	–15	–131
1996										
Quarter I	445	515	112	42	17	–15	–47	–41	–33	–105
Quarter II	674	507	116	39	–26	–36	–51	6	–8	127
Quarter III	634	517	129	52	20	–19	11	–16	–15	–45
Quarter IV	858	504	123	57	21	17	15	–4	33	92
1997										
Quarter I	785	502	142	80	52	2	–4	–18	–35	64
Quarter II	643	489	104	36	–19	–25	–3	–1	–21	83
Quarter III	873	515	114	63	30	13	25	–12	7	118
Quarter IV	644	506	105	42	7	–14	–30	–11	–11	50
1998										
Quarter I	837	532	111	62	2	–25	–21	–10	26	160
Quarter II	670	550	133	90	33	–17	–32	–12	–71	–4
Quarter III	684	488	84	25	–26	–15	–26	–10	–12	176
Quarter IV	694	495	107	58	28	23	–3	–10	–13	9
1999										
Quarter I	466	540	117	49	–17	–25	–64	–53	–44	–37
Quarter II	564	486	85	35	5	–20	5	–23	–26	17
Quarter III	562	533	110	49	–6	–25	–36	–30	–23	–10
Quarter IV	1,042	575	165	101	76	33	35	5	–6	58
2000										
Quarter I	802	519	134	71	26	13	22	–6	–1	24
Quarter II	524	506	84	21	–8	–35	–22	–42	–34	54
Quarter III	143	512	68	–2	–33	–57	–59	–55	–49	–182
Quarter IV	313	510	76	6	–43	–61	–69	–41	–68	3
2001										
Quarter I	–32	494	87	18	–49	–86	–124	117	–109	–146
Quarter II	–803	464	73	–19	–112	–128	–196	–161	–161	–563
Quarter III	–1,450	405	26	–72	–187	–190	–243	–195	–176	–818
Quarter IV	–907	490	61	–32	–148	–161	–201	–176	–162	–578
2002										
Quarter 1	5	468	105	3	–54	–81	–101	–81	–76	–178
Quarter II	–102	471	87	10	–44	–43	–84	–95	–59	–345
Quarter III	–211	469	80	–10	–95	–72	–130	–66	–84	–303
Quarter IV	–172	487	66	–17	–91	–100	–119	–83	–74	–241
2003										
Quarter I	–423	492	48	–45	–123	–91	–108	–93	–74	–429
Quarter II	–169	481	99	5	–39	–46	–104	–74	–93	–398
Quarter III	74	456	80	3	–46	–72	–87	–53	–70	–137
Quarter IV	366	486	86	6	–32	–57	–82	–44	–62	65
Average	392	499	104	34	–12	–31	–45	–42	–38	–77
Total (in percent)	100	127	27	9	–3	–8	–12	–11	–10	–20

Table 5. Quarterly net employment growth by firm size, annual base–sizing methodology, seasonally adjusted, second quarter 1993 through fourth quarter 2003

[In thousands]

Period	Total	1–4	5–9	10–19	20–49	50–99	100–249	250–499	500–999	1000 or more
1993										
Quarter II	704	282	78	73	94	66	44	15	34	18
Quarter III	682	293	92	69	82	54	53	32	15	–9
Quarter IV	720	290	92	80	78	68	63	50	27	–27
1994										
Quarter I	597	220	50	27	53	32	66	48	44	58
Quarter II	1,002	299	93	79	119	78	96	51	23	164
Quarter III	964	285	108	88	127	93	78	55	39	92
Quarter IV	602	245	54	57	40	51	69	35	19	31
1995										
Quarter I	801	252	78	63	71	68	78	42	17	132
Quarter II	415	246	64	46	36	35	28	–23	24	–40
Quarter III	641	242	63	42	60	36	39	30	29	99
Quarter IV	449	277	67	38	43	25	40	30	5	–76
1996										
Quarter I	467	274	61	36	45	36	36	8	22	–51
Quarter II	708	278	78	55	46	25	22	56	23	125
Quarter III	531	276	71	44	48	29	59	29	9	–35
Quarter IV	838	278	84	61	83	68	56	20	31	157
1997										
Quarter I	807	268	86	65	77	56	45	45	8	157
Quarter II	636	259	64	44	33	27	64	39	21	85
Quarter III	812	276	68	49	65	61	62	41	32	158
Quarter IV	675	269	56	37	39	22	41	42	34	134
1998										
Quarter I	695	262	44	25	65	19	53	27	71	131
Quarter II	791	323	105	108	102	47	52	29	–20	45
Quarter III	690	266	56	30	27	30	31	36	25	188
Quarter IV	654	263	70	58	82	61	41	31	16	30
1999										
Quarter I	312	278	73	27	29	6	–8	–19	5	–78
Quarter II	689	269	72	51	63	36	83	33	11	72
Quarter III	665	287	80	82	57	40	34	17	18	50
Quarter IV	933	303	94	70	112	83	88	28	25	128
2000										
Quarter I	767	274	75	66	73	55	42	52	–5	135
Quarter II	601	282	59	35	45	17	52	10	1	100
Quarter III	315	247	47	14	27	27	34	–14	6	–73
Quarter IV	221	242	43	23	–6	–9	–13	–26	–34	0
2001										
Quarter I	–258	238	33	10	–19	–33	–98	–83	–64	–242
Quarter II	–660	231	31	–19	–69	–80	–125	–114	–107	–406
Quarter III	–1,084	193	0	–50	–110	–119	–160	–134	–126	–578
Quarter IV	–959	247	14	–26	–83	–105	–158	–137	–137	–573
2002										
Quarter I	–103	238	51	5	–21	–35	–55	–42	–19	–226
Quarter II	–59	236	39	9	–8	–14	–26	–46	–35	–214
Quarter III	4	260	50	8	–4	–28	–40	–18	–40	–185
Quarter IV	–237	255	33	–11	–36	–45	–44	–67	–44	–277
2003										
Quarter I	–449	236	26	–35	–69	–71	–66	–66	–58	–346
Quarter II	–173	252	47	–5	–12	–25	–66	–34	–55	–275
Quarter III	234	255	51	34	20	–3	–9	–18	–27	–69
Quarter IV	311	258	56	17	25	4	4	4	–8	–50
Average	394	263	62	37	36	18	16	2	–3	–36
Total (in percent)	100	67	16	9	9	5	4	1	–1	–9

Table 6. Quarterly net employment gr owth by firm size, mean–sizing methodology, seasonally adjusted, second quarter 1993 through fourth quarter 2003

[In thousands]

Period	Total	1–4	5–9	10–19	20–49	50–99	100–249	250–499	500–999	1,000 or more
1993										
Quarter II	716	63	57	67	97	64	82	66	66	154
Quarter III	880	125	79	85	121	104	106	76	21	163
Quarter IV	524	46	59	58	105	84	82	43	58	–11
1994										
Quarter I	624	24	25	45	63	66	79	61	43	218
Quarter II	952	66	45	57	117	80	118	94	66	309
Quarter III	1,164	125	104	121	172	124	120	91	73	234
Quarter IV	435	6	21	30	64	67	89	54	46	58
1995										
Quarter I	827	67	48	58	109	87	88	44	62	264
Quarter II	385	41	23	31	38	37	54	38	19	104
Quarter III	779	38	41	54	103	77	82	67	68	249
Quarter IV	348	29	27	29	70	49	74	57	9	4
1996										
Quarter I	526	46	33	44	87	52	60	19	8	177
Quarter II	634	57	38	34	37	33	44	68	61	262
Quarter III	640	81	49	52	78	60	84	34	61	141
Quarter IV	800	40	43	59	98	89	106	59	60	246
1997										
Quarter I	847	84	62	73	123	80	77	56	33	259
Quarter II	606	41	26	31	45	45	85	58	40	235
Quarter III	852	34	44	45	111	79	115	55	71	298
Quarter IV	723	17	23	36	63	51	67	74	43	349
1998										
Quarter I	738	52	24	31	46	50	80	72	102	281
Quarter II	687	104	75	66	77	36	68	6	9	246
Quarter III	643	26	10	13	41	32	64	44	49	364
Quarter IV	764	18	36	44	116	70	84	72	26	298
1999										
Quarter I	332	57	38	30	36	20	21	–5	17	118
Quarter II	590	1	19	33	73	47	77	40	36	264
Quarter III	558	17	29	35	66	53	61	36	43	218
Quarter IV	1,153	90	83	102	144	91	123	82	53	385
2000										
Quarter I	774	53	64	67	105	75	114	85	88	123
Quarter II	514	31	6	12	37	48	51	37	47	245
Quarter III	183	2	9	5	21	22	41	9	37	37
Quarter IV	427	41	1	6	22	5	34	0	–8	326
2001										
Quarter I	–236	16	19	17	9	–23	–61	–50	–21	–142
Quarter II	–694	10	–11	–31	–65	–64	–90	–98	–90	–255
Quarter III	–1,283	–63	–55	–64	–127	–116	–163	–104	–148	–443
Quarter IV	–819	41	–7	–36	–82	–98	–132	–113	–71	–321
2002										
Quarter I	–74	18	22	12	5	–23	–26	–8	–24	–50
Quarter II	–53	35	15	2	21	16	–4	–4	–23	–111
Quarter III	–156	39	16	–8	–33	–32	–44	–28	–18	–48
Quarter IV	–179	46	6	–13	–24	–44	–50	–28	–14	–58
2003										
Quarter I	–409	–13	–22	–33	–55	–25	–21	–21	–40	–179
Quarter II	–136	33	29	20	39	–4	–10	–16	–39	–188
Quarter III	92	30	22	18	10	–9	0	–1	2	20
Quarter IV	314	53	23	31	27	7	–3	1	15	160
Average	395	41	30	32	51	34	42	26	22	116
Total (in percent)	100	10	8	8	13	9	11	7	6	29

Table 7. Quarterly net employment growth by firm size, dynamic-sizing methodology, seasonally adjusted, second quarter 1993 through fourth quarter 2003

[In thousands]

Period	Total	1–4	5–9	10–19	20–49	50–99	100–249	250–499	500–999	1000 or more
1993										
Quarter II	761	62	56	65	90	64	86	67	68	203
Quarter III	942	125	78	91	127	100	115	75	43	188
Quarter IV	640	44	54	62	101	80	89	56	55	99
1994										
Quarter I	439	23	20	42	66	58	76	57	47	50
Quarter II	1,010	61	48	61	106	82	119	96	67	370
Quarter III	1,249	137	101	122	175	122	135	83	74	300
Quarter IV	508	–1	16	35	66	71	93	56	53	119
1995										
Quarter I	677	64	44	62	102	82	87	51	51	134
Quarter II	404	43	23	27	36	30	55	33	31	126
Quarter III	867	38	40	59	108	81	91	61	77	312
Quarter IV	383	23	25	30	63	59	77	50	23	33
1996										
Quarter I	482	41	31	48	77	51	52	22	11	149
Quarter II	648	55	35	35	37	30	45	64	50	297
Quarter III	685	87	45	55	82	60	88	51	48	169
Quarter IV	821	34	41	59	96	88	113	64	63	263
1997										
Quarter I	805	77	60	77	116	77	73	54	24	247
Quarter II	616	37	27	31	39	44	83	62	37	256
Quarter III	933	35	38	59	109	89	120	60	68	355
Quarter IV	619	4	20	35	64	59	77	67	54	239
1998										
Quarter I	864	45	24	36	51	52	78	70	85	423
Quarter II	644	114	65	66	72	38	57	20	4	208
Quarter III	747	24	11	26	46	47	69	56	51	417
Quarter IV	672	6	33	53	106	87	93	61	39	194
1999										
Quarter I	499	48	37	31	31	23	13	1	19	296
Quarter II	531	–1	18	37	66	46	76	45	34	210
Quarter III	624	14	24	44	71	58	67	48	47	251
Quarter IV	1,017	88	80	102	139	104	124	76	68	236
2000										
Quarter I	839	52	56	68	97	81	108	87	69	221
Quarter II	491	29	5	12	36	37	59	39	44	230
Quarter III	207	–1	6	11	23	32	45	22	33	36
Quarter IV	293	28	0	6	19	14	32	9	1	184
2001										
Quarter I	–1	7	12	15	–2	–29	–56	–47	–21	120
Quarter II	–832	4	–12	–32	–64	–69	–96	–92	–93	–378
Quarter III	–1,383	–69	–54	–68	–119	–112	–151	–111	–123	–576
Quarter IV	–957	35	–14	–34	–85	–92	–126	–102	–90	–449
2002										
Quarter I	39	17	20	12	–5	–22	–29	–14	–19	79
Quarter II	–125	38	13	5	9	12	3	–13	–24	–168
Quarter III	–159	43	11	–4	–33	–30	–38	–19	–12	–77
Quarter IV	–215	42	3	–13	–29	–34	–41	–28	–15	–100
2003										
Quarter I	–384	–16	–24	–33	–59	–30	–30	–25	–25	–142
Quarter II	–186	32	28	22	28	–1	–10	–13	–37	–235
Quarter III	123	34	22	18	16	3	2	3	3	22
Quarter IV	340	50	21	28	22	10	7	14	0	188
Average	399	38	28	34	49	36	45	28	23	119
Total (in percent)	100	10	7	9	12	9	11	7	6	30

Chart 5. **Quarterly net employment growth by firm size, quarterly base-sizing methodology, second quarter 1993 to fourth quarter 2003, seasonally adjusted**

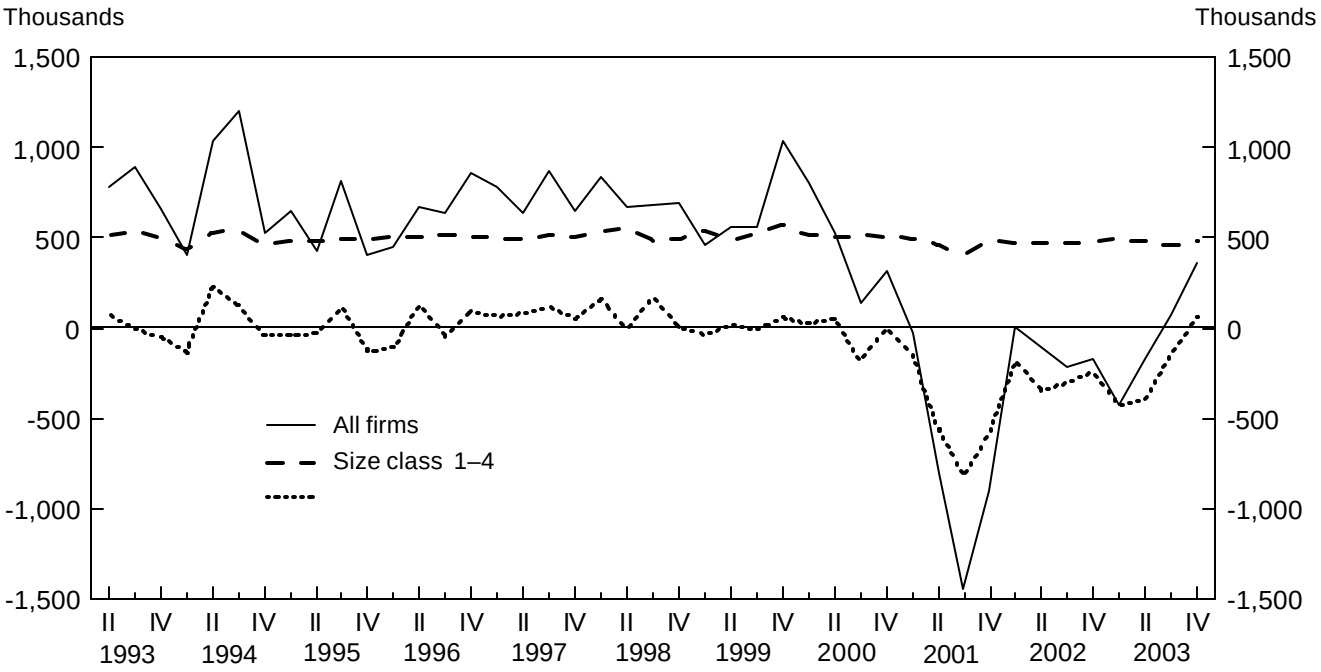


Chart 6. **Quarterly net employment growth by firm size, annual base-sizing methodology, second quarter 1993 to fourth quarter 2003, seasonally adjusted**

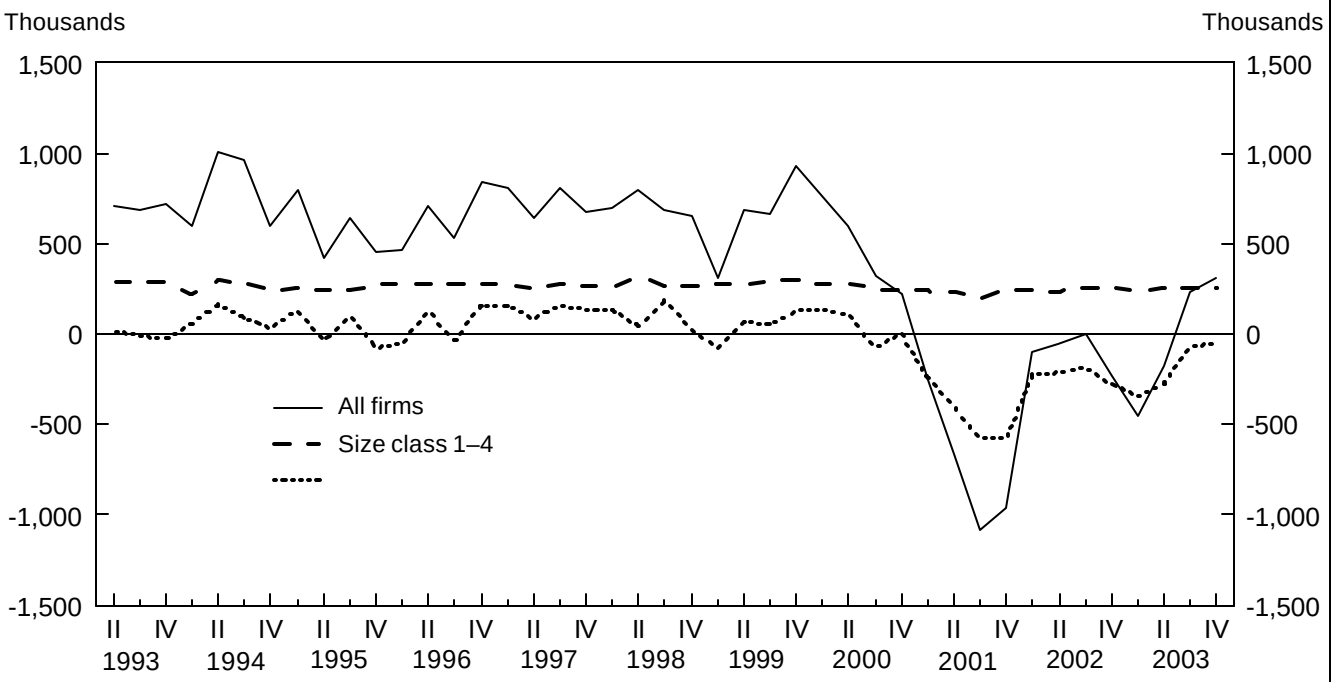


Chart 7. **Quarterly net employment growth by firm size, mean-sizing methodology, second quarter 1993 to fourth quarter 2003, seasonally adjusted**

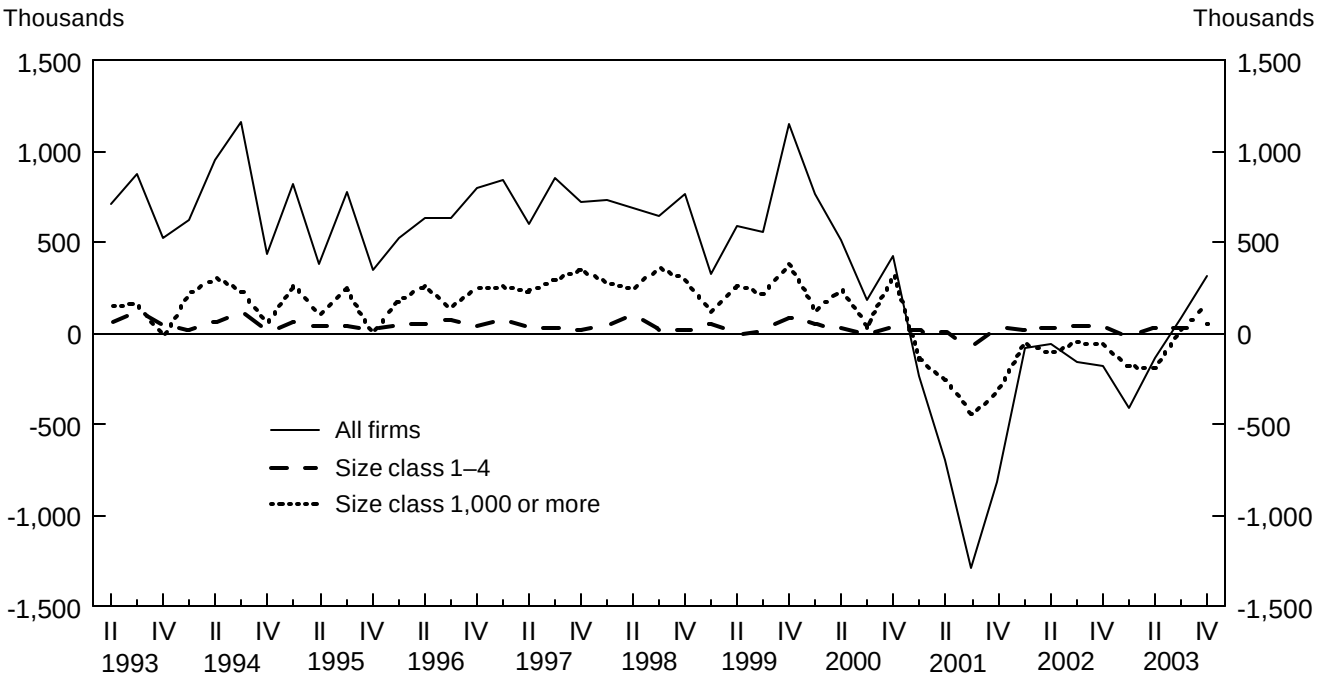
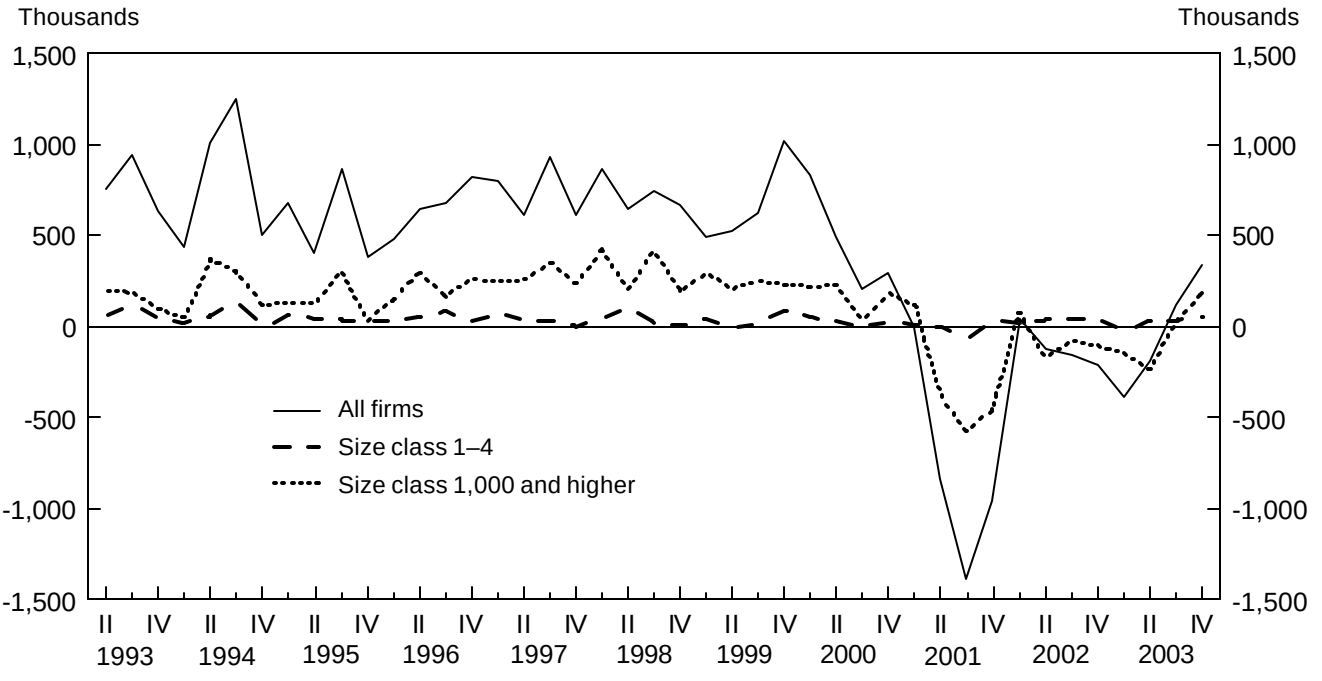


Chart 8. **Quarterly net employment growth by firm size, dynamic-sizing methodology, second quarter 1993 to fourth quarter 2003, seasonally adjusted**



NOTES

[1] This point was clearly documented in Cordelia Okolie, "Why size class methodology matters in analyses of net and gross job flows," *Monthly Labor Review*, July 2004, pp. 3–12.

[2] For example, see *The Employment Situation: January 2006*, USDL 06–160 (U.S. Department of Labor) Feb. 3, 2006. Table A-12 of the monthly *Employment Situation* press release is titled "Alternative measures of labor underutilization" and lists the six unemployment rates. For more information, see John E. Bregger and Steven E. Haugen, " BLS introduces new range of alternative unemployment measures," *Monthly Labor Review*, October 1995, pp. 19–26.

[3] These data refer to the first quarter of 2004, and are from the BLS Quarterly Census of Employment and Wages (QCEW) available on the Internet at **www.bls.gov/cew** (accessed June 2005).

[4] These data refer to the first quarter of 2004, and are from the BLS Quarterly Census of Employment and Wages, on the Internet at **www.bls.gov/cew/** (accessed June 2005).

[5] A comprehensive survey article is Walter Oi and Todd Idson, "Firm Size and Wages," in Orley Ashenfelter and David Card, eds., *Handbook of Labor Economics* (Amsterdam, North-Holland Press, 1999), pp. 2165–2214.

[6] See Charles Brown and James Medoff, "The Employer Size-Wage Effect," *Journal of Political Economy*, October 1989, pp. 1027–59.

[7] See Kenneth R. Troske, "Evidence on the Employer Size-Wage Premium from Worker-Establishment Matched Data," *Review of Economics and Statistics*, February 1999, pp. 15–26.

[8] Steven J. Davis, John C. Haltiwanger, and Scott Schuh, *Job Creation and Destruction* (Cambridge, MA, MIT Press, 1996) and Okolie, "Why size class methodology matters," *Monthly Labor Review*, 2004.

[9] At some point in the near future, BLS hopes to produce BED size-class statistics at the establishment level and release these for research purposes.

[10] Defining a size class for the employment change that crosses a size class threshold requires some discussion. For example, should the growth of 1 employee from 4 to 5 that moves the firm from the "1–4" size class to the "5–9" size class be credited to the "1–4" or the "5–9" size class? The dynamic sizing methodology classifies a firm that moves from 4 to 5 employees in the "5–9" size class. This is done for two reasons. First, we want employment change to be symmetrical—the loss of 1 job from 5 to 4 should be credited to the same size class as the gain of 1 job from 4 to 5. Second, because there is no "zero" size class, the first job credited to a birth needs to be attributed to the "1–4" size class, which would be symmetrical to the last job lost credited to a death being attributed to the "1–4" size class. Thus, when a firm moves from one size class to another by either expanding or contracting, dynamic sizing credits the single job that moves the firm across the threshold to the higher of the two size classes.

[11] See Per Davidsson, "Methodological Concerns in the Estimation of Job Creation in Different Firm Size Classes," 1996, Working Paper, Jönköping International Business School, on the Internet at **http://www.ihh.hj.se/eng/research/publications/wp/1996–1%20Davidsson.pdf** (accessed June 2005). Also see Per Davidsson, Leif Lindmark, and Christer Olofsson, "The Extent of Overestimation of Small Firm Job Creation—An Empirical Examination of the Regression Bias," *Small Business Economics*, November 1998, pp. 87–100.

[12] It is possible to construct an example in which annual base-sizing would result in nonsymmetrical statistics. If employment in March 2003 is 3, and the December 2003 to March 2004 employment growth is from 3 to 13, followed by a March 2004 to June 2004 employment decline from 13 to 3, the annual base-sizing estimator would put the employment growth of 10 into the "1–4" size class, but would put the following employment decline of 10 into the "10–19" size class.

[13] References to regression to the mean bias include Davis, Haltiwanger, and Schuh, *Job Creation and Destruction*, 1996; Davidsson, "Methodological Concerns in the Estimation of Job Creation in Different Firm Size Classes," 1996; Davidsson, Lindmark, and Olofsson, "The Extent of Overestimation of Small Firm Job Creation," 1998; and Milton Friedman, "Do Old Fallacies Ever Die?" *Journal of Economic Literature*, vol. 30, issue 4, 1992, pp. 2129–32.

[14] We also have removed a very small number of businesses involved in breakouts or consolidations at any point during the year. This is done because it is difficult to follow the employment patterns of businesses with changes in reporting configurations across five consecutive quarters. Also note that this is the only section of this article where we present new results using establishments rather than firms; we do not believe the results will change if firms rather than establishments were the unit of analysis.

[15] The full sample of BED microdata for the first quarter 1999 to the first quarter 2000 period, with births, deaths, and businesses involved in breakouts or consolidations, has an average quarterly employment of 107,578,247 jobs. Thus, our sample has 93.5 percent of all employment.

[16] The most frequent example of this is the 8,096 establishments that start in size class "1–4" in the first quarter 1999, are in size class "5–9" in the second quarter 1999, are back in size class "1–4" in the third quarter 1999, and then expand into size class "5–9" in the fourth quarter 1999, and first quarter 2000.

[17] See Okolie, "Why size class methodology matters," 2004.

[18] To be precise, annual base-sizing imposes symmetry only on changes within the year, but does not impose symmetry on transitory and reverting changes that happen before and after March.

[19] The BED net and gross job flow statistics are unique in that they measure quarterly employment change, whereas almost all other similar statistics in the United States (and elsewhere in the world) measure employment change on an annual March-to-March frequency. For a further discussion of the difference between quarterly and annual net and gross job flow statistics, see Joshua C. Pinkston and James R. Spletzer, "Annual measures of gross job gains and gross job losses," *Monthly Labor Review*, November 2004, pp. 3–13.

[20] Our review of the literature, and our e-mail conversations with Per Davidsson, have not found any references beyond the two cited earlier: Davidsson, "Methodological Concerns in the Estimation of Job Creation in Different Firm Size Classes," 1996, and Davidsson, Lindmark, and Olofsson, "The Extent of Overestimation of Small Firm Job Creation," 1998.

[21] For a thorough description of the BED program, see James R. Spletzer, R. Jason Faberman, Akbar Sadeghi, David M. Talan, and Richard L. Clayton, "Business employment dynamics: new data on gross job gains and losses," *Monthly Labor Review*, April 2004, pp. 29–42.

[22] The first cross sectional tabulations appear in the article by Okolie, "Why size class matters," 2004.

[23] One other point warrants mention. BLS is not planning on publishing firm counts for the dynamic-sizing statistics. Firm counts are trivial to calculate for tables of employment change by industry and by geography. Firm counts are also trivial to calculate for tables of employment change by size class, when size class is defined by the mean-sizing or either of the base-sizing methodologies. However, it is difficult to calculate firm counts when using the dynamic-sizing methodology. Recall the example of a firm expanding from 3 to 13 employees, in which size class "1–4" is credited with the growth of 1 employee, size class "5–9" is credited with the growth of 5 employees, and size class "10–19" is credited with the growth of 4 employees. In this example, into which size class would this expanding firm get placed? This is a question being researched.