Two new construction employment series for specialty trade contractors

Specialty trade contractors account for nearly two-thirds of workers in construction; new research permits BLS to publish separate employment series for contractors engaged in the residential and nonresidential markets

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The construction industry is vital to the American economy, with construction expenditures accounting for nearly 9 percent of gross domestic product in 2004.[1] Construction is closely integrated with a range of related industries, and it is the principal builder of real estate—one of the Nation's largest asset classes. Because of the industry's prominence in the economy, it often serves as a bellwether and is widely watched and measured.

Many kinds of data on the industry are produced, both by government agencies and by private companies and organizations. Monthly estimates of employment, produced by the Current Employment Statistics (CES) program of the Bureau of Labor Statistics (BLS), are an important component of construction industry data.[2]

The CES survey is a monthly panel survey of more than 160,000 nonfarm businesses representing about 400,000 establishments. CES estimates of employment, hours, and earnings are some of the most timely and sensitive economic indicators published by the Federal Government. CES estimates are organized according to the 2002 North American Industry Classification System (NAICS).[3] CES estimates of construction employment are grouped into three large NAICS component industry classifications: *Heavy and civil engineering construction*, *construction of buildings*, and *specialty trade contractors*. All three industries engage, to some extent, in both the residential and the nonresidential markets. Despite this, the NAICS coding system supports residential and nonresidential breakouts only for *construction of buildings*. No such detail is available for *specialty trade contractors*, the largest and most dynamic component of the construction industry.

To remedy this limitation, the CES program began producing and publishing employment series for residential specialty trade contractors and nonresidential specialty trade contractors in 2005. (Exhibit 1 contrasts the NAICS 2002 classification structure with the new CES publication structure, which includes the additional residential and nonresidential groupings.) This was done after research revealed the analytical benefits gained from the breakout.[4] This paper explains the methodology behind the research and the results that led to the new construction employment series.

Missing an important distinction

The *specialty trade contractors* industry includes establishments that are primarily responsible for performing specific trades activities related to building construction but are not responsible for the entire project. Establishments in this industry typically perform tasks such as pouring concrete, preparing sites, plumbing, painting, and doing electrical work.[5] These firms usually specialize within their trades in either residential or nonresidential construction; this specialization, however, is not captured in the NAICS coding system. Therefore, employment data for this industry include both residential and nonresidential construction, despite each being driven by different market forces.

Consider, as an example, establishments that perform electrical work. The production activities involved in electrical work for a residential structure such as an apartment complex are essentially the

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Exhibit 1. Coding of construction employment: NAICS 2002 structure versus the modified CES publication structure

NAICS 2002 structure	CES publication structure with additional residential and nonresidential series
23 – Construction	23 – Construction
236 – Construction of buildings	236 – Construction of buildings
2361 – Residential building	2361 – Residential building
2362 – Nonresidential building	2362 – Nonresidential building
237 – Heavy and civil engineering construction	237 – Heavy and civil engineering construction
2371 – Utility system construction	2371 – Utility system construction
2372 – Land subdivision	2372 – Land subdivision
2373 – Highway, street, and bridge construction	2373 – Highway, street, and bridge construction
2379 – Other heavy construction	2379 – Other heavy construction
238 – Specialty trade contractors	238 – Specialty trade contractors
	part 238 – Residential specialty trade contractors
	part 238 – Nonresidential specialty trade contractors
2381 – Building foundation and exterior contractors	2381 – Building foundation and exterior contractors
	part 2381 – Residential building foundation and exterior contractors
	part 2381 – Nonresidential building foundation and exterior contractors
2382 – Building equipment contractors	2382 – Building equipment contractors
	part 2382 – Residential building equipment contractors
	part 2382 – Nonresidential building equipment contractors
2383 – Building finishing contractors	2383 – Building finishing contractors
	part 2383 – Residential building finishing contractors
	part 2383 – Nonresidential building finishing contractors
2389 – Other specialty trade contractors	2389 – Other specialty trade contractors
	part 2389 – Other residential specialty trade contractors
	part 2389 – Other nonresidential specialty trade contractors

same as those for a nonresidential structure such as an office building. Establishments performing work on either type of structure would be classified in the industry *electrical contractors*. Therefore, examination of the employment trend for *electrical contractors* reveals the combined employment effects of market forces for both residential and nonresidential construction. This paints an incomplete picture because market demand for residential and nonresidential construction can be different and often in opposition. Given that specialty trades employment makes up 64 percent of total construction jobs (see chart 1), it is analytically limiting not to be able to measure how employees in the *specialty trade contractors* industry are distributed between residential and nonresidential work.

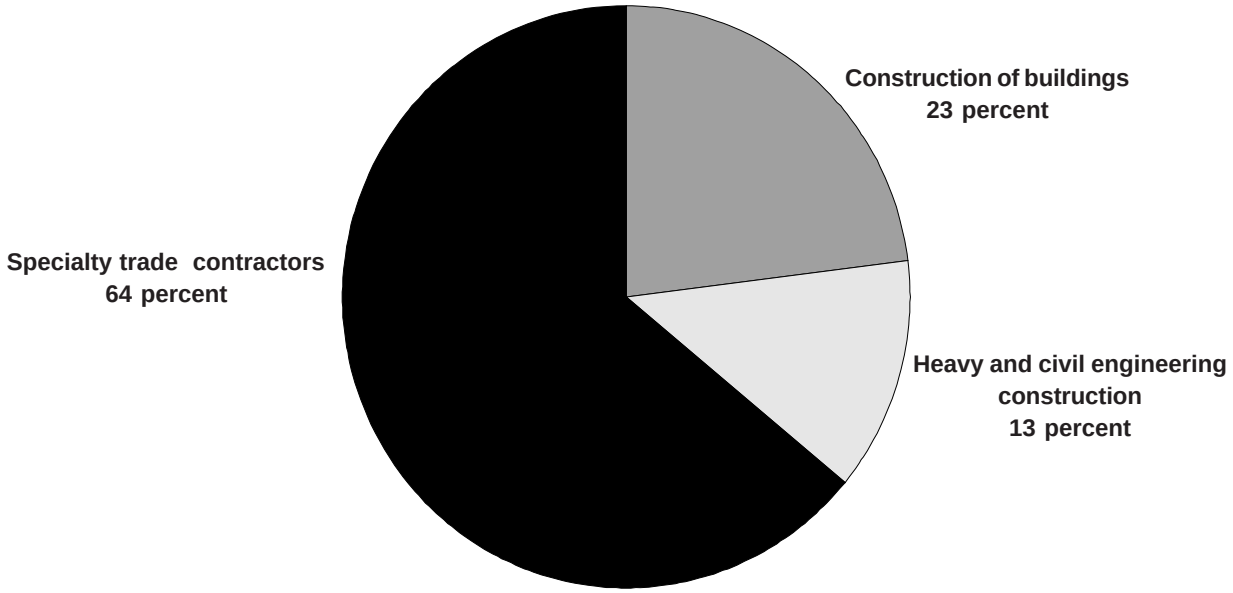
Constructing the experimental series

The CES program initiated research to determine the feasibility of producing and publishing estimates for *specialty trade contractors* in the residential and nonresidential construction industries. We independently generated two series for *specialty trade contractors* using separate estimation cells and aggregation structures but using the same microdata.[6] The first series was a control series structured to replicate current CES estimation procedures. Employment estimates were generated at the five-digit NAICS level, with most series stratified into regional estimation cells. The regional estimates were aggregated to the five-digit level by simple addition, and all of the five-digit series were used to aggregate to the four-digit and then to the three-digit levels. There was no residential or nonresidential classification in this series.

In contrast, the second series was an experimental series based on the residential or nonresidential classification of establishments. As mentioned earlier, the standard NAICS coding structure used by CES supports residential and nonresidential breakouts for four-digit NAICS industries under *construction of buildings*, but not for industries under *specialty trade contractors*. However, the Quarterly Census of Employment and Wages (QCEW) program enhanced the NAICS coding structure for *specialty trade contractors* to classify establishments as residential and nonresidential.[7] The QCEW serves as both the sampling frame and the source of annual employment benchmarks for the CES program. This enhanced coding by the QCEW program allowed the CES program to develop monthly sample-based estimates for *specialty trade contractors* on a residential and nonresidential basis.

To maintain enough sample to generate reliable estimates for the experimental series, estimation cells were established at a higher aggregate level than for the control series. Specifically, residential and nonresidential estimates were generated at the four-digit NAICS level, with most series stratified into regional

Chart 1. Construction employment by component industry, annual average 2004



estimation cells. The regional estimates were aggregated to the four-digit NAICS residential, nonresidential, and total levels, which were used to aggregate to the three-digit NAICS residential, nonresidential, and total levels. Exhibit 2 compares the cell structure for the control group (which reflects traditional cell structure) with the cell structure for the experimental series (which supports a residential-nonresidential classification).

The research was structured to replicate current monthly estimation procedures, with one major difference. The official monthly CES employment estimates are constructed from two components: A component that uses the over-the-month change in the sample reports to move the previous level to the current-month estimated level (known as a weighted link-relative technique),[8] and a model-based component used to help account for net business births and business deaths not captured by the sample (referred to as birth/death factors). Birth/death factors for residential and nonresidential specialty trade contractors were not available at the time of this research. Birth/death factors, therefore, were excluded from both the control series and the experimental series, making comparisons between the two runs appropriate.

Estimates for both series were generated for three different periods: March 2001 to March 2002, March 2002 to March 2003, and March 2003 to December 2003. The March reference month that starts each period represents a benchmark employment level for the series.[9] In practice, the benchmark employment level is made up of three components: Employment from the Quarterly Census of Employment and Wages (QCEW), presumed-not-covered (PNC) employment,[10] and a proportional share of the NAICS "other" employment.[11] However, the benchmark employment level used in this analysis reflects only the QCEW employment. PNC employment and NAICS "other" employment have historically represented an extremely small portion of the benchmark level, and as they do not impact the estimation research in this report, they were excluded when setting the benchmark level for these simulations.

Once the benchmark employment level was determined for March of a given year, the April weighted link-relative (WLR) formula was applied to that level to calculate the April estimate, the May WLR formula was applied to the April estimate to calculate the May estimate, and so on. The two independently derived series were compared at the four-digit NAICS level, the lowest industry level that the two estimates have in common. A noniterative raking procedure was used to ensure that the residential and nonresidential totals from the experimental series were consistent with the specialty trades total from the control series, calculated using the official industry-region cell structure. A noniterative raking procedure is a one-time adjustment of the

Exhibit 2. Estimation cell structures used for the control and experimental series

Control series estimation cells		Experimental series estimation cells	
BLS Tabcode for control series	Title	BLS Tabcode for experimental series	Title
Aggregates to 2381 — Building foundation and exterior contractors			
2023811000	Poured concrete structure contractors		
2023812000	Steel and precast concrete contractors	2023810100	Residential building foundation and exterior contractors
2023813000	Framing contractors		
2023814000	Masonry contractors		
2023815000	Glass and glazing contractors		
2023816000	Roofing contractors	2023810200	Nonresidential building foundation and exterior contractors
2023817000	Siding contractors		
2023819000	Other building exterior contractors		
Aggregates to 2382 — Building equipment contractors			
2023821000	Electrical contractors	2023820100	Residential building equipment contractors
2023822000	Plumbing and HVAC contractors		
2023829000	Other building equipment operators	2023820200	Nonresidential building equipment contractors
Aggregates to 2383 — Building finishing contractors			
2023831000	Drywall and insulation contractors		
2023832000	Painting and wall covering contractors	2023830100	Residential building finishing contractors
2023833000	Flooring contractors		
2023834000	Tile and terrazzo contractors		
2023835000	Finish carpentry contractors	2023830200	Nonresidential building finishing contractors
2023839000	Other building finishing contractors		
Aggregates to 2389 — Other specialty trade contractors			
2023891000	Site preparation contractors	2023890100	Other residential specialty trade contractors
2023899000	All other specialty trade contractors	2023890200	Other nonresidential specialty trade contractors

residential and nonresidential employment estimates to control totals. Because the residential and nonresidential series were derived independently of the official construction series, the residential and nonresidential series were proportionally adjusted at the four-digit NAICS level to force their sum to equal the four-digit NAICS employment estimate from the control series. It is important to note that, when calculating the estimates, we applied the WLR formula for each month to the previous month's unraked estimate.

The noniterative raking adjustment was performed for each residential and nonresidential group as follows:

1. Residential employment and nonresidential employment were aggregated at the four-digit NAICS level.
2. This aggregate total was subtracted from the control series at the four-digit NAICS level to determine the amount of employment to be raked.
3. Ratios of residential-to-total employment and nonresidential-to-total employment were calculated for each four-digit NAICS series.
4. The total to be raked was multiplied by the ratios to determine what percentage of employment to apply to the residential group and what percentage to apply to the nonresidential group.
5. Once the residential and nonresidential groups received their proportional shares of raked employment, the two groups were rounded and aggregated to the four-digit NAICS level. At this point they were equal to the control series at the four-digit NAICS level.

Additionally, the impact of NAICS code refiling was examined. Specialty trades firms may often switch back and forth between residential and nonresidential work. Large refiling impacts could lead to large benchmark revisions and distort the trends measured by the residential and nonresidential series.[12] Therefore, code changes resulting from the Annual Refiling Survey for 2002 and 2003 were analyzed, both as a level and as a percent of benchmark employment, to determine if NAICS refiling was a cause for concern.[13]

Research results

Results indicated that, in addition to producing traditional estimates, it is both feasible and beneficial to produce and publish estimates for *specialty trade contractors* engaged in residential and in nonresidential construction. There is no statistically significant difference between the sum of residential and nonresidential estimates made at the four-digit NAICS level and estimates generated at the five-digit NAICS level without the residential and nonresidential breakouts.

Initially, we examined the differences in the unraked estimates by comparing the mean of the control series with the mean of the experimental series at the three-digit and four-digit NAICS levels, and performed a simple analysis of variance (ANOVA) to test the null hypothesis that the means from the two series are equal. As table 1 shows, the absolute difference in the mean of the two unraked series is relatively small for all of the industries examined, suggesting that the mean of the experimental series is not significantly different from the mean of the control series. The results from the ANOVA test support the hypothesis that the means from the two series are equal. In particular, we focused on the F-statistic and the p-value to test the validity of our hypothesis. Generally, large F-statistics (relative to the level of significance required) lead to the rejection of the null hypothesis. Conversely, small p-values suggest that the null hypothesis is unlikely to be true.[14] In our analysis, at a 95-percent level of confidence, an F-statistic above the critical value of 3.9862 or a p-value below 0.0500 would lead us to reject the null hypothesis that the means from the two series are equal. The F-statistics for all of the series examined were quite low (0.0260 or lower)—well below the critical value of 3.9862. Furthermore, the p-values for all of the series were relatively high (.8724 or higher). These results do not disprove the null hypothesis that the means from the control series and the experimental series are equal and, hence, there is no statistically significant difference between the two series at the three-digit and four-digit levels.

Next, we compared the over-the-month changes in the two series by calculating smoothness ratios at the three-digit and four-digit NAICS levels.[15] The smoothness ratio compares the sum of the squared over-the-month changes in the experimental series with the sum of the squared over-the-month changes in the control series. A smoothness ratio below 1.00 indicates that the sum of the residential and nonresidential estimates made at the four-digit NAICS level has less variability in over-the-month changes, while a smoothness ratio greater than 1.00 indicates that estimates generated in the traditional manner provide a less variable series. A smoothness ratio equal to 1.00 indicates that there is no difference in the variation in over-the-month changes between the two series. As Table 1 illustrates, the smoothness ratio at the three-digit NAICS level is 1.00, indicating essentially no difference in the over-the-month changes in the two series at that level. At the four-digit NAICS level, differences in the over-the-month changes are relatively small, usually ranging between –1,500 and +1,500 employees. This finding is underscored by the smoothness ratios at the four-digit level, which are all either equal to or very close to 1.00, suggesting no major differences between the series.

Raking the differences

Finally, we examined the amount of raking needed to force additivity of the experimental series to the control series. As described earlier, a noniterative raking procedure was performed at the four-digit NAICS level for each residential and nonresidential group to ensure that the residential and nonresidential totals from the experimental series were consistent with the four-digit total calculated using the official industry-region cell structure (the control series). Table 2 shows the low, high, and average employment needed to rake the residential and nonresidential estimates from the experimental series to the control series. The amount of employment raked each month was relatively small, ranging from 0 in some months to 5,900 in July 2003 (in building foundation and exterior contractors). In almost every case, the amount raked represented less than 0.5 percent of the monthly employment.

The benchmark revisions calculated in this research at the four-digit NAICS residential and nonresidential levels are within

Table 1. Difference in levels and over-the-month changes in unraked series for specialty trade contractors: NAICS structure versus modified CES structure

NAICS code	Class of specialty trade contractors	Absolute difference in mean employment levels	ANOVA results		Smoothness ratio
			F-statistic	p-value	
238	All	509	0.0002	0.9879	1.00
2381	Building foundation and exterior	891	.0078	.9301	1.02
2382	Building equipment	832	.0053	.9420	.98
2383	Building finishing	1,100	.0260	.8724	.99
2389	Other	115	.0002	.9901	1.00

the normal distribution of revisions for similarly sized industries.[16] (See table 3.) However, as explained earlier, these do not reflect the "true" benchmark revision for each industry. In practice, the benchmark revision is calculated as benchmark employment minus estimated employment. Estimated employment in this research is missing a net birth/death component, while the benchmark employment level is missing PNC employment and a proportional share of the NAICS "other" employment. Nevertheless, based on the historical values of the missing components, their inclusion would not significantly affect the size of the benchmark revisions calculated here.

Finally, the impact of NAICS code refiling did not appear to be an issue. Industry code changes were relatively small and did not appear to have a major impact on benchmark revisions. Table 4 shows the code changes resulting from the Annual Refiling Survey for 2002 and 2003—both as a level and as a percent of benchmark employment—and their effect on the benchmark revision. Code changes for *specialty trade contractors* were relatively small at the three- and four-digit NAICS levels, even within residential and nonresidential groupings. In most cases, the code changes were less than 1 percent of benchmark employment, meaning that their effect on the benchmark revision was negligible.

The code changes were noticeably larger for the nonresidential group than for the residential group in both years. In 2002, the code changes were all positive, indicating that relatively few firms switched from residential to nonresidential. In 2003, the code changes for residential and nonresidential moved in different directions for three of the four 4-digit NAICS series; however, the magnitude of the differences does not suggest that firms switched from residential to nonresidential at a rapid pace. For the most part, it appears that employment entering the

Table 2. Raked employment for specialty trade contractors, March 2001 to December 2003

NAICS code	Class of specialty trade contractors	Monthly amount raked		
		Low	High	Average
238	All	0	5,900	1,300
2381	Building foundation and exterior	0	5,900	2,200
2382	Building equipment	0	3,300	1,000
2383	Building finishing	0	2,600	1,200
2389	Other	0	3,800	1,400

Table 3. Benchmark employment and magnitude of revision in benchmark employment of specialty trade contractors, 2002 and 2003

[Levels in thousands]

NAICS code	Class and group of specialty trade contractors	Benchmark employment					
		2002			2003		
		March level	Revision		March level	Revision	
			Level	Percent		Level	Percent
238	All						
	Residential	1,782	38	2.1	1,830	12	0.7
	Nonresidential	2,236	–23	–1.0	2,151	–10	–.5
	Total	4,018	15	.4	3,981	2	.1
2381	Building foundation and exterior						
	Residential	442	–1	–.2	463	7	1.5
	Nonresidential	419	–25	–6.0	410	13	3.2
	Total	861	–26	–3.0	873	20	2.3
2382	Building equipment						
	Residential	676	24	3.6	689	10	1.5
	Nonresidential	1,126	–5	–.4	1,073	-22	–2.1
	Total	1,802	19	1.1	1,762	-12	–.7
2383	Building finishing						
	Residential	455	19	4.2	466	0	0
	Nonresidential	383	6	1.6	368	0	0
	Total	838	25	3.0	834	0	0
2389	Other						
	Residential	209	–5	–2.4	211	–5	–2.4
	Nonresidential	309	1	.3	300	–1	–.3
	Total	518	–4	–.8	511	–6	–1.2

Table 4. Industry code changes for specialty trade contractors, 2002 and 2003

[Thousands]

Year	NAICS code	Class and group of specialty trade contractors	Code changes	Benchmark employment level	Code changes as a percent of benchmark employment	Benchmark revision	Benchmark revision less code changes	Percent benchmark revision	
								Total	Less effect of code changes
2002									
	238	All							
		Residential	6	1,782	0.3	38	32	2.1	1.8
		Nonresidential	16	2,236	.7	–23	–39	–1.0	–1.7
		Total	22	4,018	.5	15	–7	.4	–.2
	2381	Building foundation and exterior							
		Residential	2	442	.5	–1	–3	–.2	–.7
		Nonresidential	2	419	.5	–25	–27	–6.0	–6.5
		Total	4	861	.5	–26	–30	–3.0	–3.5
	2382	Building equipment							
		Residential	1	676	.1	24	23	3.6	3.4
		Nonresidential	9	1,126	.8	–5	–14	–.4	–1.2
		Total	10	1,802	.6	19	9	1.1	.5
	2383	Building finishing							
		Residential	2	455	.4	19	17	4.2	3.7
		Nonresidential	3	383	.8	6	3	1.6	.8
		Total	5	838	.6	25	20	3.0	2.4
	2389	Other							
		Residential	2	209	1.0	–5	–7	–2.4	–3.3
		Nonresidential	3	309	1.0	1	–2	.3	–.6
		Total	5	518	1.0	–4	–9	–.8	–1.7
2003									
	238	All							
		Residential	–3	1,830	–.2	12	15	.7	.8
		Nonresidential	18	2,151	.8	–10	–28	–.5	–1.3
		Total	14	3,981	.4	2	–12	.1	–.3
	2381	Building foundation and exterior							
		Residential	2	463	.4	7	5	1.5	1.1
		Nonresidential	7	410	1.7	13	6	3.2	1.5
		Total	9	873	1.0	20	11	2.3	1.3
	2382	Building equipment							
		Residential	–4	689	–.6	10	14	1.5	2.0
		Nonresidential	8	1,073	.7	–22	–30	–2.1	–2.8
		Total	5	1,762	.3	–12	–17	–.7	–1.0
	2383	Building finishing							
		Residential	–2	466	–.4	0	2	0	.4
		Nonresidential	2	368	.5	0	–2	0	–.5
		Total	0	834	0	0	0	0	0
	2389	Other							
		Residential	1	211	.5	–5	–6	–2.4	–2.8
		Nonresidential	0	300	0	–1	–1	–.3	–.3
		Total	1	511	.2	–6	–7	–1.2	–1.4

nonresidential *specialty trade contractors* industry is coming from outside the *specialty trade contractors* industry, not from the residential component.

Benefits are apparent

This article shows that, by using sound statistical methods, reliable estimates of residential and nonresidential construction employment can be produced, yielding analytical benefits. In particular, the breakout of residential and nonresidential construction allows analysis to determine which type of business drives employment in *specialty trade contractors*, the dominant sector in the construction industry. This is illustrated in Table 5, which displays employment trends in the specialty trade experimental series at the three-digit NAICS level. The table shows a slight decrease in specialty trade employment from March 2001 to March 2003, mirroring a general decline in the entire construction sector. However, focusing solely on the decrease in employment at the three-digit specialty trade level masks a small increase in employment of residential specialty trade contractors, which occurred from March 2001 to March 2003. This growth was overshadowed by a decrease in employment of nonresidential specialty trade contractors.

Table 5. Employment trends in the experimental construction series for specialty trade contractors, March 2001 to March 2003

[Thousands]

NAICS code	Class and group of specialty trade contractors	Employment		Difference	
		March 2001	March 2003	Level	Percent
238	All	4,096	3,980	–116	–2.8
	Residential	1,752	1,830	78	4.5
	Nonresidential	2,345	2,151	–194	–8.3
2381	Building foundation and exterior	871	872	1	.1
	Residential	435	463	28	6.4
	Nonresidential	436	410	–26	–6.0
2382	Building equipment	1,875	1,762	–113	–6.0
	Residential	671	689	18	2.7
	Nonresidential	1,204	1,073	–131	–10.9
2383	Building finishing	835	834	–1	–.1
	Residential	442	466	24	5.4
	Nonresidential	393	368	–25	–6.4
2389	Other	515	512	–3	–.6
	Residential	203	212	9	4.4
	Nonresidential	312	300	–12	–3.8

This new type of analytical breakout adds another dimension to the extensive volume of construction data. The residential and nonresidential series should be a welcome addition to data users attempting to understand opposing market forces and their impact on construction employment. □

Notes

[1] Construction expenditures data are available from the U.S. Census Bureau on the Internet at **www.census.gov/const/C30/total.pdf** (visited August 2005). Gross domestic product data are from the U.S. Bureau of Economic Analysis. See Table 1.1.5 on the Internet at **www.bea.gov/bea/dn/nipaweb/index.asp** (visited August 2005).

[2] The Current Employment Statistics (CES) program is a monthly survey conducted by State Employment Security Agencies in cooperation with the Bureau of Labor Statistics (BLS). The survey provides employment, hours, and earnings estimates based on the payroll records of business establishments. Employment, as defined by CES, is the number of persons who worked during, or received pay for, any part of the pay period that includes the 12th of the month. The CES survey scope excludes the self-employed, unpaid family workers, and workers in private households and agriculture. The employment statistics for government refer to civilian employees only. For more information on the program's concepts and methodology, see the *BLS Handbook of Methods*, Chapter 2, at **www.bls.gov/opub/hom/homch2_a.htm**. CES data are available on the Internet at **www.bls.gov/ces/**.

[3] The North American Industry Classification System (NAICS) is a six-digit hierarchical coding system that groups establishments into industries based on the activities in which they are primarily engaged. NAICS was developed using a production-oriented conceptual framework under which establishments using similar raw material inputs, similar capital equipment, and similar labor are classified in the same industry. NAICS is a collaborative effort among the United States, Mexico, and Canada and offers industry comparability among the three countries.

[4] For detailed analysis on residential and nonresidential construction employment, see John P. Mullins' article, "Recent employment trends in residential and nonresidential construction," in this issue.

[5] The work performed by establishments classified as *specialty trade contractors* may include new work, additions, alterations, maintenance, and repairs. The work is usually subcontracted from general contractors but can also be done for the owner of the property.

[6] Employment estimates are made at what is termed the basic estimation cell level and are aggregated upward to broader levels of industry detail by simple addition. Basic cells are defined by industry (usually at the five- or six-digit NAICS level). Within the construction industry, stratification by geographic region also is used.

[7] For industries classified as *specialty trade contractors,* the last digit of the six-digit NAICS code is zero and is not pertinent to the classification of the industry. The Quarterly Census of Employment and Wages (QCEW) program replaced the last digit of the NAICS code for *specialty trade contractors* with a 1 for establishments engaged in residential work and a 2 for establishments engaged in nonresidential work. More information on the QCEW program is available online at **www.bls.gov/cew/home.htm**.

[8] For more information on the weighted link-relative technique, see the *BLS Handbook of Methods*, Bulletin 2414 (Bureau of Labor Statistics, September 1992). Information is also available in the Current Employment Statistics technical notes online at **www.bls.gov/web/cestn1.htm**.

[9] Benchmarking is an annual reanchoring of the CES March sample-based employment estimates to the March full population counts derived principally from the Quarterly Census of Employment and Wages program. These population counts are much less timely than sample-based estimates and are used to provide an annual point-in-time census for employment. More information on the CES benchmark is available online at **www.bls.gov/web/cestn1.htm**.

[10] Population counts are derived from the administrative file of employees covered by unemployment insurance (UI) laws. All employers covered by UI laws are required to report employment and wage information to the appropriate State Employment Security Agency four

times a year. Approximately 97 percent of private employment within the scope of the establishment survey is covered by UI. A benchmark for the remaining 3 percent of employment, referred to as PNC employment, is constructed from alternate sources.

[11] The NAICS "other" employment group consists of unclassified employment that is allocated proportionally among all industries.

[12] The CES program annually realigns its sample-based estimates to better reflect the most current universe counts of employment—a process known as benchmarking. Comprehensive counts of employment, or benchmarks, are derived primarily from employment data reported on unemployment insurance (UI) tax reports that nearly all employers are required to file with State Employment Security Agencies. At each level of industry detail, the difference between the sample-based estimate and the universe count is referred to as the benchmark revision.

[13] The Quarterly Census of Employment and Wages program updates each establishment's industry classification every 3 years based on information obtained through its Annual Refiling Survey. Each year one-third of its universe of establishments are asked to verify or update geographic codes, ownership codes, and the primary business activity of the establishment.

[14] P-values range from 0 to 1.00, and in general, the smaller the value, the more convincing the evidence to reject the null hypothesis.

[15] The formula for the smoothness ratio is:

$$\text{Smoothness ratio} = \frac{\sum_{i=1}^{t}\left(X_i - X_{i-1}\right)^2}{\sum_{i=1}^{t}\left(Y_i - Y_{i-1}\right)^2}$$

where

X = seasonally adjusted estimate for the experimental series,
Y = seasonally adjusted estimate for the control series, and
i = time t.

[16] For 2003, the third quartile of percent absolute revisions for industries with employment ranging from 200,000 to 1.2 million is 3.1 percent. Over a 2-year span (2002-2003), 75 percent of the four-digit NAICS residential and nonresidential series had a benchmark revision of less than 3.1 percent.