APPENDIX A
Explanatory Material

SAMPLE DESIGN AND ESTIMATION PROCEDURES

The current sample was introduced in the fourth quarter of 2012 for the Quarterly Services Survey. The current sample was designed to produce estimates based on the 2007 North American Industry Classification System (NAICS). This section describes the design, selection, and estimation procedures for current new sample. For descriptions of prior samples, see the *Quarterly Services Survey* publications.

Sampling Frame

The Quarterly Services Survey sample is a subsample of the Service Annual Survey sample and has the same types of sampling units as the Service Annual Survey frame—large, multi-establishment firms and Employer Identification Numbers (EINs). Sampling units represent clusters of one or more establishments owned or controlled by the same firm. The sample is redrawn approximately every 5 years to redistribute reporting burden and to introduce sampling and processing efficiencies.

Stratification, Sampling Rates, and Allocation

The primary stratification of the Quarterly Services Survey frame is by industry group based on the detail required for publication. We publish Quarterly Services Survey estimates for less detailed industry groupings than for Service Annual Survey estimates. Therefore, the industry stratification for the Quarterly Services Survey sample is broader than the industry stratification used for the Service Annual Survey sample. We assign each sampling unit to the industry stratum corresponding to the industry that contributes the most to the unit's sampling measure of size (i.e., annual revenue).

Within each industry stratum, we substratify the sampling units by a measure of size related to their annual revenue. We select sampling units expected to have a large effect on the precision of the estimates "with certainty." This means they are sure to be selected and will represent only themselves (i.e., have a selection probability of 1 and a sampling weight of 1). To identify the certainty units, we determine a substratum boundary (or cutoff) that divides the certainty units from the noncertainty units. We base these cutoffs on a statistical analysis of data extracted from the Census Bureau's Business Register. We also use this analysis to determine the number and boundaries of noncertainty substrata for each industry group and to set sampling rates needed to achieve specified sampling variability constraints on revenue estimates for different industry groups.

Sample Selection

We select the Quarterly Services Survey sample independently within each size substratum contained in an industry stratum. The actual selection procedure follows a systematic, probability proportional-to-size scheme. Because the Quarterly Services

Survey sample is an independently selected subsample, it is possible that we select some units in the Service Annual Survey sample at a lower sampling rate than desired for the Quarterly Services Survey sample. We include such a unit in the Quarterly Services Survey sample with the Service Annual Survey sampling weight. The maximum sampling weight for a unit selected for the Quarterly Services Survey sample is 750.

Sample Maintenance

We update the QSS sample on a quarterly basis to represent EINs issued since the initial sample selection. These new EINs, called births, are EINs, recently assigned by the Internal Revenue Services (IRS), that have an active payroll filing requirement on the IRS Business Master File. An active payroll filing requirement indicates that the EIN is required to file payroll for the next quarterly period. The Social Security Administration attempts to assign industry classification to each new EIN.

EINs with an active payroll filing requirement on the IRS Business Master File are said to be "BMF active" and EINs with an inactive payroll filing requirement are said to be "BMF inactive."

We sample EIN births on a quarterly basis using a two-phase selection procedure. To be eligible for selection, a birth must either have no industry classification or be classified in an industry within the scope of the Service Annual Survey, the Annual Wholesale Trade Survey, or the Annual Retail Trade Survey, and it must meet certain criteria regarding its quarterly payroll. In the first phase, we stratify births by broad industry groups and a measure of size based on quarterly payroll. A relatively large sample is drawn and canvassed to obtain a more reliable measure of size, consisting of receipts in two recent months and a new or more detailed industry classification code. Births that have not returned their questionnaire after 30 days are contacted by telephone.

Using this more reliable information, in the second phase we subject the selected births from the first phase to probability proportional-to-size sampling with overall probabilities equivalent to those used in drawing the initial Quarterly Services Survey sample from the December 2010 Business Register. The births selected for the Quarterly Services Survey sample are a subsample of the births selected for the Service Annual Survey sample. Because of the time it takes for a new employer firm to acquire an EIN from the IRS, and because of the time needed to accomplish the two-phase birth-selection procedure, we add births to the sample approximately 9 months after they begin operation.

If a firm was selected with certainty and had more than one establishment at the time of sampling, any new establishments that the firm acquires, even if under new or different EINs, are included in the sample with certainty.

However, if a firm was selected with certainty and had only one establishment at the time of sampling, only future establishments associated with that firm's originally-selected EIN are included in the sample with certainty; any new EINs that might later be

associated with that firm are subjected to sampling through the quarterly birth-selection procedure.

To be eligible for the sample canvass and tabulation, an EIN selected in the noncertainty sampling operations must meet both of the following requirements:

- It must be on the active payroll filing requirement on the IRS Business Master File.
- It must have been selected from the Business Register in either the initial sampling or during the quarterly birth-selection procedure

Each quarter, we check against the current Business Register to determine if any EINs on the Quarterly Services Survey have become BMF inactive. Typically, we do not canvass BMF inactive EINs during the reference quarter. Likewise, if any EIN on QSS that was BMF inactive in a previous reference quarter is now BMF active on the current Business Register, we again include these EINs in the canvass. In both cases, we only tabulate data for that portion of the reference quarter that these EINs reporter payroll to the IRS.

Single-unit EINs selected into the sample with certainty are not dropped from canvass and tabulations if they were no longer BMF inactive. Rather the firm that used the EIN is contacted, and if a successor EIN is found, it is added to the survey. For both active EINs and any previously inactive EINs that are now active, data are tabulated for only the portion of the reference quarter that these EINs reported payroll to the IRS.

Estimation Method

Horvitz-Thompson estimates for each quarter are computed as the sum of weighted data (reported or imputed), where the weight for each unit is the reciprocal of the probability of selection of the unit into the QSS sample. The Horvitz-Thompson estimates are input into the benchmarking procedure to produce the published estimates, as described in the **Revisions to Previously Published Quarterly Estimates** section.
Benchmark Text

RELIABILITY OF THE ESTIMATES

The published estimates may differ from the actual, but unknown, population values. For a particular estimate, statisticians define this difference as the total error of the estimate. When describing the accuracy of survey results, it is convenient to discuss total error as the sum of sampling error and nonsampling error. Sampling error is the error arising from the use of a sample, rather than a census, to estimate population values. Nonsampling error encompasses all other factors that contribute to the total error of a survey estimate. The sampling error of an estimate can usually be estimated from the sample; whereas, the nonsampling error of an estimate is difficult to measure and can rarely be estimated. Consequently, the actual error in an estimate exceeds the error that can be estimated.

Further descriptions of sampling error and nonsampling error are provided in the following sections. Data users should take into account the estimates of sampling error and the potential effects of nonsampling error when using the published estimates.

Sampling Error

Because the estimates are based on a sample, exact agreement with results that would be obtained from a complete enumeration of the sampling frame using the same enumeration procedures is not expected. However, because each firm on the sampling frame has a known probability of being selected into the sample, it is possible to estimate the sampling variability of the survey estimates.

The particular sample used in this survey is one of a large number of samples of the same size that could have been selected using the same design. If all possible samples had been surveyed under the same conditions, an estimate of a population parameter of interest could have been obtained from each sample. For the parameter of interest, estimates derived from the different samples would, in general, differ from each other. Common measures of the variability among these estimates are the sampling variance, the standard error, and the coefficient of variation (CV). The sampling variance is defined as the squared difference, averaged over all possible samples of the same size and design, between the estimator and its average value. The standard error is the square root of the sampling variance. The CV expresses the standard error as a percentage of the estimate to which it refers. For example, an estimate of 200 units that has an estimated standard error of 10 units has an estimated CV of 5 percent. The sampling variance, standard error, and CV of an estimate can be estimated from the selected sample because the sample was selected using probability sampling. We use the random group method (with eight groups or replicates) to estimate sampling variances for the QSS estimates. Note that measures of sampling variability, such as the standard error and CV, are estimated from the sample and are also subject to sampling variability. (Technically, we should refer to the *estimated* standard error or the *estimated* CV of an estimator. However, for the sake of brevity we have omitted this detail.) It is important to note that the standard error and CV only measure sampling variability. They do not measure any systematic biases in the estimates.

The Census Bureau recommends that individuals using published estimates incorporate this information into their analyses, as sampling error could affect the conclusions drawn from these estimates.

The estimate from a particular sample and its associated standard error can be used to construct a confidence interval. A *confidence interval* is a range about a given estimator that has a specified probability of containing the average of the estimates derived from all possible samples. Associated with each interval is a percentage of confidence, which is interpreted as follows. If, for each possible sample, an estimate of a population parameter and its approximate standard error were obtained and using a t-statistic with 7 (number of replicates -1) degrees of freedom, then:

1. For approximately 90 percent of the possible samples, the interval from 1.895 standard errors below to 1.895 standard errors above the estimate would include the average of the estimates derived from all possible samples of the same size and design.

2. For approximately 95 percent of the possible samples, the interval from 2.365 standard errors below to 2.365 standard errors above the estimate would include the average of the estimates derived from all possible samples of the same size and design.

To illustrate the computation of a confidence interval for an estimate of total revenue, assume that an estimate of total revenue is $10,750 million and the CV for this estimate is 1.8 percent, or 0.018. First obtain the standard error of the estimate by multiplying the total revenue estimate by its CV. For this example, multiply $10,750 million by 0.018. This yields a standard error of $193.5 million. The upper and lower bounds of the 90-percent confidence interval are computed as $10,750 million plus or minus 1.895 times $193.5 million. Consequently, the 90-percent confidence interval is $10,383 million to $11,116 million. If corresponding confidence intervals were constructed for all possible samples of the same size and design, approximately 9 out of 10 (90 percent) of these intervals would contain the average of the estimates derived from all possible samples.

Nonsampling Error

Nonsampling error encompasses all other factors, other than sampling error, that contribute to the total error of a sample survey estimate and may also occur in censuses. It is often helpful to think of nonsampling error as arising from deficiencies or mistakes at some point in the survey process. Nonsampling errors are difficult to measure and can be attributed to many sources: the inclusion of erroneous units in the survey (overcoverage), the exclusion of eligible units from the survey (undercoverage), nonresponse, misreporting, mistakes in recording and coding responses, misinterpretation of questions, and other errors of collection, response, coverage, or processing. Although nonsampling error is not measured directly, the Census Bureau employs quality control procedures throughout the process to minimize this type of error.

A potential source of bias in the estimates is nonresponse. Nonresponse is defined as the inability to obtain all the intended measurements or responses about all selected units. Two types of nonresponse are often distinguished. *Unit nonresponse* is used to describe the inability to obtain any of the substantive measurements about a sampled unit. In most cases of unit nonresponse, the questionnaire was never returned to the Census Bureau after several attempts to elicit a response. *Item nonresponse* occurs either when a question is unanswered or the response to the question fails computer or analyst edits.

For both unit and item nonresponse, a missing value is replaced by a predicted value obtained from an appropriate model for nonresponse. This procedure is called *imputation* and uses survey data and administrative data as input.

DEFINITION OF TERMS

Establishment. A single physical location where business is conducted or services are performed.

Firm. A business organization or entity consisting of one or more domestic establishments/locations under common ownership or control.

Total expenses. (Basic dollar volume measure of expenses for firms exempt from federal income tax.) Costs incurred during the survey year whether or not payments were made in that year. Total expenses include annual payroll; employee benefits, interest, and rent expenses; supplies used for operating; cost of merchandise sold; and other expenses allocated to operations during the year. Also included are contracted or purchased services; fees paid to other organizations for fundraising, depreciation expenses, and expenses of locations providing support services (e.g., repair services, administrative services, etc.) for service establishments. Total expenses exclude outlays for the purchase of real estate (land and buildings); outlays for construction; outlays for additions, major alterations, and improvements to existing facilities; all other capital expenditures; funds invested; income taxes; and assessments (dues) paid to the parent or other chapters of the same organization.

Federal income tax status. Firms that indicate all or part of their income are exempt from federal income tax under provision of Sections 501 or 521 of the Internal Revenue Service are classified as tax-exempt. Firms indicating no such exemption are classified as taxable. For all firms, the tax status classification is based upon administrative records.

Total operating expenses. Costs incurred during the survey year, even though payment may be made at a later date. Excludes interest on loans and sales taxes and other taxes collected from customers and paid directly to a taxing authority.

Total operating revenue. Includes charges or billings for services rendered and any sales of merchandise during the survey year, even though payments may be received at a later date. Excludes income from interest, investments, gifts, loans, contributions, or grants; the sale of securities, real estate, etc; sales taxes or other taxes collected from customers and remitted directly by the firm to a local, state, or federal tax agency; revenue from the sale of merchandise and equipment from retail establishments; and revenue from a domestic parent organization, or from franchise locations owned by others and any franchise or license fees.

Total revenue. (Basic dollar volume measure for firms exempt from federal income tax.) Charges or billings to customers or clients for services rendered and merchandise sold during the survey year whether or not payment was received in that year. Also includes income from interest, dividends, contributions, gifts and grants, rents, royalties, dues and

assessments from members and affiliates, and net receipts from fundraising activities. Receipts from taxable business activities, as well as tax-exempt activities are included. Excludes sales taxes or other taxes (real estate, admissions, etc.) collected by the organization from customers or clients and paid directly to local, state, or federal income tax agencies; income from the sale of real estate, investments, or other assets; or amounts transferred to operating funds from capital or reserve funds. Firms providing legal services report payments received in the survey year regardless of when services are rendered.