Construction Spending – Methodology

Survey Design

Target population
Construction work done each month on new structures or improvements to existing structures for private and public sectors (in 50 states and the District of Columbia).

Sampling frame
Construction Progress Reporting Survey:

Privately-owned nonresidential, state and local, and federal projects are selected from lists compiled by Dodge Data & Analytics (DDA), (and supplemented with a small sample of projects in non-permit issuing areas).

Multifamily projects identified in the Survey of Construction.

Consumer Expenditures Survey:

The Consumer Expenditure Survey (CE) is a nationwide household survey conducted by the U.S. Bureau of Labor Statistics (BLS) to find out how Americans spend their money. It is the only federal government survey that provides information on the complete range of consumers' expenditures as well as their incomes and demographic characteristics.

The improvement estimates are derived from the Quarterly Interview Survey component of the CE. The Interview Survey is designed to collect data on large and recurring expenditures that consumers can be expected to recall for a period of 3 months or longer, such as rent, utilities and home improvements. CE data are collected for BLS by the U.S. Census Bureau. These data is used to estimate the residential improvements to owner-occupied housing units. More detail on this survey can be found on the BLS website, Consumer Expenditures Survey (CE).

Single Family:

Single family projects identified in the Survey of Construction.

Sampling unit
Construction Progress Reporting Survey:

Privately-owned nonresidential, state and local, and federal projects valued at $75,000 or more in the United States, and projects in a sample of areas not covered by building permit systems.

All multifamily projects identified in the Survey of Construction.

Consumer Expenditures Survey:

All residential improvements to owner-occupied housing units identified in the Consumer Expenditures Interview Survey.

Single Family:

Single family projects identified in the Survey of Construction.

Sample design

Construction Progress Reporting Survey:

Projects are selected using stratified systematic sample procedures. For Privately-owned nonresidential, state and local, and federal the strata are based on ownership, type of construction and estimated project value.

Sampling Rates for Private Nonresidential Construction Projects, by Type of Construction

Value[1] ($1,000)	Lodging	Office	Commercial	Health Care	Educational	Religious	Amusement and Recreation	Transportation	Power	Manufacturing	NEC
$100,000 or more...	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
$10,000 to $99,999.....	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
$5,000 to $9,999.....	1/5	1/4	1/4	1/5	1/5	1/2	1/3	1/1	1/1	1/1	1/3
$2,000 to $4,999.....	1/11	1/8	1/8	1/8	1/8	1/3	1/5	1/1	1/2	1/4	1/5
$750 to $1,999.....	1/11	1/8	1/24	1/11	1/16	1/11	1/11	1/2	1/3	1/4	1/8
$250 to $749.....	1/21	1/33	1/50	1/27	1/21	1/33	1/27	1/4	1/4	1/8	1/16
$75 to $249.....	1/53	1/53	1/80	1/47	1/33	1/53	1/53	1/8	1/6	1/25	1/40

[1] Based on the value shown on the Dodge Data & Analytics report.

Note: Projects in cells with sampling rates of 1/1 are selected with virtual certainty.

NEC = Public safety, communication, highway and street, sewage and waste disposal, water supply, and conservation and development.

Sampling Rates for State and Local Government Construction Projects, by Type of Construction

Value[1] ($1,000)	Residential	Office	Health Care	Educational	Public Safety	Amusement and recreation	Transportation	Highway and street	Sewage and waste disposal	Water supply	Conservation and development	NEC
$100,000 or more...	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
$10,000 to $99,999.....	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
$5,000 to $9,999.....	1/2	1/3	1/3	1/24	1/3	1/3	1/3	1/24	1/5	1/5	1/2	1/3
$2,000 to $4,999.....	1/3	1/5	1/5	1/70	1/5	1/5	1/5	1/70	1/11	1/8	1/2	1/5
$750 to $1,999.....	1/5	1/11	1/8	1/120	1/11	1/11	1/11	1/120	1/21	1/21	1/3	1/8
$250 to $749.....	1/11	1/21	1/16	1/200	1/21	1/21	1/21	1/200	1/33	1/33	1/3	1/33
$75 to $249.....	1/16	1/27	1/27	1/360	1/27	1/27	1/40	1/360	1/80	1/80	1/5	1/80

[1] Based on the value shown on the Dodge Data & Analytics report.

Note: Projects in cells with sampling rates of 1/1 are selected with virtual certainty.

NEC = Lodging, commercial, religious, communication, power, and manufacturing.

Sampling Rates for Federal Construction Projects, by Type of Construction

Value[1] ($1,000)	Lodging	Commercial	Health Care	Educa-tional	Religious	Amusement and recreation	Commu-nication	Power	Highway and street	Sewage and waste disposal	Water supply	Conservation and development	Manufac-turing	NEC
$100,000 or more...	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
$10,000 to $99,999.....	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
$5,000 to $9,999.....	1/2	1/2	1/3	1/3	1/2	1/2	1/2	1/2	1/3	1/2	1/3	1/2	1/2	1/2
$2,000 to $4,999.....	1/5	1/3	1/5	1/8	1/3	1/2	1/6	1/2	1/8	1/3	1/8	1/2	1/2	1/3
$750 to $1,999.....	1/5	1/5	1/8	1/11	1/11	1/3	1/8	1/4	1/16	1/5	1/16	1/3	1/3	1/5
$250 to $749.....	1/21	1/11	1/16	1/33	1/33	1/5	1/12	1/8	1/33	1/13	1/47	1/3	1/5	1/11
$75 to $249.....	1/53	1/27	1/27	1/53	1/80	1/11	1/30	1/20	1/80	1/27	1/80	1/5	1/11	1/16

[1] Based on the value shown on the Dodge Data & Analytics report.
Note: Projects in cells with sampling rates of 1/1 are selected with virtual certainty.
NEC = Residential, office, public safety, and transportation.

For multifamily projects, the strata are based on building location and number of housing units.

Consumer Expenditures Survey:

Please see sampling information from the Consumer Expenditure Survey.

Single Family:

Single family projects identified in the Survey of Construction. The estimated cost of all single units started is then distributed into monthly value put in place by applying fixed patterns of monthly construction progress.

Monthly Progress Patterns for Private New Single Family Residential Buildings, by Month of Start

(Percent of the value of unites started monthly)

Month of Activity[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1st	15.8	15.8	15.8	15.8	15.9	16.9	16.9	16.9	16.9	16.9	16.9	15.8
2nd	21.7	23.2	22.5	22.5	22.9	23.8	23.8	23.8	23.8	23.8	21.7	21.7
3rd	21.0	20.1	20.8	20.8	20.8	20.8	20.8	20.8	20.8	18.3	18.3	18.3
4th	16.3	16.0	16.0	16.0	16.0	16.0	16.0	16.0	13.7	13.7	13.7	16.8
5th	10.6	10.3	10.3	10.3	10.3	9.5	9.5	8.8	8.8	8.8	11.7	11.7
6th	6.1	6.1	6.1	6.1	6.1	5.8	5.8	5.1	5.1	7.4	7.6	6.7
7th	3.5	3.5	3.5	3.5	3.5	2.7	2.7	2.7	4.3	4.8	4.3	4.0
8th	2.0	2.0	2.0	2.0	1.5	1.5	1.5	2.5	2.8	3.3	2.8	2.0
9th	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.6	2.0	1.2	1.2	1.2
10th	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
11th	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
12th	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

[1] Month of start is first month of activity.

Frequency of sample redesign
The feasibility of a survey redesign is currently being researched.

Sample maintenance
Construction Progress Reporting Survey:

The frame is updated monthly with new projects. Any changes to the sample are updated on a monthly basis. Single family housing unit construction is removed from the multifamily sample as it is identified.

Consumer Expenditures Survey:

Please see above sampling information about the Consumer Expenditure Survey.

Single Family:

Nonresidential or multifamily construction is removed from the sample as it is identified.

Data items requested and reference period covered
The survey questionnaires can be found here.

Construction Progress Reporting Survey:

Data collection activities begin on the first day after the reference month and continue for about three weeks. Reported data and estimates are for activity taking place during the previous calendar month.

Consumer Expenditure Survey:

Please see information about the Consumer Expenditure Survey.

Key data items
Key data items include Total construction cost, start date of construction, completion date, and value of construction put in place during month.

Type of request
This survey is voluntary.

Frequency and mode of contact
Once a project is selected it remains in the survey until construction is completed for that project. Each sampled project is contacted every month in an effort to obtain progress reports until the project is completed. A mail survey form is sent to the owners of the projects in the project's initial month. The forms are mailed at the beginning of the month and a telephone follow-up is conducted if the form is not returned by the 15th of the month. In subsequent months, respondents are offered the option to report online. Respondents who choose to respond via Centurion receive email notifications rather than paper forms or letters. Several attempts are made to collect information by telephone follow-up if a response has not been received online or

by mail or fax. If a respondent has more than one project in the sample, information is requested for all projects with one telephone call. Each respondent is contacted at their requested time by the computer assisted interview process known as the Call Scheduler. In addition to telephone follow-ups, letters are mailed to respondents to encourage response. For State and Local Government's that publish their project spending on their websites, we extract the relevant spending information that is needed for our survey without requesting additional response from the respondent. Additionally, we have developed reporting arrangements with other State and Local Governments who send us consolidated reporting via a monthly spreadsheet.

If no contact is made, this project is labeled as a nonrespondent and its values will be imputed. If no contact is made after three months, the project is coded as a permanent nonrespondent, and all further monthly values will be imputed.

Data collection unit

Construction Progress Reporting Survey:

The monthly universe for private construction is approximately 6,200 projects with an estimated sample size of 580 new projects selected each month. State and local governments have a monthly universe of approximately 8,700 projects with an estimated sample size of 750 new projects selected each month. The federal government has a monthly universe of approximately 300 projects with an estimated sample size of 60 new projects selected each month. For multifamily, the estimated sample size is approximately 240 new projects each month.

Consumer Expenditure Survey:

Owner-occupied Housing units.

Editing

Respondent data is reviewed for consistency across related items. This review includes identifying and resolving anomalies using various analytical tools.

Nonresponse

Nonresponse is defined as the inability to obtain requested data from an eligible survey unit. Two types of nonresponse are often distinguished. Unit nonresponse is the inability to obtain any of the substantive measurements about a unit. In most cases of unit nonresponse, the Census Bureau was unable to obtain any information from the survey unit after several attempts to elicit a response. Item nonresponse occurs either when a question is unanswered or unusable.

Imputation

Imputations are made for projects that have not reported at the time of the monthly tabulation, based on estimated total construction value and month of start of the project. Weighted data are summed over all sample projects by type of construction.

We request total construction cost (Item5c), architectural, engineering, and miscellaneous construction costs (Item6), and the start date of construction (Strtdate) to be reported during the month of selection (Selmonth), i.e., the initial month of contact. If these items are not reported in the initial month then they are imputed. In any month the value of construction activity (VIP) is not reported (the selection month included), it will be imputed.

Start Date imputation

If a sampled project does not report a start date, a warm-deck procedure is used by selecting a donor from a pool of projects in the sample that have been selected within the past 24 months. Each potential donor must have reported a start date and the absolute difference between the start date and selection date of the donor must be less than or equal to 24 months. Or:

$$\left|diff_{donor}\right| = \left|seldate_{donor} - strtdate_{donor}\right| \leq 24$$
$$\Leftrightarrow -24 \leq diff_{donor} \leq 24$$

The nonreporting start date sampling project *i* is assigned to imputation cells by five TC groups and size value groups. The value groups are based on the project selection value.

A donor is selected with replacement within the appropriate cell and the start date for project *i* is imputed as the difference between the selection date of project *i* and the diff of the donor, as computed in equation.

$$strtdate_i = seldate_i - diff_{donor}$$

Total Construction Cost Imputation

The nonreporting total construction cost (Item5c) or architectural, engineering, and miscellaneous construction costs (Item6) sampled project *i* is assigned to the appropriate imputation cells as described above and is imputed as follows:

$$rvitm5c_i = \frac{x_h}{z_h} \times projselv_i$$

$$rvitm6_i = \frac{x_h}{z_h} \times projselv_i$$

where x_h represents the sum of reported rvitm5c from cases that have been completed in the past survey year.
z_h represents the sum of projselv from cases that completed construction in the past survey year and reported Item5c.

v_h represents the sum of Item6 from cases that completed construction in the past survey year and reported Item6.

x_h, z_h, and v_h are updated annually after April survey data is collected. Therefore, the "past survey year" reflects projects that have completed between April of the previous year and March of the current year.

VIP Imputation

If VIP is not reported for a sampled case due to late reporting or refusal in any month, we impute the value depending on the reporting status of the start date. We also re-impute projects that have not reported VIP for any given month (VIPMonth) in the past 24 month period. When an imputed value falls out of the 24 month period it will not be re-imputed. Each nonreporting VIP sampled project *i* is assigned to the appropriate imputation cell and is imputed as follows:

$$VIP_i = \begin{cases} \max(\frac{y_r}{x_r + x_c}, 0.01) \times rvitm5c_i, & if\ start\ date\ is\ not\ reported \\ \max(\frac{y_r}{x_r}, 0.01) \times rvitm5c_i, & if\ start\ date\ is\ reported \end{cases}$$

where y_r represents the sum of VIP from cases reporting VIP and rvitm5c.
x_r represents the sum of rvitm5c from cases reporting VIP and rvitm5c.
x_c represents the sum of rvitm5c from cases reporting VIP and rivtm5c that have completed construction activity.

y_r, x_r, and x_c are computed for each VIPMonth and VIP imputation cell, where the VIP imputation cells are defined by range groups (difference in months; VIPMonth-strtdate) and seven rvitm5c value groups.

The nonreporting monthly VIP for a particular month is re-imputed each month based on the latest distribution of data. Therefore, the VIP for a particular month can change each month until the project is complete. A project is considered complete when the sum of the monthly VIP values (VIPSUM) is greater than or equal to 1.015*Item5c. The completion date then becomes the current VIPMonth.

Other macro-level adjustments

Construction Progress Reporting Survey:

The estimates from privately owned nonresidential construction projects are increased by 25 percent to account for the undercoverage of construction projects not included in the frame. This adjustment is based on the

Nonresidential Undercoverage Evaluation(NCE), conducted by the Census Bureau, which compared the DDA frame to a sample of projects for which permits were issued. In addition, the privately owned manufacturing category is further adjusted by benchmarking the tabulated estimates to the latest detailed structures data from the Census Bureau's Annual Capital Expenditures Survey (ACES). The 1992, 1994, 1998, 2003, 2008, 2012, and 2017 levels for industrial buildings are based upon actual ACES data. Estimates for other years are extrapolations from the 1992, 1994, 1998, 2003, 2008, 2012, and 2017 levels.

The estimates from state and locally owned projects are also increased to account for undercoverage. The increase was produced from the results of a State and Local Undercoverage Evaluation(SLUE) and varies by type of construction.

Type of Construction	Factor
Highway	1.25
Education	1.20
Sewer and Water	1.24
Power	5.85
Housing and Hotel/motel	2.51
Transportation	1.53
Others	1.20

The construction estimates from federally owned projects are benchmarked to the actual budget of the federal government on an annual basis.

Other Estimates:

Direct sources for estimates include the annual U.S. Department of Agriculture report, Income and Balance Sheet Statistics and the Surface Transportation Board. Estimates might also be based on forecasts from S&P Global, American Gas Association, the Federal Energy Regulatory Commission, Edison Electric Institute, Lawrence Berkeley National Laboratory, and the American Clean Power Association. Reports from Federal regulatory agencies and private organizations are also used.

Tabulation unit:

Each contruction project is categorized into a 4 digit code that represents the Type of Costruction (TC).

Estimation:

Construction Progress Reporting Survey:

Estimates of value put in place are obtained by multiplying the final weight of each project by the monthly value and summing all projects. The final weight can be expressed as the product of the following:

Final weight=(basic weight) x (outlier adjustment factor) x (adjustment factor for architectural, engineering, and miscellaneous costs) x (frame duplication factor).

1. Basic weight. The basic weight varies with each source and project.
   a. For DDA data, the basic weight is the reciprocal of the probability of selecting a project.
   b. For projects from all other sources, the basic weight is the reciprocal of the probability of selecting a nonpermit segment.
2. Outlier adjustment factor. This factor reduces the influence on the VIP of an extreme noncertainty observation that reports an extremely large total construction value.
3. Adjustment factor for architectural, engineering, and miscellaneous costs.
4. Frame duplication factor. This factor adjusts for duplicates in the frames. The factor is 0.99 for private nonresidential projects and is 0.993 for state and local and federal projects.

Consumer Expenditure Survey:

The estimates for residential improvements are obtained from the Consumer Expenditures Survey (CE). The preliminary and revised estimates are based on forecasts of partial months because the sample design of the CE does not enable monthly estimates to be ready until months later. This leads to large uncertainty in the data and produces large monthly revisions. These incomplete data are forecasted using X-13ARIMA-SEATS and time series techniques to remove the irregular effects.

Other Estimates:

Value-in-place estimates for new farm nonresidential construction are extrapolated from the annual U.S. Department of Agriculture (USDA) report, *Income and Balance Sheet Statistics*. Monthly or quarterly estimates are not available. To estimate monthly values, including projections for the current and following year, USDA data are developed using the trend of private nonbuilding construction put-in-place estimates.

Value-in-place estimates for the telephone component of communication construction are based on reports of actual monthly construction progress. For the electric, gas, railroad, oil companies, and the TV cable component of communication, construction put-in-place estimates are based on annual capital expenditure reports compiled by federal regulatory agencies and private organizations.

Pending availability of annual data, monthly estimates for railroads are obtained by distributing Survey Transportation Board quarterly construction expenditures estimates into monthly values. Preliminary monthly estimates for TV cable, electric, and gas construction are based on annual forecasts from S&P Global, the Edison Electric Institute, and the American Gas Association; and oil estimates are projections from the latest final year of Federal Energy Regulatory Commission data. Expenditures made by nonregulated utilities are gathered in the same method as private nonresidential construction. Monthly estimates are published only for communication and electric; however, estimates for other public utilities are included in the appropriate totals.

Sampling Error

The sampling error of an estimate based on a sample survey is the difference between the estimate and the result that would be obtained from a complete census conducted under the same survey conditions. This error occurs because characteristics differ among sampling units in the population and only a subset of the population is measured in a sample survey. 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 sample design. Because each unit in the sampling frame had a known probability of being selected into the sample, it was possible to estimate the sampling variability of the survey estimates.

Common measures of the variability among these estimates are the sampling variance, the standard error, and the coefficient of variation (CV), which is also referred to as the relative standard error (RSE). 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. 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. It is also 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 these estimates incorporate sampling error information into their analyses, as this could affect the conclusions drawn from the estimates.

Construction Progress Reporting Survey:

The VIP estimates use a stratified-jackknife variance estimation procedure. The variance estimation formula is:

$$\hat{V}(\hat{Y}) = \sum_{h=1}^{H}(1-f_h)\left(\frac{n_h-1}{n_h}\right)\sum_{j=1}^{n_h}(\hat{Y}_{hj}-\hat{Y}_h)^2$$

where h indexes the strata.

H represents the number of strata.

f_h represents the sampling strata with the stratum.

n_h represents the number of replicates within the stratum.

$\hat{Y}_{hj}$ represents the total VIP in stratum *h* with the j^{th} replicate removed.

$\hat{Y}_h$ represents the total VIP in stratum *h*.

Consumer Expenditure Survey:

Follow this link to the CE Variance Procedure.

Single Family:

As estimates for single family construction spending are based on units from SOC, we use the variance estimation procedure from that survey. The variance estimates for SOC, and thus for single family construction spending, are generated by the modified half-sample (MHS) replication method (Thompson, 1998). Balanced repeated variance methods are designed for samples with 2-PSUs per stratum. SOC's sample is 1 PSU per stratum thus we combine PSUs, places and segments into groups and assign the groups lines on a 200 x 200 Hadamard matrix. The MHS variance estimate (*k*=0.5) is given by:

$$\frac{1}{200(1-k)^2}\sum_{r=1}^{200}(\hat{Y}_r-\hat{Y}_0)^2$$

where r indexes the 200 replicates.

$\hat{Y}_r$ is the estimate for single family construction spending for replicate r.

$\hat{Y}_0$ is the estimate for single family construction spending for the full sample.

Confidence Interval

The sample estimate and an estimate of its standard error allow us to construct interval estimates with prescribed confidence that the interval includes the average result of all possible samples with the same size and design. To illustrate, if all possible samples were surveyed under essentially the same conditions, and an estimate and its standard error were calculated from each sample, then:

1. Approximately 68 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average estimate derived from all possible samples.

2. Approximately 90 percent of the intervals from 1.645 standard errors below the estimate to 1.645 standard errors above the estimate would include the average estimate derived from all possible samples.

In the example above, the margin of error (MOE) associated with the 90 percent confidence interval is the product of 1.645 and the estimated standard error.

For example, suppose the tables showed that the annual VIP estimate for ‘‘total private office construction’’ was $10.0 billion in a particular year. The relative standard error of this estimate is 2.0 percent. Multiplying $10.0 billion by .02, we obtain $200 million as the standard error. To obtain a 90-percent confidence interval, multiply $200 million by 1.645 and add and subtract the result from $10.0 billion, yielding limits of $9.67 billion and $10.33 billion. The average value of the monthly VIP estimate for ‘‘total private office construction’’ may or may not be contained in this computed interval, but one can say that the average is included in the constructed interval with a specified confidence of 90 percent. No standard errors are shown for farm construction or regulated investor-owned utility construction because the estimates are based on a complete enumeration. It is important to note that the standard error and the relative standard error only measure sampling error. They do not measure any systematic nonsampling error in the estimates.

Nonsampling Error

Nonsampling error encompasses all factors other than sampling error that contribute to the total error associated with an estimate. This error may also be present in censuses and other nonsurvey programs. Nonsampling error arises from many sources: inability to obtain information on all units in the sample; response errors; differences in the interpretation of the questions; mistakes in coding or keying the data obtained; and other errors of collection, response, coverage, and processing.

Other potential sources of bias are (1) the upward adjustment made to the private nonresidential construction; (2) upward adjustments made to the state and local owned public construction; and (3) the adjustment of federal construction to agency totals in order to account for construction projects not included in their respective sampling frames. The adjustments for the nonresidential and state and local owned constructions result from coverage evaluation samples; hence, the estimated adjustments are subject to sampling errors and nonsampling errors associated with the evaluation studies. In addition, the adjustments were estimated from data collected during fixed time periods; therefore, they do not reflect any changes in the proportion of projects not included in the frames.

Consequently, even though the private nonresidential and state and local owned construction adjustments are designed to reduce the bias due to the failure to include projects in the sampling frames, for the above stated reasons, these adjustment procedures, themselves, may introduce a bias in the current estimates of value in place. Furthermore, additional nonsampling errors may be introduced into the estimates

because the procedures such as phasing, extrapolating, and forecasting used to develop the indirectly measured series are subject to the validity of the underlying assumptions made and mathematical models used. No explicit measures of the effects of these procedures are available. Although no direct measurement of nonsampling error was obtained, precautionary steps were taken in all phases of the collection, processing, and tabulation of the data in an effort to minimize its influence.
The Census Bureau recommends that individuals using these estimates factor in this information when assessing their analyses of these data, as nonsampling error could affect the conclusions drawn from the estimates.

To increase response rates, respondents are offered the option to report online. Respondents who choose to respond via Centurion receive email notifications rather than paper forms or letters. Several attempts are made to collect information by telephone follow-up if a response has not been received online or by mail or fax. If a respondent has more than one project in the sample, information is requested for all projects with one telephone call. Each respondent is contacted at their requested time by the computer assisted interview process known as the Call Scheduler. In addition to telephone follow-ups, letters are mailed to respondents to encourage response. For State and Local Government's that publish their project spending on their websites, we extract the relevant spending information that is needed for our survey without requesting additional response from the respondent. Additionally, we have developed reporting arrangements with other State and Local Governments who send us consolidated reporting via a monthly spreadsheet.

The average unit response rates (URR) for 2023 are as follows: private nonresidential construction, 25 percent; state and locally owned public construction, 62 percent; multi-family construction, 17 percent; residential improvements, 72 percent; and federal construction 53 percent. The average imputation rate is calculated as the complement of the average quantity response rate (QRR). The 2023 average imputation rates for major components are as follows: private nonresidential construction, 68 percent; state and locally owned public construction, 32 percent; private new multi-family construction, 68 percent; private residential improvements, 2 percent; and federal construction, 34 percent.

A nonresponse bias analysis for privately owned nonresidential construction and multifamily projects was completed. Response rates were analyzed using the May 2017 production data which contains data spanning 27 months from March 2015 through May 2017. The study included analysis of unit response rates (URR) and quantity response rates (QRR) for monthly CPRS data. For Private Nonresidential projects, response rates were analyzed by certainty status, type of construction, and project selection value (PSV) groups. We looked at response rates for monthly spending and for the total construction cost (collected as Revised Item 5c). The study also examined the relative bias of Project Selection Value (PSV). PSV was used because it is available for both respondents and nonrespondents and is reasonably well correlated ($r > 0.75$) with

both the revised Item 5c and the total sum of monthly value of construction put in place (VIP) for a project. Relative bias was calculated across the 27 months by certainty status, type of construction, and PSV group.

The analysis of response rates found similar reporting patterns for both certainty and non-certainty units. Certainty units have a higher URR but a lower TQRR than non-certainty units. Across type of construction and value categories the response rates were again similar but a few categories, such as projects valued at $10M or greater and manufacturing projects, have lower TQRRs than the other groups. The analysis of relative bias shows that nonresponse bias is present and largest among non-certainty cases and the Power, Healthcare and Religious construction types. Although most categories show a positive relative bias, the manufacturing category shows a negative relative bias indicating potential for underestimation of this total. However we currently benchmark this type of construction to the Annual Capital Expenditures Survey to mitigate this. Ideally this nonresponse bias would be eliminated by the current imputation methods.

For multifamily projects, response rates were analyzed by certainty status and groups based on the project size, measured by the number of units in the project. Overall the response rates have similar reporting patterns, but certainty units have a higher URR but a lower TQRR than noncertainty units. Looking at response by project size, we found that projects with 5-24 units make up about 28% of all projects, while projects with 25-49, 50-99, 100-199, 200-299, and 300 or more units make up about 14% each. Projects 50 units or more have the highest response rates while smaller projects of 25-49 units have the lowest (URR and QRR). However the response rates are reasonably similar across all project sizes. We were unable to measure the relative bias for multifamily projects because we do not have a common frame variable that is correlated with monthly expenditures. Ideally any bias due to nonresponse would be eliminated by the current imputation methods.

We completed an evaluation of the CPRS as required by the Statistical Policy Directive on Compilation, Release, and Evaluation of Principal Federal Economic Indicators; this evaluation was submitted to the OMB in March 2016. Additionally, testing and evaluation of the variance methods was conducted, which led to the implementation of updated variance programs in July 2015.

All changes to methodology or processing systems are tested. For example, during the development of our new processing system, we conducted thorough testing utilizing data from the previous production system to ensure similar and consistent survey results. Additionally, we have improved our sampling and tabulation programs to be more efficient, prior to implementation, we conducted thorough testing to ensure consistent results to the previous system.

An analysis of the revisions for the monthly seasonally adjusted estimates by

type of construction is updated annually. It shows the range and median of the percent change between the preliminary and second revision and between first and second revision, for the last 12 months. The table can be found here.

Seasonal adjustment

Seasonal adjustment is the process of estimating and removing seasonal effects from a time series in order to better reveal certain nonseasonal features. Examples of seasonal effects include a July drop in automobile production as factories retool for new models and increases in heating oil production during September in anticipation of the winter heating season. When applicable, we also estimate and remove trading day effects and moving holiday effects (e.g., Easter, Labor Day, etc.) during the seasonal adjustment process. Trading day effects are recurring effects related to the weekday composition of the month.

The seasonal adjustment factors were developed using X-13ARIMA-SEATS software. The X-13ARIMA-SEATS program provides summary statistics to indicate the overall effect of the seasonal adjustment. These tables of descriptive and diagnostic information show some of these statistics: Private, State and Local, and Federal. For more information on X-13ARIMA-SEATS see the reference manuals posted on the Census Bureau's website.

An assumption underlying the seasonal adjustment process is that the original series can be separated into a seasonal component, a trading-day component, a trend-cycle component, and an irregular component. The seasonally adjusted series consists of the trend-cycle and irregular components taken together. The trend-cycle component includes the long-term trend and the business cycle. The irregular component is made up of residual variations, such as the sudden impact of political events and the effects of strikes, unusual weather conditions, reporting and sampling errors, etc. For more information on Seasonal Adjustment, view our Seasonal Adjustment Questions and Answers here.

Seasonally adjusted estimates are developed concurrently for each month for each combination of Ownership and Type of Construction.

Concurrent seasonal factors result from re-estimating the seasonal adjustment each month when the new time series values become available.

Benchmarking

Benchmarking adjusts the level of a given series to the levels (referred to as benchmarks) from a less frequent data source that is considered to be of better quality, while attempting to minimize revisions to the period-to-period changes from the more frequent series. In this way, we produce consistent time series and attempt to reduce the effects of sampling and nonsampling errors in the original, more frequent series.

Periodically construction spending estimates for private manufacturing are benchmarked to the Census Bureau's Annual Capital Expenditures Survey (ACES) detailed structures data. This was done for data in 1992, 1994, 1998, 2003, 2008, 2012, and 2017. A carry forward factor is applied to estimates in between ACES benchmark years.

The monthly private residential improvements estimates are comprised of partially forecast data and are benchmarked to the complete data during the following annual revision period.

The Federal, Utilities, and Railroad estimates are benchmarked or derived from outside sources. Some of these sources are unable to provide estimates until a year or two after the reference period. Once the source data is available the series are revised during the following annual revision period.

Disclosure avoidance

Disclosure is the release of data that reveals information or permits deduction of information about a particular survey unit through the release of either tables or microdata. Disclosure avoidance is the process used to protect each survey unit's identity and data from disclosure. Using disclosure avoidance procedures, the Census Bureau modifies or removes the characteristics that put information at risk of disclosure. Although it may appear that a table shows information about a specific survey unit, the Census Bureau has taken steps to disguise or suppress a unit's data that may be 'at risk' of disclosure while making sure the results are still useful.
The Value of Construction Put in Place Survey uses cell suppression as the primary method of disclosure avoidance.

Cell suppression is a disclosure avoidance technique that protects the confidentiality of individual survey units by withholding cell values from release and replacing the cell value with a symbol, usually a 'D'. If the suppressed cell value were known, it would allow one to estimate an individual survey unit's too closely.

The cells that must be protected are called primary suppressions.

To make sure the cell values of the primary suppressions cannot be closely estimated by using other published cell values, additional cells may also be suppressed. These additional suppressed cells are called complementary suppressions.

The process of suppression does not usually change the higher-level totals. Values for cells that are not suppressed remain unchanged. Before the Census Bureau releases data, computer programs and analysts ensure primary and complementary suppressions have been correctly applied.

The Census Bureau has reviewed the Monthly and Annual Value Put in Place tables for unauthorized disclosure of confidential information and has approved the disclosure avoidance practices applied (Approval ID: CBDRB-FY24-0336).

The Census Bureau has reviewed the Annual Geographic Value Put in Place and Length of Time tables for unauthorized disclosure of confidential information and has approved the disclosure avoidance practices applied (Approval ID: CBDRB-FY23-0409).

For more information on disclosure avoidance practices, see FCSM Statistical Policy Working Paper 22.

History of Survey Program

Beginning in 1993, the Construction Expenditures Branch of the Manufacturing and Construction Division began collecting "Value of Construction Put in Place" data for private nonresidential and state and local government projects using a new classification system. This new system allows the classification of construction with one generalized coding scheme which bases project types on their end usage instead of building/nonbuilding types. Data collection for federal construction at the detailed project level began in January 2002.

With the changes in project classifications, data now presented are not directly comparable with those data previously published in the regular-format press releases and tables. Direct comparisons can only be made at the total, total private, total state and local, total federal, and total public levels for annual and not seasonally adjusted monthly data. Although some categories (lodging, office, educational, religious) seem identical to previously published data, there have been changes within the classifications that make these values incomparable. For example, private medical office buildings were classified as "office" buildings previously, but under the new classification these buildings are in "health care."

In addition, seasonally adjusted estimates in the new tables are not, in general, equal to the previously published seasonally adjusted estimates at any level of aggregation because: 1) the seasonal adjustment models, parameters, and factors for the two sets of estimates were developed from data covering different time spans, and 2) seasonal adjustment factors were derived directly for the previously published type of construction (TC) categories, but the factors for some new TC categories were derived indirectly from sub-category level seasonal adjustment. Both the previous and new TC seasonally adjusted series are valid. The previous TC series ended with May 2003 estimates and only the new TC series, estimated back to 1993, continue.

Before 2008, Construction Spending included estimates of the residential improvements to rental, seasonal, and vacant properties through the Survey of Residential Alterations and Repairs (SORAR). SORAR was discontinued due to budget cuts and as there is no other source of this data, the estimates are no longer included.