Reconciling Construction Data

A Comparison of the Value of Construction Put in Place Series, the 1997 Economic Census and the 1998 Annual Capital Expenditures Survey

Issued May 2002

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Introduction

The Census Bureau has three different surveys that measure the construction sector of the economy: the Value of Construction Put in Place series (VIP), the Construction Sector of the Economic Census (CSEC), and the Annual Capital Expenditures Survey (ACES). VIP collects expenditures by construction project, CSEC collects establishment level statistics, and ACES collects company capital expenditure data.

Each of these surveys plays an important role in the analysis of the construction industry. Understanding the strengths, weaknesses, and interaction among them assists us in making informed decisions regarding the construction economy.

The methodologies and universes covered by these surveys differ significantly. Because of this, they are not directly comparable as published. The reconciliation process explained here details the estimates, assumptions, and adjustments that are necessary before making an actual comparison.

Data from VIP and CSEC can be compared for years ending in two and seven, the years for which the Economic Census is conducted. The ACES data can only be compared in the years that detailed structures data are collected (1992, 1994, 1998, and every five years thereafter). Historically we have compared VIP and CSEC many times. A precedent for this procedure has been established by joint work conducted by the Census Bureau and the Bureau of Economic Analysis (BEA). This paper outlines the 1997 work and includes a reconciliation of 1998 ACES and VIP data.

Value of Construction Put in Place (VIP) Background

The VIP is a monthly measure of the dollar amount of construction put in place within the United States. The VIP data are used in the National Income and Product Accounts produced by BEA. The current historical series began in the early 1960's.

Published VIP data are compiled from: (a) a series of construction project surveys, (b) estimates from other construction series, and (c) data from secondary sources such as regulatory agencies. This approach is quite different from the establishment or company-based survey methods used by most economic surveys at the Census Bureau. Data collected through the VIP approach represents an all-encompassing economic measure of construction spending. The survey data are collected from the project owner's point of view. All construction related expenditures are included, not just contractor receipts.

The following types of expenditures are included in VIP:

- New buildings and structures
- Additions, alterations, major replacements, etc. to existing buildings and structures
- Installed mechanical and electrical equipment
- Installed industrial equipment, such as boilers and blast furnaces
- Site preparation and outside construction, such as streets, sidewalks, parking lots,

utility connections, etc.
- Cost of labor and materials (including owner supplied)
- Cost of construction equipment rental
- Profit and overhead costs
- Cost of architectural and engineering (A&E) work
- Any miscellaneous costs of the project that are on the owner's books

The VIP excludes several types of expenditures, such as the value of maintenance and repairs to existing structures and land acquisition.

Construction Sector of the Economic Census (CSEC) Background

The CSEC began on a regular basis in 1967. Data were collected for 1930, 1935, and 1940, but data from these censuses are not comparable to current data.

The scope of CSEC covers construction establishments that have one or more employees. It includes establishments classified as construction per the North American Industry Classification System (NAICS). Establishments operating as general contractors, operative builders, and specialty trade contractors are included. Some establishments engaged in construction are excluded, such as investment builders who build on their own account and rent the building rather than sell it.

Construction establishments without employees are known as "nonemployers." Nonemployers are typically self-employed individuals. They are not surveyed in the Economic Census. Instead, administrative data are compiled from other government agencies. The Census Bureau began releasing data annually for these establishments in 1997.

The Census Bureau defines a "construction establishment" as a relatively permanent office where business activities related to construction work are conducted. This office usually manages more than one project or job and the office is normally maintained on a continuing basis. Individual project site offices are not construction establishments.

The CSEC is a survey, not a complete census. For 1997, the universe was approximately 650,000 employer establishments. Of this, about 130,000 establishments were sampled. The sampling frame was compiled from the Census Bureau Business Register, a file of all known U.S. companies. All multiunit construction companies were sampled with certainty; single-location companies were stratified by industry and payroll. The largest single-location establishments were all included in the survey, smaller such establishments were sampled (the minimum sample rate was 1 in 20).

Respondents (typically construction contractors) self-code their activities into type of construction and ownership of projects (Federal, State & Local, and Private). All work conducted by the establishment is included in the survey.

Annual Capital Expenditures Survey (ACES) Background

The ACES collects capital expenditure data from a sample of nonfarm employer and nonemployer companies, rather than establishments. All capitalized construction work is collected as investment in "structures." The survey began in 1992. Total capital expenditures by structures and equipment are collected annually; detailed data on structures and equipment are collected once every five years. The following expenditures for buildings and other structures are included:

- Major additions, alterations, and capitalized repairs to existing structures, whether performed by a contractor or completed in-house
- Gross additions during the year to construction-in-progress accounts for projects lasting more than one year
- Machinery and equipment which are an integral or built-in feature of the structure
- Expenditures for land development and improvements such as demolition of buildings, site preparation, and land servicing
- Facilities which are built into or fixed to the land such as sidewalks, streets, parking lots, airfields, piers, etc.
- Exploration and development of mineral properties such as drilling gas wells, construction of offshore drilling platforms, digging and shoring mines, mine shafts, and mine exploration

VIP/CSEC Reconciliation

The major difference between VIP and CSEC is that VIP measures the value of construction currently being installed or erected, and CSEC measures and provides information on the receipts, expenditures, and characteristics of establishments performing the construction work. While both surveys measure the value of construction work done, CSEC only covers a little over three-quarters of the "construction" value that VIP covers. Some areas of "construction" not covered by CSEC:

- Nonemployer construction
- Architectural and engineering costs
- Force-account construction
- Homeowner construction
- Construction done as a secondary source of revenue by non-construction establishments

To reconcile the two surveys, we developed estimates for these missing areas and added them to CSEC data. As part of this, we made assumptions regarding data that are not directly measured.

The following steps outline the reconciliation process:

1. Tabulate 1997 Net CSEC Data

   Using 1997 CSEC microdata, calculate net or prime value by type (residential,

commercial, etc.) and class (new, additions/alterations, and maintenance/repair) of construction[1]. Net construction must be used since aggregate data contain varying amounts of duplication; both prime contractors and subcontractors may report receipts for the same projects. Net is calculated at the establishment level by subtracting the value of work subcontracted in from value of construction work done.

Work subcontracted in, class of construction, and ownership are collected as a percent of value of construction work done. The formula for calculating net assumes that maintenance and repair work is usually prime contract work and that ownership is equally distributed among receipts.

A small percent of construction work is "not specified by kind," meaning that a type of construction code was not assigned to the work done. This unclassified work is spread proportionally to all other types of construction.

2. Tabulate 1997 Net Nonemployer Data

In 1997, nonemployer establishments classified in construction had receipts of $87.1 billion, based on data compiled from administrative records. Only three pertinent data items are available for this set of data: number of establishments, receipts, and NAICS code. Using the distribution of surveyed establishments with one or two employees, we estimate nonemployer net receipts by type and class of construction and project ownership.

3. Estimate Values for Misreporting and Undercoverage

The Internal Revenue Service (IRS) develops under-reporting factors as part of their Tax Compliance Measurement and Information Return Programs. We apply these factors to administrative nonemployer data only.

The IRS also estimates receipts of firms who do not file tax returns. Since the Business Register is based on tax return data, these firms are missing from the Economic Census. We estimate receipts for these firms for both employer and nonemployer data.

4. Summarize Data and Estimates Calculated Thus Far

All data are summarized and expanded to the 6-digit NAICS level, then distributed by type of construction.

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[1]The reconciliation focuses on new and additions/alterations construction since this is the scope of VIP. CSEC maintenance and repair data are not used.

5. Adopt BEA Federal Data

BEA compiles estimates of Federal construction from federal agencies and publishes these data by type of construction. We assume BEA's estimates are more accurate than CSEC Federal data. Ownership for CSEC is based on contractor response, which is typically not as accurate as data obtained directly from the federal agencies. BEA's Federal data are distributed to the CSEC types of construction.

6. Adopt VIP State & Local Type of Construction Distribution

Unpublished VIP type of construction data are used to redistribute CSEC State & Local data. We assume that VIP data have fewer classification errors than CSEC due to VIP's increased analyst involvement.

7. Estimate Construction Work Done by Non-Construction Establishments

Three separate estimates are made for this activity:

Architectural and engineering work done by establishments classified in the Professional, Scientific and Technical Services Sector is estimated using 1997 Economic Census data.

Force account construction, i.e., work performed by non-construction establishments for their own use and by employees of those establishments. Examples of force account include owner-built homes or construction work performed at an industrial plant by the plant's own employees. This estimate is developed from unpublished data collected in the VIP survey.

Secondary construction work done by non-construction establishments. Examples of secondary construction are retail stores who perform construction work for their customers with their own labor force. This differs from force account in that the construction is not for own use.

8. Estimate Operative Builder Non-Construction Costs

Two estimates are made specifically for residential operative builders:

Operative builders are likely to report sales rather than value of work done in CSEC. To correct this we include an estimate of the value of inventory change of single-family houses based on Survey of Construction (SOC) data.

Operative builders are also likely to include in their value of work done non-construction costs such as land, landscaping, and appliances. We

subtract these costs from CSEC data using data related to SOC.

9. Summarize Data and Apply Non-Construction and Operative Builder Estimates

   All data are summarized by ownership and type of construction.

10. Adjust Data by Ownership

    As mentioned in step five, we have assumed that BEA's estimate of Federal data is the most accurate. In this step, we assume the estimate of net CSEC Public (Federal plus State & Local) is also accurate. Thus, CSEC State & Local is recalculated by subtracting BEA Federal data from CSEC Public[2].

    CSEC Private data are then adjusted by subtracting the new CSEC Public from CSEC at the type of construction level. The CSEC Private total is not changed.

11. Miscellaneous Adjustments

    Final adjustments are made to correct:

    - Negative data cells resulting from the reconciliation adjustments
    - Ownership classification discrepancies by type of construction
    - Double counting of prime activity done by both general contractors and heavy construction contractors
    - The redistribution of CSEC types of construction not specifically classified in VIP (for example, swimming pools and fences)

The resulting data are shown in Table 1. Throughout the reconciliation, data are tabulated on a CSEC type of construction basis. For the final comparison, the reconciliation data are shown by VIP categories. At the total level CSEC is only slightly higher than VIP, though there are some large differences in the Private type of construction categories. The differences are less for Public construction due to assumptions made during the reconciliation.

There are many classification differences between the two series that make a definitive comparison difficult. For example, VIP classifies office buildings at a manufacturing site as "Industrial", while CSEC would classify them as "Office". Also, public utility projects are classified by their industry rather than the type of building.

An estimate of $13.9 billion has been added to the VIP residential data shown in Tables 1 and 2. This estimate is for selected remodeling expenditures that are not currently included in VIP, but

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[2]An example of what happens here is highway construction. A substantial amount of CSEC highway construction is reported as Federal. These reports are presumably interstate construction which should have been reported as State & Local.

will be included in the future. The expenditures include remodeling work done in manufactured (mobile) homes, wall-to-wall carpeting installation, some types of kitchen appliance installation, and remodeling work that may be deducted as a business expense (such as the creation of a home office). The estimate is based on data collected in the American Housing and Consumer Expenditures Surveys.

VIP/ACES Reconciliation

Type of structure (or type of construction, as CSEC and VIP call it) detail from ACES is necessary to compare the series to VIP. These data have only been collected in 1992, 1994, and 1998. Here we compare 1998 VIP and 1998 ACES data.

The process to reconcile VIP and ACES is much simpler than reconciling VIP and CSEC because the scope of VIP and ACES is very similar.

We begin with an unpublished tabulation of ACES employer data by industry and type of structure. A small amount of data were not distributed by specific industry and type of structure. We calculated a "boost factor" to account for this nondistributed value and applied the factor to the detailed data. Construction which is not in scope for VIP is subtracted from ACES (e.g., manufactured (mobile) homes, mining, oil, and gas related construction).

In some instances, industry rather than type of structure data are more comparable to VIP. Thus, for the Manufacturing and Utility industries, industry data become the estimate for the respective type of structure. For the industrial type of structure, data are also added from all other industries having industrial expenditures.

For nonemployer companies in ACES only total new and total used structures data are collected. We developed a nonemployer type of structure distribution based on structures reported by companies with 1-5 employees. This distribution was applied to the published total new structures data for nonemployers.

Table 2 shows the resulting ACES data on a VIP type of construction basis. The ACES collects the equivalent of VIP nonfarm Private; Public data are not within the scope of ACES.

Conclusion

Although close in total, there are significant differences among the three surveys by type of construction. The reasons behind the differences are varied. Between CSEC and VIP, type of construction and ownership misclassification by CSEC respondents and definition differences exist. In CSEC, respondents select types of construction from a preprinted list on the questionnaire. Interpretation of these categories will vary among respondents. In VIP, analysts review classifications based on project description. Also, CSEC classifications are based on the function of the structure whereas VIP classification is sometimes based on the ownership of the project. For example, all VIP construction related to the utility industries is classified in the utility types of construction. The ACES and VIP use the same classification scheme, but implementation

may differ. For example, assisted living facilities are typically considered residential in VIP while ACES may classify them as institutional.

All three surveys have both sampling and nonsampling errors that must be considered when reviewing the data shown in Tables 1 and 2. Though at the total level the sampling error is about one percent, the error increases as the classification detail increases. The VIP data are adjusted by various factors to account for things like outliers, frame undercoverage, and architectural, engineering and other costs. The VIP industrial data are benchmarked to ACES; State & Local data are benchmarked to the Bureau's Annual Survey of Government Finances; VIP 1-unit residential are estimates based on SOC data; and VIP Federal data are classified by the agency responsible for the work rather than by specific type of construction work done. Response rates for the surveys also differ. For a full explanation of the limitations and errors associated with each survey see their respective publications on-line at www.census.gov.

The ACES sample is selected by number of employees and payroll, which are not necessarily predictors of capital expenditures. The sample size is relatively small considering the universe. About 32,000 employer companies represent 4.7 million companies. For nonemployers, 14,000 businesses represent 16.9 million businesses.

Individually each survey is an excellent measure of its intended scope. The process described here to compare the surveys results in some biased data due to the assumptions and estimates that were made. Nevertheless, we believe this undertaking is worthwhile. It provides perspective to data users who wish to relate the surveys to each other. Also, the process and resulting data highlight inconsistencies, often pinpointing areas of improvement.

Table 1. 1997 Adjusted CSEC and VIP by VIP Type of Construction (billions of dollars)

	CSEC	VIP	Difference	Percent Difference
Total Construction	679.3	667.3	12.0	1.8
Private Construction	524.3	516.6	7.7	1.5
Residential Buildings	251.8	302.9	(51.1)	(16.9)
1 unit	228.1	266.6	(38.5)	(14.4)
2 units or more	23.7	36.3	(12.6)	(34.7)
Nonresidential Buildings	225.4	173.9	51.5	29.6
Industrial	63.4	37.6	25.8	68.5
Office	47.6	34.3	13.3	38.7
Hotels and motels	11.8	12.9	(1.1)	(8.5)
Other commercial	59.7	51.8	7.9	15.2
Religious	7.2	5.8	1.5	25.2
Educational	4.8	8.7	(3.9)	(44.4)
Hospital and institutional	20.6	13.5	7.0	51.8
Miscellaneous	10.3	9.2	1.1	11.6
Farm Nonresidential	3.5	3.8	(0.3)	(7.0)
Public Utilities	33.8	33.6	0.1	0.4
Telecommunications/Electric light and power	23.8	23.7	0.1	0.4
Other public utilities	9.9	9.9	0.0	0.0
Railroads	4.9	4.9	0.0	0.0
Gas	4.0	4.0	0.0	0.0
Petroleum pipelines	1.0	1.0	0.0	0.0
All other private	9.8	2.4	7.4	310.0
State and Local Construction	139.4	136.6	2.8	2.1
Buildings	57.4	63.8	(6.4)	(10.0)
Housing and redevelopment	4.1	4.6	(0.5)	(11.4)
Educational	29.4	33.5	(4.1)	(12.3)
Hospital	3.0	3.7	(0.7)	(19.3)
Other	20.9	21.9	(1.0)	(4.5)
Highways and streets	43.8	42.3	1.5	3.4
Conservation and development	2.5	2.3	0.2	9.8
Sewer systems	15.1	10.5	4.6	43.8
Water supply facilities	12.3	6.5	5.8	89.7
Miscellaneous nonbuilding	8.3	11.2	(2.9)	(25.9)
Federal Construction	15.5	14.1	1.5	10.3
Buildings	10.1	6.1	4.0	65.1
Housing	1.8	0.7	1.1	162.1
Industrial	1.0	1.0	(0.0)	(1.6)
Educational	0.9	0.0	0.9	X
Hospital	1.4	1.3	0.1	11.3
Other	5.0	3.2	1.9	59.5
Highways and streets	0.3	0.3	0.0	0.0
Military facilities	0.0	2.6	(2.6)	(100.0)
Conservation and development	3.3	3.4	(0.1)	(2.3)
Miscellaneous public	1.9	1.8	0.1	6.2

X - the result is undefined

Table 2. 1998 Adjusted ACES and VIP by VIP Type of Construction (billions of dollars)

	ACES	VIP	Difference	Percent Difference
Private Nonfarm Nonresidential Construction	241.6	232.5	9.1	3.9
Nonresidential Buildings	189.1	190.7	(1.6)	(0.8)
Industrial	42.9	40.5	2.4	5.9
Office	43.2	42.2	1.0	2.4
Hotels, motels	6.6	14.8	(8.2)	(55.5)
Other commercial	41.3	53.6	(12.3)	(23.0)
Religious	11.5	6.6	4.9	74.3
Educational	13.3	9.7	3.6	36.9
Hospital and Institutional	22.5	13.8	8.7	63.0
Miscellaneous	7.9	9.5	(1.6)	(16.7)
Public Utilities	47.8	39.2	8.6	22.0
Telecommunications	19.4	12.5	7.0	56.0
Other public utilities	28.4	26.8	1.6	6.1
Railroads	6.3	5.7	0.6	10.6
Electric light and power/Gas	21.2	19.8	1.4	7.1
Petroleum pipelines	0.9	1.3	(0.4)	(30.0)
All other private	4.6	2.6	2.1	79.9