Comparing Estimates of Fixed Investment in Nonresidential Structures and Equipment

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Abstract The U.S. Bureau of Economic Analysis (BEA) has relied mainly on the U.S. Census Bureau's monthly Value of Construction Put in Place Survey (VIP) to measure levels of fixed investment in structures; the Annual Survey of Manufactures (ASM, with the commodity-flow method) to measure levels of fixed investment in equipment; and the Annual Capital Expenditures Survey (ACES) to estimate shares of fixed investment by industry. The estimated levels of fixed investment in nonresidential structures and equipment from these different surveys—with adjustments for known issues—should be similar. This paper compares estimated levels of investment in nonresidential equipment and structures from the ACES and from the other sources, using more than 20 years of published data. The results show that the estimates of fixed investment based on the ACES and the other sources are roughly similar and display similar cyclical trends. Nevertheless, some discrepancies between these estimates are worth noting. The ACES-based estimates of investment in structures are relatively higher in several years—as much as 20 percent higher—but not in all years. The ACES-based estimates of investment in new equipment are about 14–33 percent lower than the ASM/commodity-flow-based estimates. Despite these discrepancies, which could arise for many reasons, the rough similarity of the estimates from these surveys is reassuring and can be interpreted as generally supportive of BEA's estimation methods and the value of these surveys.

Keywords Fixed investment, Structures, Equipment, ACES

JEL Code E01, E22

Bureau of Economic Analysis
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Introduction

Comparing Estimates of Fixed Investment in Nonresidential Structures and Equipment

The U.S. Bureau of Economic Analysis (BEA) relies on several surveys from the U.S. Census Bureau to estimate annual fixed investment (gross fixed capital formation[1]) in nonresidential structures and equipment. To estimate levels of investment in structures, BEA relies mainly on the monthly Value of Construction Put in Place Survey (VIP). For estimates of levels of investment in equipment, BEA employs a commodity-flow method, using several data sources including the Annual Survey of Manufactures (ASM), which records shipments of equipment from manufacturing establishments. To estimate *shares* of these levels of fixed investment purchased by each industry and by legal form (corporate, nonprofits, etc.), BEA relies mainly on the Annual Capital Expenditures Survey (ACES) of a sample of U.S. companies. While these surveys differ in their samples, scope, and questions, they define fixed investment in a similar way, and so the estimated *levels* of investment from the ACES—with adjustments for known issues—should be similar to the estimates based on the other sources.

This paper compares estimates of levels of investment in equipment and structures from the ACES and from the other sources, using more than 20 years of published data. Previous research has compared estimated levels of fixed investment from these different sources, but these comparisons do not appear to have been updated recently. These comparisons, which take into account measurable differences in these surveys as much as possible, may help inform BEA's estimates and methods in the future, as many of the questions from these surveys will be part of the new Annual Integrated Economic Survey (AIES). We may be more confident in using data from all of these sources if their estimates of fixed investment are similar. These comparisons are of general interest to statistical agencies that may base estimates of fixed investment on either "supply-based" surveys of producers (construction projects or shipments) or on "demand-based" surveys of capital expenditures. In addition, the ACES provides estimates of investment in structures improvements and own-account projects, which may be understated in the VIP data.

The results show that estimates of fixed investment based on the ACES and the other sources are broadly similar and display similar cyclical trends. Some discrepancies in these estimates exist, however. The ACES estimates of investment in nonresidential structures are relatively higher in several years—as much as 20 percent higher—but not in all years. The ACES shows that a substantial share of structures

[1] This paper uses the terms "fixed investment" and "investment" (popular in the U.S. national accounts) to refer to "gross fixed capital formation" (the term commonly used in the System of National Accounts).

investment consists of own-account projects (16–21 percent) and improvements (34–40 percent), so reporting differences for these projects across surveys may account for some of the differences in estimates of fixed investment in structures. The ACES-based estimates of investment in nonresidential equipment are, on the other hand, 14–33 percent lower than the commodity-flow/ASM-based estimates. These discrepancies could arise for many reasons. These results can be interpreted as supporting BEA's methods for estimating fixed investment and confirming that these surveys all provide valuable information.

This paper begins with some background information on these Census Bureau surveys, BEAs methods for estimating fixed investment, and some reasons as to why these data sources may provide different estimates. The next sections compare estimates of nonresidential investment in structures and equipment.

Background

Census Bureau surveys

The ACES sample consists of domestic, private non-farm companies (with and without employees) from almost all industries. The ACES is conducted at the company level, although it reclassifies some expenditures to secondary industries, so that the reported statistics are moved closer to an establishment basis. The ACES reports capital spending for new and used structures and equipment for all companies, and spending by industry for companies with employees. For Economic Census (EC) years (or an adjacent year), companies with employees report more detailed capital expenditures by both industry and type of asset; for new structures, existing structures, and improvements; and for "own employees" and "contract" work. The ACES is critical for BEA's estimates because it is the only survey that provides shares of capital spending by industry and legal form of organization (LFO).[2]

The VIP is a Census Bureau measure of the value of construction installed during a period. The data for private nonresidential structures (excluding mining) are based on surveys of the owners of construction projects. According to the VIP webpage, the estimates for private nonresidential projects are increased by 25 percent to account for undercoverage. The estimates for manufacturing are adjusted by benchmarking them to the latest data from the ACES. The 1998, 2003, 2008, 2012, and 2017 levels for industrial buildings are based upon actual ACES data. Estimates for other years are extrapolations from

[2] The ACES webpage provides additional information about the survey, including survey methods and questionnaires, as well as data tables (used for this paper). Since 2012, ACES staff have provided BEA with very useful breakouts of capital spending by legal form of organization.

these years. The VIP data report spending by type of asset and are BEA's main source data for quarterly and annual estimates of levels of fixed investment in nonresidential structures.[3]

The Annual Survey of Manufactures (ASM), a Census Bureau survey of manufacturing establishments with paid employees, is conducted in the years between EC years.[4] The ASM collects data on the value of shipments for about 3,500 products manufactured, as well as capital expenditures for structures and equipment, and many other items. The principal ASM publications are statistics by industry (2- through 6-digit NAICS), and data at a similar level of detail for products as currently defined in the NAPCS structure. In EC years, the EC collects these and other data. The ASM is important for BEA because it provides two types of data for BEA's estimates: shipments of equipment as reported from the suppliers' perspective, and capital spending for structures and equipment reported by manufacturing establishments.

Definitions of nonresidential fixed investment

These surveys and the EC use common definitions of fixed investment or gross fixed capital formation for structures and equipment. These definitions are generally consistent with the Internal Revenue Service (IRS) definition of capital spending to be capitalized and depreciated and with the *System of National Accounts* (SNA). The ACES, for example, includes the following expenditures as part of structures investment:

- the capitalized cost of structures, as well as major additions and alterations to structures;
- machinery and equipment that are an integral or built-in feature of the structure;
- expenditures for land development and improvements such as building demolition, site preparation, and facilities 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.

Investment *excludes* spending for maintenance and repair and land acquisition.

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[3] The VIP webpage provides extensive information about the survey, including methods, history, definitions of types of construction, and current and historical estimates of construction spending (used for this paper). The sampling frame comes from the Construction Progress Reporting Survey: privately owned nonresidential, state and local, and federal projects valued at $75,000 or more selected from lists compiled by Dodge Data & Analytics (DDA), (and a sample of projects in non-permit issuing areas).

[4] The ASM webpage provides information about this survey, including sampling methods, technical documentation, history, questionnaires, and published data (used for this paper). BEA also uses the Census Bureau's Manufacturers' Shipments, Inventories, & Orders (M3) Survey to estimate shipments from manufacturing establishments in the months before the ASM data are available. While the M3 survey is clearly important for BEA, this paper focuses on estimates based on the ACES, VIP, and ASM.

The VIP and ASM use a similar definition of structures investment, although the VIP excludes exploration and development of mineral properties, drilling, and mining. (Fixed investment in mining structures is not capitalized in the U.S tax code but is capitalized in the SNA.)

The ACES, VIP, ASM, EC, IRS, and SNA also use similar definitions of capitalized equipment. The ACES states that equipment includes:

- capitalized office equipment, computers and other IT equipment;
- furniture and fixtures; cafeteria and warehouse equipment;
- transportation equipment: autos, buses, vans, aircraft, ships/boats, trailers, trucks, tractors, and railroad and rapid transit cars;
- production machinery, including tooling; computer assisted machines, including robots;
- medical equipment and supplies;
- artwork, books, musical instruments, and signage;
- equipment that is housed in structures and can be removed without significantly altering the structure are considered equipment, not structures.

The ACES also separately reports purchases of capitalized software as equipment. In BEA's National Income and Product Accounts (NIPAs), spending for software is classified as fixed investment in intellectual property products. This paper focuses on equipment excluding software and removes software from the ACES-based estimates of investment in equipment.

BEA estimates

For estimates of *levels* of fixed investment, BEA relies mostly on receipts reported by producers and sellers rather than on purchases reported by buyers because "supply-based" estimates are thought to be more complete, comprehensive, and reliable. BEA's estimates of levels of structures investment are based on the VIP with additional information from the EC and other sources. BEA's estimates of levels of equipment investment rely on the commodity flow method, taking full advantage of several data sources—ASM shipments, net imports from the Census Bureau, and transportation and trade margins from the EC and other sources.[5]

[5] Similarly, BEA's estimates of consumer spending rely on Census Bureau surveys of retail sales and services rather than on surveys of consumer spending. BEA's estimates of gross output are based mainly on sales and expenses reported by producers.

For estimates of fixed investment in nonresidential structures for benchmark (EC) years,[6] BEA relies mainly on the VIP data, adjusted for coverage gaps (based on EC data and other sources) for own-account construction, small projects, and improvements. BEA uses EC data to add estimates of brokers' commissions and uses other government data for estimates of net purchases of used structures from government. To estimate investment in oil and natural gas well drilling and mining exploration, which are omitted from VIP data, BEA uses the ACES. For estimates of investment for nonresidential structures for other years, BEA continues to rely mainly on the VIP (and the ACES for mining structures) and extrapolates other benchmark-year relationships.

BEA's estimates of fixed investment in nonresidential equipment consist of purchases by private businesses and nonprofit institutions of new equipment. It also includes dealers' margins on sales of used equipment; net purchases of used equipment from other sectors, and own-account production of equipment. It is measured net of equipment sold for scrap.

For equipment, the benchmark estimates are mainly prepared using the commodity-flow method. This method begins with a value of domestic output (mainly manufacturers' shipments) based on the EC. Next, the domestic supply of each commodity is estimated by adding imports and subtracting exports, based on the Census Bureau's international trade data. Using EC data, the domestic supply is allocated among domestic purchasers—business, government, and consumers—and business purchases are allocated between intermediate and final use. Estimates of trade margins, transportation costs, and transactions in used equipment are also added.

For nonbenchmark years, the estimates of equipment are prepared at a more aggregate level using an abbreviated commodity-flow method. For years except the most recent year, the main source for manufacturers' shipments is the ASM, which collects data by product class; for the most recent year, the main source for shipments is the Census Bureau's Manufacturers' Shipments, Inventories, & Orders (M3) Survey. For most components, estimates of exports and imports (based on international trade data), government purchases (based on federal agency data and Census Bureau surveys of government), and inventories (based on Census Bureau surveys and IRS tabulations of business tax returns) are available. The distributions to business final use and intermediate purchases are based on benchmark relationships.

[6] This section borrows extensively from Chapter 6 of the NIPA Handbook.

Estimates of net purchases of used equipment by business from other sectors are based on the EC, other Census Bureau surveys, and government data. Sales of used motor vehicles by business to persons account for most of these net purchases, which tends to be negative.

Industry and LFO shares of fixed investment

BEA then allocates *shares* of these estimated levels of fixed investment to industries and legal forms (LFO).[7] In EC years, the EC provides additional detailed estimates of fixed investment by both industry and type of asset for manufacturing, mining, and construction industries, and the ACES provides the additional industry by asset type data for other industries. Other key data sources are the Information and Communication Technology (ICT) surveys (discontinued in 2014), data from the Departments of Agriculture and Labor, and IRS tabulations of tax returns. For the benchmark year estimates, BEA relies on the ACES, EC, and other data to allocate shares of investment to industries for each asset type, using a balancing process that controls to the original asset type levels. Since 2012, ACES data have been used to allocate investment shares to LFOs within industries.

For non-EC years, the estimates of investment shares by industry and LFO are interpolated between EC years or extrapolated forward based on available data. Shares of fixed investment are based on the ASM (manufacturing industries) and the ACES (other industries). The ACES provides estimates of LFO shares by industry. BEA uses the ACES and ASM data to allocate shares of fixed investment to industry and LFO by asset type, controlling to the asset type levels.

Reasons for differences in estimates

As the ACES webpage points out: "Investment estimates from ACES that appear in this report are not directly comparable with investment data from other sources. Variations in survey concepts, coverage, definitions, data collection techniques, estimation methodology, and sample designs may contribute to differences among estimates." Even though the ACES, ASM, and VIP define fixed investment in a similar way, the estimates based on these surveys can differ for a number of reasons, including the following:

Different samples and questions. The ACES provides capital expenses reported by private domestic industries. The VIP provides construction expenses reported by owners of construction projects. The

[7] The industry and LFO shares are needed to prepare estimates of depreciation by industry and LFO for the estimates of Gross Domestic Income, GDP by industry, the Integrated Macroeconomic Accounts (IMAs), and the fixed assets accounts (FAAs). The Bureau of Labor Statistics (BLS) uses the estimates by industry and LFO to estimate total factor productivity (TFP). For more details on the estimates of investment shares by industry and LFO, see this article.

ASM provides capital spending and the value of shipments reported by manufacturing establishments. While, in theory, producers and purchasers should report similar spending for a given commodity, their reported spending may differ. As explained above, BEA's estimates of levels of investment rely more on receipts reported by producers and sellers, partly based on concerns that reported capital purchases alone may underreport investment.

Different industries and companies. The ACES samples companies from almost all private industries, including mining, but does not cover or underreports residential and public sector investment. The VIP covers private and public construction projects but omits the mining industry. The ASM covers only private manufacturing industries.

Different types of spending. The ACES asks respondents to include spending for structures improvements and own-account projects. As a survey of capital purchases by buyers, the ACES probably includes brokers' commissions paid by the buyer. The VIP may or may not fully capture spending for structures improvements, own-account projects, and small projects, and may omit brokers' commissions paid by the buyer. The ASM shipments data probably omit trade and transportation margins that are paid by the buyer and that may be captured by the ACES.

New versus used. The ACES survey includes spending for new and used capital, including from other private companies. The VIP and ASM data probably omit spending for used capital. The NIPAs add estimates of private business' net purchases of used capital, but only from other sectors, mainly government.

Timing. The VIP reports construction spending put in place. For long-term projects, the VIP data in theory report incremental spending each month until the project is finished. The ACES reports purchases, which may not occur until after the project is finished.

Adjustments. These surveys may incorporate adjustments for undercoverage, missing responses, or other issues. BEA adjusts the VIP data to increase coverage of improvements, own-account projects, small projects, and brokers' commissions. BEA may reclassify some shipments and imports of intermediate purchases to equipment based on research.

Sampling unit. The ACES samples companies, including multi-establishment companies, and the reported industries reflect the company's main activities. The VIP surveys sample construction projects. The ASM and EC sample establishments. When a single manufacturing establishment is part of a multi-establishment company, its capital spending will be reported under manufacturing in the ASM and the

EC but maybe under the company's different main industry in the ACES. On the other hand, when a single nonmanufacturing establishment is part of a multi-establishment company whose main activity is manufacturing, its capital spending will be reported under nonmanufacturing in the ASM and the EC but maybe under manufacturing in the ACES. These "company-establishment" reporting issues may lead to estimates of an industry's capital spending that are relatively higher or lower on a company basis than on an establishment basis.

Classification issues. Subcategories of investment across these surveys may be difficult to compare–even without measurement error or sampling issues—because they classify estimates in different ways. The VIP reports spending for types of structures, and the ASM and EC report shipments for types of equipment; the NIPA tables largely reflect these classifications. The ACES instead reports capital spending by industry, and even when it reports spending for types of assets in benchmark years, these type categories can differ from the types used in the other surveys.

Previous research

Despite these reasons to expect differences in estimated levels of fixed investment, the ACES-, VIP-, and ASM/commodity flow-based estimates of levels of fixed investment should be *approximately* similar, once we correct for measurable differences in these estimates. To the extent that the alternative estimates are roughly similar, we may be more confident in these data sources. If, on the other hand, the estimates are extremely different, we might want to know more about why the estimates differ. Some previous research has compared estimates of investment from these data sources. These studies highlight previous interest in these comparisons and the challenges for these comparisons.

The VIP webpage shows the results of a study titled "Overview: A Comparison of the Value of Construction Put in Place Series, the 1997 Economic Census, and the 1998 Annual Capital Expenditures Survey." This study compares levels of new investment in private nonfarm nonresidential structures from the ACES and the VIP, with adjustments for construction out of scope in the VIP, nonemployer investment, and other factors. Total estimated fixed investment for 1998 was $241.6 billion in the ACES and $232.5 billion in the VIP. The study also compared investment for similar groups of industries in the ASEC and asset types in the VIP and found proportionately larger differences, possibly attributable to classification differences.

An unpublished January 1998 BEA memo, written by Jeffrey Crawford, describes the results of a project to compare estimates of nonresidential fixed investment from the ACES and other surveys. The project compared capital spending for new structures reported by the ACES and VIP in 1994 and found that

total spending was roughly similar, although the ACES data from that year omitted nonemployers, which in a previous year had accounted for about 20 percent of spending. The implication was that ACES estimates that included nonemployers would provide estimates higher than those from the VIP. The project also found that, for manufacturing businesses in 1994, spending for new capital is substantially higher in the ACES than in the ASM data. Using Census Bureau microdata, the project found that some of this discrepancy may arise from multi-establishment manufacturing companies in the ACES sample.

The VIP webpage shows the results of a study titled "Expenditures for Nonresidential Improvements and Repairs." This study provides estimates of spending for improvements (included in fixed investment) and repair (not included) in nonresidential buildings for the years 1986, 1989, and 1992. The statistics are based on information collected as a supplement to the Department of Energy's triennial Commercial Buildings Energy Consumption Survey (CBECS). The webpage states that "The Census Bureau views the results of the supplement cautiously because of a number of limitations in the statistics..." although BEA has used these and other results to justify some upward adjustments to structures investment in the VIP data.

Comparing Estimates of Fixed Investment in Nonresidential Structures

A comparison of "demand-based" (based on the ACES) versus "supply-based" (based on the VIP) estimates of levels of fixed investment in nonresidential structures should take into account known, measurable differences in these estimates. The best approach may be to compare estimates that include new investment by employers and nonemployers and spending for brokers' commissions for new structures, but that exclude residential investment, and investment for the industries of mining; agriculture, forestry, fishing; mining; and water, sewer, and waste disposal. The ACES data do not fully capture residential investment. Purchases of used structures and investment in mining structures are not measured by the VIP data. The ACES and the private VIP data may understate investment in agriculture and in water, sewer, and waste disposal (which may be better reflected in estimates of public investment). These "adjusted estimates" of structures investment defined this way are presented in Table 1 and Figure 1.

Table 1: Comparable "Adjusted" Estimates of Fixed Investment, Private New Nonresidential Structures

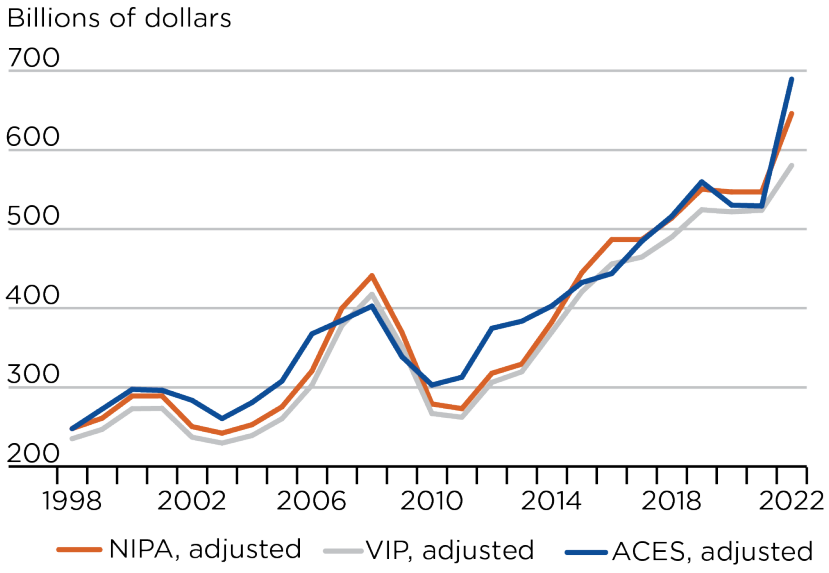
[Billions of Dollars]

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ACES, new structures, companies with employees	260.0	276.1	309.5	323.9	299.9	281.9	300.4	341.2	420.1	457.2	500.5	395.0	367.8	415.0	501.8	518.4	577.7	557.6	508.5	576.5	612.5	658.5	581.9	583.0	671.4
less agriculture, forestry, fishing; mining; water, sewer, and waste disposal	26.1	18.7	26.8	33.7	31.2	37.9	35.7	47.6	69.6	85.6	107.5	72.9	85.2	122.9	149.0	151.5	187.1	137.3	77.2	109.2	115.2	118.4	69.5	67.0	86.2
plus ACES, new structures, companies without employees	18.5	20.4	20.0	11.7	21.3	23.4	24.3	24.7	28.8	23.6	22.5	27.8	27.7	27.8	33.3	30.9	29.2	32.0	35.2	40.4	42.9	45.1	46.5	46.6	143.5
less estimated residential investment in ACES	4.7	5.3	5.4	5.6	6.4	6.9	8.1	10.5	11.7	10.6	12.9	11.2	7.2	7.0	11.5	14.3	17.1	20.0	22.8	23.0	24.1	25.5	28.7	33.1	39.2
equals ACES private new nonresidential structures, adjusted	**247.7**	**272.5**	**297.3**	**296.2**	**283.6**	**260.5**	**280.8**	**307.9**	**367.6**	**384.6**	**402.6**	**338.7**	**303.0**	**312.8**	**374.6**	**383.6**	**402.9**	**432.4**	**443.8**	**484.6**	**516.2**	**559.7**	**530.2**	**529.3**	**689.4**
VIP, private nonresidential structures	237.4	249.2	275.3	273.9	237.7	229.3	238.3	258.1	298.1	370.0	409.4	344.1	263.3	257.8	301.4	314.3	361.7	406.6	436.8	444.3	465.5	500.1	495.6	496.6	554.5
less VIP, private nonres structures, farm, water, sewer, waste disposal	5.2	6.0	7.2	6.1	6.3	5.8	6.2	6.4	6.6	7.2	9.4	8.1	7.8	7.1	8.7	10.4	11.8	10.2	8.9	10.4	7.8	9.1	9.4	9.6	11.4
plus NIPA brokers' commissions for new nonresidential structures	2.9	3.7	4.8	5.7	5.5	6.0	7.0	8.8	11.3	15.3	17.5	15.0	11.4	11.6	13.7	15.8	20.0	24.4	28.1	30.7	32.2	33.2	35.5	36.7	37.4
equals VIP private new nonresidential structures, adjusted	**235.1**	**246.9**	**272.9**	**273.5**	**237.0**	**229.6**	**239.1**	**260.4**	**302.8**	**378.2**	**417.6**	**351.1**	**266.9**	**262.2**	**306.3**	**319.7**	**369.9**	**420.8**	**455.9**	**464.6**	**489.9**	**524.3**	**521.8**	**523.7**	**580.4**
NIPA, private nonresidential structures	276.0	285.7	321.0	333.5	287.0	286.6	307.7	353.0	425.2	510.3	571.1	455.8	379.8	404.5	479.4	491.5	574.6	584.5	566.2	594.9	636.6	677.9	624.7	628.3	756.1
less NIPA private nonres structures, mining exploration, shafts, wells	22.3	18.3	23.7	34.6	30.2	38.5	47.3	69.4	96.0	102.2	120.3	79.2	93.5	124.7	152.9	152.4	180.5	128.8	69.7	97.6	114.8	117.4	68.3	70.3	93.7
less NIPA private nonres structures, farm, sewage, water, waste disposal, highways & streets, conservation & development, net purchases of used structures	5.6	6.1	7.9	9.4	5.7	5.3	6.6	7.3	7.5	6.5	8.5	6.2	6.4	5.9	7.8	8.6	10.3	8.7	6.9	8.2	5.5	6.9	6.7	7.4	12.0
less NIPA brokers commissions for used nonresidential structures	0.2	0.3	0.5	0.5	0.6	0.8	1.0	0.9	1.0	1.4	1.3	1.0	1.0	0.8	0.9	0.9	1.2	2.2	2.9	2.4	2.4	3.2	2.9	3.8	4.4
equals NIPA private new nonresidential structures, adjusted	**247.9**	**261.0**	**288.9**	**289.1**	**250.4**	**242.1**	**252.8**	**275.4**	**320.7**	**400.1**	**441.0**	**369.5**	**279.0**	**273.1**	**317.8**	**329.4**	**382.6**	**444.9**	**486.7**	**486.7**	**513.9**	**550.4**	**546.8**	**546.9**	**646.0**

ACES Annual Capital Expenditures Survey
VIP Value of Construction Put in Place Survey
NIPA National Income and Product Accounts

U.S. Bureau of Economic Analysis

Figure 1. Fixed Investment, Private New Nonresidential Structures, Adjusted for Comparability



NIPA National Income and Product Accounts
VIP Value of Construction Put in Place Survey
ACES Annual Capital Expenditures Survey

U.S. Bureau of Economic Analysis

For the ACES,[8] the "adjusted estimate" equals the sum of capital spending for new structures for companies with and without employees (assumed to include improvements, own account projects, and brokers' commissions); less the ACES estimate of spending from the agriculture, forestry, fishing; mining; water, sewer, and waste disposal industries; and less an estimate of residential construction that is included in the ACES. The last adjustment is based on ACES-reported spending for residential buildings (asset type) in the benchmark year surveys, interpolated and extrapolated to other years based on VIP residential multifamily investment.

For the VIP data, the "adjusted estimate" equals expenditures for nonresidential structures less VIP estimates for private farm, water, sewer, and waste disposal (VIP already omits mining), plus a BEA estimate of brokers' commissions for new nonresidential structures, allocated proportionally to each of the types of private structures. The VIP-based adjusted estimate is assumed to include projects for nonemployers. It may undercount construction costs for improvements and own account projects, but these are not itemized in the VIP data.

[8] In this paper, a small number of ACES data points were imputed because they were missing in published data because of disclosure issues. These imputations do not appear to affect the paper's main conclusions.

The NIPA "adjusted estimate" equals NIPA investment in private new nonresidential structures, including brokers' commissions, less NIPA private nonresidential structures for farm, sewage, water, waste disposal, highways and streets, and less net purchases of used structures and less brokers' commissions for used structures (based on shares of used structures in the ACES).

The results confirm that these adjusted measures of new fixed investment in nonresidential structures are roughly similar. All three measures display an expected cyclical pattern, falling in the 2001 recession, rising in the years afterward, falling again in the 2009 recession, rising again until the 2020 COVID–19 pandemic, and then rising again afterward. The broad similarity of these estimates enhances our confidence in these surveys and BEA's methods. The results are roughly consistent with the previous study of 1998 data.

The ACES- and VIP-based adjusted estimates differ, however, in ways that vary over time. The ACES-based estimate is relatively higher in years from 2000 to 2006, 2010 to 2014, and again in 2022. The discrepancy, in percentage terms, is highest in 2002, 2006, and 2012, when the ACES-adjusted estimate is just over 20 percent higher than the VIP adjusted estimate. But the ACES-adjusted estimate is not consistently higher than the VIP-adjusted estimate in other years.

The NIPA-adjusted estimates follow the same pattern as the VIP-adjusted estimates but are higher, as one would expect because BEA's estimates are based on the VIP and make upward adjustments to account for possible underestimates of spending for own account projects or improvements. In many years, these adjustments bring the NIPA estimate closer to the ACES estimate. The ACES-based estimates still remain relatively higher in many but not all years.

These varying discrepancies probably arise for many reasons described above—sampling issues, reporting biases, timing, adjustments, and so on. The importance of these reasons appears to vary over time. The ACES-based estimates may also reflect better coverage of own-account projects or improvements, or the ACES company-based estimates may include some capital spending for mining and other establishments that should have been omitted from the comparison.

Improvements and own account investment

The ACES also provides estimates of investment in improvements and own account projects in benchmark/EC years. For these years, the ACES asks for more detailed breakouts of capital spending for "construction of new facilities," "remodeling, renovation, modernization of existing facilities," and "acquisition of existing facilities." For the first two categories, the ACES asks for an additional breakout of capital spending for work performed by "own employees" and work performed by "contract spending." The definitions of these types of capital spending are similar to the NIPA definitions of fixed investment in new structures, improvements, and own-account construction. Table 2 (left columns) shows how the published ACES Table 6a reports this additional detail for 2017. The format of ACES Table 6a is very similar for years 2003, 2008, and 2012. The rightmost columns of Table 2 (and Figure 2) show the shares of capital spending for new structures and improvements dedicated to improvements and own-account projects.

The results show that the share of new nonresidential fixed investment in structures devoted to improvements is fairly consistent over these years, ranging 34 to 40 percent (Figure 2). The improvements share is at least as high for many types of structures, although it tends to be relatively lower for mining, and oil and gas pipeline and related facilities.

The share of new nonresidential fixed investment devoted to own account projects ranges from 16 to 21 percent over these years (Figure 2). These shares vary across types of assets and are especially high for transportation and utilities and much lower for other industries.

The substantial shares of investment in improvements and own account projects suggest that differences in the rate of coverage of these types of investment may explain some of the discrepancies between the ACES- and VIP-based estimates, assuming the VIP data miss some of these projects. The effect of this coverage issue on the discrepancy is hard to estimate, however, because we lack a clear estimate of the share of these projects captured or missing in the VIP data. Future research might provide a sense of how the VIP covers these projects. We cannot simply assume that the discrepancy between the ACES- and VIP-based estimates is entirely attributable to these projects because many other factors can cause these discrepancies, which vary considerably over the years. The only other evidence on improvements we have comes from the earlier CBECS survey conducted in the 1980s and 1990s, which showed that roughly 21–22 percent of nonresidential structures investment was dedicated to improvements.

Table 2: ACES-Reported Capital Expenditures for Structures, Improvements and Own-Account Projects, for Companies With Employees: Additional Detail in Benchmark Years

Type of Structure	ACES Data (ACES Table 6A, 2017), billions of dollars							Share of capital spending for improvements and own account projects, 2017 and earlier benchmark years							
	Total expenditures for structures	Construction of new facility		Acquisition of existing facility		Remodeling, renovation, modernization of existing facility		Share of new construction for improvements				Share of new construction for own-account projects			
		Own employees	Contract	New	Used	Own employees	Contract								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	2003	2008	2012	2017	2003	2008	2012	2017
All	**612.8**	**78.0**	**251.0**	**26.6**	**35.8**	**38.9**	**182.5**	**40.2%**	**36.7%**	**34.1%**	**38.4%**	**15.8%**	**16.0%**	**21.2%**	**20.3%**
Residential buildings	**28.1**	**2.8**	**8.6**	**1.4**	**5.5**	**1.3**	**8.5**	**49.4%**	**38.3%**	**56.2%**	**43.5%**	**12.6%**	**14.7%**	**10.0%**	**18.4%**
Hotels and motels	**9.0**	**0.7**	**2.4**	**0.2**	**1.0**	**0.3**	**4.4**	**49.8%**	**35.0%**	**54.8%**	**59.1%**	**7.2%**	**25.0%**	**12.2%**	**12.3%**
Industrial buildings	**62.4**	**6.3**	**27.5**	**2.2**	**1.7**	**3.2**	**21.5**	**52.6%**	**45.3%**	**46.9%**	**40.6%**	**8.5%**	**10.4%**	**11.7%**	**15.7%**
Manufacturing, processing, and assembly plants	50.7	2.8	21.8	2.1	1.5	2.2	20.4	**54.3%**	**51.7%**	**51.0%**	**45.9%**	**8.3%**	**11.7%**	**11.7%**	**10.0%**
Industrial nonbuilding structures	11.7	3.6	5.7	0.1	0.2	1.0	1.0	**30.9%**	**15.2%**	**12.4%**	**18.0%**	**11.1%**	**4.0%**	**10.9%**	**40.2%**
Offices	**92.8**	**4.1**	**28.7**	**6.4**	**7.2**	**3.7**	**42.7**	**55.7%**	**54.7%**	**56.0%**	**54.2%**	**6.9%**	**5.2%**	**6.8%**	**9.1%**
Office, bank, and professional buildings	82.1	3.9	25.0	6.2	6.5	3.1	37.4	**56.3%**	**54.2%**	**58.4%**	**53.5%**	**7.1%**	**4.8%**	**7.2%**	**9.3%**
Medical offices	10.7	0.2	3.7	0.1	0.8	0.6	5.3	**50.4%**	**58.8%**	**41.4%**	**59.6%**	**5.1%**	**8.2%**	**4.2%**	**7.6%**
Commercial buildings	**91.8**	**5.3**	**28.7**	**4.3**	**10.4**	**4.3**	**38.7**	**38.6%**	**41.8%**	**53.6%**	**52.8%**	**4.3%**	**7.4%**	**15.0%**	**11.8%**
Automotive facilities	5.8	0.1	2.7	0.0	0.4	0.1	2.4	**42.5%**	**46.0%**	**40.8%**	**46.9%**	**4.8%**	**2.9%**	**12.9%**	**3.5%**
Stores-food related	22.4	1.3	6.8	0.3	3.4	0.9	9.6	**33.6%**	**44.7%**	**42.3%**	**55.6%**	**3.6%**	**5.2%**	**25.6%**	**12.0%**
Multiretail stores	19.4	0.6	4.5	1.8	1.6	1.5	9.4	**37.0%**	**38.4%**	**59.0%**	**61.4%**	**2.3%**	**2.9%**	**9.7%**	**12.2%**
Warehouses and distribution centers (ex passenger)	19.8	1.2	8.9	0.8	2.4	0.6	5.9	**39.4%**	**36.7%**	**65.1%**	**37.7%**	**5.9%**	**6.7%**	**11.7%**	**10.3%**
Other commercial stores/buildings, NEC	24.5	2.1	5.8	1.6	2.6	1.1	11.3	**46.7%**	**44.5%**	**55.7%**	**57.0%**	**8.1%**	**17.6%**	**9.1%**	**14.5%**
Health care facilities	**44.6**	**1.5**	**16.1**	**1.2**	**4.8**	**2.7**	**18.3**	**47.0%**	**47.5%**	**41.9%**	**52.8%**	**9.2%**	**4.4%**	**7.0%**	**10.7%**
Hospitals	31.3	1.4	11.3	0.7	2.5	2.2	13.3	**49.3%**	**47.2%**	**38.0%**	**53.7%**	**9.2%**	**5.2%**	**7.8%**	**12.4%**
Special care facilities	13.3	0.2	4.8	0.5	2.3	0.5	5.0	**40.1%**	**48.6%**	**63.0%**	**50.4%**	**9.1%**	**1.2%**	**2.8%**	**6.2%**
Amusement and recreational facilities	**12.2**	**2.3**	**5.3**	**0.1**	**0.1**	**0.2**	**4.3**	**46.0%**	**41.2%**	**43.5%**	**36.8%**	**8.3%**	**7.3%**	**9.6%**	**20.9%**
Transportation facilities	**16.6**	**6.6**	**1.8**	**0.1**	**0.2**	**3.4**	**4.5**	**23.8%**	**50.8%**	**62.0%**	**48.2%**	**69.5%**	**64.4%**	**50.7%**	**60.6%**
Utility structures and facilities	**127.7**	**30.2**	**56.9**	**5.8**	**2.2**	**15.2**	**17.4**	**40.7%**	**20.7%**	**28.1%**	**26.0%**	**34.0%**	**30.7%**	**38.3%**	**36.2%**
Other buildings	**37.5**	**0.9**	**16.3**	**0.4**	**2.1**	**1.5**	**16.3**	**34.5%**	**43.2%**	**51.6%**	**50.3%**	**2.9%**	**2.2%**	**2.3%**	**6.7%**
Mine shafts and wells	**81.6**	**15.6**	**55.6**	**4.2**	**0.5**	**2.8**	**2.8**	**10.0%**	**24.7%**	**3.2%**	**6.9%**	**26.0%**	**18.7%**	**24.3%**	**22.7%**
Other nonbuilding structures	**8.5**	**1.6**	**3.0**	**0.3**	**0.1**	**0.2**	**3.1**	**48.8%**	**39.9%**	**46.0%**	**40.1%**	**19.0%**	**12.4%**	**14.5%**	**22.3%**

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Notes. On this page, columns 1-7 on the left are taken directly from ACES Table 6a, for 2017. The share calculations on the right are based on ACES Table 6a, which is available for 2003, 2008, 2012, and 2017.
For 2017, the share of new construction for improvements equals ((6)+(7))/ ((6)+(7)+(2)+(3)+(4)); the share of new construction for own-account projects equals ((2)+(6))/((2)+(6)+(3)+(4)+(7)).
For 2003, 2008, and 2012, the shares are calculated similarly.
"Other buildings" includes educational, religious, and public safety buildings and facilities.
"Other nonbuilding structures" includes conservation and control structures, highway and street structures, other nonbuilding structures, NEC.

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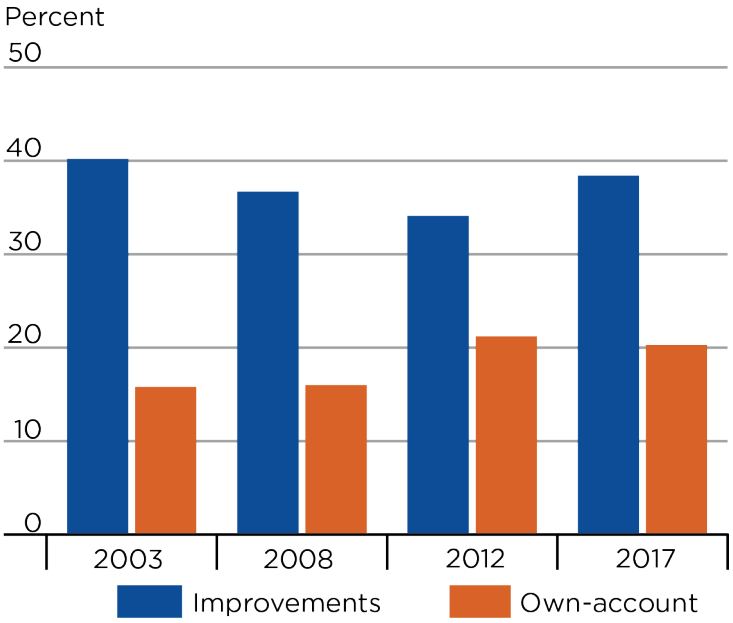
Figure 2: Share of Private New Nonresidential Structures Investment for Improvements and Own-Account Projects, ACES



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Discrepancies for specific industries or asset types

The discrepancies between ACES- and VIP-based estimates of total investment may reflect larger discrepancies for specific industries or asset types. Comparing estimates for these subcategories might provide clues as to the sources of these discrepancies—coverage issues and so on. But comparing estimates of subcategories of investment from these two sources is challenging because they classify investment in different ways. The VIP survey classifies investment by type of asset, while the ACES classifies annual investment by the company's main industries. The ACES provides additional breakouts of investment by asset type every 5 years, but these type categories differ from the type categories in the VIP data. The next tables and figures compare subcategories of investment from these data sources, although the results are admittedly inconclusive.

Table 3 and Figure 3 present comparisons of "roughly similar" subcategories of new structures investment based on ACES *industries* (NAICS codes in parentheses) the VIP *asset types*. The results employ the same adjustments used to create the adjusted estimates in Table 1. In reviewing these results, it is useful to keep in mind the statistics in ACES Table 5a (published every 5 years), which shows a breakout of structures investment by both industry and asset type.

Table 3: Fixed Investment, Private New Nonresidential Structures, by ACES Industry and VIP/NIPA Type Categories

[Billions of Dollars]

ACES, adjusted estimates, by groups of NAICS industries

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
(NAICS codes in parentheses)	247.7	272.5	297.3	296.2	283.6	260.5	280.8	307.9	367.6	384.6	402.6	338.7	303.0	312.8	374.6	383.6	402.9	432.4	443.8	484.6	516.2	559.7	530.2	529.3	689.4
Lodging (721)	6.6	7.1	6.0	6.3	6.1	4.3	4.3	9.9	16.4	11.5	17.6	8.0	4.6	5.7	5.7	6.3	6.4	9.7	8.4	7.7	7.9	7.1	3.6	4.9	6.1
Commercial (44-45, 42, 493, 532, 533, 722, 811, 812)	39.5	47.1	52.9	45.0	41.6	45.1	50.2	57.0	68.4	67.5	61.3	46.1	45.7	47.1	55.7	59.7	61.9	64.8	69.4	71.5	69.9	73.8	72.0	84.8	113.0
Health care (621, 622, 623)	21.9	24.2	23.9	23.7	27.2	29.2	31.5	38.6	38.0	43.3	48.1	43.2	42.6	43.1	45.2	46.0	46.0	46.6	47.0	55.8	59.5	61.8	59.1	66.4	68.4
Education & social assistance (61, 624, 712)	11.8	13.2	16.9	16.4	18.6	17.2	17.8	17.1	22.6	25.5	26.2	28.3	21.6	18.7	21.1	23.2	24.8	32.6	30.3	35.5	34.9	36.4	32.6	27.3	32.6
Arts, entertainment, recreation (711, 713)	4.0	7.2	11.2	7.0	6.3	5.0	6.0	7.4	10.0	8.6	9.3	9.5	6.4	5.1	7.2	7.2	11.4	7.4	12.4	13.1	13.8	13.5	9.8	9.7	17.6
Transportation (481-485, 487-492)	9.7	9.9	10.0	10.3	7.9	7.6	9.1	11.3	12.6	12.2	11.6	11.9	11.7	14.7	13.3	16.2	16.5	18.2	18.0	17.7	18.4	18.6	19.5	22.1	25.9
Communication (512, 613, 515, 517)	23.6	32.5	39.0	38.4	33.5	30.0	26.8	31.4	30.5	25.8	23.4	18.3	17.3	16.6	20.9	27.7	22.6	18.4	19.6	22.6	23.1	20.3	18.4	18.3	32.6
Power (2211, 2212, 486)	21.1	25.1	33.0	39.2	35.8	29.3	27.9	29.8	36.5	48.7	59.1	55.7	55.6	63.1	93.2	80.2	87.4	95.6	91.1	92.4	107.2	129.9	117.4	99.3	131.1
Manufacturing (31-33)	40.1	35.4	39.2	39.5	33.5	32.1	32.8	35.3	42.7	43.9	50.9	37.5	33.0	38.0	45.7	47.8	52.9	57.9	60.2	61.4	62.4	69.2	73.4	73.1	93.5
All other nonresidential	69.4	70.8	65.2	70.4	73.2	60.6	74.4	70.0	89.9	97.7	95.2	80.2	64.4	60.7	66.5	69.4	73.0	81.1	87.6	106.8	119.1	129.0	124.4	123.5	168.6

VIP, adjusted estimates, by VIP type categories

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	235.1	246.9	272.9	273.5	237.0	229.6	239.1	260.4	302.8	378.2	417.6	351.1	266.9	262.2	306.3	319.7	369.8	420.8	455.9	464.6	489.9	524.3	521.8	523.7	580.4
Lodging	15.0	16.2	16.6	14.8	10.7	10.2	12.3	13.1	18.3	28.6	36.9	26.5	11.7	8.8	10.7	13.7	17.2	22.8	28.4	30.0	32.6	34.5	29.4	20.0	20.6
Commercial	52.0	55.2	59.1	59.7	54.7	53.8	59.5	62.8	70.2	82.9	77.7	45.8	31.9	34.7	38.3	43.6	52.7	58.6	71.6	79.9	81.0	77.1	82.8	91.6	114.6
Health care	18.0	18.7	19.8	19.9	23.0	24.9	27.1	29.5	33.3	37.1	40.1	36.9	30.9	30.2	32.9	31.2	30.5	32.8	33.8	35.9	36.4	39.2	41.9	43.3	46.4
Education & social assistance	9.9	9.9	11.9	13.1	13.4	13.8	13.1	13.2	14.4	17.4	19.4	17.6	14.0	14.7	17.4	17.8	17.5	18.8	21.4	22.7	23.9	23.1	20.2	17.9	20.3
Arts, entertainment, recreation	8.7	9.7	8.9	8.0	7.7	8.0	8.7	7.8	9.7	10.6	11.0	8.8	6.8	7.1	6.5	7.3	8.2	10.6	13.4	15.5	16.8	16.9	14.5	14.7	17.1
Transportation	7.4	6.6	7.0	7.2	6.9	6.7	7.0	7.4	9.0	9.4	10.4	9.5	10.3	10.0	11.4	11.6	12.8	14.4	13.9	15.8	19.1	18.3	17.5	17.6	18.6
Communication	12.6	18.7	19.1	20.0	18.8	14.8	15.9	19.5	23.0	28.7	27.5	20.6	18.5	18.3	16.7	18.5	18.1	22.8	23.5	25.2	26.0	23.6	25.5	24.6	25.8
Power	22.0	22.4	29.9	32.2	33.4	34.5	28.4	30.2	35.0	56.4	72.3	79.5	69.1	67.2	90.4	85.5	103.8	97.1	97.8	96.1	101.0	117.9	118.7	118.8	106.9
Manufacturing	41.0	35.7	38.3	38.6	23.3	22.0	23.9	29.4	33.5	41.9	56.0	59.9	42.4	41.6	49.0	54.5	63.6	87.4	84.1	74.9	77.1	86.0	80.6	87.8	122.0
All other nonresidential	48.5	53.9	62.3	59.9	45.1	40.8	43.1	47.5	56.5	65.1	66.4	46.0	31.3	29.6	33.1	35.8	45.4	55.3	68.1	68.4	75.9	87.6	90.7	87.4	88.2

NIPA, adjusted estimates, by type categories

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	247.9	261.0	288.9	289.1	250.4	242.1	252.8	275.4	320.7	400.1	441.0	369.5	279.0	273.1	317.8	329.4	382.6	444.9	486.7	486.7	513.9	550.4	546.8	546.9	646.0
Lodging	18.6	20.0	20.5	18.3	13.3	12.6	15.3	16.2	22.6	35.4	45.6	32.8	14.5	10.9	13.2	16.9	21.3	28.1	35.0	37.1	40.2	42.6	36.3	24.6	25.8
Commercial	50.2	53.7	58.2	59.3	54.9	54.0	59.6	63.0	70.3	83.0	78.0	46.1	32.2	35.1	38.5	43.9	53.0	58.9	71.9	80.2	81.4	77.5	83.2	92.0	123.6
Health care	20.2	21.0	22.3	22.4	25.8	28.0	30.4	33.1	37.4	41.7	45.0	41.4	34.7	34.0	37.0	35.1	34.3	36.8	37.9	40.3	40.8	44.0	47.0	48.6	55.3
Education & social assistance	11.0	10.6	12.9	14.1	14.5	14.7	14.0	14.4	15.1	17.8	19.0	18.2	14.8	14.8	17.0	16.3	16.5	17.6	20.0	21.9	23.4	22.4	19.1	17.9	21.3
Arts, entertainment, recreation	10.4	11.6	10.7	9.6	9.2	9.6	10.4	9.3	11.6	12.7	13.1	10.5	8.1	8.5	7.8	8.7	9.8	12.7	16.0	18.6	20.1	20.2	17.4	17.6	21.8
Transportation	7.3	6.5	6.9	7.2	6.9	6.7	7.0	7.4	9.0	9.4	10.3	9.4	10.3	10.0	11.4	11.6	12.8	14.3	13.7	15.5	18.7	17.9	17.0	17.1	18.7
Communication	12.6	18.7	19.1	20.0	18.8	14.8	15.9	19.5	23.0	28.6	27.4	20.5	18.4	18.3	16.7	18.5	18.0	22.8	23.4	25.2	25.9	23.5	25.4	24.2	25.4
Power	21.9	22.4	29.8	32.1	33.3	34.5	28.4	30.2	34.9	56.3	72.1	79.3	68.9	67.1	90.3	85.4	103.6	105.3	108.5	95.8	100.6	117.5	118.3	118.4	117.9
Manufacturing	41.0	35.6	38.2	38.6	23.3	22.0	23.9	29.3	33.4	41.8	55.2	59.2	42.0	41.4	48.9	52.7	62.2	86.0	83.2	74.7	76.8	85.7	80.3	87.5	132.1
All other nonresidential	54.8	60.9	70.2	67.4	50.5	45.2	47.9	53.1	63.4	73.5	75.2	52.0	35.1	33.2	37.1	40.3	51.0	62.3	77.0	77.5	86.0	99.1	102.8	99.0	104.1

Difference, ACES less VIP

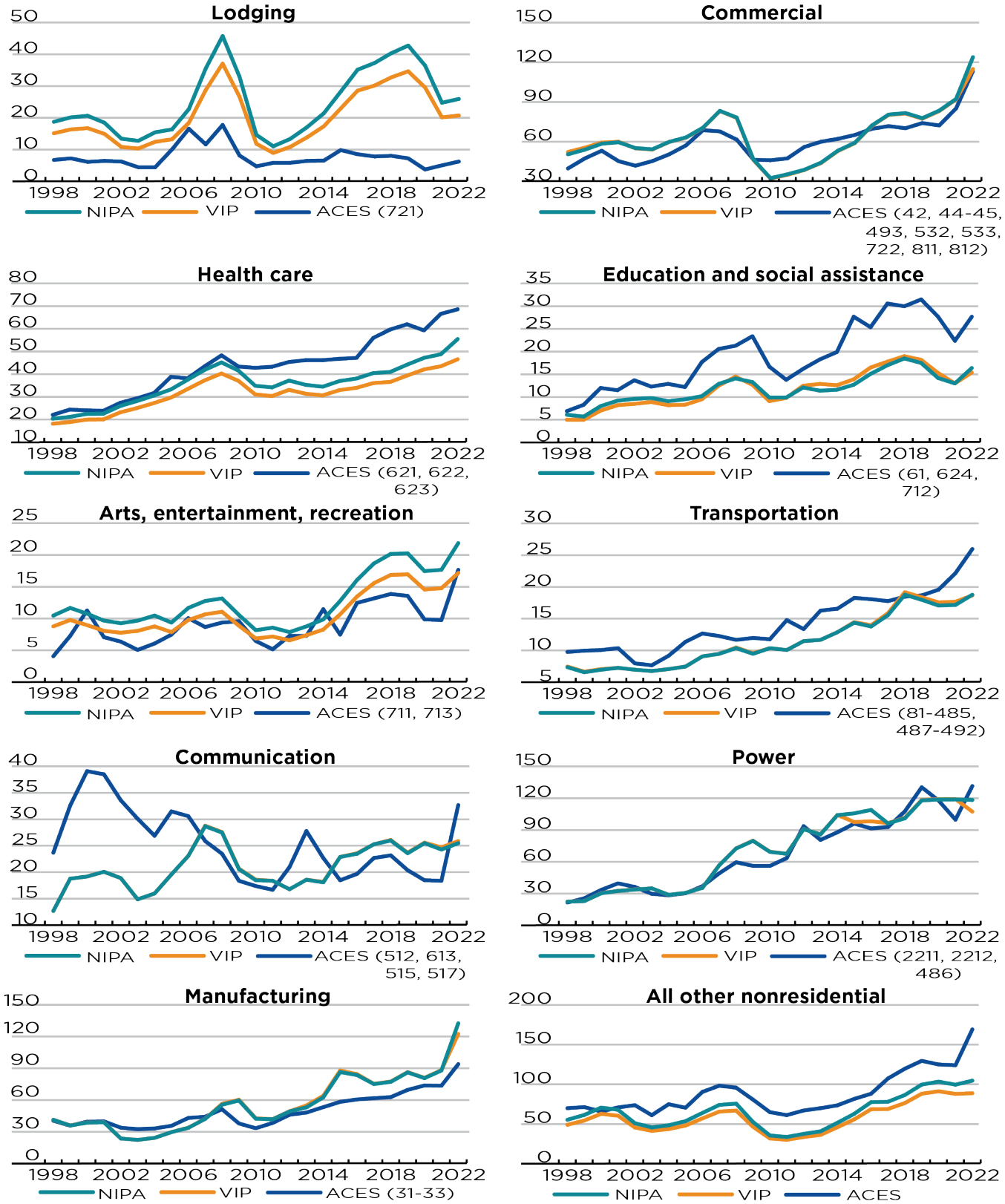
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	12.6	25.6	24.4	22.7	46.6	30.9	41.7	47.5	64.8	6.5	-15.0	-12.3	36.1	50.6	68.3	64.0	33.0	11.6	-12.1	20.0	26.3	35.4	8.4	5.7	109.0
Lodging	-8.4	-9.1	-10.5	-8.5	-4.6	-5.9	-8.0	-3.2	-1.9	-17.2	-19.3	-18.5	-7.1	-3.1	-5.0	-7.4	-10.8	-13.1	-20.0	-22.3	-24.7	-27.4	-25.8	-15.1	-14.6
Commercial	-12.5	-8.1	-6.2	-14.7	-13.1	-8.7	-9.3	-5.8	-1.8	-15.5	-16.4	0.3	13.8	12.4	17.4	16.0	9.2	6.2	-2.2	-8.4	-11.1	-3.3	-10.8	-6.8	-1.6
Health care	3.9	5.5	4.1	3.8	4.2	4.4	4.4	9.1	4.8	6.2	8.0	6.3	11.8	12.9	12.3	14.8	15.5	13.8	13.2	19.9	23.1	22.6	17.2	23.1	22.0
Education & social assistance	1.9	3.3	5.0	3.3	5.2	3.5	4.7	3.9	8.2	8.1	6.8	10.7	7.6	3.9	3.7	5.4	7.3	13.8	8.9	12.8	10.9	13.3	12.5	9.4	12.3
Arts, entertainment, recreation	-4.7	-2.5	2.3	-1.0	-1.3	-3.0	-2.7	-0.4	0.3	-2.0	-1.7	0.7	-0.4	-2.0	0.7	-0.1	3.2	-3.2	-1.1	-2.4	-3.0	-3.4	-4.8	-5.0	0.6
Transportation	2.4	3.3	3.0	3.1	0.9	0.9	2.1	3.9	3.7	2.8	1.2	2.4	1.4	4.7	1.9	4.6	3.7	3.8	4.0	1.9	-0.7	0.3	2.0	4.5	7.4
Communication	10.9	13.9	19.9	18.4	14.7	15.1	10.9	11.9	7.4	-2.8	-4.1	-2.3	-1.1	-1.7	4.2	9.1	4.5	-4.4	-3.9	-2.6	-2.9	-3.4	-7.1	-6.3	6.8
Power	-0.9	2.8	3.1	7.0	2.4	-5.2	-0.5	-0.4	1.5	-7.7	-13.2	-23.7	-13.5	-4.2	2.8	-5.3	-16.4	-1.5	-6.7	-3.7	6.1	12.0	-1.3	-19.5	24.2
Manufacturing	-0.9	-0.2	1.0	0.9	10.2	10.1	8.9	5.9	9.1	2.0	-5.0	-22.4	-9.4	-3.6	-3.3	-6.7	-10.7	-29.5	-23.9	-13.6	-14.7	-16.8	-7.1	-14.7	-28.5
All other nonresidential	20.9	16.8	2.9	10.4	28.0	19.8	31.3	22.5	33.4	32.6	28.8	34.1	33.0	31.1	33.4	33.5	27.6	25.8	19.5	38.4	43.2	41.4	33.7	36.1	80.5

Difference, ACES less NIPA

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	-0.2	11.4	8.4	7.1	33.2	18.4	28.0	32.5	46.9	-15.5	-38.4	-30.8	24.0	39.7	56.8	54.2	20.3	-12.5	-42.8	-2.1	2.2	9.3	-16.6	-17.5	43.4
Lodging	-11.9	-12.9	-14.5	-12.0	-7.1	-8.3	-11.0	-6.3	-6.2	-23.9	-28.0	-24.7	-9.8	-5.1	-7.5	-10.7	-14.9	-18.4	-26.6	-29.4	-32.3	-35.5	-32.7	-19.7	-19.8
Commercial	-10.7	-6.6	-5.3	-14.3	-13.3	-8.8	-9.4	-6.0	-1.9	-15.6	-16.7	0.0	13.5	12.1	17.2	15.8	8.9	5.9	-2.5	-8.7	-11.5	-3.7	-11.2	-7.2	-10.6
Health care	1.7	3.2	1.7	1.3	1.4	1.3	1.1	5.5	0.7	1.6	3.0	1.8	8.0	9.1	8.2	10.9	11.7	9.8	9.1	15.5	18.7	17.8	12.1	17.8	13.0
Education & social assistance	0.8	2.6	4.0	2.3	4.1	2.5	3.8	2.8	7.5	7.6	7.2	10.1	6.8	3.9	4.1	6.9	8.3	14.9	10.3	13.6	11.5	14.1	13.5	9.5	11.3
Arts, entertainment, recreation	-6.5	-4.5	0.5	-2.6	-2.9	-4.6	-4.4	-1.9	-1.6	-4.1	-3.9	-1.0	-1.7	-3.4	-0.6	-1.5	1.6	-5.3	-3.7	-5.5	-6.3	-6.7	-7.6	-7.9	-4.1
Transportation	2.5	3.3	3.1	3.2	0.9	0.9	2.1	4.0	3.7	2.9	1.2	2.4	1.4	4.7	1.9	4.6	3.7	3.9	4.2	2.3	-0.3	0.8	2.5	5.0	7.2
Communication	11.0	13.9	19.9	18.4	14.7	15.2	10.9	11.9	7.5	-2.8	-4.0	-2.3	-1.1	-1.7	4.3	9.2	4.5	-4.3	-3.8	-2.5	-2.8	-3.2	-7.0	-5.9	7.1
Power	-0.9	2.8	3.1	7.0	2.5	-5.2	-0.5	-0.3	1.6	-7.6	-13.0	-23.5	-13.4	-4.0	2.9	-5.2	-16.2	-9.7	-17.5	-3.4	6.5	12.4	-0.9	-19.1	13.2
Manufacturing	-0.9	-0.2	1.0	1.0	10.2	10.1	8.9	6.0	9.2	2.0	-4.2	-21.7	-9.0	-3.3	-3.2	-4.9	-9.3	-28.1	-23.0	-13.3	-14.4	-16.5	-6.9	-14.5	-38.6
All other nonresidential	14.7	9.9	-5.1	2.9	22.7	15.3	26.5	16.9	26.5	24.3	20.0	28.2	29.3	27.5	29.4	29.1	22.0	18.8	10.6	29.3	33.1	29.9	21.6	24.5	64.6

U.S. Bureau of Economic Analysis **ACES** Annual Capital Expenditures Survey **VIP** Value of Construction Put in Place Survey **NIPA** National Income and Product Accounts

Figure 3. Fixed Investment, Private New Nonresidential Structures, by Type/Industry Categories: Billions of Dollars



NIPA National Income and Product Accounts
VIP Value of Construction Put in Place Survey
ACES Annual Capital Expenditures Survey

U.S. Bureau of Economic Analysis

Table 3 shows that substantial shares of the value of types of buildings may be owned by "other" industries: many industries can own offices and commercial buildings, nonmanufacturing industries can own "industrial buildings," and so on. Accordingly, we would expect investment for a VIP asset type to differ somewhat from investment for a "similar" industry, even without measurement error. With these caveats in mind, a few speculative points may be worth noting:

- "Lodging" is higher in the VIP and NIPA than in the ACES, perhaps because the VIP estimate may include not only hotels owned by NAICS 721 (traveler accommodations), but also dormitories, recreation centers and other facilities that fit the definition of "lodging." In addition, the ACES estimate for NAICS 721 covers only buildings in this industry; ACES Table 5a reports that other industries may own hotels.
- "Health care" is relatively higher in the ACES in recent years, possibly because the ACES investment for the health care industry includes non-health-care structures owned by the health care industry, such as office buildings and parking structures. Similarly, "education and social assistance" is relatively higher in the ACES, possibly because these ACES estimate also includes dormitories, stadiums, offices, and other structures.
- "Manufacturing" is relatively higher in the VIP data after 2007, perhaps because the VIP survey classifies all buildings on manufacturing sites in this category (as this study implies) while nonmanufacturing companies in the ACES can own industrial buildings.
- "Other nonresidential" is larger in the ACES because it appears to include a broader category of structures than the most similar VIP categories.
- For other categories, the discrepancies vary over these years.

Table 4 and Figure 4 presents discrepancies between "roughly similar" groups of VIP and ACES *asset types* using the more detailed 5-year ACES surveys. These direct comparisons of asset types may overcome the problems of comparing asset types versus industries. However, the ACES and VIP use some different asset type definitions that cloud these comparisons. For many asset types, two estimates are reasonably similar. The size and sign of the discrepancies in some estimates varies notably over time.

- "Lodging" is higher in the VIP and NIPA than in the ACES because the ACES estimate includes only hotels, motels, and inns, while the VIP estimate of lodging may also include school dormitories, recreation centers and other facilities.
- "Manufacturing" is relatively higher in the VIP data after 2007, perhaps because the VIP survey classifies all buildings on manufacturing sites in this category, while companies in other industries in the ACES can own manufacturing buildings.
- Within the categories of commercial buildings and power, the discrepancies of several building types can offset one another, perhaps suggesting classification differences.
- "Health care" is relatively higher in the ACES in recent years, perhaps because the ACES classifies a wider range of buildings related to health care in this category.

Table 4: Fixed Investment, Private New Nonresidential Structures, by ACES, VIP, and NIPA Type Categories

[Billions of Dollars]

ACES, adjusted for nonemployers					VIP, adjusted for BCs					NIPA, adjusted for BCs					Difference, ACES less VIP				Difference, ACES less NIPA			
	2003	2008	2012	2017		2003	2008	2012	2017		2003	2008	2012	2017	2003	2008	2012	2017	2003	2008	2012	2017
Hotels, motels, and inns	4.9	21.6	5.3	8.7	Lodging	10.2	36.9	10.7	30.0	Lodging	12.6	45.6	13.2	37.1	-5.3	-15.3	-5.4	-21.4	-7.7	-24.0	-7.9	-28.4
Manufacturing	31.9	47.1	45.2	65.9	Manufacturing	22.0	56.0	49.0	74.9	Manufacturing	22.0	55.2	48.9	74.7	9.9	-8.9	-3.7	-9.0	9.9	-8.1	-3.7	-8.7
Office, bank, and professional bldgs	38.5	63.0	56.3	82.1	Office	31.4	57.9	28.7	64.2	Office	36.0	66.4	33.0	73.5	7.1	5.1	27.6	18.0	2.5	-3.4	23.3	8.6
Commercial	48.8	69.7	65.6	88.4	Commercial x farm	53.8	77.7	38.3	79.9	Commercial	54.0	78.0	38.5	80.2	-5.0	-7.9	27.3	8.5	-5.2	-8.2	27.1	8.2
Food/beverage	11.9	19.5	19.0	20.7	Food/beverage	8.6	8.4	6.1	8.7	Food and beverage	8.6	8.4	6.1	8.7	3.3	11.2	12.9	11.9	3.3	11.2	12.9	12.0
Multi-retail	17.7	18.2	15.6	19.3	Multi-retail	15.8	33.4	15.6	25.7	Multimerchandise shop	15.8	33.3	15.6	25.7	1.9	-15.2	0.0	-6.4	1.9	-15.1	0.0	-6.4
Warehouse	7.1	11.6	15.9	18.9	Warehouse	12.7	17.4	7.4	31.1	Warehouse	12.7	17.4	7.4	31.0	-5.6	-5.8	8.5	-12.2	-5.6	-5.8	8.6	-12.1
Other commercial, incl auto	12.1	20.4	15.1	29.6	Other commercial, incl auto	16.7	18.5	9.2	14.3	Other commercial	16.9	18.9	9.5	14.8	-4.6	1.9	5.9	15.3	-4.8	1.5	5.6	14.7
Health care facilities	28.5	45.3	47.7	54.1	Health care	24.9	40.1	32.9	35.9	Health care	28.0	45.0	37.0	40.3	3.6	5.2	14.8	18.2	0.5	0.3	10.8	13.8
Hospitals	18.2	30.5	32.6	31.3	Hospitals	15.6	26.7	22.2	21.6	Hospitals	17.6	30.0	25.0	24.3	2.5	3.9	10.4	9.7	0.6	0.6	7.7	7.0
Special care facilities	6.2	7.6	6.0	11.9	Special care	3.0	3.8	4.0	4.4	Special care	3.4	4.2	4.5	4.9	3.2	3.8	2.0	7.6	2.8	3.3	1.5	7.0
Medical buildings	4.1	7.2	9.1	10.8	Medical buildings	6.2	9.6	6.7	9.9	Medical buildings	7.0	10.8	7.5	11.1	-2.1	-2.4	2.4	0.9	-2.9	-3.6	1.6	-0.3
Amusement and recreation	5.7	12.8	7.8	13.2	Amusement and recreation	8.0	11.0	6.5	15.5	Amusement and recreation	9.6	13.1	7.8	18.6	-2.3	1.8	1.3	-2.3	-3.9	-0.4	0.0	-5.4
Transportation	7.1	11.2	12.0	17.9	Transportation	6.7	10.4	11.4	15.8	Transportation	6.7	10.3	11.4	15.5	0.4	0.9	0.6	2.0	0.4	0.9	0.6	2.4
Telecommunications facilities	21.1	21.0	16.0	22.6	Communication	14.8	27.5	16.7	25.2	Communication	14.8	27.4	16.7	25.2	6.3	-6.5	-0.7	-2.7	6.3	-6.4	-0.7	-2.6
Power	33.3	89.0	116.2	109.6	Power	33.9	72.3	90.4	96.1	Power	34.5	72.1	90.3	95.8	-0.6	16.7	25.7	13.5	-1.1	16.9	25.9	13.8
Electric, nuclear, other power	22.3	46.5	63.0	49.5	Electric	26.3	55.1	72.2	69.7	Electric	26.9	55.0	72.1	69.5	-4.0	-8.6	-9.2	-20.2	-4.6	-8.5	-9.1	-20.0
Oil and gas pipeline and related	11.1	42.5	53.2	60.0	Oil and gas	7.6	17.2	18.3	26.4	Other power	7.6	17.1	18.2	26.3	3.5	25.3	34.9	33.7	3.5	25.4	35.0	33.7
Education	15.1	21.2	17.3	31.1	Education	13.3	19.0	17.0	21.9	Educational and vocational	14.7	19.0	17.0	21.9	1.8	2.2	0.4	9.2	0.4	2.2	0.3	9.1
Religious	12.3	9.9	4.1	6.8	Religious	8.8	7.5	4.0	3.8	Religious	8.8	7.5	4.0	3.8	3.6	2.4	0.1	2.9	3.6	2.4	0.1	2.9

ACES Annual Capital Expenditures Survey
VIP Value of Construction Put in Place Survey
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Figure 4. Fixed Investment, Private New Nonresidential Structures, by Type Categories: Billions of Dollars

NIPA National Income and Product Accounts
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ACES Annual Capital Expenditures Survey

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To summarize, this review of discrepancies for subcategories of fixed investment in new structures seems inconclusive and does not clearly identify major reasons for the discrepancies in ACES- and VIP/based estimates of total fixed investment in new structures. Many of these discrepancies are likely to arise from differences in the definitions of the categories presented, as well as from measurement error. In many ways, the comparisons of investment for ACES industries and "similar" VIP asset types serve to highlight the fact that the two data sources provide different but useful estimates of subcategories of structures investment.

ASM, ACES, VIP estimates of capital purchases by manufacturing

We can also compare estimates of capital spending for structures reported by the ACES (for manufacturing companies) and by the ASM (for manufacturing establishments), and the VIP (for manufacturing structures types). To be clear, the ASM reports not only shipments of equipment (used to estimate investment in equipment), but also capital purchases of structures and equipment; this comparison focuses on the latter. Both the ASM and ACES data presented here are thus "demand-side" estimates of capital purchases.

Over these years, reported fixed investment in nonresidential structures is consistently higher in the ACES than in the ASM (Table 5 and Figure 5, the same general result occurs if we use ACES-reported investment in "manufacturing" or "industrial building" asset types in EC years). Since 2007, both estimates are lower than the VIP estimates for manufacturing structures. While these results could reflect relatively more underreporting of investment in the ASM, the discrepancies seem likely to reflect the different samples of these surveys, consistent with previous internal study by Crawford: the ASM captures only investment in manufacturing establishments, while the ACES captures investment in all structures that are part of manufacturing companies, and the VIP captures all buildings in manufacturing sites, including those owned by non-manufacturing companies. These results are generally consistent with ACES Table 5a, which shows that manufacturing companies can own other types of buildings and that nonmanufacturing companies can own manufacturing buildings. Similar results occur for equipment (discussed next.) The results confirm that sample definitions (company vs establishment) can have major effects on estimated levels and trends of investment by industry.

Table 5. Capital Spending by Manufacturing Establishments (ASM) and Manufacturing Industries (ACES)

[Billions of Dollars]

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ASM new and used structures, manufacturing establishments	20.0	15.9	16.8	18.6	18.5	30.0	26.4	22.2	19.4	21.8	32.1	34.9	35.3	34.6	30.2	33.7	36.6	35.2	34.8	38.6	43.2
ACES, total structures, manufacturing industries	32.6	31.1	31.8	34.1	41.6	42.5	49.3	35.7	31.2	36.3	43.1	46.6	50.5	54.7	57.2	57.7	58.9	65.8	69.1	68.6	76.5
VIP, manufacturing structures	22.7	21.4	23.2	28.4	32.3	40.2	53.6	57.4	40.6	39.8	46.8	51.8	60.1	82.4	78.9	70.0	72.0	80.5	75.1	81.6	114.2

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ASM new and used equipment, manufacturing establishments	103.0	96.3	97.0	109.7	117.3	129.4	139.6	107.0	108.2	124.6	132.6	141.5	138.6	142.1	138.1	134.7	142.6	142.5	132.0	135.3	147.6
ACES, total equipment, manufacturing industries	124.6	118.0	124.8	131.5	150.7	154.8	163.8	119.4	129.6	156.1	160.0	174.8	180.6	190.4	186.4	189.3	199.2	206.9	187.7	215.5	237.8

ACES Annual Capital Expenditures Survey
ASM Annual Survey of Manufactures
VIP Value of Construction Put in Place Survey

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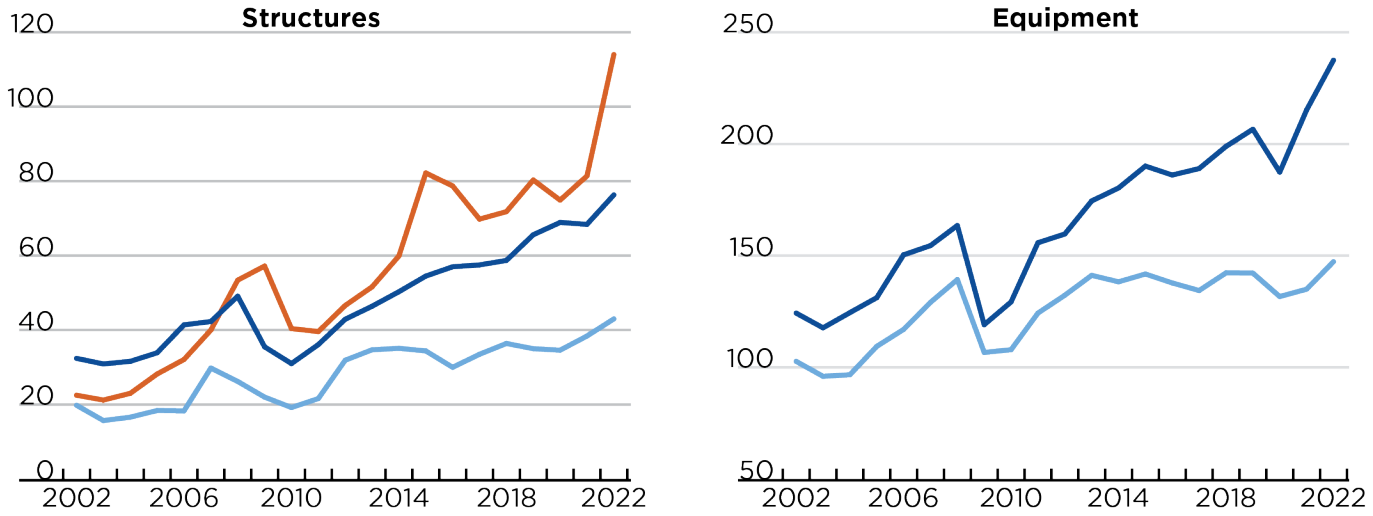
Figure 5. Total Private Fixed Investment, Strucures and Equipment, ACES and ASM, Manufacturing Industries: Billions of Dollars



VIP Value of Construction Put in Place Survey
ACES Annual Capital Expenditures Survey
ASM Annual Survey of Manufactures

U.S. Bureau of Economic Analysis

VIP, manufacturing structures
ACES, total structures, manufacturing industries
ASM new and used structures, manufacturing establishments

Comparing estimates of fixed investment in nonresidential equipment

Comparisons of estimates of investment in equipment should also take into account known, measurable differences in the estimates as much as possible. We cannot simply compare the ACES-based estimates of equipment purchases with ASM-based shipments because the ACES-based estimates would in theory include not only the ASM shipments, but also imports less exports, trade margins, and transportation costs. Perhaps the most interesting comparison is between the ACES-based and NIPA estimates of new nonresidential equipment, which reflect the commodity-flow methodology. In theory, these two estimates should be similar. Table 6 and Figure 6 compare these different estimates of nonresidential equipment. The ACES-based estimates remove software (classified as part of intellectual property products in the NIPAs).

The results again show that these measures of new fixed investment in nonresidential equipment investment are broadly similar. Both display the expected cyclical pattern, falling in the 2001 recession, rising in the years afterward, falling again in the 2009 recession, rising again until the 2020 COVID–19 pandemic, and then rising again afterward. The similarity of these estimates gives us some confidence in the results obtained from these surveys and in BEA's methods.

The ACES-based estimates for investment in new equipment are, however, 14–33 percent lower than the NIPA estimates over these years, and the discrepancy tends to grow over time. These discrepancies could reflect a number of factors, including sampling and nonsampling errors, different estimates of margins and transportation costs, various adjustments in the NIPA estimates, and perhaps underreporting of equipment purchases in the ACES.

Table 6. Fixed Investment, Private Nonresidential Equipment

[Billions of Dollars]

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ACES, total private	689.4	762.4	709.1	595.8	584.9	623.5	694.0	762.7	766.3	739.5	574.5	611.9	700.1	765.9	819.6	864.2	905.1	875.0	911.3	996.3	1,026.2	910.4	971.2	1,150.2
ACES, new private equipment*	652.1	716.4	670.4	555.1	534.0	578.7	652.1	718.5	727.3	693.0	540.0	574.1	659.0	712.9	766.1	808.6	847.3	824.8	854.7	930.0	953.7	848.0	907.9	1,065.1
NIPA, new private equipment	783.1	836.5	778.5	726.9	730.8	785.5	860.2	931.8	970.7	933.0	754.1	870.8	967.0	1,065.5	1,120.6	1,197.1	1,229.6	1,214.4	1,268.2	1,346.3	1,354.5	1,233.2	1,360.2	1,471.2

ACES Annual Capital Expenditures Survey
NIPA National Income and Product Accounts

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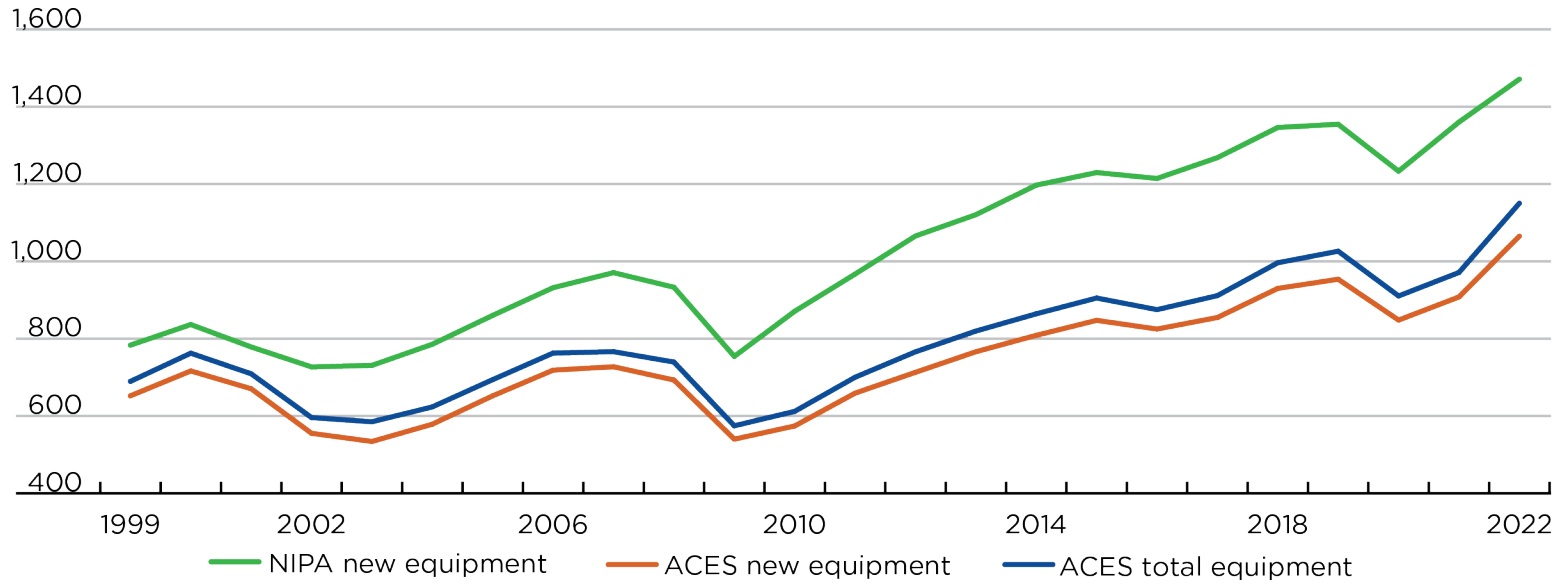
Figure 6. Fixed investment, Private Nonresidential Equipment: Billions of Dollars



NIPA National Income and Product Accounts
ACES Annual Capital Expenditures Survey

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The ACES provides more detailed breakouts of purchases of specific types of equipment every 5 years, and these asset types are roughly similar to those in the NIPAs. Table 7 and Figure 7 compare the ACES- and NIPA-based estimates for these asset types. While these comparisons do not clearly reveal the source of discrepancies in estimates, they provide some interesting insights.

- Investment in information processing equipment is consistently lower in the ACES data. Computers and peripheral equipment, communication equipment, and medical equipment and nonmedical instruments are all lower in the ACES.
- The estimates of reported investment in total industrial equipment are more similar. Within this asset type, fabricated metal products, general industrial machinery, and electrical transmission and distribution, and metalworking machinery are lower in the ACES, while engines and turbines and special industry machinery are higher in the ACES. The discrepancies within this broad category of equipment may reflect differences in the way respondents classify specific categories of equipment or other issues.
- The estimates of reported investment in transportation equipment are relatively lower in the ACES, mainly reflecting the estimates for autos and light trucks, and aircraft. (The NIPA estimates for autos and light trucks reflect BEA's use of private data).
- The estimates of reported investment in other equipment are also relatively lower in the ACES estimates, with the exception of mining and oilfield machinery (which may reflect the way respondents classify specific categories of equipment or other issues).

The final comparison is between estimates of capital spending for equipment reported by the ACES (for companies that report activity in manufacturing industries) and by the ASM (for manufacturing establishments). Reported fixed investment in equipment is consistently higher in the ACES than in the ASM (Table 5 and Figure 5). These results could reflect the samples of these surveys: the ASM captures only investment in manufacturing establishments, while the ACES captures investment in all equipment in manufacturing companies. These results show that sample definitions can have a major effect on estimates of fixed investment by industry.

Table 7. ACES and NIPA New Nonresidential Fixed Investment, Equipment, by Type

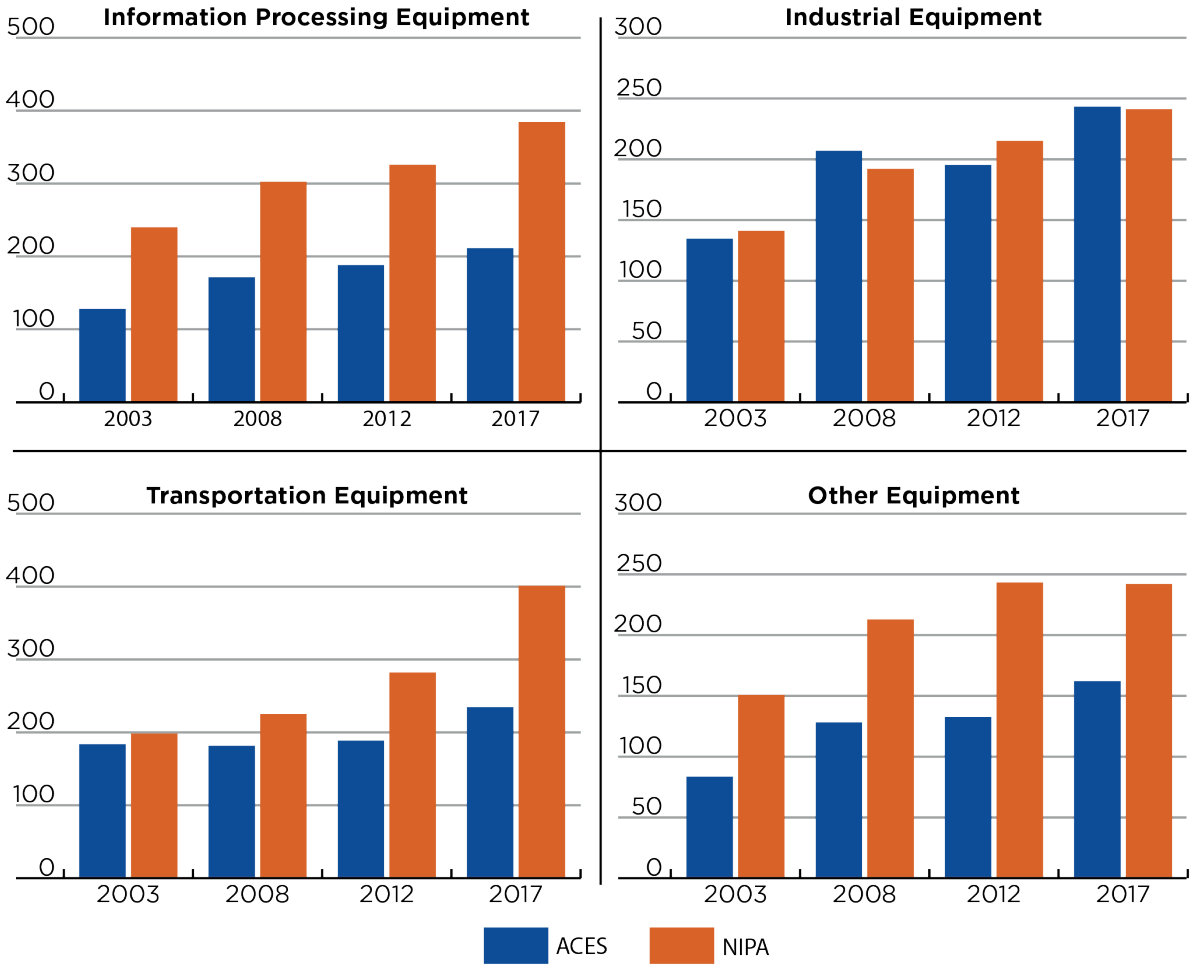
NIPA Fixed Investment					ACES Fixed Investment					Difference, ACES less NIPA				ACES as a percent of NIPA			
NIPA equipment categories	2003	2008	2012	2017	ACES equipment categories	2003	2008	2012	2017	2003	2008	2012	2017	2003	2008	2012	2017
Information processing equipment	240.0	302.6	325.9	384.4	**Information processing equipment**	128.2	171.5	188.3	211.3	-111.9	-131.1	-137.6	-173.1	53.4%	56.7%	57.8%	55.0%
Computers and peripheral equipment	77.6	90.4	98.4	104.4	Computer and peripheral equipment	61.1	69.3	72.7	75.0	-16.4	-21.0	-25.7	-29.4	78.8%	76.7%	73.9%	71.8%
Communication equipment	82.2	100.1	104.7	135.6	ICT equipment, excl computers and peripherals; video and audio equipment	33.9	66.1	70.4	85.3	-48.2	-34.0	-34.4	-50.3	41.3%	66.0%	67.2%	62.9%
Medical equipment and instruments	48.5	73.2	79.2	97.9	Electromedical and electrotherapeutic apparatus; medical equipment and supplies	21.3	25.1	29.7	33.6	-27.1	-48.2	-49.5	-64.2	44.0%	34.2%	37.5%	34.4%
Nonmedical instruments	18.7	26.6	31.6	34.1	Navigational, measuring, and control instruments	3.3	4.0	3.7	4.2	-15.5	-22.6	-27.9	-29.9	17.4%	14.9%	11.6%	12.4%
Office, accounting, photocopy, and related equipment	13.1	12.4	11.9	12.4	Office equipment except computers and peripherals	8.5	7.1	11.8	13.2	-4.6	-5.3	-0.1	0.7	65.0%	57.4%	98.8%	106.0%
Industrial equipment	141.2	192.2	215.2	241.2	**Industrial equipment**	134.7	207.0	195.3	243.3	-6.5	14.8	-19.9	2.1	95.4%	107.7%	90.8%	100.9%
Fabricated metal products	11.8	22.3	20.4	20.3	Fabricated metal products; nuclear fuel	4.0	9.6	12.1	13.3	-7.8	-12.7	-8.3	-7.1	34.2%	43.1%	59.3%	65.2%
Engines and turbines	10.3	12.5	16.4	11.3	Engine, turbine, and power transmission equipment	11.4	24.1	16.5	19.0	1.2	11.5	0.1	7.6	111.4%	192.2%	100.3%	167.5%
Metalworking machinery	22.9	29.3	32.6	34.3	Metalworking machinery	19.9	26.9	25.0	23.8	-3.0	-2.4	-7.6	-10.4	87.0%	91.9%	76.6%	69.5%
Special industry machinery, n.e.c.	28.8	32.7	35.8	44.7	Special industrial machinery	67.8	96.6	98.3	121.8	39.1	63.9	62.5	77.1	235.9%	295.0%	274.3%	272.3%
General industrial, incl. materials handling, equipment	47.0	63.5	76.7	89.7	Ventilation, heating, air-conditioning, refrigeration, other general purpose machinery	18.5	26.2	20.8	34.9	-28.5	-37.4	-55.9	-54.8	39.4%	41.2%	27.1%	39.0%
Electrical transmission, distribution, and industrial apparatus	20.5	31.8	33.3	40.8	Electrical transmission and distribution equipment	13.0	23.6	22.7	30.4	-7.5	-8.2	-10.7	-10.3	63.5%	74.2%	68.0%	74.7%
Transportation equipment	198.4	225.1	282.0	401.1	**Transportation equipment**	183.8	181.7	188.8	234.6	-14.6	-43.4	-93.2	-166.5	92.6%	80.7%	66.9%	58.5%
Autos and light trucks	148.5	149.0	186.7	275.7	Cars and light trucks	128.0	112.1	99.6	140.4	-20.4	-36.8	-87.1	-135.3	86.2%	75.3%	53.3%	50.9%
Other trucks, buses, and truck trailers			38.3	45.5	Heavy duty trucks, other transportation equipment*			51.5	50.9			13.2	5.4			134.4%	111.9%
Aircraft	20.6	34.7	38.0	61.7	Aerospace products and parts	21.7	25.1	21.7	32.4	1.0	-9.6	-16.3	-29.3	104.9%	72.5%	57.1%	52.5%
Ships, boats, and railroad equipment			19.0	18.2	Ship, boats and rail transportation*			16.0	10.9			-3.0	-7.3			84.3%	59.7%
All other transportation equipment	29.3	41.4			Other transportation equipment*	34.1	44.4			4.8	3.0			116.4%	107.3%		
Other equipment	150.9	212.9	243.5	242.1	**Other equipment**	83.6	128.3	132.7	162.2	-67.2	-84.6	-110.8	-79.9	55.4%	60.3%	54.5%	67.0%
Furniture and fixtures	36.6	41.1	37.1	45.4	Furniture and related products	30.4	37.6	30.4	37.0	-6.2	-3.4	-6.6	-8.4	82.9%	91.6%	82.1%	81.5%
Agricultural machinery	17.6	25.2	38.8	30.5	Agricultural equipment	1.5	2.6	3.4	4.4	-16.1	-22.6	-35.4	-26.1	8.5%	10.3%	8.8%	14.5%
Construction machinery	20.4	37.5	43.4	36.0	Construction machinery	14.3	23.0	20.0	26.4	-6.1	-14.6	-23.4	-9.6	70.0%	61.2%	46.0%	73.3%
Mining and oilfield machinery	4.5	19.1	36.1	28.0	Mining and oil and gas field machinery and equipment; Floating oil and gas drilling and production platforms	16.3	40.4	44.9	28.9	11.8	21.3	8.9	0.9	365.5%	212.0%	124.6%	103.2%
Service industry machinery	20.3	25.4	30.4	31.5	Service industry equipment	7.7	10.7	12.0	26.7	-12.6	-14.7	-18.4	-4.8	38.0%	42.1%	39.4%	84.7%
Electrical equipment, n.e.c.	5.2	5.5	6.2	7.4	Electrical equipment, NEC	4.8	3.6	6.2	3.7	-0.4	-1.8	0.0	-3.7	93.1%	66.4%	100.1%	49.9%
Other nonresidential equipment	46.3	59.0	51.6	63.2	Artwork, books, and other misc. equipment, NEC	8.6	10.3	15.8	35.1	-37.7	-48.7	-35.8	-28.2	18.6%	17.4%	30.6%	55.5%

ACES Annual Capital Expenditures Survey
NIPA National Income and Product Accounts

Notes. ACES values increased by 3–10 percent to account for equipment not placed in any type categories.
In the ACES, other heavy-duty trucks and other transportation equipment was combined with ships, boats, and rail for 2008 and 2003.

U.S. Bureau of Economic Analysis

Figure 7. Fixed Investment, Private New Nonresidential Equipment, by Type Categories: Billions of Dollars



NIPA National Income and Product Accounts
ACES Annual Capital Expenditures Survey

U.S. Bureau of Economic Analysis

Conclusion

BEA relies mainly on the Census Bureau's monthly construction spending (VIP) surveys of construction projects to measure levels of fixed investment in structures, the ASM (with the commodity-flow method) to measure levels of fixed investment in equipment, and the ACES to estimate shares of fixed investment by industry. The estimated levels of fixed investment in nonresidential structures and equipment from these surveys—with adjustments for known issues—should be similar. This paper compares estimated levels of investment in nonresidential equipment and structures from the ACES and from the other sources, using more than 20 years of published data and adjusting for measurable differences in the coverage of these surveys.

The results show that estimates of fixed investment based on the ACES and the other sources are roughly similar and display similar cyclical trends. Nevertheless, the discrepancies between these estimates are worth noting. The ACES-based estimates for nonresidential structures are relatively higher than the VIP-based estimates in several years—as much as about 20 percent higher—but not in all years. The ACES-based estimates for nonresidential equipment are about 14–33 percent lower than the ASM/commodity-flow based estimates; the discrepancies tend to grow over time.

These discrepancies in estimates of fixed investment could arise for many reasons. Differences in samples, sampling units, timing, various measurement errors, imputations, and adjustments for various issues could all play a role. The samples and questions of the surveys differ: the ACES asks companies to report capital spending; the VIP asks owners of construction projects to report expenditures; the ASM asks manufacturing establishments to report shipments and also capital spending. For many reasons, "demand-based" surveys of capital spending and "supply-based" surveys of producers or shipments may yield different estimates. The ACES may underreport some types of capital spending, such as equipment, but may capture a larger share of other types, such as structures investment for improvements and own-account projects.

The possible role of fixed investment in improvements and own account projects for structures may be a topic for future research. The ACES provides estimates of these types of investment every five years: improvements account for 34–40 percent of new structures investment, and own-account projects account for 16–21 percent. These substantial shares suggest that differences in the rate of coverage of improvements and own account projects may explain some of the discrepancies between the ACES- and VIP-based estimates, assuming the VIP data miss some of these projects. The effect of this coverage issue is hard to estimate, however, because we lack an estimate of the share of these projects captured in the VIP data.

A review of estimates for subcategories of investment (defined by industry or asset type) showed that the size of the discrepancies varies by subcategories but did not clearly reveal causes of the discrepancies. These comparisons are difficult to interpret because each survey classifies subgroups in a different way, so discrepancies by subgroup will exist even without measurement error. In some ways, the differences in reported structures investment for "similar" ACES industries and VIP types highlight the benefits of these surveys, each of which provides useful information for different subcategories of investment. The ACES-based estimates of equipment investment are lower than the NIPA estimates for several different asset types, perhaps because of underreporting in the ACES, but other explanations are possible. Another finding is that ASM-reported capital spending for manufacturing establishments is lower than ACES-reported capital spending for manufacturing companies; this result suggests that the choice of sampling unit (company vs establishment) can have a major effect on estimated investment for an industry.

Despite these discrepancies, the rough similarity of the estimates from these surveys is reassuring and can be interpreted as generally supportive of BEA's estimation methods. BEA's estimates of investment levels rely more on receipts reported by producers and sellers rather than on purchases reported by buyers because "supply-based" estimates are thought to be more complete and reliable. All three surveys remain extremely important to BEA: the ACES is our only source of estimates of shares of investment by industry and legal form for most industries; the VIP is our main data source of quarterly and annual investment in structures by asset type; and the ASM and the M3 are our main source of quarterly and annual shipments of equipment. The Census Bureau currently plans to include these questions in the new AIES.