Bureau of Economic Analysis
U.S. DEPARTMENT OF COMMERCE

New and Revised Statistics of the U.S. Digital Economy, 2005–2021

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This report provides an overview of new and revised digital economy statistics for 2005–2021 released by the U.S. Bureau of Economic Analysis (BEA) in November 2022. These statistics build on the 2005–2020 estimates released in May 2022 by incorporating new data for 2021 and revising source data for 2005–2020. The new data show in 2021, the U.S. digital economy accounted for $3.70 trillion of gross output, $2.41 trillion of value added (translating to 10.3 percent of U.S. gross domestic product (GDP)), $1.24 trillion of compensation, and 8.0 million jobs.[1] Growth in price-adjusted GDP (also referred to as "chained-dollar" or "real" GDP) was 9.8 percent in 2021, greatly outpacing growth in the overall economy, which increased 5.9 percent.[2] See BEA's digital economy satellite account website for the detailed data tables and other research related to measuring the digital economy.

The new 2021 statistics and growth in the past 6 years (2016–2021) are the focus of this report. Results are presented by major activity and by standard industry classifications under the North American Industry Classification System (NAICS). Digital economy activities are organized by infrastructure (software and hardware), e-commerce (business-to-business and business-to-consumer), priced digital services (cloud services; telecommunications services; internet and data services; and all other priced digital services), and federal nondefense digital services, a new activity introduced with this report. A description of the revisions to the 2005–2020 estimates are also provided, followed by a brief overview of the methodology. The report concludes with a short summary of results and plans for future work.

1. The gross output of an industry is the market value of the goods and services produced by an industry. The GDP or value added for an industry represents the market value it adds in production, or the difference between an industry's gross output and the cost of its intermediate inputs.

2. Real or constant-dollar estimates hold prices constant such that growth rates for real estimates reflect changes in quantities produced, removing the impact of inflation. Chained-dollar estimates are calculated by taking the current-dollar level of a series in the reference period and multiplying it by the change in a chained-type quantity index number for the series since the reference period. Chained-dollar estimates correctly show growth rates for a series but are not additive in periods other than the reference period.

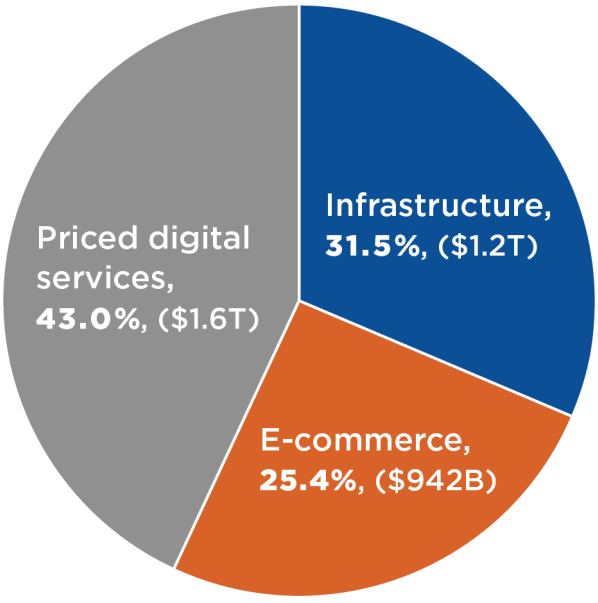
November 2022

Also included with this report are two annexes that highlight areas where BEA is currently conducting research and seeking feedback on methodology. The first provides an overview of how Census Bureau data on revenue from electronic sources may be useful for estimating digital intermediary services for rideshare platforms. Digital intermediary services represent services generated from operating a digital intermediary platform and are currently not comprehensively included in the digital economy estimates. The second annex describes experimental estimates of e-commerce for personal consumption expenditures (PCE), an area of importance for the development of digital supply-use tables as outlined by the Organisation for Economic Co-operation and Development (OECD).[3]

Gross output by activity

The digital economy produced $3.70 trillion in current-dollar gross output in 2021, up from $3.30 trillion in 2020. In real terms, digital economy gross output grew by 10.0 percent between 2020 and 2021. The annual growth rate for real gross output averaged 5.6 percent between 2016 and 2021, much faster than the overall economy's growth of 1.9 percent over the same period. Figure 1 shows priced digital services was the largest activity in the digital economy in 2021, representing 43.1 percent of total gross output, followed by infrastructure (31.5 percent) and e-commerce (25.4 percent). For clarity purposes, the proportion accounted for by federal nondefense digital services (0.01 percent) is not shown. Additional information about each activity is provided below.

Figure 1. Digital Economy Gross Output by Major Activity, 2021



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3. See "High priority indicators in the Digital Supply-Use Tables" by the Working Party on National Accounts (2019).

- **Priced digital services** produced $1.59 trillion in current-dollar gross output in 2021. In real terms, gross output increased by 9.8 percent between 2020 and 2021, more than twice the average growth rate of 4.8 percent over the 2016–2021 period. Growth in cloud services (21.8 percent) and internet and data services (17.5 percent) offset the relatively weaker growth in telecommunications services (5.7 percent) between 2020 and 2021. Telecommunications services accounted for slightly more than half of all output within this activity.
- **Infrastructure** produced $1.17 trillion in current-dollar gross output in 2021. Growth in real gross output between 2020 and 2021 for this activity was 11.1 percent. This annual growth rate exceeds the average 6-year growth rate of 7.2 percent. Both software (12.1 percent) and hardware (9.5 percent) experienced strong growth rates in 2021.
- **E-commerce** produced $942 billion in current-dollar gross output in 2021. Real gross output increased by 8.7 percent. In 2021, both business-to-business (B2B) and business-to-consumer (B2C) e-commerce experienced robust growth in real gross output at 7.6 and 11.1 percent, respectively. Between 2016 and 2021, e-commerce had an average growth rate for real gross output (5.1 percent) slightly below that observed for the digital economy (5.6 percent).
- **Federal nondefense digital services** produced $420 million in current-dollar gross output in 2021. Gross output associated with federal nondefense digital services has been consistently declining over the past 6 years. Real gross output attributable to this activity declined 0.9 percent in 2021 and had an average growth rate of –1.4 percent between 2016 and 2021.

Table 1. Digital Economy Gross Output by Activity, 2021

[Millions of dollars]

Digital economy	3,701,722
Infrastructure	1,167,116
Hardware	445,089
Software	722,027
E-commerce	941,970
Business-to-business e-commerce	642,998
Business-to-consumer e-commerce	298,972
Priced digital services	1,592,217
Cloud services	186,589
Telecommunications services	802,139
Internet and data services	213,290
All other priced digital services	390,200
Federal nondefense digital services	420

Gross output by industry

When evaluated by industry sectors, there were significant variations in both the distribution and growth of the digital economy current-dollar and real gross output estimates. Table 2 shows over 80 percent of 2021 gross output for the digital economy was produced by 3 industry sectors: information (43.2 percent), wholesale trade (21.4 percent), and professional and business services (16.6 percent). Additional information about each industry sector is provided below.

Table 2. Digital Economy Gross Output for Major Sectors, 2021
[Millions of dollars]

Digital economy	3,701,722
Information	1,600,191
Wholesale trade	792,532
Professional and business services	615,714
Retail Trade	308,818
Manufacturing	303,349
All other industries	81,118

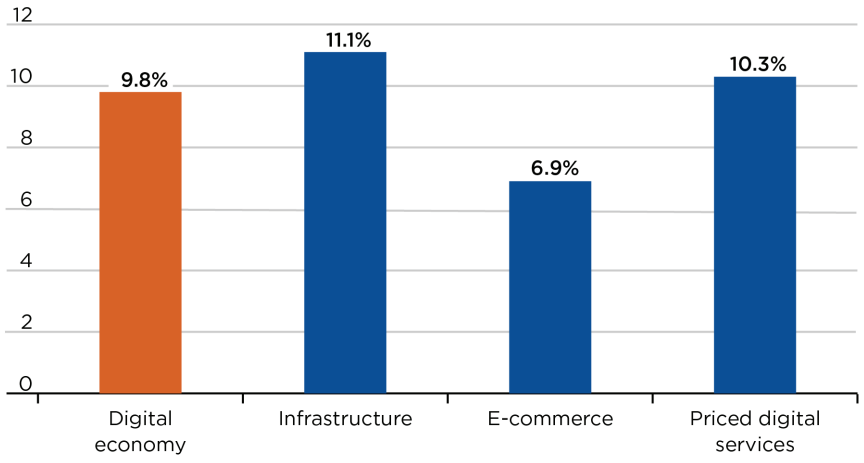
- **Information** had a higher growth rate for real gross output (12.4 percent) relative to the overall digital economy (10.0 percent). Broadcasting and telecommunications accounted for nearly half (46.6 percent) of this industry's real gross output. The relatively weaker growth in broadcasting and telecommunications in 2021 (4.3 percent) was offset by much stronger growth in data processing, internet publishing, and other information services (21.9 percent) and publishing industries, except internet (includes software) (18.7 percent) which account for much of the remaining gross output. Overall, the information industry had an average growth rate of 6.3 percent between 2016 and 2021. Nearly three quarters (73.5 percent) of the information industry's overall real gross output in the United States was produced within the digital economy in 2021.
- The second and third largest industries, **wholesale trade** and **professional and business services** both had weaker growth rates in real gross output than information in 2021 (6.2 percent and 7.4 percent, respectively). These two industries, however, diverged in terms of their longer-term growth rates. Wholesale trade, while halting the decline in real gross output observed in 2019 and 2020, had a relatively low average growth rate of 1.9 percent between 2016 and 2021. Professional and business services saw an average increase of 6.8 percent over the same period.
- The final two major sectors, **retail trade** and **manufacturing**, notched real gross output growth rates equal to, or greater than, the overall digital economy in 2021. Retail trade's real gross output increased by 10.0 percent in 2021, with manufacturing's increasing by 13.4 percent. Their longer-term growth rates were more mixed, however. Retail trade recorded an average growth rate of 13.5 percent between 2016 and 2021, outpacing the overall digital economy (5.6 percent). Manufacturing had an average growth rate of 4.9 percent for the same period.

Value added by activity

The digital economy accounted for $2.41 trillion in current-dollar value added in 2021, up from $2.17 trillion in 2020. In real terms, digital economy value added grew 9.8 percent between 2020 and 2021 (figure 2). The average annual growth rate was 6.7 percent for 2016–2021 real value added. Many of the trends in the gross output results hold for the value added estimates. Activity highlights include:

- **Infrastructure** contributed $911 billion in current-dollar value added in 2021. In real terms, infrastructure's growth rate (11.1 percent) outpaced the overall digital economy (9.8 percent) in 2021. Hardware increased by 7.8 percent and software posted a 12.9 percent increase. Over the longer term, infrastructure saw an average growth in real value added of 9.1 percent between 2016 and 2021, greater than the overall digital economy's growth of 6.7 percent.
- **E-commerce** contributed $559 billion in current-dollar value added in 2021. Growth in e-commerce's real valued added (6.9 percent) was below the overall growth in the digital economy (9.8 percent), though still outperforming the U.S. economy (5.9 percent). Between 2016 and 2021, e-commerce had an average growth rate in real value added of 4.2 percent driven by strong growth in B2C e-commerce (11.2 percent).
- **Priced digital services** contributed $939 billion in current-dollar value added in 2021. Except for telecommunications services, growth in real value added across the sub-activities exceeded 10 percent, with cloud services at nearly 20 percent (19.3 percent). Telecommunications services, the largest priced digital services component, increased its real value added by 6.3 percent in 2021. Growth in the priced digital services activity has been variable over the past six years, averaging 5.9 percent annual growth in real value added between 2016 and 2021.
- **Federal nondefense digital services** contributed $258 million in current-dollar value added in 2021. Real valued added contributed by this activity has been consistently declining since 2016. In 2021, federal nondefense digital services saw a 9.3 percent decline in real value added, with an overall average growth rate of –4.3 percent between 2016 and 2021.

Figure 2. Real Value-Added Growth for the Digital Economy and Major Activities, 2021



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Value added by industry

Similar to gross output, there is considerable variation in the annual value added growth rates by sector and associated contributions to the digital economy, with similar patterns emerging. Industry highlights include:

- Nearly all value added generated by the digital economy is accounted for by five industries: information (40.9 percent), professional and business services (19.5 percent), wholesale trade (18.8 percent), manufacturing (10.1 percent), and retail trade (8.2 percent).
- **Information**, the largest sector in the digital economy, had growth in real value added exceeding the overall digital economy for both 2021 (12.8 percent versus 9.8 percent) and between 2016 and 2021 on average (8.6 percent versus 6.7 percent).
- **Professional and business services**, **manufacturing**, and **retail trade**, like information, all had annual and growth rates for real value added that were higher than the digital economy between 2016 and 2021.
- **Wholesale trade** had below-average growth in real value added in 2021 as well as slow growth between 2016 and 2021 (1.5 percent and 0.9 percent, respectively).

Employment and compensation by industry

The digital economy employed over 8.0 million full- and part-time employees in 2021, corresponding to nearly $1.24 trillion in total compensation. The average annual growth rate for digital economy employment was 2.0 percent for 2016–2021, with 2.6 percent growth between 2020 and 2021. Compensation showed stronger growth, with an average annual rate of 8.1 percent for 2016–2021 and 13.2 percent growth between 2020 and 2021. Dividing total compensation by total employment in 2021 equates to an average compensation of $154,421 for employees in the digital economy.

Revisions to 2005–2020 estimates

Revisions to the 2005–2020 estimates stemmed from revised source data and a new methodology for cloud services. As described in the succeeding methodology section of this report, the digital economy statistics are derived from BEA's comprehensive supply-use tables (SUTs). Each year, BEA revises the data underlying the SUTs as part of an "annual update," and those updates are incorporated into the digital economy estimates. Many of the sources of revision come from the Census Bureau, the principal data source used to develop the SUTs. Revisions generally impacted years 2017–2020, with the most significant revisions occurring to the 2020 values. While overall growth rates were mostly unaffected across all digital economy estimates, some changes were seen at the activity and industry level. Notable revisions to current-dollar gross output arising from the annual update include the following:

- **Software** was revised upwards more than $20 billion in 2020 due to the incorporation of revised Census Bureau Services Annual Survey data and new National Science Foundation Research and Development data.
- **Hardware** was revised down in 2020 by over $5 billion due to new Census Bureau Annual Survey of Manufactures data, especially to manufacturing related to semiconductors.

Cloud services represents computing services that customers can access from a shared pool of configurable computing resources in a flexible and on-demand way, without active management by the customer. BEA's digital economy statistics first incorporated estimates of cloud services in the August 2020 report by using Economic Census (EC) data on revenue for industries by product line. Further research determined the EC product categories that include cloud services also include unrelated internet and data products, resulting in overestimates of cloud services output in previous reports. BEA now uses publicly available Securities and Exchange Commission (SEC) filings data and data purchased from the International Data Corporation (IDC) to estimate cloud services output, described further in the methodology section. The result is a downward revision to the 2005–2020 cloud services gross output values by about $35 billion per year, on average. These values were offset to the "internet and data services" activity, so overall levels for the digital economy were not impacted by this change.

Census Bureau data used to estimate the e-commerce share of retail trade (business-to-consumer e-commerce) and wholesale trade (business-to-business e-commerce) were also updated for the entire time series, resulting in minor revisions to these estimates. Additionally, Census Bureau wholesale e-commerce (B2B) data for medical, dental, and hospital equipment and supplies are suppressed for 2005–2014 in the public tables and those years were given a $0 value in BEA's previous digital economy reports. Estimates of suppressed values for those years were incorporated to remove the break in the time series.

Revisions to value added, employment, and compensation followed a similar pattern to the gross output revisions, also stemming from updated and revised source data.

Methodology overview

The digital economy statistics are built using BEA's comprehensive SUTs, which provide insight into the internal workings of the U.S. economy and detail the contribution of specific industries and products to gross output and GDP. The SUTs detail the flows of products (goods and services) purchased by each industry, the incomes earned from production in each industry, and the distribution of sales for each product. The purpose of the digital economy statistics is to highlight production and spending for the digital economy that is already present in the SUTs. To do this, we first identified the goods and services relevant to the digital economy within the SUTs. In cases where the good or service includes both digital and nondigital production, such as retail trade margins for clothing stores, we use external source data to isolate the digital activity. The paper "Defining and Measuring the Digital Economy" (2018) describes the initial process and methodology for developing the digital economy statistics, which relied heavily on international guidelines and statistics from other international statistical agencies including Statistics Canada and the United Kingdom's Office for National Statistics.

BEA's digital economy statistics are currently comprised of four major categories of goods and services and eight subcategories. Appendix table 1 provides the list of primary NAICS industries within these categories. The following provides an overview of the methodology and source data used to develop these estimates:

1) **Infrastructure**, or the basic physical materials and organizational arrangements that support the existence and use of computer networks and the digital economy, primarily information and communications technology (ICT) goods and services. Infrastructure products are categorized in terms of hardware and software.
    i. **Hardware** represents the manufactured physical elements that constitute a computer system including, but not limited to, monitors, hard drives, and semiconductors. Hardware also includes communications products and audio and visual equipment. The hardware values are available directly from the SUTs.
    ii. **Software** represents the programs and other operating information used by devices such as personal computers and commercial servers including both commercial software and software developed in-house by firms for their own use. The software values are found within the software publishers and custom computer programming products in the SUTs.

2) **E-commerce**, or the remote sale of goods and services over computer networks. E-commerce products are presented separately for business-to-consumer (B2C) e-commerce (that is, retail trade) and business-to-business (B2B) e-commerce (that is, wholesale trade).
    i. **B2B e-commerce** represents purchasing or ordering of goods and services between businesses using the internet or other electronic means. The 2005–2020 B2B values were determined using the U.S. Census Bureau Annual Wholesale Trade Survey (AWTS), which includes data on total sales and e-commerce sales for wholesalers. The proportion of e-commerce sales to total sales was used to estimate the share of margins earned by engaging in e-commerce for each type of wholesale trade category in the SUTs. Since the 2021 ecommerce data were unavailable from the AWTS, the 2020 B2B values were grown using the overall growth rate for wholesale trade gross output in 2021 due to the high correlation between the estimates in recent years.

ii. **B2C e-commerce** represents the sale of goods and services by businesses to consumers, or retail e-commerce, using the internet or other electronic means. The 2005–2020 B2C values were determined using the Census Bureau Annual Retail Trade Survey (ARTS) and supplemental e-commerce data. As with B2B, the proportion of e-commerce sales to total sales was used to estimate the share of margins earned by engaging in e-commerce for each type of retail trade category in the SUTs. Since ARTS data are unavailable 2021, the Quarterly Retail Trade Survey overall retail trade e-commerce totals were used to grow the 2020 values and also to revise the 2005–2020 e-commerce totals.

3) **Priced digital services**, or services related to computing and communication that are performed for a fee charged to the consumer. Priced digital services products include cloud services, telecommunications services, internet and data services, and all other priced digital services.

   i. **Cloud services** represents computing services that customers can access from a shared pool of configurable computing resources in a flexible and on-demand way, without active management by the customer. Cloud services providers offer a range of resources, such as access to processing, storage, and networks and platforms for customers to deploy their own applications. For 2013–2021, data on cloud services revenue from the International Data Corporation (IDC) were used to estimate cloud services output. The IDC data were determined to be a reliable data source after examining their methodology and comparing their company-level data to cloud revenues from BEA's 2019 Benchmark Survey of U.S. Direct Investment Abroad (BE-10) which included a new section on "Digital Economy Activities." Since IDC does not have data prior to 2013, the 2013 IDC value was back-casted using growth rates for cloud services revenue from 2005–2012 public SEC filings for major cloud companies, including AWS, Salesforce, Google, Microsoft, and IBM.

   ii. **Telecommunications services** represents services related to telephony, cable and satellite television, movie and video production, and broadcasting; internet is excluded. These values are available directly from the SUTs.

   iii. **Internet and data services** represents services related to providing internet access and to hosting, searching, retrieving, and streaming content and information on the web. Internet and data services often occur in the same product categories as cloud services. In these cases, the cloud services value was determined first, and the internet and data services values represent the difference between the cloud services value and the overall value of production for the relevant product.

   iv. **All other priced digital services** represents purchased digital services not categorized in the other activities. Specifically, computer systems design and related services, computer training, and electronic and precision equipment repair and maintenance. These values are available directly from the SUTs.

4) **Federal nondefense digital services** represents the annual budget for four federal government agencies whose services are directly related to supporting the digital economy: the Federal Communications Commission (FCC), National Telecommunications and Information Administration (NTIA), Department of Education's Office of Education Technology, and U.S. Digital Service.

Summary

In 2021, the digital economy experienced similar growth in terms of nominal gross output and value added as the overall U.S. economy. Unlike the overall U.S. economy, real (price-adjusted) growth in the digital economy was nearly as strong as nominal growth, indicating the digital economy was not impacted by inflation in the same way as the overall U.S. economy in 2021. Strong growth was seen in all major digital economy activities: infrastructure, e-commerce, and priced digital services. Within infrastructure, both hardware and software showed double-digit growth rates in real value added for 2021, the only time that happened in the time series going back to 2005. Business-to-consumer e-commerce continued to grow in 2021 following immense gains seen in 2020 due to the COVID–19 pandemic. And cloud services realized the fastest growth in the priced digital services activity as those services continue to grow in importance to the digital economy.

The future of BEA's digital economy initiative includes many possibilities for improvement and expansion. BEA intends to expand the digital economy statistics to include areas that are currently not included, including digital intermediary services (see annex 1). Additionally, BEA is investigating improvements to price indexes for certain segments of the digital economy that are experiencing rapid growth and technological improvement, including software and cloud services. These improvements could have implications for both BEA's digital economy satellite account statistics and BEA's core economic statistics. BEA will endeavor to implement these changes and other extensions subject to time, data, and resource constraints. We ask for feedback from data users and other stakeholders regarding these estimates and future plans. Please send comments to DigitalEconomy@bea.gov.[4]

4. We wish to thank the following current and former BEA employees for their invaluable assistance in preparing this report: David Curtis, Greg Linder, Greg Prunchak, Ricky Stewart, and David Wasshausen.

Appendix

Appendix Table 1. Digital Economy Activities and Detailed Industries—Continues

Digital economy activities	Primary NAICS industry	NAICS description
Infrastructure		
Hardware	333242	Semiconductor machinery manufacturing
	333293	Printing machinery and equipment
	333990	Other general-purpose machinery manufacturing, repair work
	334110	Computer and peripheral equipment manufacturing
	334200	Communications equipment manufacturing
	334310	Audio and video equipment manufacturing
	334410	Semiconductor and other electronic component manufacturing
	334610	Manufacturing and reproducing magnetic and optical media
	335920	Communication and energy wire and cable manufacturing
	335999	All other miscellaneous electrical equipment and component manufacturing
Software	511210	Software publishers
	541511	Custom computer programming services
E-commerce		
Business-to-consumer (B2C)	441000	Motor vehicle and parts dealers
	442000	Furniture and home furnishings stores
	443000	Electronics and appliance stores
	444000	Building material and garden equipment and supplies dealers
	445000	Food and beverage stores
	446000	Health and personal care stores
	447000	Gasoline stations
	448000	Clothing and clothing accessories stores
	451000	Sporting goods, hobby, book, and music stores
	452000	General merchandise stores
	453000	Miscellaneous store retailers
	454000	Nonstore retailers
Business-to-business (B2B)	423000	Merchant wholesalers, durable goods
	424000	Merchant wholesalers, nondurable goods
	425110	Business to business electronic markets

Appendix Table 1. Digital Economy Activities and Detailed Industries—Table Ends

Digital economy activities	Primary NAICS industry	NAICS description
Priced digital services		
Cloud services	518210	Data processing, hosting, and related services
Telecommunications services	512110	Motion picture and video production
	515120	Television broadcasting
	515210	Cable and other subscription programming
	517110	Wired telecommunications carriers
	517120	Wireless telecommunications carriers (except satellite)
	517410	Satellite telecommunications
	517910	Other telecommunications
Internet and data services	512110	Motion picture and video production
	517110	Wired telecommunications carriers
	517919	All other telecommunications
	518210	Data processing, hosting, and related services
	519110	News syndicates
	519130	Internet publishing and broadcasting and web search portals
All other priced digital services	541512	Computer systems design services
	541513	Computer facilities management services
	541519	Other computer related services
	611420	Computer training
	811211	Consumer electronics repair and maintenance
	811212	Computer and office machine repair and maintenance
	811213	Communication equipment repair and maintenance
Federal nondefense digital services	920000	Federal general government (nondefense)

Notes. North American Industry Classification System (NAICS). The value of these industries are included fully or partially as described in the methodology. The hardware estimates also include research and development and sales of used products. The e-commerce estimates represent margins earned on e-commerce sales. The federal nondefense digital services estimates represent the annual budget for the Federal Communications Commission (FCC), National Telecommunications and Information Administration (NTIA), Department of Education's Office of Education Technology, and U.S. Digital Service.

Annex 1. Estimating Digital Intermediary Services Output for Rideshare Platforms

Revenues for digital intermediary services are earned from operating a digital intermediary platform, which is an online interface that facilitates, for a fee, the direct interaction between multiple buyers and multiple sellers.[5] The platform does not take economic ownership of the goods, nor does it provide the services that are being sold. BEA's digital economy statistics currently do not explicitly include estimates for digital intermediary services, resulting in an incomplete picture of the digital economy, especially in an area of growing interest to BEA's users.[6] This annex provides a potential framework for developing digital intermediary services estimates for an area of growing attention, peer-to-peer (P2P) rideshare platforms.

Census Bureau data on revenue from electronic sources from the Services Annual Survey (SAS) serve as the foundation for this proposed framework. The Census Bureau is the primary source of data for BEA's SUTs and BEA's digital economy statistics, making the SAS electronic revenue data an ideal candidate for estimating output for P2P rideshare platforms. The role of the electronic revenue data is to serve as the ceiling for all digital orders in the taxi services industry.[7] There are three relevant streams of revenue originating from electronic sources for the taxi services industry:

1. Revenue to a taxi company from a digital order originating from their website/app (for example, scheduling a taxi ride via a taxi company's website).
2. Revenue to a driver whose services are facilitated via a digital intermediary service provider (the payment to a rideshare driver for a ride).
3. Revenue to a digital intermediary service provider for facilitating the ride (fee paid to ride services platform for a ride service provided by a rideshare driver). This is the share that constitutes digital intermediary services output for P2P rideshare platforms.

Figure 1 provides a schematic of these three types of revenue streams and how the SAS electronic revenue data could potentially be used to estimate digital intermediary services for P2P rideshare platforms. First, the share of taxi services' revenue that comes from electronic sources is determined from the Census Bureau electronic revenue data and applied to total gross output for taxi services to find total gross output for taxi services derived from digital orders ($B in figure 1). That gross output is then divided into output for taxi services originating from a taxi company's own website or app and output for P2P rideshare or taxi services originating from a digital intermediary platform. That output is further divided into output for the rideshare driver and output for the digital intermediary services provider or platform.

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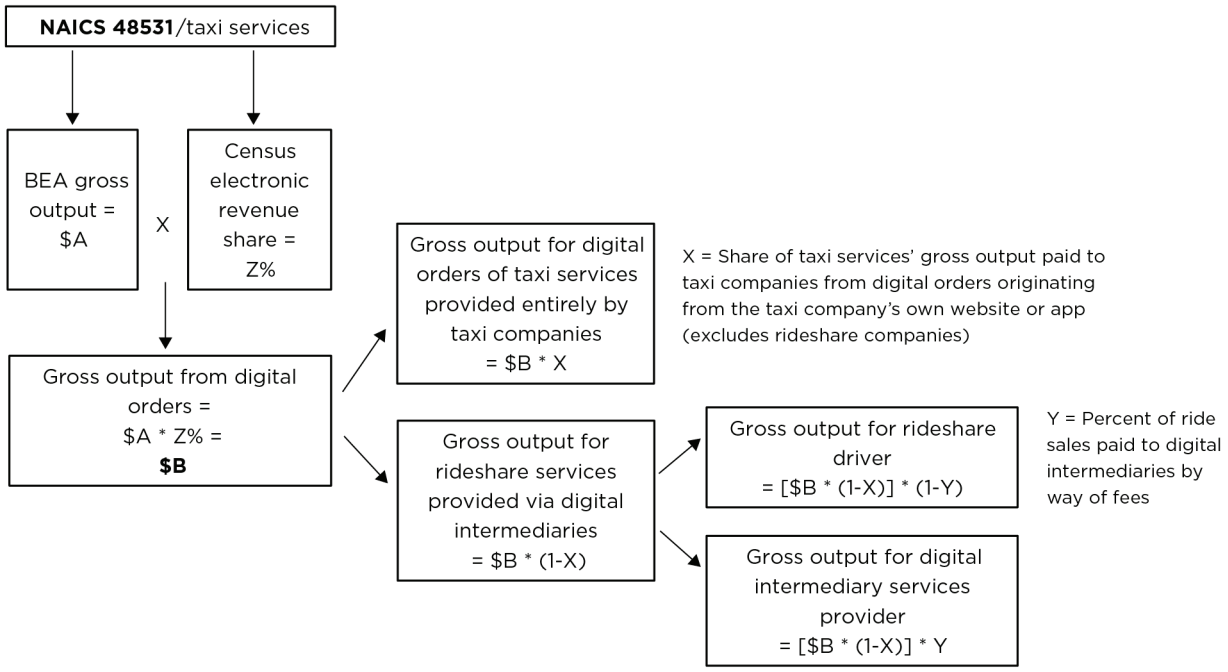
5. Definition taken from BEA's 2019 Benchmark Survey of U.S. Direct Investment Abroad (BE-10) (p. 8).
6. Digital intermediary services span multiple industries, including wholesale trade and retail trade. Since BEA's digital economy statistics include comprehensive estimates of e-commerce for whole trade and retail trade, digital intermediary services for those industries are inherently included in the current digital economy estimates.
7. Rideshare has been identified by Census Bureau as part of the taxi services industry (NAICS 48531).

Figure 1. Framework for Estimating Digital Intermediary Services Gross Output for Rideshare Using Census Bureau Revenue from Electronic Sources Data



NAICS North American Industry Classification System

To understand how the method outlined in figure 1 could work in practice to estimate digital intermediary services for P2P rideshare platforms, table 1 provides an example using pseudo data. The calculation starts on line 1 with an estimate of gross output for taxi services (NAICS 48531) derived using 50 percent of the gross output values for transit and ground passenger transportation (NAICS 485), the most detailed data that are available on BEA's website. If BEA were to use this method to calculate digital intermediary services, the true values for taxi services gross output would be used. The next step (line 2) is to apply the share of taxi services revenue that comes from electronic sources; however, only the overall values for transit and ground passenger transportation (NAICS 485) are on the published tables, and those values are suppressed for all years (table 2). While it is possible to break the suppressions using a reasonable method,[8] that unfortunately still only provides e-revenue for all of transit and ground passenger transportation, not just taxi services. Next, the portion of estimated taxi services' gross output from digital orders attributable to rideshare versus a taxi company's own website or app (excluding rideshare platforms) is estimated on line 4. Since that information is not readily available, we estimate that most taxi companies that are not rideshare companies do not receive orders for taxi services online (in other words, we assume most taxis are hailed in person or ordered via the phone), so we attribute 95 percent of digital orders for taxi services to P2P rideshare. Finally, to separate estimated rideshare gross output between rideshare drivers and the digital intermediary platform, we

8. Standard suppression-breaking methods start by subtracting the unsuppressed values from the total value to find the total suppressed value. The suppressed value is allocated to the suppressed cells based on some data-based proportion, for example, by using a weight based on data that are available in surrounding years for the suppressed cells.

use information from Uber's website that states Uber takes 25 percent of the rideshare charge as their fee. Line 7 shows this method results in estimates of digital intermediary services for P2P rideshare range from $3 billion to $5 billion between 2017 and 2020.

Table 1. Estimating Digital Intermediary Services Gross Output for Rideshare Using Census Revenue Data from Electronic Sources, an Example Using Pseudo Data

Line	Description	2017	2018	2019	2020
1	Estimated gross output for NAICS 48531, taxi services	38,080	45,141	45,790	29,231
2	Census e-revenue share for 485 after suppression breaking	56%	45%	48%	47%
3	= GO from digital orders for taxi services	21,325	20,313	21,979	13,739
4	Estimated share of digital orders for taxi services originating from digital intermediary platforms	95%	95%	95%	95%
5	= GO from digital orders of taxi services on digital intermediary platforms	20,258	19,298	20,880	13,052
6	Estimated share of ride service revenue paid to digital intermediary service platform	25%	25%	25%	25%
7	**= Estimated rideshare digital intermediary services revenue**	**5,065**	**4,824**	**5,220**	**3,263**
8	Percent change		-5%	8%	-37%
9	Estimated rideshare revenue derived from public SEC 10-K filings for Lyft + Uber	5,067	7,699	10,588	5,979
10	Percent change		52%	38%	-44%

Table 2. Estimated Revenue from Electronic Sources for Transportation and Warehousing Sector from U.S. Census Bureau's Services Annual Survey: 2015–2020

[Millions of dollars]

NAICS	NAICS Description	Item	2020 Estimate	2019 Estimate	2018 Estimate	2017 Estimate	2016 Estimate	2015 Estimate
4849	Transportation and Warehousing	Revenue	919,668	1,070,520	1,026,502	948,679	900,443	891,657
4849	Transportation and Warehousing	Revenue from Electronic Sources	120,181	192,627	181,102	181,382	NA	NA
481	Air Transportation	Revenue	110,158	236,830	224,690	208,830	198,787	199,733
481	Air Transportation	Revenue from Electronic Sources	38,118	98,897	93,097	93,161	NA	NA
483	Water Transportation	Revenue	29,653	48,902	46,042	43,010	43,366	44,373
483	Water Transportation	Revenue from Electronic Sources	S	12,153	11,454	9,992	NA	NA
484	Truck Transportation	Revenue	316,982	320,817	313,814	290,532	273,083	273,250
484	Truck Transportation	Revenue from Electronic Sources	33,422	31,939	31,982	32,040	NA	NA
485	Transit and Ground Passenger Transportation	Revenue	39,382	55,964	50,319	44,836	38,343	35,572
485	Transit and Ground Passenger Transportation	Revenue from Electronic Sources	S	S	S	S	NA	NA
486	Pipeline Transportation	Revenue	56,319	59,522	54,125	47,192	44,627	43,891
486	Pipeline Transportation	Revenue from Electronic Sources	S	S	S	S	NA	NA
487	Scenic and Sightseeing Transportation	Revenue	1,934	4,426	4,318	4,162	4,127	4,064
487	Scenic and Sightseeing Transportation	Revenue from Electronic Sources	531	1,465	1,387	1,383	NA	NA
488	Support Activities for Transportation	Revenue	206,055	201,150	196,246	181,623	178,282	178,269
488	Support Activities for Transportation	Revenue from Electronic Sources	16,733	15,338	S	14,637	NA	NA

S Estimate does not meet publication standards because of high sampling variability, poor response quality, or other concerns about the estimate's quality. Unpublished estimates derived from this table by subtraction are subject to these same limitations and should not be attributed to the U.S. Census Bureau. For a description of publication standards and the total quantity response rate, see https://www.census.gov/about/policies/quality/standards/standardf1.html.

NA Not available

In practice, the published Census revenue data from electronic sources have weaknesses that currently prevent it from being a reliable data source for estimating digital intermediary services output for P2P rideshare platforms, though it could be useful to inform or validate estimates. Even if BEA could access the unsuppressed data on electronic revenue for taxi services, the survey only covers years 2017–2020. Additionally, since the Census survey is specific to "employer firms" it is unknown whether revenue to rideshare drivers is included here. Even if the weaknesses of the Census data could be overcome, an estimate must still be made to identify the portion of taxi services' gross output paid to taxi companies from digital orders originating from the taxi company's own website or app (line 4 in table 1). Despite the weaknesses with this method, the line 9 of table 1 shows that SEC filings for Uber and Lyft provide somewhat similar revenue values to these Census-based estimates (U.S. production was estimated using geography breakouts in SEC filings to align with Census production values). However, growth rates are often very different. BEA is currently looking for additional data and methods to develop comprehensive estimates for this important area of the digital economy. Please send any comments or feedback to DigitalEconomy@bea.gov.

Annex 2. Experimental Estimates of E-commerce for Selected PCE Categories

Prepared by Rachel Goulder

Estimating e-commerce for personal consumption expenditures (PCE) is an area of importance for the development of digital supply-use tables (SUTs) as outlined by the Organisation for Economic Co-operation and Development (OECD).[9] In this annex, experimental estimates of e-commerce for select PCE goods and services using Census e-commerce data for 2019 are described. These estimates present a first step in developing a better understanding of the role e-commerce plays in PCE, which accounted for 67 percent of gross domestic product (GDP) in 2019.[10]

PCE goods

Census Annual Retail Trade Survey (ARTS) and the Census Annual E-Commerce Report were used to estimate e-commerce for PCE goods.[11] To find the e-commerce share for each industry, the e-commerce sales totals for each North American Industry Classification System (NAICS) industry were divided by the respective industry total sales from the ARTS. The next step was to apply this estimated e-commerce share to each category in the PCE goods table 2.4.5U. Since the Census ARTS data and the Census e-commerce data are on a NAICS industry basis and PCE goods are on a product basis, unpublished PCE data at the NAICS level of detail from BEA's internal databases were used. Then, the established e-commerce shares were applied to each PCE goods category. To ensure the calculation matched the published level of detail, a weighted average share of the detailed unpublished data was applied to each published PCE goods category to get the final e-commerce share of each PCE goods category. There are two important caveats:

1. "Motor Vehicle and Parts" and "Gas and Other energy goods": Source data for these categories comes exclusively from sources outside of Census ARTS, so these two categories were excluded for our estimation.
2. Smaller subcategory exclusion: "Pharmaceutical and other medical products" and "Tobacco" were also excluded due to the source data originating from sources outside of the Census ARTS.

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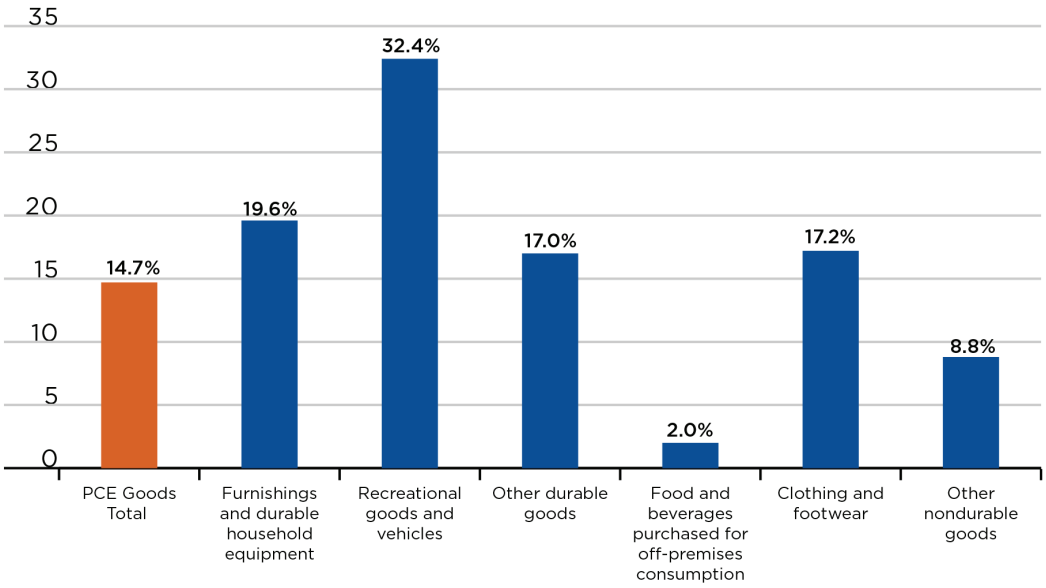
9. See "High priority indicators in the Digital Supply-Use Tables" by the Working Party on National Accounts (2019).
10. See National Income and Product Table 1.1.10. Percentage Shares of Gross Domestic Product.
11. Census e-commerce sales include sales of goods and services where the buyer places an order, or the price and terms of the sale are negotiated, over an Internet, mobile device (e-commerce), extranet, Electronic Data Interchange (EDI) network, electronic mail, or other comparable online system. Payment may or may not be made online. https://www.census.gov/library/publications/time-series/e-commerce.html.

Figure 1 shows that using this method, 14.7 percent of the included PCE goods total was estimated to be attributable to e-commerce in 2019. E-commerce shares for PCE goods ranged from 2 percent for food and beverages purchased for off-premises consumption to 32.4 percent for recreational goods and vehicles.

Figure 1: E-Commerce Share of Selected PCE Goods by Type of Product, 2019



Note. PCE Goods Total excludes motor vehicle and parts; gas and other energy goods; pharmaceutical and other medical products; and tobacco.

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PCE services

The 2019 e-commerce share for each PCE services category from table 2.4.5U. was determined using a similar process as with PCE goods. The e-commerce data came from the Census Service Annual Survey (SAS) and table 3 of the Census E-STATS publication, which provides e-commerce activity by NAICS sector.[12] The PCE services categories and SAS industries aligned closer than they did for PCE goods. For example, there is a SAS category for "Utilities" and a PCE services category for "Household Utilities."

To determine the e-commerce share, the total revenue from electronic sources (table 3) for each sector was divided by the corresponding total SAS revenue. That share was then applied to each corresponding PCE services category. As with PCE goods, many PCE services categories are comprised of a variety of source data outside of SAS. Consequently, a number of exclusions were made to arrive at a direct concordance.

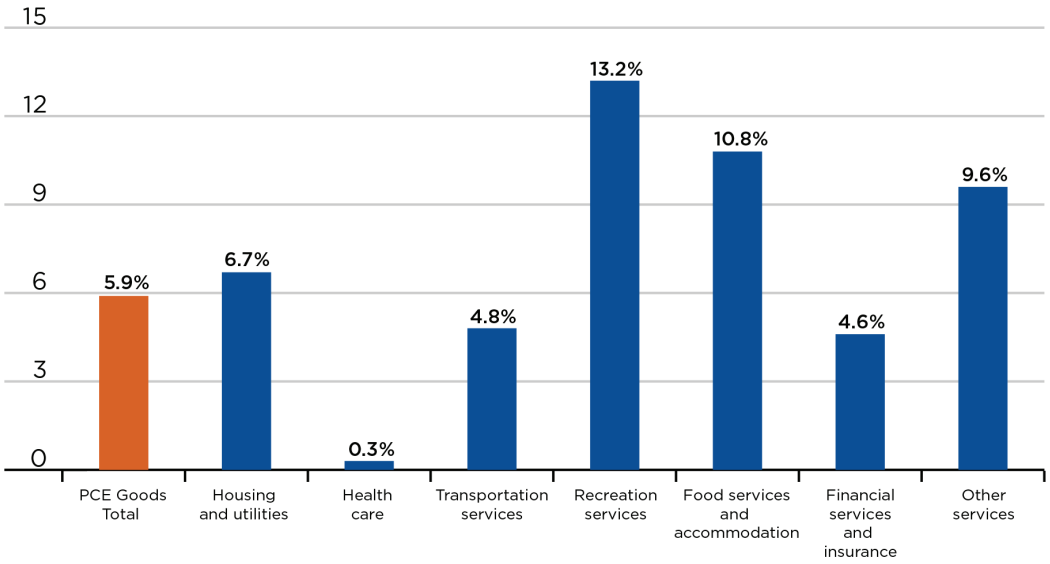
12. Census E-STATS report refers to revenue from electronic sources to include revenues from customers entering orders directly on a firm's Web site or mobile application, revenues from customers entering orders directly on third party Web sites or mobile applications, and revenues from customers entering orders via any other electronic system (such as private networks, dedicated lines, kiosks, etc.). https://www.census.gov/programs-surveys/e-stats/technical-documentation/methodology.html

For example, according to the SAS revenue table footnote, education services "Excludes NAICS 6111 (Elementary and Secondary Schools), NAICS 6112 (Junior Colleges), and NAICS 6113 (Colleges, Universities, and Professional Schools)." Therefore, those NAICS lines were excluded from the PCE services category calculation to ensure that the comparison was as close as possible.

Additionally, some rearrangement was necessary to align the PCE and SAS categories. For example, within the PCE services category for "Transportation Services," there is a subcategory for "Motor Vehicle Maintenance and Repair." According to SAS, this product would be classified under NAICS 81, "Other Services." Therefore, this line was excluded from "Transportation Services" and included in the "Other Services" PCE services category.

Figure 2 shows 5.9 percent of PCE services was estimated to be attributable to e-commerce in 2019. E-commerce shares for PCE services ranged from 0.3 percent for health care to 13.2 percent for recreation services.

Figure 2. E-Commerce Share of Selected PCE Services by Type of Product, 2019



Note. PCE Services Total excludes elementary and secondary schools; junior colleges; colleges, universities, and professional schools; funds, trusts, and other financial vehicles; and rail transportation.

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These estimates represent an initial step in developing a comprehensive understanding of e-commerce for PCE and for the development of digital SUTs. Additional data and research are proceeding for a complete set of PCE e-commerce estimates.