

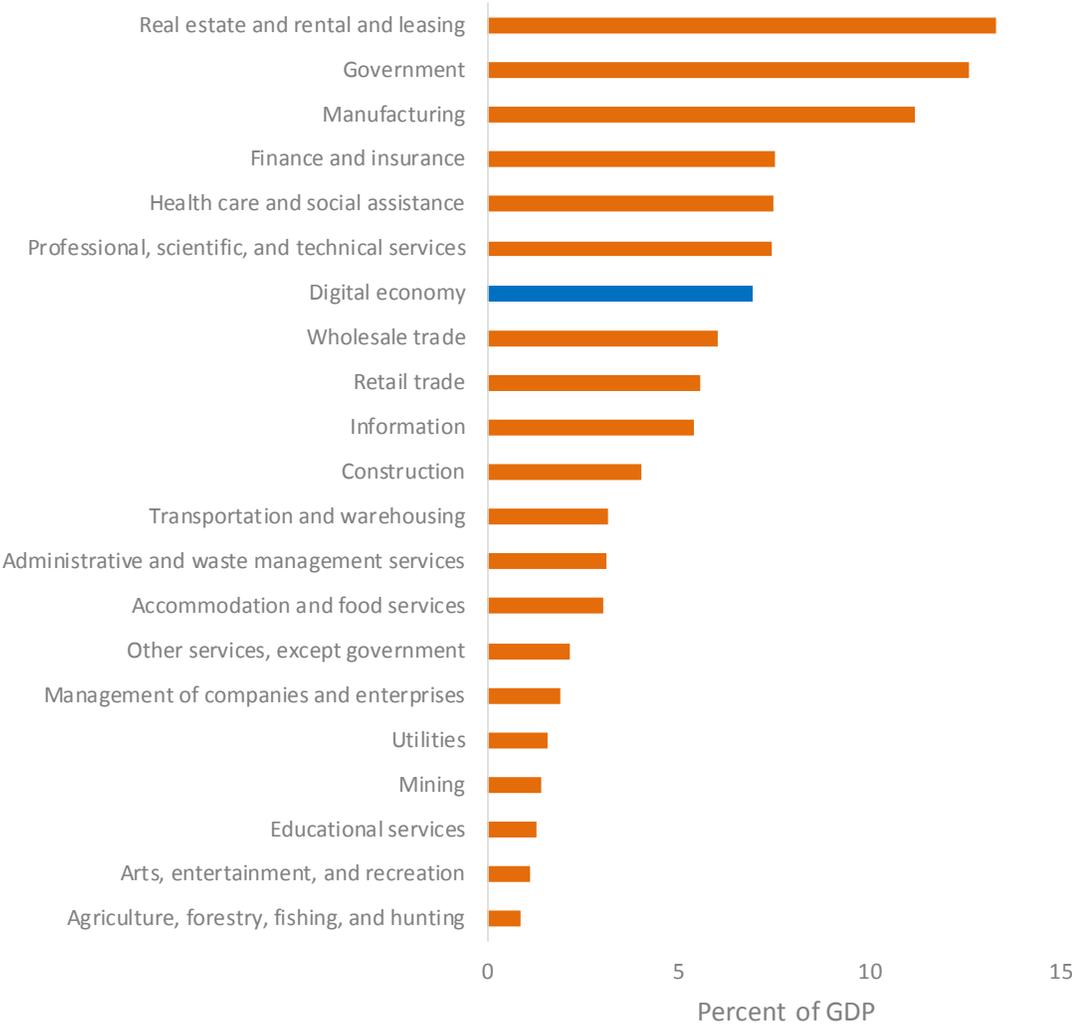
Measuring the Digital Economy: An Update Incorporating Data from the 2018 Comprehensive Update of the Industry Economic Accounts

Introduction

The estimates presented in this paper update the initial estimates toward a digital economy satellite account the Bureau of Economic Analysis (BEA) published in the March 2018 working paper titled “Defining and Measuring the Digital Economy.”¹ These updated estimates follow the same methodology for measuring the digital economy BEA introduced in March 2018, but they incorporate updated underlying data published during the 2018 comprehensive update of the Industry Economic Accounts.² Like the initial estimates, these updated digital economy estimates include only items that BEA has categorized as “primarily digital.” Additionally, this paper extends the time series for BEA digital economy estimates to cover the period from 1997 to 2017.

The updated estimates continue to show the digital economy has been a bright spot in the U.S. economy. Digital economy real value added grew at an average annual rate of 9.9 percent per year from 1998 to 2017, compared to 2.3 percent growth in the overall economy. The digital economy accounted for 6.9 percent (\$1,351.3 billion) of current-dollar gross domestic product (GDP) (\$19,485.4 billion) in 2017, up from 5.9 percent in 1997. When compared with traditional U.S. industries or sectors, the digital economy ranked just below professional, scientific, and technical services, which accounted for 7.4 percent (\$1,450.0 billion) of current-dollar GDP, and just above wholesale trade, which accounted for 6.0 percent (\$1,174.1 billion) of current-dollar GDP (chart 1).

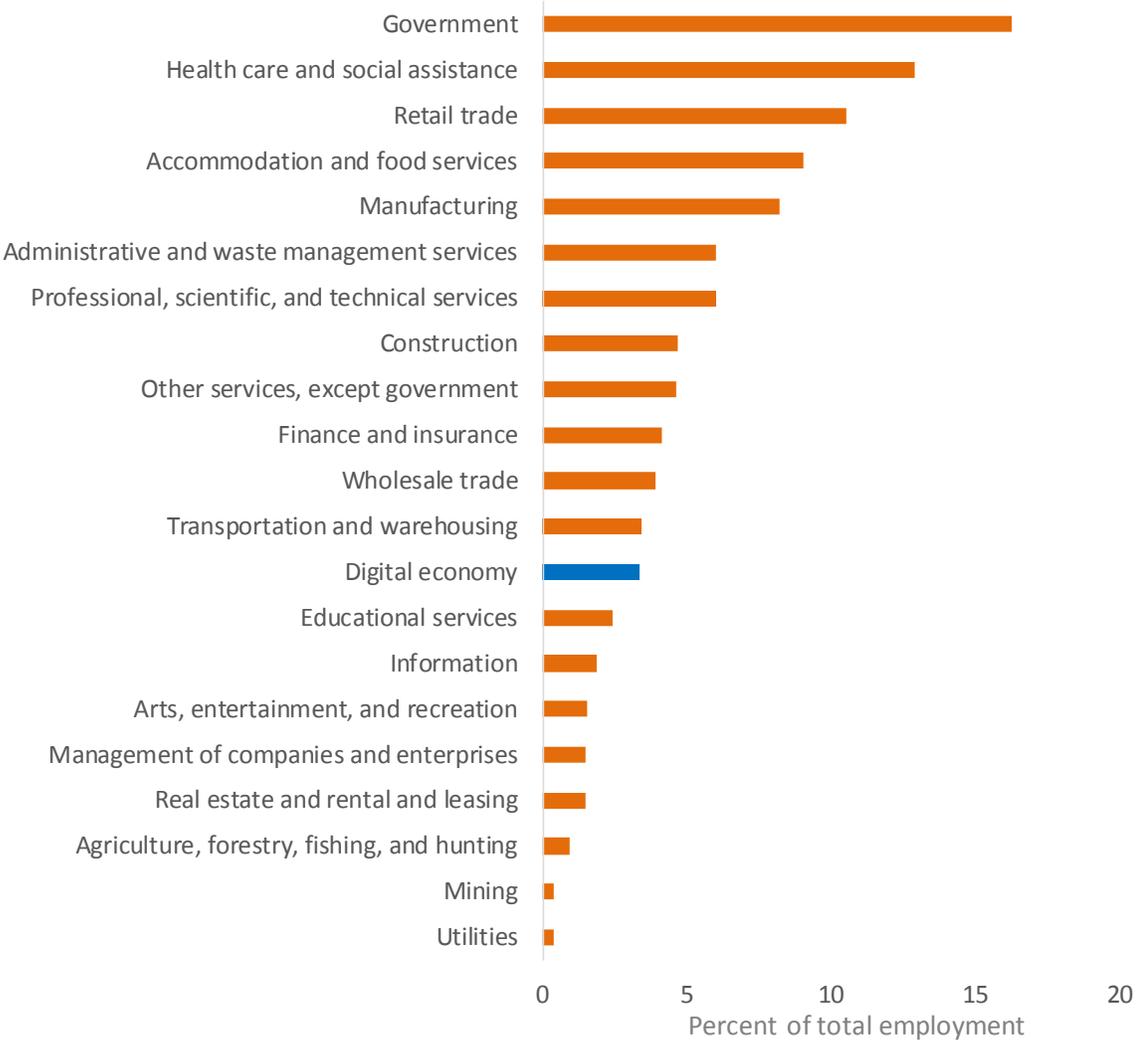
Chart 1. Digital Economy and Industry Share of Total Gross Domestic Product, 2017



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In 2017, the digital economy supported 5.1 million jobs, which accounted for 3.3 percent of total U.S. employment (152.1 million jobs), comparable to the transportation and warehousing industry (chart 2). Employees working in the digital economy earned \$132,223 in average annual compensation compared to \$68,506 average annual compensation per worker for the total U.S. economy.

Chart 2. Digital Economy and Industry Share of Total Employment, 2017



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The remainder of this report will review the definition of the digital economy BEA relied on when developing these estimates, highlight major updates BEA incorporated into underlying national accounts data, and provide updated estimates on the size of the digital economy.

Digital Economy Definition and Coverage

As introduced in the March 2018 working paper, BEA includes in the digital economy the entire information and communications technologies (ICT) sector as well as the digital-enabling infrastructure needed for a computer network to exist and operate, the digital transactions that take place using that system (“e-commerce”), and the content that digital economy users create and access (“digital media”).

The preliminary estimates published in March 2018 and this set of updated estimates included only “primarily digital” goods and services. Goods and services categories based on the North American Industrial Classification System (NAICS) include digital goods and services as well as nondigital goods and services. While BEA’s conceptual definition of the digital economy includes all digital goods and services, BEA did not attempt to include partially digital items in the preliminary estimates or in these updated estimates. This means that some components of the digital economy, like peer-to-peer (P2P) e-commerce, also known as the sharing economy, are excluded from both sets of estimates. P2P transactions such as ride-sharing services rely on internet-enabled devices to match supply and demand, but they also have a nondigital component of in-person provision of services. Splitting the output of partially digital categories into digital and nondigital portions will require additional source data and other resources to accurately identify the share of output that is in scope for the digital economy. The work to identify data to include partially digital goods and services is ongoing.

2018 Comprehensive Update of the Industry Economic Accounts

Every 5 years, BEA conducts a comprehensive update to incorporate two types of improvements: changes in definitions and classifications, which update the accounts to more accurately portray the dynamic U.S. economy and to better facilitate comparisons with economic data available from other countries, and statistical changes, which update the accounts through the use of new and improved estimation methods and newly available and revised source data, including the Economic Census, which is used to benchmark the accounts.³ During the 2018 comprehensive industry accounts update, BEA incorporated the following major updates:

- New data from the 2012 detailed benchmark supply-use tables (SUTs) that incorporate data from the 2012 Economic Census.
- New data from the full time series of annual SUTs updated to be consistent with the new 2012 benchmark SUTs, including updated 2007 detailed benchmark SUTs.⁴
- Conversion to the 2012 NAICS from the 2007 NAICS.
- Changes in methodology resulting from the 2018 comprehensive update of the National Income and Product Accounts (NIPAs).⁵

A brief discussion of some of these changes is presented below. For more information, please refer to the detailed articles and other information on the BEA website related to the comprehensive updates of the NIPAs and the Industry Economic Accounts.⁶

2012 Economic Census data

The Census Bureau conducts the Economic Census every 5 years. This collection provides the most comprehensive data on economic activity by industry at the level of the smallest operating unit, the

“establishment.” The Economic Census is the primary data source for the benchmark SUTs, providing information on inventories, receipts and expenses of business establishments and of government, sales by detailed industry and product line, final industry and product shipments, input costs by general category, and trade margins. BEA incorporated the detailed 2012 Economic Census data, the latest available, into the industry accounts, resulting in a new set of benchmark SUTs for 2012 and updated benchmark SUTs for 2007.

The 2012 Economic Census classifies business establishments according to the 2012 NAICS. At this time, BEA has maintained the same digital economy commodity list from the original estimates published in March 2018. The change to the 2012 NAICS did not impact this list. The full list of commodities included in the digital economy estimates is available in the Appendix of the [March 2018 report](#).

Software and communications equipment prices

The rapid pace of innovation in the digital economy makes price measurement challenging. Ultimately, the goal is to capture the change in price of a constant-quality good or service to improve deflation of BEA estimates. For example, in the 1980s, computers were large and expensive with relatively little functionality compared to what the lightweight and affordable computers of today can do. Because of this, the [Producer Price Index \(PPI\)](#) for electronic computers and computer equipment fell from approximately 300 in 1991 to 27 in 2018, reflecting both the fall in computer prices and the increase in the functionality provided by computers.

BEA is committed to improving price measurement for high-tech goods and services. During the 2018 NIPA comprehensive update, BEA introduced improved price indexes for software that implement an explicit production adjustment to the input-cost index for prepackaged software beginning in 1997. This improvement is based on research BEA conducted using reports from academic, commercial, and public sources. BEA also extended improvements made in past updates to historical data.⁷

BEA also incorporated a newly available price index for cellular phones from the Federal Reserve Board beginning with 2002 data. Additionally, in January 2018, BEA began making explicit quality adjustments for smartphones, generated using hedonic modeling methods.⁸ Although the explicit quality adjustments for smartphones do not affect the estimates presented in this paper, which go through 2017, future digital economy estimates will benefit from this improved measure of prices.

Results

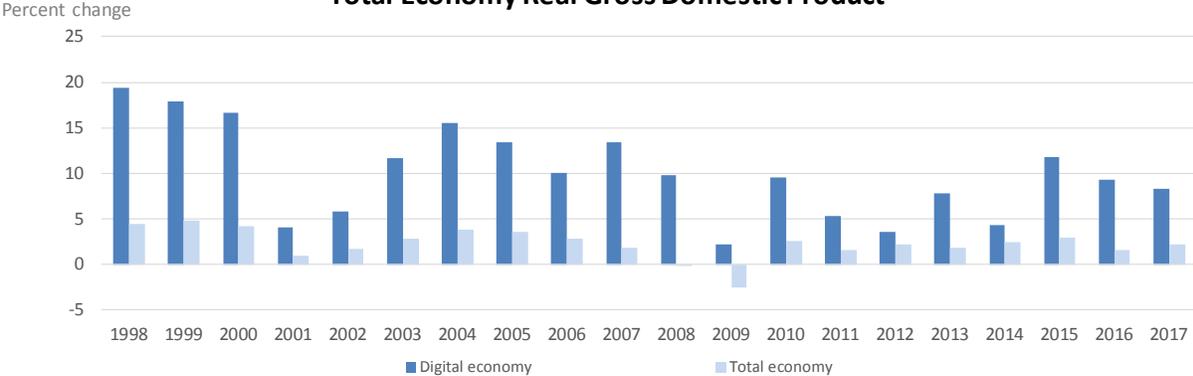
Gross domestic product or value added

GDP is the value of the goods and services produced by the nation’s economy less the value of the goods

and services used up in production. GDP by industry, or value added, is a measure of an industry’s contribution to overall GDP. According to the initial estimates, the digital economy was an engine of GDP growth throughout the period these statistics cover. In 2017, digital economy real (inflation-adjusted) value added totaled \$1,483.5 billion. From 1998 to 2017, real value added for the digital economy outpaced overall growth in the economy each year and mitigated the downturn in GDP during the recession in 2008 and 2009 (chart 3). Excluding the recessionary years of 2008 and 2009, digital economy real value-added year-over-year growth for this period was on average four times higher than total GDP growth.

The relative strength of the digital economy led it to consistently contribute more to economic growth than its share of the economy. For example, in 2017, the digital economy accounted for just 6.9 percent of the economy; however, real value-added growth of 8.3 percent in the digital economy accounted for 25 percent, or 0.55 percentage point, of the total 2.2 percent growth in real GDP.

Chart 3. Digital Economy Real Value Added and Total Economy Real Gross Domestic Product



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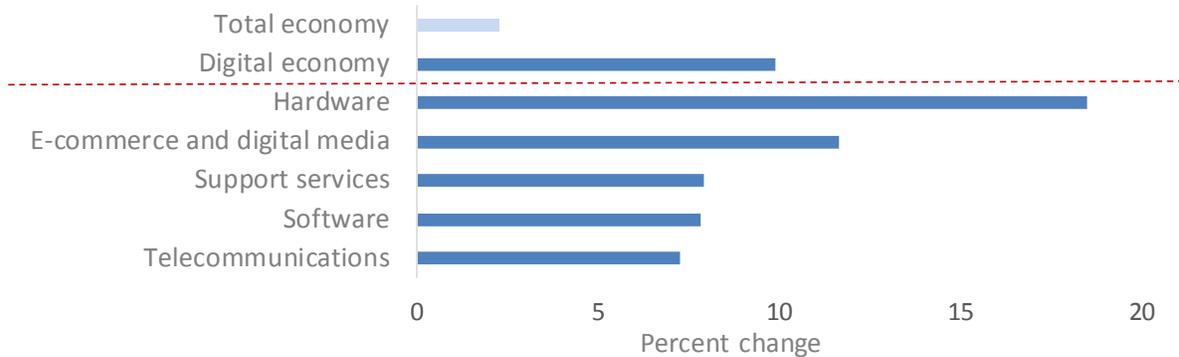
Over the entire period, the digital economy experienced real value-added average annual growth of 9.9 percent, compared to 2.3 percent for the total economy (chart 4). Within the digital economy, the hardware component grew the fastest, with 18.4 percent average annual growth over the period. However, the growth rate in hardware varied notably between the beginning and end of the period measured, ranging from 33.6 percent average annual growth between 1998 and 2007 down to 5.0 percent average annual growth from 2008 to 2017. While this component experienced the fastest average growth over the entire period, slower growth in the most recent decade placed this component at the bottom of the list for this more recent period.

Software and telecommunications exhibited slower average annual growth in the more recent years, but to a much lesser extent, with average annual growth falling about 4 percentage points between the first and second decades in the time series for both components. For software, growth fell from 9.9 percent average annual growth from 1998 to 2007 to 5.8 percent from 2008 to 2017, while telecommunications fell from 9.4 percent to 5.2 percent over the same period. E-commerce and digital

media exhibited more stable average annual growth (12.2 percent from 1998 to 2007 and 11.1 percent from 2008 to 2017). Support services was the only component that grew faster during the second half of the period, with average annual growth of 7.0 percent from 1998 to 2007 and 8.8 percent from 2008 to 2017.

Overall, average annual growth of 18.9 percent in real value added of digital goods outpaced digital services, which measured 7.7 percent. In the later decade, from 1998 to 2017, the average annual growth rates for digital goods and digital services were more aligned at 8.0 percent and 6.9 percent, respectively.

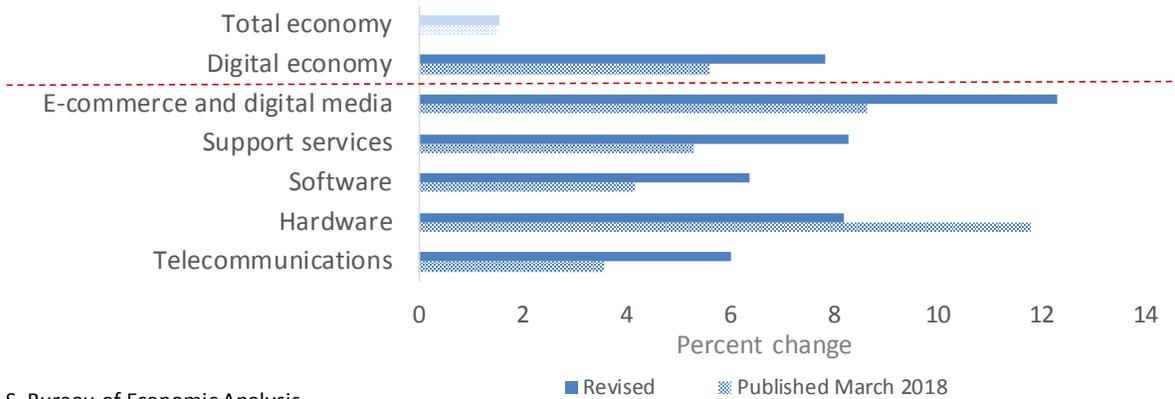
**Chart 4. Components of the Digital Economy:
Real Value-Added Average Annual Growth, 1998–2017**



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Before this update, BEA published average annual growth rates of 5.6 percent and 1.5 percent for the digital economy and the total economy overall, respectively, from 2006 to 2016. After incorporating the revised underlying data, BEA now estimates digital economy real value added grew at an average annual rate of 7.8 percent over this period, while estimated average annual GDP growth remains at 1.5 percent (chart 5).

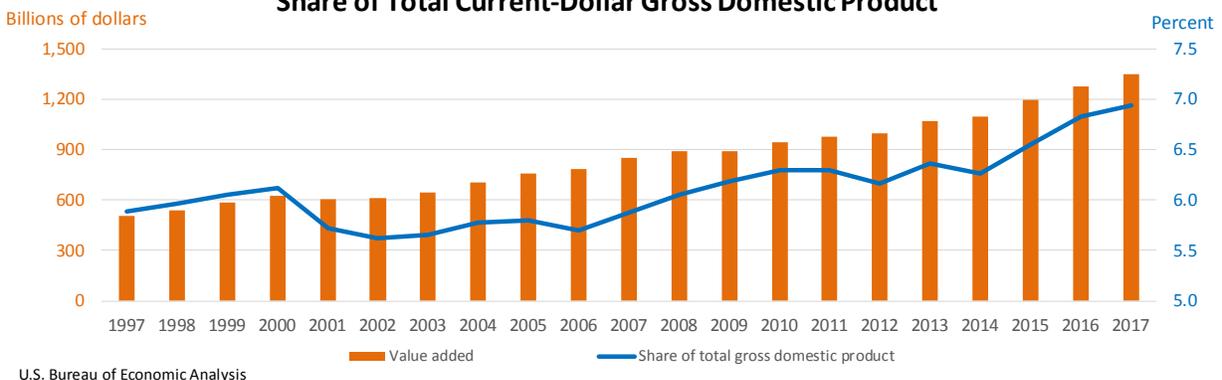
**Chart 5. Components of the Digital Economy:
Real Value-Added Average Annual Growth, 2006–2016**



From 1997 to 2017, digital economy current-dollar value added accounted for an average of 6.1 percent of total U.S. current-dollar GDP each year (chart 6). The digital economy share of total GDP has generally been rising, and in 2017, it accounted for 6.9 percent of the total economy, the highest share over this time span. In this year, digital economy current-dollar value added totaled \$1,351.3 billion.

In current dollars, digital economy value added decreased in 2001; this was the only year in the series where year-over-year, current-dollar growth was negative. From 1998 to 2001, digital economy prices rapidly decreased. The value-added price index fell by 7.3 percent from 2000 to 2001, with the index for hardware falling by 33.9 percent as the quality of computer hardware increased rapidly.

**Chart 6. Digital Economy Current-Dollar Value Added and
Share of Total Current-Dollar Gross Domestic Product**

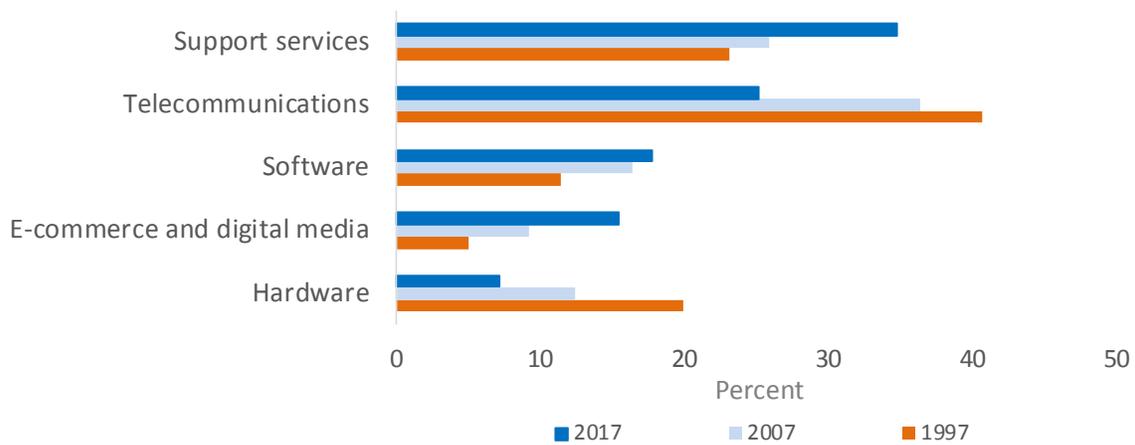


In 1997, digital-enabling infrastructure, or the hardware, software, telecommunications, and support services that allow the digital economy to exist, accounted for 95.0 percent (\$480.1 billion) of digital economy current-dollar total value added (\$505.3 billion). In 2017, digital-enabling infrastructure accounted for \$1,143.4 billion (84.6 percent) of the total estimated \$1,351.3 billion in digital economy current-dollar value added. E-commerce and digital media grew from accounting for just 5.0 percent

(\$25.2 billion) of the digital economy to 15.4 percent (\$207.8 billion) over the 20-year timespan (chart 7).

While e-commerce and digital media became a larger share of digital economy current-dollar value added, there were also shifts in the composition of the components that make up digital-enabling infrastructure. In 1997, telecommunications accounted for 40.7 percent (\$205.5 billion) of total digital economy current-dollar value added. By 2017, telecommunications current-dollar value added had grown to \$339.6 billion, but its share of the overall digital economy had fallen to 25.1 percent. Hardware declined in its total value and in its contribution to digital economy current-dollar value added, accounting for 19.8 percent (\$100.3 billion) of the total in 1997 and just 7.1 percent (\$96.3 billion) in 2017. Support services and software, the other two components of digital-enabling infrastructure, contributed more to digital economy current-dollar value added in 2017 compared to 1997, growing from 23.1 percent to 34.7 percent and 11.4 percent to 17.7 percent, respectively.

**Chart 7. Components of the Digital Economy:
Current-Dollar Value-Added Share of Total, 1997, 2007, and 2017**

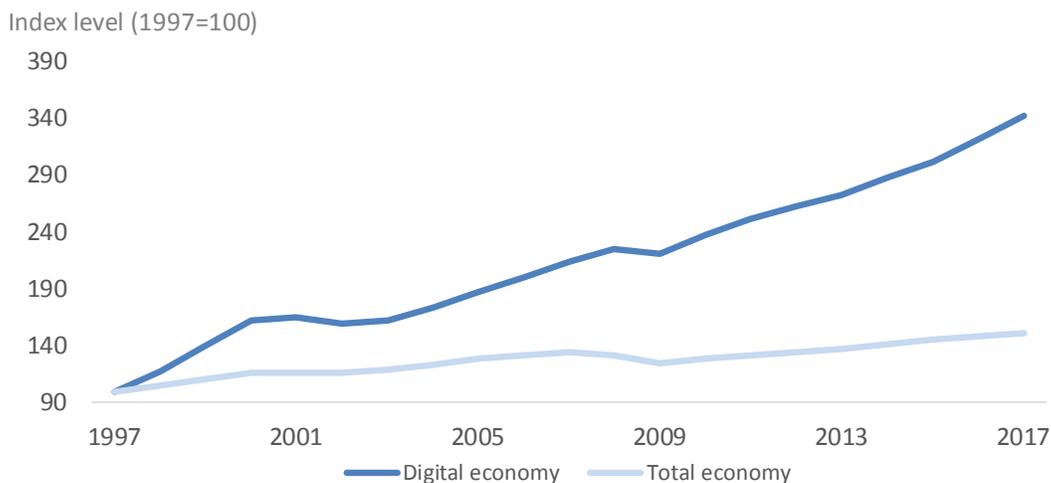


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Gross output

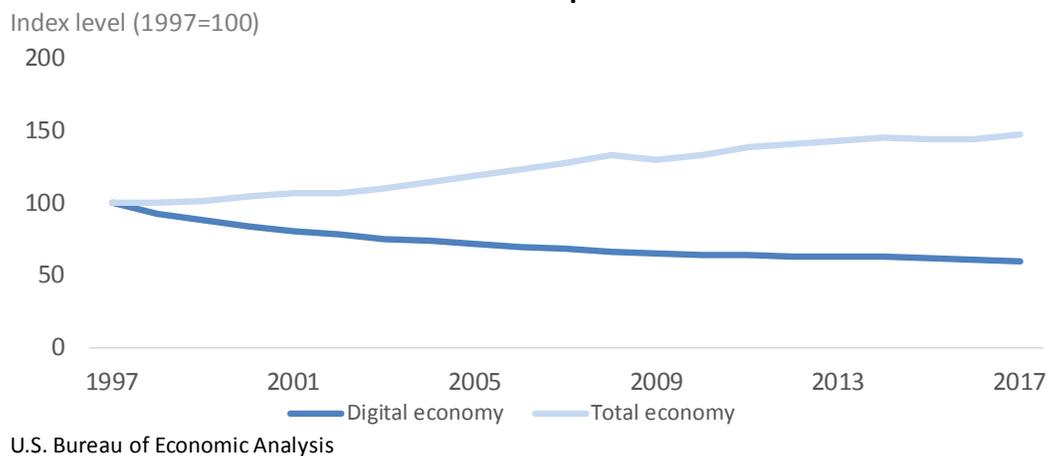
Gross output is a measure of sales or revenue from production for most industries. Real gross output for the digital economy grew at an annual rate of 6.3 percent from 1998 to 2017, faster than the total economy, which grew at an average annual rate of 2.1 percent. The compound effect of the faster output growth in the digital economy relative to the overall economy is clearly seen when output is indexed to a base year (chart 8). After the most recent recession, the output growth from the digital economy has continued to outpace the overall economy. Since 2010, digital economy real gross output growth averaged 2.5 percent per year and outpaced average annual real gross output growth of 1.0 percent in the overall U.S. economy, widening the distance between the gross output indexes displayed in chart 8.

Chart 8. Real Gross Output Index



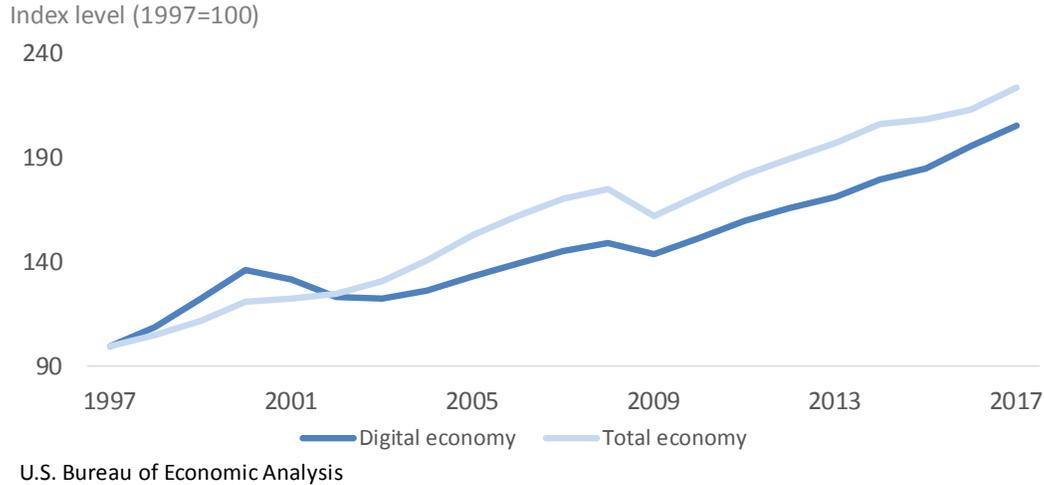
During this period of economic recovery, prices for digital economy goods and services decreased at an average annual rate of 1.0 percent (chart 9). Prices for all goods and services in the economy increased at an average annual rate of 1.6 percent.

Chart 9. Gross Output Price Index



Although real output in the digital economy accelerated faster than real output for the economy overall, the falling prices of digital goods and services caused current-dollar gross output growth in the digital economy and the overall economy to track much closer (chart 10). Digital economy nominal gross output reached \$2.05 trillion in 2017, totaling 6.0 percent of total U.S. nominal gross output.

Chart 10. Nominal Gross Output Index



Next Steps

BEA is currently working to expand the coverage of the digital economy estimates presented in this report to include selected partially digital goods and services. This work includes locating and assessing additional data sources to identify what portion of total commodity output is digital. BEA is also researching methods to estimate cloud technology's contribution to the economy.

For comments or questions, please email DigitalEconomy@bea.gov.

Acknowledgments

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¹ Kevin Barefoot, Dave Curtis, William A. Jolliff, Jessica R. Nicholson, and Robert Omohundro, "Defining and Measuring the Digital Economy", Bureau of Economic Analysis (March 2018), <https://www.bea.gov/research/papers/2018/defining-and-measuring-digital-economy>.

² Thomas F. Howells III, Edward T. Morgan, Kevin B. Barefoot, Louis E. Feagans, Teresa L. Gilmore, and Chelsea K. Smith-Nelson, "Preview of the 2018 Comprehensive Update of the Industry Economic Accounts," *Survey of Current Business* 98 (August 2018), <https://apps.bea.gov/scb/2018/08-august/0818-industry-economic-accounts-preview.htm>.

³ Ibid.

⁴ For more information, see Erich H. Strassner and David B. Wasshausen, "Preview of the 2013 Comprehensive Revision of the Industry Economic Accounts," *Survey* 93 (June 2013): 19–20, https://apps.bea.gov/scb/pdf/2013/06%20June/0613_preview_comprehensive_ia_revision.pdf.

⁵ For more information, see Jason W. Chute, Stephanie H. McCulla, and Shelly Smith, "Preview of the 2018 Comprehensive Update of the National Income and Product Accounts," *Survey of Current Business* (April 2018), <https://apps.bea.gov/scb/2018/04-april/0418-preview-2018-comprehensive-nipa-update.htm> and Pamela A. Kelly, Stephanie H. McCulla, and David B. Wasshausen, "Improved Estimates of the National Income and Product Accounts," *Survey* 98 (September 2018), <https://apps.bea.gov/scb/2018/09-september/0918-nipa-update.htm>.

⁶ For complete information on the NIPA 2018 Comprehensive Update, see <https://www.bea.gov/information-updates-national-income-and-product-accounts>.

⁷ Chute, McCulla, and Smith.

⁸ Ibid.