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PRODUCTIVITY

Productivity trends in the wired and wireless telecommunications industries

By Nathan F. Modica and Brian Chansky

The history of telecommunications services abounds with innovations. Consider the progress some people have seen in their own lifetimes: the disappearance of manual switchboard operators, the birth of cable television, and the emergence of digital technologies as the world's major source of long-distance oral and written communications, entertainment, and commerce. All of these leaps in technology involved getting more service, and better service, per hour of labor. The measurement of output per hours worked, known as *labor productivity*, is one of the best ways to study innovation.

Since the late 20th century, it has become standard to talk about the telecommunications industry as two subindustries: wired and wireless. Wired carriers move voices, data, text, and sound and video programming along electrified wires or optical fibers. Wireless carriers move the same types of information, but use electromagnetic energy on the microwave or radio spectra. The U.S. Bureau of Labor Statistics measures both industries according to the North American Industrial Classification System (NAICS).

Both the wired industry (NAICS 5171) and the wireless industry (NAICS 5172) have enjoyed a great deal of technological innovation in recent years.[1] For example, in providing broadband internet access, wired carriers have progressively introduced digital subscriber lines (DSL), cable, and fiber-optic services, increasing the speed and capacity of transmissions with each advancement. Meanwhile, the shifts in dominant technologies used by wireless carriers have been so frequent, so pervasive, and so transformative that they are numbered. The industry standard was still analog radio signals (1G) until the arrival of second generation (2G) digital signals technology in the early 1990s. Wireless carriers are beginning to roll out 5G.

Both industries have seen strong labor productivity growth since 1987. However, since around 2000, the paths have diverged: new production processes have enabled wireless to increase productivity in a more compelling fashion.

This **Beyond the Numbers** article will examine the history and sources of labor productivity growth in the telecommunications industries. First, we will compare these growth rates to those of other industries. Next, we will compare the labor productivity trends of wired telecommunications to wireless, and determine the most important services provided by each industry. Lastly, we will try to uncover what unique facets of the wireless telecommunications industry are responsible for its past and present advantage in productivity growth as compared to wired telecommunications. To do so, we will look at each industry's respective investment in productive capital assets and also the composition of their work forces.

High performance industries

The wired and wireless telecommunications industries are both standout performers in the field of labor productivity growth statistics over the past 31 years. BLS maintains labor productivity indexes for more than 154 industries (classified under NAICS 4-digit groups). Wireless telecommunications ranks second highest in labor productivity growth over the 1987–2018 period, surpassed only by a manufacturing industry, computer and peripheral equipment (NAICS 3341).[2] Wired telecommunications ranks 20th. Notably, communications equipment manufacturing (NAICS 3342) ranks 13th in productivity growth over the period 1987–2018. Telecommunications industries use, and benefit from, technological improvements in communications equipment and digital equipment. Therefore, we expect to see some similarities in the productivity trends with the industries that manufacture such equipment.

Likewise, the manufacture of information and communications technology (ICT) equipment is dependent on the supply of its components, particularly semiconductors. The semiconductors and other electronic components industry (NAICS 3344) posted the third-fastest growing productivity.

Table 1 lists the cumulative productivity growth of the telecommunications industries from 1987 through 2018, along with selected manufacturers of ICT products. The wireless industry's impressive annual increase of 11.9 percent over 31 years means that carriers produced almost 32.5 times as much output per hour worked in 2018 as

they did in 1987.[3] For some context, we have included the productivity of the nonfarm business sector, which is one of the broadest measures of U.S. economic production.[4]

Table 1. Productivity of selected information and communications technology (ICT) producing and using industries, 1987–2018

Selected industries	2018 growth relative to 1987[(1)]	Average annual percentage growth
Greatest gainers		
Computer and peripheral equipment manufacturing	71.1	14.7
Wireless telecommunications carriers	32.5	11.9
Semiconductors & other electronic components manufacturing	30.0	11.6
Other industries		
Communications equipment manufacturing	4.2	4.7
Wired telecommunications carriers	2.9	3.5
Major sector		
Nonfarm business sector	1.8	1.9

(1) The amount of output per hour worked that was produced in 2018 as a multiple of the 1987 amount.
Source: U.S. Bureau of Labor Statistics.

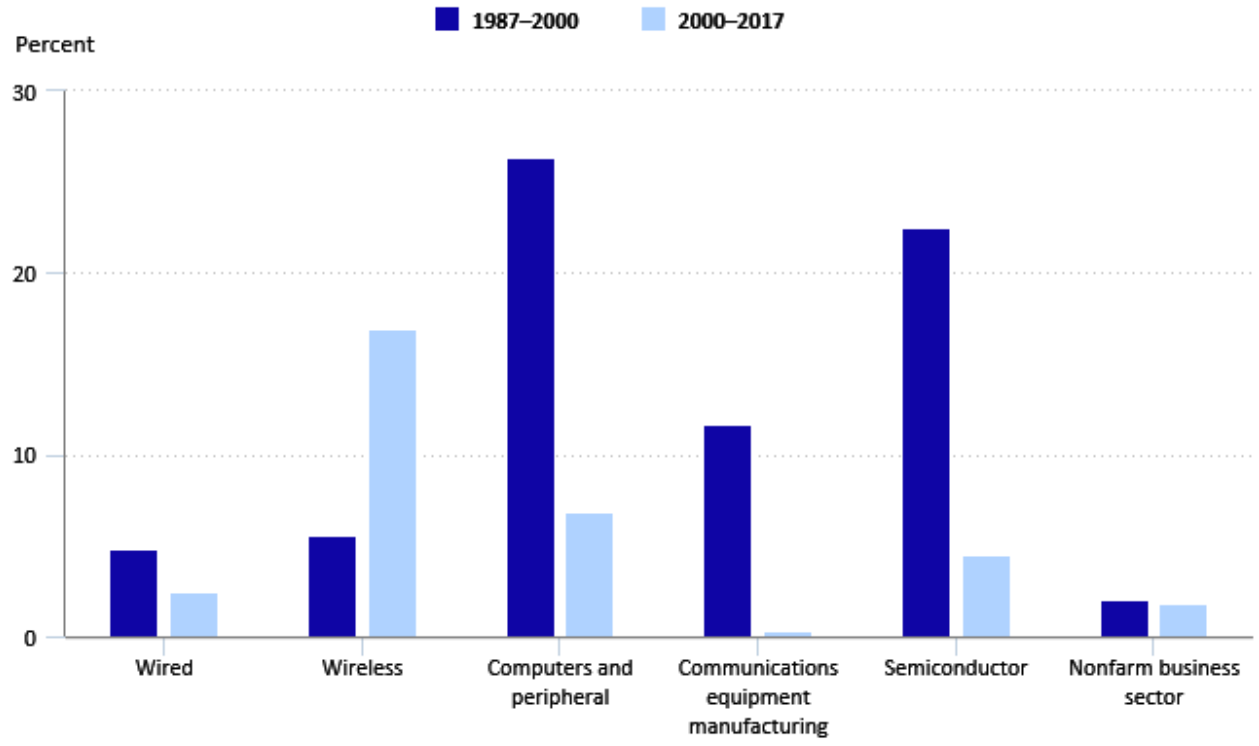
Rapid increases in semiconductor processing speed in the mid-1990s drove productivity growth in the industries that are most reliant on information and communications technology. In turn, these investments in informational capital drove efficiency improvements in many other industries, lifting productivity growth in the broader U.S. economy in the late 1990s and early 2000s.

A turning point

The information revolution may have lifted productivity in information and communications technology (ICT)-producing and ICT-using industries, but the effect on productivity growth was not permanent for some.

Chart 1 shows that the wired industry, like the ICT manufacturing industries pictured, experienced a post-2000 slowdown in productivity growth. While productivity growth occurred, the growth rates converged closer to the average of the nonfarm business sector.

Chart 1. Labor productivity of selected information and computer technology (ICT) industries, average annual growth rates, 1987–2017



Click legend items to change data display. Hover over chart to view data.
Source: U.S. Bureau of Labor Statistics.

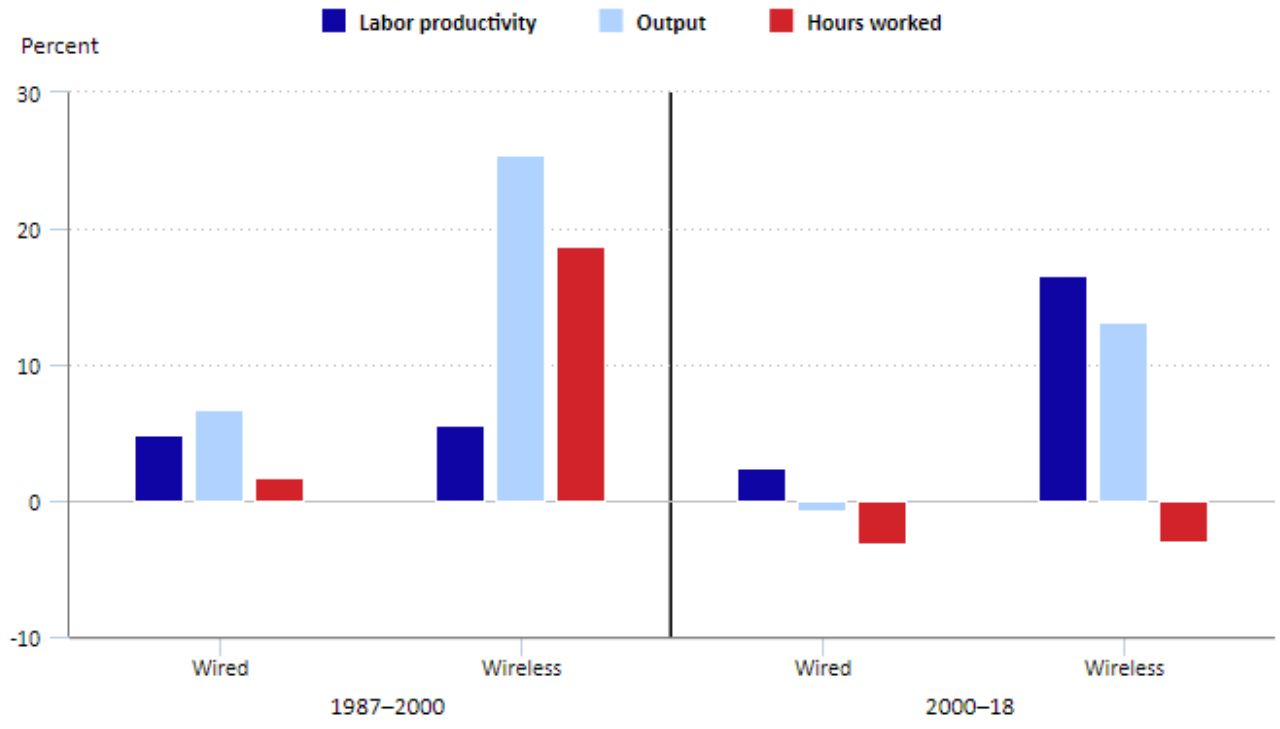
At the same time, the wireless industry continued to achieve rapid productivity growth. In fact, the rate of growth nearly tripled between 2000 and 2018. Accordingly, the wireless industry's productivity growth was the fastest of all industries measured by BLS from 2000 to 2018.

Towering cellular: the wireless productivity boom

The year 2000 was a turning point in many ways for telecommunications. First, the turn of the millennium is a reasonable dividing point for productivity analysis comparisons because a business cycle began in 2001. The recession that began in the first quarter of 2001, after the bursting of the "dot-com bubble," was of particular relevance to the telecommunications industries. Specifically, changes in regulations and technology in the late 1990s resulted in a massive expansion—in the number of firms, employment, and capital investments. When the bubble burst, dot-coms and telecommunication companies alike experienced a wave of consolidation.[5]

This period also saw a break in the productivity trends of the two main telecommunications industries. Before the year 2000, the rapid expansion of the wireless industry did not result in a notably faster rate of productivity growth. Chart 2 shows that although wireless had much faster growth in output and hours worked than the wired industry, labor productivity growth for the wireless industry was only a little faster during the 1987–2000 period. (Recall that productivity is the ratio of output to hours worked.)

Chart 2. Labor productivity, output, and hours worked for telecommunications industries, 1987–2018



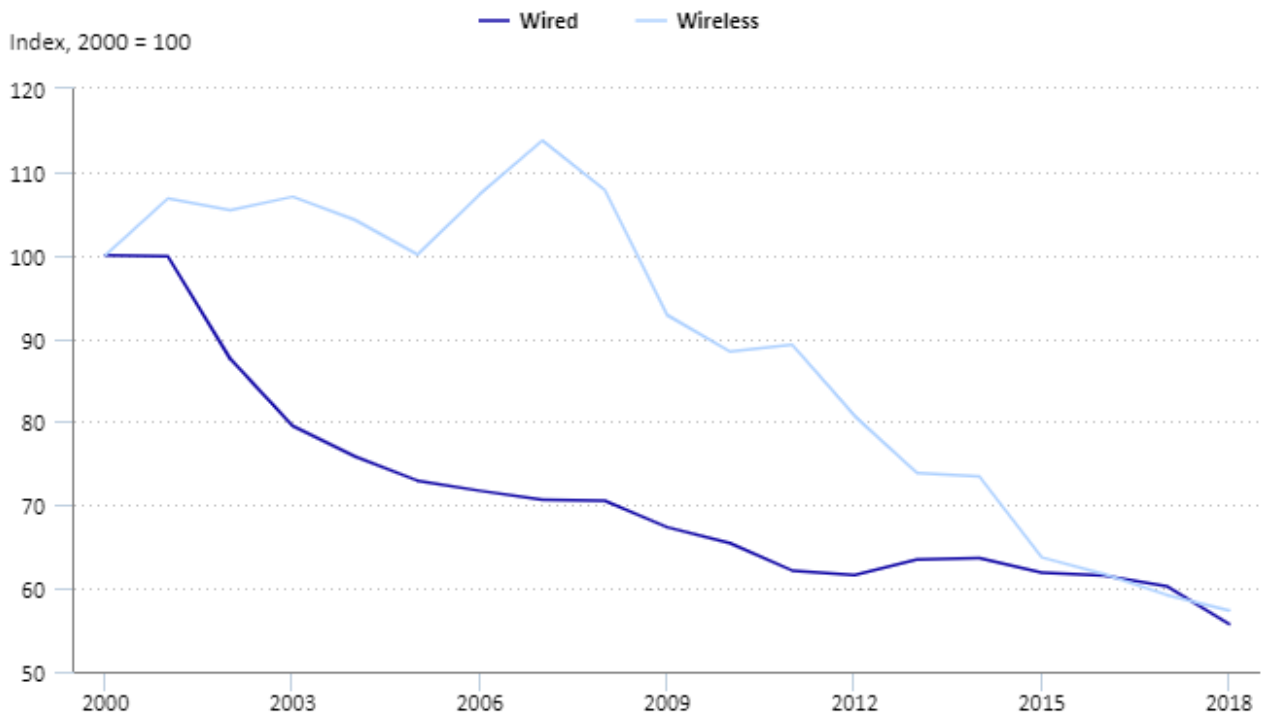
Click legend items to change data display. Hover over chart to view data.
Source: U.S. Bureau of Labor Statistics.

The industry output index measures the amount of services produced. In the wired industry, output peaked in 2000. Chart 2 shows that the wired industry actually produced less output in 2018 than it did in 2000. Conversely, output for the wireless industry has continued to multiply, growing at an average annual rate of 13.1 percent since 2000.

The number of hours worked peaked in the wired industry in the year 2000. At that time, spending on cell phone services was slightly more than one-third of what was spent on landlines. (By 2007, cellular expenditures exceeded landline expenditures.)[6] After 2000, hours worked in the wired industry collapsed, which caused productivity to grow moderately. Although hours worked fell in wireless too, large increases in output meant that productivity increased very fast.

On the whole, the wired and wireless industries displayed similarities in hours worked during the post-2000 period. Chart 3 shows that hours worked in the wired industry have declined almost every year since the peak in 2000. For wireless, hours worked grew mostly until 2007, then began a steep descent that continued well after the Great Recession ended in 2009. Although the bulk of the wired and wireless industries' declines in hours worked occurred during different periods, the final result was a similar proportional loss from 2000 to 2018.

Chart 3. Hours worked, 2000–18



Click legend items to change data display. Hover over chart to view data.
Source: U.S. Bureau of Labor Statistics.

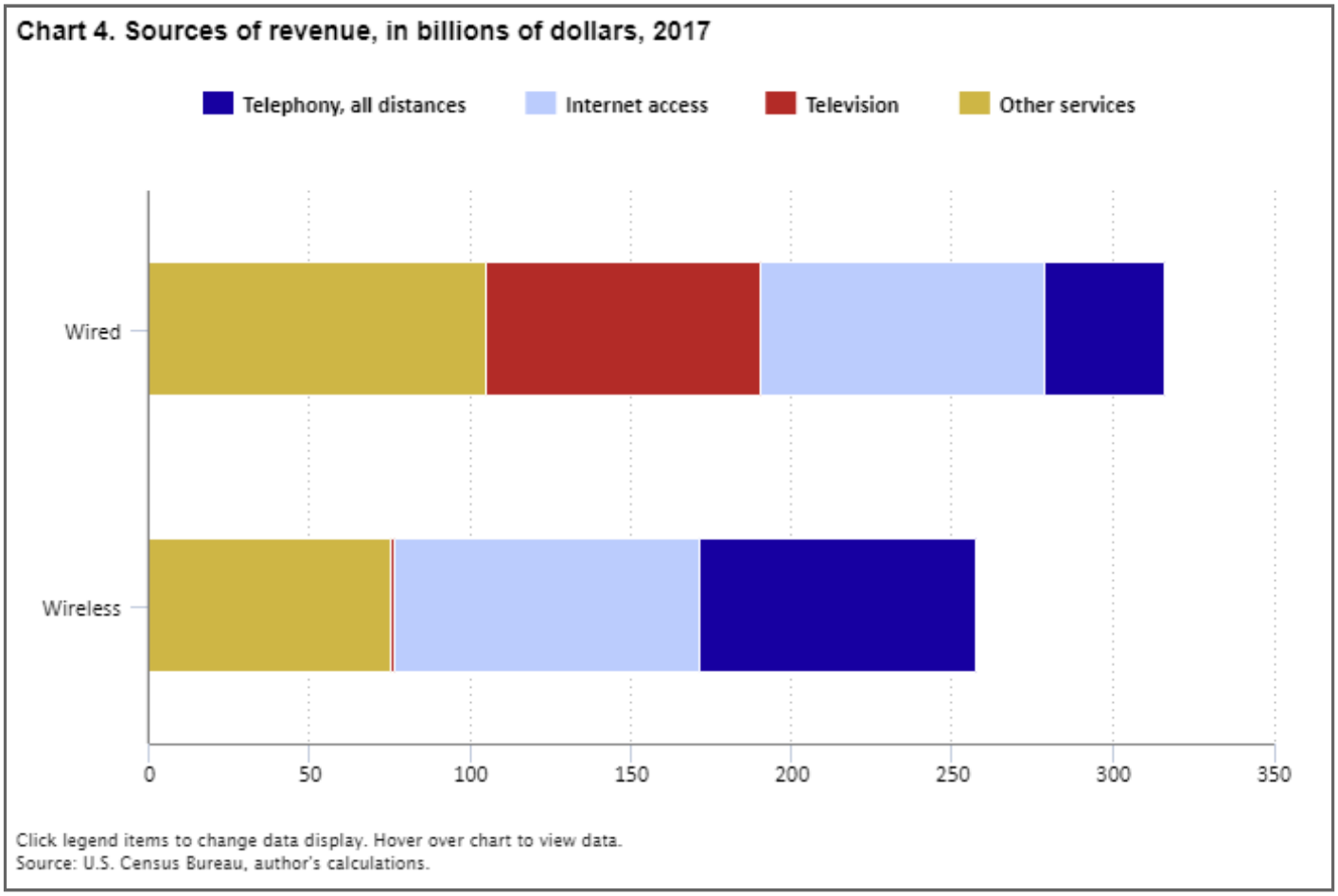
A higher definition picture of the industries

The output of telecommunications carriers is a somewhat abstract concept to grasp. (Especially with bundled service plans or unlimited voice and text plans.) Let's zoom in on the product of the wired and wireless industries.

In the early 20th century, the telecommunications industry—which meant wired—consisted of fixed (i.e., landline) telephony and related services for consumers and workplaces. Under the old Standard Industrial Classification (SIC) system, wired and wireless telecommunications services were not classified as separate industries. Wireless telecommunications, which are classified separately from radio and television broadcasting, were, until the 1980s, more the subject of scientific research than of major economic activity. By the time NAICS was introduced in 1997, it was clear that wired and wireless services were distinct economic phenomena deserving of analysis. (The BLS Productivity Program apportioned data for components of the SIC telecommunications industry into the detailed NAICS industries for 1987–97.)

In recent years, continuing improvements to Census Bureau revenues data and BLS deflators data have allowed us to get an increasingly more detailed view of what services the wired and wireless industries provide. Chart 4 breaks down the shares of major current sources of revenue for both telecommunications industries. Telephony has made up a decreasing share of the wired industry's revenues in recent years. In 2017, this figure was 11.8 percent of industry revenues. Internet access services contributed 28 percent. Television revenues—which include cable and satellite programming and pay-per-view—made up another 27 percent. (Satellite telecommunications

other than television programming belong to a different NAICS industry.) The remaining 33.2 percent of industry revenues consisted of private network services, rental and reselling services for program distribution equipment, internet telephony (such as Voice Over Internet Protocol service), and all other services. The relatively small share of telephony in the wired industry's revenues comes after a long decline in the market share of landline service, relative to cellular.

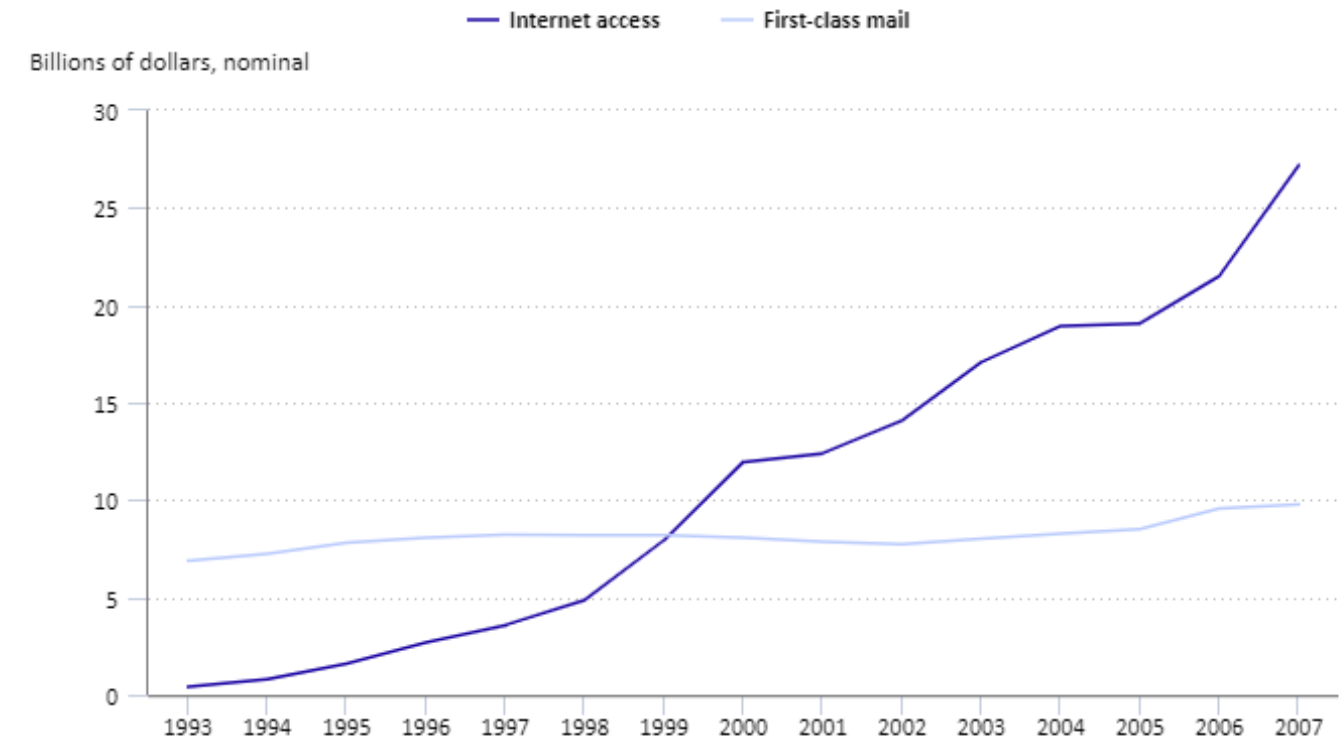


For the wireless industry, telephony retained a 33.5-percent share. Thanks to the rise of smartphones and other mobile devices, connecting to the web is also now a key function of wireless service: internet access accounted for another 37.3 percent share of the industry's revenue. The rest of the revenue sources contributed 29.2 percent.

The impact of the internet on both industries is enormous. An illustrative example is the change in spending on two different types of services that transmit information and conduct commerce over long distances: mail (letter-size, not parcels) delivered by the U.S. Postal Service, and access to the internet.

Chart 5 depicts the relative lack of U.S. consumer spending on internet access in 1993 ($0.4 billion), against the $6.9 billion spent on first-class mail. By the year 2000, for the first time, consumers spent more on internet access ($12.0 billion) than on first-class mail ($8.1 billion). Since then, this difference has continued to widen. In 2007, the totals reached $27.2 billion for internet access, $9.8 billion for first-class mail. By 2017, Americans spent $76.1 billion on internet access versus $6.1 billion on first-class mail.

Chart 5. Household expenditures on internet services and first-class mail, in billions of dollars, 1993–2007



Click legend items to change data display. Hover over chart to view data.
Source: U.S. Bureau of Economic Analysis.

Initially, most expenditures on internet access came from dial-up or DSL services associated with wired telephone lines. But by 2016, 76.5 percent of U.S. households had smartphones and 57.8 percent had a tablet or other portable wireless computer.[7]

Building networks: capital

Businesses benefit from productivity increases because such growth restrains labor costs. Consumers, in turn, often benefit from improvements in service quality and from downward pressure on prices.[8] The mass adoption of broadband internet and smartphones are examples of this. Improvements in the design and manufacture of communications equipment are essential, but providing reliable, affordable connections between devices is the job of telecommunications carriers. What are the underlying causes of their productivity gains?

One way labor productivity can grow is from an increase in the quantity and quality of capital per worker. *Capital* means the productive resources (such as equipment, structures, and software) that firms use for more than 1 year. In recent years, telecommunications industries have given us new ways to work, play, and connect with people. This requires a vast array of physical assets—from desktop equipment to the 9,587-mile long TAT-14 fiber-optic cable between New Jersey and Europe. If firms get more productive use out of capital, this reduces the need for labor. (Consider all the tasks that are now done by computers, or what a single truck driver can do in place of dozens of mule drivers.)

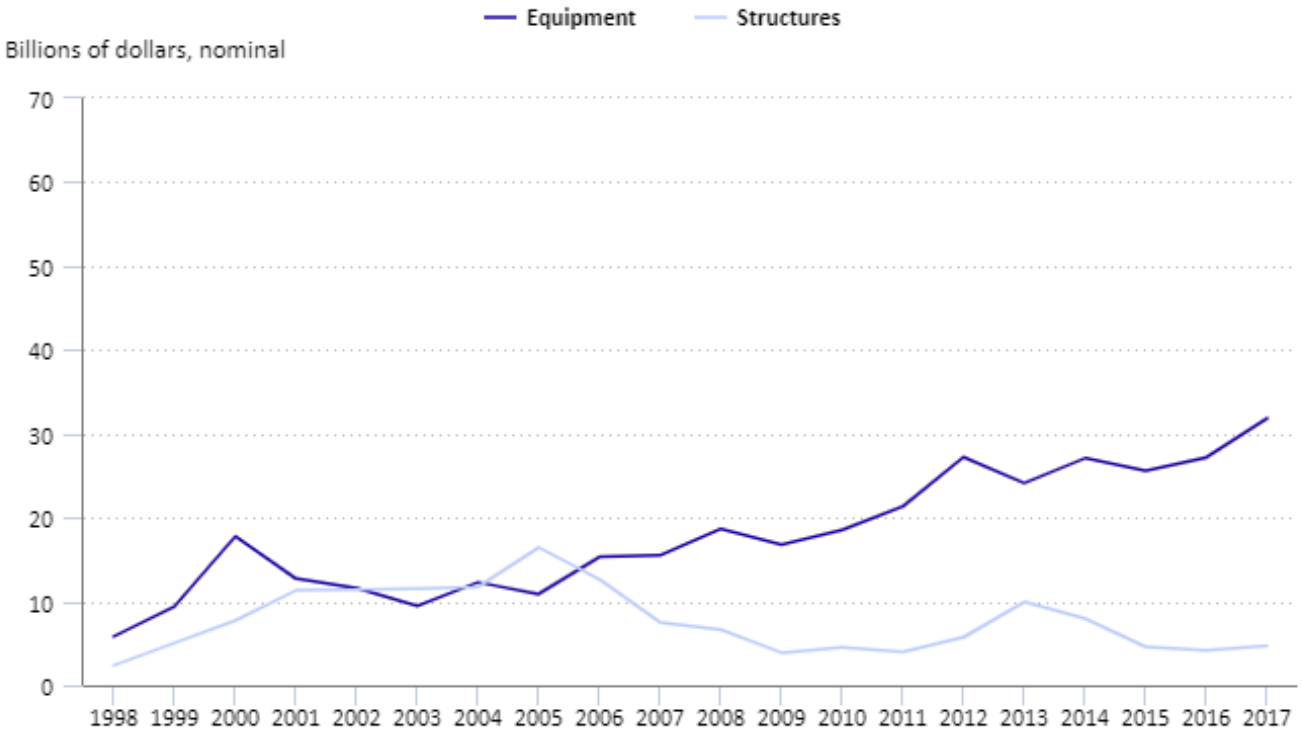
Because of a lack of asset-specific data for the wired or wireless telecommunications industries, BLS does not produce capital services measures at this level of industry detail.[9] However, the U.S. Census Bureau's Annual Capital Expenditures Survey (ACES) provides annual investment data for two broad categories of physical capital: equipment and structures. Comparing the investment patterns can provide some insight into how these industries' paths have diverged.

Charts 6A and 6B show that both industries bulked up on equipment investments in the last few years of the 20th century, only to pull back after the bursting of the telecom bubble in the early 2000s. (The pullback was more severe in the wired industry.) Equipment investments bounced back in both industries thereafter.

Chart 6A. Nominal capital investment in wired telecommunications industry, in billions, 1998–2017

Click legend items to change data display. Hover over chart to view data.
Source: U.S. Census Bureau.

Chart 6B. Nominal capital investment in wireless telecommunications industry, in billions, 1998–2017



Click legend items to change data display. Hover over chart to view data.
Source: U.S. Census Bureau.

The investments in structures tell a different story: the wired industry's investments dipped during the tech recession of the early 2000s but—at least in nominal terms—have been stable since then. In the wireless industry, investments in structures kept growing until 2005, after which spending plummeted and never fully recovered. Productivity growth can occur when any aspect of an industry's production process becomes more efficient. The fact that wireless output was able to grow with substantially less investment in structures demonstrates such an efficiency gain.

This might sound counter-intuitive. Given the continuing huge increases in the output of the wireless industry after 2005, wouldn't a lot of new structures need to get built—such as cell towers? Or at least a proliferation of small cell sites? Certainly, to a point. The early 2000s ACES data suggest that wireless companies were investing a lot into building out their nationwide networks, but may have largely achieved this by 2005. Note that the steep decline in structures investment began in 2006—before the Great Recession.

Table 2 sheds some light on the changing relationship between deployment of new cell sites and the BLS output index for the wireless industry. [10] During the decade before the ACES data became available, there initially were not a lot of cell sites operating. Therefore, the national stock of cell sites multiplied quickly—and at a much faster rate than industry output. Cellular companies had to establish good network coverage, first, to attract customers.

Table 2. Cell sites and wireless output, selected years (annual growth in percent)

Year (end)	Active cell sites	Period	Sites growth, annual average (in percent)	Output growth, annual average (in percent)

See footnotes at end of table.

Table 2. Cell sites and wireless output, selected years (annual growth in percent)

Year (end)	Active cell sites	Period	Sites growth, annual average (in percent)	Output growth, annual average (in percent)
1987	2,305			
1997	51,600	1987–1997	36.5	24.3
2005	183,689	1997–2005	17.2	23.9
2016	308,334	2005–16	4.8	10.8
Sources: CTIA, The Wireless Association, and Federal Communications Commission.				

From 1997 to 2005, as dollar investments in structures peaked, the rate of annual increase in cell sites (17.2 percent) was still very high. However, output now grew at a faster rate than cell sites.

Over the next 11 years, the number of active cell sites increased more slowly. The growth rate of output (10.8 percent) also slowed but, again, greatly exceeded the growth in the cell site stock (4.8 percent). By comparison, output in the wired industry grew by 0.6 percent per year from 2005–16.

This provides some insight into how wireless carriers can provide new services with fewer resources now than in the past. Imagine you move into a newly built home and decide to get a new wireless account. If you are within range of an existing cell site, no new infrastructure needs to be built to connect you to the existing wireless network in the neighborhood. Setting up cable or other wired services in a new building is a different story—it would take more time and effort.

The continuing need to invest in physical structures may help to explain why the wired industry lags behind wireless in labor productivity growth. The delivery of new wired services requires more labor hours because of the physical infrastructure that must be put in place. We can see this in BLS Occupational Employment Statistics (OES) datasets. The OES program collected survey data on the wired and wireless telecommunications industries between 2002 and 2016, in accordance with Standard Occupational Codes (SOC).[11] In each of these years, OES has reported more installation, maintenance, and repair workers (SOC 49-0000) in the wired industry than in all occupations combined in the wireless industry.[12]

Building networks: workers

Worker skill is another driver of labor productivity. No matter how much high-tech equipment or infrastructure firms accumulate, they still need workers with the right amount of education, training and experience who know how to use it.[13]Dale W. Jorgenson, Mun S. Ho, and Jon D. Samuels have argued that “the growth of college-educated workers and investments in both IT and non-IT capital, explains by far the largest proportion of U.S. economic growth” in recent years.[14]

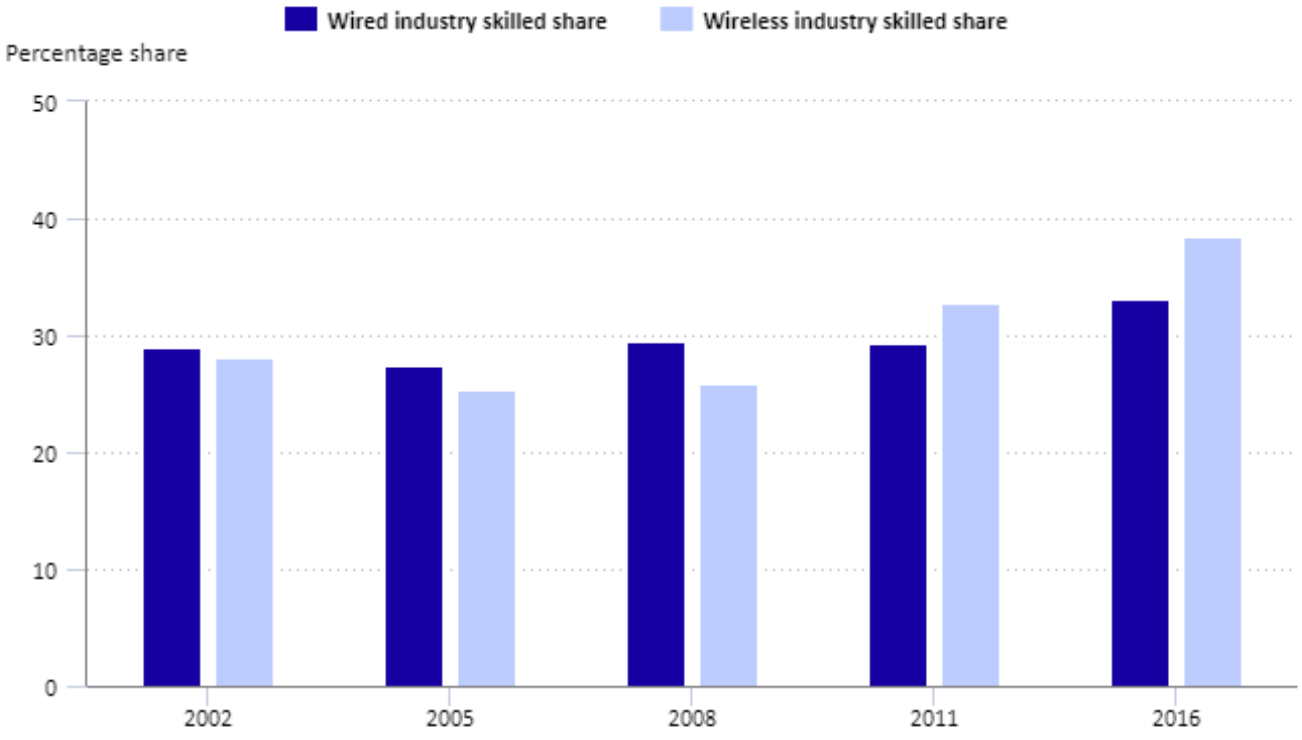
Although both telecommunications industries have reduced hours worked since 2000, the wireless industry’s faster productivity growth rate means that value of production has nearly converged with the wired industry. In 2018, the wired industry’s employees worked 5.1 times as many hours as workers in wireless, while producing only 1.2 times as much nominal output.

Why have workers in the wireless industry become more productive than workers in wired? As previously mentioned, one possibility is that capital per worker has increased. Another possibility is that the wireless industry has shifted to an increasingly skilled workforce. The relative shares of workers in skilled occupations can serve as informative indicators of the different directions that the two industries’ productivity trends moved in after 2000.[15]

The OES program's coding structure refers to an aggregation of all occupations in SOC 11-29 as "Management, Business, Science, and Arts Occupations." [16] We define this group of occupations as "skilled." The Employment and Training Administration's O*NET categorizes most occupations in this group as Job Zone 4, meaning these employees need "considerable preparation" in terms of education, related experience, and job training. Most occupations in the other SOC groups are in Job Zone 3 ("considerable preparation") or Job Zone 2 ("some preparation"), which we define as "less skilled."

Using OES data, we calculated the shares of skilled workers for selected years between 2002 and 2016. (See chart 7.) In 2002, the wired industry had about the same percentage of skilled workers (29.0 percent) as the wireless industry (28.0 percent). By 2016, the share of jobs assigned to the more skilled occupational groups increased to 33.1 percent in the wired industry, but jumped to 38.5 percent in the wireless industry.

Chart 7. Share of skilled labor in the wired and wireless industries, selected years



Click legend items to change data display. Hover over chart to view data.
Source: U.S. Bureau of Labor Statistics.

More interesting than the overall 2002–16 trends is the timing of when the gains occurred. The skilled share in wireless *fell* between 2002 and 2005—as it did in wired. The wireless industry's skilled share remained below its 2002 level even in 2008. Thus, the 2002–16 gain in the wireless industry's skilled share all occurred after 2008. This industry's productivity boom was already underway before the share of skilled workers increased. The increasing skill of workers may well have contributed to productivity growth, but it does not line up with our cross sections of OES data.

Behind the wireless productivity boom

Why does the wired industry use so many more work hours than the wireless industry? And why doesn't the wired industry produce a correspondingly large multiple of output, relative to wireless? A simple explanation is that the technology used by the wireless industry is less labor-intensive than that of the wired industry.

Let's return to the scenario where you move into a newly constructed home. Your wired telecommunications carrier is going to need a lot of labor, even apart from the most prominent example of installation workers. In order to set up a new account, you might talk to a customer service representative (SOC 43-4051) or a sales worker (SOC 41-0000), who will discuss service and pricing options available at your location. A personal interaction with a telecom company representative may be necessary regardless of whether you are setting up a cable account or a wireless account. Even so, service plans for cable and other wired services tend to be more specific to your local area, and therefore more complicated to discuss. (If you live in an apartment building, you may have a different set of options than your neighbors in the building next door.) This could be part of the reason why, in 2016, the wired industry employed 3.2 times as many customer service representatives as the wireless and 1.9 times as many sales workers. (Table 3 compares industry employment for selected occupations other than Management, Business, Science, and Arts Occupations.)

Table 3. Employment in wired industry, by occupation, as a multiple of wireless industry

Type of worker	2002	2009	2016
Industry total	3.9	3.4	4.8
Installation, maintenance, and repair	14.4	20.6	14.1
Customer service representatives	2.7	1.6	3.2
Sales	1.4	1.3	1.9

Source: U.S. Bureau of Labor Statistics, Occupational Employment Statistics.

As we saw with the skilled labor shares, the difference in labor input between wired and wireless is mainly a matter of scale. The occupational distributions may change over time, but the wired industry's labor requirements tend to be greater in almost any category. If it requires more installers to physically expand service in wired, then it also requires more of other types of employees to arrange the installations over the phone, establish accounts, and bill customers. Then, you need enough employees to plan and administer the expansions, buy equipment and supplies, or process paychecks.

Any way you look at it, the wireless industry seems better positioned to boost output without necessarily clocking more hours worked. The extreme rapidity of the labor productivity growth in wireless suggests that technological innovations—new ways of doing things with new types of hardware and software—still play a leading role in the story. The continuing steady innovation in the wired industry, however, has enabled persistent productivity growth.

Meanwhile, new wireless technologies, developed by researchers and other innovators from all over the world, have become more efficient, more reliable, and more versatile. The carriers have learned how to build out the appropriate infrastructure, distribute the new services on a large scale, and to market and sell the new products. As a result, the amount of output that wireless carriers can produce with a single hour of work has multiplied by almost 16 times since 2000.

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NOTES

[1] BLS productivity measures are published on a NAICS 2012 basis. 5171 and 5172 on a NAICS 2012 basis correspond to 517311 and 517312, respectively, in NAICS 2017.

[2] For 52 industries, data from 1987–2017 only are included. Most of these industries are in the wholesale trade or retail trade sectors, for which 2018 source data are not yet available.

[3] Some observers believe that BLS has understated the magnitude of producer price declines over this period because of insufficient accounting of improvements to wireless service quality, particularly since the mass adoption of smartphones. If true, this means that deflated revenues, which the Productivity Program uses to measure output, increased more than the published figures. Effective with the release of Producer Price Index (PPI) data for December 2016, on January 13, 2017, the Bureau of Labor Statistics began using hedonic quality adjustment for PPI data for internet access services of wired carriers—also known as broadband.

[4] The BLS Labor Productivity and Costs website includes documentation on the different data sources and methodologies that underlie productivity measures for major sectors compared to detailed industries.

[5] A 2006 article, from the BLS Employment and Unemployment Statistics program, examined the expansion, and subsequent contraction, focusing on employment trends: Christopher Carbone, "Cutting the cord: telecommunications employment shifts toward wireless," *Monthly Labor Review*, July 2006, pp. 27-33, https://www.bls.gov/opub/mlr/2006/07/art3full.pdf.

[6] Source for Personal Consumption Expenditures: PCE underlying data tables, table 2.4.5U, lines 279-281 (U.S. Bureau of Economic Analysis, 2018), https://www.bea.gov/data/consumer-spending/main.

[7] Source for household communications devices data: Camille Ryan, "Computer and Internet Use in the United States: 2016," *American Community Survey Reports* (U.S. Census Bureau, 2018), table 1.

[8] We found in a previous cross-industry analysis that there is often an inverse relationship between industry productivity and the prices that consumers pay for the products of those industries. See slide 5 in Michael R. Brill and Samuel T. Rowe, "Industry Labor Productivity Trends from 2000 to 2010," *Spotlight on Statistics,* (U.S. Bureau of Labor Statistics, March 2013), https://www.bls.gov/spotlight/2013/productivity/home.htm.

[9] Capital services indexes are available for broader subsectors including broadcasting and telecommunications (NAICS 515, 517). See table 1-2.2: https://www.bls.gov/mfp/special_requests/klemsmfpbymeasure.xlsx.

[10] The term *cellular* comes from the cost-minimizing spatial organization of wireless sites. A diagram of the effective range of each site resembles a microscopic view of biological cells, with the cell sites as nuclei.

[11] To improve the efficiency of the OES sample, and improve the quality of published data, OES is no longer producing separate estimates for wired and wireless telecommunications carriers.

[12] OES data are not organized along time series principles. For more information, please see the question "Can OES data be used to compare changes in employment or wages over time?" in the OES FAQs at https://www.bls.gov/oes/oes_ques.htm. To minimize inconsistency in occupational classifications over time, we used occupational groups at a more aggregated level. Also, note that for data years 2002–07, the wired industry comprises NAICS 5171 + 5175 to be consistent with later NAICS definitions.

[13] Claudia Goldin and Lawrence F. Katz, in a study of early 20th century manufacturers using innovative production methods, called this "technology-skill complementarity," p. 695. The subject of their research was an early example of skill-biased technical change in which growth in high-tech capital increases demand for skilled workers while decreasing demand for less-skilled workers, pp. 704–5. Claudia Goldin and Lawrence F. Katz, "The Origins of Technology-Skill Complementarity," *Quarterly Journal of Economics*, vol. 113, no. 3, August 1998, pp. 693–732, https://www.jstor.org/stable/2586871.

[14] Dale W. Jorgenson, Mun S. Ho, and Jon D. Samuels, "Educational attainment and the revival of U.S. economic growth," in Charles R. Hulten and Valerie A. Ramey, eds., *Education, Skills, and Technical Change: Implications for Future US GDP Growth* (Chicago, IL: University of Chicago Press, forthcoming in 2019), p. 29, https://www.nber.org/chapters/c13695.pdf.

[15] The BLS Productivity Program normally uses Current Population Survey data on educational attainment to help measure labor force quality adjustment in major economic sectors. However, these data are not available at the detailed industry level for the wireless industry.

[16] As previously noted, OES data are not a time series. The use of six semiannual data panels to create a set of estimates means that sudden changes in occupational employment or wages in the population or changes in methodology show up in the OES estimates gradually.

However, we did account for recoding of occupations: we inspected the SOC crosswalk for the 2002 and 2010 SOC systems used in the 2002–16 OES datasets. We found no redefinitions of occupations that would affect telecommunications employment shares in Management, Business, Science, and Arts Occupations.

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