



WIRELESS INVESTMENT AND ECONOMIC BENEFITS

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Executive Summary

The major wireless providers are among the top companies as measured by investment (total capital expenditures) in the United States economy. From 2020, the five publicly-traded mobile carriers—AT&T, Dish, Verizon, T-Mobile, and UScellular—have invested an average of \$54 billion per year, making them the second-highest investing industry after the Tech/internet sector. Since 2011, the biggest five wireless providers' capital expenditures of \$591 billion are comparable to the capital expenditures of the “Big 5” tech companies (\$611 billion).

This investment has provided infrastructure that has facilitated economic activity and investment throughout the US economy, including from other companies with sizable capital expenditures.

Wireless investments have produced substantial economic benefits in recent years. Growth in wireless services stimulates growth in related industries, including those that supply inputs for wireless infrastructure and create complementary products, such as wireless devices. Similarly, improvements in the quality and capacity of wireless networks facilitate demand for new and/or improved products and services that run on these networks, such as internet search and social networking. Over the 2010s-decade, economic activity facilitated by wireless providers accounted for a \$500 billion increase in Gross Domestic Product (9 percent of the total increase in US GDP) and 10 million additional jobs (25 percent of the increase in US employment).

The ongoing investment in telecom infrastructure by wireless service providers has continued to provide economic benefits. Since 2020, while overall inflation has hit levels not seen in several decades (an almost 20 percent increase between 2020 and 2023), wireless prices were close to flat. At the same time, key measures of wireless output grew substantially. Data traffic, which reflects the use of wireless capacity by other businesses contributing to economic and employment growth, e.g., video conferencing, increased by 75 percent between 2020 and 2022.

Wireless Companies' Capital Expenditures Remain Among the Highest in the US Economy

Wireless carriers have had and continue to have capital expenditures (investment levels) that are among the largest amounts by US companies. From 2020,¹ the five publicly-traded national mobile carriers—AT&T, Dish², Verizon, T-Mobile, and UScellular—have invested an average of \$54 billion per year in their infrastructure,³ as shown in Table 1.⁴

Table 1: Capital Expenditures by Publicly Traded US Wireless Carriers (billions)

Year	AT&T	Dish	Verizon	T-Mobile	UScellular	Total
2020	\$15.551	\$0.096	\$16.103	\$11.325*	\$0.940	\$44.015
2021	\$20.288	\$1.012	\$20.286	\$12.326	\$0.780	\$54.692
2022	\$23.539	\$2.596	\$23.087	\$13.970	\$0.717	\$63.909
2020-2022 average						\$54.205

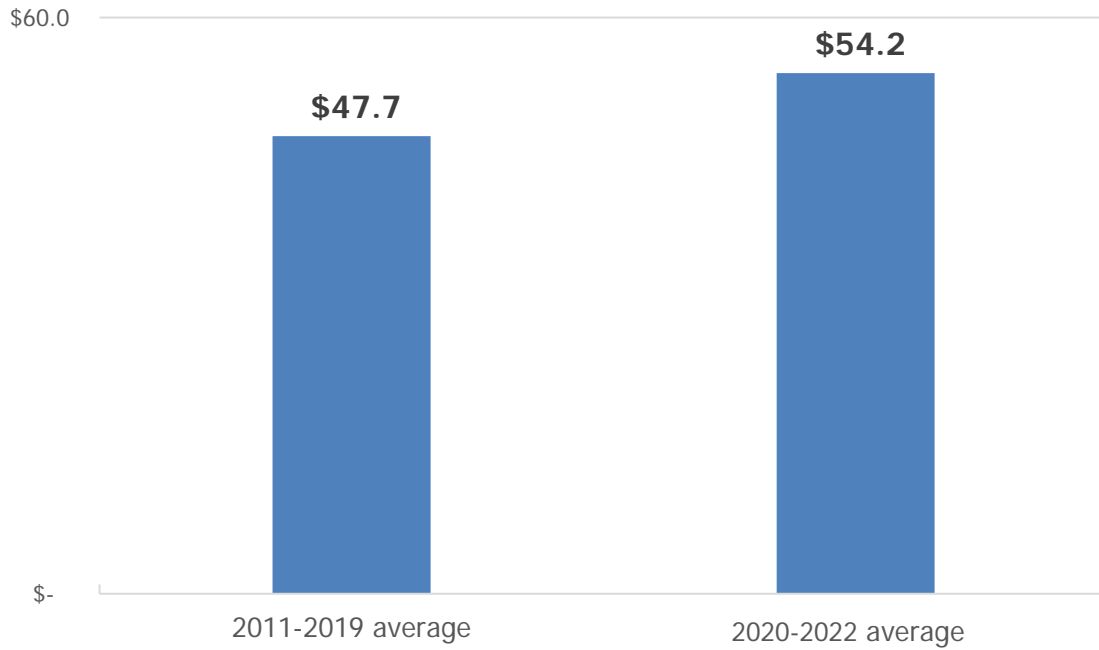
Sources: Progressive Policy Institute (PPI), Investment Heroes reports, 2022 (p. 8) and 2023 (p. 3) for AT&T and Verizon, 2022 and 2021 Dish 10-K reports, 2022 T-Mobile 10-K report, 2022 and 2021 UScellular 10-K reports.

* Includes \$291M of capex from Sprint before the merger with T-Mobile in April 2020

These recent infrastructure investments are of comparable magnitude to the investments observed in other sources. In particular, starting with investment levels for 2011, the Progressive Policy Institute (PPI) has produced annual Investment Heroes reports, which identify the capital expenditures of the top 25 US nonfinancial companies.⁵ AT&T and Verizon ranked first and second from 2011 through 2017 and remained among the top five companies from 2018 through 2022 (most recently available report). Over the twelve-year period covered by PPI's reports (2011-2022), the major wireless providers—AT&T, Sprint, T-Mobile, Verizon, UScellular (and Dish from 2020) invested a total of about \$591 billion,⁶ which is comparable to the \$611 billion combined investment of the "Big 5" tech companies—Alphabet (Google), Amazon, Apple, Meta (Facebook) and Microsoft.⁷ It is worth noting that the wireless industry's \$591 billion does not include the \$182 billion paid to the US Treasury from 2011 through 2022 for the spectrum licenses that power wireless networks.⁸

The wireless industry's combined average investment from 2011 through 2019 was \$47.7 billion. Therefore, the most recent average annual investment levels are 14 percent higher than they were throughout the 2010s, as shown in Figure 1.

Figure 1: Average Annual Wireless Company Capital Expenditures (billions).



Sources: PPI Investment Heroes reports, 2012-2023 for AT&T and Verizon, Annual 10-K reports for all other carriers.

How Wireless Capital Expenditures Compare to Other Major Investing Companies

To provide context for the magnitude of wireless investment, **Table 2 compares** the 2022 US capital expenditures for AT&T, Verizon, and T-Mobile⁹ to U.S capital expenditures of the other companies in PPI's top 25.¹⁰

Table 2: 2022 Capital Expenditures of Wireless and Other Major Investors

Rank	Company	Estimated 2022 Domestic Capital Expenditures (billions)	Percent of Total	Sector
1	Amazon	\$46.488	13.7%	Tech/internet & Ecommerce/retail
2	Meta (Facebook)	\$28.738	8.5%	Tech/internet
3	Alphabet (Google)	\$24.223	7.2%	Tech/internet
4	AT&T	\$23.539	7.0%	Wireless
5	Verizon	\$23.087	6.8%	Wireless
6	Microsoft	\$18.400	5.4%	Tech/internet
7	Intel	\$15.467	4.6%	Tech/internet
8	Walmart	\$14.232	4.2%	Ecommerce/retail
9	T-Mobile US	\$13.970	4.1%	Wireless
10	Comcast	\$12.221	3.6%	Cable
11	Duke Energy	\$11.367	3.4%	Energy distribution
12	PG&E	\$9.584	2.8%	Energy distribution
13	ExxonMobile	\$9.547	2.8%	Energy exploration and production
14	Charter Communications	\$9.376	2.8%	Cable
15	Chevron	\$8.856	2.6%	Energy exploration and production
16	Apple	\$8.435	2.5%	Tech/internet
17	Dominion Energy	\$7.758	2.3%	Energy distribution
18	Exelon	\$7.147	2.1%	Energy distribution
19	Conocophillips	\$6.721	2.0%	Energy exploration and production
20	FedEx	\$6.448	1.9%	Transportation
21	Delta Air Lines	\$6.366	1.9%	Transportation
22	General Motors	\$6.196	1.8%	Automotive
23	Target	\$5.528	1.6%	Ecommerce/retail
24	Tesla	\$4.869	1.4%	Automotive
25	United Airlines	\$4.819	1.4%	Transportation
26	Ford Motor	\$4.774	1.4%	Automotive
Total		\$338.156	100.0%	
Tech/internet		\$113.858	33.7%	
Wireless		\$60.596	17.9%	
Ecommerce/retail		\$47.653	14.1%	
Energy distribution		\$35.856	10.6%	
Energy exploration and production		\$25.124	7.4%	
Cable		\$21.597	6.4%	
Transportation		\$17.633	5.2%	
Automotive		\$15.839	4.7%	

Sources: PPI 2023 Investment Heroes Report, p. 3 (Table 1) and 2022 T-Mobile US 10-K report.

The table shows that in 2022, the major wireless companies were all among the top ten companies, with capital expenditures at a combined level of \$61 billion (18 percent of the capital expenditures among the top 26 companies).

The last column identifies the sectors PPI's most recent report assigned to each of its top 25 companies,¹¹ with two modifications. First, Amazon has many business interests, but two distinct revenue-producing services—Amazon Web Services (AWS) and amazon.com. Amazon Web Services is clearly part of the Tech/internet industry, with Google's and Microsoft's cloud services being major competitors. In accordance with analyst estimates, 40 percent of Amazon's capital expenditures are assigned to the Tech/internet sector and 60 percent to Ecommerce/retail.¹² Second, to evaluate the wireless industry on its own, PPI's Wireless/broadband sector has been replaced with separate Wireless and Cable sectors.¹³

Total investments within the sectors are listed in the bottom rows of the table. The Wireless sector had the second highest capital expenditures, ranking behind the Tech/internet sector. The top two sectors accounted for more than half the total capital expenditures for the year.

While recent wireless company capital expenditures are significant by themselves, as described in greater detail below, they provide the infrastructure that makes services provided by other companies more robust and capable, which in turn stimulates capital investments by those companies.¹⁴ For example, the expanding capacity of wireless networks makes devices such as smartphones more attractive, which, in turn, stimulates investment by Apple and other device providers. Among other "Big 5" tech companies, wireless infrastructure has facilitated the growth of social networking services, such as Meta's Facebook, and search engines (e.g., Google).¹⁵ In other words, rather than viewing capital expenditures by particular sectors in isolation, investments in sectors such as wireless are part of a virtuous circle that stimulates economic activity and investment in other sectors, which in turn provide incentives to increase further wireless quality and capacity.

Table 3 illustrates these interconnections. The table shows (1) the contribution to Gross Domestic Product¹⁶ of social networking and search engines facilitated by wireless (calculated in the Compass Lexecon report), (2) capital expenditures by Alphabet (Google) and Meta (Facebook) since 2016 (the first year Meta appeared in the PPI reports), and (3) wireless industry capital expenditures. GDP facilitated by wireless companies increased from \$88 billion in 2016 to \$226 billion four years later—an increase of 156 percent. Capital investment by Google and Facebook increased by 149 percent: from \$12 billion in 2016 to about \$30 billion in 2020.

Table 3: Wireless-Generated GDP Growth (billions)

Year	Wireless-Driven Search Engine and Social Networking Contribution to GDP	Alphabet & Facebook Investment	Wireless Industry Investment
2016	\$88.1	\$12.0	\$47.9
2017	\$123.5	\$12.8	\$49.9
2018	\$132.2	\$20.4	\$52.2
2019	\$221.7	\$32.6	\$53.1
2020	\$225.6	\$29.8	\$44.0

Sources: PPI Investment Heroes Reports, 2017 through 2023; Dish, T-Mobile, UScellular, and Sprint 10-K reports; and Compass Lexecon Report, pp. 37-39 (Appendix A).

Wireless Infrastructure Investment Has Produced Substantial Economic Benefits

Wireless network operators' capital expenditures are a relatively small percentage of US GDP,¹⁷ but the industry has an outsized impact on the overall economy. This effect occurs through four major channels. First, companies known as mobile virtual network operators (MVNO) that do not own their own wireless facilities leverage providers' networks and resell services to customers. Second, wireless infrastructure providers purchase inputs needed to build their networks from "upstream" companies. These purchases, as well as input purchased by wireless input suppliers further and further upstream generate additional economic activity. Third, purchases by the employees of wireless companies and upstream companies generate additional economic activity. Fourth, companies "downstream" from wireless companies offer services to their customers leveraging services offered by wireless companies, e.g., mobile apps to play video games and/or participate in video meetings.

A recent study used this framework to analyze how the four channels magnify the economic effects of wireless industry growth from 2011 through 2020.¹⁸ Table 4 presents the highlights. During the 2010s, the wireless industry and its upstream and downstream linkages experienced over \$520 billion in growth for their contribution to GDP (from \$303 billion to \$825 billion), which accounted for 9.1 percent of the \$5.72 trillion growth in US GDP. The employment outcome is similar. The 2.58 million increase in wireless-generated employment accounted for one-fourth of the 2010s 10.24 million growth in jobs.

Table 4: Wireless Industry-Generated Economic Growth: 2011-2020

Year	GDP (trillion)		Employment (Million)	
	Wireless-generated	US	Wireless-generated	US
2011	\$0.30	\$15.60	1.86	131.92
2020	\$0.83	\$21.32	4.45	142.16
Change	\$0.52	\$5.72	2.58	10.24
Percent of US growth		9.1%		25.2%

Sources: Compass Lexecon Report, pp. 37-39 (Appendix A), BLS, and BEA.

The impacts identified by Compass Lexecon may be conservative for two reasons. First, BEA's currently available wireless industry GDP data average about 10 percent higher for 2017 through 2020 than the values in the Compass Lexecon report, suggesting that the historical economic effects may be even larger. Second, while the linkages between the wireless industry and upstream firms were quite stable throughout the 2010s, i.e., a dollar increase in wireless industry GDP generated almost an additional three dollars of upstream GDP, the contribution of the wireless industry to downstream firms increased substantially as wireless connectivity grew in its importance to society, offering increased opportunities for downstream companies to leverage. In particular, one dollar in wireless GDP resulted in 18 cents of additional downstream GDP in 2011, but by 2020, the impact had increased to \$2.45, suggesting that as this trend continues, future economic benefits will be even larger.

The recent (post 2019) increases in wireless infrastructure investment (Table 1) are accompanied by lower prices and greater output, which have long been an important standard for evaluating economic performance.¹⁹ Turning first to prices, although the overall economy experienced high inflation relative to that experienced for several decades, wireless prices were essentially flat (or even decreasing by another measure). Figure 2 displays the recent trends in the consumer price index (CPI) for economy-wide prices and the CPI for wireless services.²⁰

Figure 2: Economy-wide and Wireless Price Indices: 2020-2023

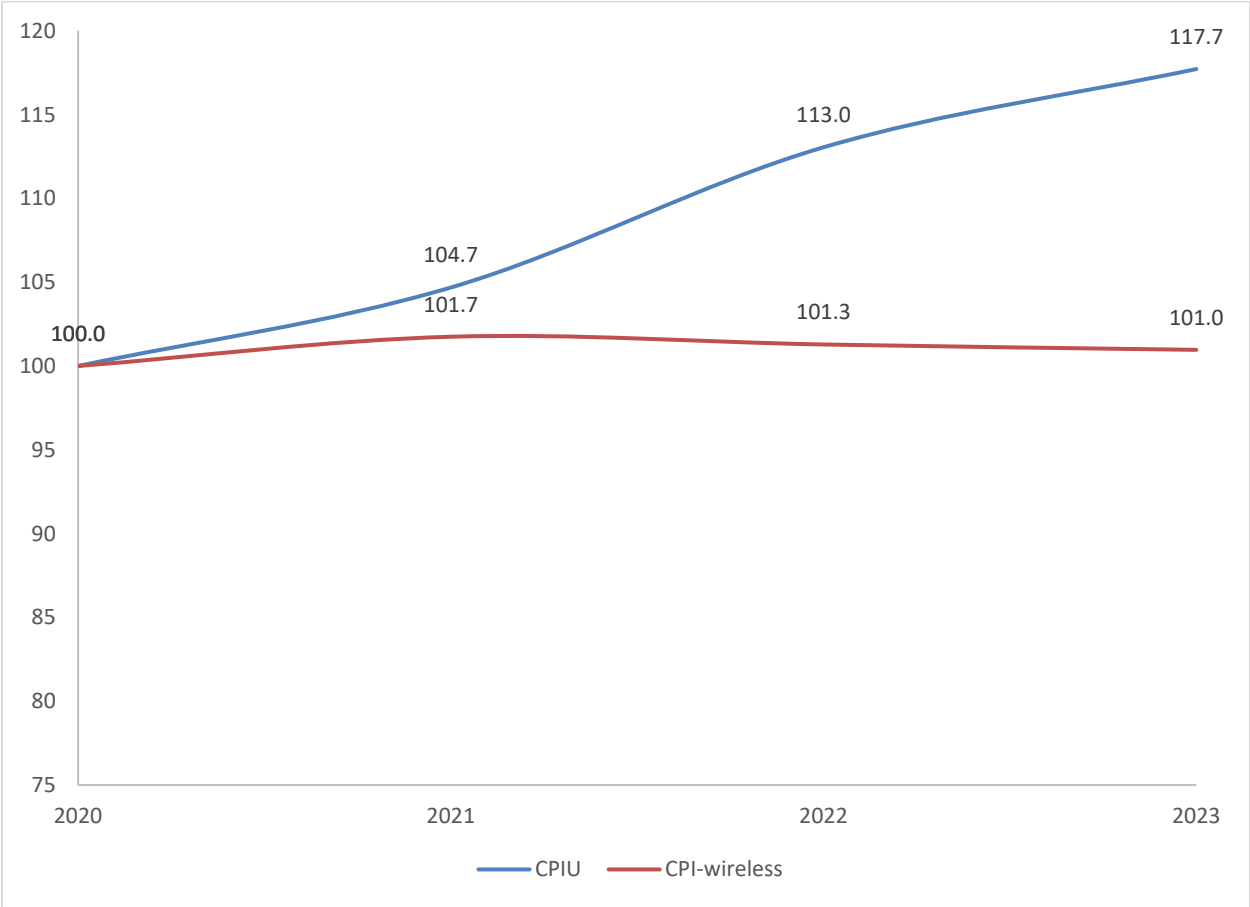


Figure 2 shows that while economy-wide prices increased by 18 percent from 2020 through 2023, wireless prices increased by only one percent.²¹ Relative to economy-wide prices, between 2020 and 2023 wireless prices (real prices) decreased by 14.2 percent (5.0 percent annually).²²

Wireless output also increased substantially during the post-2019 years, likely in part due to the emergence of COVID and the increasing use of video conferencing as a substitute for in-person meetings and conversations. Previous and ongoing wireless infrastructure investment provided the capacity for smartphone and other wireless-device users to participate. The increase in data traffic is especially instructive, as shown in Table 5.²³

Table 5: Increase in Data Traffic: 2020-2022

Year	Data Traffic (trillion megabits)	Monthly Traffic Per Unit (gigabits)
2020	42.2	7.7
2021	53.4	9.1
2022	73.7	11.9
2020-2022 Increase	31.5	4.2
2020-2022 Growth	75%	55%
Average Annual Growth	32%	24%
2011-2019 increase	36.7	6.9

Source: CTIA's Wireless Industry Indices Report, Year End 2022 Results, p. 13, Chart 2 and p. 15, Chart 4.0

Total data traffic increased 75 percent in two years, which represents an annual growth rate of 32 percent. Traffic per unit increased somewhat less—by 55 percent (24 percent annually).²⁴ The increases in the volume of data traffic over the two-year period in Table 5 represent a substantial proportion of data traffic volumes that emerged in the 2010s: the 31.5 trillion MB increase in total traffic is 86 percent of the increase of the previous nine years. Similarly, the 4.2 GB per month in traffic per unit is 61 percent of the growth during the previous nine years.

Conclusion

Wireless network operators have been among the leading investors in the US economy, with average annual capital expenditures of \$54 billion since 2020. Only the Tech/internet sector has exceeded this level of investment in recent years. Since 2011, the major wireless providers' capital expenditures of \$591 billion are comparable to the capital expenditures of the "Big 5" tech companies.

The increased quality and capacity of wireless infrastructure enabled by this investment has produced economic benefits throughout the economy—a recent study attributed 9 percent of the growth from 2011 to 2020 in US GDP and 25 percent of the growth in US employment to economic activity facilitated by wireless providers. Wireless capital expenditures in subsequent years have supported increased wireless data consumption—all while prices have remained stable during an inflationary period—facilitating continuing economic growth.

¹ T-Mobile US 2020 Form 10-K was the first year to include the recently completed merger with Sprint.

² Dish's significant 5G/wireless investment began in 2020.

³ These wireless providers' 2023 10-K reports list \$55 billion in capital expenditures. Consistent with PPI, AT&T's capital expenditure amount (1) includes vendor financed purchases and (2) multiplies the sum of capital expenditures and vendor financing by the proportion of total net plant used for US operations (about 97 percent).

⁴ In addition to these four national carriers, the Federal Communications Commission's 2022 Communications Marketplace Report lists larger regional carriers and "dozens of other facilities-based mobile wireless service providers throughout the United States, many of which provide service in a single, often rural, geographic area." Federal Communication Commission, 2022 Communications Marketplace Report, GN Docket No. 22-203, December 30, 2022, par. 64, available at https://docs.fcc.gov/public/attachments/FCC-22-103A1_Rcd.pdf.

⁵ See, for example, Michael Mandel and Jordan Shapiro, *Investment Heros 2023*, Progressive Policy Institute, October 2023, available at <https://www.progressivepolicy.org/wp-content/uploads/2023/10/PPI-Investment-Heroes-2023.pdf>.

⁶ PPI updated its methodology for calculating AT&T's 2021 capital expenditures to include payment of vendor financing. Michael Mandel and Jordan Shapiro, *Investment Heros 2022: Fighting Inflation with Capital Investment*, Progressive Policy Institute, July 2022, p. 12, available at <https://www.progressivepolicy.org/wp-content/uploads/2022/07/InvestmentHeroesPPI2022.pdf>. Had PPI updated its calculation in the first year the line item appeared (2018), the 2011-2022 wireless capital expenditures would total about \$598 billion.

⁷ Based PPI for AT&T and Verizon and on annual 10-K reports for the other carriers. Total wireless investments for 2020 through 2022 are listed in Table 1. For the "Big 5" tech companies, in years in which particular companies were not among PPI's top 25, the investment for the 25th company was used as a conservatively high estimate.

⁸ Federal Communications Commission, 2025 Budget Estimates to Congress, March 2024, available at <https://docs.fcc.gov/public/attachments/DOC-401057A1.pdf>.

⁹ In 2011 and 2012, Sprint-Nextel was the 16th and 13th largest company, respectively. While PPI does not include T-Mobile, because it is owned by a non-US company, it observed that its 2021 capital expenditures were more than \$12 billion, as shown in Table 1. Mandel and Shapiro, *supra* note 6, p. 11.

¹⁰ Mandel and Shapiro, *supra* note 5, p. 3 (Table 1). The authors observe: "All told, the 25 companies in the Investment Heroes list invested \$324 billion in the US in 2022 (Table 1)."

¹¹ *Ibid.*, pp. 7-8.

¹² A recent article reported that 40 percent of Amazon's capital expenditures went to its AWS service. Sebastian Moss, "AWS revenues increase 12%, 'significant capital expense' goes to generative AI," *The Investment & Markets Channel*, August 4, 2023, available at <https://www.datacenterdynamics.com/en/news/aws-revenues-increase-12-significant-capital-expense-goes-to-generative-ai/>.

¹³ Broadband/internet account for only 11 percent of AT&T's and Verizon's wireless plus broadband revenues (AT&T 2023 10-K report, pp. 24 and 26; Verizon 2023 10-K report, pp. 30-31). For Comcast

and Charter, internet revenues accounted for 42 percent of residential revenue (Comcast 2023 10-K report, p. 71; Charter 2023 10-K report, p. 37).

- ¹⁴ Amazon's 2023 Form 10-K (pp. 2-3) describes how its customers access its services through mobile apps and lists among its actual and potential competitors various internet-based operations: "Customers access our offerings through our websites, mobile apps, Alexa, devices, streaming, and physically visiting our stores...Our current and actual competitors include...web search engines, comparison shopping websites, social networks, web portals, and other online and app-based means of discovering, using, or acquiring goods and services, either directly or in collaboration with other retailers..."
- ¹⁵ Aren Megerdichian, *The Importance of Licensed Spectrum and Wireless Telecommunications to the American Economy*, prepared for CTIA, December 7, 2022, available at <https://api.ctia.org/wp-content/uploads/2022/12/Compass-Lexecon-Licensed-Spectrum-Report.pdf>, ("Compass Lexecon Report").
- ¹⁶ Gross Domestic Product is the total market value of the final goods and services produced within the United States in a year. Bureau of Economic Analysis (BEA), *What is GDP?*, available at <https://www.bea.gov/system/files/2020-04/GDP-Education-by-BEA.pdf>. Value added is the contribution of a particular industry (or sector) to GDP.
- ¹⁷ The Bureau of Economic Analysis produces economy-wide and industry-level GDP data (available at <https://apps.bea.gov/iTable/?reqid=150&step=2&isuri=1&categories=ugdp&ind=1&unit=1&year=2022>). In 2022, the wireless industry accounted for 0.7 percent of US GDP.
- ¹⁸ Compass Lexecon Report, *supra* note 15, pp. 23-34 identified five downstream industries: (1) social networking, (2) mobile gaming, (3) smart phone apps, (4) search engines, and (5) digital advertising.
- ¹⁹ See, for example, Herbert Hovenkamp, *Antitrust in 2018: The Meaning of Consumer Welfare Now*, 58 Wharton. Public Policy Initiative. Issue Briefs (2018), <https://repository.upenn.edu/pennwhartonppi/58>. In evaluating competitive performance, the consumer welfare standard analyzes whether output increases and/or prices (broadly defined) decrease. Macroeconomic measures, such as the contribution of particular industries to total economywide GDP, do not capture the full effect of improvements in price and output improvements. For example, if an industry's output expanded by the same percentage as its prices decreased (relative to the overall economy), its share of total GDP would not change, even though consumers are clearly better off from consuming more at lower prices.
- ²⁰ There is one alternative measure of economy-wide inflation—the price index for gross national product (GDP-PI)—and two alternate measures of wireless prices—producer price index (PPI-wireless), and GDP-PI-wireless. CPI data are available at <https://data.bls.gov/PDQWeb/cu> and PPI data are available at <https://data.bls.gov/PDQWeb/pc>. CPI-wireless differs from PPI-wireless because (1) it includes retail taxes, while the PPI does not and (2) it is based only on urban consumers, while PPI includes both urban and rural. See <https://www.bls.gov/ppi/factsheets/producer-price-index-for-wireless-telecommunications-carriers-naics-517312.htm>. Annual GDP price index data from 2017 through 2022 are from the Bureau of Economic Analysis (BEA) is available at the same site identified in note 17 *supra*.
- ²¹ Figure 2 displays average annual prices. The price changes from January 2020 through December 2023 were 19.2 percent and 1.9 percent for CPIU and CPI-wireless. The change in the PPI-wireless was 2.3 percent. The GDP-PI wireless had actually decreased by more than seven percent through 2022.

²² The decrease in the real PPI wireless was and 12.8 percent (4.5 percent annually). The real wireless price as measured by GDP-PI-wireless decreased even more—by 17.3 percent between 2020 and 2022 (9.0 percent annually).

²³ Robert F. Roche and Sean McNicholas, CTIA’s Wireless Industry Indices Report: Year-End 2022 Results, July 23, 2023.

²⁴ *Ibid.*, p. 18. Table 2 shows that the average number of wireless units increased from 448 million to 503 million between 2020 and 2022, or by 12.3% (6.0% annually). This growth is comparable to the output growth in the BEA’s real value added data (available at the link in note 17 *supra*) of 15.2% between 2020 and 2022 (7.3% annually). In contrast, economywide real GDP grew by 7.8 percent (3.8% annually).