NTCA-USF Study

Universal Service Contribution Methodology

Michael A. Williams, Ph.D. and Wei Zhao, Ph.D.

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TABLE OF CONTENTS

I. INTRODUCTION AND SCOPE OF THE REPORT

A. *Summary of qualifications*

Michael A. Williams

1. My name is Michael A. Williams. I am a Managing Director at Berkeley Research Group, LLC.[1] I specialize in analyses involving antitrust, industrial organization, and regulation. I have published articles in a number of academic journals, including *Proceedings of the National Academy of Sciences*, *Science Advances*, *American Economic Review*, *Journal of Law and Economics*, *International Journal of Industrial Organization*, *Journal of Industrial Economics*, *Physica A*, *Journal of Economics & Management Strategy*, *Economics Letters*, *Journal of Public Economic Theory*, *Behavioral Science*, *Review of Industrial Organization*, *Antitrust Bulletin*, *Texas Law Review*, and the *Yale Journal on Regulation*.

2. I have provided testimony before the United States District Court, Middle District of Alabama; United States District Court, Western District of Arkansas; United States District Court, Central, Northern, and Southern Districts of California; United States District Court, District of Delaware; United States District Court, Middle District of Florida; United States District Court, Northern District of Georgia; United States District Court, Eastern Division, District of Idaho; United States District Court, Northern and Southern Districts of Illinois; United States District Court, District of Kansas; United States District Court, District of Massachusetts; United States District Court, District of Minnesota; United States District Court, District of New Jersey; United States District Court, Eastern and Southern Districts of New York; United States District Court, Eastern District of Pennsylvania; United States District Court, Eastern District of

[1] The views and opinions expressed in this article are those of the authors and do not necessarily reflect the opinions, position, or policy of Berkeley Research Group, LLC or its other employees and affiliates.

Tennessee; United States District Court, Northern and Southern Districts of Texas; United States District Court, District of Utah; United States District Court, Eastern District of Virginia; United States Court of Federal Claims; State of Connecticut, Superior Court; State of New Mexico, Second Judicial District; State of Nevada, Gaming Commission and State Gaming Control Board; public utilities commissions in Arkansas, Hawaii, Michigan, Minnesota, Missouri, Nebraska, New Mexico, Texas, and Washington; and The Netherlands, Amsterdam District Court.

3. I have been retained as an economic consultant by the U.S. Department of Justice, Antitrust Division, the U.S. Federal Trade Commission, and the Canadian Competition Bureau. Previously, I was an economist with the U.S. Department of Justice, Antitrust Division.

4. I hold a B.A. degree in economics from the University of California, Santa Barbara, and I received my M.A. and Ph.D. degrees in economics from the University of Chicago. My résumé, which contains more information on my background and qualifications, is contained in Appendix I.

Wei Zhao

5. My name is Wei Zhao. I am a Managing Director at Berkeley Research Group, LLC (BRG). I specialize in analyses involving antitrust, industrial organization, and regulation. I have published articles in a number of academic journals, including *RAND Journal of Economics, Mathematical Social Sciences, Review of Industrial Organization, Physica A, Virginia Law & Business Review, University of Cincinnati Law Review*, and *ABA Economics Committee Newsletter*.

6. I have been an economic consultant to the U.S. Department of Justice, the U.S. Federal Trade Commission, and the Canadian Competition Bureau, as well as many leading law firms in the United States. I have provided testimony before the United States District Court, Northern District of Georgia. I hold a B.A. degree in finance from the Remin University of China,

an M.A. from Columbia University, and a Ph.D. in economics from the Johns Hopkins University. During my studies at Johns Hopkins, I served as a lecturer for the graduate-level course Mathematical Methods for Economists. My résumé, which contains more information on my background and qualifications, is contained in Appendix I.

B. *Assignment*

7. We were previously asked by NTCA–The Rural Broadband Association (NTCA) to analyze from an economic perspective the appropriate contribution methodology for the federal Universal Service Fund (USF). In a prior study we analyzed the effects of modifying and expanding the "contribution base," i.e., the supply of financial resources for the USF, to include both voice and broadband connections.[2] In particular, our prior study investigated the economic effects of modifying and expanding the contribution base on broadband adoption rates. In this paper, we have been asked by NTCA to evaluate and respond to critiques of our prior study as submitted to the Federal Communications Commission (FCC).

8. NTCA represents nearly 850 independent, community-based telecommunications companies that provide telecommunications and broadband services in rural and small-town America. NTCA advocates on behalf of its members in matters relating to legislative and regulatory needs, organizes training, development, industry events, and offers an array of employee benefit programs.

C. *Outline of report*

9. Section II presents an executive summary of our prior report and the current paper. Section III provides industry background on the evolution of the USF and why the contribution

[2] NTCA-USF Study, Expert Report of Michael A. Williams, Ph.D. and Wei Zhao, Ph.D., May 7, 2020.

methodology must be updated, including updated estimates of how such reforms would translate into monthly charges to consumers. Section IV presents an updated analysis of how contribution reform would affect broadband adoption and retention, along with responses to recent critiques of our prior findings. Section V contains our conclusions.

II. EXECUTIVE SUMMARY

10. This section summarizes our findings and conclusions. The facts or data upon which we are basing the opinions and inferences discussed in this report are of a type reasonably relied upon by experts in the field of Industrial Organization.[3]

11. The primary conclusions from our prior 2020 study are summarized as follows:

- We examined from an economic perspective the effects of modifying and expanding the "contribution base"—the supply of financial resources—for the USF to include both voice and broadband connections. We investigated the economic effects of the proposed contribution base modification and expansion on broadband adoption rates.

[3] The field of Industrial Organization has been defined as: "the study of the structure of firms and markets and of their interactions." Carlton, D. and Perloff, J. (2005), *Modern Industrial Organization*, 4th ed., Boston, MA: Pearson Addison-Wesley, p. 2. As one well-known textbook summarizes: "A focus and concern with market power underpins industrial organization. . . . What are the determinants of market power? How do firms create, utilize, and protect it? When are antitrust enforcement or regulation appropriate policy responses to the creation, maintenance, or exercise of market power?" Church, J. and Ware, R. (2000), *Industrial Organization: A Strategic Approach*, Boston, MA: Irwin McGraw-Hill, p. vii. For this reason, Industrial Organization textbooks contain extended analyses of antitrust issues. *See*, for example, Carlton, D. and Perloff, J. (2005), *Modern Industrial Organization*, 4th ed., Boston, MA: Pearson Addison-Wesley, Chapters 4, 5, 11, and 19; Church, J. and Ware, R. (2000), *Industrial Organization: A Strategic Approach*, Boston, MA: Irwin McGraw-Hill, Chapters 1, 5, 6, 7, 10, 19, 20, 21, 22, and 23; and Belleflame, P. and Peitz, M. (2015), *Industrial Organization: Markets and Strategies*, Cambridge University Press, Chapters 14, 15, 16, and 17.

- We conducted a survey that measures the effects on consumer broadband adoption and retention caused by including broadband internet access services in the contribution base. The survey conducted a robust examination of consumer preferences and sensitivities.
- For the survey, we adhered to generally accepted principles of questionnaire design to minimize the probability of various forms of "response bias," which "occurs when respondents either consciously or unconsciously tend to answer questions with a certain slant that misrepresents the truth."[4]
- The economic literature supports the conclusion that the demand for broadband connection has become more inelastic—i.e., less sensitive to price changes, over time.
- The results of the survey supported this conclusion. The estimated percentage reduction in demand for broadband services was approximately 0.08% for every 1% increase in total service fees.
- This was a conservative estimate based on the number of total accessible connections, and it did not take into account any other gains in broadband adoption that might be realized and sustained as a result of programs supported by the USF.

12. Several critiques raised in the record before the FCC with respect to our prior paper, and our responses to these critiques, are summarized as follows.

[4] Zikmund, W., D'Alessandro, S., Winzar, H., Lowe, B., and Babin, B. (2017), *Marketing Research: Asia-Pacific Edition*, Cengage.

- NCTA – The Internet & Television Association (NCTA) commented on our prior study, arguing that the survey methodology was "unclear and potentially flawed."[5] NCTA is incorrect. The survey analysis and the methodology used in our prior study are both explained in clear and painstaking detail. In fact, the entire survey design is attached to our prior study as a lengthy appendix, detailing every step of our survey analysis such that another survey expert could use it to replicate our survey design.[6]
- Dr. Roslyn Layton also commented on our prior study.[7] As we discuss below, her criticisms of our paper miss the mark altogether because they are not grounded in well-established and commonly accepted economic principles, analysis, and literature.
- In sum, we continue to find that modifying the USF contribution methodology to include both voice and broadband connections within the contribution base would not have a material impact on broadband adoption or retention.

III. INDUSTRY BACKGROUND AND THE NEED TO MODIFY THE USF CONTRIBUTION METHODOLOGY

13. Transformative innovations in the field of communications have tremendously impacted our daily lives in a significant and long-lasting way. The presence of computers and smartphones has grown considerably in recent years, connecting people all over the world. Among

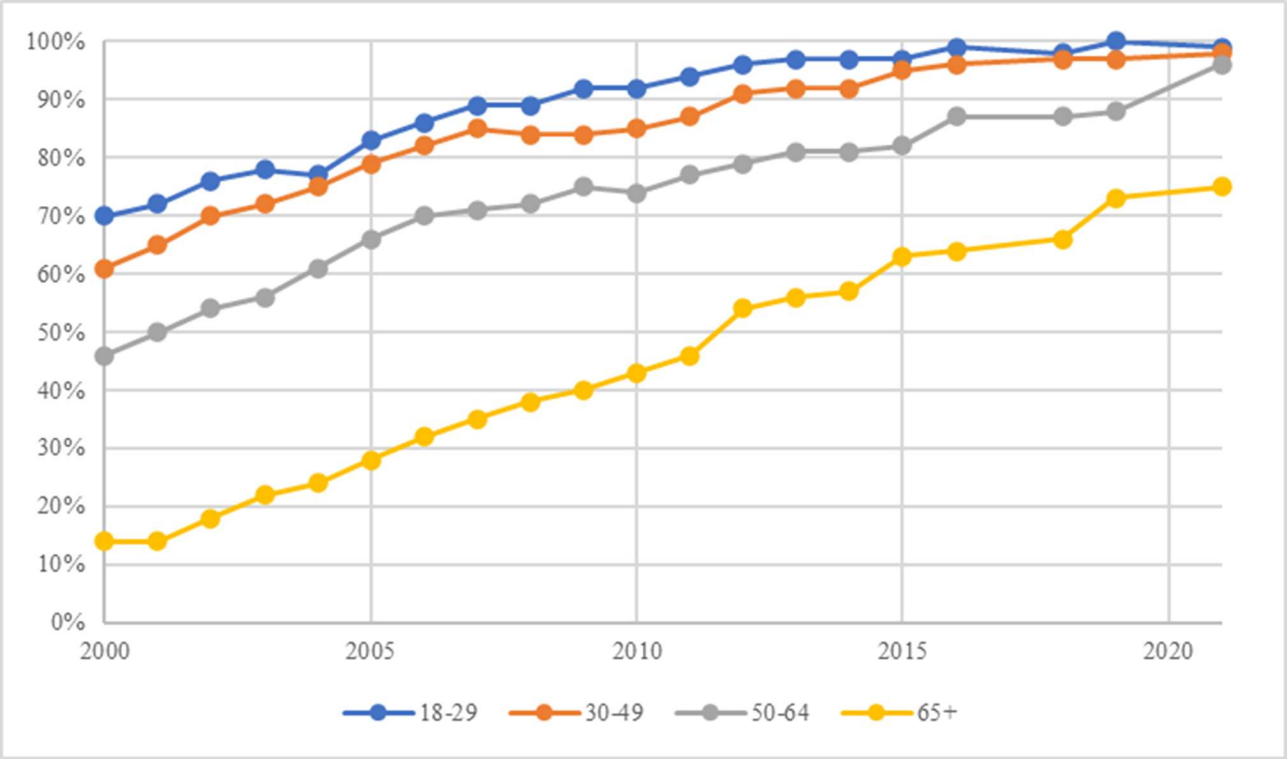
[5] NCTA, "Comments of NCTA," February 17, 2022, p. 19, footnote 43.

[6] NTCA-USF Study, Expert Report of Michael A. Williams, Ph.D. and Wei Zhao, Ph.D., May 7, 2020, Appendix II.

[7] Layton, R. (August 1, 2022), Letter to the FCC, p. 5.

all U.S. households in 2018, 92 percent had at least one type of computer, smartphones were present in 84 percent of households, and 85 percent had a broadband internet subscription.[8] As shown in Figures 1 and 2, demand for advanced Internet connectivity has been increasing among all adult demographics.

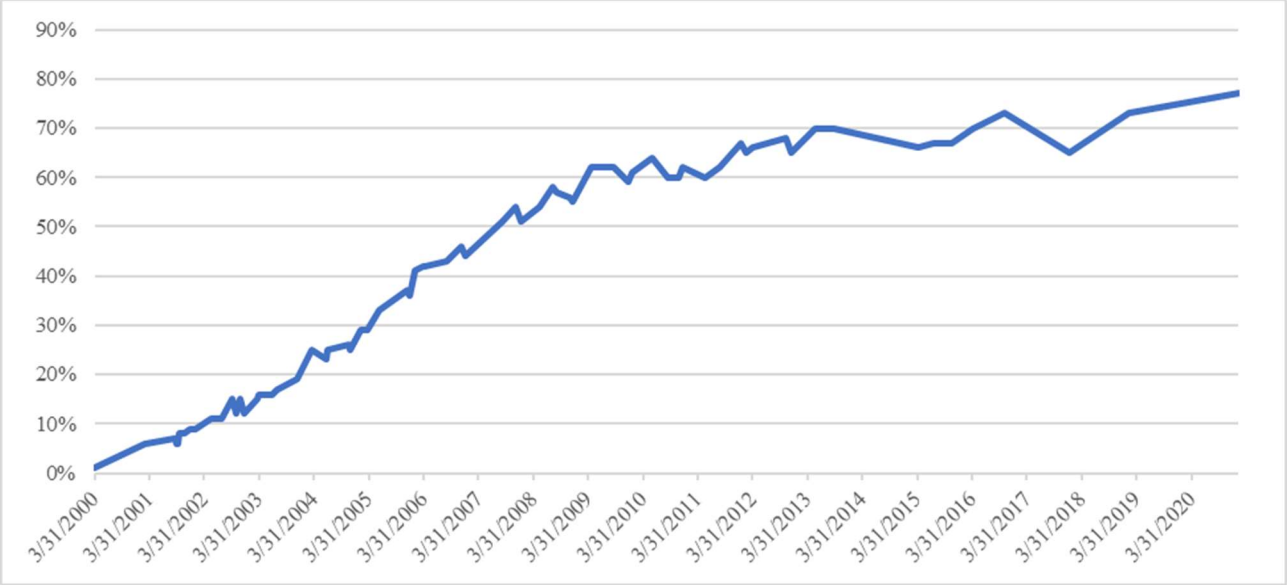
FIGURE 1
PERCENTAGE OF U.S ADULTS WHO USE THE INTERNET, BY AGE



Source: "Internet/Broadband Fact Sheet," Pew Research (April 7, 2021), available at https://www.pewresearch.org/internet/fact-sheet/internet-broadband/

[8] "Computer and Internet Use in the United States: 2018," U.S. Census Bureau (April 21, 2021), available at https://www.census.gov/newsroom/press-releases/2021/computer-internet-use.html.

FIGURE 2
PERCENTAGE OF U.S ADULTS WITH BROADBAND CONNECTIONS AT HOME



Source: "Internet/Broadband Fact Sheet," Pew Research (April 7, 2021), available at https://www.pewresearch.org/internet/fact-sheet/internet-broadband/

14. The Telecommunications Act of 1996 was the first major amendment to the Communications Act of 1934. The Act created a regulated platform to encourage competition in the provision of various communications services.[9] Among other factors, changes in the technical capabilities of and consumer demand for communications services in the preceding two decades led to the Act. One of these key technical innovations was development of digitally based information processing. The ever-changing structure of this industry progressed out of the binds of the outdated rules and regulations, warranting a revision. Though the terms of regulation may have changed and technology has evolved dramatically, the core principle of "Universal Service" continues to be maintained as a vital public policy by Congress and the FCC.

[9] Aufderheide, P. (1999) *"Communications Policy and the Public Interest: The Telecommunications Act of 1996"* Guilford Publications; pp 1-37.

A. *Universal Service Fund*

15. The Universal Service Administrative Company (USAC)[10] calculates collections of contributions for the USF under the direction of the FCC. The FCC's annual monitoring report tracks contributions and disbursements. The USF is collected in order to support four crucial programs: the high-cost program, the schools and libraries (or "E-rate") program, the rural health care program, and the lifeline program. Each of these programs has multiple sub-programs and components. The 2021 total program collection (revenue requirement) for all of the four programs totaled approximately $8.6 billion.[11]

B. *Evolution of the USF and the need to expand the contribution base*

16. Since 2010, the FCC has taken a series of steps to reform and "modernize" the various USF programs to orient them more toward furthering access to and use of broadband internet access services. For example, in 2011, the FCC rechristened parts of the High-Cost program as the "Connect America Fund," and for the first time attached broadband buildout obligations to the distribution of support.[12] The FCC has taken similar steps with respect to other

[10] USAC *available at* https://www.usac.org/about/.

[11] "2021 Annual Report," Universal Service Administration, p. 5, available at https://www.usac.org/wp-content/uploads/about/documents/annual-reports/2021/2021_USAC_Annual_Report.pdf. *See also* USAC quarterly contribution factor announcements at "Contribution Factor & Quarterly Filings - Universal Service Fund (USF) Management Support," FCC, available at https://www.fcc.gov/general/contribution-factor-quarterly-filings-universal-service-fund-usf-management-support.

[12] *Connect America Fund, et al.,* WC Docket No. 10-90, et al., Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663 (2011).

parts of the High-Cost program in ensuing years,[13] as well as the other USF programs.[14] Thus, as of 2022, all of the programs share the objective of promoting affordable access to high-speed connectivity for rural and low-income consumers, for schools and libraries, and for rural health care facilities.

17. The USF does not receive any federal appropriations. Instead, to fund the program, telecommunications carriers must contribute to the federal USF based on a percentage of their end-user interstate and international telecommunications service revenues. Providers of interstate telecommunications (a distinct class of service under the statute[15]) may also be required to contribute "if the public interest so requires" as determined by the Commission. The Commission has previously used this permissive authority to require other kinds of providers, such as interconnected Voice over Internet Protocol (VoIP) services for example, to contribute likewise based upon a certain percentage of their revenues.[16] The FCC determines each quarter what the "contribution factor" – the percentage of assessable revenues that each contributor must pay into the USF – based on the ratio of (1) total projected quarterly costs of the universal service support

[13] *See*, for example, *Connect America Fund, et al.,* WC Docket No. 10-90, et al., Report and Order, Notice of Proposed Rulemaking, Order, and Order on Reconsideration, 31 FCC Rcd 3087 (2016); *Rural Digital Opportunity Fund,* WC Docket No. 19-126, Notice of Proposed Rulemaking, 34 FCC Rcd 6778 (2019).

[14] *See*, for example, *Lifeline and Link-Up Modernization, et al.,* WC Docket No. 11-42, et al., Order on Reconsideration, 31 FCC Rcd 3962 (2016); *Rural Healthcare Support Mechanism,* WC Docket No. 02-60, Report and Order, 27 FCC Rcd 16678 (2012); *Modernizing the E-Rate Program for Schools and Libraries,* WC Docket No. 13-184, Second Report and Order and Order on Reconsideration, 29 FCC Rcd 15538 (2014).

[15] *Compare* 47 U.S.C. § 15(50) and (53).

[16] *Universal Service Contribution Methodology, et al,* WC Docket No. 06-122, *et al*., Report and Order and Notice of Proposed Rulemaking, 21 FCC Rcd 7518 (2006).

mechanisms to (2) contributors' total projected collected assessable revenues, net of projected contributions.[17]

18. The companies contributing currently to the federal USF include wireline telecommunications service providers, wireless telecommunications service providers, and certain VoIP providers.[18] Thus, although all of the USF programs have been amended to promote broadband deployment and/or enable broadband adoption as described above, the current revenue-based "contribution base" for the USF does not include broadband services as a contributing element. The FCC allows, but does not require, contributors to the USF to recover the cost of their USF contributions from end user ratepayers. Thus, consumers may have a "Universal Service" line item among their telecommunications and telecommunications service charges,[19] but these surcharges today do not apply to broadband services procured by end user customers.

19. In recent years, the contribution base for the USF has been shrinking as consumers and businesses migrate from traditional telecommunications services towards more data-intensive communications services, such as broadband internet access. The shift in the FCC's own programs to emphasize broadband deployment and adoption have contributed to this trend. For example, in the first quarter of 2010, USAC reported that the contribution base would be $17.25 billion. By contrast, USAC stated that the contribution base for first quarter 2022 was $9.2 billion—a 47% decrease in the contribution base over the last twelve years.[20] Yet, projected quarterly

[17] Proposed Fourth Quarter 2019 Universal Service Contribution Factor (12 September 2019), CC Docket No. 96-45; FCC Public Notice.

[18] Federal Lifeline Program: Frequently Asked Questions available at https://fas.org/sgp/crs/misc/R44487.pdf.

[19] *Id.*

[20] *See* "Federal Universal Service Support Mechanisms Quarterly Contribution Base for the First Quarter 2022," Universal Service Administrative Company, Before the Federal Communications

funding/collection requirements for the USF have actually *decreased* as well over the years — from $2.11 billion in the first quarter of 2010 to $1.84 billion for the first quarter of 2022.[21]

20. The declining revenue base has led to a marked increase in the contribution factor, from 6.7% for the first quarter of 2001, to 14.1% for the first quarter of 2010, to 25.2% for the first quarter of 2022 (*see* Figure 3).[22] Despite the increase in the USF contribution factor, the total size of the USF from a distribution perspective has been essentially unchanged since 2010. Beyond the quarterly comparisons referenced above, for the entirety of 2010, the USF disbursed approximately $8 billion in support.[23] The (unaudited) disbursement value for 2021 was $8.6 billion,[24] representing less than eight percent total growth in annual disbursements over this eleven-year period. Thus, it seems clear that the increase in the contribution factor can be attributed almost entirely to the shrinking base of revenues in the contribution base as currently constituted.[25]

Commission, (December 2, 2021), available at https://www.usac.org/wp-content/uploads/about/documents/fcc-filings/2022/first-quarter/financials/USAC-1Q2022-Universal-Service-Contribution-Base-Filing.pdf, from https://www.usac.org/about/reports-orders/fcc-filings/.

[21] *See* "Proposed First Quarter 2022 Universal Service Contribution Factor, CC Docket No. 96-45," Federal Communications Commission, Public Notice, DA 21-1550 (December 13, 2021), available at https://www.fcc.gov/document/proposed-1q-2022-usf-contriibution-factor-252, from https://www.fcc.gov/general/contribution-factor-quarterly-filings-universal-service-fund-usf-management-support.

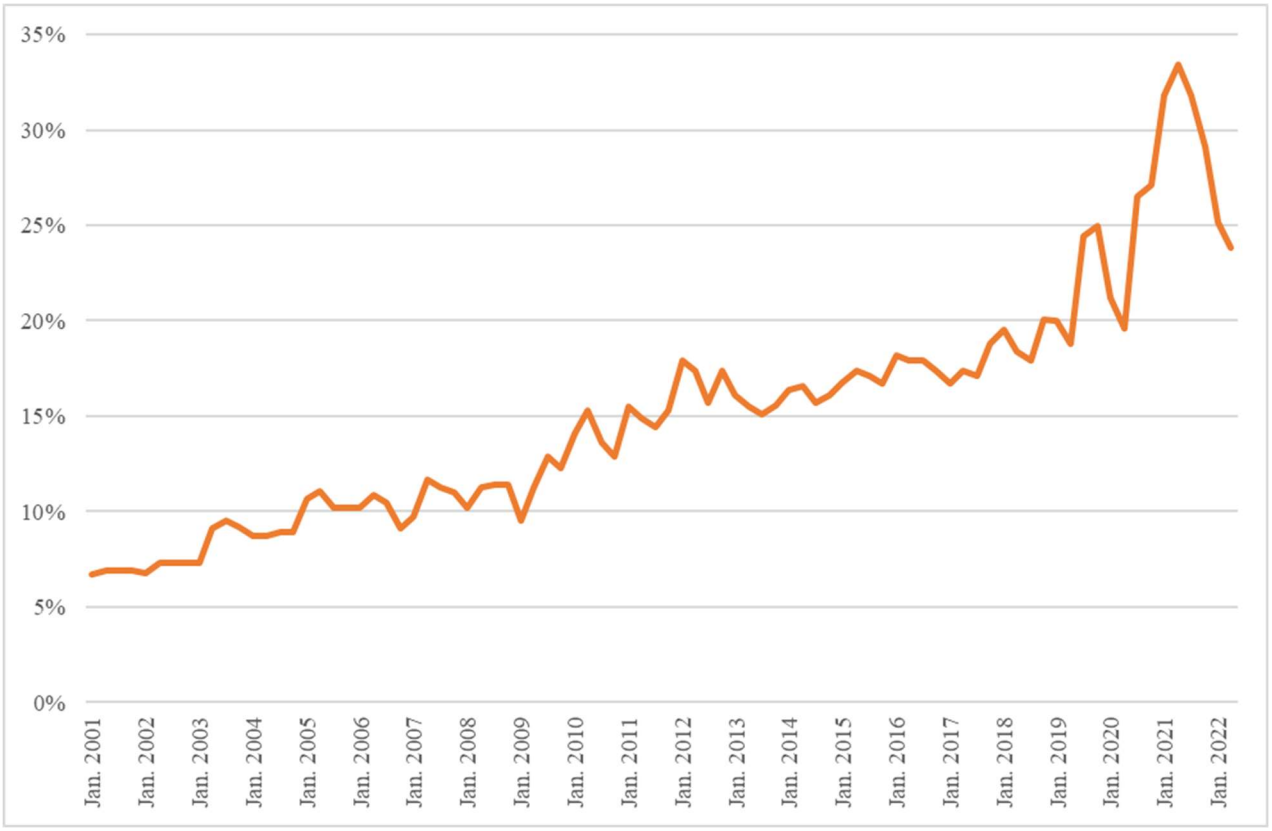
[22] From FCC Public Notices *available at*: https://www.fcc.gov/general/contribution-factor-quarterly-filings-universal-service-fund-usf-management-support.

[23] "2010 Annual Report," Universal Service Administration, p. 4, available at https://www.usac.org/wp-content/uploads/about/documents/annual-reports/2010/2010-Annual-Report.pdf, from: https://www.usac.org/about/reports-orders/annual-report/.

[24] "2021 Annual Report," Universal Service Administration, p. 5, available at https://www.usac.org/wp-content/uploads/about/documents/annual-reports/2021/2021_USAC_Annual_Report.pdf, from: https://www.usac.org/about/reports-orders/annual-report/.

[25] *See* Comments of Free Press submitted before the Federal Communications Commission (2019); WC Docket No. 06-122.

FIGURE 3
QUARTERLY CONTRIBUTION FACTOR FOR UNIVERSAL SERVICE FUND



Source: "Contribution Factor & Quarterly Filings - Universal Service Fund (USF) Management Support," FCC, available at https://www.fcc.gov/general/contribution-factor-quarterly-filings-universal-service-fund-usf-management-support.

21. In light of the trends with respect to the contribution factor specifically and the communications marketplace more broadly, the FCC has examined a few times over the past fifteen years whether and how it might reform the USF contribution methodology to promote the sustainability of the programs and ensure that contributions continue to be equitable and nondiscriminatory.[26] One option that has been proposed by some parties, as discussed further below,

[26] *Universal Service Contribution Methodology et al.,* WC Docket No. 06-122 et al., Report and Order and Notice of Proposed Rulemaking, 21 FCC Rcd 7518 (2006); *Universal Service Contribution Methodology et al.,* WC Docket No. 06-122 et al., Further Notice of Proposed Rulemaking, 27 FCC Rcd 5357 (2012).

would be to include broadband internet access services within the "contribution base." Recovering USF contributions from broadband services in addition to services already contributing today would clearly reduce the escalating contribution factor currently applied only to interstate and international telecommunications services and selected offerings of telecommunications. Some, however, have conjectured that doing so would have a negative effect on broadband adoption, contrary to the goals of universal service.

C. *Estimating a contribution factor based upon reform that would assess both voice and broadband connections*

22. In our 2020 paper, to provide an empirical economic analysis of the broad conjectures made by some parties regarding how contribution reform would affect broadband adoption, we evaluated the effect of a "per-connection" USF contributions assessment on consumer procurement and retention of broadband services. While the current contributions mechanism is "revenues-based" as described above, and while parties have proposed a variety of methods for reform, our 2020 paper reviewed a connections-based approach for purposes of this analysis simply to leverage publicly available data to the greatest extent possible upon existing connections and to be able to map consumer effects based upon each consumer's clearly established "connections" rather than varying "telecom spends" that may be harder for any consumer to identify and isolate from month to month. We provide here an updated assessment of that approach, leveraging more recent data as indicated below.

23. To develop such an analysis, as shown in Table 1 below, we start from FCC data on the total number of U.S. voice and broadband connections and the total USF disbursement budgets. Using such data, we estimate that the monthly contribution per connection would be $1.53 based upon current fixed and mobile voice connections if such connections were used as the

assessable unit in place of telecommunications service revenues.[27] If broadband internet access service connections were included in the contribution base, however, we estimate that the monthly contribution per connection would fall to $0.77–which means that there would be a USF surcharge of $0.77 per month upon broadband connections that did not apply previously, but also a $0.76 reduction in USF surcharges per month per connection for voice services.[28] For purposes of this analysis, and to mitigate any concern that the most price-sensitive customers might be adversely affected by the inclusion of broadband within the contribution base as revised, we also assumed for purposes of our analysis that any subscriber receiving Lifeline USF support would not be subject to a per-connection assessment.

[27] We recognize that there are certain telecommunications services—specifically, business data services or "special access connections"—that are not included within this analysis even though they are part of the revenues-based USF contribution base today. To our knowledge, unfortunately, there is no reliable publicly available comprehensive database on the number of such connections that may be in service presently. However, as shown in Section IV, consumers are not sensitive to small changes in the total charges of their Internet and voice bills. Specifically, we found similar results when adding or subtracting approximately 80 million connections to the identifiable quantity of voice and broadband connections. Thus, we do not expect excluding these telecommunications services in the connections-based analysis would materially affect our analysis and findings with respect to how the average consumer would view the kind of changes examined herein.

[28] As a robustness check, we also constructed two other alternative scenarios where we decrease or increase the total number of broadband connections by 20%. As shown in Table 1, when the total number of broadband connections is decreased by 20%, monthly contributions per connection lowers to $0.86, which means that there will be a USF surcharge of $0.86 per month per connection for internet services, but a $0.67 reduction in USF surcharges per month per connection for voice services. When the total number of broadband connections is increased by 20%, monthly contributions per connection lowers to $0.70, which means that there will be a USF surcharge of $0.70 per month per connection for broadband services, but a $0.83 reduction in USF surcharges per month per connection for voice services.

TABLE 1
USF CONTRIBUTION PER CONNECTION PER MONTH

Row	Description	Value
1	Mobile voice services (number of connections)/1	357,225,000
2	Wireline incl. all interconnected VoIP services (number of connections)/2	99,326,000
3	Total voice connections (Row 1 + Row 2)	456,551,000
4	Lifeline subscriber connections/3	5,771,410
5	Total assessable connections - before surcharge change (Row 3 - Row 4)	450,779,590
6	USF total disbursement budgets/4	$8,274,000,000
7	Monthly contribution per connection – before surcharge change ((Row 6 / Row 5) / 12)	$1.53
8	Mobile Internet services (number of connections)/5	330,531,000
9	Landline Internet services (number of connections)/6	110,866,000
10	Total Internet connections (Row 8 + Row 9)	441,397,000
11	Total assessable connections – after surcharge change (Row 5 + Row 10）	892,176,590
12	USF total disbursement budgets/7	$8,274,000,000
13	Monthly contribution per connection - after surcharge change ((Row 12 / Row 11) / 12)	$0.77
14	Reduction in monthly contribution per voice connection (Row 7 - Row 13)	$0.76
15	Variations of total assessable connections – after surcharge change	
16	Decrease by 20% (Row 5 + (Row 10 x 0.8))	803,897,190
17	Corresponding monthly contribution per connection ((Row 12 / Row 16) / 12)	$0.86
18	Reduction in monthly contribution per voice connection (Row 7 - Row 17)	$0.67
19	Increase by 20% (Row 5 + (Row 10 x 1.2))	980,455,990
20	Corresponding monthly contribution per connection ((Row 12 / Row 19) / 12)	$0.70
21	Reduction in monthly contribution per voice connection (Row 7 - Row 20)	$0.83

Notes:
/1 /2 From Voice Telephone Services Report as of June 30, 2020. (rel. August 2022).
/3 Total Lifeline subscribers as of end of 2nd Quarter 2021, USAC 4th Quarter 2021 FCC Filings attachment LI08 Lifeline Subscribers by State or Jurisdiction ("FCC Filings," Universal Service Administrative Co., available at https://www.usac.org/about/reports-orders/fcc-filings/#results). Lifeline Subscribers will include some fixed broadband-only Lifeline customers, however, given the high-cost of these services, it is not likely that the number of these customers is high, so the subscribers are applied to telecommunications connections for the monthly contribution per connection calculation in Row 3.
/4 /7 2020 Universal Service disbursements. *See* FCC Universal Service Monitoring Report 2021, page 23, Table 1.10 (rel. January 14, 2022), available at https://www.fcc.gov/general/federal-state-joint-board-monitoring-reports.
/5 /6 Broadband connections from FCC Report: Internet Access Services Status as of December 31, 2018, Figure 6. (September 2020).

IV. IMPACTS OF REFORM UPON BROADBAND ADOPTION AND RETENTION AND RESPONSES TO FILED COMMENTS

24. As demonstrated in our prior study, the demand elasticity for broadband is highly inelastic. Based on our study, we calculated the percent change in the demand for subscriptions to broadband services as the ratio of (1) total reduction in number of broadband service connections divided by (2) total number of broadband connections to which the survey respondents currently subscribe.[29] We consider six definitions of broadband service reduction as shown in Table 2.

[29] For example, if the survey began with ten respondents with two connections each, and three respondents choose to discontinue one connection each, then, the percentage change in connections in calculated as 3/ (10*2) = 15%.

25.

TABLE 2
ESTIMATED CHANGES IN HOUSEHOLD SUBSCRIPTION OF INTERNET CONNECTIONS

Definitions of Internet Service Reduction	Percentage change in total service fees (%)	Percentage reductions in connections (%)	Elasticity (in absolute value)
Discontinuation[/1]	1.58	0.13	0.08
Downgrade[/2]	1.58	0.80	0.50
Discontinuation and downgrade	1.58	0.93	0.59
Net discontinuation[/3]	1.58	0.13	0.08
Net downgrade[/4]	1.58	0.68	0.43
Net discontinuation and net downgrade	1.58	0.81	0.51

Notes:
[/1] Discontinuation means that the respondent chose to discontinue existing Internet connections.
[/2] Downgrade means the respondent would replace their existing service with a cheaper service, offered by either the same carrier or a different carrier, which has reduced download and upload speeds for their Internet connection and/or a reduced monthly data limit.
[/3] Net discontinuation means discontinuation net of number of new lines that respondents choose to add.
[/4] Net downgrade means downgrade net of number of lines that respondents choose to upgrade.

26. As shown in Table 2, the average percentage change in total service fees is 1.58%, and the resulting percentage reductions in broadband service connections range between 0.13% and 0.93%. The estimated price elasticity of demand for subscriptions to Internet services range between 0.08 (i.e., 0.13/1.58) and 0.59 (i.e., 0.93/1.58). When studying the net reduction in the number of Internet service connections, net discontinuation is the relevant concept. The value "0.08" for the elasticity can be interpreted as follows: a 1% increase in the total service fee leads to a 0.08% reduction in number of broadband service connections.

27. These results make common sense. First, recent surveys of households in the U.S. indicate that Americans adults generally regard broadband access as a necessity.[30] Second, there are

[30] *See* "70% of U.S. adults believe high-speed internet is a basic necessity – New consumer survey," Kajeet, August 4, 2022, available at https://www.kajeet.net/70-of-u-s-adults-believe-

no substitutes for broadband services.[31] Third, the monthly broadband weighted average price in the U.S. for the most popular speed tiers by subscription is approximately $46, and the weighted average price for the fastest speed tiers is approximately $74,[32] which equals approximately 1% of the monthly U.S. median household income.[33]

28. NCTA – The Internet & Television Association commented on our prior study, stating: "The methodology used to support this conclusion, however, is unclear and potentially flawed, and the survey questions did not contemplate situations where households might see an increase in overall amounts, as described above." [34] NCTA further asserted: "This report used a survey to estimate how many subscribers would drop broadband service (fixed and/or wireless) if the price of broadband went up while, at the same time, the price of their voice service went down, with the price decrease for voice that might offset any increase in the price of broadband. That seems to be a questionable way to test the price responsiveness of broadband because the survey respondents might interpret this as no change in price. And, as explained above, the price changes seen by each household would vary depending on the services."[35]

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high-speed-internet-is-a-basic-necessity-new-consumer-survey/. *See also* "The Internet and the Pandemic," *Pew Research* (September 1, 2021), available at https://advocacy.consumerreports.org/wp-content/uploads/2021/03/2021-Feb-Broadband-Survey.pdf.

[31] *See* "FCC faces backlash for saying Americans might not need fast home Internet," (August 11, 2017) *Ars Technica,* available at https://arstechnica.com/information-technology/2017/08/mobile-broadband-cant-replace-fast-home-internet-americans-tell-fcc/.

[32] *See* "2022 Broadband Pricing Index," (June 29, 2022) ZDNet.com, available at https://www.ustelecom.org/wp-content/uploads/2022/06/USTelecom-Broadband-Pricing-Report2022.pdf

[33] For U.S. median household income, *see:* U.S. Census Bureau, Table D1: Historical Median Income Using Alternative Price Indices: 1967 to 2021. Available at https://www.census.gov/data/tables/2022/demo/income-poverty/p60-276.html

[34] NCTA, "Comments of NCTA," February 17, 2022, p. 19.

[35] NCTA, "Comments of NCTA," February 17, 2022, p. 19, footnote 43.

29. NCTA's statements miss the mark. The survey analysis and the methodology used are both explained in clear and painstaking detail in our prior study. In fact, the entire survey design is attached to our prior study as an appendix, detailing every step of our survey analysis such that another survey expert could use it to replicate our survey design.[36] Beyond NCTA's cursory assertion that we failed to provide sufficient detail, it is not clear what detail NCTA in fact deems lacking. Moreover, as explained in our prior study, and in contrast to NCTA's substantive misinterpretations, our prior study does build in the "situations where households might see an increase in overall amounts" and does allow "the price changes seen by each household [to] vary depending on the services."

30. First, as clearly stated in our prior study: "Earlier in the survey, we collected the number of voice and/or Internet service connections subscribed to by the respondent or their household. Multiplying each line by the expected surcharge and summing up the results gives an estimate of the *net* change the respondent would receive on their bill."[37] That is, in our survey analysis, the expected surcharge shown to each survey respondent is the *net* amount taking into account the respondent's voice and internet service connections. The respondents did not "interpret this as no change in price," as NCTA misrepresents, because they were shown an individualized, non-zero net amount based on their actual services.

31. Second, as shown in Table 3 below, which is identical to Table 2 in the part of our prior study specifically cited by NCTA, the estimated effects on internet and voice services are based on actual data and they do not offset each other.

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[36] NTCA-USF Study, Expert Report of Michael A. Williams, Ph.D. and Wei Zhao, Ph.D., May 7, 2020, Appendix II.

[37] NTCA-USF Study, Expert Report of Michael A. Williams, Ph.D. and Wei Zhao, Ph.D., May 7, 2020, p. 29 (emphasis added).

TABLE 3
TABLE 2 OF WILLIAMS AND ZHAO PRIOR STUDY
SCENARIOS OF USF SURCHARGE CHANGES PRESENTED TO THE RESPONDENTS

Scenario	Internet Bill Increase Per Line	Voice Bill Decrease Per Line
1	$0.77	$0.76
2	$0.86	$0.67
3	$0.70	$0.83

32. Third, our findings do not arise in a vacuum. As much as NCTA may want to assert without empirical evidence or detailed analysis that our study somehow falls short, our findings correspond to long-standing reviews of the market for these services. To the contrary, a substantial economic literature exists that has studied the demand for Internet services by U.S. households over the last two decades. The results of these studies show that demand for Internet services was price-inelastic twenty years ago and has become even more price-inelastic in recent years as Internet service has been increasingly viewed by consumers as a "household necessity."[38]

33. Our work and findings track with long-standing analysis in this area, but our study provides thorough and updated analysis in ways that others (like NCTA) have not in simply asserting "suppression of demand." For example, Dutz et al. (2012) estimate the price elasticity for broadband using survey data from 2005 to 2009 and find that it declined monotonically from -1.53 in 2005 to -0.69 in 2008.[39] Consistent with Dutz et al. (2012), Carare et al. (2015) used survey data from 2011 and found that the price elasticity of demand of non-adopters is inelastic with a

[38] Dutz, M., Orszag, J., and Willig, R. (2009), "The Substantial Consumer Benefits of Broadband Connectivity for US Households," *Mimeo*.

[39] Dutz, M., Orszag, J., and Willig, R. (2012), "The Liftoff of Consumer Benefits from the Broadband Revolution," *Review of Network Economics,* vol. 11(4).

value of -0.62.[40] Similarly, Glass and Stefanova (2010) estimate the price elasticity for broadband using surveys of subscribers in rural areas in 2005 and 2009. Specifically, Glass and Stefanova (2010) find that the estimated elasticity declined from -0.66 in 2005 to -0.21 in 2009.[41] Their results support the conclusion that the demand for broadband has become more inelastic over time.

34. Glass and Stefanova (2010) conclude that the elasticity of demand for broadband has become more inelastic because the integration services such as voice, data, and video have satisfied "a wide variety of needs from entertainment to education to healthcare."[42] In this regard, Dutz et al. (2012) conclude that the elasticity of demand for broadband has become more inelastic over time because an increasing number of households consider broadband to be a necessity and, thus, are less willing to alter their purchases as the price of broadband changes.[43] The explanations offered by Glass and Stefanova (2010) and Dutz et al. (2012) are consistent with Varian (2002), who predicted that the demand for Internet services would grow as new applications appeared that required larger bandwidths.

35. Prior to our study, the most recent estimate of the demand elasticity of broadband services across all groups in the U.S. is -0.69 for the year 2008, as estimated by Dutz et al. (2012).[44] As discussed above, studies in the literature suggest that demand elasticity of broadband services

[40] Carare, O., McGovern, C., Noriega, R., and Schwarz, J. (2015), "The Willingness to Pay for Broadband of Non-Adopters in the U.S.," *Information Economics and Policy*, vol. 30, pp. 19-35.

[41] Glass, V. and Stefanova, S. (2010), "An Empirical Study of Broadband Diffusion in Rural America," *Journal of Regulatory Economics,* vol. 38.

[42] Glass, V., Stefanova, S. (2010), "An Empirical Study of Broadband Diffusion in Rural America," *Journal of Regulatory Economics,* vol. 38.

[43] Dutz, M., Orszag, J., and Willig, R. (2012), "The Liftoff of Consumer Benefits from the Broadband Revolution," *Review of Network Economics,* vol. 11(4).

[44] Dutz, M., Orszag, J., and Willig, R. (2012), "The Liftoff of Consumer Benefits from the Broadband Revolution," *Review of Network Economics,* vol. 11(4).

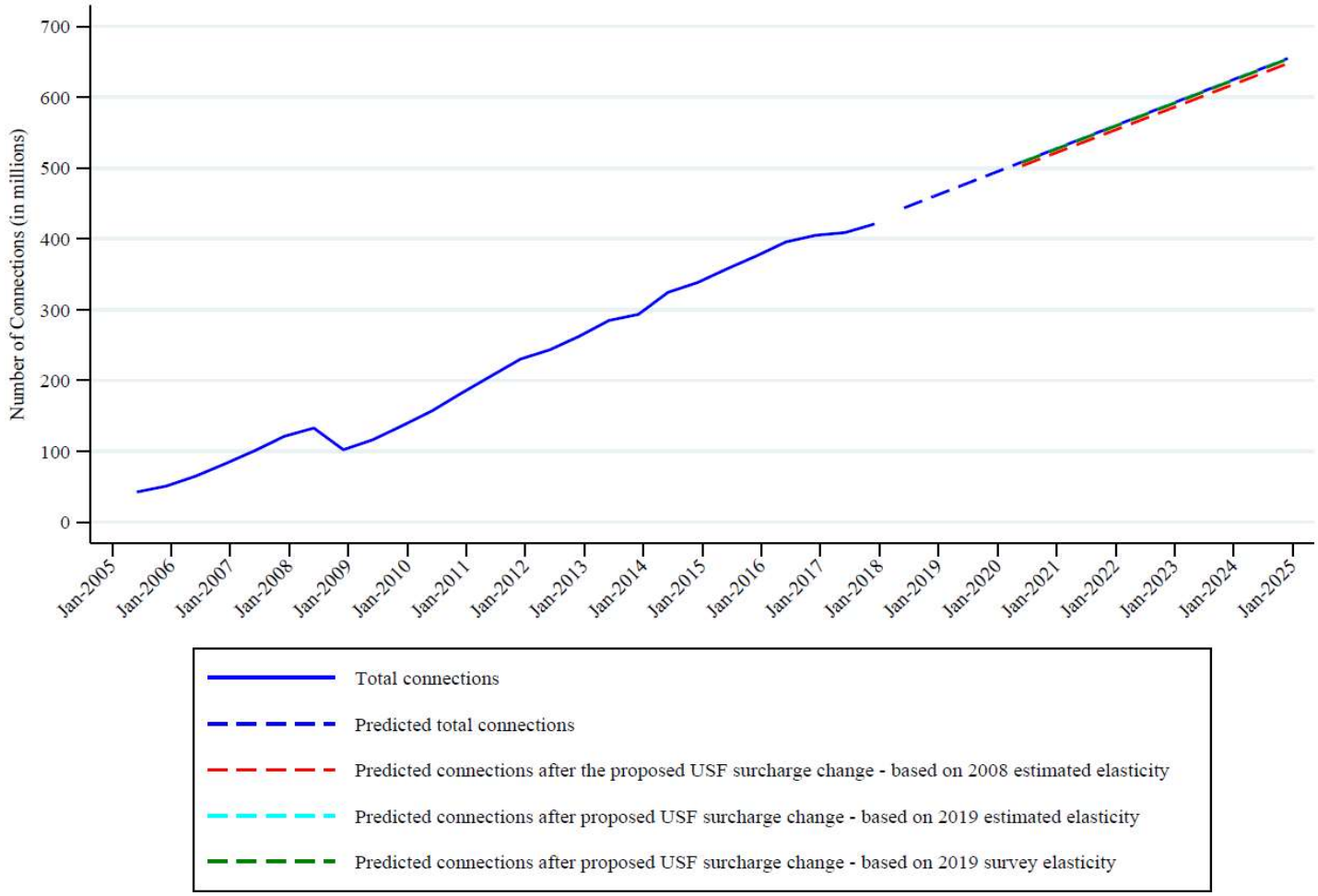
would be even lower today. In Table 4 below, we show the expected percentage reduction in broadband services in response to the proposed revision of the USF contribution methodology, when applying three different demand elasticities. First, we use the estimate of -0.69 in 2008 from Dutz et al. (2012) as a conservative estimate of demand elasticity today. Second, we extrapolate from the estimates of demand elasticities in 2005-2008 in Dutz et al. (2012) to achieve an estimate of -0.05 demand elasticity in 2019. Third, as a comparison, we use the estimated elasticity for net discontinuation in Internet service subscriptions from our survey as shown in Table 4.

TABLE 4
ESTIMATED PERCENTAGE REDUCTION IN DEMAND FOR INTERNET CONNECTIONS
AFTER THE PROPOSED USF SURCHARGE CHANGE

Specification	Elasticity	Percentage change in total service fees (%)	Percentage change in connections (%)
Based on 2008 estimated elasticity	-0.69	1.58	-1.09
Based on 2019 estimated elasticity	-0.05	1.58	-0.08
Based on 2019 survey elasticity	-0.08	1.58	-0.13

36. As shown in Table 4, the estimated percentage reduction in demand for broadband services based on 2019 estimates is approximately 0.1%. In Figure 4 below, we present the actual and predicted number of broadband connections in the U.S. To evaluate the effect of the proposed revision of the USF contribution methodology on broadband connections, we lower the predicted number of broadband connections in the period 2020-2024 by the estimated percentage shown in the last column of Table 4. As shown in the figure, the proposed revision of the USF contribution methodology has a negligible effect in deterring the expansion of broadband services.

FIGURE 4
PREDICTED U.S. INTERNET CONNECTIONS WITH AND WITHOUT THE PROPOSED USF SURCHARGE CHANGE



Source: Connections over 200 kbps in at least one direction in FCC Internet Access Services Reports.
Note: The three predicted values of number Internet connections after the USF surcharge change are very close so that they overlay each other in the figure.

37. Additional feedback on our work comes from Dr. Roslyn Layton, who begins her comments by approvingly and uncritically referring to speculation by Singer and Tatos that a "tax on broadband could, via pass-through, result in nearly ten million broadband customers dropping out of the broadband market."[45] As a threshold matter, however, the Singer/Tatos review provides no meaningful foundation for such a critique or conclusion. Among other shortcomings, Singer and Tatos appear to assume that (1) the total annual funding required is $17.5 billion, which is 85% higher than the current $9.3 billion fund; and (2) the existing funding of USF will cease such that the entire USF in their hypothetical world would be paid for solely through an assessment on broadband connections. As a result of artificially increasing demand and inexplicably decreasing supply in these assumptions, they substantially overestimate the required USF fee for broadband connections. Furthermore, their claim that "nearly ten million broadband customers [would] drop[] out of the broadband market" is based on a dubious assumption of the elasticity of demand. They use an elasticity of demand for broadband equal to -0.62, based on a survey conducted in 2011 of individuals who did *not subscribe to any broadband service*.[46] Thus, even assuming, *arguendo*, that this demand elasticity was accurate, it is not the relevant elasticity. As shown in Table 4, based on our 2020 survey research, the elasticity of demand for a broadband connection equals -0.08.

38. Dr. Layton further asserts: "Elasticity measures how much demand shifts with economic change."[47] This is simply incorrect on its face as an economic matter. The elasticity of demand equals the percentage change in the quantity demanded for a given product in response to

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[45] Singer, H. and Tatos, T. (March 11, 2022), letter to the FCC re: Report on the Future of the Universal Service Fund (Docket Number: 21-476), p. 2.

[46] Carare, O., McGovern, C., Noriega, R., and Schwarz, J. (2015), "The Willingness to Pay for Broadband of Non-adopters in the U.S.," *Information Economics and Policy.*

[47] Layton, R. (August 1, 2022), Letter to the FCC, p. 5.

a given percentage change in the price of that product. In particular, the demand curve does not "shift" when evaluating the elasticity of demand—it is held constant. The elasticity of demand measures the curvature of a given demand curve.

39. Dr. Layton next speculates that if the USF contribution methodology were based on expanding the contribution base to include both voice and broadband connections, "the [Affordable Connectivity Program] would have to be expanded to cover additional low-income consumers and/or the subsidy to current consumer would have to increase."[48] First, Dr. Layton offers no empirical support for such speculation. Second, given the that the elasticity of demand for a broadband connection equals -0.08, any such increase in the ACP would be small if it applied to such customers at all. This follows because a demand elasticity of -0.08 for a broadband connection means that in response to a one percent increase in price, the quantity demanded would fall by only 0.08%. Third, this criticism somehow misses altogether the fact that in our prior study "to mitigate any concern that the most price-sensitive customers might be adversely affected by the inclusion of broadband within the contribution base as revised, we also assumed for purposes of our analysis that any subscriber receiving Lifeline USF support would not be subject to a per-connection assessment."[49] Thus, this criticism is entirely misplaced.

40. Finally, Dr. Layton offers a normative opinion without economic basis that expanding the contribution base to include both voice and broadband connections would be "regressive."[50] In particular, she asserts: "price increases on necessities like water, electricity, gas,

[48] Layton, R. (August 1, 2022), Letter to the FCC, p. 5.

[49] NTCA-USF Study, Expert Report of Michael A. Williams, Ph.D. and Wei Zhao, Ph.D., May 7, 2020, p. 18.

[50] Layton, R. (August 1, 2022), Letter to the FCC, p. 5.

trash collection and broadband are regressive public policy."[51] Dr. Layton fails to acknowledge the plain fact that firms that provide water, electricity, gas, and trash collection all charge prices that cover their total costs, and many have low-income programs such as the ACP. NTCA's proposal is no different and, in fact, expressly proposed to care for such customers by suggesting they would not contribute.

41. Regarding our finding that the elasticity of demand for a broadband connection equals -0.08, Dr. Layton argues the results in Carare et al. (2015) lead to the "opposite conclusion."[52] Dr. Layton is wrong. First, as discussed above, Carare et al. find that the price elasticity of demand for non-adopters of broadband services equals -0.62.[53] That is not the "opposite" of -0.08. Second, Carare et al. rely on a survey performed in 2011. Since our results rely on a survey performed in 2020, our results better reflect current market realities. Third, Carare et al.'s primary policy recommendation is that "[e]xpanding the access to high-speed Internet communications for millions of Americans in rural and urban areas can be achieved, at least in part, through a system of discounts on broadband service for qualifying low-income consumers. These discounts are similar to the discounts employed for more than two decades for the Lifeline and Link-Up programs."[54] Clearly, Carare et al.'s policy recommendation is not the "opposite" of NTCA's proposal—in fact it is entirely consistent with that proposal.

[51] Layton, R. (August 1, 2022), Letter to the FCC, p. 5.

[52] Layton, R. (August 1, 2022), Letter to the FCC, p. 5.

[53] Carare, O., McGovern, C., Noriega, R., and Schwarz, J. (2015), "The Willingness to Pay for Broadband of Non-Adopters in the U.S.," *Information Economics and Policy*, vol. 30, pp. 19-35.

[54] Carare, O., McGovern, C., Noriega, R., and Schwarz, J. (2015), "The Willingness to Pay for Broadband of Non-Adopters in the U.S.," *Information Economics and Policy*, vol. 30, pp. 19-35.

V. CONCLUSIONS

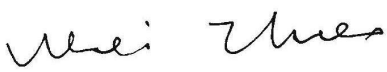
42. Our primary conclusions are as follows. NCTA – The Internet & Television Association commented on our prior study, arguing that the survey methodology was "unclear and potentially flawed." NCTA is incorrect. The survey analysis and the methodology used in our prior study are both explained in clear and painstaking detail. In fact, the entire survey design is attached to our prior study as an appendix, detailing every step of our survey analysis such that another survey expert could use it to replicate our survey design.

43. Dr. Roslyn Layton also commented on our prior study. But, her several criticisms of our study are not grounded in well-established economic principles or analysis.

44. In sum, we continue to find that modifying the USF contribution methodology to include both voice and broadband connections within the contribution base would not have a material impact on broadband adoption or retention.

December 13, 2022

Michael A. Williams



Wei Zhao

APPENDIX I: RESUMES

MICHAEL A. WILLIAMS

I am a Managing Director at Berkeley Research Group, LLC. I specialize in analyses involving competition, antitrust, industrial organization, and regulation. I have published articles in a number of academic journals, including the *Proceedings of the National Academy of Sciences, Science Advances*, *American Economic Review, Journal of Industrial Economics, International Journal of Industrial Organization, Journal of Law and Economics, American Law and Economics Review, Journal of Economics & Management Strategy, Review of Industrial Organization, Journal of Institutional and Theoretical Economics, Economics Letters, Journal of Public Economic Theory, Behavioral Science, Antitrust Bulletin, Physica A, Texas Law Review,* and *Yale Journal on Regulation.*

I have provided written and/or oral testimony before:

- United States District Court, Middle District of Alabama
- United States District Court, Western District of Arkansas
- United States District Court, Central, Northern, and Southern Districts of California
- United States District Court, District of Delaware
- United States District Court, Middle District of Florida
- United States District Court, Northern District of Georgia
- United States District Court, Eastern Division, District of Idaho
- United States District Court, Northern and Southern Districts of Illinois
- United States District Court, District of Kansas
- United States District Court, District of Massachusetts
- United States District Court, Eastern District of Michigan, Southern Division
- United States District Court, District of Minnesota
- United States District Court, District of New Jersey
- United States District Court, Eastern and Southern Districts of New York
- United States District Court, Eastern District of Pennsylvania
- United States District Court, Eastern District of Tennessee

- United States District Court, Northern and Southern Districts of Texas
- United States District Court, District of Utah
- United States District Court, Eastern District of Virginia
- United States Court of Federal Claims
- State of Connecticut, Superior Court
- State of New Mexico, Second Judicial District
- State of Nevada, Gaming Commission and State Gaming Control Board
- Public utilities commissions: Arkansas, Hawaii, Michigan, Minnesota, Missouri, Nebraska, New Mexico, Texas, and Washington
- The Netherlands, Amsterdam District Court

I have been retained as an economic consultant by the U.S. Department of Justice, Antitrust Division, the U.S. Federal Trade Commission, and the Canadian Competition Bureau.

Previously, I was an economist with the U.S. Department of Justice, Antitrust Division. I hold a B.A. degree in economics from the University of California, Santa Barbara, and I received my M.A. and Ph.D. degrees in economics from the University of Chicago.

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UNITED STATES DISTRICT COURT, NORTHERN DISTRICT OF CALIFORNIA
In Re Google Play Developer Antitrust Litigation.

UNITED STATES DISTRICT COURT, NORTHERN DISTRICT OF ILLINOIS
In Re Broiler Chicken Antitrust Litigation.

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In Re: Disposable Contact Lens Antitrust Litigation.

UNITED STATES DISTRICT COURT, EASTERN DISTRICT OF NEW YORK
In Re: Payment Card Interchange Fee and Merchant Discount Antitrust Litigation.

THE NETHERLANDS, AMSTERDAM DISTRICT COURT
Unilever et al./Smurfit Kappa, DS Smith et al. (Cardboard).

UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF ILLINOIS
In Re: Dealer Management Systems Antitrust Litigation.

UNITED STATES DISTRICT COURT FOR THE DISTRICT OF UTAH
Union Pacific Railroad Co. v. Utah State Tax Commission, et al.

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In Re: Capacitors Antitrust Litigation.

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Malden Transportation, Inc., et al., v. Uber Technologies, Inc., and Rasier, LLC.

UNITED STATES DISTRICT COURT, CENTRAL DISTRICT OF CALIFORNIA
Grasshopper House, LLC v. Clean & Sober Media LLC, et al.

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Norfolk Southern, Inc.'s acquisition of North American Van Lines.

Cooper Industries, Inc.'s acquisition of Westinghouse Electric, Corp.'s Lighting Fixture Business.

Southwestern Public Service Company's acquisition of New Mexico Electric Service Company.

ITT-Continental Baking Company's acquisition of Bost Bakery, Inc.

Williams Companies' acquisition of Northwest Energy, Corp.

Archer-Daniel-Midland's acquisition of Gold Kist's Valdosta, Georgia soybean processing plant.

PRICE FIXING

United States of America v. Weeks Marine, Inc.

CONSENT DECREES

United States of America v. Wallpaper Institute

United States of America v. Greyhound, Corp.

United States of America v. Balley Manufacturing, Corp.

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SUMMARY

Wei Zhao specializes in analyses involving price-fixing, mergers, and product-liability matters. He has been a consultant to the US Department of Justice, Federal Trade Commission, and Canadian Competition Bureau, as well as many leading law firms in the United States. He has testified in the United States District Court, Northern District of Georgia. He holds a Ph.D. in economics from the Johns Hopkins University. He has published articles in a number of academic journals, including *RAND Journal of Economics*, *Mathematical Social Sciences, Review of Industrial Organization*, *Physica A, Virginia Law & Business Review*, *University of Cincinnati Law Review*, *ABA Economics Committee Newsletter, Financial Theory and Practice*, and *Journal of Henan University of Finance and Economics*. He has also taught courses for M.A. in Applied Economics at Johns Hopkins University.

PRESENT EMPLOYMENT

Managing Director, Berkeley Research Group, LLC

PREVIOUS POSITIONS

Director, Competition Economics, LLC

PUBLICATIONS

1. "Dynamic Efficiencies of the 1997 Boeing-McDonnell Douglas Merger" (with Yonghong An), *RAND Journal of Economics,* 50 (2019), pp. 666-694.

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2. UNITED STATES DISTRICT COURT, DISTRICT OF MINNESOTA
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3. UNITED STATES DISTRICT COURT, NORTHERN DISTRICT OF ILLINOIS

In Re: Broiler Chicken Antitrust Litigation, Commercial and Institutional Indirect Purchaser Plaintiff Actions (2020-2021).

4. UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA
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5. THE NETHERLANDS, AMSTERDAM DISTRICT COURT
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6. UNITED STATES DISTRICT COURT, EASTERN DISTRICT OF VIRGINIA
   In Re: Peanut Farmers Antitrust Litigation (2020).

7. UNITED STATES DISTRICT COURT, MIDDLE DISTRICT OF FLORIDA
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