EXHIBIT A

DECLARATION OF DR. JOHN MAYO

I. Introduction

A. Qualifications

1. I am a Professor of Economics, Business and Public Policy in the McDonough School of Business at Georgetown University. I am also the Executive Director of the Georgetown Center for Business and Public Policy. I previously served as Dean of the McDonough School at Georgetown University. My business address is Georgetown University, McDonough School of Business, 37th and O Streets, N.W., Washington, D.C., 20057.

2. I hold a Ph.D. in economics from Washington University in St. Louis (1982), with a principal field of concentration in industrial organization, which includes the analysis of antitrust and regulation. I also hold both an A.M. (Washington University in St. Louis, 1979) and a B.A. (Hendrix College, Conway, Arkansas, 1977) in economics. I have served as a Visiting Scholar at the University of California, Berkeley and Stanford University. I have taught both undergraduate and graduate economics, business and public policy courses at Georgetown University, Washington University, the University of Tennessee, Virginia Tech and the University of Basel (Switzerland).

3. I have authored numerous peer-reviewed articles, research monographs and a number of specialized articles in industrial organization economics, both generally in antitrust and regulation and specifically in the area of the economics of telecommunications regulation. These have appeared in academic journals such as the *RAND Journal of Economics*, *Journal of Law and Economics*, *Journal of Industrial Economics, International Journal of Industrial Organization*, *Review of Network Economics*, *Review of Industrial Organization*, *Journal of Regulatory Economics* and the *Yale Journal on Regulation*. I have also written a comprehensive textbook entitled *Government and Business: The Economics of Antitrust and Regulation*. In addition, I have served as President of the Transportation and Public Utilities Group and am currently serving in editorial capacities for the *Journal of Regulatory Economics, Economic Inquiry* and the *Review of Industrial Organization*.

4. Additionally, I have been an economic advisor for, and consultant to, both public agencies and private companies, including the Antitrust Division of the United States Department

of Justice, the Federal Trade Commission, AT&T, Sprint, UPS and AmerenUE. A more detailed accounting of my education, publications, prior depositions and expert testimony, and my employment history is contained in Exhibit 1.

B. Assignment

5. In November 2017, the Federal Communications Commission (hereafter, "the Commission") issued a Fourth Report and Order, Order on Reconsideration, Memorandum Opinion and Order, Notice of Proposed Rulemaking and Notice of Inquiry.[1] In the Notice of Proposed Rulemaking portion of this document, (hereafter, the "NPRM") the Commission proposed to limit Lifeline support to facilities-based broadband service provided to qualifying low-income consumers. I have been asked by CTIA to provide an assessment of the economic merits of this proposal.

C. Summary of Findings

6. The NPRM's proposal to limit Lifeline support to facilities-based carriers is not supported by economic principles and evidence.

7. The Declaration and its conclusion is developed by first analyzing the respective economic roles of different providers of modern retail communications services, and the underlying economic foundation for the Lifeline program. While providing a foundation for conducting an economic assessment, the Declaration finds that:

- Facilities-based and non-facilities-based carriers (Mobile Virtual Network Operators or MVNOs) operate symbiotically to each provide economic value and enhance consumer welfare in the provisioning of modern communications services. The result of this relationship is enhanced capacity utilization and hence more investment than would happen in the absence of MVNOs. (Section II. A)

- The FCC has consistently used Lifeline as the nation's principal policy tool for advancing the adoption of modern telecommunications service to consumers that would, but for a subsidy, fail to subscribe. By comparison, other federal Universal

[1] Fourth Report and Order, Order on Reconsideration, Memorandum Opinion and Order, Notice of Proposed Rulemaking and Notice of Inquiry, Federal Communications Commission, adopted November 16, 2017, *available at*: https://ecfsapi.fcc.gov/file/120198349434/FCC-17-155A1.pdf.

Service programs are designed for deployment, including the High Cost programs. While Lifeline also has a positive impact on deployment, the Lifeline program's primary goal is to promote the adoption of essential communications services. (Section II.B)

8. With this background in hand, Section III of the Declaration provides an economic assessment of the NPRM's proposal. Several economic conclusions emerge from the Commission's proposal to limit Lifeline support to facilities-based providers:

- Proposing to limit Lifeline support to facilities-based providers is inconsistent with general economic principles and the economic role of Lifeline. (Section III. A)
- Proposing to limit Lifeline support to facilities-based providers will harm, rather than advance, universal connectivity and adoption. (Section III. B)
- The proposal's "competitive impacts" assessment is unsupported by general principles of economic regulation. (Section III. C)
- The data on network investment indicate that greater MVNO activity promotes investment. (Section III. D)

II. Background

A. The Economic Role of the MVNO Sector

9. In 2016, hundreds of millions of Americans consumed wireless narrowband and broadband services. The supply of these services is from two types of firms. First, some firms (e.g., AT&T, Verizon) operate as fully vertically-integrated providers. That is, such firms own and operate their own underlying networks and facilities, and additionally provide retail-stage services. Economic decisions by facilities-based providers are innately affected by the fact that they must manage capital-intensive, high-fixed-costs networks. In particular, these firms seek to avoid capacity utilization on their networks that is either too high or too low. If customer demand is too high on an existing network, the marginal cost of providing service can rise rapidly, putting upward pressure on prices or acting to diminish customer quality. These consequences not only harm the firm's competitive position, but can also adversely affect profits. Alternatively, if a facility-based carrier's network is under-utilized,

the idle capacity represents a foregone revenue opportunity to "fill up its pipes" and increase its profits.

10. Second, some firms (e.g., Consumer Cellular, Credo Mobile, Liberty Wireless, and TracFone) operate exclusively at the retail stage. These firms, referred to as MVNOs, conduct marketing campaigns and interface with retail consumers but do not own or operate the underlying (upstream) facilities with which communications services are provided. Instead, they purchase capacity from facilities-based firms and then resell services to retail-level customers. In total, MVNOs provided service to more than 38.8 million retail customers as of year-end 2016.

11. This resale model adopted by MVNOs – that is, purchase of a product from an upstream supplier and subsequent sale of that product to final consumers – is a common phenomenon throughout the U.S. economy. Many products from relatively complex items such as refrigerators, automobiles, and computers, to simpler goods, such as books, groceries, and blue jeans are sold by separate firms at the final, retail stage of production without physically altering the product(s) acquired from their upstream suppliers. That is not to say that resellers do not add value to the product through various retail stage activities such as marketing, servicing, providing product-specific information, and so on. In this sense, resale is economically equivalent to any other process in which firms combine inputs to produce a good or service.

12. While some have characterized resellers as adding little to consumer and economic welfare, economic analysis has shown otherwise.[2] MVNOs and other resellers throughout the economy have been shown to promote economic efficiency, invigorate competition, drive price reductions and satisfy the nuanced need of consumers that would otherwise go unfulfilled. Some MVNOs have focused on niche markets. For example, Disney Mobile was family oriented with "parental control features, subscriptions to Disney content and games." Great Call has been targeting baby boomers and the elderly community with

[2] See e.g., John W. Mayo and Scott Wallsten "Secondary Markets: The Quiet Economic Value Creator," Georgetown Center for Business and Public Policy, Economic Policy Vignette 2011-12-1, December 2011. Available at: http://cbpp.georgetown.edu/sites/cbpp.georgetown.edu/files/Mayo-Wallsten-secondary-markets-the%20quiet-economic-value-creator-122011.pdf, and Allesandro Gavazza "Leasing and Secondary Markets: Theory and Evidence from Commercial Aircraft," *Journal of Political Economy*, Vol. 119, 2011, pp. 325-377.

"easy-to-use handsets, 24-hour Operator assistance and simple price plans;" and Boost Mobile appealed to the youth market with "sponsorship of action sports events, television programs, festivals, concerts, and other youth-centric activities." Faith Wireless, launched in 2017, targets church-goers.[3] In short, resale fills a valuable role in satisfying consumer needs, improving economic efficiency and expanding economic welfare, and it is for that reason that economic policies generally are permissive of – indeed, encouraging of – the resale business model.[4]

13. Given their different positions in the market, over time facilities-based firms and MVNOs have developed symbiotic business models that provide economic returns to both types of firms and which enhance economic efficiency and consumer welfare. In particular, facilities-based firms establish a price and quality level that provides these firms with valued flexibility that often leaves some amount of their network capacity in reserve. Rather than letting this capacity stand completely idle, however, facility-based firms contract with MVNOs for the use of that capacity.

14. MVNOs, in turn, market services to two types of retail customers. First, MVNOs attract customers that would otherwise subscribe to a facility-based carrier but who are instead attracted to MVNO prices (that are often lower than the prices charged by facilities-based carriers)[5] or the MVNOs' tailored service offerings. Because, however, the prices and tailored offerings of the MVNO better match the needs of this set of consumers, consumer demand expands beyond the level that would prevail were only facilities-based providers

---

[3] *MVNO business models and marketing approach*, Veridian Systems, *available at* http://veridian.ro/aboutmvno/mvno-business-models-and-marketing-approach/?lang=en. *See also* Matt Hunter, *New smartphone targets elderly nonphone users*, CNBC (Sept. 7, 2014), *available at* https://www.cnbc.com/2014/09/05/new-smartphone-targets-elderly-nonphone-users.html; Sue Marek, *Boost Broadens its Appeal*, WIRELESS WEEK (Feb. 28, 2007), *available at* https://www.wirelessweek.com/news/2007/02/boost-broadens-its-appeal; Colin Gibbs, *Faith Wireless targets churchgoers with new MVNO service*, FIERCEWIRELESS (Feb. 8, 2017), *available at* https://www.fiercewireless.com/wireless/faith-wireless-targets-church-goers-new-mvno-service

[4] See John W. Mayo and Scott Wallsten "Secondary Markets: The Quiet Economic Value Creator," Georgetown Center for Business and Public Policy, Economic Policy Vignette 2011-12-1, December 2011, *available at*: http://cbpp.georgetown.edu/sites/cbpp.georgetown.edu/files/Mayo-Wallsten-secondary-markets-the%20quiet-economic-value-creator-122011.pdf

[5] That MVNO prices are often lower than the prices charged by facilities-based carriers is commonly recognized, See, for instance, Alexander Maxhem "The Real Cost of a Carrier vs MVNO's" (sic), January 28, 2016, AH Android Headlines, available at https://www.androidheadlines.com/2016/01/prepaid-vs-postpaid.html.

present. This, in turn, expands the capacity utilization of the facilities-based network provider. Second, MVNOs attract customers that would, but for the MVNO, simply not subscribe. This additional demand from the MVNO sector also expands the capacity utilization of the underlying facilities-based network provider. In sum, the symbiotic association between facilities-based providers and MVNOs act to promote both universal service (by adding subscribers to the communications network) and augment network capacity utilization, which promotes industry investment.

15. Given the focus of MVNOs on sales to value-oriented customers, data reveal that MVNOs enjoy their largest market presence in lower per-capita income, rural states. As seen in Table A1, the market presence of MVNOs is highest in the states of Arkansas, Maine, West Virginia, Kansas, Vermont, Kentucky and South Dakota with resold services in these states capturing over 15 percent of 2016 subscribers. In Table A2 we see that these MVNO-intensive states are markedly more rural than the national average, and also include some states with a higher percentage of their populations living in poverty than the national average.

16. Given MVNOs' focus on value-oriented customers, it is natural that MVNOs serve a substantial fraction of Lifeline customers throughout the nation. As seen in Figure A1, MVNOs disproportionately serve Lifeline subscribers, the group of customers that are most vulnerable to dropping off the network absent the Lifeline subsidy.

B. The Economic Foundation of Universal Service and the Lifeline Program

17. For nearly a century, the United States has embraced the goal of universal service by promoting the deployment and adoption of communications services among all Americans. Critically, deployment and adoption are distinct universal service policy challenges. For this reason different policies emerged to tackle these different policy challenges.[6] The roots of the Lifeline program spring from the economic observation that absent a subsidy, some individuals will not subscribe to the communications network even though the value to

[6] For an economic analysis of the effectiveness of these respective approaches, see Ross C. Eriksson, David L. Kaserman and John W. Mayo "Targeted and Untargeted Subsidy Schemes: Evidence from Post-Divestiture Efforts to Promote Universal Telephone Service," *Journal of Law & Economics*, Vol 41, October 1998, pp. 477-502.

society of their subscription exceeds the costs associated with their subscription.[7] Thus, the Lifeline Program was established to promote the goal of promoting subscription to the telecommunications network.[8] The Lifeline program now serves as the nation's primary policy mechanism to promote consumer adoption of modern communications service.[9] The High Cost Fund (now relabeled the Connect America program) was established to provide incentives for firms with high costs to expand connectivity through infrastructure build-out in unserved or underserved areas. Thus, the High Cost Fund serves as the nation's primary policy mechanism to fund the deployment facilities in areas where private market forces alone might not provide service.

18. Over the years, the connectedness of the American people has increased substantially, in part driven by new and increasingly affordable wireless technologies that provide consumers with highly-valued services, and partly due to universal service policies such as Lifeline and the High Cost Fund.[10] Nonetheless, today two challenges continue to confront the Commission as it seeks to advance its universal service mission. First, while the vast majority of Americans have full access to the communications infrastructure and routinely employ modern communications services to improve their personal and professional lives, many Americans do not partake in these benefits.[11] This shortfall points to the critical

[7] The centrality of this goal has been emphasized by the Commission repeatedly since the inception of the Lifeline Program. *See, e.g., Federal-State Board on Universal Service*, Report and Order, 12 FCC Rcd 8776, 8993 ¶ 406 (1997) (*First USF Order*) ("the "Federal Lifeline and Link Up programs … were designed to make residential service more affordable for low-income consumers"). Most recently, the 2016 Order reforming the Lifeline program states that "The Commission stressed that a central goal of the Lifeline program is affordability, emphasizing the purpose of the program to increase participation." Third Report and Order, Further Report and Order, and Order on Reconsideration, April 27, 2016, ¶47. (Hereafter, 2016 Lifeline Order).

[8] For a discussion of the congruence of this goal and the economic rationale for a universal service policy, see David L. Kaserman and John W. Mayo "The Quest for Universal Telephone Service: The Misfortunes of a Misshapen Policy," in *Telecommunications Policy: Have Regulators Dialed the Wrong Number?*, Donald L. Alexander, Editor, Praeger, 1997, pp. 131-144 at p. 133.

[9] The Commission's Schools and Libraries (aka E-Rate) and the Rural Health Care programs also seek to advance adoption for schools, libraries and rural health care providers.

[10] For a recent analysis of the gains in connectivity across time, see Jeffrey T. Macher, John W. Mayo and Olga Ukhaneva "From Universal Service to Universal Connectivity," Journal *of Regulatory Economics*, Vol. 52, August 2017, pp. 77-104.

[11] As noted by the Commission, "There are still 64.5 million people without a connection to the Internet and that figure hits hardest on those with the lowest incomes." 2016 Lifeline Order, ¶2.

.

importance of universal service programs designed to encourage adoption. Second, while a number of improvements to the Lifeline program and the High Cost fund have been made over time, these programs continue to face challenges. For instance, while an ideal program to support adoption would target precisely and only those consumers that would, but for the Lifeline subsidy, not subscribe to the network, the practical filter adopted by the Commission for identifying these individuals centers on income.[12] Because this proxy (income) is necessarily imperfect, some households that do not meet the Lifeline program's income eligibility threshold will not subscribe, but would with a subsidy; while other households that meet the income threshold for eligibility would choose to subscribe even without the Lifeline subsidy. The result is that the Lifeline program is necessarily less effective and more costly than would be ideal. In light of these challenges, it is natural that the Commission seek wherever possible to identify and implement programmatic changes that will improve the effectiveness of these programs. Yet, as I describe in the next section, while the desire to make improvements in the Lifeline program to enhance its effectiveness is commendable, the proposal in the NPRM to focus Lifeline support exclusively on facilities based providers would, if adopted, be inconsistent with the economic principles that underlie universal service as well as a number of other legitimate objectives of the Commission, including increasing network investment by facilities-based providers.

III. An Economic Assessment of the NPRM's Proposal to Focus Lifeline Exclusively on Facilities Based Providers

A. Proposing to limit Lifeline support to facilities-based providers is inconsistent with the economic basis of Lifeline.

19. As described in the NPRM, the proposal rests on an assumption that "Lifeline support will best promote access to advanced communications services if it is focused to encourage investment in broadband-capable networks."[13] The NPRM's proposal conflicts with the economically well-established focus of Lifeline as a tool to promote subscription, and

---

[12] The income eligibility associated with Lifeline, in turn, is proxied by either household income relative to the federal poverty guidelines or household participation in various federal social-assistance programs,

[13] NPRM at ¶65.

replaces it with a new goal of promoting investment. In so doing, the proposal ignores the economic reality that, regardless of the extent of deployment, there are consumers who would not subscribe to the modern communications network absent Lifeline support. That is why, as described in Section II.B. above, the Lifeline program is designed to promote adoption of services, not deployment. While encouraging investment in broadband network deployment also serves as a legitimate economic goal, the Commission's proposal to shoehorn investment-promotion into the Lifeline program is inconsistent with Lifeline's economic role as an affordability program and ignores the fact that a variety of other policy tools apart from Lifeline are both available to, and better-suited for, the Commission to advance broadband investment.[14] As shown below, however, retaining MVNO eligibility for Lifeline serves both goals: promoting connectivity and encouraging network investment.

B. The NPRM's proposal to limit Lifeline support to facilities based providers is unlikely to advance the Commission's goal of universal connectivity.

20. The NPRM states that "We believe this proposal would do more than the current reimbursement structure to encourage access to quality, affordable broadband service for low-income Americans."[15] The logic behind this statement is then offered: "In particular, Lifeline support can serve to *increase* the ability to pay for services of low - income households."[16]

21. This logic of this statement is exactly right, but the NPRM does not explain why the proposal would provide an improved vehicle for advancing "the ability to pay for services of low-income households." Specifically while it is true that Lifeline, as *currently* structured does "increase the ability to pay for services of low-income households", the NPRM's proposal, if adopted, would actually eliminate the ability of some MVNO Lifeline-eligible customers to receive Lifeline benefits. Millions of MVNO Lifeline customers would face higher prices, as MVNOs would no longer be eligible to provide Lifeline discounts to these customers. The consequence would be a *decrease*, not an

[14] As described in Section II. B., the High Cost Fund has historically served the role of encouraging the deployment of; that is, investment in, unserved and underserved areas of the country.

[15] NPRM at ¶65.

[16] Id. (emphasis added)

increase, in the "the ability to pay for services of low-income households." This decrease would cause customers to drop off the modern communications network, exactly the opposite of the belief expressed in the NPRM that the proposal encourage universal service.

22. While not stated in the NPRM, it might be thought that adoption of the proposal will simply cause current Lifeline customers of MVNOs to seamlessly transition to the service offerings of facilities-based carriers, thereby increasing the incentive for these carriers to make network investments and enhance universal connectivity. Two problems arise, however, that sever the logic of this thought. First, as described in Section II.A., facilities-based carriers are already the beneficiaries of the capacity utilization caused by MVNO customers, including their Lifeline customers. Indeed, as explained, MVNO customers are likely to cause greater utilization of the facilities-based carriers' networks than if the facilities-based carriers were to solely provide the services themselves. Thus, to the extent that MVNO customers do switch to facilities-based firms as a consequence of the proposal, capacity utilization is likely to fall rather than increase, thereby reducing incentives for network investment. Second, some MVNO customers will not switch to facilities-based providers as a consequence of the regulatory-induced price increase brought about by the proposal's adoption. This will, in turn, leave a set of vulnerable customers with higher bills and with a heightened sense that their most salient option is simply to not subscribe. In this manner, adoption of the proposal would be to harm, rather than advance, the goal of universal connectivity. In sum, some customers will simply not switch (though they will be harmed) and will provide no extra business for facilities-based firms, while other customers who do switch from MVNOs to facilities-based carriers will decrease, not increase, facilities-based carriers' capacity utilization. The result will be no improvement in incentives for network investment among facilities-based firms.

C. The NPRM's proposed "competitive impacts" assessment is inconsistent with general principles of economic regulation.

23. The Commission further seeks to support its proposal by stating that "the competitive impacts of having multiple competing facilities-based networks can also help to lower

prices for consumers. If Lifeline can help promote more facilities, it can then indirectly also serve to reduce prices for consumers."[17]

24. While it is certainly true that multiple competitors can help lower prices, there is no economic evidence that I am aware of indicating that MVNOs' presence in the market is less powerful in driving price reductions than facilities-based providers. Indeed, it is widely recognized that many MVNOs charge lower prices than facilities-based providers, acting to reduce market prices relative to the counter-factual that all services were provided by facilities-based firms.[18]

25. The "competitive impacts" feature of the NPRM's proposal also runs counter to the economic principles that underlie the universal service system. Among other widely agreed-to economic principles, an efficient Lifeline program requires that both the collection and distribution of the subsidy be competitively neutral.[19] Yet in the current case, the proposal would through regulation substantially shift the relative prices charged by MVNOs and facilities-based carriers for millions of Lifeline customers creating potentially massive shifts in the competitive landscape. Critically, such a shift is not because the current system competitively favors one type of carrier. Indeed, under the current system, both MVNOs and facilities-based competitors establish prices and are able to – in a competitively neutral fashion – be reimbursed for discounts that are afforded to Lifeline customers. The adoption of the proposal, whether implemented as a flash-cut or over a transition period, would be counter to the widely adhered to standard that economic regulation be competitively neutral.

D. Available data on network investment indicate that greater MVNO activity promotes investment.

26. While I have identified a number of features of the proposal that make it an undesirable candidate for adoption, a final compelling reason is that an analysis of available, relevant data do not support the NPRM's assertion that the proposal's adoption would stimulate

[17] NPRM at ¶65. (footnote omitted)

[18] See note 5, *supra*.

[19] For a complete discussion of these principles, see David L. Kaserman and John W. Mayo "The Quest for Universal Telephone Service: The Misfortunes of a Misshapen Policy," in *Telecommunications Policy: Have Regulators Dialed the Wrong Number?*, Donald L. Alexander, Editor, Praeger, 1997, pp. 131-144 at p. 140.

investment. Specifically to test the NPRM's belief I have developed several very simple investment models designed to shed light on the impact that MVNO activities have on investment in the wireless communications sector.

27. Specifically, I gathered annual data on wireless investment over the 2001-2016 period, along with corresponding data on total wireless subscriptions, subscriptions to wireless facilities-based firms, subscriptions to MVNOs, the share of MVNO subscriptions as a share of total subscriptions, and the inflation-adjusted GDP growth rate. Using these data, I estimated several straightforward models of investment, which are described in detail in the Appendix. Across seven different models that I estimated, and after controlling for other determinants of investment (e.g., GDP growth), the impact in each case is that greater MVNO activity (as measured by MVNO subscribers) is to increase investment. Stated alternatively, the econometric analysis indicates that policy measures such as the NPRM's proposal which would reduce the number of MVNO customers will reduce wireless investment in the United States. While the models I have estimated admittedly rely upon a relatively short time period, the fact that MVNO activity is consistently seen to increase investment in a statistically significant fashion provides a strong indication that the proposal's plan to eliminate MVNOs' ability to collect Lifeline support and the consequent harm to their subscriber bases will cause results that are precisely the opposite of those intended in the NPRM.

IV. Conclusion

28. For all the reasons stated above, the NPRM's proposal to limit Lifeline support to facilities-based firms should not be adopted, and the Commission should remain focused on the economic role of Lifeline to support low-income consumer's access to communications services by continuing to permit their ability to choose services offered by MVNOs.

Table A1: MVNO Presence, by State (Mid-Year 2016)

	U.S. Population	Mobile Wireless Subscribers	Mobile Wireless Penetration	Resold Wireless Subscriptions	Resold Wireless Market Share
Arkansas	2,988,231	2,956,000	98.9%	648,000	21.9%
Maine	1,330,232	1,239,000	93.1%	264,000	21.3%
West Virginia	1,828,637	1,458,000	79.7%	292,000	20.0%
Kansas	2,907,731	3,116,000	107.2%	618,000	19.8%
Vermont	623,354	560,000	89.8%	101,000	18.0%
Montana	1,038,656	983,000	94.6%	168,000	17.1%
Kentucky	4,436,113	4,247,000	95.7%	722,000	17.0%
South Dakota	861,542	801,000	93.0%	125,000	15.6%
Louisiana	4,686,157	5,092,000	108.7%	736,000	14.5%
Puerto Rico	3,406,520	3,205,000	94.1%	461,000	14.4%
South Carolina	4,959,822	4,730,000	95.4%	666,000	14.1%
Nebraska	1,907,603	1,919,000	100.6%	258,000	13.4%
Alabama	4,860,545	4,849,000	99.8%	645,000	13.3%
Minnesota	5,525,050	5,807,000	105.1%	761,000	13.1%
Wyoming	584,910	585,000	100.0%	76,000	13.0%
Tennessee	6,649,404	7,091,000	106.6%	872,000	12.3%
Indiana	6,634,007	6,313,000	95.2%	771,000	12.2%
New Hampshire	1,335,015	1,283,000	96.1%	155,000	12.1%
Oklahoma	3,921,207	3,769,000	96.1%	451,000	12.0%
North Carolina	10,156,689	9,828,000	96.8%	1,162,000	11.8%
Mississippi	2,985,415	2,761,000	92.5%	326,000	11.8%
Wisconsin	5,772,917	5,445,000	94.3%	619,000	11.4%
Missouri	6,091,176	6,090,000	100.0%	683,000	11.2%
Pennsylvania	12,787,085	13,192,000	103.2%	1,477,000	11.2%
Georgia	10,313,620	10,658,000	103.3%	1,149,000	10.8%
North Dakota	755,548	729,000	96.5%	78,000	10.7%
New York	19,836,286	23,230,000	117.1%	2,451,000	10.6%
Ohio	11,622,554	12,111,000	104.2%	1,234,000	10.2%
Michigan	9,933,445	10,255,000	103.2%	1,039,000	10.1%
Delaware	952,698	966,000	101.4%	97,000	10.0%
Iowa	3,130,869	2,943,000	94.0%	294,000	10.0%
Idaho	1,680,026	1,586,000	94.4%	145,000	9.1%
Virginia	8,414,380	8,273,000	98.3%	747,000	9.0%
Oregon	4,085,989	4,032,000	98.7%	353,000	8.8%
New Jersey	8,978,416	9,863,000	109.9%	838,000	8.5%
Colorado	5,530,105	5,676,000	102.6%	479,000	8.4%
Nevada	2,939,254	2,976,000	101.3%	246,000	8.3%
Arizona	6,908,642	6,788,000	98.3%	554,000	8.2%
District of Columbia	684,336	1,498,000	218.9%	120,000	8.0%
Rhode Island	1,057,566	1,033,000	97.7%	82,000	7.9%
Illinois	12,835,726	13,757,000	107.2%	1,078,000	7.8%
Washington	7,280,934	7,277,000	99.9%	569,000	7.8%
Massachusetts	6,823,721	7,486,000	109.7%	558,000	7.5%
Florida	20,656,589	21,129,000	102.3%	1,493,000	7.1%
New Mexico	2,085,432	2,028,000	97.2%	139,000	6.9%
Connecticut	3,587,685	3,653,000	101.8%	242,000	6.6%
Texas	27,904,862	28,527,000	102.2%	1,772,000	6.2%
Utah	3,044,321	2,785,000	91.5%	164,000	5.9%
Maryland	6,024,752	6,390,000	106.1%	369,000	5.8%
Hawaii	1,428,683	1,538,000	107.7%	87,000	5.7%
Alaska	741,522	687,000	92.6%	38,000	5.5%
California	39,296,476	42,229,000	107.5%	1,984,000	4.7%
Virgin Islands	108,000	N/A	N/A	N/A	N/A
U.S. TOTAL	323,405,935	337,789,000	104.4%	31,514,000	9.3%

Sources: U.S., Census, Table 1. Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2017 (NST-EST2017-01), FCC Voice Telephone Services Report, State-Level Subscriptions (2016).

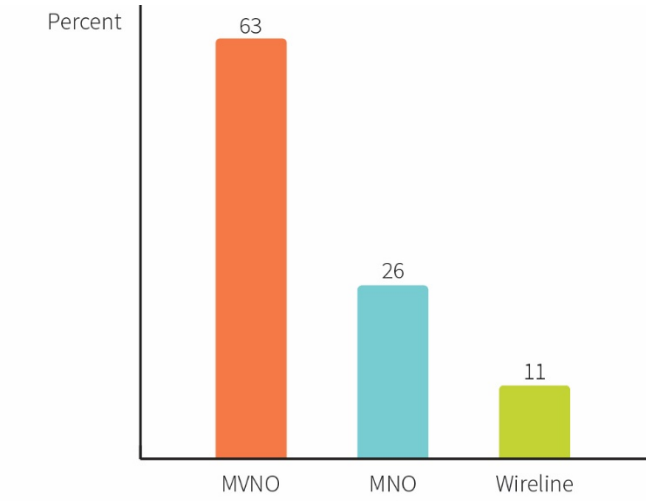
Table A2: Economic and Demographic Characteristics of MVNO-Intensive States

MVNO-INTENSIVE STATE*	MVNO MARKET SHARE	% LIVING IN RURAL AREA	% LIVING IN POVERTY
ARKANSAS	21.9%	43.8%	18.8%
MAINE	21.3%	61.3%	13.5%
WEST VIRGINIA	20.0%	51.3%	17.7%
KANSAS	19.8%	25.8%	13.3%
VERMONT	18.0%	61.1%	11.6%
MONTANA	17.1%	44.1%	14.9%
KENTUCKY	17.0%	41.6%	18.8%
SOUTH DAKOTA	15.6%	43.3%	14.0%
U.S. TOTAL	9.3%	19.3%	15.1%

* MVNO-intensive states are defined as those states where the percentage of total mobile voice subscriptions not directly billed (*i.e.*, served by resale / MVNOs) per the FCC's Voice Telephone Services report is over 15%.

Sources: FCC Voice Telephone Services Report, State-Level Subscriptions (2016); U.S., Census, Table 1. Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2017 (NST-EST2017-01); U.S. Census Bureau, 2010 Census, Summary File 1, Table P2, County Rurality Level (2010); U.S. Census Bureau, Selected Economic Characteristics, 2012-2016 American Community Survey 5-Year Estimates.

Figure A1: Lifeline Payments by Carrier Type, 2016



Source: USAC Fourth Quarter 2017 Filing, Appendix LI05 Annual Low Income Support Claimed by State and Company, January 2014 through June 2017

APPENDIX

This Appendix provides a description of (1) the data and data source; and (2) the regression models that I have used to explore how MVNO activity influences investment in the United States. The Appendix then provides the estimation results from seven alternative models. The models are necessarily simple as the available data are quite limited. Nonetheless, the results consistently indicate that increases in MVNO activity act to positively influence investment in the wireless communications industry.

Data and Sources

INV, the annual data on wireless investment over the 2001-2016 period, is derived from the CTIA's Annual Wireless Industry Survey.[20] Robustness checks are also performed using the Census Bureau's Annual Capital Expenditure Survey (ACES)[21] data as an alternative source of data on investments made by wireless telecommunications carriers. INVLAG, which is the INV of the previous year, is also used as a control variable.

The nationwide subscriber data comes from the FCC Local Competition reports[22] for the period 2001-2013, and from the FCC Voice Telephone Services reports[23] from 2014-2016. SUBSTOT represents the total number of wireless subscribers, and SUBSFB represents the number of subscribers to facility-based subscribers while SUBSMNVO represents the number of subscribers to MVNO providers. MVNOSHARE represents the ratio of MVNO subscriptions to total wireless subscriptions. Each of the subscriber variables are lagged by one year under the assumption that changes in MVNO activity cannot cause contemporaneous changes in investment, but may create adjustments in the following year.

The inflation-adjusted GDP growth rate, GDPGROWTH, from the World Bank[24] is also included to control for other determinants of investment. Variants FGDPGROWTH, the GDP growth rate one year in the future, and LGDPGROWTH, the GDP growth rate in the previous year, are also included alternatively as controls.

---

[20] INV represents the incremental capital expenditures in $1000s. In its earlier surveys, CTIA originally requested cumulative capex, so the incremental capex is derived from the reported figures, but after 2004, CTIA requested incremental capex directly. For more information on the CTIA's Annual Wireless Industry Surveys, see https://www.ctia.org/industry-data/ctia-annual-wireless-industry-survey.

[21] Data are sourced from the collection of tables titled "Capital Expenditures for Structures and Equipment for Companies With Employees by Industry," see https://www.census.gov/programs-surveys/aces/data/tables.html.

[22] See FCC Local Telephone Competition reports, 2001-2013, https://www.fcc.gov/general/local-telephone-competition-reports.

[23] See FCC Voice Telephone Services reports for periods 2014-2016, https://www.fcc.gov/voice-telephone-services-report.

[24] GDPGROWTH is the annual percentage growth rate of GDP at market prices based on constant 2010 U.S. dollars as derived by the World Bank, see https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=US for more details.

Regressions

Table A3 provides the results of seven different simple regression models for wireless investment. The dependent variable in each case is INV. In each of these seven models, I estimate the impact of MVNO activity on wireless industry investment. In each of the seven models, the indicator of MVNO activity, as represented by either the number of MVNO subscribers or the share of MVNO subscribers, positively and significantly influences investment.

In the first six models, MVNO activity is measured by MVNO subscribers in the prior year.[25] In regressions one through six, I control alternatively for facility-based wireless subscribers SUBSFB, total wireless subscribers SUBSTOT, the lagged effect of investment INVLAG, the GDP growth rate in the current, previous, or following year, and different combinations thereof. In Model (3) the GDP growth rate has a positive and significant effect on investment. In Model (1), the number of facility-based subscribers has a significant negative effect on investment, and in Model (6) total wireless subscribers also has a significant negative effect on investment. In each of these six models, however, SUBSMNVO positively and significantly influences investment.

In the seventh and final model, MVNO activity is measured in the form of MVNO subscribers as a share of total wireless subscribers in the prior year. Even in the form of subscription shares, MVNO activity has a positive and significant effect on investment.

In each of the seven models, the indicator of MVNO activity, as represented by either the number of MVNO subscribers or the share of MVNO subscribers, positively and significantly influences investment. Each regression was also estimated using ACES investment data from the Census Bureau with no substantive difference to what is reported here.

[25] Because the effects of wireless subscriptions are estimated as lagged effects, there are 15 observations per regression despite the 16 years of data total. In Model (5), the observations further shrink to 14 due to the current unavailability of the 2017 GDP growth rate.

TABLE A3: REGRESSION RESULTS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	INV	INV	INV	INV	INV	INV	INV
SUBSMVNO	0.622***	0.626*	0.417**	0.604**	0.630**	0.691***	
	(0.188)	(0.287)	(0.182)	(0.212)	(0.214)	(0.222)	
MVNOSHARE							2.182e+08***
							(6.920e+07)
SUBSFB	-0.0684*	-0.0687	-0.0227	-0.0645	-0.0574		
	(0.0364)	(0.0424)	(0.0367)	(0.0415)	(0.0424)		
INVLAG		-0.00550					
		(0.313)					
GDPGROWTH			1.194e+06**				
			(509,831)				
LGDPGROWTH				128,930			
				(571,131)			
FGDPGROWTH					403,897		
					(586,727)		
SUBSTOT						-0.0684*	-0.0291
						(0.0364)	(0.0245)
Constant	2.708e+07***	2.721e+07**	1.923e+07***	2.641e+07***	2.413e+07***	2.708e+07***	1.429e+07***
	(4.601e+06)	(8.767e+06)	(5.164e+06)	(5.659e+06)	(5.990e+06)	(4.601e+06)	(2.966e+06)
Observations	15	15	15	15	14	15	15
R-squared	0.638	0.638	0.758	0.640	0.746	0.638	0.642
Standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge and belief.

Executed on February 19, 2018

Dr. John Mayo

EXHIBIT 1

DR. JOHN MAYO

VITA 2018

VITA

JOHN W. MAYO

Georgetown University
McDonough School of Business
527 Hariri Building
37th and O Streets, N.W.
Washington, D.C. 20057
Email: mayoj@georgetown.edu, Telephone: (202)-687-6972

ACADEMIC APPOINTMENTS:

Georgetown University, McDonough School of Business
- Professor of Economics, Business and Public Policy 1998-present
- Executive Director, Georgetown Center for Business and Public Policy, 2002 – present
- Dean, 2002-2004
- Senior Associate Dean, 1999-2001

Georgetown University, Department of Economics
- Professor of Economics (by courtesy), 2011-present.

Stanford University
- Visiting Scholar (February 2013, February 2015, February 2018)
- Stanford Institute for Economic Policy Research

University of California, Berkeley
- Visiting Scholar (January-May 2011)
- Haas School of Business

University of Tennessee, Knoxville
- Professor of Economics, 1994-1998
- Research Associate Professor, Center for Business and Economic Research 1989-1994
- Associate Professor of Economics, Department of Economics, 1989-1994
- Research Assistant Professor, Center for Business and Economic Research, 1981-1989
- Assistant Professor of Economics, Department of Economics, September 1981-1989.

Virginia Polytechnic and State University (Virginia Tech)
- Visiting Assistant Professor, fall 1983

EDUCATION:

Honorary Doctorate in Economics, 2007, University of Basel, Basel, Switzerland

Ph.D., Economics, 1982, Washington University in St. Louis
Dissertation: "Diversification and Performance in the U.S. Energy Industry"
A.M., Economics, 1979, Washington University in St. Louis
B.A., Economics, 1977, Hendrix College, Conway, Arkansas

FIELDS OF SPECIALIZATION:

Industrial Organization
Regulatory and Antitrust Policy
Applied Microeconomics
Econometrics

NON-ACADEMIC APPOINTMENTS

U.S. Senate, Small Business Committee
Chief Economist, Democratic Staff, June 1984 - June 1985

International Institute for Applied Systems Analysis (IIASA)
Energy Research Fellow, Laxenburg, Austria, summer 1979

Transportation and Public Utilities Group
President, 2005-2006; 2014-15.

National Safety Council,
Board of Directors, Vice President, October 2002- 2006.

HONORS, AWARDS, AND GRANTS:

Undergraduate: Mosley Economics Prize (#1 graduating economics major), Alpha Chi (scholastic), Blue Key Honor Society, Senior Honors Seminar.

Graduate: University Fellowship, Washington University (1977-78); National Academy of Sciences Young Research Fellow, Laxenburg, Austria (1979); President, Washington University Economics Graduate Student Association (1979-81); Dissertation Fellowship, Center for the Study of American Business, Washington University (1980-81).

Post-Graduate: Public Utility Research Center Distinguished Service Award (2006); Zaeslin Fellow of Law and Economics, University, of Basel, Basel, Switzerland (2000 - present); William B. Stokely Scholar, College of Business Administration, The University of Tennessee (1993-1995); South Central Bell Research Grant (1988); Research Affiliate, Center of Excellence for New Venture Analysis, The University of Tennessee (1985); Summer Faculty Research Fellowships, The University of Tennessee (1983-1985).

COURSES TAUGHT:

Undergraduate: The Miracle of Markets?, Principles of Microeconomics, Economic Foundations of Commerce, Current Economic Problems, Government and Business, Intermediate Microeconomics, Energy Economics

Graduate: Managerial Economics (MBA), Firm Analysis and Strategy (MBA), The Miracle of Markets?, Managing in a Regulated Economy (MBA), Economics (Executive MBA), The Economics of Strategy (MBA), Business and Public Policy (MBA), Competition and Competition Policy (MBA), Regulation and Deregulation in the American Economy (MBA), Strategic Pricing: Theory, Practice and Policy (MBA), Understanding International Business (MBA), Industrial Organization and Public Policy (Ph.D.), The Economics of Antitrust and Regulation (Ph.D.)

PUBLICATIONS:

A. JOURNAL ARTICLES

"Will Ideology Block Opportunity? Regulatory Reform in the Infrastructure Industries," Federal Communications Law Journal, forthcoming.

"From Universal Service to Universal Connectivity," (with Jeffrey T. Macher, Olga Ukhaneva and Glenn Woroch), Journal of Regulatory Economics, Volume 52, August 2017, pp. 77-104.

"The Evolution of 'Competition': Lessons for 21st Century Communications Policy," (with Amanda B. Delp), Review of Industrial Organization, Vol. 50, June 2017, pp. 393-416.

"International Telecommunications Demand" (with Olga Ukhaneva), Information Economics and Policy, Vol. 39, June 2017, pp. 26-35.

"Regulation in a 'Deregulated' Industry: Railroads in the Post-Staggers Era" (with David E. M. Sappington), Review of Industrial Organization, Vol. 49, September 2016, pp. 203-227.

"Targeting Efforts to Raise Rivals' Costs: Moving from 'Whether' to 'Whom'" (with David M. Mandy and David E.M. Sappington), International Journal of Industrial Organization, Volume 46, May 2016, pp. 1-15.

"When Do Auctions Ensure the Welfare-Maximizing Allocation of Scarce Inputs?" (with David E.M. Sappington), RAND Journal of Economics, Vol. 47, Spring 2016, pp. 186-206.

"Can you Hear me Now: Exit, Voice and Loyalty Under Increasing Competition" (with T. Randolph Beard and Jeffrey T. Macher). Journal of Law and Economics, Vol. 58, August 2015, pp. 717-745.

"Influencing Public Policymaking: Firm-, Industry- and Country Institution-Level Determinants," (with Jeffrey T. Macher) Strategic Management Journal, Vol. 36, December 2015, pp. 2021-2038.

"Revenue Adequacy: the Good, the Bad and the Ugly" (with Jeffrey T. Macher and Lee F. Pinkowitz), Transportation Law Journal, Volume 41**,** 2014, pp. 85-127.

"The Evolution of Innovation and the Evolution of Regulation: Emerging Tensions and Emerging Opportunities in Communications" (with Larry Downes) CommLaw Conspectus: Journal of Communications Law and Policy, Vol. 23, 2014, pp. 10-51.

"Moving Past the Ideological Debate: A Results-Based Regulation Approach to Net Neutrality," Democracy: A Journal of Ideas, No. 34, fall 2014, pp. 21-27.

"The Evolution of Regulation: 20th Century Lessons and 21st Century Opportunities," Federal Communications Law Journal, Vol. 65, April 2013, pp. 119-156.

"It's Time to Unify Telecommunications Policy" (with Jeffrey T. Macher), The Economists' Voice, Vol. 9, 2012, pp. 1-6.

"The World of Regulatory Influence" (with Jeffrey T. Macher), Journal of Regulatory Economics, Volume 41, February 2012, pp. 59-79.

"Regulator Heterogeneity and Endogenous Efforts to Close the Information Asymmetry Gap: Evidence from FDA Regulation," (with Jeffrey T. Macher and Jackson A. Nickerson), Journal of Law and Economics, Vol. 54, February 2011, pp. 25-54.

"From Network Externalities to Broadband Growth Externalities: A Bridge Not Yet Built" (with Scott Wallsten), Review of Industrial Organization, Vol. 38, March 2011, pp. 173-190.

"The Influence of Firms on Government" (with Jeffrey T. Macher and Mirjam Schiffer), The B.E. Journal of Economic Analysis & Policy, Vol. 11, Issue 1, January 2011, pp. 1-25.

"Making a Market Out of a Molehill?: Geographic Market Definition in *Aspen Skiing*," (with Jeffrey T. Macher), Journal of Competition Law and Economics, Vol. 6, December 2010, pp. 911-926.

"Enabling Efficient Wireless Communications: The Role of Secondary Spectrum Markets" (with Scott Wallsten), Information Economics and Policy, Vol. 22, March 2010, pp. 61-72.

"Wireless Technologies," (with Glenn Woroch), Information Economics and Policy, Vol. 22, March 2010, pp. 1-3.

"Endogenous Regulatory Constraints and the Emergence of Hybrid Regulation" (with Larry Blank), Review of Industrial Organization, Vol. 35, November 2009, pp. 233-255.

"Warm Glow and Charitable Giving: Why the Wealthy Do Not Give More to Charity" (with Catherine H. Tinsley), Journal of Economic Psychology, Vol. 30, June 2009, pp. 490-499.

"Common Costs and Cross-Subsidies: Misestimation Versus Misallocation" (with Mark L. Burton and David L. Kaserman), Contemporary Economic Policy, April 2009, pp. 193-199.

"It's No Time to Regulate Wireless Telephony," The Economists' Voice, Vol. 5 : Iss. 1, pp, 1-4, 2008.

"Understanding Participation in Social Programs: Why Don't Households Pick up the Lifeline?" (with Mark Burton and Jeffrey T. Macher), The B.E. Journal of Economic Analysis & Policy, Volume 7, Issue 1 (Topics), 2007.

"A Graphical Approach to the Stiglerian Theory of Regulation," (with T. Randolph Beard and David L. Kaserman), Journal of Economic Education, Vol. 38, Fall 2007, pp. 447-451.

"Antitrust Economics Meets Antitrust Psychology: A View From the Firms" (with Mirjam Schiffer), International Journal of the Economics of Business, Vol. 13, July 2006, pp.281-306.

"Regulatory Opportunism and Investment Behavior: Evidence from the U.S. Electric Utility Industry," (with Thomas P. Lyon) RAND Journal of Economics, Vol. 36, Fall 2005, pp. 628-644.

> Reprinted in The Political Economy of Regulation, Thomas P. Lyon, Edward Elgar, Northampton, MA, 2007.

"On the Impotence of Imputation" (with T. Randolph Beard and David L. Kaserman), Telecommunications Policy, Volume 27, Issues 8-9, September-October 2003, pp. 585-595.

"A Graphical Exposition of the Economic Theory of Regulation" (with T. Randolph Beard and David L. Kaserman), Economic Inquiry, Volume 41, October 2003, pp. 592-606.

"Regulation, Competition, and the Optimal Recovery of Stranded Costs," (with T. Randolph Beard and David L. Kaserman) International Journal of Industrial Organization, Volume 21, June 2003, pp. 831-848.

"The Supreme Court Weighs in on Local Exchange Competition: The Meta-Message," (with David L. Kaserman) Review of Network Economics Volume 1, September 2002, pp. 119 – 131.

"Regulation, Vertical Integration and Sabotage" (with T. Randolph Beard and David L. Kaserman), Journal of Industrial Economics, Volume 49, September 2001, pp. 319-334.

"Efficient Telecommunications Policies for the 'New Economy': The Compelling Case for Access Charge Reform" (with David L. Kaserman), International Journal of Development Planning Literature, (Special Issue edited by William J. Baumol and Victor A. Becker), Volume 1, April 2001.

"Regulatory Policies Toward Local Exchange Companies Under Emerging Competition: Guardrails or Speedbumps on the Information Highway," (with David L. Kaserman) Information Economics and Policy, Volume 11, December 1999, pp. 367-388.

"Open Entry and Local Telephone Rates: The Economics of IntraLATA Toll Competition," (with David L. Kaserman, Larry R. Blank, and Simran Kahai) Review of Industrial Organization, Vol. 14, June 1999, pp. 303-319.

"Modeling Entry and Barriers to Entry: A Test of Alternative Specifications," (with Mark L. Burton and David L. Kaserman), Antitrust Bulletin, Summer 1999, pp. 387-420.

"Targeted and Untargeted Subsidy Schemes: Evidence from Post-Divestiture Efforts to Promote Universal Telephone Service," (with Ross Eriksson and David L. Kaserman) Journal of Law and Economics, Vol. 41, October 1998, pp. 477-502.

"Dominant Firm Pricing with Competitive Entry and Regulation: The Case of IntraLATA Toll," (with Larry Blank and David L. Kaserman) Journal of Regulatory Economics, Vol. 14, July 1998, pp. 35-54.

"The Role of Resale Entry in Promoting Local Exchange Competition," (with David L. Kaserman) Telecommunications Policy, Vol. 22, No. 4/5, 1998.

"Telecommunications Policy and the Persistence of Local Exchange Monopoly," (with David L. Kaserman), Business Economics, Vol. 33, April 1998, pp. 14-19.

"An Efficient Avoided Cost Pricing Rule for Resale of Local Exchange Telephone Service," (with David L. Kaserman) Journal of Regulatory Economics, Volume 11, January 1997, pp. 91-107.

"A Dynamic Model of Advertising by the Regulated Firm," (with Francois Melese and David L. Kaserman) Journal of Economics (Zeitschrift fur NationalÖkonomie), Volume 64, 1996, pp. 85-106.

"Is the 'Dominant Firm' Dominant? An Empirical Analysis of AT&T's Market Power,"(with Simran Kahai and David L. Kaserman), Journal of Law and Economics, Volume 39, October 1996, pp.499-517.

"Competition and Asymmetric Regulation in Long Distance Telecommunications: An Assessment of the Evidence,"(with David L. Kaserman) CommLaw Conspectus: Journal of Communications Law and Policy, Volume 4, Winter 1996, pp. 1-26.

"Deregulation and Predation in Long-Distance Telecommunications: An Empirical Test," (with Simran Kahai and David L. Kaserman), Antitrust Bulletin, Vol. 40, Fall 1995, pp.645-666.

"Cross-Subsidies in Telecommunications: Roadblocks on the Road to More Intelligent Telephone Pricing" (with David L. Kaserman), Yale Journal on Regulation, Volume 11, Winter 1994, pp. 120-147.

> Reprinted in Public Utilities Law Anthology, Allison P. Zabriskie, editor, Vol. 17, Part 2 (July-December, 1994), pp. 899-929.

"Demand and Pricing of Telephone Services: Evidence and Welfare Implications" (with Carlos Martins-Filho), RAND Journal of Economics, Volume 24, Autumn 1993, pp. 399-417.

"Two Views of Applied Welfare Analysis: The Case of Local Telephone Service Pricing -- A Comment and Extension" (with David L. Kaserman and David M. Mandy), Southern Economic Journal, Volume 59, April 1993, pp. 822-827.

"The Political Economy of Deregulation: The Case of Intrastate Long Distance" (with David L. Kaserman and Patricia L. Pacey), Journal of Regulatory Economics, Volume 5, March 1993, pp. 49-64.

> Reprinted in The Foundations of Regulatory Economics, Robert E. Ekelund, Jr. (Ed.), Edward Elgar Publishing, Northhampton, MA.

"Demand, Pricing and Regulation: Evidence from the Cable TV Industry" (with Yasuji Otsuka), RAND Journal of Economics, Volume 22, Number 3, Autumn 1991, pp. 396-410.

"The Measurement of Vertical Economies and the Efficient Structure of the Electric Utility Industry" (with David L. Kaserman), Journal of Industrial Economics, Volume 39, Number 5, September 1991, pp. 483-502.

"Regulation, Market Structure and Hospital Costs: Reply and Extension" (with Deborah A. McFarland), Southern Economic Journal, Volume 58, Number 2, October 1991, pp. 535-538.

"Firm Size, Employment Risk and Wages: Further Insights on a Persistent Puzzle" (with Matthew N. Murray), Applied Economics, Volume 23, Number 8, August 1991, pp. 1351-1360.

"Competition for 800 Service: An Economic Evaluation" (with David L. Kaserman), Telecommunications Policy, October 1991, pp. 395-408.

"Regulation, Advertising and Economic Welfare" (with David L. Kaserman), Journal of Business, Volume 64, Number 2, April 1991, pp. 255-267.

Reprinted in The Foundations of Regulatory Economics, Robert E. Ekelund, Jr., (Ed.), Edward Elgar Publishing, Northhampton, MA.

"Cross-Subsidization in Telecommunications: Beyond the Universal Service Fairy Tale" (with David L. Kaserman and Joseph E. Flynn), Journal of Regulatory Economics, Volume 2, Number 3, September 1990, pp. 231-250.

"Barriers to Trade and the Import Vulnerability of U.S. Manufacturing Industries" (with Don P. Clark and David.L. Kaserman), Journal of Industrial Economics, Volume 38, Number 4, June 1990, pp. 433-448.

"Firm Entry and Exit: Causality Tests and Economic Base Linkages" (with Joseph E. Flynn), Journal of Regional Science, Volume 29, Number 4, November 1989, pp. 645-662.

"Regulation, Market Structure and Hospital Costs" (with Deborah A. McFarland), Southern Economic Journal, Volume 55, Number 3, January 1989, pp. 559-569.

"Long Distance Telecommunications Policy: Rationality on Hold" (with David L. Kaserman), Public Utilities Fortnightly, Volume 122, Number 13, December 22, 1988, pp. 18-27.

"The Effects of Regulation on R&D: Theory and Evidence" (with Joseph E. Flynn), Journal of Business, Volume 61, Number 3, July 1988, pp. 321-336.

"The Effectiveness of Mandatory Fuel Efficiency Standards in Reducing the Demand for Gasoline" (with John E. Mathis), Applied Economics, Volume 20, Number 2, February 1988, pp. 211-220.

"Market Based Regulation of a Quasi-Monopolist: A Policy Proposal for Telecommunications" (with David L. Kaserman), Policy Studies Journal, Volume 15, Number 3, March 1987, pp. 395-414.

"The Ghosts of Deregulated Telecommunications: An Essay by Exorcists" (with David L. Kaserman), Journal of Policy Analysis and Management, Volume 6, Number 1, Fall 1986, pp. 84-92.

"Economies of Scale and Scope in the Electric-Gas Utilities: Further Evidence and Reply," Southern Economic Journal, Volume 52, Number 4, April 1986, pp. 1175-1178.

"Advertising and the Residential Demand for Electricity" (with David L. Kaserman), Journal of Business, Volume 58, Number 4, October 1985, pp. 399-408.

"Multiproduct Monopoly, Regulation and Firm Costs," Southern Economic Journal, Volume 51, Number 1, July 1984, pp. 208-218.

"The Technological Determinants of the U.S. Energy Industry Structure," The Review of Economics and Statistics, Volume 66, February 1984, pp. 51-58.

B. BOOKS, MONOGRAPHS, AND OTHER PUBLICATIONS

"Staying with Success? Not at the FCC," Forbes, February 26, 2015.

"Bringing Mobile Broadband to Rural Americans," (with Anna-Maria Kovacs) Roll Call, May 9, 2014.

"Modernized Telecom Policy Must Reflect That Change is the Only Constant," Roll Call, February 7, 2014.

"Conclusion" in The Information Technology Revolution and the Transformation of the Small Business Economy: A Collection of Essays," The American Consumer Institute, March 2012.

"How to Regulate the Internet Tap," (with Bruce Owen, Marius Schwartz, Robert Shapiro, Lawrence J. White and Glenn Woroch) New York Times, April 21, 2010, p. A25.

"Regulating Early Termination Fees: When 'Pro-Consumer' Legislation Isn't," Economic Policy Vignette, Georgetown Center for Business and Public Policy, January 2010, available at http://cbpp.georgetown.edu/publications/.

"Universal Service: Can We Do More with Less?" in New Directions in Communications Policy, Randolph J. May, Editor, Carolina Academic Press, 2009.

"The Economic Facts and FAQs of National Video Franchising: Reflections on the House of Representatives Debate," Policy Matters 06-16, AEI-Brookings Joint Center, June 2006.

"We're all for Competition, But…," Policy Matters 06-03, AEI-Brooking Joint Center, February 2006.

"The Role of Antitrust in a Deregulating Telecommunication Industry: The Economic Fallacies of Trinko," in The Future of Telecommunications Industries, Arnold Picot, Editor, Springer Verlag, 2006, pp. 129-146.

"Competition in the Long Distance Market," (with David L. Kaserman) in Handbook of Telecommunications Economics, Martin E. Cave, Sumit K. Majumdar and Ingo Vogelsang, Editors, North Holland Elsevier, 2002.

"Shakeout or Shakedown? The Rise and Fall of the CLEC Industry," (with Mark Burton and David L. Kaserman), in Michael A. Crew, Editor, Markets, Pricing, and Deregulation of Utilities, Kluwer Academic Publishers, 2002.

"Resale and the Growth of Competition in Wireless Telephony," (with Mark L. Burton and David L. Kaserman), in Expanding Competition in Regulated Industries, Michael A. Crew, Editor, Kluwer Academic Publishers, 2000.

"Monopoly Leveraging, Path Dependency, and the Case for a Competition Threshold for RBOC Reentry into InterLATA Toll," (with T.R. Beard and David L. Kaserman), in Regulation Under Increasing Competition, Michael A. Crew, Editor, Kluwer Academic Publishers, 1999.

"The Quest for Universal Service: The Misfortunes of a Misshapen Policy," (with David L. Kaserman) in Telecommunications Policy: Have Regulators Dialed the Wrong Number?, Donald L. Alexander, Editor, Praeger Publishing Group, Westport, CT, 1997, pp.131-144.

Government and Business: The Economics of Antitrust and Regulation (with David L. Kaserman), The Dryden Press, Harcourt Brace College Publishers, 1995.

"Long-Distance Telecommunications: Expectations and Realizations in the Post-Divestiture Period" (with David L. Kaserman), in Incentive Regulation for Public Utilities, Michael A. Crew, Editor, (Boston, MA.: Kluwer Academic Publications), 1994.

Monopoly Leveraging Theory: Implications for Post-Divestiture Telecommunications Policy (with David L. Kaserman), Center for Business and Economic Research: University of Tennessee, April 1993.

State-Level Telecommunications Policy in the Post-Divestiture Era: An Economic Perspective (with William F. Fox), Center for Business and Economic Research, University of Tennessee, March 1991.

A review of After Divestiture: The Political Economy of State Telecommunications Regulation, by Paul E. Teske. Albany: State University of New York Press, 1990. Publius, Winter 1991, pp. 164-166.

Deregulation and Market Power Criteria: An Evaluation of State Level Telecommunications Policy" (with David L. Kaserman) in Telecommunications Deregulation: Market Power and Cost Allocation Issues, J. Allison and D. Thomas (eds.), Quorum Books, 1990.

The Economics of Local Telephone Pricing Options (with J. E. Flynn), Center for Business and Economic Research, The University of Tennessee, October 1988.

Firm Entry and Exit: Economic Linkages in Tennessee (with J. E. Flynn), Center for Business and Economic Research, The University of Tennessee, Knoxville, July 1988.

"The Economics of Regulation: Theory and Policy in the Post-Divestiture Telecommunications Industry" (with David L. Kaserman) in Public Policy Toward Corporations, Arnold Heggestad, editor, University of Florida Presses, 1988.

"Entries and Exits of Firms in the Tennessee Economy: Foundations for Research," Survey of Business, The University of Tennessee, Vol. 23, Summer 1987, pp. 21-23.

"The Relationship of Manufacturing and Nonmanufacturing Firm Entry and Exit in Tennessee" (with Joseph E. Flynn), Survey of Business, The University of Tennessee, Volume 23, Number 2, Fall 1987, pp. 11-16.

A Review of Municipal Ownership in the Electric Utility Industry, by David Schap. New York: Praeger Publishing Company, 1986. Southern Economic Journal, Volume 54, Number 1, July 1987.

Entries and Exits of Firms in the Tennessee Economy (with W. F. Fox, et al.), Center for Business and Economic Research, University of Tennessee, Knoxville, May 1987.
Condensed report published in Survey of Business, The University of Tennessee, Volume 23, Number 2, Fall 1987, pp. 3-10.

"The U.S. Economic Outlook," Survey of Business, The University of Tennessee, annual contributor, 1986-1994.

An Economic Report to the Governor of the State of Tennessee, Center for Business and Economic Research and the Tennessee State Planning Office, Annual Contributor, 1981-1994.

"An Economic Analysis of a Monitored Retrievable Storage Site for Tennessee" (with W. F. Fox, L. T. Hansen, and K. E. Quindry), Final Report and Appendices, December 17, 1985.

CONGRESSIONAL AND REGULATORY TESTIMONIES:

U.S. Senate (Commerce, Science and Transportation Committee; Energy and Natural Resources Committee, Subcommittee on Water and Power); U.S. House of Representatives, Subcommittee on Railroads, Pipelines, and Hazardous Materials); Federal Communications Commission; U.S. International Trade Commission; Tennessee State Legislature (Senate Finance, Ways and Means Committee; Special Joint Legislative Committee on Business Taxation; and, Senate State and Local Government Committee); Maryland State Legislature (Environmental Works Committee); Pennsylvania Public Utility Commission; Michigan Public Service Commission; Missouri Public Service Commission; Illinois Commerce Commission; West Virginia Public Utility Commission; Wyoming Public Utility Commission; Washington Utilities and Transportation Commission; Utah Public Service Commission; Wisconsin Public Service Commission; California Public Utilities Commission; Florida Public Service Commission; Delaware Public Service Commission; Montana Public Service Commission; Maryland Public Service Commission; Massachusetts Department of Public Utilities; Georgia Public Service Commission; Colorado Public Utilities Commission; North Carolina Public Utilities Commission; Missouri Public Service Commission; Texas Public Utility Commission; Arkansas Public Service Commission; Connecticut Department of Public Utility Control; Kansas State Corporation Commission; and New Jersey Board of Public Utility Commissioners.

INVITED SEMINARS AND SELECTED CONFERENCE PRESENTATIONS:

Columbia University, MIT, University of Chicago, London Business School, University of Paris (Dauphine IX), Vanderbilt University, INSEAD, Washington University in St. Louis, University of Michigan, Ohio State University, University of Minnesota, University of Florida, University of Arkansas, University of Texas, University of Missouri, Florida State University, Rutgers University, American University, University of Missouri, Kansas University, University of Utah, University of Colorado, University of Basel (Switzerland), ESMT, University of Freiburg (Germany), University of Central Florida, American Enterprise Institute, Brookings Institution, Federal Communications Commission, Australian Competition and Consumer Commission (ACCC), COFECE (Mexican antitrust commission), Telecommunications Policy Research Conference (TPRC), National Conference of State Legislatures, U.S. Advisory Commission on Intergovernmental Relations

SELECTED CONSULTING:

U.S. Department of Justice, Antitrust Division; U.S. Federal Trade Commission; AT&T; Sprint; MCI Telecommunications; Verizon; Optus Communications (Australia); United Parcel Service; Commonwealth of Virginia, Tennessee Valley Authority; Antitrust Division, Office of the Attorney General, State of Tennessee; U.S. Senator Howard Baker, Jr., U.S. Senate Majority Leader; Oak Ridge National Laboratory; AmerenUE; Arkansas Consumer Research; Division of Energy Conservation and Rate Advocacy, Office of the Arkansas Attorney General; U.S. Department of Energy

PROFESSIONAL PRESENTATIONS:

American Economic Association Annual Conference, Western Economic Association Annual Conference, Southern Economic Association Annual Conference, European Association for Research in Industrial Economics Annual Conference, Center for Research in Regulated Industries Eastern Annual Conference, Center for Research in Regulated Industries Western Annual Conference, Southeastern Economic Analysis Conference

WORKING PAPERS:

"Formal and Informal Channels: How Firm Size Affects Nonmarket Strategy," (with Jeffery T. Macher and Stephen Weymouth), January 2017.

"Demand in a Portfolio Choice Environment: The Evolution of Telecommunications" (with Jeffrey T. Macher, Olga Ukhaneva and Glenn Woroch), October 2014.

"Does the Internet Alter Consumer Healthcare Behaviors?" (with Jeffrey T. Macher and Olga Ukhaneva), January 2018.

EDITORIAL REVIEWER:

National Science Foundation, Brookings Institution, Federal Trade Commission, The MIT Press, American Economic Review, Quarterly Journal of Economics, Journal of Law and Economics, Economic Journal, Journal of Business, RAND Journal of Economics, Journal of Regulatory Economics, Review of Economics and Statistics, Economic Inquiry, Journal of Industrial Economics, Journal of Economics & Management Strategy, Journal of Law, Economics and Organization, Journal of Economic Behavior and Organization, Review of Industrial Organization, Scandinavian Journal of Economics, Eastern Economic Journal, Southern Economic Journal, Contemporary Economic Policy, Economic Development and Cultural Change, Industrial Relations, Growth and Change, Review of Regional Studies, Journal of Economics and Business, Quarterly Review of Economics and Business, Journal of Policy Analysis and Management, Quarterly Journal of Business and Economics, Regional Science and Urban Economics, Financial Review, Journal of Money, Credit, and Banking, Social Science Quarterly, Telecommunications Systems, Public Finance Quarterly, Japan and the World Economy, Energy Economics, Information Economics and Policy

EDITORIAL AND ACADEMIC OVERSIGHT BODIES

Associate Editor, Information Economics and Policy, 2007-2011.

Editorial Board, Journal of Regulatory Economics, 1999-present.

Editorial Board, Review of Industrial Organization, 2002-2003; 2010-present.

Associate Editor, Economic Inquiry, 2013-present.

Board of Academic Advisors, The Free State Foundation, 2008 – 2009.

Research Advisory Committee, National Regulatory Research Institute (Ohio State University), 1993-1997.

PROFESSIONAL MEMBERSHIPS:

American Economic Association
Western Economic Association
Southern Economic Association
American Law and Economics Association
International Telecommunications Society
European Association for Research in Industrial Economics