EXHIBIT F

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Protecting Against National Security Threats to the Communications Supply Chain Through FCC Programs	)))	WC Docket No. 18-89

Declaration of Allan L. Shampine

May 30, 2018

Contents

I. Qualifications 1

II. Overview and summary of conclusions 2

III. Huawei is an innovative and significant competitor 4

IV. Allowing Huawei to compete more freely in the United States could create significant consumer benefits 8

A. There are only a few large telecommunications infrastructure suppliers competing in the United States 8

B. Entry by Huawei could significantly reduce market concentration 9

V. Increased competition in telecommunications infrastructure would benefit the U.S. economy 15

Appendix A – C.V. 18

I. Qualifications

1. My name is Allan L. Shampine. I am an Executive Vice-President of Compass Lexecon, an economic consulting firm. I received a B.S. in Economics and Systems Analysis *summa cum laude* from Southern Methodist University in 1991, an M.A. in Economics from the University of Chicago in 1993, and a Ph.D. in Economics from the University of Chicago in 1996. I have been with Compass Lexecon since 1996.

2. I specialize in applied microeconomic analysis with a particular focus on technological innovation. I am the editor of the book Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies, a contributor to the Telecom Antitrust Handbook, and have published a variety of articles and book chapters on the economics of telecommunications and network industries, as well as patents, technology diffusion and antitrust issues. I am an editor of the American Bar Association journal Antitrust Source.

3. I have worked on telecommunications matters throughout my career, and have submitted testimony concerning the regulation of telecommunication and broadband networks in multiple countries. I have previously provided economic evidence to the United States Federal Communications Commission, International Trade Commission, state public utility commissions, Federal Maritime Commission, United States district courts, European Commission, Korean Fair Trade Commission, Chinese National Development & Reform Commission, Info-Communications Development Authority of Singapore, and the Australian Competition & Consumer Commission. A copy of my curriculum vitae is included as Appendix A.

II. Overview and summary of conclusions

4. In its recent Notice of Proposed Rulemaking ("NPRM"), the Federal Communications Commission ("Commission") has asked for comments on its proposal to "prohibit, going forward, the use of USF funds to purchase equipment or services from any communications equipment or service providers identified as posing a national security risk to communications networks or the communications supply chain."[1] The Commission has sought comment on the costs and benefits of the proposed rule. I have been asked by counsel for Huawei to discuss the potential economic costs of the proposed rule and the likely impact on competition. In doing so, I focus on the following questions raised by the Commission[2]:

- "What are the potential costs associated with our proposed rule to USF recipients, the Fund, end users, consumers, the public safety and law enforcement community, the Commission, or other federal agencies?"

- "How do covered companies' equipment and services perform relative to equipment and services of companies unaffected by the proposed rule? What is the cost difference to USF recipients between equipment and services that may be covered by the proposed rule and those that are not?"

5. In this declaration I assume that the effect of the Commission's rulemaking would be to effectively exclude Huawei and ZTE from competing in the U.S. market for telecommunications infrastructure equipment. I do not offer any opinion on the national security aspects of the NPRM.

6. I begin by noting that the potential benefits of additional competitors in a market are not limited to just introducing lower priced products. Indeed, the presence of additional competition can result in all firms lowering prices, improving quality and seeking to innovate in order to

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1. Federal Communications Commission, In the Matter of Protecting Against National Security Threats to the Communications Supply Chain Through FCC Programs, FCC 18-42, WC Docket No. 18-89, April 18, 2018, https://www.fcc.gov/document/fcc-proposes-protect-national-security-through-fcc-programs-0, ("NPRM"), ¶ 2.

2. NPRM, ¶ 34.

attract customers. This can be the case even when an entrants' list prices are no lower, or even higher, than those of incumbent firms. Thus, a narrow focus on the list prices of potentially excluded firms can miss the broader benefits created for consumers from increased competition.

7. Regulators have noted that worldwide there are a relatively small number of large telecommunications infrastructure providers, which include Huawei and ZTE elsewhere in the world. While Huawei has had relatively little presence within the United States in recent years, during periods when it has been able to bid on proposals, its presence has been reported to result in increased competition and lower prices for carriers. It is my general understanding from press reports and other public sources that Huawei's presence in the United States has been restricted by the concerns of some within the government about potential national security risks. I understand that the rule proposed in the NPRM would further restrict Huawei's activities in this country by effectively prohibiting many entities in the telecommunications and information services sectors from dealing with Huawei. Eliminating these restrictions and allowing Huawei an opportunity to compete in the provision of telecommunications infrastructure equipment in the United States could reduce the concentration of the industry, increase competition, reduce prices, and encourage increased deployment by carriers. Given the upcoming 5G deployments and the benefits of improved telecommunications for the economy as a whole, the benefits to consumers of increased competition for infrastructure equipment could be substantial. Conversely, excluding Huawei from the market would deprive consumers of the benefits of entry or increased competition from its presence. The Commission should consider carefully the costs of excluding significant competitors from participating in a highly concentrated market.

III. Huawei is an innovative and significant competitor

8. Huawei has a history of significant investment in research and development. Over the past decade it has invested roughly $62 billion in research and development, including $34 billion between 2012 and 2016 and $14 billion in 2017.[3] To put these figures into context, between 2012 and 2016 Nokia is reported to have spent roughly $17 billion on research and development and Ericsson spent roughly $23 billion. While Huawei and Nokia have been increasing their expenditures, Ericsson is decreasing. In the last several years, Huawei spent more than Ericsson and Nokia combined. See Table 1 below.

Table 1: Research & Development Investment ($ Millions)[4]

Year	Ericsson	Nokia	Huawei
2012	$ 4,852	$ 3,961	$ 4,283
2013	$ 4,932	$ 2,616	$ 4,417
2014	$ 5,315	$ 2,591	$ 5,881
2015	$ 4,134	$ 2,359	$ 8,583
2016	$ 3,702	$ 5,428	$ 11,000

9. Huawei is one of the largest vendors of radio access network ("RAN") equipment worldwide and, in particular, in Europe. The European Commission reports that in 2014,

3. Huawei Investment & Holding Co, Ltd. 2017 Annual Report, http://www-file.huawei.com/-/media/CORPORATE/PDF/annual-report/annual_report2017_en.pdf?la=en, p. 50, reporting 2017 research and development expenditures of CNY89,690,000,000 and expenditures over the last decade of CNY394,000,000,000. Values above use exchange rate of 6.38 CNY per dollar, per Bloomberg, as of May 15, 2018. https://www.bloomberg.com/quote/USDCNY:CUR. Jamie Davies, "Ericsson is losing the R&D game and that needs to change," telecoms.com, June 5, 2017, http://telecoms.com/482479/ericsson-is-losing-the-rd-game-and-that-needs-to-change/.

4. Jamie Davies, "Ericsson is losing the R&D game and that needs to change," telecoms.com, June 5, 2017, http://telecoms.com/482479/ericsson-is-losing-the-rd-game-and-that-needs-to-change/.

Huawei had between a 20% and 30% share of RAN equipment sales globally and between 30% and 40% in Europe.[5] That remains true today. According to market research firm Dell'Oro, Huawei had 32% of global RAN sales as of 4Q 2017, followed by Ericsson with 30% and Nokia with 25%.[6] In 2017, the industry consulting firm GlobalData ranked Huawei's Mobile Access solutions as "Very Strong" or "Leader" in all seven of the ranked aspects in its Competitive Index. In particular, GlobalData ranked Huawei's 2G, 3G and LTE RAN product portfolios as "Leaders" in the market, citing "a broad radio unit portfolio and spectrum support" and "advanced antenna solutions."[7]

10. Huawei and Ericsson built the first commercial LTE networks in the world in 2009 (for TeliaSonera in Norway and Sweden, respectively).[8] To date, Huawei has supplied over half of the 4G and 4.5G networks globally, and has Memorandums of Understanding to trial 5G equipment with many carriers, including BT in the United Kingdom, Bell Canada in Canada, Deutsche Telekom in Germany, Orange in France, and Vodafone.[9] Huawei has also previously been called upon to modernize networks in, for example, European countries. For example, Huawei was engaged in 2013 by the Danish telecommunications company TDC to modernize and manage its mobile network, including deployment of LTE, and completed that upgrade in

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5. European Commission, Case No COMP/M.7632 – Nokia / Alcatel-Lucent, Regulation (EC) No 139/2004 Merger Procedure, Article 6(1)(b) Non-Opposition, July 24, 2015, document number 32015M7632, http://ec.europa.eu/competition/mergers/cases/decisions/m7632_788_2.pdf, ("EC Nokia/Alcatel Decision"), ¶ 82.

6. Eric Auchard & Sijia Jiang, "China's Huawei set to lead global charge to 5G networks," Reuters, February 23, 2018, https://www.reuters.com/article/us-telecoms-5g-china/chinas-huawei-set-to-lead-global-charge-to-5g-networks-idUSKCN1G70MV.

7. Ed Gubbins, "Huawei – Mobile Access," GlobalData, November 15, 2017.

8. TeleGeography, "TeliaSonera launches world's first commercial LTE networks in Sweden and Norway," December 19, 2009, https://www.telegeography.com/products/commsupdate/articles/2009/12/14/teliasonera-launches-worlds-first-commercial-lte-networks-in-sweden-and-norway/.

9. Eric Auchard & Sijia Jiang, "China's Huawei set to lead global charge to 5G networks," Reuters, February 23, 2018, https://www.reuters.com/article/us-telecoms-5g-china/chinas-huawei-set-to-lead-global-charge-to-5g-networks-idUSKCN1G70MV.

2015.[10] TDC then engaged Huawei to upgrade its landline hybrid fiber-coaxial cable network to support 1Gbps download speeds.[11] Similarly, Bouygues Telecom in France, citing "past common success" working with Huawei, is deploying its first 5G network trial in Bordeaux with Huawei.[12] I also understand that with its recent announcement of 5G base station and 5G modem chipsets, Huawei is set to become the first company in the world offering both infrastructure and terminal technologies for 5G.[13] The European Commission specifically called out Huawei as a "credible alternative" for customers for 4G and 5G equipment when evaluating the Alcatel-Lucent/Nokia merger.[14]

11. The fact that Huawei has little presence in the U.S. today does not imply that additional competition from Huawei would be without benefit. A small sales share does not by itself indicate a firm lacks competitive significance. Firms with small sales shares can nonetheless provide important competitive constraints, particularly in bidding markets where there are relatively few, large contracts being awarded. However, Huawei's relatively large sales shares globally are evidence that it is a credible alternative supplier for U.S. telecommunications

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10. TeleGeography, "Huawei completes modernisation of TDC network," June 3, 2015, https://www.telegeography.com/products/commsupdate/articles/2015/06/03/huawei-completes-modernisation-of-tdc-network/. TDC was originally the government-owned incumbent operator in Denmark, but the last state-owned shares were sold in 1998. Anders Henten, "Telecoms in Denmark: Investment, Performance and Regulation," in Stimulating Investment in Network Development: Roles for Regulators, A.K. Mahan and W.H. Melody (eds.), World Dialogue on Regulation for Network Economics, 2005, p. 330.

11. TeleGeography, "Huawei to upgrade TDC's HFC network to 1Gbps," January 28, 2016, https://www.telegeography.com/products/commsupdate/articles/2016/01/28/huawei-to-upgrade-tdcs-hfc-network-to-1gbps/.

12. TeleGeography, "Bouygues, Huawei to trial 5G in Bordeaux," February 28, 2018, https://www.telegeography.com/products/commsupdate/articles/2018/02/28/bouygues-huawei-to-trial-5g-in-bordeaux/.

13. Light Reading, "Huawei Unveils 5G-Ready Base Station, New Massive MIMO AAU," November 20, 2017, https://www.lightreading.com/mobile/5g/huawei-unveils-5g-ready-base-station-new-massive-mimo-aau/d/d-id/738338. Arjun Kharpal, "Mobile World Congress – Huawei unveils its first 5G chip in a challenge to Qualcomm and Intel," CNBC, February 25, 2018, https://www.cnbc.com/2018/02/25/huawei-unveils-5g-chipset-at-mobile-world-congress.html.

14. EC Nokia/Alcatel Decision, ¶ 85.

carriers, as many carriers globally have shown a preference for Huawei's equipment over alternatives offered by other firms.

IV. Allowing Huawei to compete more freely in the United States could create significant consumer benefits

12. Antitrust economics is devoted to studying certain of the types of questions posed in the NPRM – in particular, what are the likely competitive effects of reducing the number of competitors for telecommunications infrastructure equipment in the United States, or, given Huawei's limited role in recent years in the U.S., preventing entry by new competitors. For example, a merger between two competing firms can eliminate one of the firms as an independent competitor. That can potentially reduce the overall competitiveness of the market in which the firms compete, resulting in higher prices, reduced innovation, lower quality, or other harms to consumers. The U.S. Department of Justice and Federal Trade Commission Horizontal Merger Guidelines state that when there are only a few, large competitors (i.e., a market is highly concentrated) then the elimination of a competitor is, in fact, presumed to increase market power of the remaining firms, resulting in higher prices or other harm to consumers.[15] Mergers are nonetheless often permitted by regulators because of the expectation that they will produce offsetting benefits. Here, however, we are discussing the effective exclusion of one or more competitors by regulatory fiat without any offsetting merger efficiencies. Any expected benefits related to national security should be weighed against the harm to consumers from eliminating one or more competitors from the market for telecommunications infrastructure in the United States.

A. There are only a few large telecommunications infrastructure suppliers competing in the United States

13. As of 2015, market research firm Infonetics reported U.S. wireless infrastructure sales shares of 33% for Ericsson, 27% for Alcatel-Lucent, 20% for Nokia and 11% for Samsung.[16] Subsequently, Alcatel-Lucent and Nokia merged, which yields shares of 47% for the merged

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15. U.S. Department of Justice and the Federal Trade Commission, Horizontal Merger Guidelines, August 19, 2010, https://www.justice.gov/atr/horizontal-merger-guidelines-08192010, §§1, 2.1, 5.3, 6.

16. Simon Zekaria, "Merger of Nokia with Alcatel-Lucent Could Put Pressure on Prices," Dow Jones Institutional News, April 14, 2015.

Nokia, 33% for Ericsson, and 11% for Samsung – three firms becoming responsible for 91% of sales.

14. The Horizontal Merger Guidelines classify how concentrated markets are based on the Herfindahl-Hirschman Index ("HHI"), which is simply the sum of the squared shares of the firms involved. This can run from close to zero (a large number of firms with very small shares) to 10,000 (a monopolist). A market with an HHI above 2,500 is considered "Highly Concentrated" by the Department of Justice and Federal Trade Commission. The HHI for wireless infrastructure sales in the United States after the Alcatel-Lucent/Nokia merger would be above 3,400.[17]

15. The level of concentration for sales of RAN equipment remains high today. Using estimates from the IHS market research firm, the successor to Infonetics, the HHI for North America for RAN equipment for 2Q 2017 was greater than 5,000.[18]

B. Entry by Huawei could significantly reduce market concentration

16. Worldwide, mobile infrastructure sales are substantially less concentrated than in the United States, largely due to the presence of Huawei and ZTE. For example, the market research firm IHS reports mobile infrastructure shares in 2017 of 28% for Huawei, 27% for Ericsson, 23% for Nokia, 13% for ZTE, and 3% for Samsung.[19] These shares correspond to an HHI of

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17. 47^2 + 33^2 + 11^2 = 3,419. I treat the remaining 9% of sales as comprised of 1% firms, yielding a total HHI of 3,419 + 9 = 3,428. If they were made by a single firm, the HHI could be as high as 3,500. The Chinese Ministry of Commerce and the European Commission both examined RAN products as a product market when evaluating the Alcatel-Lucent/Nokia transaction. PaRR, "MOFCOM conditionally clears Alcatel/Nokia deal with behavioral remedies (full translation)," October 19, 2015, §3.1.A. EC Nokia/Alcatel Decision, §§4.2.1, 5.2.2.1.

18. Using either data for 2G, 3G, 4G mobile infrastructure equipment overall or 2G, 3G RAN equipment revenues. IHS Markit Mobile Infrastructure Market Tracker, August 28, 2017.

19. Stephane Teral, "Global mobile infrastructure market down 14 percent from a year ago," IHS, March 13, 2018, https://technology.ihs.com/600864/global-mobile-infrastructure-market-down-14-percent-from-a-year-ago.

below 2,300, substantially lower than that calculated above for North America.[20] Similarly, the European Commission in evaluating the Alcatel-Lucent/Nokia transaction reported market shares for overall RAN equipment in Europe of 30-40% for the merged Nokia, 30-40% for Ericsson, 30-40% for Huawei, and 0-5% for both ZTE and Samsung.[21] Assuming 30% each for Nokia, Ericsson and Huawei, and 5% each for ZTE and Samsung yields an HHI of 2,750, again substantially lower than that calculated above for North America.[22]

17. With respect to the Alcatel-Lucent/Nokia merger, the European Commission apparently viewed the merger as going from six credible alternatives to five, noting that post-merger, Ericsson, Huawei, ZTE and Samsung would remain as credible alternatives for customers of RAN equipment.[23] China's Ministry of Commerce ("MOFCOM") applied similar logic, noting that for 4G LTE RAN equipment, for example, Huawei, ZTE and Ericsson "are all strong rivals, among which the first two companies' respective market shares are larger than that of Nokia post-merger, so the competition dynamics will be maintained."[24] The U.S. Department of Justice did not provide any public analysis of the transaction.

18. I note that permitting a merger does not mean the regulators concluded there were no competitive effects – rather, it means that the benefits were deemed to outweigh any potential loss of competition. That is, regulators weigh potential benefits from a proposed merger against the potential costs of losing a competitor. In the Alcatel-Lucent/Nokia merger, for example, the merging firms had been experiencing "wrenching restructuring" and "years of losses" at Alcatel-Lucent,[25] and one stated goal of the merger was to become a stronger competitor to Ericsson and

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20. 28^2 + 27^2 + 23^2 + 13^2 + 3^2 + 6 = 2,226. As before, I assume the 6% of "Other" sales are made by 1% firms. If the 6% of sales were made by a single firm, the HHI could be as high as 2,256.

21. EC Nokia/Alcatel Decision, ¶ 82.

22. 30^2 + 30^2 + 30^2 + 5^2 + 5^2 = 2,750.

23. EC Nokia/Alcatel Decision, ¶ 85.

24. PaRR, "MOFCOM conditionally clears Alcatel/Nokia deal with behavioral remedies (full translation)," October 19, 2015.

25. Kevin Kelleher, "Why Nokia's Blockbuster Merger Turned Into Such a Mess," Time, April 20, 2015, http://time.com/3828400/nokia-alcatel-lucent/.

Huawei.[26] The European Commission noted, for example, that customers indicated the transaction would strengthen the merging firms "and guarantee viable competition going forward in the RAN equipment marketplace."[27]

19. Generally speaking, new entry does not involve a similar weighing as it introduces a new competitor rather than eliminating an existing one, so entry can be expected to benefit consumers. Any consumer that purchases from the entrant will have indicated that they are better off, having demonstrably chosen the entrants' products over the incumbents, and other consumers are also likely to benefit as the incumbents compete to retain the consumers' business. Thus, the addition of two significant competitors to a concentrated market can significantly enhance competition. Indeed, given a highly concentrated market, a merger involving an increase in HHI of more than 200 points is presumed by the Department of Justice and Federal Trade Commission to be likely to enhance market power.[28] Conversely, given the shares discussed above, a new entrant gaining even a 5% share could reduce concentration in North America by more than 400 points.[29]

20. As just mentioned, it is not necessary for Huawei to gain significant sales in order to benefit consumers in the United States. As the European Commission has noted, given large contracts, firms can provide competitive benefits even if they have low actual shares of sales, simply because they provide credible alternatives and participate in the bidding process.[30] Anecdotally, prior to the 2012 House report on Huawei and ZTE, Huawei's presence in the

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26. Chad Thomas and Ville Heiskanen, "Nokia CEO Stung by Failed Mergers Speeds Alcatel Integration," Bloomberg News, September 14, 2016, https://www.bloomberg.com/news/articles/2016-09-14/nokia-ceo-stung-by-failed-mergers-speeds-alcatel-integration.

27. EC Nokia/Alcatel Decision, ¶ 101.

28. U.S. Department of Justice and the Federal Trade Commission, Horizontal Merger Guidelines, August 19, 2010, https://www.justice.gov/atr/horizontal-merger-guidelines-08192010, § 5.3.

29. See note 17, *supra*. Taking 5% from the 47% firm and assigning it to a new entrant would reduce the HHI from 3,428 to 3,008. 42^2 + 33^2 + 11^2 + 5^2 + 9 = 3,008.

30. EC Nokia/Alcatel Decision, ¶¶ 18, 87, 96.

bidding process provided competitive pressure that helped U.S. carriers obtain better terms from Ericsson and Alcatel-Lucent.[31]

> Over the last few years, U.S. mobile industry has undergone a big transformation, building its next generation of LTE mobile networks. … Huawei bid on all of those contracts, but except for a WiMAX deal with Clearwire and a few minor networks with regional providers, it failed to win any of them. Every analyst and industry insider I've talked to, however, said that Huawei's presence was felt during those negotiations. Established vendors were forced to underbid Huawei or risk losing key contracts. A deal with a nationwide U.S. operator is a marquee deal, involving billions of dollars and tens of thousands of cellsites. To lose a nationwide U.S. contract to Huawei would be a major black eye for an Ericsson.

21. The Chief Technical Officer of the Canadian carrier Telus recently made the same point, stating that "One of the great things about Huawei being in the market is they have dropped prices by 15% at least. … They forced the Ericssons and Nokias to follow suit."[32] Such a result would not be surprising in a highly concentrated industry. That is, given a small number of credible alternatives for carriers to purchase telecommunications infrastructure from, the addition of one or more new credible alternatives can be expected to improve competition. Conversely, excluding one or more of a small number of credible alternatives from a market can be expected to reduce competition – as noted above, there is a presumption in the Horizontal Merger Guidelines that such effects will occur in a concentrated market.

22. News reports indicate that carriers are attempting to address concentration in infrastructure vendors by combining equipment from multiple vendors within a single deployment, even though there are costs and inefficiencies associated with that strategy. Industry analyst GlobalData reports that carriers have created groups "aimed at disaggregating the elements of the RAN to foster more flexible network architectures and a more competitive

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31. Kevin Fitchard, "Why the US needs Huawei more than Huawei needs the US," GigaOm, May 31, 2013, https://gigaom.com/2013/05/31/why-the-us-needs-huawei-more-than-huawei-needs-the-us/.

32. Iain Morris, "Telus CTO: NFV Burden May Cripple Telcos," LightReading, May 14, 2018, https://www.lightreading.com/carrier-sdn/nfv-(network-functions-virtualization)/telus-cto-nfv-burden-may-cripple-telcos/d/d-id/743076.

RAN vendor ecosystem. … The creation of these groups is in part a reaction by operators to a consolidated RAN vendor landscape that wields too much concentrated power following the combination of Nokia and Alcatel-Lucent."[33] As noted by GlobalData, "It's also not surprising to see U.S. operators as key instigators in this movement, given that – with meaningful access to Huawei and ZTE blocked for political reasons – they face the fewest options for RAN gear. A sign of how serious U.S. operators are on this topic came in the form of Samsung's announcement during the show that it had won its first contract to provide Verizon with LTE microcell baseband and radio units. … With the Samsung deployment, Verizon is demonstrating that pairing one vendor's BBU with another vendor's RU is possible but not that it is quick and easy… This hurdle would be even higher in virtual RAN networks because different vendors may not have the same division of functions between baseband and radio."[34] Of course, a more efficient way to provide U.S. carriers with more options to address concentration is to provide them with "meaningful access" to Huawei and ZTE equipment, such as carriers in Europe and Canada take advantage of.

23. Although large national carriers such as AT&T and Verizon could benefit from increased competition in mobile infrastructure, Huawei has also been serving dozens of small and rural carriers who could lose access to its equipment and services as a result of this proceeding.[35] The Wall Street Journal reports that "many regional American providers of wireless, TV and internet services have flocked to Huawei, attracted by what they say are Huawei's cheaper prices, quality products and attentive customer service."[36] For example, Huawei upgraded Union Wireless's

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33. Ed Gubbins, "MWC18: The Radio Access Network Roundup – As 5G Dawns, Integrating Massive MIMO & Breaking Up the RAN," GlobalData, March 7, 2018.

34. Ed Gubbins, "MWC18: The Radio Access Network Roundup – As 5G Dawns, Integrating Massive MIMO & Breaking Up the RAN," GlobalData, March 7, 2018.

35. Phil Goldstein, "Huawei exec: We treat Tier 3 U.S. carriers like they're the 'belle of the ball,'" FierceWireless, March 27, 2015, https://www.fiercewireless.com/wireless/huawei-exec-we-treat-tier-3-u-s-carriers-like-they-re-belle-ball.

36. Drew Fitzgerald and Stu Woo, "In U.S. Brawl With Huawei, Rural Cable Firms Are an Unlikely Loser," The Wall Street Journal, March 27, 2018, https://www.wsj.com/articles/caught-between-two-superpowers-the-small-town-cable-guy-1522152000.

Rocky Mountain based territory to LTE. Union Wireless reported that Huawei's "smooth upgrade, upgraded service offering and Huawei support [were] key to Union's success."[37]

37. RCR Wireless News, "Case study: Huawei enables rural carriers to compete," September 22, 2016, https://www.rcrwireless.com/20160922/carriers/case-study-huawei-enables-rural-carriers-compete.

V. Increased competition in telecommunications infrastructure would benefit the U.S. economy

24. In the United States, AT&T, Verizon, T-Mobile and Sprint have collectively reported 2018 capital spending of more than $50 billion.[38] Increased competition to provide equipment can provide many benefits to these firms and to U.S. consumers generally, including lower prices, higher quality and greater innovation. Indeed, basic economics teaches that increased competition to supply inputs such as telecommunications infrastructure will increase investment in such infrastructure.[39]

25. The benefits to the broader economy of increased investment in telecommunications infrastructure can be enormous. The GSM Association, for example, has estimated that the direct economic contribution of the mobile ecosystem to GDP globally for 2017 was roughly $1.1 trillion, and the indirect impact was roughly $2 trillion, contributing, in total, roughly 4.5% of global GDP.[40] The Commission's own National Broadband Plan notes that "Like electricity a century ago, broadband is a foundation for economic growth, job creation, global competitiveness and a better way of life. It is enabling entire new industries and unlocking vast new possibilities for existing ones." However, the Plan also notes that "broadband in America is not all it needs to be," and discusses ways to improve investment, including reforming "current universal service mechanisms to support deployment of broadband…"[41] The Commission should take note of the potential impact on infrastructure costs of excluding significant competitors from the U.S. market through the universal service mechanism. The Wall Street

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38. Mike Dano, "No more penny pinching: Wireless carriers' capex to surge in 2018," Fierce Wireless, February 20, 2018, https://www.fiercewireless.com/wireless/no-more-penny-pinching-wireless-carriers-capex-to-surge-2018.

39. That is, demand curves are assumed to slope downwards, so if increased competition reduces quality-adjusted prices for infrastructure equipment, carriers will purchase more of it.

40. GSM Association, "The Mobile Economy 2018," https://www.gsma.com/mobileeconomy/wp-content/uploads/2018/05/The-Mobile-Economy-2018.pdf, pp. 27-28.

41. Federal Communications Commission, "Connecting America: The National Broadband Plan," March 17, 2010, https://www.fcc.gov/general/national-broadband-plan, p. xi.

Journal, for example, reports that Huawei "has been actively courting small-town internet companies that wanted to replace old-fashioned landlines with high-speed internet connections—no small feat in a country where most rural residents are stuck with dial-up speeds. … Many of these customers now worry the new heat over Huawei in Washington may rob them of what has so far been an important alternative to Western suppliers. Others worry that if Huawei exits the U.S. completely, it will leave them without the customer and technical support they need to maintain the Huawei hardware they already own."[42]

26. Economists have also studied the impact of faster or slower deployment of telecommunications technologies. For example, Robert Crandall and Charles Jackson have evaluated the impact on the U.S. economy of faster roll-out of broadband access, including both wireless and landline, and concluded that the benefits are enormous.

> Although it will take many years, the widespread adoption of broadband access service will bring enormous economic benefits to our economy. No doubt many of the impacts cannot be foreseen. But some benefits can. … A faster rollout of high-speed access services gives us these benefits earlier. Under optimistic – but still reasonable – scenarios the net present value of a faster rollout of high-speed access could be as high as $700 billion, and a mid-range estimate of the value of faster rollout is $500 billion.[43]

27. The general proposition that delaying the introduction of new goods or services can be very costly to consumers and the economy is well accepted in economics. Jerry Hausman has analyzed the impact of FCC regulatory delays on the introduction of cellular service in the first place, stating that the FCC did not adequately consider the costs to consumers in its proceedings.

> The consumer welfare cost of holding up the introduction of a new good is much larger than the effects of higher prices or other regulatory effects on demand… Looked at another way, the introduction of cellular has created significant value for consumers. Thus, new telecommunications services can improve consumer

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42. Drew Fitzgerald and Stu Woo, "In U.S. Brawl With Huawei, Rural Cable Firms Are an Unlikely Loser," The Wall Street Journal, March 27, 2018, https://www.wsj.com/articles/caught-between-two-superpowers-the-small-town-cable-guy-1522152000.

43. Robert Crandall and Charles Jackson, "The $500 Billion Opportunity," in Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies, Allan Shampine (ed.), Nova Science Publishers, 2003, p. 184.

> welfare by very large amounts. Regulatory delay can therefore have potentially large negative effects on the U.S. economy.
>
> Again the possible question arises of why the FCC created such a large amount of harm to U.S. consumers and the U.S. economy. The FCC was confronted with a very difficult decision with respect to cellular. Delaying a difficult decision appears to be the FCC's chosen response. Losses in consumer welfare arising from the regulatory delay did not appear to be involved in the FCC's regulatory approach. Indeed, if cellular service had not begun in other countries, which helped create pressure for the FCC to finally come to a decision, it is quite likely that the advent of cellular telephone service would have delayed for an even greater period in the U.S.[44]

28. Given the prospect of massive 5G investment and deployment over the next few years, additional competition in the provision of 5G infrastructure equipment could be of particular benefit to both U.S. carriers and U.S. consumers. The Commission should consider carefully the costs of excluding significant global competitors from the U.S. market, global competitors that have helped build, and are continuing to supply, telecommunications carriers throughout the rest of the world, including throughout Canada and Europe.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 30, 2018.

Allan Shampine

44. Jerry Hausman, "Mobile Telephone," in Handbook of Telecommunications Economics, Vol. 1, Martin Cave, Sumit Majumdar and Ingo Vogelsang (eds.), North-Holland, 2002, p. 591.

Appendix A – C.V.

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EDUCATION

Ph.D. UNIVERSITY OF CHICAGO: Economics, 1996
(Full scholarship from the University)
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M.A. UNIVERSITY OF CHICAGO: Economics, 1993
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B.S. SOUTHERN METHODIST UNIVERSITY: Economics and Systems Analysis, Mathematics Minor, 1991
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PROFESSIONAL EXPERIENCE

Compass Lexecon (formerly Lexecon), Chicago, Illinois: (1996 – date)

Editor for *The Antitrust Source*, American Bar Association (2011 – Present)

TESTIMONY AND REPORTS

Declaration, Before the Federal Communications Commission, Protecting Against National Security Threats Through FCC Programs, WC Docket No. 18-89, May 30, 2018.

Trial Testimony, Before the U.S. District Court, Eastern District of Wisconsin, Case No. 2:14-CV-01296, Milwaukee Electric Tool Corp. et al., v. Snap-On Inc., October 24, 2017.

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Contributor to American Bar Association Telecom Antitrust Handbook (2017 edition), forthcoming.

"Economics of Patents and Standardization: Network Effects, Hold-Up, Hold-Out, Stacking," with Timothy Simcoe, in The Cambridge Handbook of Technical Standardization Law (2017 edition).

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"The Evolution of Telecommunications Switching in the Central Office," in Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies, Nova Science Press (2003).

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"The Impact of Technology on the Modern Labor Market," 11 *Southwestern Journal of Economic Abstracts* 1 (1990).

RESEARCH PAPERS

"Identifying Benchmarks for Applying Non-Discrimination in FRAND" with Dennis Carlton (2014 - SSRN)

"An Economic Interpretation of FRAND" with Dennis Carlton (2013 – SSRN)

"An Evaluation of the Social Costs of Payment Methods Literature" (2012 – SSRN)

"A New Direction in Mixed Income Housing," submitted to Chicago Housing Authority (1993).

"A Survey of the Economics of Information, Focusing on Water" (1992).

"Petroleum Price Shocks and Rationality," B.S. Honors Paper (1991).

OTHER PROFESSIONAL EXPERIENCE

Panelist at American University, Washington College of Law's Patent Pledges: Developing a Research Agenda conference, May 30, 2014.

Panelist at Texas Intellectual Property Law Journal's 15th Annual Intellectual Property Symposium, FRAND and the Antitrust / Intellectual Property Interface, February 21, 2014.

Panelist at Georgetown University Law Center's Hotel & Lodging Legal Summits, "Navigating Antitrust Issues Arising from the Online Distribution World" (October 24-25, 2013).

"An Economic Interpretation of FRAND" paper with Dennis Carlton, presented by Carlton at the Heath Lecture & Workshop on FRAND, University of Florida Law Advocacy Center (September 2013).

Interviewed by *IEEE Spectrum* for "The High Cost of Taking Your Money" (June 2012).

"Testing Interchange Fee Models Using the Australian Experience," presented as part of a special session "Interchange Fees: Regulation and Implications" at Economics of Payments VI conference, Bank of Canada, May 24, 2012.

Interviewed by *The Oregonian* for "Those credit card rewards cost us a lot of cash" (July 31, 2010).

Participant in "The Law and Economics of Interchange Fees and Credit Card Markets" symposium sponsored by International Center for Law & Economics (December 8-9, 2009).

"The Evaluation of Social Welfare for Payment Methods," 2009 Oxford Business & Economics Conference (June 24-26, 2009).

Interviewed by *Cards Insider* for "Payments: Cash Replacement, Anonymity provides lifeline for cash over cards" (January 28, 2008).

"Boom and Bust in Network Industries: Rising from the Ashes," 6th Global Conference on Business & Economics, Harvard University (October 15-17, 2006), with Hal S. Sider.

"House of Cards: The Economics of Interchange Fees," Presentation to the Federal Reserve Bank of New York Conference, *Antitrust Activity in Card-Based Payment Systems: Causes and Consequences* (September 16, 2005), with Alan S. Frankel.

"The Impact of Technology on the Modern Labor Market," 68th Annual Meeting of the Southwestern Social Science Association (March 29, 1990)

Presented papers on information externalities and technology diffusion at the *Economics and Public Policy Workshop* (3) and *Price Theory Workshop* (1), University of Chicago (1995, 1996)

Coordinated the *Conference on Valuing Non-Market Goods*, University of Chicago (July 21-22, 1995)

Assisted in coordinating the *Conference on Research in Health Economics*, University of Chicago (October 21-22, 1994)

Assisted in organizing the *Economic Policy and Public Finance Workshop*, University of Chicago (1993 - 1996)

Member of the *American Economics Association*

Associate member of the *American Bar Association*

Referee for the *Agricultural and Resource Economics Review*, *American Journal of Agricultural Economics*, *Antitrust Law Journal*, *Journal of Business*, *Journal of Legal Studies* and *Journal of Evolutionary Economics*.

ACADEMIC HONORS

Undergraduate:
Graduated Summa Cum Laude, Honors, Departmental Distinction
Award for Excellence (given to the outstanding senior in the Economics Department as decided by the vote of the faculty)
Presidential Scholarship (full scholarship)
National Merit Scholar (honorary)
Hyer Society (honorary society of Southern Methodist University)
Honor Roll (1987-1991)
Phi Beta Kappa
Alpha Lambda Delta (Treasurer, honorary society recognizing academic achievement)
Phi Eta Sigma (honorary society recognizing academic achievement)
Omicron Delta Epsilon (international honor society in economics)
Kappa Mu Epsilon (honor society in mathematics)

Graduate:
Full Merit Scholarship (tuition and stipend)