PHOENIX CENTER POLICY BULLETIN NO. 38

T. Randolph Beard. PhD
George S. Ford, PhD
Michael Stern, PhD

September 2016

PRIVATE SOLUTIONS TO BROADBAND ADOPTION:

AN ECONOMIC ANALYSIS

Abstract: For the last twenty years, promoting broadband adoption has been a focal point of communications policy around the world. Despite significant advances, there is still much work to be done. To help bridge this adoption gap, in many countries private communications companies are now offering services at deeply discounted prices or even for free. Facebook's "Free Basics" program, for instance, helps to address the awareness, digital literacy and affordability barriers to adoption by offering consumers in more than 45 countries free access to basic on-line services such as communication tools, health services, educational information, and job tools. And, by increasing digital awareness, many of the program's users upgrade to fee-based services to the broader Internet in a short amount of time. Nonetheless, questions are being asked about the propriety of the basic connectivity offered by such programs. Using economic theory, we demonstrate that the price-quality variations of such programs are economically sensible, if not necessary, to address the key barriers to adoption without attenuating investment incentives. In addition, we demonstrate that such "free but limited" programs can increase adoption by "smoothing" Internet consumption over time and present econometric evidence of "connectivity insurance," keeping consumers on-line during periods of financial distress.

I. Background

Broadband Internet service is seen as critical to economic and social progress yet broadband is not ubiquitously available and, even where available, the adoption rate is often seen as being

too low. Consequently, expanding broadband deployment and adoption are top policy goals in nearly every industrialized nation and also in many developing regions. It's not proving to be an easy task. Faced with many impediments of both a public and private nature, progress on improving availability and adoption has proven unsatisfactory, resulting in what is often described as a "digital divide" separating the information "haves" from the "have nots."[1] In the United States, for example, broadband adoption appears to have plateaued even while systematic differences in adoption rates exist among subpopulations. The global digital divide is even more pronounced.[2] In less-developed economies, the hurdles to availability and adoption are especially high and Internet adoptions rates remain very low.

Despite differences in the economic fundamentals of nations, the barriers to deployment and adoption are categorically of the same underlying nature. On the supply-side, the lack of access to broadband is mostly a financial issue driven by the high infrastructure costs of network deployment relative to the revenue potential.[3] On the demand-side, research consistently points to the related concepts of awareness and digital literacy as well as affordability.[4] An effective

---

[1] J.B. Horrigan and M. Duggan, *Home Broadband 2015*, PEW RESEARCH CENTER (December 21, 2015) (available at: http://www.pewinternet.org/files/2015/12/Broadband-adoption-full.pdf); *Mapping the Digital Divide*, COUNCIL OF ECONOMIC ADVISORS, THE WHITE HOUSE (July 2015) (available at: https://www.whitehouse.gov/sites/default/files/wh_digital_divide_issue_brief.pdf); K. Zickuhr and A. Smith, *Digital Differences*, PEW RESEARCH CENTER (April 13, 2012) (available at: http://www.pewinternet.org/2012/04/13/digital-differences).

[2] J. Kloc, *Mind the Gap: The World's 'Digital Divide' is Not Closing Any Time Soon*, NEWSWEEK (April 24, 2014) (available at: http://www.newsweek.com/mind-gap-worlds-digital-divide-not-closing-any-time-soon-248454); L. Treisman, *Access to Information: Bridging the Digital Divide in Africa*, THE GUARDIAN (January 24, 2014) (available at: http://www.theguardian.com/global-development-professionals-network/2014/jan/24/digital-divide-access-to-information-africa); *Offline and Falling Behind: Barriers to Internet Adoption*, MCKINSEY & COMPANY (October 2014) (available at: http://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/high%20tech/pdfs/offline_and_falling_behind_full_report.ashx).

[3] The economics of deployment are explained in G.S. Ford, T.M. Koutsky, and L.J. Spiwak, *Competition After Unbundling: Entry, Industry Structure and Convergence*, 59 FEDERAL COMMUNICATIONS LAW JOURNAL 331-367 (2007) (available at: http://phoenix-center.org/papers/FCLJCompetitionAfterUnbundling.pdf).

[4] K. Zickuhr, *Who's Not Online and Why*, PEW RESEARCH CENTER (2013) at p. 2 (available at: http://www.pewinternet.org/~/media//Files/Reports/2013/PIP_Offline%20adults_092513_PDF.pdf); *Broadband Adoption Among Low-Income Households: Insights from Connected Nation Research*, Connected Nation (July 11, 2011) (available at: http://www.connectednation.org/sites/default/files/bbadoptionamonglow-incomehh_final_071111.pdf); CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, Federal Communications Commission (March 16, 2010) at p. 136 (available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296935A1.pdf) (hereinafter "*National Broadband Plan*") at Chapter 9; *Broadband: The Lifeline of Digital India*, Deloitte & Aegis School of Business (November 2014) (available at:

policy for expanding broadband adoption, therefore, seemingly must expose consumers to broadband service, do so at very low prices (or even free), and yet secure sufficient revenue for network deployment, maintenance, and upgrades. Thus far, despite much effort and discussion, no government has found an effective solution to this complex problem.

Private companies have begun their own search for methods to increase adoption, perhaps driven in part by altruism and in part by the pursuit of income. In the United States, for instance, Comcast's Internet Essentials program provides a 10 Mbps connection and low-cost computers to qualified lower-income households.[5] While privately funded, the program is connecting more households to the Internet than multibillion dollars efforts by the U.S. federal government.[6] Similarly, Facebook's Free Basics program helps to address the awareness and affordability barriers to adoption by offering consumers free access to basic on-line services such as communication tools, health services, educational information, and job tools.[7] Free Basics is available in more than 45 (mostly developing) countries, and Facebook's connectivity efforts, including Free Basics, have successfully brought more than 25 million people on-line.[8]

Despite the obvious success of these programs at increasing adoption, some questions are being asked about the propriety of the basic connectivity offered by such programs.[9] These

---

http://www2.deloitte.com/content/dam/Deloitte/in/Documents/technology-media-telecommunications/in-tmt-broadband-noexp.pdf).

5 https://internetessentials.com/about.

6 *Id.*; *Recovery Act: USDA Should Include Broadband Program's Impact in Annual Performance Reports*, General Accountability Office (2014) at p. 19 ("BIP status reports have previously contained information that was determined unreliable by GAO and USDA's OIG) (available at: http://www.gao.gov/assets/670/664129.pdf).

7 https://info.internet.org/en/story/free-basics-from-internet-org. Being free of data charges, the Free Basics platform grants users access to the Internet but only permits low-bandwidth communications. Even so, the available content includes socially-valuable content such as basic person-to-person communications, news, employment, health, education and local information. Free Basics is an open platform available to any content provider willing to meet the specified limitations on bandwidth. Facebook manages the software, which is combined with the services of mobile providers choosing to participate in the program. Facebook receives no direct revenue for its efforts.

8 https://info.internet.org/en/impact. *Highlights from Internet.org at AfricaCom*, Press Release: Internet.Org (November 19, 2015) (available at: https://info.internet.org/en/2015/11/19/highlights-from-internet-org-at-africacom).

9 D. Reisinger, *Why Facebook's Free Basics Internet Service Stirs Up Controversy*, EWEEK (February 17, 2016) (available at: http://www.eweek.com/cloud/slideshows/why-facebooks-free-basics-internet-service-stirs-up-controversy.html); R. Guha *Net Neutrality Debate: Facebook Shuts Down Free Basics in India*, THE ECONOMIC TIMES (India) (February 12, 2016) (available at: http://articles.economictimes.indiatimes.com/2016-02-12/news/70568594_1_internet-org-facebook-founder-mark-zuckerberg-neutrality); N. Purnell, *Facebook Sees Big Growth in Asia Despite Free Basics Controversy*, WALL STREET JOURNAL (Mar 15, 2016) (available at: http://blogs.wsj.com/digits/2016/03/15/facebook-sees-big-growth-in-asia-despite-free-basics-controversy); E.

concerns often appear to be inspired by the belief that a program must provide a full Internet experience to be socially valuable.[10] Such claims are, thus far, based on ideology alone and are bereft of any serious economic analysis.

In this BULLETIN, we take a more positive approach to the issue, using economic theory to demonstrate that these price-quality variations are economically sensible—if not necessary—to address the awareness, digital literacy and affordability barriers to adoption. At the center of our analysis is the economic concept of the *separating equilibrium*, which requires that the "quality" of a free service be sufficiently adjusted relative to market-priced services to make it privately profitable. These programs obviously increase adoption, but we also show that such programs, due to network effects, both increase consumer surplus and restrain the market price of full Internet connectivity. If the user experience leads to the adoption of market-priced services, then the program also leads to increased income for providers, thereby providing motivation to providers to implement the program and increase infrastructure investment.

An additional benefit of such "free-but-limited" programs is that they can increase adoption by "smoothing" Internet consumption over time, increasing the present value of use and thereby increasing incentives for non-users to make a commitment to the technology. For instance, if connectivity may be interrupted in the future, then non-users may be reluctant to commit to Internet-based communications modalities (e.g., email or Skype). Also, such programs may serve as a type of "connectivity insurance" by providing basic Internet connectivity to individuals or households during periods of financial stress. To illustrate how such programs can play this role, we provide empirical evidence demonstrating that the quantity of subscribers to the Lifeline program in the United States, which provides subsidies to consumers for telecommunications services, increases during periods of financial distress. We expect that the value of "connectivity insurance" will be greater for private programs since they often have limited or no qualifications for subscription. Free Basics, for instance, is available through participating operators to all users without meeting or demonstrating income or other qualifications. Also, government-funded

---

Steel, *Comcast Critics Cast Doubt on its Intensions*, NEW YORK TIMES (April 22, 2015) (available at: http://www.nytimes.com/2015/04/23/business/media/comcast-critics-cast-doubt-on-its-intentions.html?_r=0); A. Schriber, *Comcast Internet Essentials: Is It Bridging the Digital Divide?*, INTERNET ACCESS GUIDE (September 30, 2014) (available at: http://internet-access-guide.com/comcast-internet-essentials-is-it-bridging-the-digital-divide).

[10] *See, e.g.*, M. Murthy, *Facebook Is Misleading Indians with Its Ads About Free Basics,* TECHINASIA (December 28, 2015) ("In their ads, [Facebook claims] they want to bring 'digital equality' when they're actually bringing digital slavery or digital apartheid to our poor.") (available at: https://www.techinasia.com/talk/facebook-misleading-indians-fullpage-ads-free-basics); A. Lele, Facebook's *Free Basics: A Digital Apartheid,* IDSA COMMENT (January 7, 2016) ("Free Basics actually leads to converting the internet, which is supposed to be a global public good, into a 'controlled' platform. For some this even amounts to compromising on their 'human rights'.") (available at: http://www.idsa.in/idsacomments/facebooks-free-basics_avlele_070116).

programs may be caught up in political disputes about government spending, and fraud and abuse, thereby limiting their effectiveness and sustainability.[11] Privately-provided programs are largely free from such concerns.

II. Understanding the Barriers to Broadband Adoption

Formulating a policy to solve a particular problem requires first a good knowledge of the problem to be solved. Here, the quandary is a perceived shortfall in broadband adoption, which results from both demand-side and supply-side factors. Research suggests that the key barriers to adoption are the related concepts of (a) awareness; (b) digital literacy; and (c) affordability. That is, some individuals are simply not aware of the benefits of broadband or have trouble using the technology, and others simply can't afford to pay market prices for either the service or equipment required for connectivity. On the supply-side, the barriers are financial in nature. Networks are expensive to deploy, and in some instances the revenue potential is inadequate to justify the necessary investments.

A. *Demand-Side Barriers*

Survey evidence indicates that it is demand-side factors that are most responsible for the failure of individuals to adopt broadband, at least in the United States where broadband is widely-available. Table 1 summarizes some findings from a 2013 survey by the Pew Research Center.[12] Awareness and digital literacy are the dominant explanations for the failure to adopt broadband. Affordability was also a determining factor, though much less significant than either relevance and usability, though we suspect affordability is more relevant in developing economies.[13] Also, affordability was mostly related to the cost of a computer rather than the broadband service.[14] Availability was not found to be one of the more significant explanations,

---

[11] K. Leswing, *The FCC Never Collected Fines Stemming from "Obama Phone" Fraud*, FORTUNE (November 23, 2015) (available at: http://fortune.com/2015/11/23/fcc-never-collected-lifeline-fines); L. Markay, *FCC Kept "Obamaphone" Fraud Under Wraps Until After It Expanded Program*, FREE BEACON (April 13, 2016) (available at: http://freebeacon.com/issues/fcc-kept-obamaphone-fraud-wraps-expanded-program); J.K. Melchior, *Expanding the Lifeline Phone Subsidy – Here Comes Obamanet*, NATIONAL REVIEW (June 1, 2015) (available at: http://www.nationalreview.com/article/419123/if-abuse-obamaphones-werent-enough-fcc-wants-subsidize-broadband-jillian-kay-melchior); D. Porter, *AT&T Voucher Program Threatens Phone Service for Low-Income Californians*, SAN DIEGO FREE PRESS (August 16, 2013) (available at: http://sandiegofreepress.org/2013/08/att-voucher-program-threatens-phone-service-for-low-income-californians).

[12] Zickuhr, *supra* n. 4.

[13] *See, e.g.*, *Offline and Falling Behind*, *supra* n. 2; G.S. Ford, T.M. Koutsky and L.J. Spiwak, *The Frontier of Broadband Adoption Across the OECD: A Comparison of Performance*, 25 INTERNATIONAL ECONOMIC JOURNAL 111-123 (2011) (available at: http://www.informaworld.com/smpp/ftinterface~content=a934600750~fulltext=713240930~frm=content0).

[14] *Id*. Not having a computer was the explanation for "no broadband" twice as often as broadband service being "too expensive."

though such responses are obviously impacted by the widespread availability of broadband services in the United States (a situation not common across all countries).

Table 1. Main Reasons Adults Don't Adopt Internet (USA)

Reasons Offline	Percentage
Relevance (not interested, waste of time, too busy, don't need/want)	34%
Usability (difficult/frustrating, too old, don't know how, physically unable, worried about spam/viruses/hackers/etc.)	32%
Price (too expensive, no computer)	19%
Lack of Availability	7%

Source: *Who's Not Online and Why*, PEW RESEARCH CENTER (2013).

In economics terminology, the *awareness* issue implies that broadband is an *experience good*. An experience good is a product for which the value is difficult to ascertain prior to its consumption.[15] Experience goods are very common. Purveyors of such products often craft ways for potential customers to "taste" the product prior to purchase: computer software vendors offer trial versions of their software; wine distributors hold tastings; movie studios provide trailers; and record companies offer sound clips. It seems plain enough that a lack of awareness of the value of broadband can only be resolved by allowing customers to experience broadband connectivity somehow. This experience must also address affordability concerns, which can be pronounced in certain populations. In many cases, using broadband also requires knowledge of how to operate a computer or a smartphone, and technology poses challenges for some users. For instance, below-average adoption by older adults is based, in part, on the complexity of operating the technology.[16] Illiteracy is also a barrier to adoption.[17] Again, getting some experience with the Internet, preferably at low cost, is the solution to such concerns.[18]

15 *See, e.g.*, P. Nelson, *Information and Consumer Behavior*, 78 JOURNAL OF POLITICAL ECONOMY 311-329 (1970).

16 There's a great deal of research on this topic, but see, for example, A. Smith, *Older Adults and Technology Use*, PEW RESEARCH CENTER (April 2014) (available at: http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use).

17 *See, e.g., Offline and Falling Behind, supra* n. 2.

18 In the United States, at least, numerous programs exist to expose individuals both to the technology and the capabilities of broadband. *See*, *e.g.*, www.digitalliteracy.gov.

B. *Supply-Side Barriers*

On the supply-side, availability is primarily a financial issue. Broadband networks are expensive to deploy, maintain, and upgrade. An analysis prepared by FCC staff as part of the United States' *National Broadband Plan* sums the issue up concisely: "[p]rivate capital will only be available to fund investments in broadband networks where it is possible to earn returns in excess of the cost of capital. In short, only profitable networks will attract the investment required."[19] In areas lacking access to broadband, the *National Broadband Plan* explains that "service providers in these areas cannot earn enough revenue to cover the costs of deploying and operating broadband networks, including expected returns on capital, there is no business case to offer broadband services."[20] Without a sufficient financial return, the networks will not be deployed, or the capabilities of the networks will not be upgraded over time to modern standards. Financial issues are obviously not limited to the U.S. marketplace but are ubiquitous across the globe.

In many countries, broadband networks are constructed and operated by private entities, so prices and demand must be sufficiently large relative to costs to spur investment. In the United States, statistics show that about 95% of households have access to broadband with the lack of availability mostly occurring in rural areas where the costs are especially high relative to demand.[21] The economics of deployment are, of course, much more unfavorable in developing countries due to low effective demand (from low incomes) and relatively high deployment costs.[22] Deployment is dependent on the relative sizes of demand and costs. While economic conditions may vary across geographic areas and nations, it is always the case that if more availability is the target, then policies must be designed to either increase effective demand or reduce costs (or

---

[19] *The Broadband Availability Gap*, FCC OMNIBUS BROADBAND INITIATIVE (OBI) TECHNICAL PAPER NO. 1 (2010) at p. 1 (available at http://download.broadband.gov/plan/the-broadband-availability-gap-obi-technical-paper-no-1.pdf);

[20] *See National Broadband Plan, supra* n. 4 at p. 136.

[21] *See, e.g.*, 2016 BROADBAND PROGRESS REPORT, Federal Communications Commission (January 29, 2016) (available at: https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf); *National Broadband Plan*, *supra* n. 4, at Ch. 9; T. Kelly and C.M Rossotto (eds.), *Broadband Strategies Toolkit*, WORLD BANK GROUP (2012), at Section 6.3 (available at: http://broadbandtoolkit.org/en/home); R. Laezman, *Broadband Awareness Programs Pushing Adoption Rates*, ELECTRICAL CONTRACTOR (June 2014) (available at: http://www.ecmag.com/section/your-business/broadband-awareness-programs-pushing-adoption-rates%E2%80%A9); S. Savage and D. Waldman, *Broadband Internet Access, Awareness, and Use: Analysis of United States Household Data*, 29 TELECOMMUNICATIONS POLICY 615-633 (2005) (available at: http://www.sciencedirect.com/science/article/pii/S0308596105000510); B. Singh, *The Rise in Internet Penetration and the Changing Face of Digital India*, IAMWIRE (January 27, 2015) (available at: http://www.iamwire.com/2015/01/rise-internet-penetration-changing-face-digital-india/108808).

[22] *Competition After Unbundling, supra* n. 3.

both).[23] Increasing demand, as discussed, must address in part the lack of awareness, literacy, and affordability.

C. *Social Value*

A third reason adoption is argued to be too low is that broadband is believed to provide a social benefit above and beyond the private benefits of the service.[24] If broadband provided only private benefits, then the decisions of consumers and profit-motivated sellers should be sufficient to produce the desired availability and adoption outcomes. Social benefits, however, accrue neither to broadband providers nor their consumers, but to a third party. "Network effects"—where the value of a network is larger as the number of users on that network increase—are a type of third-party effect. If these third-party effects are large enough, then the private incentives of consumers to pay for and the private incentives of firms to deploy the "right amount" of broadband are systematically too low from a social perspective.[25] These social benefits *may* be a type of positive network effect (or externality, in some cases), thus producing a systematic departure of the private equilibrium from the desirable social outcome. The persistent and near ubiquitous pleas for more adoption suggest that these external effects play a key role in the thinking about broadband policies. Public policies for broadband adoption aim to close this gap between privately profitable and socially desirable outcomes, but not all such policies are properly motivated and some have proven failures despite large expenditure levels.[26]

---

[23] *Id.*

[24] S.J. Liebowitz and S.E. Margolis, *Network Externality: An Uncommon Tragedy*, 8 JOURNAL OF ECONOMIC PERSPECTIVES 133-150 (1994) (available at: http://www.jstor.org/stable/2138540?seq=1#page_scan_tab_contents).

[25] *See, e.g.*, *National Broadband Plan*, *supra* n. 4 at p. 3 ("Broadband is a platform to create today's high-performance America—an America of universal opportunity and increasing innovation, an America that can continue to lead the global economy, an America with world-leading broadband-enables health care, education, energy, job training, civic engagement, government performance and public safety."); S. Greenstein & R. McDevitt, *The Broadband Bonus: Accounting for Broadband Internet's Impact on U.S. GDP*, NBER WORKING PAPER NO. 14758 (February 2009) (available at: http://www.nber.org/papers/w14758); T.R. Beard, G.S. Ford, L.J. Spiwak, and M. Stern, *The Broadband Adoption Index: Improving Measurements and Comparisons of Broadband Deployment and Adoption*, 62 FEDERAL COMMUNICATIONS LAW JOURNAL 343 (2010) (available at: http://phoenix-center.org/papers/FCLJBAI.pdf).

[26] M. Jamison, *Failure to Connect: USDA's Rural Utilities Service Shows Why Government Subsidized Broadband is a Losing Investment*, U.S. NEWS & WORLD REPORT (August 6, 2015) (available at: http://www.usnews.com/opinion/economic-intelligence/2015/08/06/usda-shows-government-subsidized-broadband-is-a-bad-investment); D. Mataconis, *The Final Verdict on the 2009 Stimulus: A Failure*, OUTSIDE THE BELTWAY (July 6, 2011) (available at: http://www.outsidethebeltway.com/the-final-verdict-on-the-2009-stimulus-a-failure); *Recovery Act: USDA Should Include Broadband Program's Impact in Annual Performance Reports*, GENERAL ACCOUNTABILITY OFFICE (2014) at p. 19 ("BIP status reports have previously contained information that was determined unreliable by GAO and USDA's OIG) (available at: http://www.gao.gov/assets/670/664129.pdf).

D. *Global Adoption Data*

While the underlying nature of barriers to increased adoption are likely similar across the globe, different nations face varied economic conditions. In Table 2, data on demographics and fixed and mobile Internet penetration for 2014, the last year the data is widely available, are presented for the twenty most populous countries (about 70% of the world's population).[27] The average income (measured as GDP per capita in Tabled 2) in the U.S. is about $54,000, which is substantially higher than that in India where average incomes are about $1,600 (in U.S. dollars). India's population is nearly four-times larger than that of the United States, so affordability is a very serious global concern. Wide variation is observed for both fixed and mobile broadband adoption, and such variations are highly correlated with income.[28] In the U.S., fixed-line connections added to about 78% of total households, while mobile connections summed to 98% of persons at the time. Market penetration of both services were also very high in Japan. Compare these successes with India, Pakistan, Bangladesh, Ethiopia, Nigeria, and Congo, where both fixed were about 6% or less.

---

[27] Data is provided by the World Bank (http://data.worldbank.org/?display=default). Household size data, used to convert fixed broadband connections per 100 persons to per household, is provided by *The World Economic Factbook 2014* (21st edition), EUROMONITOR INTERNATIONAL LTD. (2014) (available at: http://www.euromonitor.com/medialibrary/PDF/Book_WEF_2014.pdf). *See, e.g.*, *Developing a "National Broadband Strategy" - Understanding the OECD Rankings and the Drivers of Broadband Adoption*, Presentation of Phoenix Center Chief Economist George S. Ford, B-340 Rayburn House Office Building (July 28, 2008) (available at: http://www.phoenix-center.org/PC_HlllEventJuly28_2008.pdf); G.S. Ford, *Broadband Expectations and the Convergence of Ranks*, PHOENIX CENTER PERSPECTIVE No. 08-03 (October 1, 2008) (available at: http://www.phoenix-center.org/perspectives/Perspective08-03Final.pdf); *Broadband Adoption Index, supra* n. 25.

[28] There are, of course, other factors affecting broadband adoption such as education and age. *See, e.g.*, G.S. Ford, T.M. Koutsky and L.J. Spiwak, *The Frontier of Broadband Adoption Across the OECD: A Comparison of Performance*, 25 INTERNATIONAL ECONOMIC JOURNAL 111-123 (2011) (available at: http://www.informaworld.com/smpp/ftinterface~content=a934600750~fulltext=713240930~frm=content), among many other studies on this topic.

Table 2. Fixed and Mobile Internet Penetration in Largest Twenty Countries (2014)

Country	Pop. (mil)	Fixed Broadband Connections Per 100 Households	Mobile Connections per 100 Persons	Pop. with Access to Modern Plumbing (%)	GDP Per Capita ($US)
China	1,364	42.54	92.27	86.6	7,590
India	1,295	5.81	74.48	62.6	1,582
United States	319	77.71	98.41	100.0	54,629
Indonesia	254	5.09	126.18	72.3	3,492
Brazil	206	35.50	138.95	88.0	11,384
Pakistan	185	6.06	73.33	83.1	1,317
Nigeria	177	0.04	77.84	32.8	3,203
Bangladesh	159	4.21	75.92	57.7	1,087
Russia	144	43.06	155.14	77.0	12,736
Japan	127	70.19	120.23	100.0	36,194
Mexico	125	43.16	82.54	88.0	10,326
Philippines	99	82.67	111.22	77.9	2,873
Ethiopia	97	1.16	31.59	27.2	574
Vietnam	91	20.40	147.11	94.4	2,052
Egypt	90	12.62	114.31	96.8	3,199
Germany	81	69.55	120.42	99.3	47,822
Iran	78	22.99	87.79	92.8	5,443
Turkey	76	44.51	94.79	98.3	10,515
Congo	75	0.01	53.49	28.5	442
Thailand	68	24.72	144.44	89.9	5,977

Table 2 suggests that mobile connectivity is likely to be the dominant form of access to broadband, especially in less developed nations. In Indonesia, for example, about 5% of household had fixed-line access in 2014 while there were more mobile connections than there were people.[29] Even in India, while only 15% of persons had a mobile broadband connection in 2014, about 75% had mobile phone service. Similarly, in Congo, there was almost no fixed-line adoption in 2014, but just above half of its population had a mobile phone. Most countries, in fact, had much higher adoption rates for mobile than fixed services. Successful adoption programs for less-developed economies, therefore, will likely be targeted to mobile broadband where the high penetration of mobile telephones suggests that mobile broadband is likely to be a relatively easy transition for the less developed countries.

From a global perspective, there is much work to do. Some of the world's most populous nations are far behind in the adoption of Internet technology. Given the profound lack of Internet use and challenging economic conditions, expanding broadband adoption in less-developed nations could prove difficult and expensive for governments.[30] Each country will likely face its

[29] The statement is a bit loose as we ignore the possibility of multiple mobile broadband connections per person.

[30] *See, e.g., Offline and Falling Behind, supra* n. 2.

own challenges. Public policies in one country may not transfer well to others due to very low incomes, high deployment costs, or just a lack of economic infrastructure. Certainly, policy concerns in the U.S., Japan, and Germany may not be well-suited, for instance, in India and the Philippines. Some countries still struggle to provide basic services like modern plumbing (see Table 2 above). On the supply-side, public policy must maintain or enhance financial incentives for private actors, not destroy them.[31] On the demand-side, policies must address limited digital literacy and awareness, a lack of relevance and attractiveness, and affordability.[32] What is clear is that an effective policy to increase broadband adoption must address some or, ideally, all of these supply- and demand-side concerns, and these conditions vary widely.

III. A Model of Broadband Adoption

Where awareness, digital literacy and affordability concerns are severe, as they are for many of the most populous countries, offering an on-line experience for free obviously has great potential for addressing adoption shortages. Free service, however, does nothing to address the financial needs of network providers. Why then, do we see private-sector programs, like Free Basics, that offer free access to basic on-line services? And, what are the consumer implications of such offerings? And, what motivates the design of such programs? To answer these important questions, we now turn to an economic analysis of private-sector incentives to implement a program to encourage broadband adoption by offering free (or low-cost) connectivity.[33]

As noted above, an individual's demand for broadband service differs along many dimensions but the key factors determining whether broadband is used or not include: (a) the awareness of the Internet's value; (b) digital literacy, or the skills and abilities necessary to use broadband technology; and (c) affordability concerns, which may relate to income differences. In keeping with the scenario under study and keeping it simple but informative, we imagine that there are two types of consumers for broadband access services—those that are aware and literate

---

[31] G.S. Ford, *Is the FCC's Regulatory Revival Deterring Infrastructure Investment?* BLOOMBERG BNA (November 13, 2015) (available at: http://phoenix-center.org/BloombergBNAInvestmentCounterfactual13Nov2015.pdf); *Competition After Unbundling, supra* n. 3.

[32] *See, e.g., Broadband Strategies Toolkit, supra* n. 21 at Section 6.3.

[33] Often, these "free but limited" are lumped in with "zero rating" or "free data" plans, in which data arriving from certain content providers is not counted against a carrier's data cap. While such "free data" plans can also be socially beneficial, these "free data" programs are not the same as the "free-but-limited" programs we discuss herein. *See, e.g.,* W.P. Rogerson, *The Economics of Data Caps and Free Data Services in Mobile Broadband,* CTIA (August 17, 2016) (available at: http://www.ctia.org/docs/default-source/default-document-library/081716-rogerson-free-data-white-paper.pdf); *Understanding and Appreciating Zero-Rating: The Use and Impact of Free Data in the Mobile Broadband Sector,* MULTICULTURAL MEDIA, TELECOM AND INTERNET COUNCIL (MMTC) (May 2016) (available at: http://mmtconline.org/WhitePapers/MMTC_Zero_Rating_Impact_on_Consumers_May2016.pdf))

and have a "high demand" (*H*) and those that are neither aware nor literate and thus have a "low demand" (*L*) for broadband service. More formally, the *H* buyers have a higher willingness to pay for broadband than the *L* buyers at all quality levels, and they have a higher *marginal* willingness to pay for quality improvements.

On the supply-side, we assume, for convenience and to comport with earlier research on this topic, that there is a single seller of broadband service.[34] This seller is able to affect the quality of the services it sells, where quality is regarded as a vertical feature of service; that is, all buyers prefer a higher to a lower quality.[35] Quality is costly, of course, and the firm is permitted to set the prices and qualities of service free of direct regulation.

In this setting, the seller faces the challenge of designing service offerings to maximize its profits. In particular, given the two types of consumers, the seller faces the challenge of deciding whether to offer a single type of service, or two different types, each tailored for the different customer types. That is, should the seller offer a lower-quality, lower-priced service to the type *L* customers? The fundamental problem for the seller is that the *H* buyers will be sorely tempted by the lower-priced offering the seller intends for the *L* customers, thereby costing the seller some of its paying customers. In a seminal paper, Mussa and Rosen (1978) show that the solution to this problem—absent some effective mechanism (e.g., income or age certification) by which to prohibit defection—is to reduce the quality (and price) of the offering intended for the *L* buyers in the proper manner, so as to achieve market *separation* through the self-interested behavior of buyers.[36]

Our model is not merely a restatement of Mussa and Rosen (1978), however, though their results are very informative. To this now-standard model of quality choice we incorporate two additional nuances relevant to broadband adoption: First, we add a type of network effects to

---

[34] A benchmark model of quality choice is M. Mussa and S. Rosen, *Monopoly and Product Quality*, 18 JOURNAL OF ECONOMIC THEORY. 301-317 (1978) (available at: http://www.sciencedirect.com/science/article/pii/0022053178900856). Monopoly supply is not very common in these markets, especially in mobile broadband service where competition exists even in many less developed countries. B. Shrivastava, *India Mobile Phone Subscribers Cross 1 Billion, Shows TRIA Data*, LIVEMINT.COM (December 30, 2015) (available at: http://www.livemint.com/Industry/2z7rdOSjNYi6cJShRUDvaL/India-mobile-phone-subscribers-cross-1-billion-shows-Trai-d.html). Also, in assuming monopoly, the effects on consumers of the firm's profit-maximizing decisions can be evaluated in a setting where market power is present, which is a common claim in broadband policy debates.

[35] With vertical differentiation, all consumers prefer one type at equal prices. With horizontal product differentiation, consumers may prefer different types if all prices are the same.

[36] Mussa and Rosen, *supra* n. 34. Our model does not directly address programs like Comcast's Internet Essentials or subsidy programs like the Lifeline program in the U.S. since both have income qualifications.

the model by permitting the broadband consumer's utility to rise with the number of broadband users. Second, to account for the claim that *awareness* and *literacy* are barriers to broadband adoption, we allow for an experience with Internet service to change some type *L* customers into type *H* customers. That is, a non-paying customer of a low-quality service may become a paying customer of a high-quality service as a result of the experience with the low-quality service.

A. *Choosing the Number of Quality Tiers*

Suppose that the two types of consumers (*H*, *L*) have equal unit masses: N_L, $N_H \in \{0, 1\}$.[37] Hence, N_L would equal one if the low-type consumers purchase broadband service and N_L would equal zero if they did not purchase any service. (The good is either purchased or it is not; quantity does not vary for purchases.) The same is true for N_H, or the high-type consumers. Recall that the high-type consumers place a larger valuation on quality compared to low-type consumers. Consumers must also obtain a piece of equipment to use broadband service, and we assume that both types of consumers use the same equipment (at least, we assume the equipment costs the same). Specifically, we assume the following expressions for consumer utility:

$$U_L = (N_L + N_H) + Q - (P + 3), \text{ and} \tag{1}$$

$$U_H = (N_L + N_H) + 2Q - (P + 3), \tag{2}$$

where *Q* denotes the quality of service, *P* denotes the price of service, and we assume hardware devices cost three (3) units merely to calibrate the example. Looking at Equation (1), we see that the "utility" or satisfaction derived by the *L*-type customer is equal to the number of users (N_L, N_H) plus the quality of the service (*Q*) less the price paid for the service and the equipment required to use it (*P* + 3). Also, in keeping with the awareness issue, notice that type *H* customers value quality twice as much as type *L* customers (2*Q* rather than just *Q*) and that both types of consumers experience a positive network effect from having other consumers using broadband service (utility is a function of both types of *N*). To complete the setup, we assume a very simple quadratic cost function of providing a given quality of service per unit of consumer mass:

$$C = \tfrac{1}{2}(Q^2 - 1). \tag{3}$$

Again, purely for convenience, we calibrate the cost of a single quality unit to zero.

---

[37] We will simplify the proceedings by assuming that the numbers of *H* and *L* customers are equal, although this is probably an excessive simplification.

In light of the two customer types, the firm faces an important and consequential choice: should it offer one service contract or two of different qualities? If it offers a single contract, then this contract will appeal either to only the *H* buyers or else to both *H* and *L* types. (The contract could appeal to nobody, but we ignore this case). So, the real issue is whether the firm is better off attracting both types or only those with a high demand for broadband. To attract both types, the firm must select price and quality so that the welfare U_L in Equation (1) is non-negative. As inspection shows, any contract that does this will automatically attract the higher income buyers (due the higher valuation of quality). Alternatively, the firm could ignore the *L* buyers and simply design an offering to maximize its profits from the type *H* customers. In this latter case, higher prices and quality would presumably be offered, at the cost of foreclosing the network to the type *L* consumers.

In order to solve the firm's problem, it is useful first to solve the simpler problem: what if the firm could offer specific services to each group and did not have to worry about the type *H* buyers selecting the lower priced service intended for the *L* types? This scenario would be ideal from the firm's perspective, but is often not feasible in reality without some effective mechanism by which to keep the two types separate.[38] Still, the analysis is important.

So, suppose the firm was dealing with each of the two consumer types in isolation. Assuming reservation utilities are uniformly zero (a consumer gets zero utility if the service is not purchased), the firm would raise prices until the reservation utilities were exactly met:

$$P_L = Q_L + (N_L + N_H) - 3, \text{ and} \tag{4}$$

$$P_H = 2Q_H + (N_L + N_H) - 3. \tag{5}$$

The profit rate per market segment would be:

$$(P_L - C_L) = Q_L - \tfrac{1}{2}(Q_L^2 - 1) + (N_L + N_H) - 3, \text{ and} \tag{6}$$

$$(P_H - C_H) = 2Q_H - \tfrac{1}{2}(Q_H^2 - 1) + (N_L + N_H) - 3. \tag{7}$$

The simple quadratic structure in quality immediately implies that the profit-maximizing level of quality for the two types in isolation are: $Q_L^* = 1$ and $Q_H^* = 2$, which renders margins of zero for

---

[38] Comcast's Internet Essentials program accomplishes such a division (and forecloses arbitrage) by offering a discounted broadband program only to families with at least one child who qualifies for the National School Lunch Program (among other requirements) (available at: https://apply.internetessentials.com).

L-type and 1.5 for *H*-type consumers if both types buy the service. Notice that if the *H* types do not purchase service ($N_H = 0$), then the *L* types could only be served at a loss (negative price): by Equation (4), the price is -1.0. But, if the *H* types are in the market, then the network externality is sufficient to allow the low types to be served at break-even (at zero price for a free low-quality service). Hence, if the firm is restricted to only one quality level of service, then the low-type consumers will be priced out of the market ($N_L = 0$) and the firm will set $Q^* = Q_H^* = 2$ and $P^* = 2$. This results in a profit for the firm of 0.5 and zero consumer surplus (the latter is an artifact of the specification).

Next, suppose the firm is allowed to offer two quality levels and thus potentially serve both customer types. From above we see that the best the firm can do with *L*-type consumers is to simply give away a very basic level of service, $Q_L^* = 1$ and $P_L^* = 0$. If a *H*-type consumer were to consume that basic free service, then they would receive one unit of utility: $U_H = (1 + 1) + 2 - (0 + 3) = 1$. Hence, the best the firm would be able to achieve with the *H*-types is $Q_H^* = 2$ and $P_H^* = 2$. The firm cannot extract a higher price from the *H*-types because they would switch to the free, low-quality service at any price above 2 units. (The low-quality service acts as a type of competitor to the high-quality service). The firm will once again make a half-unit of profit from the high types. However, the *H*-types will now earn one unit of consumer surplus due to the increased network effect from the presence of the *L*-types are on the network ($N_L = 1$, $N_H = 1$). Consumers, as a whole, would clearly prefer two quality tiers because surplus is higher, but the firm would be indifferent (in terms of profits) between the single-quality regime and the two-quality regime.

To summarize, we may say that the sale of a reduced-price, lower "quality" service can improve social welfare, even when we restrict our attention solely to the consumer surplus analysis and ignore the probable additional social benefits (i.e., external effects) of a more connected society. The crucial issue, though, is that the ability of the firm to do this depends on its ability to offer differentiated services, one with higher prices and quality, and the other basic service with a low or zero price. This limitation is in fact crucial: *the seller doesn't offer a basic service out of any animus toward the low income or inexperienced consumers. Rather, the purpose of the differentiation is to dissuade the rich and/or experienced from buying what is intended for the poor and/or inexperienced.* If regulations mean that differentiated services cannot be offered, then the seller is deprived of the ability to introduce quality differentials to support expansion of service to the lower end of the market. A prohibition on the free, basic service leaves only the high-value customer being served, which reduces consumer surplus and could lead to higher prices for those that do subscribe.

B. *Awareness, Literacy and Promotion*

Of course, there are other incentives the seller may have to offer a free basic service that are not included in the example above. Even putting aside the charitable impulse (i.e., in the analysis

above, the seller is indifferent between selling to both or just the high types), it is quite plausible that a seller might wish to engage in a form of "introductory pricing" in order to overcome resistance born of unfamiliarity with on-line access. In developing economies, where adoption rates remain very low, this sort of unfamiliarity seems likely for large blocks of potential users. From the firm's point of view, these users may transition to full-service accounts once they experience the benefits of service introduced by the free offering. Evidence from Facebook's Free Basics program sheds some light on this issue. Evidence indicates that about 50% of Free Basics users upgrade to a paid data plan in the first month.[39]

This is a simple argument and can be illustrated by the model using a simple modification. Suppose a fraction θ of the *L*-type consumers quickly experience an "acquired taste" once exposed to broadband service and their quality valuation rises to become identical to that of a *H*-type consumer. In this case, the firm would strictly prefer (just like consumers) the two-quality regime as profits would be $(1+\theta)/2$ instead of just one-half unit under the single-quality regime (under which the *L* types are never exposed as they are priced out of the market). In other words, if there exists any introductory benefit of the sort contemplated here, then it works in the same direction, incentive-wise, as suggested in the example. In particular, it is often the case that introductory offers for websites, software, and memberships for clubs or organizations offer a less-than-complete menu of services. For the reasons exposed in the analysis above, the purpose of a free and basic version of a product (or a trial that expires) is to make it low risk for the potential buyer to examine the service, not to provide a service in competition with the standard offering.

C. *Summary*

The analysis presented above demonstrates why a private-sector firm would offer a free on-line service and why the quality of the free service must be below that of the standard, market offering. Given the zero price, the seller must sufficiently reduce the capabilities of the zero-price plan to discourage defection by the paying customers that ensure the financial viability of the network. Due to the network effect, consumer benefit from the expanded adoption as more consumers get on-line. Thus, the program is good for consumers, and certainly good for society as a whole (especially given external effects). The seller is indifferent unless some of the *L*-type consumers, as a consequence of their experience, eventually buy the higher quality service. Evidence suggests that they do, thereby providing the profit motive for the program.

---

[39] *Free Basics: Myths and Facts*, Press Release: Internet.org (November 19, 2015) (available at: https://info.internet.org/en/2015/11/19/internet-org-myths-and-facts) ("50% of people who use Free Basics are paying for data—and access the internet outside of free basic services—within 30 days of coming online for the first time."); V. Mathur, *Facebook Free Basics: Moral Conundrum Overshadows Benefit Aspect*, LIVEMINT.COM (December 29, 2015) (available at: http://www.livemint.com/Consumer/a5r6BLvsCWBF6HaMOa1eCP/Facebook-Free-Basics-Moral-conundrum-overshadows-benefit-as.html).

Criticism of such programs, due largely to the limited capabilities of the free service, do not appear to have much merit. We stress, however, that the example described here is an extremely simple one, and it is not intended to establish any particular policy beyond the most obvious and prudent: before such programs are criticized or even banned, it is sensible to examine the circumstances under discussion, rather than rely on ideological principal. It seems likely that naked prohibitions against "free-but-limited" access services will prohibit firms from offering very low-cost services to address the awareness, literacy, and affordability barriers to Internet adoption. If all customers are required to have services fully equal in quality to the standard fare, then the zero-price offerings would attract high demand users, rendering the entire exercise unprofitable in the extreme. Thus, efforts to impede such programs will lead to a lack of Internet access for the least aware and poorest customers, an outcome with no apparent benefits.

IV. Additional Ways "Free but Limited" Access Encourages Adoption

Our analysis above shows how deeply discounted or even free access to the Internet can address the barriers to Internet adoption while also being profitable for private companies to offer. Availability of a steeply discounted, lower "quality" service is shown to increase consumer surplus and improve social welfare more generally. In terms of economic analysis, the analysis presented above represents a necessary first step in understanding the fundamental economics of adoption programs like Facebook's "Free Basics."

There are, of course, other mechanisms by which adoptions programs may influence Internet use and economic well-being. We address two here with some formality. First, we demonstrate how such programs can increase adoption by "smoothing" Internet consumption over time, increasing the present value of use and thereby increases incentives for non-users to make a commitment to the technology. Second, and related somewhat to the former, we provide econometric evidence showing that "free but limited" programs can provide a type of "connectivity insurance," keeping consumers subscribed to communications services during periods of financial distress.

A. *Increasing Adoption by Ensuring Continual Access*

In a community where electricity is only intermittently available, consumers may still be interested in air conditioning, televisions and lamps, but, it probably would not make much sense to invest in, say, a chest freezer. Video entertainment is not a perishable product, but any investment in foods that require freezing would be wasted at the next outage. In the same way, if consumers feel that their Internet connectivity and access to basic services could be interrupted in the future (at least, for an extended period), then their willingness to make a commitment to Internet technology may be diminished, other things constant.

We need look no further than to decades-old models of telephone adoption for a theoretical analysis of this problem.[40] A concise summary of this theoretical work is as follows. Consumer must pay some positive price to obtain access to the communications network (r), and once access is obtained, the consumer will communicate q messages at a per-message price of p. The net benefits to the consumer of using the communications network is the value from consuming the q messages less the price paid for them (pq). If the present value of usage (S) over the relevant future period exceeds the access price r, then the consumer subscribes to the system (when $S > r$), otherwise the consumer does not subscribe.

While we do not formalize an extension of the access model to fit Internet adoption and interruptible service, the results of such an analysis are not terribly difficult to predict. If the service could be interrupted in the future (say, a negative income shock makes it unaffordable), then the consumer will perceive the system to be of less value because fewer messages can be sent.[41] Other things constant, a positive expectation of interrupted service reduces the incentive of a consumer to purchase access.

Practically, it is not difficult to see how such a framework applies with even greater effect to Internet adoption. When a consumer begins using the Internet, the communications applications adopted by the consumer (i.e., email, Facebook, Skype, and so forth) become a contact point recognized by other users. For instance, an email address may be the chosen modality of communications between a job applicant and the potential or actual employer. If the applicant lost connectivity, even for a short interval, then important communications may be missed (some forms of communications are "perishable"). Therefore, uncertain access poses a risk to the commitment to use the Internet as a primary communications modality, which is a key source of value from Internet use. If so, non-Internet-based communications modalities may be preferred. By offering connectivity to basics services at a zero price, adoption programs like Free Basics (and other discounted, limited service options) maintain, in large part, the integrity of the

---

[40] *See* L. Taylor, TELECOMMUNICATIONS DEMAND IN THEORY AND PRACTICE (1993) at Ch. 2, summarizing R. Artle and C. Averous, *The Telephone System as a Public Good: Static and Dynamic Aspects*, 4 BELL JOURNAL OF ECONOMICS AND MANAGEMENT SCIENCE 89-100 (1973) and J. Rolphs, *A Theory of Interdependent Demand for a Communications Service*, 5 ECONOMICS AND MANAGEMENT SCIENCE 16-37 (1974).

[41] In the Information Systems community, the Technology Acceptance Model ("TAM") is used to predict consumer usage of a technology based on the broad categories of "perceived usefulness" and "perceived ease of use," two concepts that essentially boil down to a cost-benefit analysis based on objective and subjective effort. *See, e.g.,* F.D. Davis, *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology*, 13 MIS QUARTERLY 319-40 (1989); V. Venkatech and F.D. Davis, *A Model of the Antecedents of Perceived Ease of Use: Development and Test*, 27 DECISION SCIENCES 451-481 (1996); V. Venkatech and F.D. Davis, *A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies*, 46 MANAGEMENT SCIENCE 186-201 (2000).

communications modality and the future stream of net benefits from access, thereby encouraging adoption.

B. *Adoption Programs as Connectivity Insurance*

Globalization and technology have made economic activity across the globe very volatile. Nearly every country has experienced economic stress, with a global recession in 2008 and continued struggles in many countries. These economic downturns lead to higher unemployment and greater poverty. At the same time, finding employment and new business opportunities is increasingly dependent on Internet connectivity.[42] When unemployment hits, however, paying for an Internet connection becomes difficult, and many subscribers are forced to abandon the service. Having an option for low-cost or free on-line access to basic services, even if with limited capabilities, softens the blow and provides for economic opportunity during periods of economic stress. Such programs provide a type of "connectivity insurance," ensuring that financial stress does not persist as long or is as deeply as without any connectivity.

Is there any evidence to support such a role for such programs? In the United States, the federal (and some state) government's Lifeline program offers financial support for low-income households in the form of a monthly subsidy for the purchase of wireline or mobile wireless telephone services (but not both).[43] Whether or not the program provides a type of "connectivity insurance" can be determined by evaluating the relationship between the use of such programs during periods of financial distress. To do so, we gathered annual data on state-level subscriptions (per-capita) to such programs over the period 1998 through 2014 as well as data on state-level unemployment and poverty rates.[44] Using time-series econometric techniques, we then test whether subscriptions rise during periods of financial stress.

---

[42] A. Smith, *Searching for Work in the Digital Era*, PEW RESEARCH CENTER (November 19, 2015) (available at: http://www.pewinternet.org/2015/11/19/1-the-internet-and-job-seeking); T.R. Beard, G.S. Ford, R.P. Saba, and R.A. Seals Jr., *Internet Use and Job Search*, 36 TELECOMMUNICATIONS POLICY 260-273 (2012) (available at: http://www.sciencedirect.com/science/article/pii/S0308596111002217).

[43] https://www.fcc.gov/general/universal-service; *In the Matter of Lifeline and Link Up Reform and Modernization Telecommunications Carriers Eligible for Universal Service Support, Connect America Fund,* FCC 16-38, THIRD REPORT AND ORDER, FURTHER REPORT AND ORDER, AND ORDER ON RECONSIDERATION, 31 FCC Rcd 3962 (rel. April 27, 2016) (available at: https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-38A1.pdf). At present, the Lifeline program provides a $9.25 per month subsidy for eligible low-income families for either wireline or wireless services (*see* https://www.fcc.gov/consumers/guides/lifeline-support-affordable-communications).

[44] Alaska is excluded for lack of subscription data for some years. Subscription data is available at: https://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/Monitor/2015_MR_Supplementary_Material.zip; state unemployment data is available at:

The econometric model is quite sophisticated and the full details are beyond the scope of this BULLETIN.[45] Our procedure involves the use of principal components to estimate a common latent component of subscriptions as well as idiosyncratic components analysis (dynamic factor analysis) for each state. The technique is likewise applied to the data on unemployment and poverty. A bivariate vector autoregressive model is then used to study the dynamic adjustment of subscriptions in response to structural shocks to the unemployment and poverty variables. We found a substantial degree of heterogeneity across states in the estimated factor loading coefficients, a likely consequence of variations in state programs that implement the Lifeline program. The common component for the poverty and unemployment rates and associated factor loading coefficients are more homogenous, and the dynamics are closely associated with the recent financial crises in 2001 and 2008.

While the analysis is rich in implications, our interest primarily relates to the response of Lifeline subscriptions to unemployment and poverty shocks. Such responses are computed using Impulse-Response Functions for a 1% structural shock to the unemployment and poverty common components. We found the responses to be robust to different lag structures. Though we obtained qualitatively similar results using the unemployment and poverty common components, we note that the results for unemployment are weaker than those with the poverty rate. The Impulse Response Functions indicates that for a 1% shock to the poverty component, the subscription component increases by 0.6% on impact, then increase by over 1% in about two years. The responses are statistically significant based on the one standard deviation confidence bands of the responses computed using 500 bootstrap replications. For 1% shock to unemployment, the subscription component rises by about 0.2% on impact, then increases by over 0.6% in about two years. The response is also statistically significant. These results suggest that the use of programs targeted at low-income households is responsive to changes in unemployment and poverty rates. The Lifeline program appears to provide a type of "connectivity insurance" to American households experiencing financial distress.

While there is insufficient data to assess the details, we suspect a program like Free Basics would be even more effective in providing "connectivity insurance." The Lifeline program requires households to certify eligibility, which is not an easy task for many low-income households. Free Basics, alternately, is available through participating operators to everyone. Government programs have likewise faced a significant amount of concern over fraud and abuse,

---

http://www.icip.iastate.edu/tables/employment/unemployment-states; population and poverty data is from the U.S. Census Bureau.

[45] Additional details may be requested from the authors.

concepts that have no meaning for programs such as Free Basics.[46] Government programs such as Lifeline also have been subject to a great deal of political hostility. For each subscriber, the subsidies are also quite small (about $9.25 per line), forcing many of its users to pay positive prices for services.[47] Free Basics is free and enables users to experience the benefits of being on-line, thereby promoting the adoption of higher-quality data services. Unlike Lifeline and other government programs, private-sector programs have no budgetary consequence for government and thus avoid most, but not all, political interference and related complications.

V. Conclusion

Getting the world on-line is no easy task. Building and maintaining broadband networks is a tremendously expensive endeavor and even where networks are built they provide less benefit if vast swaths of the earth's population does not see any value in using them. Research indicates that awareness, digital literacy, and affordability are the key barriers to adoption. A successful program, whether implemented by the public or private sectors, must expose non-users to the benefits of being on-line and do so at low prices (or even free). While some governments have attempted to spur deployment and adoption, the public sector operates with limited resources. Recently, private sector programs have been deployed to provide consumers access at low prices. One such program offers users free access to basic on-line services in order to help address the awareness and affordability barriers to broadband adoption. Evidence from that program indicates that many users of the free service quickly upgrade to market-priced Internet services, a consequence of overcoming the awareness barrier.

Why do private firms offer free services? While altruism may certainly be a key motivator, these programs are also shown here to be profitable to providers under plausible conditions. The free, basic services must be, however, sufficiently different from market-priced services to prevent defection to the basic service of the higher income, more experienced users. Absent the ability to freely set the "quality" of the free service, consumers with low demand, either due to a lack of awareness or income, will not be served. With such a program, however, all types of consumers can experience the benefits of on-line access services, increasing consumer surplus and infrastructure investment.

Such programs also serve as a basic level of connectivity for consumers experiencing financial distress, making them unable to pay for market-priced services. We demonstrate that non-users may be reluctant to adopt the Internet for fear of service interruption, perhaps fearing a negative income shock that renders service unaffordable in the future. Using email as a primary

---

[46] *See, e.g., In the Matter of Total Call Mobile, Inc.*, FCC 16-44, NOTICE OF APPARENT LIABILITY FOR FORFEITURE AND ORDER, File No. EB-IHD-14-00017650; NAL/Acct. No. 201632080004, 31 FCC Rcd 4191 (rel. April 7, 2016).

[47] Fact Sheet on Lifeline Modernization Proposal, Federal Communications Commission (March 8, 2016) (available at: https://apps.fcc.gov/edocs_public/attachmatch/DOC-338113A1.pdf).

communications modality is risky if messages cannot be received if service is not available. "Free but limited" services can increase adoption by "smoothing" Internet consumption over time, increasing the present value of Internet access for users. We also offer some new econometric evidence that these programs may serve as a type of "connectivity insurance." We offer some new econometric evidence of such "connectivity insurance." Using subscriptions from the Lifeline program in the United States, we find that the use of the subsidy program rises with increases in unemployment and poverty. We suspect that private programs such as Facebook's Free Basics may even be more effective than public programs, since the private programs are not influenced by political concerns and are available through participating operators to everyone for free without eligibility criteria.

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES
5335 Wisconsin Avenue, NW, Suite 440
Washington, D.C. 20015
Tel: (+1) (202) 274-0235 • Fax: (+1) (202) 318-4909
www.phoenix-center.org