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Does Competition Between Cable and Fiber Increase Adoption?

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Abstract

U.S. broadband policy has emphasized the importance of facilities-based competition given its potential to encourage investment, improve quality, and lower prices. A natural question to ask today is whether this competition can encourage more adoption. Using Census-tract-level data from the FCC and the American Community Survey (ACS) from 2017-2019, I find that competition between cable and fiber does not seem to bring the last group of unconnected people online. More accurately, broadband adoption, all else equal, is not higher in tracts with cable and fiber providers than it is in tracts with only a cable provider or only a fiber provider.

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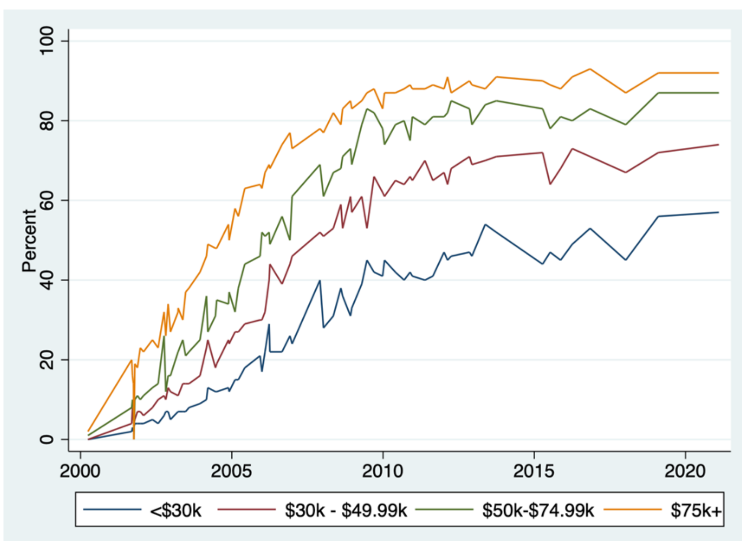
U.S. broadband policy has long emphasized the importance of facilities-based competition—competition among providers who use their own infrastructure rather than leasing others'—due to its potential to encourage investment, improve quality, and lower prices. Today, focus has shifted to considering ways of getting the last unconnected people online. It is natural to wonder if, among its benefits, facilities-based competition could encourage adoption. The answer is not obvious. On one hand, more competition nearly always brings benefits of some sort, and additional varieties of offers to encourage the unconnected to subscribe might be among them. On the other hand, there is no guarantee that competition will focus on acquiring subscribers who have the weakest demand for broadband, and therefore may have little effect on adoption.

Using Census-tract-level data from the FCC and the American Community Survey (ACS) from 2017-2019, I find that competition between cable and fiber does not seem to bring the last group of unconnected people online. More accurately, broadband adoption, all else equal, is not higher in tracts with cable and fiber providers than it is in tracts with only a cable provider or only a fiber provider.

While adoption continues to increase, the rate of increase in home wireline broadband subscriptions has slowed, almost to nothing according to the Pew Research Center (Figure 1). The ACS shows continued, but very slow, growth in the adoption of home wired connections—increasing from 67.8% of households in 2015 to 70.8% in 2019.

Figure 1: Home Broadband Adoption by Income



Source: Pew Research Center[1]

[1] https://www.pewresearch.org/internet/fact-sheet/internet-broadband/?menuItem=2ab2b0be-6364-4d3a-8db7-ae134dbc05cd

This slowdown may be irrelevant to policy for wealthier groups—92% of households that earn at least $75,000 annually report having a home broadband connection, which is quite close to the 96% adoption of fixed telephones at its peak popularity. However, according to Pew, fewer than 60% of households that earn less than $30,000 annually have no home connections and, according to the ACS, about 64% of households with less than $20,000 a year in income, or about six million households, have either wired or mobile broadband at home.

The key policy question is determining the most cost-effective way of encouraging the remaining unconnected people to subscribe. In this analysis, I ask whether additional facilities-based competition is likely to increase broadband adoption, particularly among low-income people.

Ultimately, whether competition affects adoption is an empirical question, and this paper tries to answer that question. Using Census-tract level data from the FCC and the U.S. Census, I find that all else equal, adoption in tracts with both a cable and a fiber provider is not higher than tracts with only a single cable or fiber provider.

Competition and Adoption

Little empirical literature evaluates the connection between facilities-based competition and adoption, particularly in recent years. Instead, the research on competition and adoption has tended to focus on comparing the effects of facilities-based competition to facilities-sharing competition, typically across countries.

Broadband providers can compete along many dimensions for customers, including price, bandwidth, bundled services, and other factors. The nature of the competition may change over time, as well. When high-speed broadband first became widely available, providers competed for customers to upgrade from dialup. One would expect competition to increase adoption of the new technology. As the share of people already connected increases, the potential effects of competition on overall adoption are likely to become smaller simply because fewer people remain unconnected.

One of the first empirical papers on the effects of competition on adoption, Aron and Burnstein (2003), found that competition between DSL and cable providers was correlated with increased adoption at the state level.[2] Their broadband adoption data was from 2000, when, according to the Pew Research Center, only about one percent of adults had broadband at home. Using data from 2000 through 2006, Prieger and Hu (2008) find that intermodal competition is correlated with a higher share of minorities adopting broadband.[3] By 2006, more than 40% of adults had broadband at home.

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[2] Debra J. Aron and David E. Burnstein, "Broadband Adoption in the United States: An Empirical Analysis," SSRN, 2003.

[3] James E. Prieger and Wei-Min Hu, "The Broadband Digital Divide and the Nexus of Race, Competition, and Quality," *Information Economics and Policy* 20, no. 2 (June 2008): 150–67, https://doi.org/10.1016/j.infoecopol.2008.01.001.

Wallsten and Mallahan (2010) used nonpublic data at the FCC combined with publicly available Census data and commercially available price data to explore the effects of competition.[4] They found that the number of broadband providers in a Census tract was positively correlated with the maximum available speed and negatively with the price of the slowest broadband tier. These results included endogenizing the number of providers, which revealed that penetration was driven partly by housing density and primarily by income. In 2010, just over 60 percent of adults had broadband at home.

Both demand and supply have changed considerably since those studies were done. Today, cable and fiber networks both commonly offer gigabit service downstream, with fiber offering it also upstream and cable generally offering up to 35 Mbps upstream. DSL is now generally considered outdated technology, at least in the U.S., with the telephone companies replacing it with fiber.

Newer research has focused more on the effects of competition on speed rather than adoption. Fister (2019) finds that entry encourages faster technology upgrades and higher maximum available speeds.[5] Somewhat contrarily, when controlling for factors that affect entry, Fenner (2020) finds that fiber entry does not affect the mean available speed and is negatively correlated with the fastest speed offered by the incumbent.

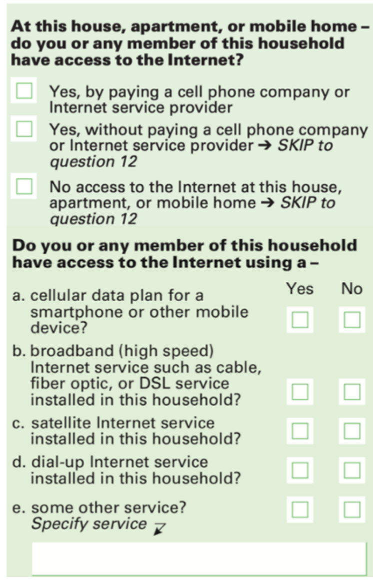
Data

Data from the FCC and the U.S. Census make it possible to test whether multiple facilities-based providers affect adoption. The FCC's "Form 477" provides data on availability at the Census block level and the American Community Survey (ACS) from the Census make public data available at the Census tract level beginning in 2017. Because tracts are comprised of several blocks, our geographic unit of analysis is therefore the Census tract. The most recent data on availability is June 2020 while the most recent Census data on adoption is from 2019. Thus, from 2017 – 2019 we have a dataset in which an observation is a Census-tract-year. Prior to 2017 the Census made data public only to the county level, so we can go further back in time at this less disaggregated level.

The ACS asks whether anyone in the surveyed household has internet, and then, if the answer is yes, asks from which technology (Figure 2).

[4] Scott Wallsten and Colleen Mallahan, "Residential Broadband Competition in the United States" (March 2010), http://ssrn.com/paper=1684236.
[5] Joanna Fister, "The Impact of Competition and Regulation on Broadband Internet Deployment in the Telecommunications Industry" (Dissertation, Northeastern University, April 2019), http://hdl.handle.net/2047/D20318694.

Figure 2: ACS Questions About Internet Use


At this house, apartment, or mobile home – do you or any member of this household have access to the Internet?

- ☐ Yes, by paying a cell phone company or Internet service provider
- ☐ Yes, without paying a cell phone company or Internet service provider → *SKIP to question 12*
- ☐ No access to the Internet at this house, apartment, or mobile home → *SKIP to question 12*

Do you or any member of this household have access to the Internet using a –

	Yes	No
a. cellular data plan for a smartphone or other mobile device?	☐	☐
b. broadband (high speed) Internet service such as cable, fiber optic, or DSL service installed in this household?	☐	☐
c. satellite Internet service installed in this household?	☐	☐
d. dial-up Internet service installed in this household?	☐	☐
e. some other service? *Specify service*	☐	☐

Source: ACS

Unfortunately, the public data do not link the second question to the demographics. Thus, while we know the overall share of the population that subscribes to different technologies, we do not know the share of different income or racial groups by technologies. In other words, we know the share of the population overall that subscribes to home wired broadband and mobile broadband only but not the share of the low-income population that subscribes to fixed wired broadband. Table 1 shows share of households with internet access from the ACS data.

Table 1: Share of Households with Internet by Type and Income

ACS 1-Year Estimates						
			Any Internet			
Year	Fixed broadband	Mobile only	Total	Less than $20k	$20k-$75k	$75k and up
2017	68.8%	11.0%	83.5%	59.3%	81.6%	95.0%
2018	69.6%	11.6%	85.3%	62.3%	83.0%	95.3%
2019	70.8%	11.8%	86.6%	64.2%	84.1%	95.6%

ACS 5-Year Rolling Average Estimates						
			Any Internet			
Year	Fixed broadband	Mobile only	Total	Less than $20k	$20k-$75k	$75k and up
2017	67.0%	7.5%	78.7%	51.5%	76.1%	93.4%
2018	67.9%	8.8%	80.9%	54.7%	78.1%	94.0%
2019	70.8%	10.0%	83.0%	58.0%	80.2%	94.6%

Source: American Community Survey.[6]
Note: This paper uses the 5-year estimates as the 1-year estimates are not available at the Census tract level.

[6] https://data.census.gov/cedsci/table?q=S2801&tid=ACSST1Y2017.S2801

Increasing adoption among low-income people is a key policy objective, and this paper evaluates one possible mechanism that might increase adoption – competition. Broadband adoption is a function of demand and supply, each of which is affected by many factors. At an individual or household level, demand is strongly correlated with income and the perceived value of activities available online. Average income across a geographic area affects supply because demand is likely to be higher. Other factors affect the costs of building out broadband in an area, including population density, ease of access to rights-of-way, the cost of pole attachments, and local and state rules an ISP must follow. Demand and supply (competition) together may then affect various measures of broadband, including adoption and varying available features.

Another way to think about the many factors affecting supply and demand is to recognize that these factors differ across locations and time. So, for example, if the objective is to compare the effects of competition on adoption, it would not make sense to compare a wealthy suburban area to a poor rural area and attribute adoption differences solely, or even primarily, to different levels of competition. Double-blind controlled studies such as those done to test pharmaceuticals represent the gold standard, in principle, for eliminating confounding effects such as those described above. While experimental economics has become increasingly popular, that kind of experiment is usually not possible in the real world.[7]

Without a controlled experiment, we rely on the natural experiment of differences across space and time and attempt to control for factors like income, density, and topography that will also affect the variable we care about, which in this case is adoption. With only one year of data and a cross-section, the best we could do empirically is to control for factors that are measured. But even that approach is flawed because indicators are measured with error and it is not possible to capture all the local effects that drive adoption in order to leave us with only the competition effect.

Multiple years of data, which gives us a panel across space and time, opens up more rigorous options. Specifically, we can eliminate the confounding effects that do not change much, if at all, across years by subtracting the data for a given place in one year from the data for that place in the previous year. Econometrically, we do that by including "fixed effects"—a separate indicator variable for each geographic area (Census tract fixed effects in this case) as well as an indicator for each year (year fixed effects). Those remove all the location-specific, time-invariant factors as well as factors caused by events across areas but attributable to time, such as trends or macroeconomic shock.

[7] While double-blind trials are usually not possible with telecom, the area is ripe for experimentation. For example, different approaches to improving Lifeline could be implemented across states, making it possible to study which approaches are more successful.

To implement this approach, I estimate the following equation:

$$adoption_{ty} = f(\text{cable}_{ty}, \text{fiber}_{ty}, \text{cable \& fiber}_{ty}, \text{year fixed effects}_{y}, \text{census tract fixed effects}_{t})$$

As an observation is a Census tract-year, the subscript *t* indicates census tract and *y* indicates year. $Cable_{ty}$, $fiber_{ty}$, and $[cable \& fiber]_{ty}$ are whether census tract *t* in year *y* has a cable broadband provider, fiber provider, or both. So, for example, for a tract with only a cable provider, $Cable_{ty} = 1$, $fiber_{ty} = 0$, and $[cable \& fiber]_{ty} = 0$. In a tract with cable and fiber, all three variables equal one. Census tract and year fixed effects act as controls as described above.

I estimate the equation several times using different measures of adoption available from the Census, including wireline broadband, any internet, by income, and by race. As discussed, the ACS shows wireline broadband only for the overall population. It does not divide adoption into wired and mobile for demographic breakdowns, so those variables measure adoption of either technology.

Table 2 shows the results of the adoption regressions. In these regressions, tracts with both cable and fiber providers are the excluded category, meaning that the coefficients on the "cable only" and "fiber only" variable tell us about adoption in those tracts relative to tracts with both cable and fiber.

Table 2: Cable or Fiber Alone vs Cable and Fiber and Adoption, Regression Results

	Share of Households with		
	Wireline Broadband	Any Internet	Mobile Only
Cable Only	-0.07	-0.31***	-0.19***
	(0.05)	(0.04)	(0.03)
Fiber Only	-0.01	0.37***	0.43***
	(0.14)	(0.12)	(0.09)
Other	0.33*	-0.23	-0.13
	(0.20)	(0.18)	(0.13)
2018	0.87***	2.35***	-2.69***
	(0.02)	(0.02)	(0.01)
2019	1.83***	4.70***	-1.34***
	(0.02)	(0.02)	(0.01)
Constant	64.45***	76.56***	10.46***
	(0.01)	(0.01)	(0.01)
Obs.	218,394	216,620	216,620
R-squared	0.98	0.97	0.92
Tract Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Standard errors are in parenthesis			

Note: Cable and Fiber together and year 2017 are reference categories.

The results suggest that broadband adoption is not higher when both technologies are present. The first column of results in the table shows adoption of fixed, wired technology, such as cable or fiber. The coefficients on the cable only and fiber only variables are small in magnitude and not statistically significant, meaning we cannot reject the hypothesis that having both cable and fiber has no effect on adoption.

The second column shows the results of estimating the regression when the share of households with any internet, including mobile only, is the dependent variable. Here, too, the results do not support the notion that adoption is higher when cable and fiber are both present, as they suggest that adoption of any internet is highest in areas with only fiber, followed by areas with fiber and cable, and then areas with only cable. The results are statistically significant, but very small in magnitude: Each one percentage point increase in fiber coverage is associated with a 0.4 percentage point increase in adoption of any technology. These results are likely driven by the inclusion of mobile-only adoption in the dependent variable. The third column, in which the share of households with mobile-only coverage is the dependent variable shows similar results, consistent with the hypothesis that patterns in mobile adoption are driving this seemingly odd result.

As discussed, the Census data on broadband by income and race are connections of any type, including mobile only, so have the same potential problem just discussed. Table 3 shows the results of estimating the equation with internet adoption by income and race as the dependent variables. Again, the evidence does not support the hypothesis that areas with cable and fiber have more internet adoption than areas with only one or the other. Cable only, fiber only, and cable and fiber together areas do not have statistically different adoption rates, and the other groups show the same pattern as the overall result for any technology: negative for cable and positive for fiber, relative to having both cable and fiber, presumably also driven by patterns of mobile only adoption.

Table 3: Cable or Fiber Alone vs Cable and Fiber and Adoption by Income and Race

	Share of People with Specified Income with Any Internet Connection			Share of People of Specified Race with Any Internet Connection		
	<$20k	$20k-$75k	>=$75k	White	Black	Hispanic
Cable Only	-0.05	-0.26***	-0.22***	-0.40***	-0.36**	0.01
	(0.13)	(0.06)	(0.07)	(0.06)	(0.18)	(0.16)
Fiber Only	-0.18	0.36*	0.41**	0.37**	0.78	0.78*
	(0.37)	(0.18)	(0.19)	(0.18)	(0.57)	(0.46)
Other	0.18	-0.03	-0.56*	-0.59**	0.88	-0.61
	(0.55)	(0.27)	(0.29)	(0.27)	(0.85)	(0.70)
2018	3.08***	2.15***	0.98***	2.01***	2.40***	2.49***
	(0.05)	(0.02)	(0.03)	(0.02)	(0.06)	(0.06)
2019	6.38***	4.37***	1.96***	3.97***	4.80***	4.94***
	(0.05)	(0.02)	(0.03)	(0.02)	(0.07)	(0.06)
Constant	53.99***	74.53***	89.33***	81.55***	77.07***	79.76***
	(0.04)	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)
Obs.	218394	218394	218394	216079	190755	208646
R-squared	0.88	0.93	0.91	0.92	0.87	0.85
Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Standard errors in parentheses						

I also estimate these equations again using the share of the Census tract that has cable only, fiber only, and cable and fiber rather than indicator variables. These shares, though, may be measured with significant error. We derive them from the share of the population in the tract in each block that has access to the technology combinations. Still, it is a robustness check of the results above. The results, shown in Table 4, are similar to those above.

Table 4: Share of Population with Access to Cable, Fiber, and Cable & Fiber and Adoption

	Fixed	Any Internet	Mobile Only	Income			Race		
				<$20k	$20k-$75k	>=$75k	White	Black	Hispanic
Share with cable	0.002	0.23	-0.18	0.42	0.12	0.58*	0.7**	-2.13**	0.43
	(0.002)	(0.19)	(0.14)	(0.61)	(0.3)	(0.32)	(0.3)	(0.89)	(0.75)
Share with fiber	0.001	1.34***	0.52***	-0.19	0.6*	1.36***	1.55***	-1.53	2.77***
	(0.002)	(0.21)	(0.15)	(0.65)	(0.32)	(0.34)	(0.32)	(1.01)	(0.8)
Share with cable and fiber	0.004*	-0.89***	-0.6***	0.35	-0.29	-1.24***	-0.91***	1.81*	-2.47***
	(0.002)	(0.22)	(0.16)	(0.67)	(0.33)	(0.35)	(0.33)	(1.04)	(0.83)
2017	-0.02***	-4.66***	-2.72***	-6.37***	-4.36***	-1.96***	-3.92***	-4.8***	-4.88***
	(0.0002)	(0.02)	(0.01)	(0.05)	(0.03)	(0.03)	(0.03)	(0.07)	(.06)
2018	-0.01***	-2.34***	-1.34***	-3.3***	-2.22***	-.97***	-1.95***	-2.4***	-2.42***
	(0.0002)	(0.02)	(0.01)	(0.05)	(0.02)	(0.03)	(0.02)	(0.06)	(.06)
Constant	0.66***	80.79***	10.64***	60.03***	78.76***	90.85***	84.53***	83.67***	84.1***
	(0)	(0.17)	(0.12)	(0.54)	(0.26)	(0.28)	(0.26)	(0.81)	(0.67)
Observations	217989	216619	216619	217989	217989	217989	216078	190755	208646
R-squared	.98	.97	.92	.88	.92	.9	.92	.87	.85
Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard errors are in parentheses									
**** p<.01, ** p<.05, * p<.1*									

The one difference between Table 2 and Table 4 is that the regression using shares shows a statistically significant, but extremely small, positive relationship between the share of the households with access to cable and fiber and fixed line subscriptions. An increase from zero to 100 percent of households with cable and fiber available would be associated with an increase of 0.4 percentage points in adoption.

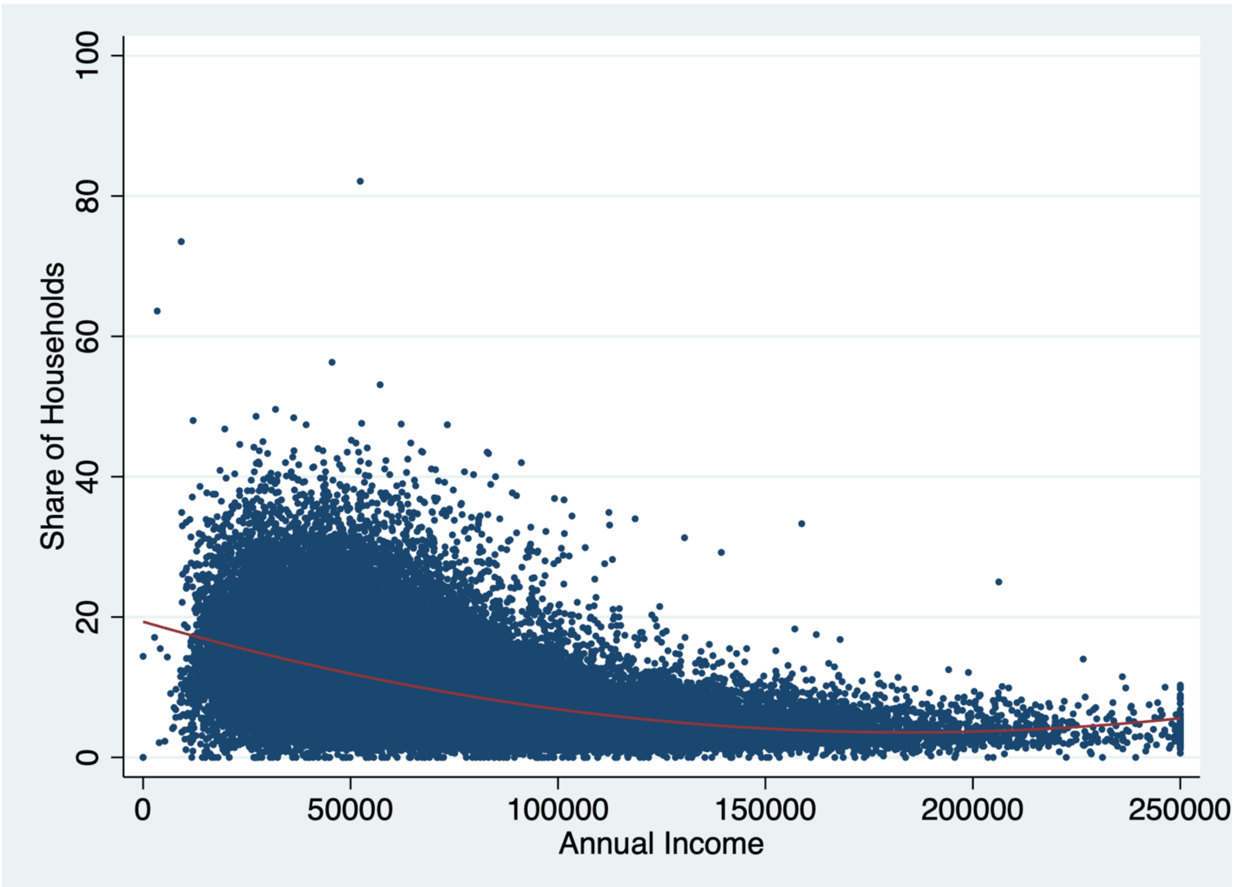
Discussion

It is not possible to explore with this data why competing cable and fiber providers do not affect adoption relative to having only a cable or fiber provider, but we can hypothesize.

First, wireless competition—via cellular and fixed wireless—may be enough of a competitor to wireline for enough people that the additional competition from a second high-quality wireline provider has limited effect on adoption. While still small, an increasing share of households are mobile broadband only—nearly 12% by 2019, as shown above. In that case, it would not make conceptual sense to think of cable or fiber being lone competitors since those areas almost always have wireless providers.

This mobile effect may be particularly true for low-income households. Data from the National Center for Health Statistics show that low-income people are more likely to be mobile only for voice.[8] Broadband data suggest the same is true for broadband (Figure 3). This correlation is sensible considering that low-income people move homes more frequently than wealthier people,[9] potentially making them less likely to sign up for a service tied to a single location.

Figure 3: Share of Households with Only Mobile Broadband by Income at the Census Tract Level, 2019



Source: Derived from American Community Survey, 2019

Second, broadband demand may have become inelastic enough that the number of connections is not affected much by changes in price. Demand by low-income people may also be inelastic. While people who do not subscribe to home broadband reliably list affordability and relevance as the top two reasons for not subscribing, in the real world, low prices have not been sufficient to encourage large numbers of low-income people to subscribe.[10]

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[8] Stephen J. Blumberg and Julian V. Luke, "Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July-December 2019" (National Center for Health Statistics, September 2020), https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless202009-508.pdf.

[9] Peter J. Mateyka, "Desire to Move and Residential Mobility: 2010–2011" (U.S. Census, Economics and Statistics Administration, March 2015), https://www.census.gov/content/dam/Census/library/publications/2015/demo/p70-140.pdf.

[10] See, for example, Wallsten (2016) or Rosston and Wallsten (2020). Wallsten, Scott. "Learning from the FCC's Lifeline Broadband Pilot Projects." Technology Policy Institute Working Paper, March 2016.

Relatedly, it is possible that entry level home wireline broadband prices for low-income people have little room to come down, given that every major provider offers plans ranging from $10 - $20 per month to qualifying households. And given that those households are eligible for a $9.25 per month Lifeline subsidy, in principle many can get service for close to zero dollars, although in practice Lifeline subsidies tend to be used for mobile rather than fixed service.

Third, providers may choose to compete on areas other than those that would affect adoption, particularly when unconnected households are reluctant to get online. Providers do not compete solely to solve the digital divide. Providers may compete with each other for existing subscribers instead of for new ones.

An important caveat to this discussion is that we still know little about how the pandemic itself has affected demand. Some evidence suggests, not surprisingly, that demand has increased. Specifically, the number of broadband subscribers as reported on providers' SEC filings suggest an inflection point in the increase in subscribers when the pandemic hit.[11] That could mean either that the remaining unconnected are more likely to respond to incentives to connect because the benefits of subscribing are larger or that they are less likely to respond to incentives because the people who would subscribe when the benefits of doing so increase already have.

These results do not imply that facilities-based competition is unimportant. It is. ISPs compete along many dimensions in ways that benefit consumers. Instead, the results simply show that competition is unlikely to be the key to getting the last group of offline people to subscribe even when they have access to fixed and mobile providers.

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https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2757149. Rosston, Gregory L., and Scott Wallsten. "Increasing Low-Income Broadband Adoption through Private Incentives." *Telecommunications Policy* 44, no. 9 (October 2020): 102020. https://doi.org/10.1016/j.telpol.2020.102020.

[11] https://techpolicyinstitute.org/2021/02/10/covid-19-is-narrowing-the-digital-divide/