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A Failed Regulatory Remedy? An Empirical Examination of Affordable Broadband Plan Obligations

HERNAN GALPERIN[1]
University of Southern California, USA

This study examines whether three affordable broadband plans that emerged from merger proceedings in the United States have helped connect low-income households. The study employs a difference-in-difference approach that compares the change in adoption rates in the areas served by each service operator with the change in adoption rates in areas not served by the operator following the introduction of the affordable plan. This allows for isolating the additional contribution that each plan has had over and above the growth in adoption that would have occurred in absence of the plan. The results indicate that these affordable plan commitments have had no significant impact on residential connectivity among low-income households. Weak oversight and misaligned incentives are the main factors that explain these findings, which raise questions about the value of these commitments as a regulatory tool to advance digital equity.

Keywords: broadband regulation, digital equity, difference-in-difference, Internet affordability

The passage of the Telecommunications Act of 1996 represented a paradigm shift in the regulation of the U.S. telecommunications and media industries (Aufderheide, 1997). The Act attempted to force competition while at the same time doing away with restrictions on what types of services companies could offer and the markets they could enter. By the early 2000s, it became clear that this grand bargain had failed, in part because of several judicial and administrative decisions pushed for by industry incumbents that weakened key provisions of the Act (Crawford, 2013; McChesney, 1999). Rather than more competition and choice, the Act was followed instead by a long wave of industry consolidation that persists to these days (Frieden, 2020; Kimmelman, Cooper, & Herra, 2006).

Underpinning this deregulatory thrust was a shared conviction among legislators and regulators that unshackling market forces would ultimately serve the public interest (Winseck & Pooley, 2017). While the 1996 Act reaffirmed the Federal Communications Commission's (FCC's) authority to review mergers and acquisitions, in practice the agency has rarely used this authority to block corporate transactions, opting instead to impose behavioral conditions on the new entity (Barkow & Huber, 2000; Pickard & Berman, 2019).

Hernan Galperin: hernan.galperin@usc.edu
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These conditions seek to attenuate potential losses to competition and advance the public interest in merger and acquisition proceedings.

In recent transactions involving large Internet service providers (ISPs), a common regulatory condition has been the requirement that the new entity make available an affordable broadband plan for low-income households. The details vary in each case, but the obligation typically involves offering a basic, standalone access plan at a price significantly below market rates for a period of several years, using a predetermined set of rules to determine eligibility. The obligations also involve outreach efforts to promote awareness among potential subscribers, and reporting requirements for compliance monitoring.

This study examines whether three affordable broadband plans that emerged from recent merger proceedings have helped connect low-income households in California. In particular, it explores whether these plans have helped connect households that would otherwise not have subscribed to residential broadband at regular market rates. The mandated period for these affordable plans has now elapsed although service providers have continued to offer the plans (or similar plans) on a voluntary basis. This offers a unique opportunity to take stock of these public interest obligations and evaluate whether industry oversight agencies should continue to use this regulatory tool to advance digital equity.

The plans included in the study are:

1. "Access from AT&T," an affordable plan that emerged from the proceedings related to AT&T's acquisition of DirecTV in 2015.
2. "Internet Assist" by Spectrum, a low-cost plan created by Charter Communications as a condition of its merger with Time Warner Cable and Bright House Networks in 2016.
3. "Affordable Broadband" by Frontier Communications, a plan mandated by the California Public Utilities Commission (CPUC) as a condition for Frontier's acquisition of Verizon's wireline assets in 2015.

To evaluate whether these plans have contributed to increasing residential connectivity among eligible households, the study employs a difference-in-difference (DiD) approach based on a number of alternative estimation strategies. In essence, the approach rests on comparing the change in broadband adoption among eligible households before and after the introduction of the affordable plan in the areas served by each ISP with the change in adoption rates among eligible households in areas not served by the ISP over the same period. This allows for isolating the additional contribution that the affordable plan has had over and above the growth in broadband adoption that would have occurred in the absence of the plan. In DiD terms, the households that are eligible (based on each plan's eligibility criteria) but are located outside the ISP territory serve as the control group to similar households located within the ISP territory (the potentially treated households).

Overall, the results indicate that affordable plans have had no significant impact on connectivity rates among eligible households. Weak oversight and misaligned incentives are the main factors that explain these findings, which in broad terms raise questions about the value of these public interest mandates as a regulatory tool in consolidation cases involving large ISPs. These results call for a reevaluation of the tools

used to protect the public interest in merger proceedings while also underlining the need to modernize existing universal access programs to meet the equity challenges of the broadband era.

Broadband Competition and Digital Equity

Broadly speaking, the tools that regulators use to address concerns about market power and anticompetitive conduct fall into two categories: structural and behavioral remedies (Farrell & Weiser, 2003). Structural remedies involve the breakup into separate legal entities (the prime example being the breakup of AT&T in 1982) or the ex-ante blocking of merger and acquisition transactions. As Khan (2019) argues, since the passage of the 1996 Act U.S. regulators and courts have generally shied away from the use of structural remedies in the communications industry, favoring instead behavioral remedies that seek to prevent anticompetitive conduct and align business incentives with the public interest.

An example of such behavioral remedies in merger and acquisition transactions involving ISPs is the obligation to offer a standalone, affordable access plan to low-income households. This obligation seeks to address several regulatory concerns, including the impact on competition (and therefore on service affordability) as well as a potential reduction in the availability of unbundled service plans. For example, as part of the FCC's review of the Comcast–NBCUniversal merger in 2011, which raised concerns about vertical foreclosure and service bundling, Comcast made a "voluntary commitment" to launch a standalone, high-speed access service to eligible households for less than $10 a month (FCC, 2011). Eligibility for the new plan was initially determined on the basis of participation by at least one household member in the National School Lunch Program (NSLP) but was later expanded to include recipients of other public assistance programs (Davidson, Santorelli, & Kamber, 2012).

There is considerable debate about whether affordable plans that emerged from regulatory proceedings have in fact lowered the affordability barrier and helped connect low-income Americans to residential broadband (Crawford, 2013; Koutsky & Spiwak, 2010). Local advocacy and consumer protection organizations have argued that ISPs often fail to promote these offerings, and that onerous certification and sign-up procedures discourage participation (e.g., Consumer Reports, 2021; Partnership for Los Angeles Schools, 2020). Others have argued that due to a lack of network investments in low-income communities, these plans are not available in the areas where they are most needed (National Digital Inclusion Alliance, 2016).

Several recent studies validate these concerns. According to the Census Bureau, more than a quarter of California households (27.7%) lacked residential broadband in 2016, when the affordable plans analyzed in this study were introduced, and these households were disproportionately poor and located in areas with large Black and Hispanic populations (Ryan, 2018). A survey conducted after the onset of the COVID-19 pandemic in early 2020 found that despite the increased need for connectivity, only about a third of California households without residential broadband were aware of affordable broadband plans, and among those who were aware only a quarter have ever applied (California Emerging Technology Fund [CETF], 2021). Other studies point to additional uptake barriers beyond awareness, such as burdensome enrollment procedures, poor or incomplete information, and lack of trust in affordable programs operated by private ISPs (e.g., Levine, 2020).

These challenges are not unlike those faced by Lifeline, a federal program that subsidizes voice and data services to eligible households since 1984. After peaking at about 18 million recipients in 2012, participation in Lifeline has since declined to about 6.5 million recipients (FCC, 2021). California is one of the several states that also administers its own Lifeline program, which provides additional support for qualifying households. Yet despite offering the second-highest level of support among all U.S. states, participation in California Lifeline declined from a 2007 peak of about 3 million subscribers to less than 1.5 million in 2020 (CPUC, 2022).

Research indicates that multiple factors explain the low uptake of Lifeline, including lack of awareness, limited benefits, and burdensome certification procedures (Burton, Macher, & Mayo, 2007; Hauge, Jamison, & Todd, 2008). There is also debate about the potential displacement effects of Lifeline. Using data from the National Health Interview Survey, Ukhaneva (2015) estimated that 95% of Lifeline participants would have subscribed to the service without the subsidy. However, Ford (2021) has disputed these results, finding evidence of network effects whereby the program promotes subscription to market-rate services by other household members (Lifeline is restricted to one beneficiary per household).

Several scholars have called for a thorough reform of the universal service programs in the U.S. communication industry, favoring a portable voucher system that, it is argued, will empower low-income consumers and promote competition among ISPs while also reducing administrative burden (Lyons, 2019; Skorup & Kotrous, 2020). There is however limited evidence to support these claims. A study by Ogbo (2022) analyzes a broadband voucher program for school-age children implemented in Alabama during the first months of the Covid-19 pandemic. The author finds evidence of high participation rates (more than 40%) for the program, but the results also suggest that the program may not have reached the families most in need, raising questions about appropriate targeting.

Only a handful of academic studies have examined the affordable broadband plans offered by ISPs. Davidson and colleagues (2012) offer a useful description that traces the origins, characteristics, and overall results of Internet Essentials, the affordable plan launched by Comcast in 2011 following its merger with NBCUniversal. Using data submitted by Comcast to the FCC, the authors conclude that low-income households are heterogeneous in terms of attitudes toward technology and digital skills and that schools have played a critical role in promoting program enrollment among eligible families.

Rosston and Wallsten (2020) also examine the impact of Internet Essentials, using microdata from the Current Population Survey to estimate the impact on residential connectivity among eligible households. Using a DiD strategy similar to the one used in this study, the authors find a positive impact on residential connectivity of about 7 percentage points, relative to a control group of eligible households located outside Comcast territory. Based on this result, the authors estimate that about two-thirds of the increase in broadband adoption among eligible households in Comcast territory during the study period (2011–15) is attributable to Internet Essentials. At the same time, the study finds that other components of the program, in particular, a low-cost computer device offer, did not result in meaningful impact among target households.

Yet another study of Internet Essentials by Zuo (2021) examines the impact of the program on employment. The study uses a triple-difference strategy that exploits variations in Comcast coverage and

household eligibility, in addition to temporal variation before and after the launch of the program. The results indicate that the availability of Internet Essentials is associated with a small but significant increase of about 1 percentage point in the probability of employment among eligible individuals.

In summary, there is limited evidence about the effectiveness of regulatory obligations imposed on ISPs to offer an affordable broadband plan. Furthermore, the evidence comes from a handful of studies of a single case (Comcast's Internet Essentials). The current study fills a gap in the literature by examining three plans launched in 2016, offered by different ISPs and based on different eligibility criteria. As the wave of consolidation continues to wash over the communications industry, the results of this study offer guidance about the tools federal and state regulators can harness to reduce affordability barriers and advance digital equity.

Methods and Data

The empirical analysis in this study rests on several key estimates. First, households that qualify for each of the affordable plans under study are identified using the American Community Survey (ACS). Because eligibility combines a number of variables (discussed below), it can only be estimated consistently using household-level microdata. Once eligible households are identified, the ACS provides information about residential (fixed) broadband adoption, our main outcome of interest. Household-level data are then aggregated to the public use microdata area (PUMA) level, where they are matched with service availability data from the CPUC.[2]

At the core of the DiD approach is a comparison between treated and control units. The units in this study are the PUMAs, for which we observe adoption rates among eligible households before and after the launch of the affordable plans. However, a criterion is needed to distinguish between PUMAs that will be considered treated and the ones that will serve as controls. To accomplish this task, the share of households in a PUMA served by each ISP (regardless of service speed) is estimated using broadband deployment data from the CPUC. This is computed for the major cable and Digital Subscriber Line (DSL) providers of residential broadband, excluding fixed wireless and satellite-based ISPs. It is worth noting that availability data from the CPUC are significantly more reliable than similar data from the FCC's Form 477, as they are subject to a number of validity checks. Critically, service deployment data submitted by an ISP are validated against subscription data, which allows the CPUC to remove census blocks where service presence cannot be validated.

Next, two alternative criteria are used to determine which PUMAs are considered treated and which are used as controls, each leading to different estimation strategies. In the first criterion, a PUMA is considered treated if at least 90% of the households in the PUMA are served by an ISP; otherwise, the PUMA is considered not treated, and thus serves as control. In other words, households that are eligible (based on each plan's eligibility rules) and are located within the ISP territory (based on the 90% coverage criteria)

[2] PUMAs are geographic boundaries delineated by state data centers following guidelines from the Census Bureau. Among other guidelines, PUMAs must contain at least 100,000 and less than 200,000 residents. Therefore, counties with large populations typically are subdivided into multiple PUMAs, while PUMAs in rural areas often extend over two or more counties. For reference, there are 265 PUMAs in California.

are considered potentially treated. Those that are also eligible but are located outside the ISP territory (using a similar 90% threshold) serve as the control group.[3] In DiD terms, this is commonly referred to as intention-to-treat estimation, a strategy used by similar studies on the impact of affordable broadband plans (e.g., Rosston & Wallsten, 2020; Zuo, 2021).

Using this criterion, a standard DiD setup is obtained, with two groups of units (treated and control) and two time periods (before and after treatment). This allows for both a parametric and a nonparametric estimation of impact. The nonparametric alternative is based on the simple difference in the average adoption rate among eligible households in the before and after periods for the treated (within the ISP territory) and the control units (outside the ISP territory). The quantity of interest, or Average Treatment Effect on the Treated (ATT), is given by:

$$ATT = (E[\bar{Y}_{treat}|Post] - E[\bar{Y}_{treat}|Pre]) - (E[\bar{Y}_{control}|Post] - E[\bar{Y}_{control}|Pre]) \quad (1)$$

where $\bar{Y}$ is the average residential broadband adoption rate among eligible households for the corresponding group (treated or control) and time period (pre- or posttreatment).

The parametric alternative, which allows for including PUMA-level covariates as controls, is estimated by:

$$Y_{it} = \alpha + Y_t + \delta_i + \beta D_{it} + X_{it} + \mu_{it} \quad (2)$$

where Y_{it} is the residential broadband adoption rate among eligible households for PUMA i in year t, α is a constant, γ_t are year fixed effects, δ_i are PUMA fixed effects, D_{it} indicates whether PUMA i was "treated" in year t, X_{it} is a vector of PUMA-level covariates (in models with covariates), and μ_{it} is the error term (with errors clustered at the PUMA level). This is a standard two-way fixed-effects (TWFE) model in which the parameter of interest is β, which recovers the DiD estimator (Imai & Kim, 2021).

Two sets of PUMA-level control variables are used. The first set includes the following demographic characteristics that are known to affect residential broadband uptake: Population density, median household income, share of population with a college degree, total households, and race/ethnicity characteristics. Second, some models also include the share of households in a PUMA served by other ISPs (that is, other than the ISP being evaluated), which serves to control for competition effects.

In the second criterion, rather than using a coverage threshold to distinguish between treated and control PUMAs, the share of households served by the ISP of interest in a PUMA enters the model as a continuous (rather than binary) variable. In this case, since there is no binary distinction between treated and control groups, the nonparametric approach is unfeasible. Yet it is possible to use a parametric approach similar to equation (2), in which all model terms are the same except for D_{it}, which now indicates the degree

[3] As a validity check, other thresholds were used with no discernable differences in the main findings. These results are available from the author on request.

to which PUMA *i* was treated in year *t*. This will be zero for all pretreatment periods but will now take a value between zero and one in posttreatment periods.

Each of these alternative criteria has merits and limitations. Modeling broadband coverage as a continuous (rather than binary) variable provides a better representation of the true availability of the affordable plans in each PUMA. However, the interpretation of the ATT coefficients is more complex since a comparison is made not simply between the treated and control groups but rather across multiple groups based on differences in treatment "dosage" (see Callaway, Goodman-Bacon, & Sant'Anna, 2021). The binary distinction between treated and control offers advantages in terms of estimation and interpretation, and yet somewhat artificially distinguishes between treated and control PUMAs. The next section presents findings using both criteria. As discussed, the results are remarkably consistent, thus validating the findings.

Results

"Access From AT&T"

In July 2015 the FCC approved AT&T's acquisition of DirecTV subject to a number of conditions. Among these conditions was the obligation that AT&T make available "an affordable, low-price standalone broadband service to low-income consumers in the combined entity's wireline footprint" (FCC, 2015a, p. 397). This was broadly similar to the condition imposed a few years earlier on Comcast for approving its merger with NBCUniversal. In both cases, the commission emphasized the need to protect choice for low-income customers by making available a standalone, affordable broadband plan not bundled with video or other services.

The new plan was required to offer a minimum of between 5Mbps and 10Mbps of download speed for no more than $10 per month. Where not "technically feasible," AT&T could offer 3Mbps for no more than $5 per month. Eligible households were determined to be those where at least one member participated in the Supplemental Nutrition Assistance Program ("SNAP") program. Due to state law that excluded recipients of Supplemental Security Income (SSI) from SNAP benefits, California residents could also qualify based on participation in the SSI program. The mandate was set to expire in four years and included additional requirements related to marketing and outreach efforts in coordination with schools and community-based organizations. Additionally, AT&T was required to submit semiannual compliance reports to the FCC.

Called "Access from AT&T," the new plan was launched in early 2016. Using the 90% coverage threshold to distinguish between treated and control PUMAs (binary criteria), it is estimated that when the affordable plan was launched about 6.9 million California households (54% of the total) were located within AT&T territory. In other words, about half of the state's households were potentially treated (subject to eligibility), with the other half serving as the control group.

Based on this criterion, the residential broadband adoption rate among Californian households eligible for "Access from AT&T" during the study period is presented in Figure 1. The darker line represents the adoption rate for eligible households in AT&T territory, and for which the affordable plan was made available in 2016 (the treated group), while the lighter line shows the adoption rate for eligible households outside AT&T territory (the control group). The vertical dash line notes the year in which the affordable plan was introduced (2016). It is

worth noting that, despite an overall growth in adoption during the study period, about a third of eligible households remained unconnected to residential broadband in 2020, when the plan mandate expired.

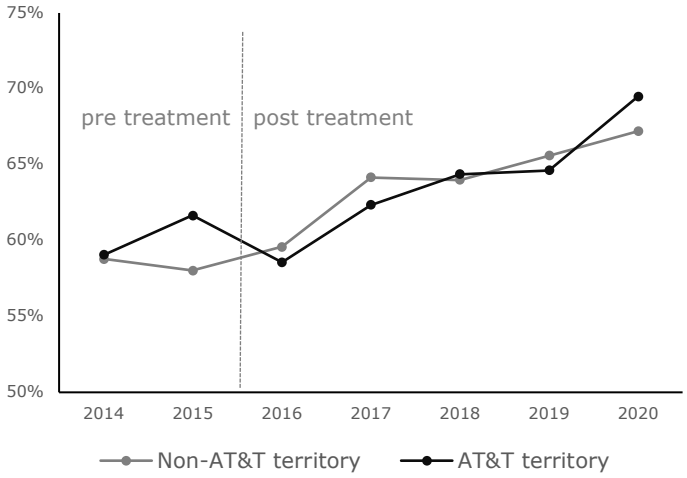

Figure 1. Residential (fixed) broadband adoption among households eligible for "Access from AT&T." Source: Own calculations based on ACS and CPUC.

To estimate the impact of AT&T's affordable plan, Table 1 presents a simple calculation of the difference in the average adoption rate in the before and after periods (pre-2016 vs. post-2016) for the treated (those within AT&T territory) and the control households (those outside AT&T territory). As shown, broadband adoption among eligible households outside AT&T territory grew from 58.4% in the pre-2016 period to 64.2% in the post-2016 period, thus increasing by 5.8 percentage points. In contrast, the growth in eligible households within AT&T territory was only about half as much (3.3 percentage points). The implied DiD is -2.5 percentage points, which suggests that the launch of the affordable plan did not result in an increase in residential connectivity among eligible households relative to a control group of similar households located outside AT&T territory.

Table 1. Nonparametric DiD Estimation of AT&T's Plan Impact.

	Non-AT&T Territory	AT&T Territory
(A) Average adoption pretreatment (2014–15)	58.4%	60.4%
(B) Average adoption posttreatment (2016–20)	64.2%	63.7%
Difference (B − A)	5.8 p.p.	3.3 p.p.

Source: Own calculations based on ACS and CPUC.

To formally test this result, the TWFE modeling strategy described above is used (Equation 2). As noted, the parameter of interest is given by the combination between AT&T territory (which denotes the treated units) and the post-2016 variable (which denotes posttreatment). Table 2 presents three alternative models, each including additional covariates: Model 1 is a base model without covariates; Model 2 adds controls for the share of households in the PUMA served by other ISPs; finally, Model 3 includes population

density, race and ethnicity, median household income, education (college degree or higher), and total households as additional controls.

Table 2. Parametric DiD Estimation of AT&T's Plan Impact (Binary Variable).

	(1)	(2)	(3)
VARIABLES	Base Model	+ISPs	+Demographic
AT&T territory × post 2016	**−0.0170**	**−0.0181***	**−0.0122**
	(0.0107)	**(0.0109)**	**(0.0109)**
Constant	0.589***	0.607***	0.618**
	(0.00670)	(0.141)	(0.240)
Observations	1,855	1,855	1,855
R-squared	0.569	0.569	0.575
Number of PUMAs	265	265	265
ISP controls	No	Yes	Yes
Demographic controls	No	No	Yes

Note. Robust standard errors are in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. Clustered standard errors at PUMA level.

The results corroborate the finding that the launch of "Access from AT&T" did not result in a meaningful increase in the share of low-income households connected to residential broadband during the study period. There is, in fact, a small negative impact in Model 2 that essentially disappears as demographic covariates are added in Model 3.

To further validate this finding, Table 3 presents results from the parametric estimation using the second criteria, in which the share of households served by AT&T enters the model as a continuous (rather than binary) variable. In this case, none of the models yield a significant result, thus corroborating that the regulatory obligation imposed on AT&T did not achieve the goal of lowering the broadband affordability barrier for low-income households in California.

Table 3. Parametric Estimation of AT&T's Plan Impact (Continuous Variable).

VARIABLES	(1) Base Model	(2) +ISPs	(3) +Demographic
AT&T territory × post 2016	**−0.0184**	**−0.0207**	**−0.00843**
	(0.0160)	**(0.0161)**	**(0.0161)**
Constant	0.737***	0.731***	0.768***
	(0.121)	(0.176)	(0.255)
Observations	1,855	1,855	1,855
R-squared	0.569	0.569	0.575
Number of PUMAs	265	265	265
ISP controls	No	Yes	Yes
Demographic controls	No	No	Yes

Note. Robust standard errors are in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. Clustered standard errors at PUMA level.

"Internet Assist" by Spectrum

Following a lengthy review, in May 2016 the FCC announced its decision to approve the merger of Charter Communications with Time Warner Cable and Brighthouse Networks, creating the nation's second-largest broadband Internet provider (FCC, 2016). The approval included a number of conditions, one of them being that the combined company begin offering an affordable, standalone broadband plan with minimum speeds of 30/4Mbps for no more than $14.99 per month. Two eligibility criteria were established: (1) having at least one child who receives free or reduced lunch (NSLP program), or (2) being enrolled in the SSI program for low-income people with disabilities. The mandate was set to expire after four years, with a total enrollment target of 525,000 households. Additionally, the FCC order included a vaguely worded requirement for the company to "conspicuously market" the plan.

Given that the transaction had a significant impact on the broadband market in California, the CPUC conducted its own review, which imposed additional conditions. These included the extension of the affordable plan mandate for an additional year (now 5 years in total) and an "aspirational" goal of enrolling 350,000 new broadband subscribers throughout the state. The plan, called "Internet Assist" by Spectrum, was launched in late 2016.

Using the 90% coverage criteria to distinguish between treated and control PUMAs, it is estimated that when the plan was launched about 5.3 million California households (42% of the total) were located within Charter territory. These are the potentially treated households, subject to eligibility based on the criteria above. Figure 2 presents the residential broadband adoption rate among households eligible for "Internet Assist." As in Figure 1, the darker line represents the adoption rate for eligible households in Charter territory (the treated group), while the lighter line shows the adoption rate for eligible households outside Charter territory (the control group).

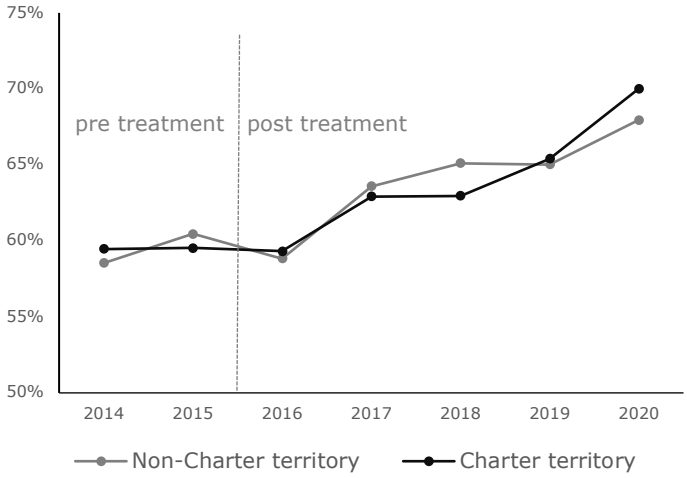

Figure 2. Residential (fixed) broadband adoption among households eligible for "Internet Assist" by Spectrum. Source: Own calculations based on ACS and CPUC.

The empirical strategy is similar to the case of AT&T. First, Table 4 presents results from the non-parametric approach, which computes the difference in the average adoption rates in the before and after periods for the treated (those within Charter service areas) and the control households (those outside Charter territory). As shown, the growth in residential adoption for eligible households within and outside the Charter service areas was similar at 4.6 percentage points. With the implied DiD being zero, the table suggests that the affordable plan failed to promote connectivity among low-income households above and beyond what one would expect had the plan not been launched.

Table 4. Nonparametric Estimation of Charter's Plan Impact.

	Non-Charter Territory	Charter Territory
(A) Average adoption pretreatment (2014–15)	59.5%	59.5%
(B) Average adoption posttreatment (2016–20)	64.1%	64.1%
Difference (B − A)	4.6 p.p.	4.6 p.p.

Source: Own calculations based on ACS and CPUC.

This finding is formally tested using the parametric approach. The parameter of interest—which recovers the DiD estimator—is given by the combination between Charter territory and the posttreatment indicator variable (post 2016). Table 5 presents the results using the binary criteria to distinguish between PUMAs within and outside Charter's service area. As in the AT&T case above, the table includes a base model without covariates (Model 1) and two alternative models, each with additional covariates. Model 2 includes controls for the share of households in the PUMA served by other ISPs, while in Model 3 PUMA-level demographic controls are added.

Table 5. Parametric Estimation of Charter's Plan Impact (Binary Variable).

VARIABLES	(1) Base Model	(2) +ISPs	(3) +Demographic
Charter territory × post 2016	**0.00402**	**0.00462**	**−0.00708**
	(0.0120)	**(0.0120)**	**(0.0119)**
Constant	0.589***	0.491***	0.529**
	(0.00678)	(0.166)	(0.251)
Observations	1,855	1,855	1,855
R-squared	0.548	0.549	0.564
Number of PUMAs	265	265	265
ISP controls	No	Yes	Yes
Demographic controls	No	No	Yes

Note. Robust standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. Clustered standard errors at PUMA level.

As expected, the DiD estimator is not statistically different from zero, thus indicating that the introduction of "Internet Assist" in 2016 did not alter the trajectory of residential adoption among eligible households. This confirms the finding of the nonparametric analysis in Table 4. Similarly, the results in Table 6, which uses the continuous variable criteria, suggest that the affordable plan introduced by Charter in 2016 had no observable impact on residential connectivity for low-income households.

Table 6. Parametric Estimation of Charter's Plan Impact (Continuous Variable).

VARIABLES	(1) Base Model	(2) +ISPs	(3) +Demographic
Charter territory × post 2016	**0.0116**	**0.0148**	**-0.00290**
	(0.0131)	**(0.0132)**	**(0.0135)**
Constant	0.568***	0.576***	0.606**
	(0.0139)	(0.194)	(0.256)
Observations	1,855	1,855	1,855
R-squared	0.549	0.550	0.564
Number of PUMAs	265	265	265
ISP controls	No	Yes	Yes
Demographic controls	No	No	Yes

Note. Robust standard errors are in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. Clustered standard errors at PUMA level.

"Affordable Broadband" by Frontier

The last plan under study emerged from Frontier Communications' acquisition of Verizon's wireline assets in California, Florida, and Texas in 2015. The transaction received relatively light scrutiny from the FCC, which approved it without conditions in September 2015 (FCC, 2015b). However, after conducting its

own review, the CPUC approved the transaction subject to a number of public interest obligations. For the purposes of this study, the relevant conditions are contained in the Memorandum of Understanding (MoU) between Frontier Communications and the CETF.[4] In the MoU, Frontier commits to offer its Lifeline voice customers (existing or new) the option to purchase broadband service for no more than $13.99 a month. The minimum speed to be offered was set at 7Mbps downstream although should these speeds not be available in an area the company committed to offer "the highest available downstream and upstream speeds of service" (CETF, 2015, p. 4). In addition, in rural areas "where network buildout is too costly" (CETF, 2015, p. 4), the MoU allowed Frontier to offer a satellite broadband product instead.

The new plan was made available to households subscribing to Lifeline voice service from Frontier, and therefore the relevant eligibility rules were those of the state's Lifeline program. Households were eligible for Lifeline in California either on the basis of participation in a number of public assistance programs (such as Medicaid, SNAP, SSI, and NSLP, among others) or on an income basis (150% below the Federal Poverty Line [FPL]).[5] According to the MoU, Frontier was to offer the plan "until the FCC enacts a Broadband Lifeline Program and it becomes effective" (CETF, 2015, p. 3) and agreed to work with CETF and community-based organizations on outreach activities with the "aspirational goal" of connecting 200,000 low-income households within three years. The plan, called "Affordable Broadband" by Frontier, was launched in mid-2016.

Using the 90% coverage criteria to distinguish between treated and control PUMAs, the residential broadband adoption rate among eligible households is presented in Figure 3, with the darker line representing the adoption rate for households in Frontier territory (the treated group), and the lighter line showing the adoption rate for households outside Frontier territory (the control group). For 2014 and 2015, the areas served by Verizon were recoded as Frontier territory, so that the same areas are followed before and after Frontier's acquisition of Verizon's wireline customers.

[4] CETF is a statewide nonprofit organization dedicated to closing the digital divide. It was established pursuant to orders from the CPUC in approving the mergers of SBC–AT&T and Verizon–MCI in 2005.

[5] Note that the income threshold for Lifeline in California is different from the 135% of the FPL used at the federal level.

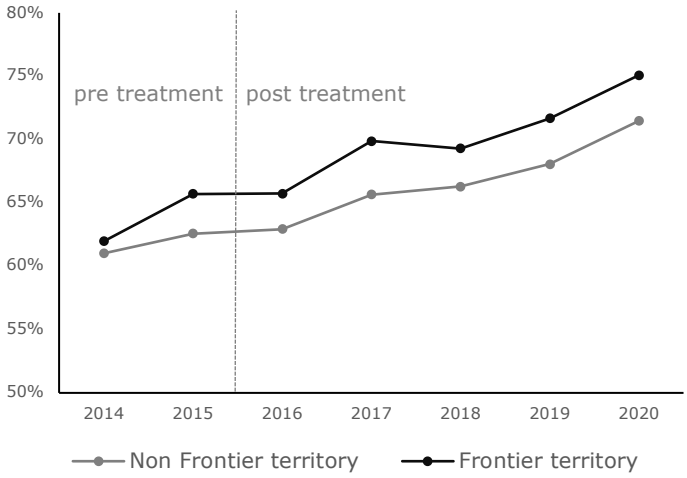

Figure 3. Residential (fixed) broadband adoption among households eligible for "Affordable Broadband" by Frontier. Source: Own calculations based on ACS and CPUC.

Table 7 presents the nonparametric estimation of the impact of Frontier's affordable plan. The calculation yields an implied positive impact of 1.3 percentage points over and above the expected adoption rate in Frontier territory had the plan not been launched. It should be noted, however, that because of the more limited Frontier service footprint, when using the 90% coverage criteria the number of treated households (those located within the Frontier service area) is relatively small (about 780,000 households). This is likely an underestimation of the true availability of the plan, which is better represented in the parametric results using the continuous variable criteria (see Table 9 below).

Table 7. Nonparametric Estimation of Frontier's Plan Impact.

	Non-Frontier Territory	Frontier Territory
(A) Average adoption pretreatment (2014–15)	61.8%	63.8%
(B) Average adoption posttreatment (2016–20)	66.9%	70.2%
Difference (B − A)	5.1 p.p.	6.4 p.p.

Source: Own calculations based on ACS and CPUC.

Turning to the parametric estimates, the results in Table 8 generally confirm that the affordable plan launched by Frontier in 2016 had a small but measurable impact of about 2 percentage points on residential connectivity among eligible households. The estimated magnitude of the impact is reasonably robust to the inclusion of the competition and demographic controls in models 2 and 3, respectively.

Table 8. Parametric Estimation of Frontier's Plan Impact (Binary Variable).

VARIABLES	(1) Base Model	(2) +ISPs	(3) +Demographics
Frontier territory × post 2016	**0.0216****	**0.0222****	**0.0178***
	(0.00944)	**(0.00959)**	**(0.00962)**
Constant	0.611***	0.480***	0.524***
	(0.00366)	(0.0848)	(0.141)
Observations	1,855	1,855	1,855
R-squared	0.806	0.807	0.811
Number of PUMAs	265	265	265
ISP controls	No	Yes	Yes
Demographic controls	No	No	Yes

Note. Robust standard errors are in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.
Clustered standard errors at PUMA level.

However, when using the continuous variable criteria, which as noted better represents the true coverage of Frontier's plan, there is no evidence of a meaningful impact. The results in Table 9 indicate that an increase in Frontier coverage is not associated with an increase in residential broadband adoption among eligible households. As noted above, the interpretation of the DiD coefficient in this case is less direct than with the binary variable criteria since the control PUMAs are not those untreated but rather those treated at a lower "dosage" (in our case, that have lower Frontier coverage). In summary, the table suggests that the positive impact identified in Table 8 may be a function of the relatively small number of PUMAs in California (only about 7%) where Frontier broadband coverage is equal to or exceeds 90%.

Table 9. Parametric Estimation of Frontier's Plan Impact (Continuous Variable).

VARIABLES	(1) Base Model	(2) +ISPs	(3) +Demographic
Frontier territory × post 2016	**0.0111**	**0.0139**	**0.00569**
	(0.0112)	**(0.0111)**	**(0.0114)**
Constant	0.608***	0.519***	0.562***
	(0.0113)	(0.0908)	(0.146)
Observations	1,855	1,855	1,855
R-squared	0.806	0.806	0.811
Number of PUMAs	265	265	265
ISP controls	No	Yes	Yes
Demographic controls	No	No	Yes

Note. Robust standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. Clustered standard errors at PUMA level.

Discussion and Conclusion

In recent merger proceedings involving telecommunications and media companies, U.S. regulators have often imposed merger-specific conditions aimed at protecting low-income households and more generally advancing digital equity. Among these conditions is an obligation to offer basic, low-cost access plans to qualifying households. This study raises questions about whether this remedy truly serves the public interest. Empirically, the findings indicate that the affordable plans introduced by AT&T, Charter, and Frontier as a result of merger proceedings did not result in an increase in residential connectivity among eligible California households, above and beyond the levels one would expect had the plans not been introduced. Of the three cases analyzed, only Frontier's plan is associated with a small increase in adoption rates, and this result depends on an assumption that likely underestimates the true availability of the plan. The use of an alternative measurement criterion (continuous variable) shows no evidence of impact among eligible households.

These results add to a growing list of concerns about affordable plan commitments exacted through regulatory proceedings. Advocacy organizations have pointed out that these plans are inadequately promoted due to a lack of effective engagement with local community organizations, and that they fail to meet the quality standards of market-rate alternatives, thus discouraging uptake.[6] Legal scholars have raised concerns about the arbitrary use of merger-specific conditions and the lack of public input into last-minute agreements struck behind closed doors (Koutsky & Spiwak, 2010). In addition, these commitments are plagued with well-known problems in the theory of regulation, including information asymmetry,

[6] See CETF Petition to Modify Decision No. 15–12–005 to Compel Frontier Communications to Comply with Memoranda of Understand, In the Matter of the Joint Application of Frontier Communications Corporation, Frontier Communications of America, Inc. (U5429C), Verizon California, Inc. (U1002C), Verizon Long Distance LLC (U5732C), and Newco West Holdings LLC for Approval of Transfer of Control Over Verizon California, Inc. and Related Approval of Transfer of Assets and Certifications (March 18, 2015).

incomplete contracting, and unenforceable rules (Laffont, 1994; Levy & Spiller, 1994). As Crawford (2013) notes, "voluntary commitments" shrouded in vague language about "aspirational goals" lack enforcement mechanisms and are easily reneged on.

Research suggests that promoting awareness, lowering eligibility barriers, and minimizing administrative procedures for enrollment and recertification are key to increased participation in public assistance programs (Currie, 2004). However, the affordable plans examined in this study present a fundamental misalignment of incentives since the same (private) operators offering affordable broadband also market comparable plans at standard rates. Under normal circumstances, the regulated entity will always seek to minimize uptake by restricting eligibility, limiting marketing and outreach activities, and creating administrative barriers to enrollment.

The monitoring and enforcement of these merger-specific commitments is therefore critical. Nonetheless, the evidence suggests that U.S. federal agencies lack the resources, and likely the political incentives, to undertake these tasks (Ali, 2020). In the AT&T and Charter cases, the FCC delegated monitoring and compliance to a third party (so-called Independent Compliance Officers, or ICOs). Lacking adequate resources, the oversight activities of these ICOs were almost entirely dependent on information provided by the regulated companies.[7] In contrast, several state regulators (including but not limited to the CPUC) took a more aggressive oversight approach, leading to protracted legal battles over whether the merger conditions were being met.[8] At the same time, as Witteman (2022) notes, the classification of broadband as an interstate service under the light-touch treatment of Title I of the U.S. Communications Act significantly limits the scope of enforcement action by state regulators.

In the Frontier case, monitoring and enforcement tasks were delegated to the CETF, a public interest organization with extensive expertise in broadband policy in the state of California. As a result, the merger commitments were subject to significant public scrutiny. This was made apparent in 2018 when the CETF filed a complaint alleging that Frontier had failed to honor its obligations under the CETF–Frontier MoU that laid out the affordable plan mandate. The complaint led to an amendment of the original MoU in which, among other things, Frontier committed to increase its outreach and marketing activities and to report progress to CETF on a semiannual basis. Notably, the new agreement included specific outreach commitments targeting seniors, people with disabilities, and minority youth groups. Though the mandate ultimately had little impact on adoption, the example suggests that public interest organizations have a key oversight role to play alongside state and federal regulators.

As Curran, Fenton, and Friedman (2012) argue, the Internet is hardly the first communications technology that serves both public goals and private interests. Yet the Internet is unique in having

[7] For example, see "Independent Compliance Officer's Compliance Report on AT&T/DirecTV merger conditions," MB Docket No. 14–90 (July 31, 2020). It is worth noting that the ICO report is heavily redacted, effectively preventing public oversight.

[8] A notable case is the threat made by New York's Public Service Commission in 2018 to revoke Charter's operating license after finding that the company had failed to meet its merger commitments. See "PSC Rescinds Charter Merger Approval," PSC Case number 15–M–0388.

emerged amidst a strong deregulatory ethos. From a regulator's perspective, compelling an ISP to offer an affordable broadband plan is an appealing remedy that seeks to balance public and private goals by shifting the cost of subsidizing access to the regulated entity. This is particularly the case after the reclassification of broadband as an information service under Title I of the U.S. Communications Act, which effectively foreclosed any attempts at rate regulation.[9] However, the findings of this study suggest that this remedy may be fraught with enforcement challenges, and ultimately does little to advance digital equity.

The recent creation of the Affordable Connectivity Program (ACP), a semipermanent federal program that supports broadband service for low-income households, represents a critical turning point in the U.S. government's strategy to address digital equity.[10] In particular, it suggests a turn from the opportunistic imposition of hard-to-enforce obligations on individual ISPs to system-wide solutions. Future studies will be needed to understand whether the ACP program is more effective than affordable plan commitments at narrowing the income gap in residential broadband adoption.

This study has a number of limitations that warrant further research to validate its findings. First, subscription to affordable plans cannot be observed at the household level. As a result, the findings must be interpreted within an intention-to-treat framework, as comparisons are made between adoption rates for eligible households in treated PUMAs to similar households in untreated PUMAs. Second, the estimations based on the binary variable criteria, which yield an easily interpretable distinction between treated and untreated PUMAs, rely on a conservative coverage threshold (90% of households served) that underestimates the true availability of the affordable plans. This is particularly problematic in the case of Frontier due to the characteristics of its service footprint. Third, the observed lack of impact may be related to the limited service quality offered by the specific plans examined in this study. Fourth, the use of a large geographical aggregation (PUMAs) as the unit of analysis presents challenges to the investigation of differences between urban and rural areas, as well as for the examination of specific impacts on tribal lands.[11] Finally, further studies are needed to better understand how to strengthen regulatory oversight mechanisms, and more generally public accountability, in merger and acquisition proceedings in the U.S. communications industry. Taken together, these limitations call for extending the analysis to other affordable broadband plans, other U.S. states with different types of support for low-cost broadband, other geographical aggregations, and potentially other countries with similar policy initiatives.

[9] In the "Matter of Restoring Internet Freedom, Declaratory Ruling, Report and Order, and Order," WC Docket No. 17–108 (January 4, 2018).

[10] The ACP was launched in early 2022 and subsidizes the cost of broadband to qualifying families (up to $30/month). While participation by ISPs remains voluntary, early evidence suggests that most ISPs are offering ACP-supported services.

[11] For a discussion of these limitations, see Schroeder and Pacas (2019).

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