



TECHNOLOGY
POLICY
INSTITUTE

RESEARCH PAPER

OCTOBER 2026

Already Being Built

What Rural Broadband Subsidies Paid For, 2018 to 2025

Scott Wallsten

President and Senior Fellow, Technology Policy Institute

swallsten@techpolicyinstitute.org

techpolicyinstitute.org
2001 L Street NW, Suite 500, Washington, DC 20036

Already Being Built

What Rural Broadband Subsidies Paid For, 2018 to 2025

Scott Wallsten*

Technology Policy Institute

October 2026

* President and Senior Fellow, Technology Policy Institute. I am solely responsible for any errors. swallsten@techpolicyinstitute.org

Contents

- Executive summary**3
- A note on methods and the use of AI**7
- Chapter 1. What subsidies buy, and how we know.....8
- Chapter 2. Data and methods16
- Chapter 3. The Rural Digital Opportunity Fund.....20
- Chapter 4. The 2018 CAF II auction33
- Chapter 5. Enhanced A-CAM41
- Chapter 6. The Capital Projects Fund.....47
- Chapter 7. State grant programs: Wisconsin and New York.....52
- Chapter 8. The programs side by side.....60
- Chapter 9. Does any of this still matter?.....66
- Appendix. Data sources and definitions**.....69
 - Appendix A. Symmetric 100/100 offers.....72
 - Appendix B. RDOF robustness tables72
 - Appendix C. CAF II access series detail76
 - Appendix D. Wisconsin and New York detail78
 - Appendix E. Cost tables, all rows.....79
 - Appendix F. Regression results85
 - Appendix G. Further work.....91
- References**93

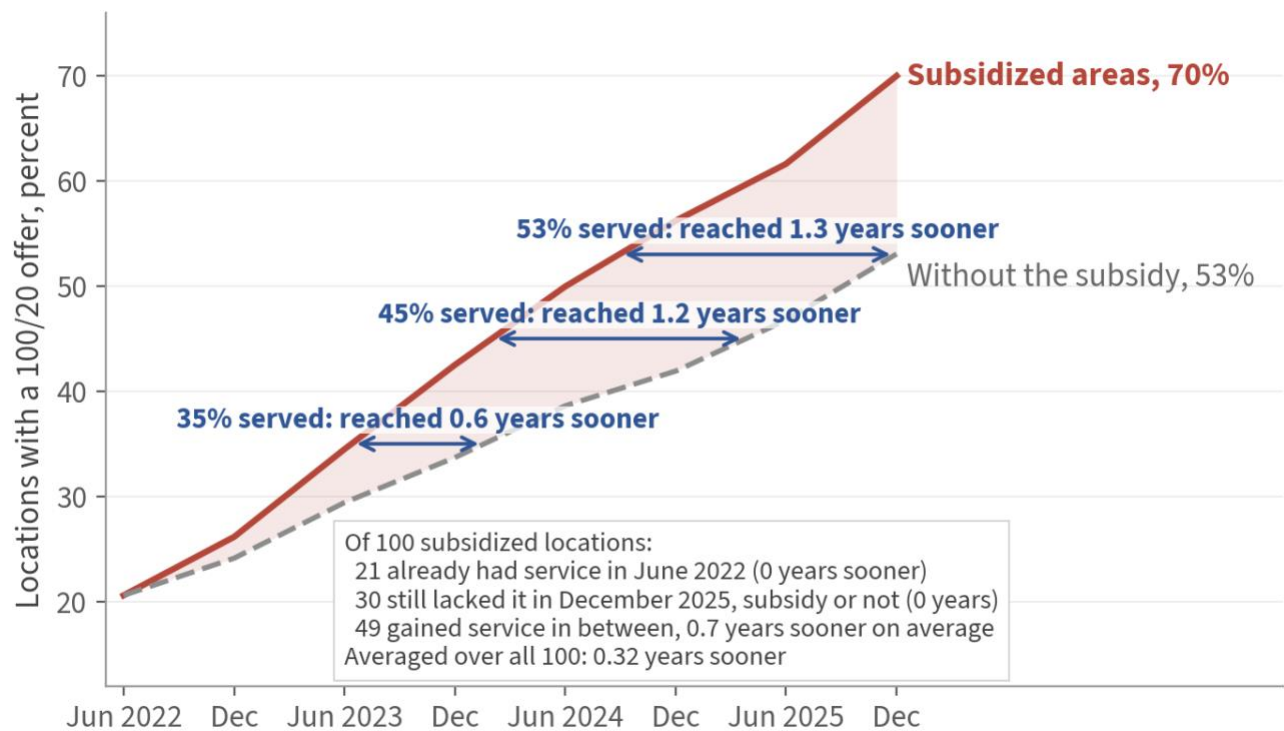
Executive summary

Governments spend billions of dollars to bring broadband to places that lack it. This report asks how much of the new service in the places six programs subsidized the subsidies caused, and how much would have arrived anyway. We compare the areas each program funded with similar areas it did not fund, track both over time, and call the difference the program’s effect. The main measure is access, whether a location can buy at least 100/20 Mbps from a wired or licensed wireless provider. A location is what the FCC’s data call a broadband serviceable location, a structure where service is or could be installed; a multiunit building counts once, and businesses count as well as homes. We also measure fiber where a program set out to build it, adoption, and measured speeds, and we restate each access effect as years of earlier service and a public cost per location-year. The answer, through 2025, is that the programs mostly paid for service that was coming anyway and bought time. Figure ES.1 shows what buying time means, and Table ES.1 gives each program’s headline result.

Table ES.1 summarizes the six programs. For each, it reports how much the share of locations that could buy at least 100/20 Mbps service from a wired or licensed wireless provider rose, over the program’s study period, in the areas it subsidized and in comparable areas it did not; the program effect, which is the share of locations, in percentage points, that had service by December 2025 because of the subsidy; what the public has paid so far for each subsidized location; and the effect restated as time.

Subsidized areas gained service faster than comparison areas, but the comparison areas kept gaining, so most of what a subsidy bought is earlier service rather than service that would never have arrived. Figure ES.1 shows this for RDOF. Reading across, subsidized areas reached each level of service sooner than they would have without the subsidy: 35 percent of locations served 0.6 years sooner, 53 percent served 1.3 years sooner. The arrows measure how much faster deployment occurred for the 49 of every 100 subsidized locations that gained service between June 2022 and December 2025. Not all of them gained it because of the subsidy. The program effect in the table, 17 points, is the share that did. For the other 51 the subsidy changed nothing in time, because 21 already had service in June 2022 and 30 still had none in December 2025 with or without the subsidy. Averaging over all 100 locations gives 0.32 years, the figure in the table. Dividing the public money by those location-years gives the cost of a year of earlier service at one location, the last column of the table and the one measure on which a ten-year support stream and a one-time grant can be compared.

FIGURE ES.1
A subsidy mostly moves service forward in time: RDOF areas and what they would have had without it



Share of locations in RDOF-subsidized areas with a qualifying 100/20 offer, June 2022 to December 2025, and the path the same areas would have followed without the subsidy, which is their own starting level plus the comparison areas' gain. Each arrow is the time between the two paths reaching the same level. The shaded band, the sum of those arrows over every level, spread over all subsidized locations, is 0.32 years per location. Chapter 2 and Figure 2.1 define the measures; Chapter 3 gives the estimates.

TABLE ES.1

What each program bought, December 2025

Program	Compared with	100/20 access increase (percentage points)			Public cost per subsidized location, paid so far	Years sooner service arrived, averaged over all subsidized locations (Figure ES.1)	Public cost per location-year of earlier service
		in subsidized areas	in comparison areas	caused by the program ⁱ			
Federal programs, from the most credible comparison group to the least							
RDOF, 2020 auction (\$9.2 billion)	Winners the FCC rejected or that withdrew	49	30	17	\$610 ^e	0.32	\$1,900
CAF II, 2018 auction (\$1.5 billion)	Areas with bids but no award	35	24	10	\$1,160 ^e	0.56	\$2,080 ^a
Enhanced A-CAM, 2023 offer (\$1 billion a year for fifteen years)	Carriers that declined the offer	8	7	none ^d	\$625 ^e	—	—
Capital Projects Fund, 2022 on (\$8.4 billion)	Equally unserved blocks, same counties	55	51	3.5	\$2,690 ^f \$4,200 ^g \$6,900 ^h	0.38 ^{b, f} 0.59 ^g	\$7,100 ^{b, g} \$11,600 ^{b, h}
State programs							
Wisconsin grants, 2022 to 2023 (\$236 million)	Applications ranked below the cutoff	81	39	43	\$2,780	0.97	\$2,850
New York, 2016 to 2018 (\$473 million)	Blocks the state awarded to satellite	— ^c	— ^c	4	\$2,670	0.15 ^c	\$18,000 ^c

Increases run from the first date the location data allow for each program (mid-2022 for RDOF and CAF II, June 2022 for CPF and Wisconsin, June 2023 for Enhanced A-CAM) to December 2025, among locations in the areas studied; the Wisconsin figures are for areas with no 100/20 service in 2022. Cost per subsidized location is support paid through December 2025 divided by the locations the program funded. The chapters give fiber effects, confidence intervals, and the dollar basis of each cost. **a** Block measure from 2018, a lower bound on cost. **b** Projected to 2029 on the assumption that every funded location is built by the December 2026 deadline; the fade assumption matters more than sampling error. **c** New York's access series is a block measure that begins in 2018, when the satellite areas were ahead, so the increases are not comparable with the other rows; the years and cost are net of the years awarded areas trailed. On fiber, where the program aimed, awarded areas led by 42 points in 2021 and 32 in 2025, and the state bought five years of earlier fiber at about \$1,100 per location-year. **d** Not distinguishable from zero. **e** Support continues: RDOF and CAF II pay for ten years (\$1,740 per location for RDOF over the full commitment) and Enhanced A-CAM for fifteen. **f** Per location in the blocks CPF funded (1,137,000 locations), the base on which the effect is estimated. **g** Per CPF-funded location (728,000 in the sample) on Treasury's commitment of \$4,200 per location, the basis the report's tables use. **h** Per CPF-funded location on the FCC Broadband Funding Map, which records 1.22 million CPF locations, about 60 percent of Treasury's estimate, at \$6,900 each; the cost per location-year on this basis is about 60 percent higher. All three omit the provider match most states required. **i** Estimated within matched groups of areas and weighted by the subsidized locations in each, so it does not equal the difference between the two increase columns; rounding adds to the gap.

RDOF, the FCC's 2020 auction. The comparison group is the 1.7 million locations in areas with winning bids but ultimately no subsidy after the FCC rejected LTD Broadband and Starlink and let about 80 smaller winners walk away. It is the best comparison group in the report because those areas lost funding for reasons that had to do with the companies, not the places, although the places still matter in that those companies chose to bid there. From mid-2022 to the end of 2025, access rose 49 points in subsidized areas and 30 in the comparison areas. The program caused about a third of the gain in subsidized areas. In terms of adoption, subscriptions to any broadband did not detectably change although subscribers moved to faster tiers.

CAF II, the FCC's 2018 auction. The comparison group is areas that drew bids but no award. From 2022 to 2025, access rose 35 points in winners' areas and 24 in the comparison areas, so the program's effect is about 10 points, 29 percent of the gain, at a cost of about \$2,080 per location-year of earlier access. That measurement starts late. The location-level data begin in 2022, four years after the auction and after most of the building, so they miss whatever CAF II added before then. The only earlier record is where fiber existed, block by block, from 2015. Bidders in CAF II committed to a service level, and the winners that committed to gigabit service, mostly fiber companies, are therefore the one group whose building the data can follow from the start. They put fiber in 39 points more of their areas within five years, 34 points of which remained in 2025, at \$860 per location-year of earlier fiber. Two things cut the other way. Those winners were already extending fiber into these areas before the auction, so part of that lead is theirs, and the comparison areas, which no program has funded since, were falling behind before 2022. Both push the effects up and the costs down, so CAF II's figures are less reliable than RDOF's.

Enhanced A-CAM, the FCC's 2023 offer to rural telephone companies. The comparison group is the carriers that declined fifteen years of support for their whole territories, served and unserved alike, in exchange for a 100/20 commitment. The decliners kept the support they already received, so the comparison is between two support arrangements, not between support and none. Both groups started above 84 percent access and moved together. A-CAM recipients also did not upgrade their networks faster than decliners. A-CAM buys a commitment and a stable budget, but whether it buys more will take years to see.

The Capital Projects Fund, Treasury's grants to states. The comparison group is unfunded areas in the same counties that were equally unserved in 2022. We constructed this comparison group because states did not publish the applications they rejected. Funded areas fell behind for two years and pulled ahead in 2025 with 4 percent of locations reported complete, so the effect so far is small on access and about a quarter of the fiber gained. CPF committed its money faster than any federal program here but left no way to be rigorously evaluated.

Wisconsin's grant program. The comparison group is places that applied for grants and were turned down, which Wisconsin publishes. Among areas with no 100/20 service in 2022, access rose 81 points in funded areas and 39 in unfunded areas, so the program's effect is about 43 points, half the gain, at a cost of about \$2,850 per location-year of earlier access. The unfunded applications were ranked lower partly for reasons that may also predict deployment, which is the design's weakness. Wisconsin is the strongest state result in the report and the one program whose effect comes close to RDOF's cost per location-year.

New York's 2016 to 2018 auction. The comparison group is areas the state assigned to satellite after no wired bidder wanted them. Awarded areas led on fiber by 42 points in 2021 and 32 in 2025, and New York bought five years of earlier fiber at about \$1,100 per location-year. On 100/20 access from any technology the satellite areas have caught up, in part with later federal money.

Generalizations. Access in comparison areas kept increasing, so stating raw gains would overstate every program's effect. Because the trends already showed steady increases, the programs mostly buy earlier

access. Counting the national mobile carriers' fixed wireless, which the access measure leaves out, lowers every effect and raises every cost, because the carriers expanded more in the comparison areas (Table 8.2). By the end of 2025, with RDOF less than half built, some of the subsidy substituted for private deployment. Three-fifths of what RDOF's winners and CAF II's terrestrial winners built, and a third of what Wisconsin's grantees built, duplicated coverage that private providers delivered or would have delivered without the money, and where subsidized fiber winners were building, other providers built less. No program drew additional private deployment in where it funded fiber. None of this is a failure by the recipients, who did what they promised to do. RDOF's gain sits at the locations winners report as deployed and is absent where they have not yet built, CAF II's winners delivered the technology they bid, and Wisconsin's grantees built. The low return comes from program design, which fixed eligibility on a snapshot and paid for places private providers were about to serve. Whether a year of earlier service is worth the sums in Table ES.1 is a separate question.

A note on methods and the use of AI

I used Anthropic's Claude, working as an agent, to carry out the empirical work in this report under my direction. It wrote and ran the code that assembles the FCC, Census, Ookla, and program data, estimates the regressions, and produces the tables and figures. It drafted text that I then revised. I specified the questions, the designs, and the comparison groups, reviewed the results and the design choices at each step, and inspected some, but not all, of the code. As a check, OpenAI's Codex replicated the entire analysis independently from the same data. Of 563 coefficient and standard error entries in the tables, 561 matched to printed precision. The two that did not were rounding errors in Table 1.2, which are corrected in this version. The replication also found the description and labeling problems that this version corrects and the limitations the appendix notes now disclose. Independent agents from Claude and Codex acting as referees reviewed the draft before I revised it. This draft is roughly the thirtieth revision of the report, each made after my own edits to or comments on the one before, and the third to follow an independent review. The code and data behind every table are in the project repository. Any errors of analysis or interpretation are mine.

Chapter 1. What subsidies buy, and how we know

Since 2018 the federal government has committed tens of billions of dollars to broadband subsidies through four programs alongside the Universal Service Fund's other ongoing support, and states have added their own. Each program reports how many locations it funded. None reports how many of those locations would have gotten service without it, which is the number that says what the money bought. This report estimates that number for four federal programs and two state programs, by comparing the areas each program funded with similar areas it did not fund and tracking both over time.

The question is hard because private providers never stopped building. They invest \$80 to \$100 billion a year, and in the areas these programs subsidized, service kept arriving in the comparison areas too, so the raw gain in a funded area overstates what the subsidy added. The report answers with three metrics: coverage at the locations the programs funded, what other providers built around them, and the years by which service arrived earlier than it otherwise would have.

What earlier work finds

Researchers have evaluated few US broadband subsidies against a comparison group, and the evaluations that exist find modest effects. Dinterman and Renkow (2017) found that ZIP codes with USDA Rural Utilities Service broadband loans gained about 0.09 more providers a year than ZIP codes without them, and Kandilov and Renkow (2020) found that the largest USDA program raised local payroll, with confidence intervals wide enough to include benefits below cost. Hauge and Prieger (2015) found that an apparent effect of BTOP spending on county adoption largely disappeared once they controlled for time trends, Pender, Goldstein, and Mahoney-Nair (2022) estimated that BIP raised tract adoption by 1 to 3 percentage points, and Rosston and Wallsten (2013) documented hundred-fold differences across BTOP grants in cost per projected connection. Whitacre and Gallardo (2020) found that county broadband availability from 2012 to 2018 was higher in states with funding programs, particularly for fiber. The program chapters review what has been written about each of the six programs here; in short, the federal literature counts money, defaults, and compliance, the state literature is audits, and we found no independent estimate of what any of the six added to deployment.

Economists have long asked how much subsidized activity would have happened anyway. Wallsten (2000) found that SBIR grants crowded out firm-financed R&D roughly dollar for dollar. The broadband evidence comes mostly from Europe and points both ways. Bourreau, Grzybowski, and Muñoz-Acevedo (2026) estimated that 36 percent of French municipalities receiving fiber subsidies would have gotten private fiber within three years, and that the subsidies still sped up coverage. Duso, Nardotto, and Seldeslachts (2025) found that German state aid raised coverage, drew in more providers, and lowered prices, and Briglauer and Grajek (2024) found that state aid raised fiber deployment across OECD countries. In the United States, Kang and Xiao (2024) found that large providers invest more in electorally competitive counties, which they interpret as investment to head off state policies that favor entrants. Rosston and Wallsten (2020) applied the same logic to a demand subsidy and estimated that about two thirds of Comcast Internet Essentials subscribers would not otherwise have subscribed.

Availability explains part of the rural adoption gap. Whitacre, Strover, and Gallardo (2015) attributed about 38 percent of the metro and non-metro adoption gap to infrastructure and about half to income, education, and other household differences. Chapter 2 reviews what is known about the availability data themselves.

On the auctions that three of the programs used, Wallsten (2009) reviewed universal service auctions in six countries and concluded that they can reveal the cost of coverage and lower subsidies, and Oh (2021) estimated that a reverse auction could have connected nearly twice as many buildings as BTOP's grant

review for the same money. Rosston and Wallsten (2025) argued that BEAD's 2025 rules, by denying states the money they save, remove the reason to seek low bids. This literature judges auctions by price per committed location. We found no study that measures how many additional locations an auction bought.

This report adds four things. It estimates additionality for six programs with one outcome and one estimator, using comparison groups from each program's own records wherever the records allow; the US studies above each cover one program, mostly at the ZIP code or county level. It measures access, adoption, and speed for every program. It restates effects as years of earlier service and cost per location-year, the timing question Bourreau, Grzybowski, and Muñoz-Acevedo (2026) asked of French fiber. And it tests whether RDOF, CAF II, and Wisconsin's grants displaced other providers' deployment, the first US counterpart we know of to the European crowd-out studies.

What we find

The four federal programs we explore are the 2020 Rural Digital Opportunity Fund (RDOF, \$9.2 billion), the 2018 Connect America Fund Phase II auction (CAF II, \$1.5 billion assigned), the 2023 Enhanced Alternative Connect America Cost Model offer (Enhanced A-CAM, about \$1 billion a year for fifteen years), and the 2022 Capital Projects Fund (CPF, \$8.4 billion for broadband). The two state programs are Wisconsin's Broadband Expansion Grant program (the \$236 million awarded in 2022 and 2023) and New York's 2016 to 2018 New NY Broadband Program (\$473 million in state grants).

Through 2025, the most recent data available, and with RDOF less than half built, the programs partly crowded out private investment and partly added coverage. Three-fifths of what RDOF's winners and CAF II's terrestrial winners built, and a third of what Wisconsin's grantees built, duplicated coverage that private providers delivered or would have delivered without the money. Enhanced A-CAM by design paid for territories that were already served, and CPF, with only a small fraction of its funded locations reported complete, has so far added little its comparison areas did not get on their own, so its final share depends on what the rest of the build adds. Where the subsidy funded fiber, other providers built 9 to 16 points less. No program raised entry, and the places other providers built more are CAF II's baseline tier, which bought 25/3 service, and, on fiber, Enhanced A-CAM's footprints. What the programs bought was less time to wait for access. Chapter 8 derives these figures, prices the years, and says what the data cannot see: dollars of private capital, and what the subsidized firms would have spent on their own.

Access as an outcome. People care about whether they can buy adequate service regardless of the technology that delivers it. The main outcome in this paper is the share of a block's locations with a terrestrial offer of at least 100/20 Mbps and low latency from any provider including fiber, cable, copper, and licensed fixed wireless alike.

We exclude satellite, not because it is inadequate but because it is available everywhere and so cannot register a local effect. We also exclude the home internet products of the national mobile carriers (T-Mobile, Verizon, AT&T, and UScellular) because of what the FCC data record. A carrier's fixed wireless offer in the BDC is a claim that its mobile network had capacity to spare at that location when the filing was made. The carriers sell the product with waitlists and withdraw it as mobile load rises, so a location shown as served in one release can be unserved in the next without anyone having built or removed anything, and the claim moves with the carriers' mobile plans rather than with anything a subsidy program did. That makes it a real service and a poor outcome measure. Because none of the national carriers won fixed wireless support in these programs, fixed wireless from other providers counts. The exclusion is conservative for everything the report concludes. Counting the carriers' fixed wireless lowers every program's effect and raises every cost, because the carriers expanded more in the comparison areas than in the subsidized ones: RDOF's effect falls from 17 to 15 points, CAF II's from 10 to 8, and Wisconsin's from 43

to 37 (Table 8.2). Both exclusions are measurement choices, and both technologies improved over the study period, satellite in capacity and carrier fixed wireless in coverage. Counting satellite would raise access in both groups and move every effect toward zero, a row we have not run (Appendix G), which is the sense in which the report measures years of earlier terrestrial service; Chapter 9 takes up what low earth orbit satellite means for whether high-cost areas, in this report's sense, still exist. We also report fiber effects because several programs targeted it. Ookla speed tests serve as a check on whether reported availability is real.

The additional share. For each program we report the effect in coverage percentage points and, where the design supports it, the additional share, which is the effect divided by the gain in subsidized areas over the same period. A share of one third means the subsidy caused a third of what happened in the areas it funded and the other two thirds would have happened anyway. It is the number a policymaker needs but programs generally do not report. Because the effect and the treated gain weight areas differently under fixed effects, Chapter 8 reweights before multiplying an effect by a population. The share is also incomplete. A subsidy can add a provider where none would have come, deter a second provider, or displace one about to build, and the share counts only the first. Chapters 3, 4, and 7 test for displacement, and Chapters 3 and 5 for entry.

Years bought. A subsidy that ends with 15 points more coverage than its comparison group has usually not created service that would never have existed because existing trends suggest most comparison groups will catch up. Instead, the subsidy bought time, so we restate every effect as years of earlier service and, with additional locations and support accrued, as a cost per location-year, the one measure on which a ten-year support stream and a one-time grant are comparable. Years bought are the area between the subsidized path and its counterfactual, per funded location; the coverage lead, a different quantity, is how many years earlier subsidized areas reached the coverage their counterfactual has now. Chapter 2 defines them. Tables 8.1 and E.4 report them with the costs.

Table 1.1 gives the headline method and results. The chapters provide detail on each.

TABLE 1.1

Six programs, one pattern: comparison areas gained too, and the programs caused a third or less of the gain except in Wisconsin

Program Design quality	Comparison group	Effect on the targeted outcome points of locations, Dec 2025	Gain in comparison areas same outcome and period, points	Additional share 95% interval	Years bought per funded location (Table 8.1)
RDOF ●●● Strong	Winners the FCC rejected or that withdrew	17 of 100/20 access	30	34% (30 to 39)	0.32 access · 0.37 fiber
CAF II ●●○ Weak to moderate	Areas with bids but no award	34 of fiber, gigabit winners (39 at the 2023 peak)	44 fiber, gigabit comparison	29% of access gain, all winners (15 to 41) ^a	2.0 fiber, gigabit
Enhanced A-CAM ●○○ Weak	Carriers that declined the offer	None on access in two years	6	not estimable ^b	none
Capital Projects Fund ●●○ Weak to moderate	Equally unserved blocks, same counties	11 of fiber, 3.5 of access, mid- build	31 fiber · 51 access	24% fiber · 6% access (19 to 28 · 2 to 10) ^c	0.4 access · 1.2 fiber, projected ^e
Wisconsin ●●○ Moderate	Applications the Commission did not fund	43 of 100/20 access, blocks unserved in 2022	39	53% (36 to 67)	0.97 access · 1.0 fiber
New York ●○○ Weak	Blocks the state awarded to satellite	42 of fiber by 2021, 32 by 2025	58 fiber	35% fiber (27 to 44) ^d	2.4 fiber

Gain in comparison areas is the change in the same outcome over the same period in the comparison group, so the effect divided by the funded areas' gain (the effect plus, roughly, this column) is the additional share. Years bought are the area between the funded areas' coverage path and their counterfactual, per funded location (Chapter 2). CPF years are per location in the funded blocks (1,137,000); per CPF-funded location (728,000) they are 0.59 access and 1.83 fiber. Intervals from a county-cluster bootstrap, 1,000 draws. a. The gigabit fiber share is not defensible because winners' fiber lead was growing before the auction. b. Little was left to add; both groups started at or above 84 percent. c. Rising as construction finishes; 4 percent of funded locations reported complete. d. The 25/3 access effect is not distinguishable from zero by 2025; the 100/20 effect is 4.3 (2.0), Table 7.3. Design quality: Strong = assignment about the firm, not the place; Moderate = comparison group wanted the areas; Weak = comparison group chose itself or was a residual. e. Negative to date, because funded blocks trailed comparison blocks for two years; projected to December 2029 on completion by the deadline.

The coverage data do not point at the recipients. RDOF's gain sits at the locations winners report as deployed and is absent where they have not yet built (consistent with the causal reading, though not proof of it), CAF II's winners delivered the technology they bid, and Wisconsin's grantees built; whether every recipient met its deadlines and delivered the service it reported is a compliance question these data do not settle. The low return is the programs' design, which fixed eligibility on a snapshot of where service was absent and paid for places private providers were about to serve.

Adoption. The programs targeted access, which makes it the fair metric of whether the programs worked. Ultimately, however, we care about whether people use that new access. To that end, we also measure the effects of the new coverage on the share of households with a broadband subscription, by type and by speed tier, and on measured download speeds.

Where it can be measured, adoption data suggest the subsidies bought upgrades rather than new subscribers. Table 1.2 collects each program's adoption and speed results; RDOF is the only program with a clean test, and the others are early, weak, or mis-timed.

TABLE 1.2

Adoption and measured speed by program

	Form 477	ACS household shares, points (SE)			Ookla	
Program	25 Mbps+ subs. per 100 households (SE)	Wired	Any broadband	No internet	Download speed % faster (SE of log)	What it shows
RDOF	+6.5 (2.0)	+3.2 (1.0)	+0.2 (0.6)	+0.3 (0.6)	+65% (0.06)	Upgrades, not new subscribers; satellite share fell 2.8 points
CAF II	— ^a	+6 (7)	+6 ^a	−5 ^a	+14% (0.12)	Nothing distinguishable from zero; gigabit areas suggestive
Enhanced A-CAM	+1.4 (1.2)	+1.4 (0.5)	+0.8 (0.5)	−0.8 (0.4)	+5% (0.03)	Within the pre-offer movement; ACS window ends before the money
Capital Projects Fund	within ±4	— ^b	— ^b	−1.5 (0.7)	+48% (0.05)	Not testable yet; most of the speed gain precedes any CPF service
Wisconsin	+15 (13)	−2 (3)	−2 (3)	+2 (3)	+18% (0.15)	Early and coarse; standard errors as large as the effects
New York	— ^c	−7 (4)	—	—	+47% (0.11)	Data do not cover the build years

Subscriptions from the FCC's Form 477 tract series through December 2024, relative to each chapter's reference period; ACS from the 2015 to 2019 and 2020 to 2024 five-year estimates at the block group; speed from Ookla tests through October 2025, as percent faster than comparison areas with the standard error of the log effect. a. Tract series has no power for CAF II (420 tracts); the ACS columns are all assigned areas, none two standard errors from zero. b. ACS effects within two standard errors of zero except the no-internet share in the 25 percent sample. c. Awards precede the series. Chapters 3 to 7 give the sources and windows.

Five generalizations follow from the results, with the caution that they rest on one strong design and five weaker ones.

First, setting eligibility at one point in time is a problem. Every program fixed eligibility with a snapshot of where service was absent, and in every case private deployment kept moving after the snapshot. RDOF declared areas unserved on 2019 Form 477 data. Between June 2022 and December 2025, the areas it then left unfunded gained 30 points of 100/20 access on their own, and funded areas gained 49. The raw difference is 20 points, but the effect within state-by-cost cells is smaller (Table 1.1). An eligibility rule based on current service cannot distinguish the area no one will ever serve from the area someone is about to serve, and the programs paid for both. BEAD uses the same rule with map snapshots from 2023 and 2024 that states could challenge, and its money arrives in 2026 and later.

Second, in RDOF, cost did not sort the areas that needed a subsidy from the areas that did not, at least not on access. Additionality should rise with cost if unsubsidized deployment is least likely where service is most expensive, but the results do not show that, as Table 3.4 demonstrates. Across terciles of the FCC's reserve price per location, cancelled-award areas gained 26 to 31 points of 100/20 access whether they were cheap or expensive to serve, and the additional share is 33 to 35 percent in every tercile on the regression estimates and 34 to 41 percent on the treated-weighted ones, neither rising with cost. The fiber additional share does not detectably differ across cost terciles. Concentrating money in high-cost areas does buy fewer additional locations per dollar, about \$6,700 each in support accrued so far in the top tercile against \$1,650 in the bottom (Table E.1). The range tested is the auction's own, and it says nothing about the costliest locations BEAD now faces. The same holds for dollars: interacting treatment with the support each location received shows no gradient in RDOF, CAF II, or Wisconsin (Appendix Table E.5); larger grants did not go with larger effects, so the programs bought about the same share of what appeared wherever they spent and paid several times as much for it in the expensive places.

Third, programs get the technology the winner bid, so the auction settles the technology. Where CAF II and RDOF bidders committed to fiber, fiber appeared. Where they committed to fixed wireless, fixed wireless offers appeared. On access, the firm mattered more than the technology. RDOF's wireless and hybrid winners, 437,000 locations, show an access effect of 4 points, which is not statistically different from zero. That average combines Resound Networks, which holds about half of those locations and reported 5 percent of them deployed, and shows no effect, with the other wireless winners, which show a 9-point effect, about a quarter of their gain. Wireless recipients in other programs delivered. CAF II's above-baseline winners raised access 17 points and Wisconsin's funded fixed wireless projects 31. The RDOF wireless result is one firm's slow build and says nothing about the technology. Resound reaches its first build milestone, 40 percent of locations, three years after authorization, so what it has reported complete is not yet a default; it does mean the wireless average describes a build that has barely started.

Fourth, Enhanced A-CAM is a support program, and deployment is the wrong test for it. The FCC offered support for served and unserved locations alike, because the high-cost fund pays for operating networks in expensive places. Accepting and declining carriers moved together because there was little left for either to build. The questions that matter for a program that pays incumbents for their own territory are whether the payment deters entry and whether it speeds upgrades. Two years in, Chapter 5's tests with the block panel's second-provider count and with provider-level records find no evidence of entry deterrence but also no evidence that subsidies encouraged faster network improvement.

Fifth, where adoption can be measured, the subsidy bought upgrades, not new subscribers. RDOF is the one program with a clean adoption test. In its areas wired subscriptions rose 3 points more and satellite subscriptions 3 points less than in cancelled-award areas, subscriptions at 25 Mbps or better also rose more, and the shares of households with any broadband and with no internet did not move differently (Table 3.8 and Figure 3.3). The subsidy moved households from satellite and slow tiers to wired and faster service; it did not detectably connect households that had nothing. The other programs' adoption tests are too early or too weak to say.

Chapter 2. Data and methods

Every chapter uses the deployment data, outcome definitions, weights, and estimator described here. Each program chapter describes only the data that define its treatment and comparison groups.

Two FCC deployment datasets that do not match

Both datasets have been studied. Form 477 counted a census block as served if a provider could serve one location in it, which overstated access (Grubestic 2012; GAO 2018), and GAO (2026a) found that the FCC had not evaluated the quality assurance of the location-level map that replaced it in 2022. On the speed tests that check availability claims, Ford (2021) found that Ookla tests roughly matched Form 477's national 25/3 coverage, Paul et al. (2021) found that higher-income areas run more tests, and Feamster and Livingood (2020) report that home Wi-Fi and older devices often limit measured speed.

Until 2021 the FCC collected deployment data on Form 477, on which each provider listed the census blocks it served and the maximum speed it advertised. The FCC's Broadband Data Collection (BDC) replaced it with the filing for June 30, 2022. The BDC rests on a national address list, the Broadband Serviceable Location Fabric, and reports each location a provider can serve, with technology, speed, and latency, so June 2022 is the first period with location-level availability. We use twelve Form 477 filings, from December 2015 through June 2021, and eight BDC releases, from June 2022 through December 2025. Every series that spans the change of instrument between June 2021 and June 2022 has a seam there.

Geography

The unit of observation in the federal chapters is the 2010 census block, because RDOF and CAF II assigned support by 2010 block and Form 477 reports by it. Wisconsin uses 2020 blocks, because its program data are polygons. A Fabric location is a serviceable structure; a multiunit building is one location. BDC locations carry 2020 block codes, which we map to 2010 blocks with the Census Bureau's relationship files by largest shared area. We weight every block regression by the block's residential locations in the December 2025 BDC.

The same December 2025 count is the denominator of every location-share outcome in the RDOF, CAF II, and Wisconsin panels, and a location absent from an earlier release counts as having no offer. The CPF and Enhanced A-CAM panels divide each release's count of locations with the offer by that release's location count, CPF treating a block absent from a release as unserved and A-CAM leaving it missing; on fixed December 2025 denominators their December 2025 access effects are 3.5 and 0.9 points, the same to the printed digit. The Wisconsin main sample selects blocks with no 100/20 offer in June 2022; its 25/3 and unlicensed alternatives use release counts and are count proxies. For CAF II, Enhanced A-CAM, and New York the fixed denominator applies to release-level counts without joined location identifiers, so a block's historical ratio can exceed one where the Fabric later dropped locations; we bound those shares at one in the cost calculations only.

Technology groups

We sort every BDC record into five groups. Wireline covers fiber, cable, and copper. Licensed fixed wireless covers licensed and licensed-by-rule spectrum from providers other than the national mobile carriers. Unlicensed fixed wireless covers the rest of non-carrier fixed wireless. Carrier fixed wireless covers the home internet products of T-Mobile, Verizon, AT&T, and UScellular. We exclude it from the main access measure because a carrier's offer is a capacity claim that moves with mobile load rather than with local deployment (Chapter 1), and report every program's effect with it counted in Table 8.2. Low earth orbit

satellite, Starlink and its competitors, is the fifth group, which we exclude because it is available everywhere and responds to nothing local. Geostationary satellite never counts as broadband access here. Excluding unlicensed fixed wireless does not depress the measured effect for programs whose winners built fixed wireless, as RDOF's wireless winners committed to licensed, low-latency service, which the measure counts, and adding unlicensed offers lowers RDOF's access effect rather than raising it because the comparison areas gained more of them (Table 3.1). Table 3.6 counts the wireless winners' own offers on every definition.

Outcomes

The main outcome is access, the share of a block's residential locations with an offer of at least 100/20 Mbps and low latency from wireline or licensed fixed wireless. An offer is the BDC's unit of availability, a provider's report that it can serve the location at that speed, whether or not anyone subscribes. "Points" always means percentage points of locations. Three alternatives, for the BDC releases only, add unlicensed fixed wireless at 100/20, lower the floor to 25/3 with unlicensed fixed wireless included, or count only wireline at 100/20.

The second outcome is fiber, in two forms. At the location level, for the BDC period, it is the share of a block's locations with a residential fiber offer; at the block level, for all twenty periods, an indicator equal to one if any residential location in the block has one. For Form 477 filings we count a block as having fiber only if a provider reported consumer fiber there, the same provider still reported it in June 2021, and the block shows fiber in the June 2022 BDC. The rule removes transient misfilings (one Pennsylvania provider reported fiber in 57,000 blocks for six filings, then none) and real fiber from providers that exited or merged before 2022, so the pre-2022 series understates fiber somewhat. The block indicator overstates coverage relative to the location share throughout, by construction.

Adoption and delivered speed. The third outcome is adoption, which is not part of availability data. Two data sources cover adoption. One is the American Community Survey's five-year estimates of household subscriptions by type (wired, satellite, cellular only, any broadband, none), 2015 to 2019 against 2020 to 2024, at the block group. The second is the FCC's Form 477 residential fixed connections per household by census tract, semiannual through December 2024, at any speed and at 25 Mbps or better.

Ookla speed tests, aggregated to the BDC's hexagons, check whether reported availability is real. Each chapter's Adoption and speeds section uses these three series with the chapter's own comparison group. The ACS windows straddle every program's build years, so the chapters read adoption as a check on direction and on whether new service was taken up, not as a measure of the program's effect, and adoption carries no additional share.

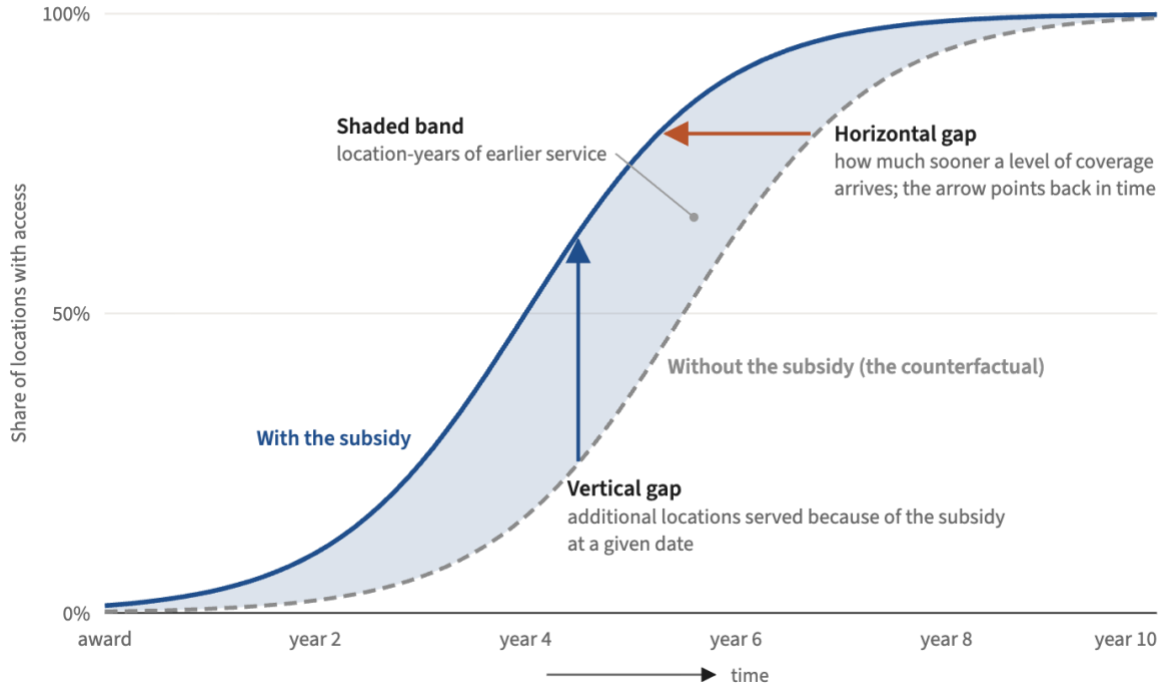
Years bought and cost per location-year

A program's effect at one date says how far ahead its areas are, not for how long. Because comparison areas keep gaining service, most of what a subsidy adds is time, and the report prices time in three steps that every program chapter repeats and Chapter 8 puts side by side. Figure 2.1 describes cost per location-year.

Assuming access continues to increase over time, a subsidy moves service forward in time. Read vertically at one date, the gap between the two paths is extra locations served. Read horizontally at one coverage level, the gap is how much sooner that level arrived. The shaded band between the paths adds up every vertical gap, and equally every horizontal lead, into location-years of earlier service. Dividing the subsidy by those location-years gives the cost per location-year.

FIGURE 2.1

A subsidy that moves service forward in time: the vertical gap, the horizontal gap, and the shaded band



Federal funding

The FCC’s Broadband Funding Map records every location any federal program has funded, with program, winner, committed technology, and, where reported, completion date. We remove locations funded by a federal program other than the one under study, with the scope by chapter in the Appendix; blocks whose only other program is BEAD stay in every sample, because BEAD marks locations still unserved in 2025 and screening on it would select on the outcome. The committed technology splits RDOF winners into fiber and wireless or hybrid and CAF II winners by tier, and the completion dates give the shares the program chapters report. The map records only what participating programs report, and no federal source records state grant programs, whose locations remain in the data (Chapter 7).

The estimator

Every chapter compares treated with comparison blocks before and after the award. For the access outcome, which exists only from June 2022, we estimate one regression per BDC release.

$$s_{bt} - s_{b, \text{Jun 2022}} = \beta_t A_b + \gamma_{s(b), k(b)} + u_{bt} \quad (1)$$

Here s is the share of block b ’s locations with a qualifying offer in release t , A is one for treated blocks and zero for comparison blocks, and γ is a fixed effect for each state and cost tercile. The cost measure is the FCC’s reserve price per location for the auction programs and the prior support mechanism for Enhanced A-CAM. The differenced regression is identical to a panel event-study regression with block and state by tercile by period fixed effects. Each β is the gap in access growth between treated and comparison blocks since June 2022.

For the block fiber indicator, which runs from December 2015, we estimate a difference-in-differences regression that lets the effect differ by period, an event-study specification, with a pre-award reference period.

$$y_{bt} = \sum_{\tau \neq \tau_0} \beta_{\tau} A_b \mathbf{1}[t = \tau] + \alpha_b + \gamma_{s(b),k(b),t} + \varepsilon_{bt} \quad (2)$$

Here y is one if block b has any residential fiber in period t , α is a block fixed effect, and γ now varies by period. The reference period is the last Form 477 filing before the award. Pre-award coefficients test for divergence before treatment; post-award coefficients estimate the effect on the narrower outcome from a clean baseline.

Neither equation uses dollars. The treatment is an indicator, because the question is what the program added, and the cost tables divide the support into the effect afterward. To ask whether more support per location bought a larger effect, Chapter 8 and Appendix Table E.5 add the dollars to the first equation:

$$s_{bt} - s_{b, \text{Jun 2022}} = \beta_t A_b + \delta_t A_b (D_b - \bar{D}) + \gamma_{s(b),k(b)} + u_{bt} \quad (3)$$

Here D is the ten-year support per funded location in block b , in thousands of dollars, and $\bar{D}$ its mean across treated blocks, so β is the effect at the mean support and δ the change in the effect per \$1,000 more per location. Comparison blocks have no support, so δ is identified from variation among treated blocks only. A second version replaces the linear term with indicators for the quartile of D .

We weight by locations and cluster standard errors by county, except by carrier for Enhanced A-CAM, where the treatment is a carrier decision, and by application for Wisconsin, where the Commission funded applications. The additional share is the December 2025 coefficient divided by the gain in the treated group over the same period.

The cost tables use a second, treated-weighted version of each effect.¹

Delivered performance

To check availability provided to the FCC, we aggregate Ookla's open speed-test tiles from 2019 through 2025 to the resolution-8 H3 hexagons the BDC uses. Coverage in this publicly available dataset is only about 6 percent of hexes in rural areas, so the test could be more robust with additional data.

Scope

The national panel covers every RDOF-eligible block in the fifty states and the District of Columbia with at least one residential location, 539,000 blocks and 4.9 million locations, plus every CAF II eligible block, every block in an Enhanced A-CAM offer footprint, and every block with a CPF-funded location. The RDOF access regressions use the 488,441 authorized and cancelled-award blocks with December 2025 locations, in 49 states, of which 486,649 blocks in 47 states lie in state by cost cells that contain both groups and identify the effect; the fiber difference-in-differences series adds blocks with no December 2025 locations and reaches 50 states. The block availability tables behind it cover 6.4 million blocks across all eight BDC releases.

¹ The regression coefficient weights the state-by-cost cells by their variance, which is not how the treated locations are distributed across them, so multiplying it by funded locations does not count every funded location once. For the cost tables, Chapter 8 recomputes each effect as the difference in gains between the subsidized areas and the comparison areas reweighted to the subsidized areas' cell distribution, the treated-weighted difference. The chapter tables print the regression coefficients; the cost tables print the treated-weighted differences and say so in their notes. The two agree within about a point on the headline samples (RDOF 16.9 and 18.0 on access) and differ more in subgroups, where a few cells carry most of the treated locations.

Chapter 3. The Rural Digital Opportunity Fund

The Rural Digital Opportunity Fund (RDOF) auction assigned \$9.2 billion to serve 5.2 million locations in December 2020. The FCC then rejected the applications of, or accepted withdrawals from, winning bidders covering about 1.7 million of those locations, most held by two bidders it found unqualified. Those areas received no subsidy, though they had qualified under the same rules, at the same auction, as the areas that did. We compare broadband access in the two groups.

The cancelled awards break the usual link between eligibility and treatment. The same rule judged every area in our sample unserved and the same model priced it, so the usual objection to comparing subsidized with unsubsidized areas, that the program chose the ones that needed help, does not apply. What separates the two groups is whether the winning bidder later passed the FCC's review, a decision about the firm rather than the area.

The program: the auction and its cancelled awards

The FCC ran RDOF Phase I as a reverse auction in October and November 2020. Eligible areas were census blocks where Form 477 showed no provider offering 25/3 Mbps. The FCC grouped blocks into bidding units, set a reserve price for each from its cost model, and let bidders compete by offering to serve at a discount from the reserve, with bids weighted by the performance tier and latency the bidder committed to. Support runs ten years, and winners must reach 40 percent of their locations by year three and all of them by year six.

The winning bids covered 786,000 blocks. Each winner then filed a long-form application, and the FCC reviewed its finances, technical plan, and state carrier designation before authorizing payment, in public notices from September 2021 into 2023. As of June 2026 it has authorized bids covering about 490,000 blocks and recorded pre-authorization defaults on 286,000, and winners abandoned another 27,000 blocks after authorization.

Two bidders account for most of the cancelled awards. LTD Broadband won \$1.3 billion, more than any other bidder, and then failed to obtain carrier designations in several states, and the FCC found its application deficient in August 2022. Starlink won \$886 million at the 100/20 tier, and the FCC rejected its application the same month on speed test data below the auction's requirements and affirmed the rejection in December 2023. About 80 smaller bidders that withdrew or failed review account for the rest. The FCC's files label all three groups as defaults.

We use the three groups separately. Starlink's awards are the cleanest comparison, because the FCC rejected them on a technology-wide finding about satellite performance that says nothing about the areas. LTD's fell to the firm's finances and regulatory standing. A bidder that looks at its areas and decides they are not worth building is the selection we worry about, so the withdrawn awards serve as a robustness check.

What earlier work found

Writing on RDOF has been about its rules and its defaults, not its effect. Rivkin-Fish (2020, 2021) argued that the auction's technology weights let untested satellite and fixed wireless bids beat fiber on promised speeds they were unlikely to deliver, and Wallsten and Rosston (2023) traced the program's problems mainly to eligibility rules that fixed the unserved areas on 2019 data. Rosston and Wallsten (2023) read the bidding records the other way: where SpaceX competed to the final round and lost, winning bids were a smaller share of reserve than where it never bid, so its presence lowered the subsidies the FCC later refused to pay it. The defaults have been counted. GAO (2026b) and Dunning and Garner (2025) put them

at about 38 percent of the program's funding and locations. We found no independent estimate of what RDOF added to deployment in the areas it funded, which is what this chapter provides.

Program data

RDOF status comes from three FCC sources. The auction's public reporting system gives the eligible blocks, the bidding units, and the reserve prices. The FCC's authorization spreadsheet lists every authorized block by applicant, and its default spreadsheet lists every cancelled block. We assign each block one status, giving precedence to post-authorization default, then authorization, then pre-authorization default by Starlink, by LTD, and by anyone else. The Funding Map records the technology each winner committed to at each funded location, which classifies winners as fiber, fixed wireless or hybrid, or other wireline. Removing locations funded by any other federal program drops 8 percent of locations, 5.4 percent of authorized locations and 12 to 17 percent of cancelled-award locations. The panel has 539,000 blocks, 4.9 million locations, and 20 periods from December 2015 to December 2025.

Identification and the endogeneity problem

We compare authorized blocks with cancelled-award blocks before and after the December 2020 auction, using the two estimators in Chapter 2. The access outcome uses a June 2022 reference period, eighteen months after the auction and a year after the first authorizations and so not a pre-treatment baseline, with state by reserve-price tercile fixed effects. The fiber difference-in-differences series uses June 2020, the last Form 477 filing before the auction.

β in equations (1) and (2) of Chapter 2 equals the causal effect of authorization if deployment in cancelled-award blocks is what deployment in authorized blocks would have been without authorization. Four things could break that.

The first is selection by the cancelled bidders. Starlink bid where the reserve price was high relative to its own costs, which do not vary by location, so it won where terrestrial bidders dropped out early. Those may be the areas hardest to serve terrestrially, which would bias β upward, or areas terrestrial bidders expected to serve without subsidy, which would bias it downward, but theory does not tell us which direction. The pre-auction coefficients in Figure 3.2 are small, but fiber in both groups was near zero before 2020, so a cancelled bidder that bid in areas an incumbent was about to upgrade would look identical before 2020 to one that bid in areas nobody planned to touch.

The second is selection by the winners. Rational bidders bid where the subsidy makes the largest difference to their own return, which need not be where it makes the largest difference to deployment, and a bidder that would have built anyway can take the subsidy at a small discount from the reserve. We have not yet used the observable discount (Problems item 2).

The third is spillover. RDOF builds next to cancelled-award areas lower the cost of extending into them, which makes the comparison group partly treated and beta too small; if subsidized builders instead draw crews and capital away from neighboring unsubsidized areas, the bias runs the other way. The test below finds small positive spillovers.

The fourth is the shadow of the award itself. FCC rules treated an area with a pending RDOF bid as spoken for, the Enhanced A-CAM offer and NTIA's initial BEAD rules excluded such areas, and a cancelled area returned to the pool only after the FCC announced the default. A later program funded some of them once released, and we remove every location the Funding Map records as funded by another federal program, so the remaining comparison areas had no recorded federal subsidy in our window. An incumbent that expected a subsidized competitor might have delayed building, and one that saw the award collapse might have accelerated. Appendix G lists this mechanism among the planned tests; here it is a confound.

We do not claim the estimates are bounds. Selection by the cancelled bidders and the shadow of the award could run either way, selection by the winners is untested, and the spillovers we measure are positive and small. Two mechanisms outside that list, state grants in cancelled-award areas (Problems item 1) and a late-authorized wireless winner that has built almost nothing, make the estimate smaller than the truth.

Access effect

Appendix Table F.1 reports the period-by-period coefficients and standard errors behind this section.

Table 3.1 reports the effect of authorization on access by December 2025, against all pre-authorization cancellations. In authorized areas the share of locations with a terrestrial 100/20 offer rose 49 points between June 2022 and December 2025, and in cancelled-award areas it rose 30. Within state-by-cost cells, which remove the part of the raw difference that comes from where the two groups sit, authorization added 17 points, about a third of the gain in subsidized areas. The effect belongs to the fiber winners. The wireless and hybrid winners' areas show an effect we cannot tell from zero (Appendix Table B.2 and Table 3.6). Counting the national mobile carriers' fixed wireless, which the access measure excludes, lowers the effect to 15 points: the carriers' 100/20 home internet reached 15 percent of authorized locations and 18 percent of cancelled-award locations by December 2025, from about 1 percent in June 2022, so their expansion ran slightly against the program. Table 8.2 gives the same sensitivity for every program.

TABLE 3.1

Effect of RDOF authorization on access, December 2025, 47 states

Outcome	Effect of authorization percentage points (SE)	Share of gain effect ÷ gain in authorized areas
Any terrestrial offer at 100/20	16.9 (1.3)	34%
Same, adding unlicensed fixed wireless	14.3 (1.4)	30%
Same, adding the national carriers' fixed wireless	14.6 (1.2)	28%
Any terrestrial offer at 25/3	10.6 (1.3)	28%
Wireline offer at 100/20	19.3 (1.3)	44%
Any fiber offer	20.7 (1.3)	46%

Each effect is the change from June 2022 to December 2025 in the share of locations with the offer in authorized areas, minus the same change in cancelled-award areas, estimated within state by reserve-price tercile cells and weighted by each block's December 2025 residential locations. Share of gain divides the effect by the gain in authorized areas; on 100/20 access, authorized areas gained 49.4 points and cancelled-award areas 29.5. 488,441 blocks, 3.0 million authorized locations; the national carriers' row counts T-Mobile, Verizon, AT&T, and UScellular home internet at 100/20, which the access measure otherwise excludes (Chapter 2); county-clustered SEs. Effects for fiber winners and for wireless or hybrid winners separately, bootstrap intervals, and the intention-to-treat estimate are in Appendix B (Tables B.1 and B.2).

A count of fiber overstates what the subsidy bought by about a third, because cancelled-award areas gained cable and fixed wireless service that a fiber measure ignores, which is why this chapter leads with access.

Robustness. The headline effect survives every check in Appendix B, including dropping any one state, using any one group of cancelled awards as the comparison, keeping only locations that existed in June 2022, or dropping cancelled blocks within 2 km of a subsidized network moves it between 16 and 19 points (Tables B.2 and B.3).

Changing the level of clustering is the only thing that has any effect. The FCC accepted or rejected each bidder's application as a whole, and three bidders hold most of the locations, Starlink and LTD 66 percent

of the comparison group and Charter 31 percent of the authorized group. Clustering by bidder nearly triples the standard error, and the effect remains distinguishable from zero on a wild cluster bootstrap (Table B.1).

The effect is not uniform across winners. Charter's areas show 32 points, half of their gain, and all other winners together 11 points, a quarter of theirs (Table B.2).

The Funding Map's deployment records give the sharpest test that the effect is the program's. Locations the winner reports deployed since June 2022 gained 75 points of access, against 30 in cancelled areas, and the gain appears in the BDC release that matches the reported date, while RDOF-funded locations not yet reported deployed gained the same as cancelled areas (Table 3.2). A difference in underlying trends would appear at the unbuilt locations too, and it does not.

TABLE 3.2

Effect of RDOF authorization by the deployment status winners report, June 2022 to December 2025

Locations in authorized blocks	Locations	100/20 access effect (SE)	Fiber effect (SE)
All (Table 3.1)	2,994,670	16.9 (1.3)	20.7 (1.3)
Reported deployed, July 2022 to Dec 2025	1,332,227	40.5 (1.5)	48.5 (1.5)
RDOF-funded, not yet reported deployed	1,395,029	-0.2 (1.3)	-1.7 (1.1)
Reported deployed by June 2022	162,285	-24.6 (2.0)	-14.7 (1.9)
Not RDOF-funded	105,129	7.6 (1.5)	12.9 (1.4)

Each row compares the block share of that row's locations with all cancelled blocks, fixed effects, weights, and clusters as in Table 3.1. Status and dates from the September 2026 Funding Map. Locations reported deployed by June 2022 already had 83 percent access then, so they had little to gain.

FIGURE 3.1
Effect of RDOF authorization on access and fiber at each BDC release

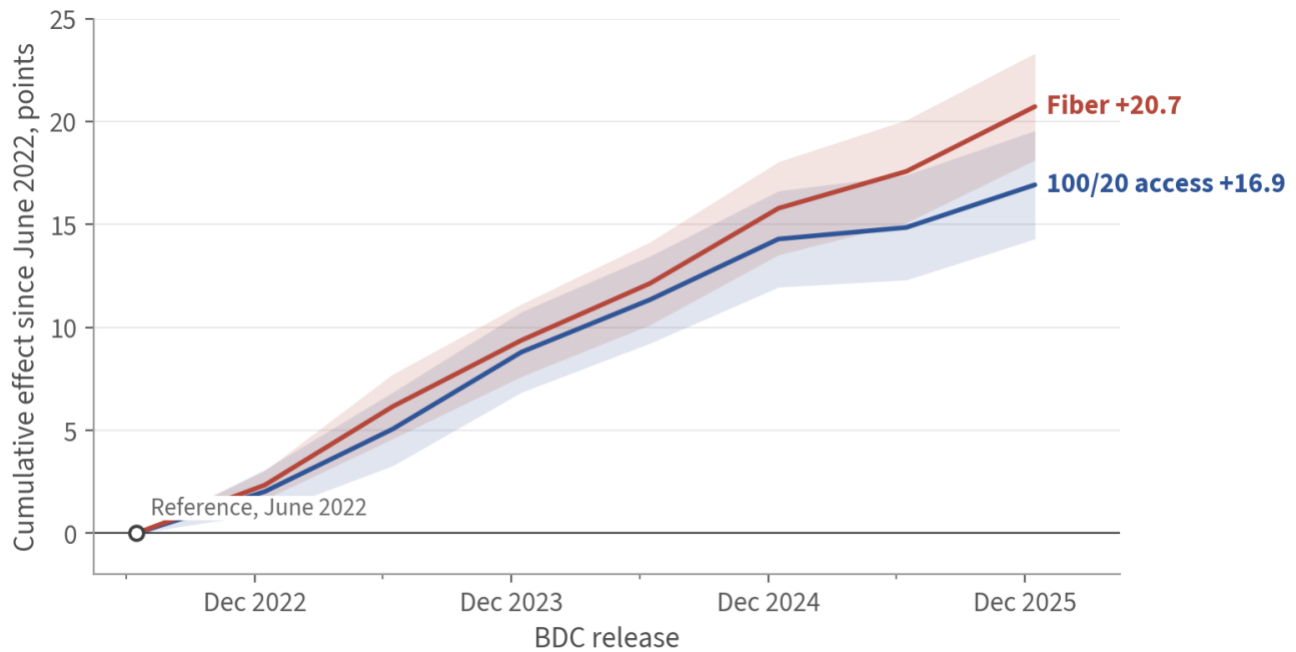


Figure 3.1 plots the cumulative effect since June 2022. The subsidy added 2 to 4 points of access and of fiber in every release through 2024, less in the first half of 2025, and 2 to 3 points again in the second half, so the effect is still growing.

Table 3.3 uses the fiber indicator to check trends before the auction and to give a second estimate with a clean baseline. Both groups started near zero in June 2020. By December 2025 authorized areas reached 69 percent of locations in blocks with fiber and cancelled-award areas 38 percent, an effect of 23 points against all cancellations.

TABLE 3.3
Fiber difference-in-differences series, December 2025 effect by comparison group, reference June 2020

Comparison group	States	Blocks	Effect, Dec 2025 points (SE)	Additional share
Starlink cancellations	34	263,940	26.7 (2.0)	39%
LTD cancellations	15	189,628	22.9 (2.7)	40%
All pre-authorization cancellations	47	486,649	23.3 (1.5)	36%

Outcome is one if any location in the block has a fiber offer. Additional share is the December 2025 coefficient divided by the gain in authorized areas since June 2020. The all-cancellation estimate includes a 3.7-point gap that opened across the Form 477 to BDC seam, so the effect since June 2020 lies between about 20 and 23 points. Pre-auction coefficients are in Figure 3.2.

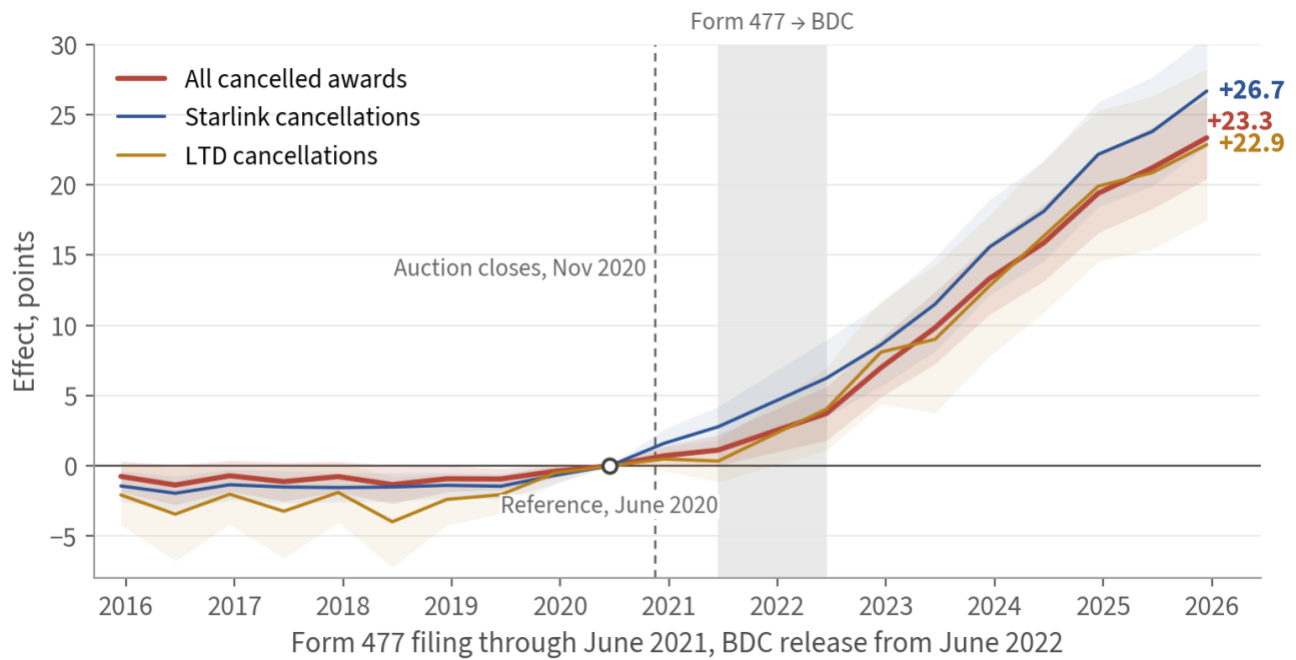
FIGURE 3.2**Fiber difference-in-differences series, authorized versus three groups of cancelled awards**

Figure 3.2 draws the three rows of Table 3.3 at every period, with 95 percent bands and the seam shaded. Pre-auction coefficients are within 2 points of zero for the Starlink and all-cancellation comparisons and within 3.5 points for LTD, and they shrink toward zero as the auction approaches. Extrapolating that slow catch-up through 2025 removes about 3 points from the effect. The three lines track one another after the auction and end close together in December 2025 (Table 3.3).

The fiber additional share in Table 3.3, 36 to 40 percent, is below Table 3.1's 46 percent, because the June 2020 baseline predates any subsidized building and the block indicator counts a block as served once one location is. Table 3.1 is the better measure of what the subsidy bought. Table 3.3 is the one with a pre-period.

The access effect and its additional share do not differ detectably across cost bands. Table 3.4 splits the December 2025 estimates by within-state tercile of the reserve price per location, with the comparison group and fixed effects of Table 3.1. A regression that interacts authorization with the three terciles does not reject equal effects on access or on fiber.

TABLE 3.4

Effect of RDOF authorization by reserve-price tercile, December 2025 relative to June 2022

Tercile median reserve price per location	Access effect points (SE)	Gain, authorized	Gain, cancelled	Share	Fiber effect points (SE)	Share, fiber	Support per additional location accrued
Lowest (\$227)	17.3 (1.7)	51.8	31.4	33%	21.7 (1.7)	43%	\$1,700
Middle (\$501)	17.0 (1.9)	49.4	30.0	34%	20.4 (1.8)	46%	\$3,600
Highest (\$925)	16.1 (2.1)	45.8	25.5	35%	19.3 (1.9)	49%	\$6,500

Within-state terciles, 160,000 to 165,000 blocks each; county-clustered SEs. The access share in the highest tercile exceeds the lowest by 1.7 points (95 percent interval -7.5 to 11.7); fiber by 5.5 (-3.3 to 15.5). A test of equal effects across terciles gives $p = 0.88$ on access and 0.61 on fiber. Support per additional location is on this table's effects; Table E.1 gives \$1,650, \$3,000, and \$6,700 on the treated-weighted effects, and additional shares of 34, 41, and 34 percent.

Unsubsidized fiber in cancelled-award areas thins out as cost rises, from 24 points in the cheapest tercile to 14 in the costliest. Cancelled-award areas gained 26 to 31 points of access in every band (Table 3.4), so the unsubsidized arrival of fixed wireless and cable does not thin out where the cost model says fiber is expensive.

Deployment by other providers

A subsidy can also change what other providers do. If a subsidized winner deters a cable or fixed wireless provider that would otherwise have built, part of the winner’s coverage replaces private deployment. The BDC identifies the provider behind every record and the Funding Map the winner at every funded location, so we split coverage in authorized areas into the winner’s and everyone else’s and compare everyone else’s growth with total growth in cancelled-award areas. The winner is the provider identifier the Funding Map records most often in the block, which identifies a winner in nearly every authorized block; affiliates filing under other identifiers count as other providers, and in LTD’s cancelled areas we drop LTD’s own records.

TABLE 3.5
Deployment by winners and by other providers, authorized versus cancelled-award areas, June 2022 to December 2025

100/20 access from	Gain, authorized	Gain, cancelled	Effect points (SE)
Providers other than the winner	23.0	29.5	–9.1 (1.3)
Providers other than the winner, wireline only	12.8	20.2	–12.2 (1.1)
Any provider	49.4	29.5	16.9 (1.3)
The RDOF winner	40.9	0 by construction	41.2 (1.3)
Any provider, wireline only	44.3	20.2	19.3 (1.3)

Provider-level BDC records, 486,649 blocks and 4.3 million locations in 47 states. The winner is the provider identifier the Funding Map records most often in the block; affiliates filing under other identifiers count as other providers. Fixed effects, weights, and clusters as in Table 3.1. Within-cell effects can exceed the raw treated gain where the comparison gain is zero by construction, because cells are weighted by location.

Providers other than the winner raised 100/20 access by 23 points in authorized areas and by 30 in cancelled-award areas, and within cells their measured availability grew 9 points less where a subsidized winner was building. On wireline alone the gap is larger (Table 3.5), which fits one mechanism, that a cable or fiber provider declines to overbuild an area where a subsidized fiber network is arriving while fixed wireless providers are less deterred. The table is consistent with that and does not demonstrate it, and availability is not spending, so it does not measure private capital.

The same records measure competition. Locations with 100/20 offers from two or more providers rose 17 points in authorized areas and 12 in cancelled-award areas, and within cells authorization added 6 points, all of it in fiber winners’ areas. The winner is one of the two providers at most of those locations. Counting only providers other than the winner, two-provider coverage grew 7 points less in authorized areas than in cancelled-award areas. Where RDOF paid for one network, two unsubsidized networks at the same location became less common. Providers are distinct BDC identifiers, so affiliates that file separately count twice.

The same records show what the wireless winners built.

TABLE 3.6

Wireless or hybrid winners versus cancelled awards, fixed wireless outcomes, June 2022 to December 2025

Outcome	Level, June 2022 winners' areas	Gain, winners' areas	Gain, cancelled	Effect points (SE)
The winner's own fixed wireless 100/20 offer	14.3	11.2	0	13.8 (2.2)
Fixed wireless 100/20 from any non-carrier provider	30.0	30.5	15.3	9.7 (2.9)
Any provider, 100/20 (the access measure)	22.5	31.9	31.6	4.2 (2.7)

155,194 blocks. Fixed wireless rows count licensed and unlicensed spectrum from providers other than the national mobile carriers, without the latency condition. Appendix B adds the 25/3, licensed-low-latency, and other-provider rows.

Wireless winners built what they bid, as far as provider filings can show. Fixed wireless 100/20 offers from any non-carrier provider grew faster in their areas than in cancelled-award areas, and the winners' own fixed wireless 100/20 offers grew to 26 percent of their locations, in line with the 26 percent the Funding Map records as complete (Table 3.6; Appendix Table B.4 gives their licensed, low-latency offers, the ones the access measure counts). These winners bid where they already claimed service, with 64 percent coverage at 25/3 in June 2022 against 47 percent in the comparison areas.

Their effect on access, 4 points that we cannot tell from zero (Table 3.6), averages two different firms. Resound Networks holds about half of the 437,000 wireless-winner locations, has reported 5 percent of its funded locations deployed, and shows an access effect of minus 4 points. All other wireless winners together show 9 points, about a quarter of their gain. The wireless average describes one firm that has not built and several that have.

Cost per additional location and per location-year

Table 3.7 prices the effect on support accrued from authorization through December 2025. On the treated-weighted access effect of Chapter 8's location-weighted sample, that support comes to \$3,400 per additional location with 100/20 access and, with years bought measured as the area between the subsidized and counterfactual paths rather than as the coverage lead of Table E.4, \$1,900 per location-year of earlier access. Fiber is cheaper on both measures because its effect is larger. Over the full ten-year commitment the figure is \$9,700 per additional location at today's effect, and it will fall as the effect keeps growing.

Cost per additional location rises with the cost model, from about \$1,700 in the cheapest tercile to \$6,500 in the costliest on accrued support (Table 3.4; Table E.1 on the treated-weighted effects), and Table E.3 shows the same rise over the full commitment.

TABLE 3.7

RDOF: support per funded location, per additional location, and per location-year, accrued through December 2025

Measure	Effect percentage points (SE)	Per funded location	Per additional location (95% interval)	Years bought per funded location (95% interval)	Cost per location-year (95% interval)
100/20 access	18.0 (1.4)	\$610	\$3,400 (2,900 to 4,000)	0.32 (0.27 to 0.38)	\$1,900 (1,620 to 2,260)
Fiber, location share	21.4 (1.4)	\$610	\$2,850 (2,500 to 3,300)	0.37 (0.32 to 0.42)	\$1,650 (1,470 to 1,930)

Support is \$1,821 million accrued from authorization through December 2025 for winners still authorized, on 2,985,000 funded locations. Effects are the treated-weighted differences of Table E.3. Years earlier are the trapezoid integral of Figure 3.1's path, which ends at 16.9 points; on the 18.0 endpoint the access cost per location-year is about \$1,780. Intervals from a county bootstrap with 1,000 draws. Over the full ten-year commitment, \$1,740 per funded location and \$9,700 per additional location with access. Chapter 2 defines the measures and Chapter 8 the computation.

Adoption and speeds

The American Community Survey asks households whether they subscribe to internet service and of what kind, and its 5-year estimates reach the block group. We compare the 2015 to 2019 estimates, which end before the auction, with the 2020 to 2024 estimates, which span the first three years of building, on 2020 block groups, with the earlier estimates re-apportioned from 2010 block groups by location count. Treatment is the share of the block group's locations in surviving-authorized RDOF blocks and the comparison variable the share in cancelled-award blocks, so the effect is the difference between a block group entirely in authorized areas and one entirely in cancelled-award areas, with state fixed effects, household weights, and county clusters.

TABLE 3.8

ACS household subscription shares, 2015 to 2019 versus 2020 to 2024

Subscription type	2015 to 2019 %	2020 to 2024 %	Change points	Effect of authorization points (SE)
Wired broadband (cable, fiber, or DSL)	34.8	43.0	+8.2	3.2 (1.0)
Satellite	17.9	19.6	+1.7	-2.8 (0.7)
Any broadband	69.5	81.7	+12.2	0.2 (0.6)
Cellular data plan only	18.0	20.5	+2.5	-0.3 (0.6)
No internet access	26.3	15.5	-10.8	0.3 (0.6)

5,443 block groups with at least half their locations in the RDOF sample; shares of households. Effect = coefficient on the authorized share minus coefficient on the cancelled share; county-clustered SEs. Wider samples give 3.0 (0.9) and 2.1 (0.9) on wired.

The changes are consistent with substitution from satellite to wired broadband. Wired subscription rose 3 points more, and satellite 3 points less, than in cancelled-award areas, and the shares with any broadband and with none did not move differently (Table 3.8). The ACS does not list fixed wireless, and the window averages two years before most subsidized construction with three after, which dilutes the effect. We do

not convert this into a take-up rate, because the subscription and access effects have different populations and windows, and a subscription gain can be an existing subscriber upgrading.

The Form 477 subscription series. The FCC’s Form 477 subscription data count residential fixed connections per household by census tract, semiannually, in six bins of 20 connections per 100 households, at any speed and at a speed tier, 10/1 through December 2021 and 25 Mbps downstream or better from June 2022. We use bin midpoints. The unit is the 2020 tract, with the 2010-tract filings through June 2021 re-apportioned by block location counts, and the design follows the ACS test with location weights. The main sample is the 4,000 tracts with at least a quarter of their locations in the RDOF sample. This build lacked the December 2022, June 2023, and June 2024 files.

FIGURE 3.3
Effect of RDOF authorization on fixed subscriptions per household, by filing

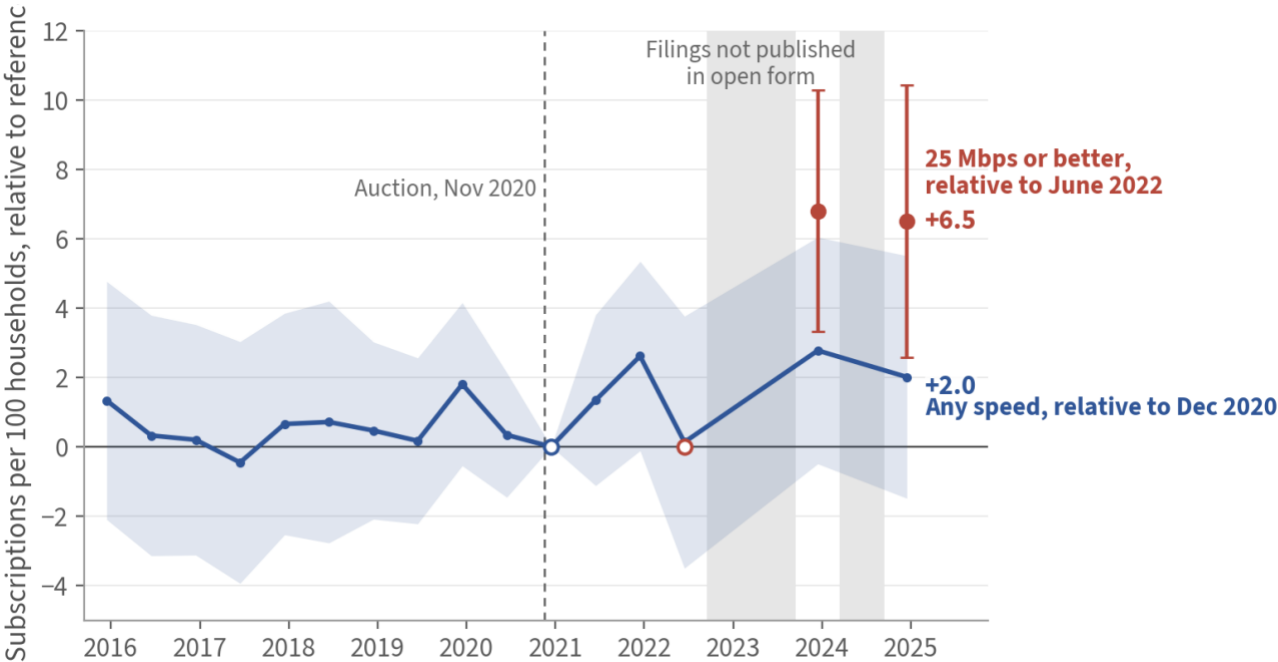


Figure 3.3 plots both subscription series at every filing, each relative to its own reference, with 95 percent bands; the 25 Mbps series skips the filings the FCC has not published in an open form, the shaded band. Its pre-auction coefficients and the wider samples are in Appendix B.

Subscriptions at 25 Mbps or better rose 6.5 to 8.5 per 100 households more in authorized tracts than in cancelled-award tracts between June 2022 and December 2024. Subscriptions at any speed rose less, by an amount that depends on the sample, and only the widest sample’s estimate is distinguishable from zero (Appendix B). Most of the subsidy’s effect on adoption is households moving from slow or satellite service to a connection at 25 Mbps or better, and a smaller part is households subscribing for the first time. A take-up rate, with households in both denominators and new subscribers separated from upgrades, is a matched calculation for the next round.

Measured speeds. Ookla speed tests on the national hex panel show download speeds rising about 65 percent faster in authorized areas by October 2025, and the share of tests at 100/20 rising 4 points more. The speed effect is larger against Starlink cancellations alone and smaller against LTD cancellations. Pre-period coefficients are near zero, and the effect is flat through October 2021, before authorizations began to bind.

The panel assigns 829,000 hexes to a group, of which 48,000 have tests in both periods. Authorized areas started at 16 Mbps against 29 in cancelled-award areas, so part of the log gain is convergence.

Problems

This section lists what could be wrong with the estimates, in rough order of how much each could move them, and what would resolve each.

1. State grants. We netted out the grants we could locate in three states, from Wisconsin's block-level award footprints and county award lists for Virginia's VATI and Minnesota's Border-to-Border programs; removing state-funded blocks from both groups, coding them as a separate comparison group, or subtracting Virginia's and Minnesota's excess cancelled-area gain moves the access effect by less than a point. Minnesota fits the concern best, with an effect of 5 points against 17 elsewhere and much larger cancelled-award gains, yet dropping it raises the national estimate by 0.4 points. Block-level grant areas for Virginia and Minnesota remain unavailable, grant programs in the other states remain in the comparison group, and the three states we can measure suggest they lower the additional share by a point or two.
2. Bidder selection. Three tests would help: effects by the auction's discount from reserve, a measure of how much the winner needed the money; a comparison of Starlink-cancellation areas that terrestrial bidders bid on and lost in earlier rounds with those no terrestrial bidder ever touched; and a never-bid comparison group built from the CAF II auction of 2018, since RDOF has almost none, only 42,000 locations nationally.
3. Advertised versus delivered service. Every availability measure here is a provider's claim, and fixed wireless claims in particular swing by hundreds of thousands of locations between BDC releases. The Ookla comparison is the only measure of delivered service, and it covers 6 percent of hexes. The FCC's challenge process data and the Measuring Broadband America panel would give a fuller test.
4. External validity. The comparison group is areas Starlink, LTD, and other cancelled bidders won, and other cancellations hold a third of comparison locations. The effect of RDOF in areas terrestrial bidders wanted may differ. The three comparison groups give similar answers (Tables 3.3 and B.2), which helps; a joint test on a common treated sample would be the stronger check.
5. What the outcome misses. Access measures record whether service is offered, not whether anyone buys it or what it costs. RDOF's terms require winners to offer service at rates comparable to urban rates and an unsubsidized incumbent faces no such constraint, so two areas with identical coverage could differ in price and adoption.

Conclusion

RDOF bought less access than its footprint suggests. Areas whose awards were cancelled gained most of what subsidized areas gained between mid-2022 and the end of 2025 without a dollar of federal support. The subsidy caused about a third of the gain in subsidized areas, and the rest would have arrived anyway. Those points came at the low end of the report's range of cost per additional location and per location-year (Table 3.7). The additional share is about half where Charter won and about a quarter for all other winners together.

The FCC did not run RDOF badly. The auction drove bids well below reserve. Its admission rules let bidders win locations they could not serve, and FCC rules then held those areas off other programs until the defaults were announced, a cost of the design that the comparison group makes visible. The problem is that a snapshot of where service was absent in 2019 determined eligibility, and those places were about to change, both as private providers extended fiber into low-density areas at a pace no one in 2019 predicted and as the FCC updated its mapping methods. An eligibility rule based on current service cannot distinguish the area no one will ever serve from the area someone is about to serve. RDOF paid for both.

Two design changes follow. One is to pay for locations that remain unserved after a waiting period, which converts a subsidy for deployment into a subsidy for deployment that did not happen on its own; it trades speed for efficiency, and whether the trade is worth making depends on the value of connecting a household in 2023 rather than 2026, which this report does not answer. The other is to concentrate money where costs are highest, and the evidence here does not support it. Table 3.4 finds no difference in the additional share of access between cheap and expensive areas, and the interval on the difference rules out a large gain from moving to the costliest tercile, so targeting on the cost model does not buy more additionality and buys far fewer additional locations per dollar.

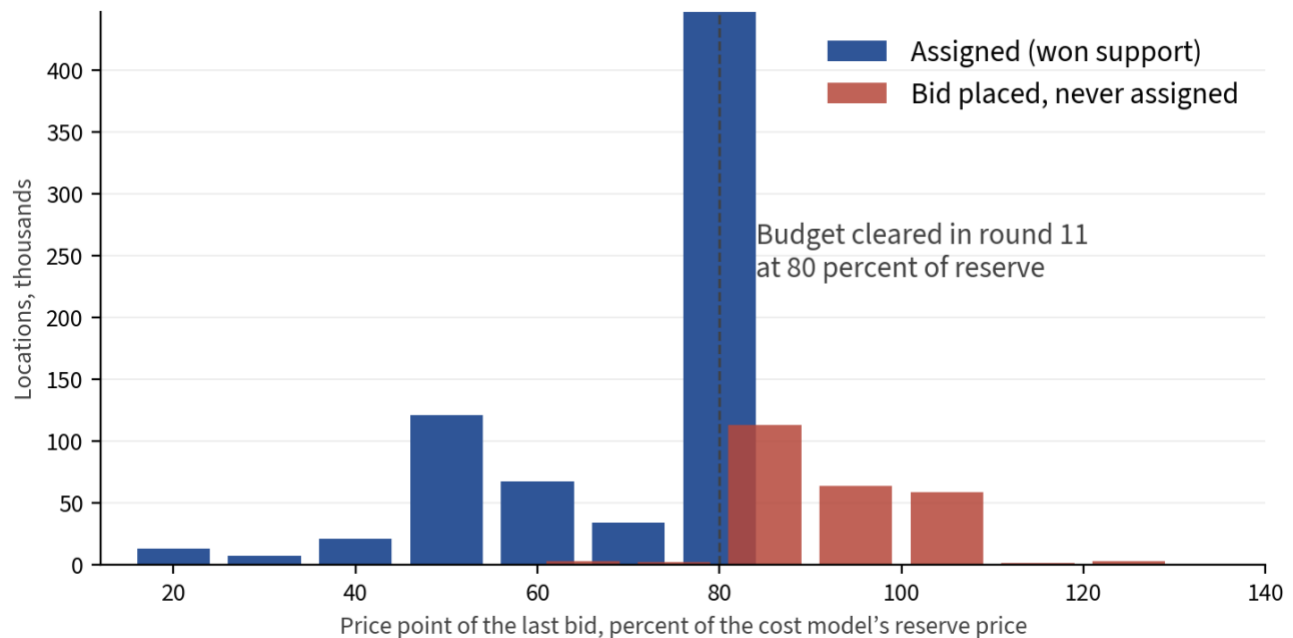
The fixed wireless winners' small average effect on access combines Resound Networks, which holds about half of their locations and has built almost nothing, with the other wireless winners, whose effect is about a quarter of their gain.

Chapter 4. The 2018 CAF II auction

CAF II winners built what they bid and no more. Gigabit winners produced a large fiber effect that peaked in 2023 and has shrunk since as unsubsidized areas catch up. Fixed wireless winners produced 100/20 coverage claims and no fiber. Viasat, the largest winner by block count, produced nothing local, and its areas serve as a check on the comparison group.

The program

The FCC ran its first reverse auction for high-cost support in July and August 2018. Eligible areas were census blocks in price-cap carrier territories where the carriers had declined model-based support in 2015 and Form 477 showed no 10/1 Mbps service. The auction assigned support over ten years to 103 bidders for 713,000 locations in 158,000 blocks. The FCC weighted bids by performance tier, from gigabit down to a 10/1 minimum, and by latency, so a satellite bid carried a large penalty. It assigned \$1.49 billion of a budget of up to \$1.98 billion, so the budget did not bind in the simple sense. Another 53,000 blocks in the auction's block lists drew bids the FCC never assigned. Those blocks are the comparison group, and the auction's public round-by-round records say why they lost. The clock opened at 180 percent of each area's reserve price and fell 10 points a round. In round 11, at 80 percent of reserve, the bids still standing first fit within the budget, and the FCC assigned support from round 12 on. Of the 29,603 items that drew any bid, 16,950 were assigned, 12,750 of them at that 80 percent clearing price and the rest after further competition at 20 to 70 percent; 12,653 items, with 249,000 locations, were never assigned because their last bidder had already dropped out, nearly all between 85 and 125 percent of reserve (Figure 4.1). The unassigned areas are therefore the ones whose bidders needed more than the clearing price, and the budget, through that price, is what rationed them. That the auction then spent \$1.49 billion of a \$1.98 billion budget reflects the discounts competition forced after clearing, not slack in the budget. The item records carry no bidder identity, so we cannot say which bidders held the lost items or how the performance-tier weights shifted individual bids.

FIGURE 4.1**Where CAF II bids stopped: locations by the price point of the last bid, assigned and never assigned**

Each bar is the locations in auction items whose last bid stood at that price point, as a percent of the cost model's reserve price; the clock started at 180 and fell 10 points a round, so bidders exited from right to left. Navy items were assigned support, rust items were not. Assigned items are placed at the clock price of the round in which they were assigned, unassigned items at the midpoint of the round in which their last bid was placed. Source: Auction 903 public item status by round.

Figure 4.1 is the CAF II counterpart of Figure 1 in Wallsten (2013), which ordered the Mobility Fund Phase I bids by subsidy per road mile and marked where the \$300 million ran out: winning bids ran from \$130 to \$35,000 per road mile and the rejected bids above them to \$430,000. The shape here is the same, a block of areas funded at or below the clearing price and a tail of areas whose bidders wanted more, with two differences. CAF II's clock stopped the losers at a common percentage of each area's model cost rather than at a common dollar figure, so the tail is measured against the reserve, and most of the funded areas took the first price at which the budget cleared rather than bidding below it, which the pay-as-bid Mobility Fund did not allow.

What earlier work found

Published assessments of CAF II stop at the auction's outcome or at early deployment reports, so none measures what the money changed in the areas it funded. Gillan (2019), writing for NARUC's research institute, read the results as a success for auctions. He reported that the auction awarded \$148.8 million a year, 70 percent less than the Connect America Cost Model had estimated the same areas would need, that wireless providers, mostly fixed wireless, took over half of the support, and that 53 percent of funded locations were to receive at least 100 Mbps with another 19 percent at a gigabit. In the printed reaction to that paper, Matthey (2019) called it too early to say whether the alternative providers and technologies could deliver, noted that winners in the Mobility Fund Phase I auction and the Rural Broadband Experiments had defaulted, and asked whether a further auction would close the gap left by areas with no winning bid. Wallsten (2013) made the same points about the FCC's first reverse auction, the 2012 Mobility Fund Phase I, which awarded \$300 million to 33 of 52 qualified bidders. He credited the auction with revealing costs the FCC could not have modeled, and faulted pay-as-bid pricing, the road-mile metric, and the thinness of competition, since 837 of the 865 areas with bids drew a single bid. The FCC's own

accounting of CAF II has tracked compliance rather than effect. By March 7, 2022, winners had certified 257,886 locations in the HUBB, against a requirement to reach 40 percent of model locations by December 31, 2022, and the Commission sent letters to every company that had not yet reported deployment in an authorized state (FCC 2022). The final deadline for all locations was December 31, 2025, and the Commission was still settling disputes over location counts, carrier by carrier, in February 2026 (FCC 2026). The one field check is of the auction’s predecessor, the model-based CAF II support to the large price-cap carriers: Manda et al. (2024) found service available at 55 percent of the addresses four of those carriers had certified as served, and service meeting the FCC’s requirements at about a third. None of this work compares funded areas with similar areas that got nothing, which is what this chapter does.

Program data and design

Assigned blocks and each winner’s tier and latency come from the auction’s public reporting system and bid results file. The comparison group is blocks that drew a bid but no award because the clock stopped above their last bid, that RDOF did not later authorize, and that carry no other federal funding in the Funding Map. Of the unassigned blocks, 26,431 hold locations in the December 2025 BDC and enter the panel; the RDOF screen and the other-federal screen together remove 53 percent of those, leaving 12,499 blocks with 115,590 locations. The reference period is June 2018, the last Form 477 filing before the auction. The fiber outcome runs from December 2015 and the access outcome from June 2022, four years into the buildout. We use the Chapter 2 estimators with state by reserve-price tercile fixed effects and estimate separately for each winner tier against the same comparison group. The ACS adoption run screens losers on RDOF eligibility only.

Access effect

Appendix Table F.2 reports the period-by-period coefficients and standard errors behind this section.

TABLE 4.1

CAF II effect by winner tier relative to areas with bids but no award

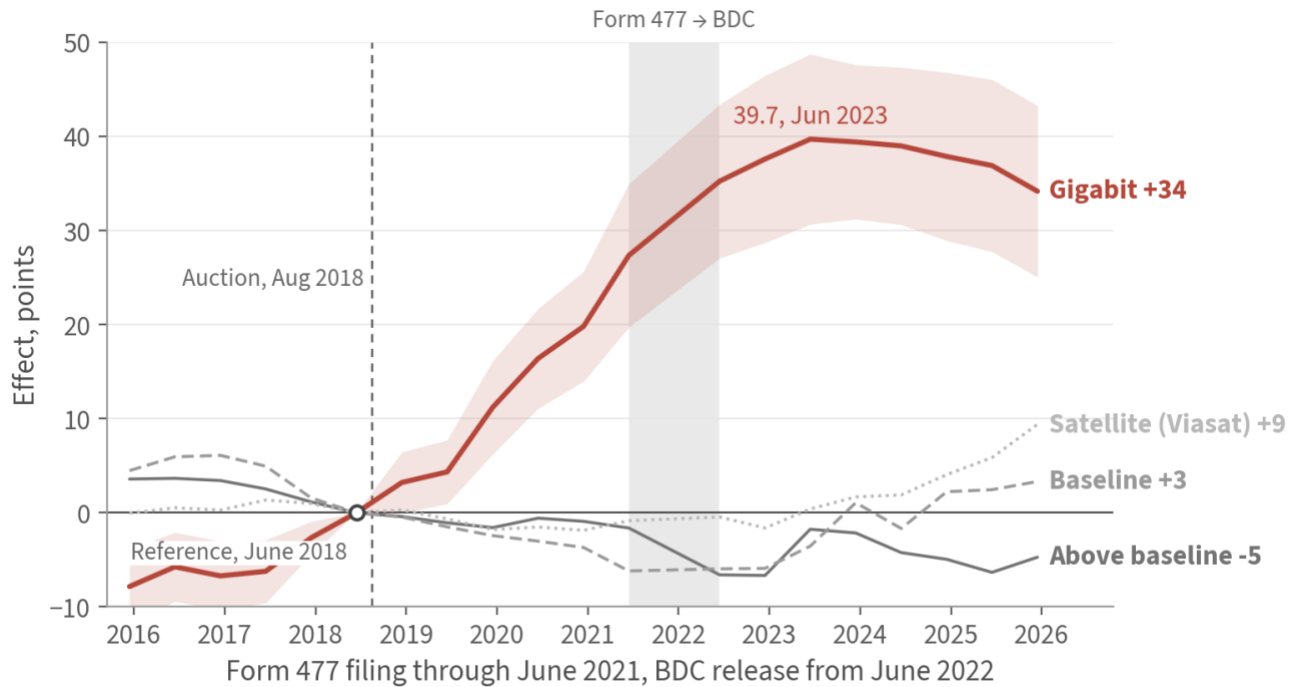
Winner tier	Fiber points (SE)		Access, 2022 to 2025 points (SE)		Growth of winners’ fiber lead, June 2017 to June 2018 pre-auction, points (SE)	Locations
	Dec 2023	Dec 2025	100/20	25/3		
Gigabit	39.4 (4.2)	34.2 (4.6)	0.3 (3.9)	−5.8 (3.1)	+6.2 (1.7)	135,000
Above baseline, 100/20	−2.1 (4.0)	−4.7 (4.3)	17.0 (4.7)	−6.7 (3.7)	−2.5 (1.9)	240,000
Baseline, 25/3	1.1 (4.5)	3.3 (4.5)	15.0 (3.5)	3.8 (4.0)	−5.0 (2.8)	138,000
Satellite (Viasat)	1.7 (2.9)	9.4 (3.3)	5.3 (3.5)	2.1 (2.4)	−1.4 (0.8)	144,000

Fiber columns are the block indicator relative to June 2018; access columns the change in the share of locations with a qualifying offer from June 2022, on fixed December 2025 denominators. The pre-trend column is the June 2018 coefficient minus the June 2017 coefficient: a positive number means winners’ fiber lead over the comparison group grew in the year before the auction. Comparison group: 12,499 screened loser blocks. County-clustered SEs. Pooled across all assigned blocks, the 100/20 access effect is 10.1 (2.6), an additional share of 29 percent (15 to 41).

Pooled across all assigned blocks against the same comparison group, the 100/20 access effect from June 2022 to December 2025 is 10 points (Table 4.1). For terrestrial winners only, Viasat excluded, it is 11 points, an additional share of 31 percent, with a county-bootstrap interval of 15 to 44 percent.

FIGURE 4.2

CAF II fiber difference-in-differences series by winner tier, 2015 to 2025

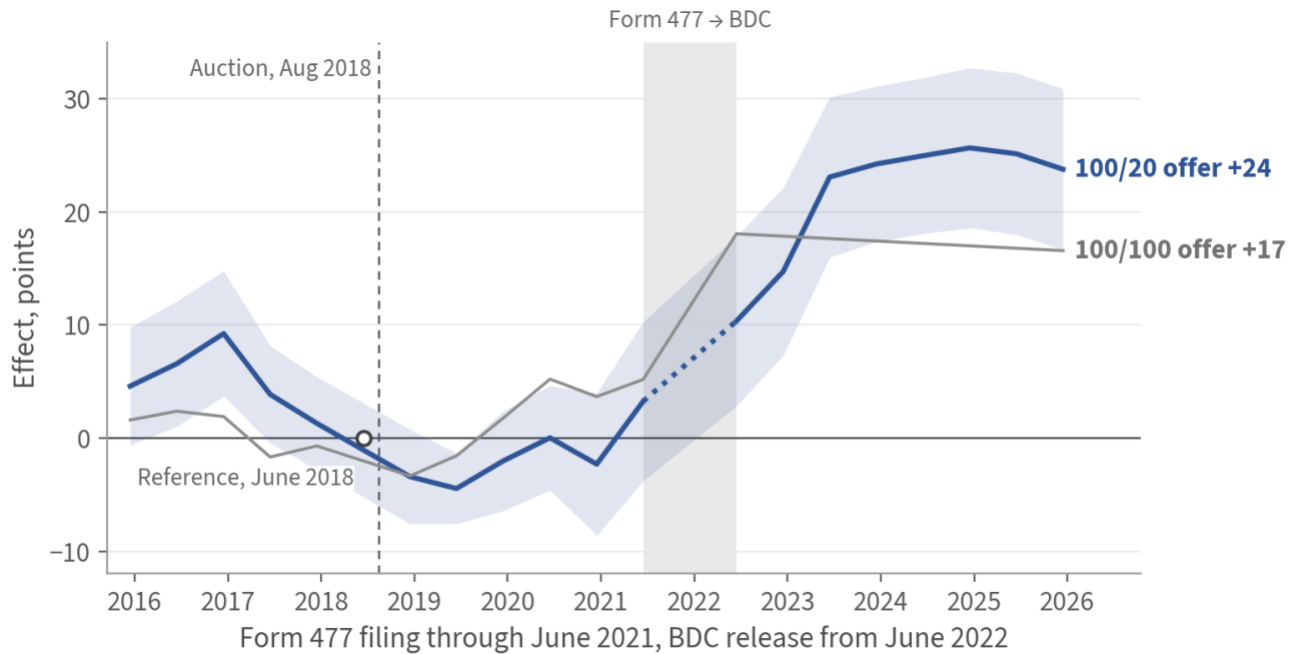


One line per tier, relative to the comparison group and to June 2018; the gigabit tier carries its 95 percent band and the other tiers are drawn in gray without bands. The seam is shaded.

Location-level access data begin in June 2022. For 2019 to 2021 we built a block-level 100/20 indicator from Form 477 deployment records, the construction used for New York in Chapter 7; from then a block counts if any location has a qualifying terrestrial offer (tn100). Figure 4.3 plots the effect for terrestrial winners, Viasat excluded, with the 100/100 offer as a thin gray line. Winners' blocks sat a few points behind the comparison blocks in 2019 and 2020, and the joined series stands at +3 points in June 2021 and +10 at the switch to the BDC in June 2022, then rises further over the next year and holds through 2025; the series for all assigned winners, Viasat included, runs a few points lower (Appendix C). The seam segment, about 7 points, coincides with the change in data source, so it may be service that arrived in the second half of 2021 or winners' filings that location-level BDC reporting caught and the block-level Form 477 missed. Within the BDC alone, with reference June 2022, the effect rises a further 13 points by December 2025, so more than half of the post-2021 effect arises inside one data source. The 100/100 series in Figure 4.3 moves at or before the seam and is flat within the BDC, so the whole 100/100 gap sits at or before the seam. If any of the seam jump is a reporting artifact, the effect and the location-years are too high.

FIGURE 4.3

CAF II and 100/20 access over the build years, terrestrial winners against areas with bids but no award



Treated blocks are terrestrial winners; Viasat's blocks are excluded. Block indicators from Form 477 through June 2021 and the BDC (tn100) from June 2022, reference June 2018, state-by-cost fixed effects, December 2025 location weights, 95 percent bands from county-clustered standard errors. The seam segment is dotted because the jump across it may be a change of instrument; the 100/100 offer is the same construction on the symmetric flag.

Three things stand out. First, the technology each winner committed to is the technology that appeared. Gigabit winners raised block fiber coverage by 39 points within five years and show no effect on 100/20 access from June 2022, because that series starts after most gigabit building and by 2025 the comparison areas had reached 100/20 from cable and fixed wireless. The gigabit subsidy bought, on fiber and years earlier, service that would have existed by 2025 from some technology. Above-baseline winners, mostly fixed wireless, raised 100/20 access claims by 17 points and produced no fiber. Baseline winners raised 100/20 claims by 15 points (Table 4.1).

Second, the fiber effect for gigabit winners has faded since 2023. The gap peaked in mid-2023 (Figure 4.2), was 39 points in December 2023, and was 34 in December 2025, narrower by about an eighth and not closed. Gigabit winners' areas reached the block fiber coverage their counterfactual path has now about four years before December 2025, and the counterfactual path needs four to five more years to reach the winners' level (Table E.4). Table 4.3 prices the tier.

Third, gigabit winners bid where they were already building. Winners' fiber lead over the comparison group grew by 6.2 points in the year before the auction (Table 4.1). In levels, winners' areas had about 9 percent block fiber coverage in June 2017 against 2 percent in losers' areas. Gigabit bidders, mostly electric cooperatives and small telcos, bid on areas adjacent to networks they were extending, which inflates the measured fiber effect by an amount these data cannot pin down.

Deployment by other providers

Chapter 3 finds that providers other than RDOF's winners expanded 100/20 service less in authorized areas. We run the same test for CAF II with provider-level BDC records for June 2022 and December 2025,

linking each winning bidder to its BDC identifiers through its FCC Registration Number, the Funding Map's CAF II records, which tie consortia to the members that file for them, and, for nine bidders, its brand name. The match covers all but six of the terrestrial winners and nearly all of their locations (Table 4.2). We drop the six unmatched bidders, count affiliates filing under other identifiers as other providers, and in losers' blocks count every provider, as in Chapter 3.

TABLE 4.2

Deployment by CAF II winners and by other providers, June 2022 to December 2025

100/20 access from	Gain, winners' areas	Gain, losers' areas	Effect points (SE)
Terrestrial winners			
The CAF II winner	29.7	0 by construction	28.9 (2.2)
Providers other than the winner	22.8	22.8	-3.5 (2.6)
Same, wireline only	13.4	18.6	-5.1 (2.2)
All assigned, Viasat included			
Providers other than the winner	24.4	23.5	-1.5 (2.3)
Gigabit tier			
Providers other than the winner	11.9	22.2	-12.3 (3.1)
Same, wireline only	5.1	19.8	-15.5 (2.8)
Above-baseline tier			
Providers other than the winner	24.9	22.4	2.0 (4.3)
Baseline tier			
Providers other than the winner	30.4	21.9	10.3 (3.7)

Matched winners only (96 of 102 terrestrial winners, 96.7 percent of their locations). Location-weighted changes in the share of December 2025 locations. 82,400 blocks for terrestrial winners; 25,575, 45,030, and 22,306 for the three tiers. Design as in Table 4.1.

Pooled, CAF II shows no crowd-out. Other providers' 100/20 coverage grew 23 points in both terrestrial winners' and losers' areas, an average of opposite results by tier. In gigabit winners' areas other providers grew 12 points against 22 in losers' areas, with a wider gap on wireline alone, the pattern Chapter 3 finds for RDOF (Table 4.2). Gigabit winners already offered 100/20 at 61 percent of their locations in June 2022, so the window shows other providers staying out after the subsidized fiber was in place. Above-baseline winners show no displacement, and in baseline winners' areas, where the winner committed only to 25/3, other providers gained more than in losers' areas. The gigabit pre-trend in Table 4.1 is a reason for caution about the size of that tier's gap.

Cost per additional location and per location-year

Table 4.3 prices the two effects the chapter can measure. For all winners on access, the support accrued through 2025 comes to \$2,080 per location-year of earlier access on the block series from 2018 (Appendix C, Table C.1), a lower bound on cost because the seam may inflate the location-years; terrestrial winners alone buy more years per funded location at a lower cost per location-year (Table E.2). Those figures use the funded-location base and would be 3 to 4 percent higher on the regression samples. The gigabit tier's fiber is the cheapest earlier service in the report, \$860 per location-year, because its fiber arrived in 2019

and 2020, four years before its counterfactual, on a block indicator that overstates the locations reached and a comparison group that was drifting away before the auction.

TABLE 4.3

CAF II: support per funded location, per additional location, and per location-year, accrued through December 2025

Measure	Effect percentage points (SE)	Per funded location	Per additional location (95% interval)	Years bought per funded location (95% interval)	Cost per location-year (95% interval)
100/20 access, all winners, from June 2022	10.1 (2.6)	\$1,160	\$11,400 (7,900 to 22,300)	0.56 (0.28 to 0.86)	\$2,080 (1,350 to 4,180)
Block fiber, gigabit tier, from June 2018	36.9 (4.3)	\$1,710	\$4,600 (3,800 to 6,000)	1.98 (1.54 to 2.43)	\$860 (700 to 1,110)

Support accrued from authorization through December 2025, \$790 million on 682,000 funded locations for all winners and \$230 million on 135,000 for the gigabit tier; the full ten-year commitments give \$17,600 and \$7,100 per additional location. The access row is the pooled estimate on 101,620 blocks, with years earlier integrated over the Form 477 block indicator through 2021 and the BDC after, so the seam makes its cost per location-year a lower bound. The gigabit row counts locations in blocks with fiber, which overstates locations reached, on a comparison group that was drifting before the auction. Intervals from a county bootstrap. Chapter 2 defines the measures and Chapter 8 the computation.

Adoption and speeds

Chapter 3's tract-intensity design has little power here. Only 420 tracts have a quarter or more of their locations in bid areas, and their Form 477 coefficients swing by 10 to 20 connections per 100 households between filings with standard errors of the same size. The ACS, which compares 2015 to 2019 with 2020 to 2024 and so brackets the build, is steadier. Across all assigned areas, wired subscriptions rose 6 points more than in loser areas, any broadband 6, and the share with no internet fell 5, none of them as much as two standard errors from zero.

In gigabit winners' areas alone, wired subscriptions rose 29 points more than in loser areas, with winners' areas up 15 points per unit share and losers' areas down 14; any broadband rose 14, satellite fell 18, and no internet fell 9, with standard errors of 5 to 8 points. It is the one adoption result in the report that reaches the extensive margin, and the 2015 to 2019 window includes the first two build years, which pushes it toward zero. It is also fragile. In the block groups with 10 to 25 percent of their locations in bid areas, a low-intensity band that still contains gigabit treatment and so is not a placebo, wired adoption rose with the share in bid areas of either kind, by 88 points per unit share for winners' locations and 49 for losers'. It needs the tract series at a finer grain before it is more than suggestive.

Measured speeds add nothing. Across the Ookla hexagons with tests in both periods, log download speed in gigabit winners' hexagons stays within 0.3 of the losers' in every period, with standard errors nearly as large, the lower tiers show +0.18 by October 2025, within two standard errors of zero, and both groups' median speeds rose from about 40 Mbps in 2019 to about 240 in 2025.

Problems

The access baseline is four years post-auction and unusable as a pre-period. The comparison group is areas terrestrial bidders wanted at a price above what the budget allowed, and after the screens it is the areas no one funded through two auctions and several grant programs. A BEAD award marks a location still unserved in 2025, and 56 percent of comparison locations carry one, against 5 percent for gigabit and

above-baseline winners; terrestrial baseline winners and Viasat sit closer to the comparison group. By 2025 the comparison group trails even Viasat's areas on fiber, by 9 points (Table 4.1), though Viasat built no fiber, and reweighting the comparison blocks to Viasat's own cost cells makes the drift larger, 16 points on block fiber (Table E.1). Viasat's areas are not the other tiers' areas, so the drift gives no correction for each tier, and the 2023 columns are the safer reading. We have not netted out state grants. And the pre-trend means we cannot defend an additional share for the gigabit fiber effect.

The FCC assigned support to bidders, so errors may be correlated within a bidder's blocks, but clustering by bidder instead of county barely changes the standard errors, 2.3 against 2.6 points for the pooled access effect and 5.6 against 4.6 for gigabit fiber.

Viasat and Wisper hold 85 percent of comparison locations, however, so the comparison group behaves like two clusters, and a wild cluster bootstrap by bidder gives a p-value of about 0.06 for the pooled access effect when every Viasat-only item forms one cluster and 0.01 when we cluster those items by county, the choice we prefer because Viasat's bid does not shape terrestrial deployment. The gigabit fiber effect has a bootstrap p-value below 0.001 either way; the pooled access effect is weaker evidence than its county-clustered standard error suggests.

Chapter 5. Enhanced A-CAM

Enhanced A-CAM has produced no measurable deployment on access in its first two years because the carriers that took the money had mostly finished building before they took it. Carriers that accepted the 2023 offer and carriers that declined it added service at the same rate through 2025. By itself that is not a criticism of the providers as they were not obligated to add access. We can still test whether A-CAM caused any changes.

The program

Enhanced A-CAM succeeds the model-based support that about half of rate-of-return carriers have received since 2016. In 2023 the FCC offered every rate-of-return carrier, state by state, a fixed annual payment for fifteen years, computed from the A-CAM cost model and capped at \$350 per location per month, in exchange for a commitment to offer 100/20 Mbps by 2028 at the locations the model designates as required. The offers carried a September 2023 deadline. Carriers accepted 356 of them, covering 3.2 million eligible locations and \$1.0 billion a year, and declined 453, covering 3.6 million locations; decliners kept their existing support, model-based or legacy, with its obligations. The offer included support for locations the carrier already served at 100/20 where no unsubsidized competitor also served them, and because it came from the model rather than from the carrier's costs, for many carriers, especially those on legacy support, it paid less than they already received. Acceptance therefore depended on the offer relative to existing support, on what remained to build, and on the carrier's plans, and the data do not say which of these selected carriers in.

What earlier work found

No one has evaluated Enhanced A-CAM, which is two years old, but the high-cost fund it belongs to has a record. Wallsten (2011) found that about 59 cents of each high-cost dollar went to the recipients' general and administrative expenses, GAO (2020) found the FCC's performance goals for the fund unmeasurable, and the FCC's inspector general found that the deployment verification behind the HUBB did not check whether reported dates matched when service began (FCC OIG 2025). Rosston and Wallsten (2024) concluded from twenty-five years of that spending that the fund has not made much difference in connecting households. None of this work has a comparison group, which the 2023 offer created by letting carriers decline it.

Program data and design

The FCC published the offer and acceptance lists keyed by state and Form 477 holding company number. We build each offered carrier's footprint from the blocks where it reported consumer copper or fiber service in June 2021, keep blocks with exactly one offered carrier, and drop blocks with RDOF, CAF II, CPF, or other program funding; blocks whose only other program is BEAD stay in, for the reason Chapter 2 gives. That leaves 640,000 blocks, 7.9 million locations, and 658 carriers. Standard errors cluster by carrier. The reference period is June 2023, the last BDC release before the offers, and the fixed effects are state by prior support mechanism. Figure 5.1 draws the block fiber series back to 2015 as a check on pre-offer trends.

Access effect

Appendix Table F.3 reports the period-by-period coefficients and standard errors behind this section.

TABLE 5.1

Effect of accepting Enhanced A-CAM, December 2025 relative to June 2023

Outcome	All offers points (SE)	Prior A-CAM carriers points (SE)	Prior legacy carriers points (SE)
Block has any fiber	-1.7 (1.1)	0.1 (1.7)	-3.4 (1.4)
Share of locations at 100/20, any terrestrial	0.9 (1.0)	2.1 (1.5)	-0.3 (1.2)
Share of locations with fiber	-1.2 (1.3)	0.6 (1.7)	-2.8 (1.9)
For scale: accepting carriers' own gain in 100/20 share	8.1	9.0	6.0

SEs clustered by carrier; 605 carriers with both groups in their state by prior-mechanism cell. Each release's location count is the denominator of the location shares. Seven holding companies hold both a prior A-CAM and a legacy study area in the same state (14,235 blocks, 146,452 locations), and the Form 477 footprint does not separate study areas, so those blocks carry one prior-mechanism label; assigning all of them to prior A-CAM instead moves the all-offers block fiber effect from -1.7 to -2.0 and turns the prior A-CAM carriers' fiber-share effect negative, and leaves the access effect unchanged. In June 2023, 84 percent of locations in accepting footprints and 88 percent in declining footprints already had a 100/20 offer.

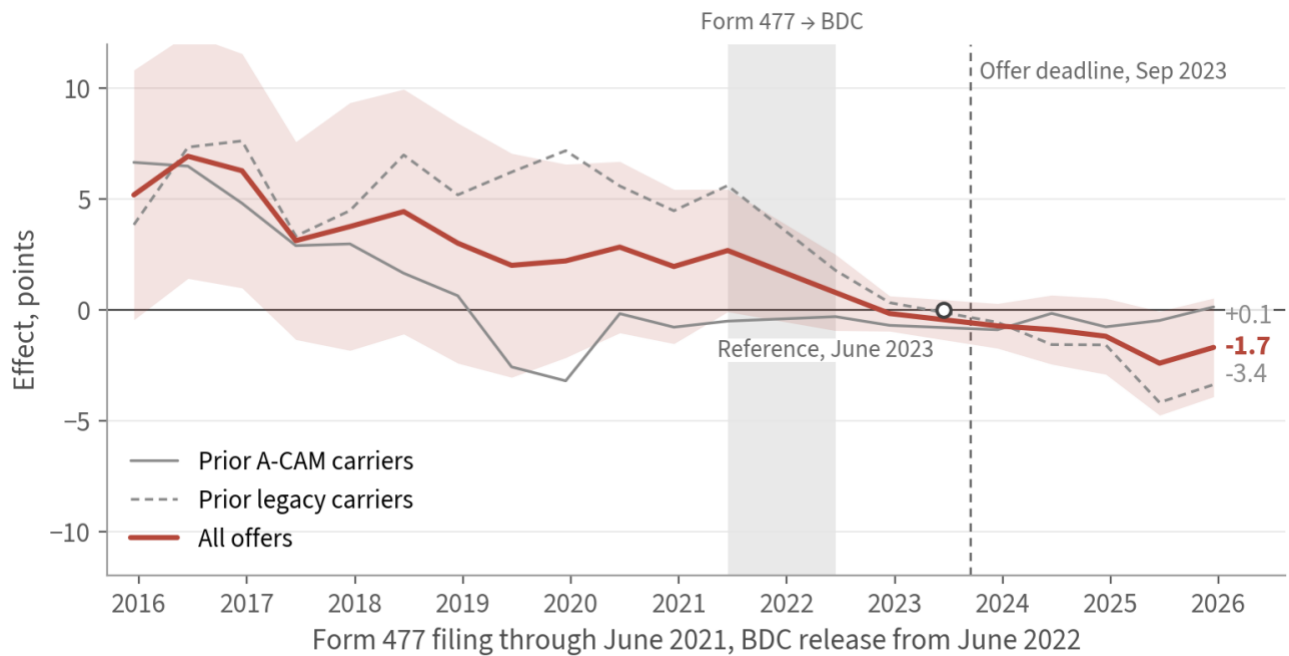
Little has happened yet that the data can see. The estimates in Table 5.1 are small and run in both directions. One is conventionally distinguishable from zero, minus 3.4 points of block fiber for prior legacy carriers. The prior A-CAM access estimate is 2.1 points against a gain of 9.0 points in those carriers' own footprints.

The levels explain why. In June 2023, 84 percent of locations in accepting carriers' footprints and 88 percent in decliners' already had a terrestrial 100/20 offer, 80 percent of both groups' blocks had fiber, and by December 2025 both groups were above 90 percent on both measures. Two years of support bought an effect whose interval includes zero (Table 5.3).

Because both groups started so close to full coverage, we also ask what share of the locations unserved in June 2023 gained a qualifying offer by December 2025. About 60 percent did in both groups' footprints, and within cells the accepting carriers' footprints filled that gap at the same rate as the decliners', a difference of 1.2 points with location weights and 4.9 points with blocks weighted by their unserved locations, neither distinguishable from zero.

FIGURE 5.1

Enhanced A-CAM fiber difference-in-differences series, accepting versus declining carriers, 2015 to 2025



Accepting-minus-declining difference in the block fiber indicator, relative to June 2023, with state by prior-mechanism fixed effects and 95 percent bands clustered by carrier; accepting carriers were 5 to 8 points ahead in 2016, the gap closed steadily through 2022, and nothing separates the two groups after the offer.

Entry

The support pays mostly for locations the accepting carrier already served, so the question that fits the program is whether that payment deters other providers from entering. The first test uses the block panel's count of locations with 100/20 offers from two or more terrestrial providers at every BDC release, with the reference, fixed effects, and clusters above. The second uses provider-level BDC records for June 2022 and December 2025, takes each offered carrier's BDC identity to be the copper or fiber provider covering the most of its footprint in June 2022 (a median of 84 percent), and counts locations with a 100/20 offer from any other provider, in the cleanest version only among the locations the incumbent already served at 100/20 in June 2022 (Table 5.2).

TABLE 5.2

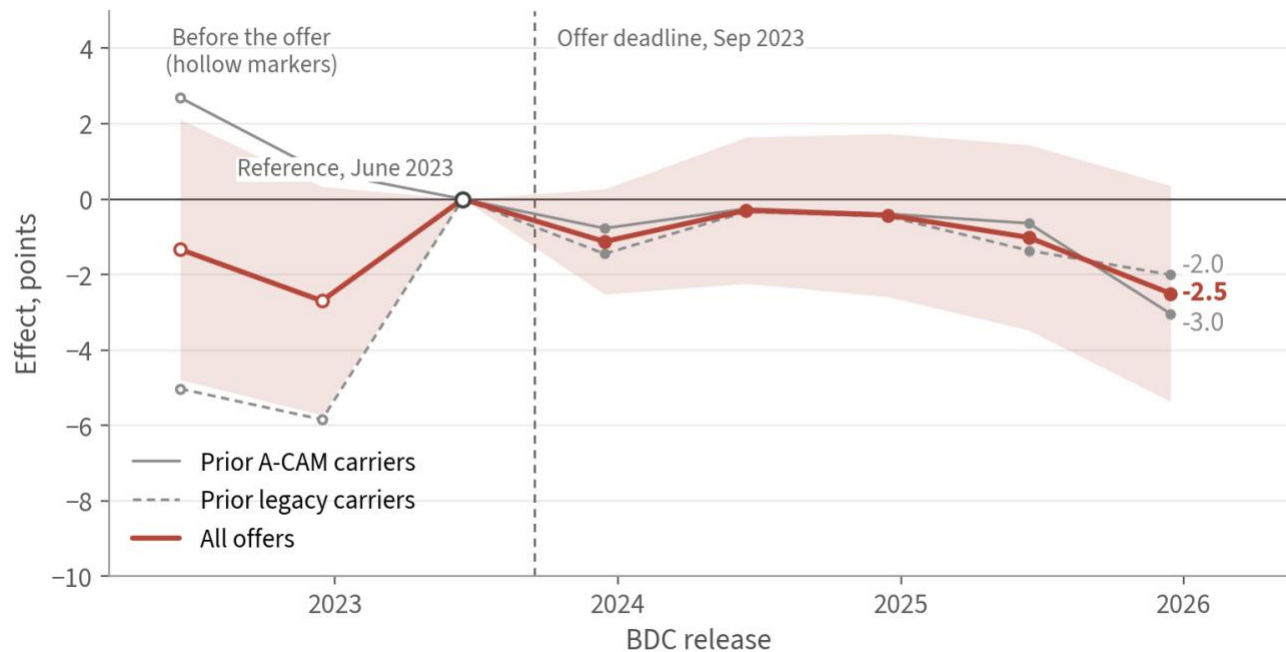
Entry by other providers, accepting versus declining carriers

Outcome	All offers points (SE)	Prior A-CAM carriers points (SE)	Prior legacy carriers points (SE)
Two or more 100/20 providers, Dec 2025 relative to June 2023	-2.5 (1.5)	-3.0 (1.9)	-2.0 (2.2)
Placebo: same, June 2022 relative to June 2023 (before the offer)	-1.3 (1.8)	2.7 (1.4)	-5.0 (3.0)
Non-incumbent 100/20 offer, June 2022 to Dec 2025	-1.2 (1.7)	-2.5 (2.7)	0.1 (2.0)
Non-incumbent fiber offer, June 2022 to Dec 2025	3.3 (1.6)	3.8 (2.4)	2.9 (2.0)
Among the 4.5 million locations the incumbent already served at 100/20 in June 2022			
Non-incumbent 100/20 offer, June 2022 to Dec 2025	-2.6 (1.7)	-5.1 (2.4)	-0.8 (2.4)
For scale: growth of that share in declining footprints	5.4	8.6	4.0

First four rows: shares of December 2025 locations, 534,555 to 541,808 blocks, 605 carriers. Last two: 365,971 blocks, 552 carriers. State by prior-mechanism fixed effects, carrier-clustered SEs. Negative means entry grew less in accepting footprints.

FIGURE 5.2

Locations with two or more 100/20 providers, accepting minus declining carriers



The first row of Table 5.2 at every BDC release, relative to June 2023, with 95 percent bands.

Second-provider coverage grew about 12 points in both groups' footprints between June 2023 and December 2025. Table 5.2 shows accepting carriers' footprints gaining slightly less of it within cells and slightly less entry onto locations the incumbent already served. Only the estimate for prior A-CAM carriers on those already-served locations, 5.1 points less, is conventionally distinguishable from zero.

Two things stop us from calling it deterrence. The placebo row of Table 5.2 shows differences of the same size in the year before the offer, in both directions, so the post-offer differences sit within the range the series shows with no treatment. And decliners may have declined because they saw an entrant coming. Non-incumbent fiber grew more in accepting footprints, not less. The point estimates lean toward a small effect on 100/20 overbuilding, about 3 points on a base of 5 to 9, and none on fiber entry, neither distinguishable from the pre-offer movement.

Cost per additional location and per location-year

Table 5.3 shows why the chapter reports no cost per additional location. Two years of support comes to \$625 per funded location, and the access effect it bought is 0.4 points with an interval that includes zero, so the cost per additional location is undefined and no location-years can be computed; the point estimate alone would imply about \$139,000. The cost that matters for A-CAM is the difference between the new offer and the legacy support the decliners kept, which Chapter 8 lists among the missing pieces.

TABLE 5.3
Enhanced A-CAM: support per funded location and the cost the effect does not identify, two years through December 2025

Measure	Effect percentage points (SE)	Per funded location	Per additional location (95% interval)	Years bought per funded location (95% interval)	Cost per location-year (95% interval)
100/20 access	0.4 (1.2)	\$625	— ^a	—	—

Support is two years of Enhanced A-CAM payments to accepting carriers, \$1,997 million on 3,195,000 locations in the analytic sample. a. The interval on the effect includes zero, so no cost per additional location or location-year is identified; the point estimate, 0.45 unrounded, implies about \$139,000. The relevant cost for A-CAM is the difference between the new offer and the legacy support the decliners kept, which the report does not have (Chapter 8). Chapter 2 defines the measures.

Adoption and speeds

A carrier with fifteen years of predictable support might upgrade its plant beyond the required 100/20, so Table 5.4 tests offered tiers, measured speeds, and subscriptions on the same footprints and fixed effects as Table 5.1.

TABLE 5.4

Enhanced A-CAM: offered tiers, measured speeds, and adoption, accepting minus declining carriers

Outcome	Accepting		Declining		Effect (SE)
	before	after	before	after	
Offered tiers, percent of locations; effect in points (June 2022 to Dec 2025)					
Gigabit download offer, incumbent	49	63	47	64	−3.1 (2.1)
Symmetric 100/100 offer, incumbent	52	64	49	64	−3.7 (1.8)
Fiber offer, incumbent	54	65	52	66	−3.8 (1.5)
Gigabit download offer, any provider	70	86	73	90	−1.4 (1.7)
Measured speed, Ookla (Apr 2023 to Oct 2025)					
Median download, Mbps; effect in 100 × log points	162	266	175	265	+5.3 (2.7)
Share of tiles at 100/20, percent; effect in points	57	79	59	79	+0.8 (1.7)
Adoption; effect in points					
Form 477 connections per household, any speed (Dec 2020 to Dec 2024)					+0.8 (0.9)
Form 477 connections at 25 Mbps or better (June 2022 to Dec 2024)					+1.4 (1.2)
ACS wired broadband, 2015 to 2019 vs 2020 to 2024					+1.4 (0.5)
ACS any broadband					+0.8 (0.5)
ACS no internet					−0.8 (0.4)

Offered tiers from the provider-level BDC, 541,808 footprint blocks, state by prior-mechanism fixed effects, location weights, carrier clusters. Ookla from 59,000 hexagons. Adoption from tracts and block groups with at least half their locations in offered footprints, state fixed effects, county clusters.

Median measured download speeds rose 64 percent in accepting carriers' footprints and 51 percent in decliners' between April 2023 and October 2025, and the within-cell difference of about 5 percent in the accepting carriers' favor is within the movement of the two years before the offer. Subscriptions moved by one to two connections per 100 households, with standard errors of the same size, and the ACS wired-broadband difference comes from a window that ends before most of the offer's money arrived (Table 5.4). Two years in, the offer has not changed what the accepting carriers' territories get, and the test that matters for a support program, whether the payment deters entry, shows nothing distinguishable from the pre-offer movement (Table 5.2). What the money bought over the legacy support the decliners kept is the cost the report cannot compute.

Problems

The comparison group chose itself. Carriers declined when the offer paid less than legacy support or when they had little left to build, so decliners were further along and the estimates understate any effect; an effect large enough to matter would show up as accepting carriers closing a gap that is now under ten points, and it has not. The fiber series for legacy carriers shows a pre-trend, with accepting carriers ahead by 7 to 8 points in 2016 and converging by 2022, the same self-selection seen from the other side. The footprints come from 2021 Form 477 and inherit its errors. Two years is early for a fifteen-year program with a 2028 deadline, and early for the entry test.

Chapter 6. The Capital Projects Fund

CPF has no comparison group of its own because states chose projects and neither they nor the Treasury Department, which oversaw the program, published rejected applications. The design here rests on seven years of parallel fiber history before the program rather than on anything the program created.

The program

The American Rescue Plan Act of 2021 gave Treasury \$10 billion for capital projects, and states directed most of it to broadband. Treasury approved the first state broadband plans in June 2022 and the last of the fifty in September 2023, by which point it had awarded \$8.4 billion for broadband and estimated that the projects would reach two million locations, \$4,200 per location. States then ran their own grant competitions, most of them in 2023 and 2024, under a program rule that funded networks deliver 100/100 Mbps or be scalable to it. The FCC Funding Map records 1.22 million unique CPF locations in 46 states, \$6,900 per mapped location, 93 percent of them fiber, with 4 percent reported complete by December 2025 and most deployment dates blank. The map covers about 60 percent of Treasury's estimate, so some CPF locations sit in our comparison group, which pushes every estimate below toward zero.

What earlier work found

We found no evaluation of the Capital Projects Fund. Treasury published award totals and state plans, and GAO (2026a) reviewed the federal broadband effort it belongs to without estimating its effect. Treasury's inspector general began an implementation audit of the program, one of eight covering the department's pandemic programs, and terminated all eight in December 2025 because the programs were reaching the end of their performance periods and the office lacked the resources to continue; the closing memorandum reports no concerns about how Treasury set up and administered CPF, and says nothing about what the money built (Treasury OIG 2025). The program will therefore be judged, if at all, on data like the data here.

Program data and design

With no rejected applications to use, we build a comparison group. The comparison blocks lie in the same counties as CPF blocks, fall inside the range of location density of the county's CPF blocks, carry no federal award from any other program, and, like the CPF blocks, had fewer than half their locations with qualifying 100/20 access in June 2022. The restriction applies to both groups; restricting only the comparison group pairs blocks that had nothing with blocks that had half, and the pre-period coefficients fail. That leaves 1.14 million locations in CPF blocks and 2.07 million in comparison blocks, in counties that contain both, 76,284 CPF blocks and 195,732 comparison blocks. Blocks with BEAD awards stay in both groups, for the reason Chapter 2 gives; dropping them would remove 39 percent of CPF locations.

The estimator is the one used for RDOF. For each period we regress the change in the outcome since June 2022, the last BDC release before the first Treasury approval, on a CPF indicator with county fixed effects, weight by locations, and cluster by county. The block fiber series from Form 477 extends the pre-period to December 2015, twelve periods before the program in which to check that the two groups moved together. They did: the pre-period coefficients on block fiber lie between -0.2 and -0.9 points, with standard errors near 0.4 (Figure 6.1, panel B). That is the testable half of the parallel-trends assumption; the other half, that a state's choice of project was unrelated to what would have happened without the grant, cannot be tested.

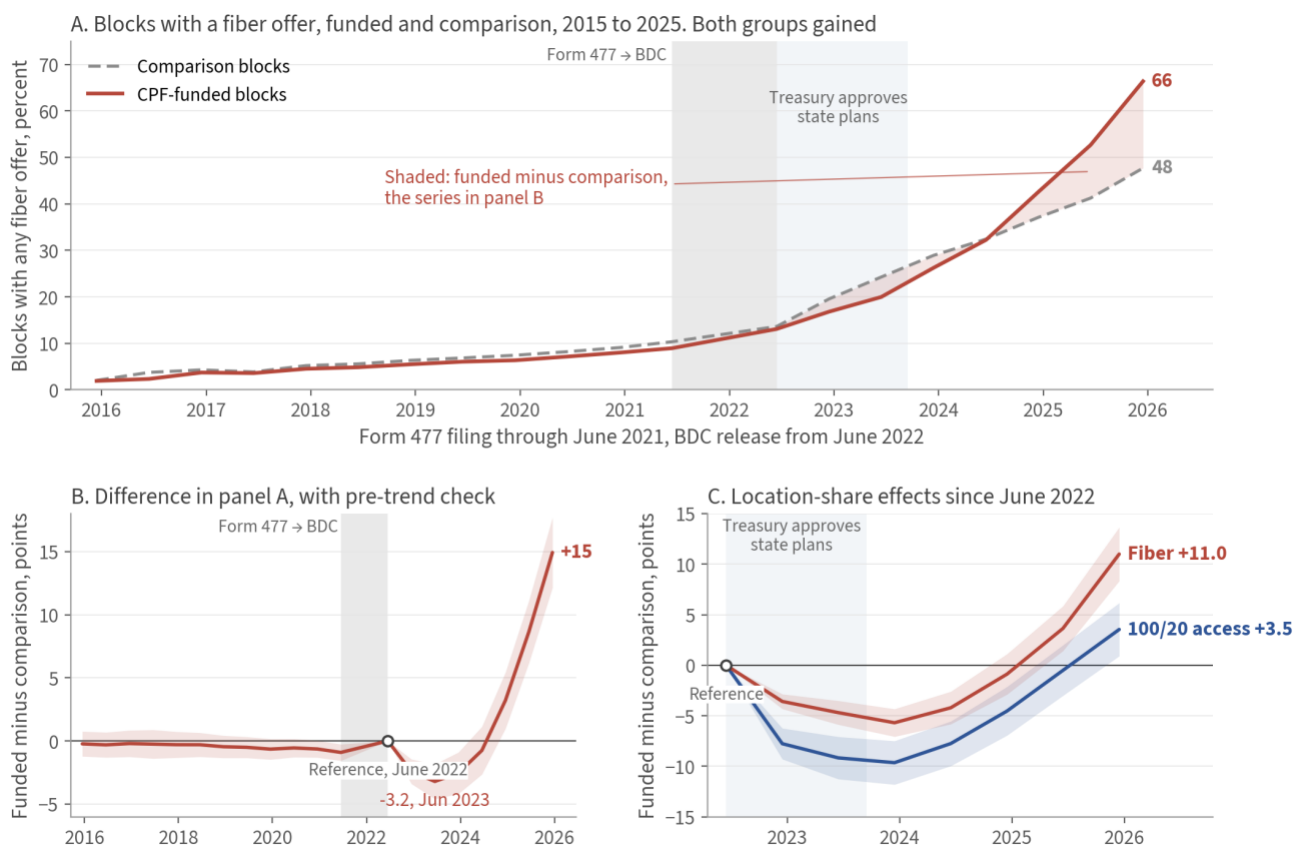
Access effect

Appendix Table F.4 reports the period-by-period coefficients and standard errors behind this section.

Figure 6.1 shows what happened to fiber in both groups and what the program added. Panel A plots the share of blocks with a fiber offer from 2015 to 2025. Both groups were transformed over the period, from under 5 percent to 66 percent in funded blocks and 48 percent in comparison blocks, and the comparison blocks did it without federal money. The program's contribution is the gap between the two paths, shaded, which panel B plots as a series with its pre-trend check.

FIGURE 6.1

Fiber in CPF-funded and comparison blocks, both under 50 percent access in June 2022, the difference between them, and the effects on access and fiber since June 2022



Panel A: location-weighted share of blocks with any fiber offer, Form 477 through June 2021 and the BDC from June 2022, with the funded-minus-comparison gap shaded from June 2022. Panels B and C: coefficients on CPF funding from period-by-period regressions of the change since June 2022 with county fixed effects, location weights, and county-clustered standard errors, with 95 percent bands; panel B is the block fiber indicator over the full period, panel C the BDC location shares. 76,284 CPF blocks and 195,732 comparison blocks. The blue band marks Treasury's approvals of state plans, June 2022 to September 2023.

Panels B and C show the differences, and the path is a J. Relative to June 2022, CPF blocks fell 9 to 10 points behind comparison blocks on access and 3 points on block fiber by the end of 2023. On block fiber the gap had already turned positive by December 2024; on access and location-level fiber the funded blocks stayed behind through 2024 and overtook the comparison blocks in 2025.

Two explanations fit the dip, and the data do not separate them. Providers may have held off building where a grant was expected, the anticipation Appendix G proposes to test. Or states may have directed grants to the places no one was about to build, in which case the comparison blocks were on a rising private path the CPF blocks were not on, and the dip is the selection showing through. Either way, with 96 percent of funded locations not yet reported complete, the December 2025 coefficient is the whole of what the program had added by then. It will rise as the build completes if the comparison blocks do not catch up

in the meantime, which CAF II and New York show they can, so the projection in Table 6.2 is a scenario, not a floor.

TABLE 6.1

What CPF added by December 2025, blocks under 50 percent access in June 2022

Outcome	Effect points (SE)	Share of CPF gain	Gain in CPF blocks pts	Gain in comparison blocks pts
Qualifying 100/20 access	3.5 (1.3)	6%	55	51
Fiber, location share	11.0 (1.4)	24%	46	31
Block fiber indicator	14.9 (1.4)	28%	53	34
Symmetric 100/100 offer	7.5 (1.4)	16%	48	38
Gigabit download offer	5.4 (1.5)	12%	46	39

Effects are the December 2025 coefficients from Figure 6.1 and the same regression on the location-level tiers; share = effect ÷ gain in CPF blocks. Bootstrap intervals, which resample counties, are 2 to 10 percent on access, 19 to 28 on location fiber, and 24 to 32 on block fiber. Starting levels were near equal by construction, at 9 and 11 percent on access, 3 and 3 on location fiber, and 13 and 14 on block fiber. Ookla median download in CPF hexagons rose 39 log points (SE 5) relative to comparison hexagons between April 2020 and October 2025, from 20 to 190 Mbps against 54 to 255, over 57,000 hexagons with tests in both periods.

Table 6.1 puts the effects beside the gains. CPF blocks gained 53 points of block fiber coverage, of which 15 are attributable to the program. The additional share is 28 percent on block fiber and 6 percent on qualifying access, with the location-level fiber share and the bootstrap intervals, which resample counties, in the table. The pattern matches RDOF's. The money bought fiber in places that were mostly getting 100/20 service by some technology anyway, and the technology-neutral measure of what the program did is small.

Cost per additional location and per location-year

Table 6.2 converts the effects to cost. On Treasury's commitment per funded location, the program has bought fiber at about \$24,500 per additional location and qualifying access at \$76,000; the cost per additional location in a block with fiber is about \$18,000, and on the Funding Map basis each figure is about 60 percent higher. The figures omit the provider matches most states required, and they treat every CPF location missing from the Funding Map as unfunded, which pushes the effect down and the cost up.

TABLE 6.2

CPF: support per funded location, per additional location, and per location-year, committed, with the 2029 projection

Measure	Effect percentage points (SE)	Per funded location	Per additional location (95% interval)	Years bought per location in funded blocks (95% interval)	Cost per location-year (95% interval)
100/20 access	3.5 (1.3)	\$4,200	\$76,000 (45,000 to 280,000)	–0.19 observed; 0.38 projected (0.31 to 0.45)	\$7,100 projected (6,000 to 8,610)
Fiber, location share	11.0 (1.4)	\$4,200	\$24,500 (19,700 to 32,200)	–0.05 observed; 1.17 projected (1.12 to 1.22)	\$2,300 projected (2,200 to 2,400)

Support is Treasury’s commitment, \$3,056 million on 728,000 funded locations, not disbursements; the interval on cost per additional location inverts the bootstrap interval on the effect at that fixed support, so it is an inverted effect interval rather than a percentile interval of cost draws (six of 1,000 draws have a negative effect); 4 percent of funded locations were reported complete in December 2025. Per additional location is on the full commitment and the December 2025 effect, which the effect at completion will lower. Years earlier and location-years are per location in the funded blocks (1,137,000, of which 728,000 are CPF-funded); observed values are negative because funded blocks trailed comparison blocks for two years. The projection takes the effect to 36 points of fiber and 17 of access at the December 2026 deadline, fades it at 5.9 percent a year, and integrates through December 2029; with no fade the access figure is \$6,300 and with a three-year fade to zero \$15,900. Intervals from a county bootstrap with the projection held fixed. Chapter 2 defines the measures and Chapter 8 the computation.

They are also December 2025 figures for a program that had reported few completions and must finish construction by December 2026, or June 2027 with the extension Treasury offered in May 2026. CPF-funded locations are 64 percent of the locations in the funded blocks, so if every funded location has fiber at completion and the rest follow the comparison blocks, which have added about 10 points of fiber and 11 points of access a year, the effect at completion is that share of the comparison locations that still lack fiber then.

At that pace the funded blocks would be 36 points ahead on fiber at completion and 17 on access, which puts the cost near \$7,500 per additional fiber location and \$15,800 per additional location with access; a mid-2027 finish adds a thousand or two to each. Both assumptions favor the program, since not every funded location will be built and the comparison pace may hold.

After completion the effect fades, at 5.9 percent a year on the CAF II gigabit and New York pattern, because the unfunded blocks keep getting fiber (Figures 4.2 and 7.2), and the projection integrates it only through December 2029, which understates location-years and overstates the cost relative to a longer horizon. Table 6.2, restated in Table 8.1, gives the projected cost per location-year on these assumptions; the fade assumption matters more than sampling error, and the table note gives the access figure with no fade and with a three-year fade to zero.

Table E.4 restates the effects as time. By December 2025 the funded blocks had reached the fiber coverage their counterfactual path has now about five months earlier, and the counterfactual needs about 1.1 more years to reach where the funded blocks are; on access the figures are two and four months. At completion, on the assumptions above, the program would have bought about three and a half years on fiber and about a year and a half on access.

Adoption and speeds

CPF’s stated goal was 100/100 service. Table 6.1 shows the program raised the share of locations with a gigabit download offer by 5.4 points and with a symmetric 100/100 offer by 7.5 points, twice its effect on qualifying access, which is what a fiber program should show against a comparison group that was getting cable and fixed wireless.

Measured speeds rose more in funded areas than in comparison areas, and most of the rise came before any CPF service. Ookla speed tests, aggregated to hexagons assigned to CPF or comparison by the plurality of their sample locations, show download speed in CPF hexagons rising 39 log points relative to comparison hexagons between April 2020 and October 2025, about 48 percent, with pre-period coefficients near zero through 2022 and a steady rise from 2023 (Table 6.1). The share of tests reaching 100/20 ran 5 to 9 points behind the comparison hexagons from 2022 through 2024 and had caught up by October 2025.

The log effect had reached 19 points by October 2024, before any access effect, since the access coefficient was still negative then, so that part of the speed gain is not the program's service. Comparison hexagons also started well ahead of CPF hexagons (Table 6.1), so part of the log effect is convergence, and the level gap says the two groups differ in ways the block design does not remove.

Adoption cannot be tested yet. The Form 477 tract subscription series ends in December 2024, when the access effect was still negative, and shows nothing in either direction: connections per household, at any speed or at 25 Mbps downstream or better, moved by no more than four per 100 households in either direction, with standard errors of three. The ACS 2020 to 2024 five-year estimates end before most construction and show effects within two standard errors of zero on every category except the no-internet share, which fell 1.5 points (SE 0.7) in the 25 percent sample, a window that ends before the access effect turned positive. CPF's adoption test will need the 2025 ACS and Form 477 releases.

Speed and its price

Congress authorized CPF in March 2021 and BEAD in November 2021. Treasury had all fifty state CPF plans approved by September 2023; NTIA approved the last BEAD final proposals in August 2026, and providers expected construction to begin in the second half of that year. By the end of 2025 CPF had added 15 points of block fiber coverage across the funded blocks in our sample against a BEAD baseline of zero, and at any discount rate a location served in 2025 is worth more than the same location served in 2028. CPF was fast, and it left no evaluation record, since states published neither scoring rules nor the applications they rejected.

Problems and what would help

A rejected-applicant comparison in the three or four states that publish scored applications would give CPF a design of the same quality as CAF II's; Chapter 7 applies that design to Wisconsin, and Appendix G lists the other states with usable data. Treasury's annual compliance reports will eventually give completion dates that allow a difference-in-differences series around construction rather than around the award.

Chapter 7. State grant programs: Wisconsin and New York

Wisconsin

Wisconsin's Broadband Expansion Grant program shows a higher additional share than RDOF. The comparison group is applications the Public Service Commission did not fund, the best comparison a discretionary grant program can offer, and the estimates rest on blocks that lacked 100/20 service in mid-2022, where the two groups had no fiber and parallel trends for six years before the awards.

The program

The PSC has awarded broadband grants every year since 2014, \$197.6 million for 339 projects through the FY2023 round, plus \$99.9 million for 83 projects from ARPA funds in 2021 to 2022 and \$5.4 million from CARES funds in 2020. A staff screening panel ranks every application on statutory priority factors, chiefly match percentage, unserved locations, and public-private partnership, adjusts for overlap with other proposals and prior awards, and the Commission funds down the merit list until the money runs out. In FY2023, applicants requested \$73.7 million, the Commission had \$16.9 million, and the cutoff fell at rank 20.

What earlier work found

The state's Legislative Audit Bureau reviewed the program in 2022 and found that the Commission did not document whether providers built the infrastructure it reimbursed (Wisconsin LAB 2022). Whitacre and Gallardo (2020) found availability higher in states with funding programs over 2012 to 2018, before Wisconsin's large rounds. Neither compares funded areas with the applicants the Commission turned down, which is the design here.

Program data and design

The PSC publishes polygons for every awarded project since FY2014, with award, technology, and application number, and applicant polygons for three rounds, FY2022, FY2022 ARPA, and FY2023. Application numbers match award numbers exactly, which gives 168 funded and 326 unfunded applications with mapped areas; the other 15 have no polygon. We assign each 2020 census block to the application and award polygons containing its internal point and take outcomes from the Chapter 2 block panel; the merit lists come from the Commission's dockets. The 2022 awards came in March and June 2022, so the June 2022 BDC baseline precedes construction.

Treated blocks lie inside a funded application's polygon. Comparison blocks lie inside an unfunded application's polygon of the same round, outside every PSC award footprint of any round, and outside any federally funded area other than BEAD. The estimator is the Chapter 2 period-by-period regression with round and county fixed effects, weighted by locations, with standard errors clustered by application, the unit the Commission funded or rejected.

The baseline problem is severe. In June 2022, 75 percent of locations in unfunded application areas had a terrestrial 100/20 offer against 49 percent in funded areas. A full-sample comparison would confound the subsidy with the headroom left to gain, so the main sample is blocks with no 100/20 offer in June 2022, a condition on the baseline level in both groups. Both groups had under 1.5 percent block fiber coverage in June 2021, and the pre-award coefficients for every filing from 2015 to 2020 are no larger than their standard errors of about 0.6 points, so the restriction does not pick blocks on different trajectories.

Access effect

Appendix Table F.5 reports the period-by-period coefficients and standard errors behind this section.

TABLE 7.1

Effect of a Wisconsin grant, blocks unserved at 100/20 in June 2022

Outcome, December 2025	Effect points (SE)	Gain, funded areas	Gain, unfunded areas	Share of gain
Any terrestrial offer at 100/20	42.8 (4.3)	80.9	38.7	53%
Same, adding unlicensed fixed wireless	40.1 (4.3)	82.1	43.6	49%
Any terrestrial offer at 25/3 ^a	24.6 (4.1)	42.2	11.0	58%
Share of locations with fiber	47.3 (4.2)	78.9	27.6	60%

8,138 blocks in identifying cells (8,140 before dropping singleton cells), 3,704 treated, 72,000 locations, 343 applications. Round and county fixed effects, December 2025 location weights, SEs clustered by application. Gains are location-weighted changes from June 2022. Share intervals: 36 to 67 percent on access, 43 to 75 on fiber. a. Uses release-level counts whose ratios can exceed one in early releases; provisional.

FIGURE 7.1

Fiber in funded and unfunded application areas, blocks unserved in June 2022, and the difference between them

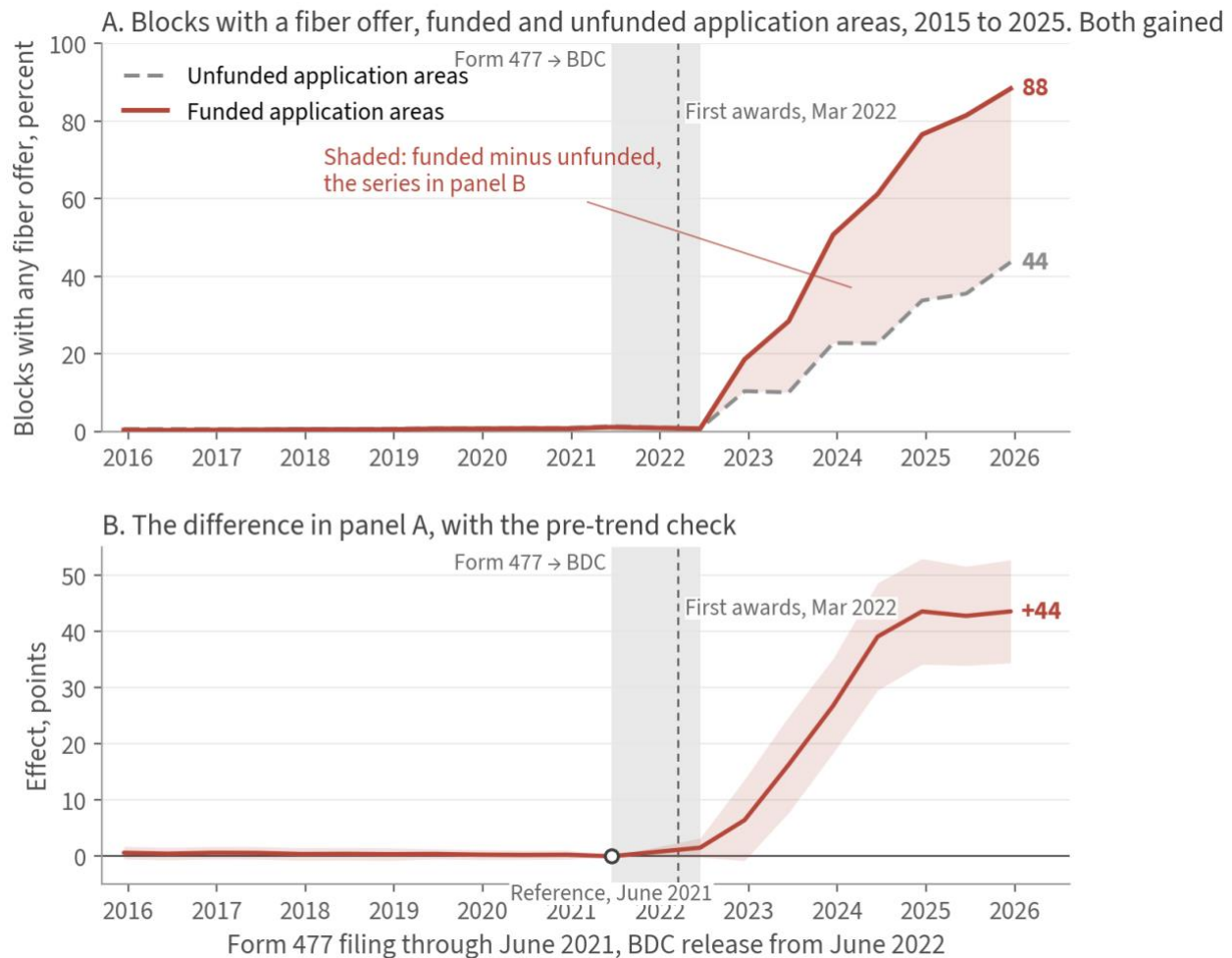


Figure 7.1 plots the share of blocks with a fiber offer in funded and unfunded application areas from 2015 to 2025 (panel A) and the funded-minus-unfunded difference relative to June 2021 (panel B) for the Table 7.1 blocks. Both groups went from almost no fiber to a great deal of it, 88 percent of funded blocks and 44 percent of unfunded blocks by December 2025, so the unfunded applicants' areas got about half as far on their own. Panel B plots the difference with 95 percent intervals clustered by application; the pre-award points sit on zero, and the effect reaches 44 points by December 2025 (Table 7.1's fiber row in a different specification).

The grants raised 100/20 access by 43 points at December 2025, an additional share of 53 percent, and raised fiber's additional share to 60 percent; Table 7.1 gives the intervals from resampling counties, and resampling applications, the unit of clustering, gives a similar interval. The effect appears within a year of the awards and levels off in 2025 as funded projects close out. Table 7.2 prices the effect.

The effect is 36 points in the FY2022 state round, 39 in the ARPA round, and 67 in FY2023, which has only 420 blocks.

Funded fixed wireless projects show 31 points on 100/20 access, unlike RDOF's wireless winners, though on 265 blocks and on the provider's own filings.

The merit lists let us narrow the comparison to applications ranked near the funding line. The Commission did not fund strictly down the list; in FY2022 it funded applications ranked as low as 132 and passed over some ranked as high as 45, so rank selects the comparison group rather than serving as a running variable.

Keeping only unfunded applications ranked no more than 20 places below the last funded one leaves the access effect at 42 points, and no more than 10 places below at 38; fiber moves from 47 to 42 points. Applications ranked just below the line did about as well without money as those ranked far below, so low-ranked applications were not areas about to be served anyway.

Provider-level BDC records test for displacement. We match each funded application to the BDC identifiers of the provider it names, which covers 97 percent of the locations in funded applications; the nine unmatched applications name no provider or file under no recognizable name. With Table 7.1’s fixed effects, weights, and clusters, other providers’ coverage grew 13 points less in funded areas by December 2025. About half of that gap is rejected applicants building on their own; removing their offers from unfunded areas, as we remove the grantee’s from funded areas, leaves a gap we cannot distinguish from zero. The rest is third providers staying out of funded areas. Table 7.1’s additional share already counts the rejected applicants’ building as part of the counterfactual.

Cost per additional location and per location-year

Table 7.2 prices the effect in the unserved sample. The state money that went to blocks unserved in June 2022 bought access at \$6,400 per additional location and \$2,850 per location-year. Fiber costs about the same per location-year. The full-sample estimate, which the problems section treats as confounded, gives \$10,800 per additional location.

TABLE 7.2
Wisconsin: support per funded location, per additional location, and per location-year, blocks unserved in June 2022

Measure	Effect percentage points (SE)	Per funded location	Per additional location (95% interval)	Years bought per funded location (95% interval)	Cost per location-year (95% interval)
100/20 access	43.3 (4.4)	\$2,780	\$6,400 (5,300 to 8,000)	0.97 (0.66 to 1.23)	\$2,850 (2,240 to 4,160)
Fiber, location share	47.3 (4.2)	\$2,780	\$5,800 ^a	1.01 (0.70 to 1.27)	\$2,740 (2,170 to 3,960)

Support is the \$91 million of the state’s \$236 million that went to blocks with no 100/20 offer in June 2022, 33,000 funded locations, one-time grants, all paid. The access effect is the treated-weighted difference of Table E.3; the fiber effect is Table 7.1’s. a. Point estimate on the Table 7.1 effect; no interval computed. On all funded blocks, the estimate the problems section treats as confounded, the grants are \$2,800 per funded location and \$10,800 per additional location. Intervals from a county bootstrap. Chapter 2 defines the measures and Chapter 8 the computation.

Adoption and speeds

Neither adoption nor measured speed shows an effect yet, and neither test has much power; only 306 tracts have a quarter of their locations in application areas, and the standard errors are about as large as the effects. Form 477 connections at any speed rose 4.5 per 100 households more in funded tracts than in unfunded ones by December 2024, relative to December 2021, and connections at 25 Mbps downstream or better rose 15 more relative to June 2022; the pre-award coefficients from 2018 to 2021 are within one standard error of zero. The ACS window ends before most construction and shows nothing distinguishable from zero on any category (wired –2.2 (3.3), any broadband –2.0 (2.9), no internet +2.4 (2.9) points). Ookla log download speed in funded hexagons rose 0.16 more than in unfunded ones by October 2025, relative to October 2021, and the share of tiles at 100/20 rose 4 points more. These are early and coarse.

Problems

Even within blocks unserved at baseline, unfunded applications may have proposed areas that were cheaper to serve without a grant or that another provider was about to serve, and the pre-trend test cannot see intentions that had not yet produced fiber, as in Chapter 3. The near-cutoff comparison keeps every funded application and drops only unfunded applications ranked far below the line, so it is one-sided, and because the Commission skipped applications it is not a discontinuity design.

The unserved-in-2022 restriction conditions on a noisy baseline, but it applies to both groups and the pre-period is flat, so we do not think mean reversion drives the result. The full-sample estimate with baseline-bin fixed effects is 26 points on the reweighted run and 22 with cells (Table E.1), about half the restricted estimate, and the difference is not fully explained.

Project polygons are the applicant's proposal, not the built network, so partial builds count whole areas as treated, which biases the effect toward zero. We exclude federally funded blocks from the comparison group and not from the treated group; 26 percent of treated blocks in the unserved-2022 sample carry RDOF, Enhanced A-CAM, ReConnect, or CPF funding. Dropping those blocks gives 41 points on access. Coding them as untreated comparison blocks gives 28 points, a lower bound, since it treats subsidized locations as unsubsidized.

In the other direction, Wisconsin's 2020 to 2023 award footprints cover 16 percent of the RDOF-authorized and 25 percent of the RDOF-cancelled locations in the state's part of the Chapter 3 sample. The fiber pre-trend is flat; a Form 477 pre-period at 25/3 is not quite, and Appendix D reports it.

New York

The program

New York's Broadband Program, a reverse auction run in three phases from 2016 to 2018, was the template for RDOF. Its awards raised block fiber coverage within five years, and the effect has since faded as the comparison areas catch up, the RDOF and CAF II pattern with a longer horizon. The comparison group, the blocks the state awarded to Hughes satellite service, is not a clean one.

Empire State Development ran the program with \$500 million of state money, awarding \$487.2 million over three phases (March 2016, November 2016, and January 2018) for 126 projects, the state comptroller's audit total, of which \$472.6 million went to terrestrial awards and is the figure used here. Awards went by census block at a 100 Mbps standard. After the third phase the state assigned every remaining eligible block, 34,000 of them, to Hughes Network Systems for satellite service. Terrestrial winners took 21,000 blocks; Verizon, Frontier, Fairpoint, Armstrong, and TDS were the largest.

What earlier work found

The State Comptroller audited the program in 2022 and found that 31 percent of its housing units were connected by satellite at 25 Mbps (New York OSC 2022), the awards this chapter uses as its comparison group. We found no estimate of what the terrestrial awards added.

Program data and design

The state publishes the awarded blocks for each phase with the awardee and housing units awarded. It does not publish losing bids, so the comparison group is the Hughes blocks, the role Viasat plays in Chapter 4. In the estimation sample, 57 percent of the blocks in each group later received federal funding, mostly RDOF. Outcomes are Form 477 block indicators for fiber and for any terrestrial offer at 25/3 and at 100/20

from December 2015, the last filing before the first awards, extended with the BDC block indicators from 2022. The sample is 27,449 blocks, 15,163 of them terrestrial awards.

Access effect

Appendix Table F.6 reports the period-by-period coefficients and standard errors behind this section.

The main sample keeps blocks that BEAD later funded and drops blocks that RDOF, CAF II, Enhanced A-CAM, CPF, or another program funded before 2025, for the reason Chapter 2 gives, which leaves the 108,000 funded locations of Table 7.3. On fiber, the gap opens in the second half of 2018 after the phase 3 awards, reaches 42 points in June 2021, and declines to 32 points by December 2025 as Hughes areas gain fiber from other sources (Table 7.3). Dropping the federal-funding screen raises both numbers a little, and excluding every federally funded block, BEAD included, lowers them.

The additional share of fiber is about 58 percent at the peak and 35 percent by 2025, with a 95 percent interval of 27 to 44 percent. The series begins in December 2015 and the first awards came in March 2016, so the coefficients through mid-2018, within 1.5 points of zero, are early post-award coefficients for the first two phases, not a parallel-trends test; awarded blocks had 4.0 percent block fiber in June 2016 against 0.1 percent in satellite blocks.

On 25/3, both groups started level in December 2015 and both are above 95 percent of blocks by December 2025. The effect peaks at 12 points in mid-2020 and falls to 5 points by December 2025, an additional share of 18 percent that we cannot distinguish from zero.

On 100/20, Hughes blocks were ahead in 2018, awarded blocks caught up by 2020, and the effect is 7 points in June 2022 and 4 points by December 2025 (Table 7.3). The 2018 rise in the Hughes blocks' 100/20 share looks like a provider claim rather than a build; the 25/3 series shows no such dip. Because 100/20 is the report's common measure, the summary and Table 7.3 use the 100/20 series.

FIGURE 7.2

New York fiber difference-in-differences series, terrestrial-awarded versus satellite-awarded blocks

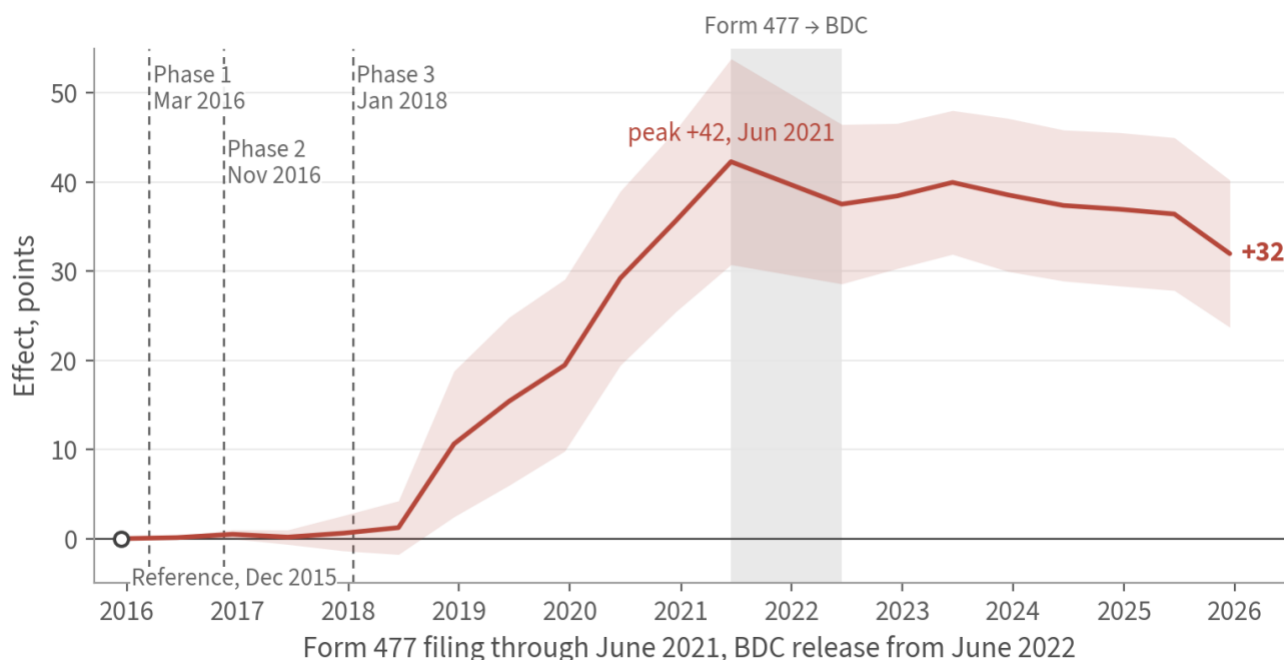


Figure 7.2 plots the terrestrial-award coefficient by period relative to December 2015, with 95 percent intervals; the vertical rules mark the phase 1 and phase 3 award dates.

Cost per additional location and per location-year

Table 7.3 prices the two effects. On access the state's terrestrial awards, before the federal CAF match, bought little that the satellite areas did not get, \$62,000 per additional location and \$18,000 per location-year net of the years awarded blocks trailed. On fiber they bought time, \$8,300 per additional location and \$1,120 per location-year, because awarded areas have led on fiber since 2018.

TABLE 7.3

New York: support per funded location, per additional location, and per location-year, terrestrial awards, from 2015

Measure	Effect percentage points (SE)	Per funded location	Per additional location (95% interval)	Years bought per funded location (95% interval)	Cost per location-year (95% interval)
100/20 access, block indicator	4.3 (2.0)	\$2,670	\$62,000 (33,000 to 700,000)	0.15 ^a	\$18,000 ^a
Block fiber	32.0 (4.2)	\$2,670	\$8,300 (6,600 to 11,300)	2.38 (1.89 to 2.87)	\$1,120 (930 to 1,420)

Support is the state's \$472.6 million for terrestrial awards before the federal CAF match, \$289 million on 108,000 funded locations in the blocks that survive the federal-funding screen. Both rows are block indicators, which count a block as served once one location in it is. a. Net of the years awarded blocks trailed; 0.32 years and \$8,400 counting only the years they led; no interval computed. The 25/3 series gives 0.51 years and \$5,300 with no upper bound (Appendix Table E.2). Chapter 2 defines the measures and Chapter 8 the computation.

Adoption and speeds

The adoption data are mis-timed, since the ACS pre-period (2015 to 2019) holds the build and the post-period (2020 to 2024) holds the satellite areas' catch-up, so wired subscriptions fell 7 points relative to satellite areas and satellite subscriptions rose 6. The Form 477 tract series shows connections at 10/1 or better rising 25 per 100 households more in awarded tracts by December 2019, less by December 2020, and turning negative in 2021 as the comparison tracts move.

Ookla tiles begin in April 2019, after most awards, and relative to that date download speed in awarded hexagons rose about 47 percent more than in satellite hexagons by October 2025, and the share of tiles at 100/20 rose 15 points more, which cannot separate fiber activating in awarded areas from the satellite areas' later catch-up.

Problems

The comparison group is the residual of a reverse auction, the blocks nobody bid to serve at the state's price cap, more remote and more expensive than the treated blocks in ways county fixed effects do not remove. The selection overstates the effect if remote blocks would have waited longer for fiber anyway, and understates it if those blocks were about to get fiber from a federal program, which many did.

Excluding federally funded blocks removes over half the sample. The 35 percent additional share in the main sample, which keeps BEAD blocks, and 28 percent after excluding every federally funded block are the numbers closest in spirit to the RDOF estimate, with a weaker design behind them.

Chapter 8. The programs side by side

The program chapters each measure coverage, what other providers built, and the timing of what arrived, and each prices its own effect. This chapter puts the six programs on one page. The first section says whether the programs substituted for private deployment or added to it, and the second puts their costs side by side on the one measure that makes a ten-year support stream and a one-time grant comparable, the public cost per location-year of earlier service.

Substitute or complement

Most of what the subsidized firms built duplicated coverage that private providers delivered or would have delivered without the subsidy. RDOF winners offered 100/20 service at 41 percent of their funded locations by December 2025 against a net effect of 17 points (Table 3.5), so three-fifths of the subsidized build substituted for private deployment; CAF II's terrestrial winners built 29 points against a net effect of 11 (Table 4.2), the same three-fifths; Wisconsin's grantees built 63 points against a net effect of 43, so about a third substituted, the best ratio in the report. CPF and Enhanced A-CAM paid almost entirely for places that were already served or about to be. Where the subsidy funded fiber, other providers built less: 9 to 12 points less 100/20 coverage in RDOF areas, 12 to 16 less in CAF II's gigabit areas, and 13 less in Wisconsin's funded areas, 7 net of the rejected applicants' own building. On RDOF's 3.0 million funded locations that is 270,000 to 370,000 locations other providers would have passed and did not, some of them locations the winner itself would have built unsubsidized, since in cancelled areas the same firms build as private providers. And no program drew private deployment in where it funded fiber. The two results with the other sign are other providers building more in CAF II's baseline tier, which bought 25/3 service (Table 4.2), and non-incumbent fiber growing 3 points more in Enhanced A-CAM footprints, within the pre-offer movement (Table 5.2). The data cannot say whether total private capital in these areas rose or fell, because the report measures deployment, not dollars, and cannot separate coverage others would have supplied from coverage the winner would have built on its own.

The coverage data do not point at the recipients. RDOF's effect sits at the locations winners report as deployed and is absent at the locations they have not yet reported (Table 3.2), CAF II's winners delivered the technology they bid (Table 4.1), RDOF's wireless winners built the fixed wireless they bid (Table 3.6), and Wisconsin's grantees built (Table 7.1); the exception is one RDOF wireless winner that has built 5 percent of its locations, and whether recipients met their deadlines and delivered the service they report is a compliance question these data do not settle. The return is low because of design. Eligibility was fixed on a snapshot of where service was absent, the money went to places private providers were about to serve, and support was priced on the cost of serving a location rather than on what the money would add.

What the money bought and what it cost

Table 8.1 prices every program's effect three ways: support per additional location, which divides the support by the locations that would not have had service without it; years of earlier service per funded location, the area between the subsidized path and its counterfactual (Chapter 2, Figure 2.1); and public cost per location-year, the support divided by the location-years bought. Appendix Table E.3 gives the per-location figures with their dollar bases and full-commitment versions, Table E.4 restates the effects as coverage leads, and Table E.2 gives the secondary rows.

TABLE 8.1

Years of earlier service per funded location and public cost per location-year, support accrued through December 2025

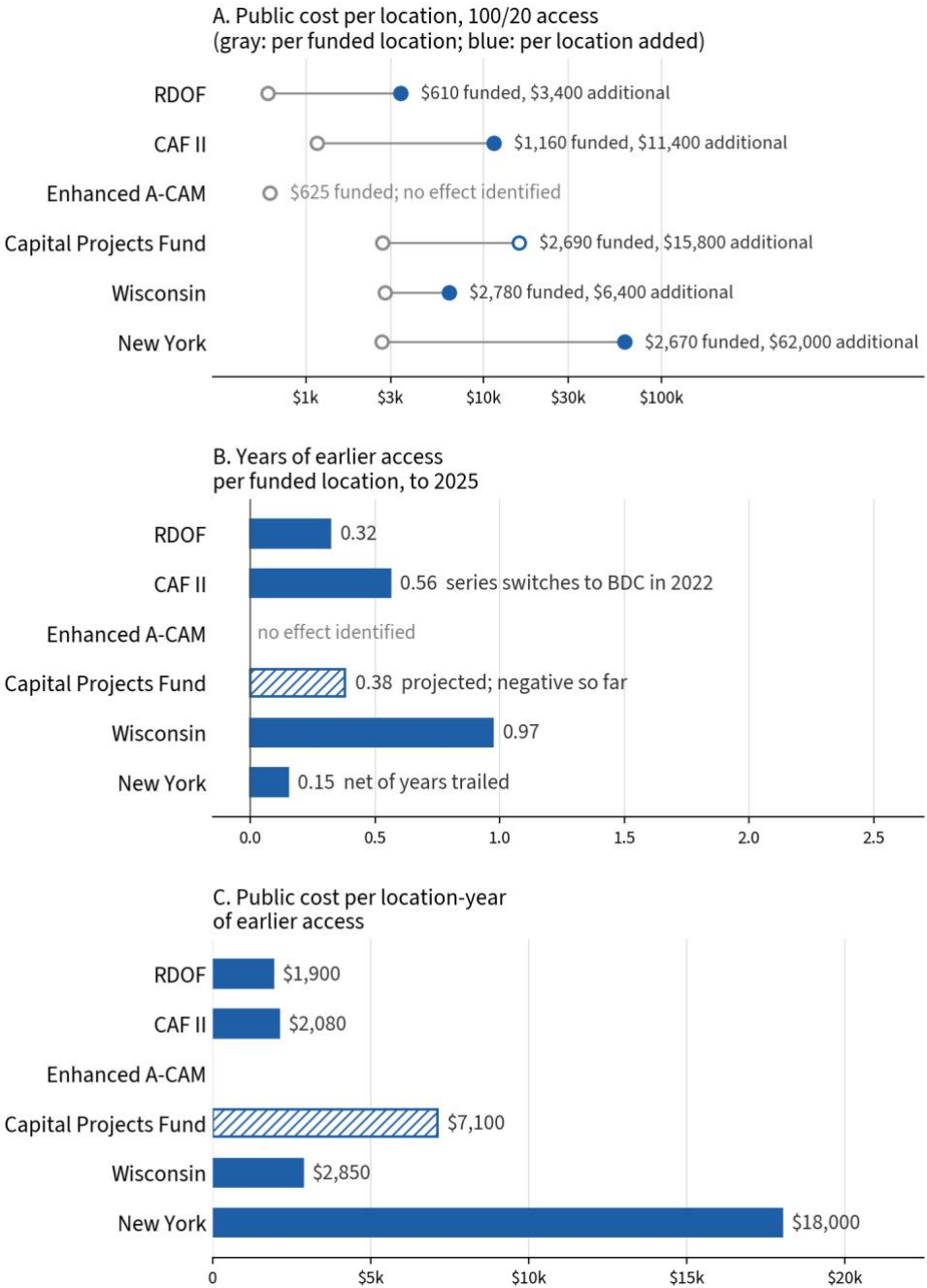
Program and series	Support \$ millions	Funded locations	Per additional location, accrued	Years bought per funded location (95% interval)	Cost per location-year (95% interval)
100/20 access					
RDOF, winners still authorized, from June 2022	1,821	2,985,000	\$3,400	0.32 (0.27 to 0.38)	\$1,900 (1,620 to 2,260)
CAF II, all winners, from June 2018 ^a	790	682,000	\$11,400	0.56 (0.28 to 0.86)	\$2,080 (1,350 to 4,180)
Enhanced A-CAM	1,997	3,195,000	—	— ^b	—
CPF, observed through 2025 ^c	3,056	1,137,000	—	-0.19 (-0.25 to -0.13)	— ^d
CPF, projected to 2029 ^c	3,056	1,137,000	\$76,000 ^f	0.38 (0.31 to 0.45)	\$7,100 (6,000 to 8,610)
Wisconsin, blocks unserved in June 2022	91	33,000	\$6,400	0.97 (0.66 to 1.23)	\$2,850 (2,240 to 4,160)
New York, terrestrial awards, from 2015, net of years trailed ^e	289	108,000	\$62,000	0.15	\$18,000
Fiber					
RDOF, winners still authorized, location share	1,821	2,985,000	\$2,850	0.37 (0.32 to 0.42)	\$1,650 (1,470 to 1,930)
CAF II, gigabit tier, block indicator, from June 2018	230	135,000	\$4,600	1.98 (1.54 to 2.43)	\$860 (700 to 1,110)
CPF, location share, observed through 2025 ^c	3,056	1,137,000	—	-0.05 (-0.09 to -0.01)	— ^d
CPF, location share, projected to 2029 ^c	3,056	1,137,000	\$24,500 ^f	1.17 (1.12 to 1.22)	\$2,300 (2,200 to 2,400)
Wisconsin, blocks unserved in June 2022, location share	91	33,000	—	1.01 (0.70 to 1.27)	\$2,740 (2,170 to 3,960)
New York, terrestrial awards, block indicator, from 2015	289	108,000	\$8,300	2.38 (1.89 to 2.87)	\$1,120 (930 to 1,420)

Years of earlier service are the trapezoid integral of the period effects from each chapter's difference-in-differences series, zero at the reference period; location-years are that integral times funded locations, and cost per location-year is support (as in Table E.3) divided by location-years. Rows are not on one basis: RDOF integrates a location share from June 2022, CAF II and New York a block indicator from 2018 and 2015. The table is undiscounted; at 3 percent every figure rises 1 to 17 percent, CPF's the most. Intervals are from a county-cluster bootstrap with 1,000 draws that re-estimates every period's effect with support and funded locations held fixed. The CPF projection takes the effect to 36 points of fiber and 17 of access at the December 2026 deadline, fades it at 5.9 percent a year, and integrates through December 2029; the fade matters more than sampling error, since no fade gives \$6,300 per location-year of access and a three-year fade to zero \$15,900. RDOF rows integrate the regression path of Figure 3.1, which ends at 16.9 points; on Table E.3's treated-weighted 18.0 the access figure would be about \$1,780. a. Form 477 block indicator through 2021 and the BDC after; the seam caveat in Chapter 4 makes it a lower bound on cost. b. No effect identified (Table E.3). c. Committed, not paid; the effect applies to the 1,137,000 locations in funded blocks, 728,000 of them CPF-funded, so years and location-years are per location in funded blocks and the cell shows that base. d. Negative location-years to date, because funded blocks trailed comparison blocks for two years. e. 0.32 years and \$8,400 counting only the years awarded blocks led; no interval computed. Location-years, the CAF II lower tiers and terrestrial winners, New York's 25/3 series, and the Table E.4 rows omitted are in Appendix Table E.2. Per additional location is support divided by the locations the effect added, as in Table E.3; f. full commitment, since CPF's observed effect is a lower bound and its support is a commitment. Wisconsin's fiber row has no per-location figure because the fiber effect is estimated on a different sample (Table E.1).

Three things stand out. First, the two programs with credible comparison groups sit close together. RDOF has accrued about \$3,400 per additional location with 100/20 service and \$1,900 per location-year of earlier access; Wisconsin's grants, in blocks unserved in 2022, cost \$6,400 per additional location and \$2,850 per location-year. CAF II's winners sit between them per location-year on a block series that makes their figure a lower bound, so the three programs that bought access support a range of about \$1,650 to \$2,850 per location-year with overlapping intervals, not a ranking within it. Second, cost per additional location rises with the cost model while the effect does not: RDOF's lowest-cost tercile added service at \$1,650 per additional location and its highest at \$6,700, with nearly the same effect in each (Table E.1), so the subsidy bought a similar share of what appeared in each band and paid four times as much for it in the expensive one. Third, timing changes the ranking. CAF II's gigabit tier, middling per additional location, has the lowest cost per location-year in the report, \$860, because its fiber arrived in 2019 and 2020, and New York's fiber, at \$1,120, is next; both bought two or more years of earlier fiber per funded location, against a third of a year for RDOF. CPF has bought negative location-years so far, because its funded blocks trailed comparable blocks for two years, and lands at \$7,100 per location-year of access on a projection that assumes every funded location is built by the December 2026 deadline. New York's \$18,000 per location-year of access reflects awarded areas that had almost nothing left to gain on access by 2025.

More money per location does not buy a larger effect. Appendix Table E.5 estimates equation (3), which interacts treatment with the support each funded location received. In RDOF the effect falls by 0.16 points (SE 0.13) for every \$1,000 more of ten-year support per location, and the quartiles of support, from \$355 to \$5,050 per location, show effects of 15 to 20 points with no gradient; CAF II's slope is -0.04 (0.10) on access and -0.15 (0.17) on fiber; Wisconsin's is -0.09 (0.22) on access, with quartile effects of 30 to 61 points that do not rise with the grant, across quartiles that run from \$570 to \$9,800 per location. The reading needs care. In the auctions, support per location is the reserve price times the winning bid's share of it, so the variation within a cost tercile is mostly the bid discount, which depends on who bid, not on what the money did; Wisconsin's awards vary with the applicant's request and match, which is cleaner, but grant size is not assigned at random anywhere, so a flat slope says that larger grants did not go with larger effects, not that a larger grant would have bought nothing more. On that reading the result is the one Table E.1's cost terciles gave: the programs bought about the same share of what appeared wherever they spent, and paid several times as much for it in the expensive places.

FIGURE 8.1
What a dollar bought: cost per location, years of earlier access, and cost per location-year



Support accrued through December 2025 (RDOF, CAF II, A-CAM), one-time grants (Wisconsin; New York state grants only), or Treasury's commitment (CPF, hatched, a projection through 2029, with every CPF figure per location in the funded blocks, 1,137,000, and the cost per location added at the assumed completion effect). All rows are 100/20 access; Wisconsin is the areas unserved in 2022; New York is net of the years awarded areas trailed during construction. Years and cost per location-year integrate the effect at each date (Tables 8.1 and E.3). Discounting at 3 percent raises each cost per location-year by 1 to 17 percent.

Figure 8.1 plots the headline rows of Table 8.1. The measure prices earlier service only; a location never served without the subsidy contributes its whole stream of years. It does not say what a location-year is worth, which is the question Chapter 9 takes up.

Table 8.2 answers an objection the national mobile carriers will raise, that an access measure which leaves out their fixed wireless understates how served these areas are. It re-estimates each program's headline

access effect counting the carriers' 100/20 home internet, from the provider-level records, on the chapter's own sample and specification. In every program the carriers expanded more in the comparison areas than in the subsidized ones, by 2 to 5 points of locations, so counting them lowers the effect and raises the cost. RDOF's effect falls from 17 to 15 points, CAF II's from 10 to 8, and Wisconsin's from 43 to 37; on the December 2025 endpoint the cost per location-year would be about 15 percent higher for RDOF and Wisconsin and about a third higher for CAF II. Enhanced A-CAM's effect stays indistinguishable from zero. The exclusion in the access measure is therefore conservative for the report's conclusions, since counting the carriers makes the programs look like worse buys. The Capital Projects Fund and New York rows are not run, because their location-level extracts carry no carrier records.

TABLE 8.2

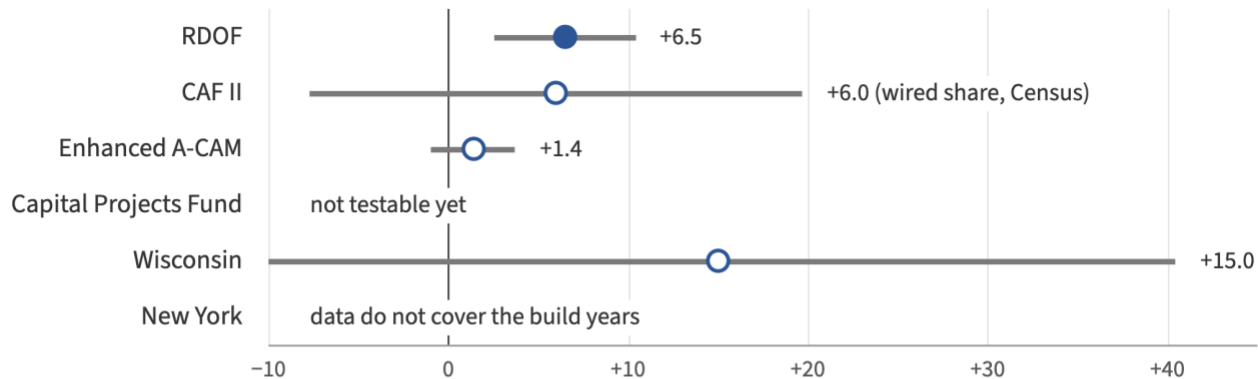
The access effect counting the national mobile carriers' fixed wireless, June 2022 to December 2025

Program and design	Headline effect, points (SE)	Counting the carriers' fixed wireless, points (SE)	Carriers' fixed wireless alone, points (SE)	Carriers' gain, subsidized and comparison areas, points	Share of the gain caused, headline and with carriers
RDOF, authorized vs cancelled (Table 3.1)	16.9 (1.3)	14.6 (1.2)	-0.7 (0.4)	13.5 and 16.0	34% and 28%
CAF II, all winners vs screened losers (Chapter 4 pooled)	10.4 (2.5)	7.6 (2.3)	-3.8 (1.2)	14.0 and 17.1	28% and 19%
Enhanced A-CAM, accepting vs declining carriers	0.6 (1.3)	0.7 (1.3)	-1.7 (1.2)	24.4 and 27.0	—
Wisconsin, blocks unserved in June 2022 (Table 7.1)	42.8 (4.3)	37.3 (3.9)	-6.0 (2.0)	10.0 and 15.3	53% and 46%
Capital Projects Fund; New York	not run	not run	not run	—	—

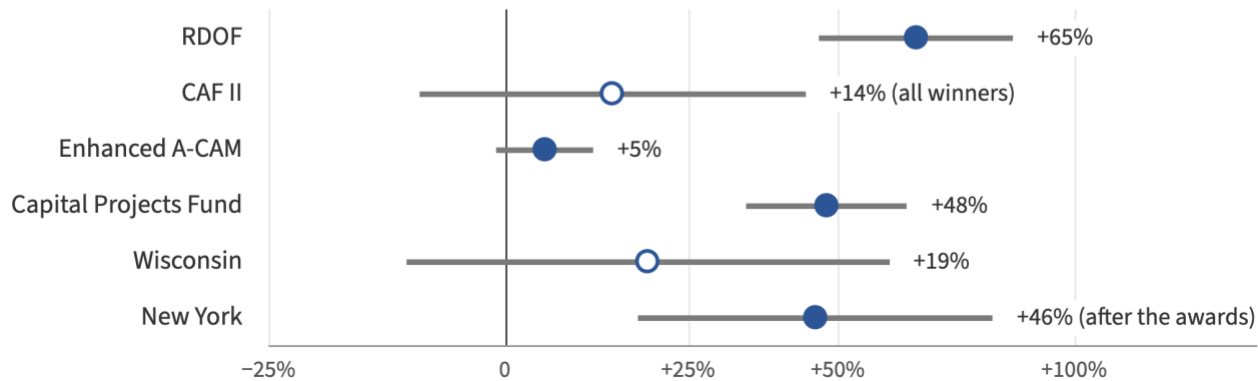
Each row uses the chapter's sample, fixed effects, weights, and clusters: RDOF as in Table 3.1 (488,441 blocks); CAF II the pooled all-winners design of Chapter 4 (101,620 blocks, state by cost cells, county clusters); Enhanced A-CAM state by prior-mechanism cells with carrier clusters (541,808 blocks), measured from June 2022 rather than the chapter's June 2023 reference; Wisconsin as in Table 7.1 (8,138 blocks, application clusters). Shares are of December 2025 locations in the provider-level BDC extracts, so the headline column can differ from the chapter's figure by a few tenths of a point. Carrier fixed wireless is any fixed wireless record from T-Mobile, Verizon, AT&T, or UScellular at 100/20 with low latency; the counting column treats a location as served if it has a qualifying terrestrial offer or a carrier offer. Gains are location-weighted changes from June 2022 to December 2025. The Capital Projects Fund and New York location extracts carry no provider identities, so those rows await a re-extract (Appendix G).

FIGURE 8.2
Adoption and measured speed by program

A. Subscriptions at 25 Mbps or better, extra per 100 households



B. Measured download speed, percent faster than comparison areas



Panel A is subscriptions at 25 Mbps downstream or better per hundred households in funded areas relative to comparison areas by December 2024, the change in the ACS wired share for CAF II. Panel B is the Ookla log-download effect by October 2025 as a percent, for all winners in CAF II; hollow markers cannot be told from zero.

Appendix Table A.1 reports each program’s effect on the share of locations with a symmetric 100/100 offer, which moves with the fiber effect in every program and adds a check rather than a new finding.

Chapter 9. Does any of this still matter?

The programs in this report were designed for a world in which a location either had a wire or had nothing. That world ended while the programs were being built. By 2023 low earth orbit satellite service was on offer at nearly every location in the country, and by 2025 the national mobile carriers' fixed wireless products reached a growing share of the areas these programs paid to serve, 17.7 percent of RDOF's cancelled-award locations, from about 1 percent three years earlier (Chapter 3). This chapter asks what the report's results mean once those technologies exist, and what a government that still wants to subsidize rural broadband should take from them. It draws on our earlier work with Greg Rosston on universal service, which argued most of this before the evidence in Chapters 3 through 8 existed.

What the report measured, restated

Every effect in this report is an effect on terrestrial service. We excluded satellite from the access measure because it is available everywhere and so cannot register a local effect, and we noted in Chapter 1 that counting it would move every effect toward zero, a row the report has not yet run (Appendix G). That is not a technicality. It says what the programs bought. A household in a funded area that gained a 100/20 wired or fixed wireless offer in 2024 could have bought satellite service instead. Starlink's residential plan sold for about \$90 to \$110 a month in 2023 (Rosston and Wallsten 2023), and in 2026 its plans run from \$55 to \$130 a month for 50 to 400 Mbps, with a \$349 dish (CableTV.com 2026); whether a given location and date met the 100/20 low-latency standard on upload as well as download is a question the FCC data answer only for the records this report did not extract. What the subsidy added for that household was the difference between the terrestrial offer and the satellite one, sooner than the difference would otherwise have arrived. Chapter 8's \$1,900 per location-year for RDOF and \$2,850 for Wisconsin are therefore the public price of a year of that difference, not of a year of broadband where there was none.

Rosston and Wallsten (2023) made the point before the evidence existed. Satellite had been kept out of the availability programs for two reasons, one practical and one political. The practical one, the latency and capacity of geostationary service, weakened considerably once low earth orbit service existed. The political reason remained. Terrestrial recipients sit in congressional districts, and admitting satellite as a broadband provider means admitting that the whole country already has coverage, which removes much of the rationale for the subsidies. The paper also read the RDOF bidding records. Where SpaceX competed to the final round and lost, winning bids were a smaller share of the reserve price than where it never bid, and SpaceX was most competitive where reserve prices were highest, so excluding it from later programs, as BEAD's original rules did, raised the grant per location and made unserved households wait longer. The results here add a measurement to that argument. Because the comparison areas kept gaining terrestrial service on their own, the subsidies bought little that was permanent. Because satellite was already there, the thing they bought sooner was an increment, not a connection.

The value of a terrestrial location-year

A cost-benefit test needs a value for that increment, and the report does not estimate one. What it can do is say what the value would have to be. The benefit of a location-year of earlier terrestrial service is the chance that the household at that location takes the terrestrial service because it arrived earlier, times what that household gains from it over the satellite or fixed wireless alternative it would otherwise use, plus whatever the network is worth to households that do not subscribe.

The report's adoption results do not give the first term. RDOF raised subscriptions at 25 Mbps or better by about 6 per 100 households while subscriptions to any broadband did not detectably change, and the other

programs' adoption estimates are small or too imprecise to read (Table 1.2); those are net effects on subscription counts across whole areas, not the share of newly covered households that signed up, and Chapter 3 says the two cannot be converted into a take-up rate. So the comparison here is a scenario, not a bound. Suppose every household at a newly covered location subscribed, and value the increment at the price gap between a satellite plan and a rural fiber plan, on the order of \$600 a year. The benefit is then \$600 per location-year, against a public cost of \$1,900 to \$2,850 per location-year in the two programs with credible designs and \$7,100 for CPF on its projection (Table 8.1). On that scenario the subsidies would break even only if a year of earlier terrestrial service were worth about \$1,900 to \$2,850 per location to the households that got it, and proportionally more per subscribing household where not every household subscribes.

Two things could make the value that large. The first is that the gain from fiber over satellite may be much larger than the price gap, if satellite capacity binds as subscribers accumulate, if upload speed or reliability matter more than the price reflects, or if the speeds that matter in a decade are speeds satellite will not deliver; a price gap does not cap the value of those differences. The report cannot test that, and it is the strongest argument the fiber programs have. But it is an argument about the future value of fiber relative to satellite, not about the subsidies' effect, and it applies equally to the comparison areas, which were getting fiber without the money at a pace that would have closed most of the gap within a few years (Tables E.4 and 8.1). The second is that some funded locations would never have been served by any terrestrial provider, so for them the subsidy bought the whole stream of years rather than a few. The report's design cannot count those locations. The comparison areas in RDOF, CAF II, and Wisconsin had gained 30, 44 (on fiber), and 39 points on their own by 2025 and were still gaining, which says the never-served share of the funded areas is not large, but turning that into a bound would need an assumption about where the comparison areas' growth stops. For the remainder, satellite is the counterfactual service, and the question is the one above.

What the programs could have done instead

Our earlier work made four recommendations that the evidence here supports, and adds a fifth.

First, count the additional location, not the funded one. Every program in this report reported locations funded; none reported locations that would not have had service without it, and the gap between the two numbers is most of the money. Wallsten and Gamboa (2017) proposed ranking projects by new locations connected per subsidy dollar, and Rosston and Wallsten (2013) showed hundred-fold differences in cost per projected connection across the broadband stimulus grants when no one ranked them. The additional share in Table 1.1 is the number that ranking needs, and it can be estimated before the money is spent, from the trend in comparable unfunded areas, rather than after.

Second, let eligibility move. Every program fixed eligibility with a snapshot, and the snapshots were overtaken by private building within two or three years. The cancelled RDOF areas gained about 8 points of access a year with no subsidy. A rule that re-tested eligibility against current filings before each disbursement, or that paid only for locations still unserved at the time of the build, would have removed the places providers were about to serve from the subsidized set. The waiting-period design Chapter 3 proposes is one version of this.

Third, be neutral about technology and strict about quality. CAF II and RDOF weighted bids by tier and latency, and RDOF's weights let bids that could not deliver win, the case Rivkin-Fish (2020, 2021) made, while Wallsten and Rosston (2023) trace RDOF's problems mainly to its eligibility rules. The alternative is not to favor fiber by rule but to set a quality floor that any technology can meet, verify delivered performance, and pay the lowest bid that meets it. Rosston and Wallsten (2023) argued that low earth orbit

service was already fast enough for the applications households run, with latency close to terrestrial options, and that its cost of connecting a location does not depend on whether a neighbor is connected, which is what makes it cheap in exactly the places the cost model prices highest; Rosston and Wallsten (2024) added that the high-cost fund has not made much difference in connecting households over twenty-five years of spending. BEAD's 2025 restructuring moved in this direction, with 22 percent of its 3.8 million locations going to satellite in the approved plans and the deployment budget falling to \$18.2 billion (Broadband Breakfast 2026), though Rosston and Wallsten (2025) note that the rules give states no reason to seek the savings.

Fourth, pay once, and evaluate from outside. Enhanced A-CAM pays for fifteen years for territories that were already served, and the report finds nothing it bought in the first two (Chapter 5). A one-time payment tied to a verified build, as Wallsten and Gamboa (2017) proposed, does not create a constituency for its own renewal, and Wallsten and Rosston (2023) argued that the Universal Service Fund needs a budget ceiling rather than a floor and an evaluator other than the agency that runs it. Every result in this report came from public data a program could have published alongside its own; none did, and the FCC's inspector general found that deployment verification did not check when service began (FCC OIG 2025).

Fifth, and new, price the alternative to building. If a terrestrial location-year is worth less to households than the thousands of dollars it cost, the better buy for the hardest locations is the satellite or fixed wireless service that is already there, with a subsidy on the demand side where the price is the barrier. Wallsten (2011) proposed redirecting high-cost money toward low-income consumers, and Rosston and Wallsten (2020) found that about two thirds of the subscribers to a private low-income program would not otherwise have subscribed, an additional share higher than any deployment program in this report. The programs here bought time at a price that a demand subsidy would not have charged. That is the result to carry into the next program, which is already spending.

What the report cannot say

The report measures deployment, not welfare. It does not know what a household would pay for fiber over satellite, how satellite capacity will hold up, what the subsidized firms would have spent on their own, or what the coverage other providers would have built without the subsidy was worth. Appendix G lists the work that would answer those questions, in order.

Appendix. Data sources and definitions

Sources

FCC, Broadband Data Collection, fixed availability by location, releases June 2022 through December 2025, by state. FCC, Form 477 fixed deployment data, filings December 2015 through June 2021, via opendata.fcc.gov. FCC, Auction 904 (RDOF) public reporting system, eligible blocks, items, reserve prices, and assigned bids. FCC, Historical Authorized Auction 904 Long-Form Applicants Data and Auction 904 blocks covered by defaults, as of June 8, 2026. FCC, Auction 903 (CAF II) public reporting system and bid results file. FCC, Enhanced A-CAM offer list and acceptance list, 2023. FCC, Broadband Funding Map, funded locations by state and program, data as of September 16, 2026, downloaded for 50 states. Census Bureau, 2010 to 2020 block relationship files. Wisconsin Public Service Commission, grant footprints, applicant polygons, and screening panel memoranda. Empire State Development, New NY Broadband Program awarded blocks by phase. Ookla, Open Data fixed performance tiles, 2019 through 2025.

Definitions

Authorized. An RDOF block whose winning bid the FCC authorized for support in one of the 17 public notices issued between July 2021 and January 2023, and whose winner had not defaulted as of June 2026.

Cancelled award (the FCC's pre-authorization default). An RDOF block whose winning bid never reached authorization, because the FCC rejected the long-form application, the bidder withdrew, or the bidder failed to obtain state carrier designation. Subdivided by bidder into Starlink, LTD Broadband, and other.

Post-authorization default. An RDOF block whose winner received authorization and later relinquished the award.

Authorization cohort. The half-year of the public notice that authorized the winner, as recorded in the FCC's authorization spreadsheet; ready-to-authorize notices are not authorizations.

CAF II tier. Gigabit, above baseline (100/20), baseline (25/3), or minimum (10/1), from the bid results file. Viasat's bids are baseline tier with high latency (8,207 items, all Viasat; the ten minimum-tier items are low latency and not Viasat) and we report them separately.

Technology groups. Wireline is BDC technology codes 10, 40, and 50. Licensed fixed wireless is codes 71 and 72 from providers other than the national mobile carriers. Unlicensed fixed wireless is code 70 from those providers. Carrier fixed wireless is any fixed wireless record whose brand matches T-Mobile, Verizon, AT&T, or UScellular. Non-geostationary satellite is code 61.

Access flags. tn100 is a location with an offer of at least 100/20 Mbps and low latency from wireline or licensed fixed wireless. tn100u adds unlicensed fixed wireless. tn25 and tn25u are the same at 25/3. wl100 is wireline only at 100/20. fiber is any residential fiber offer. Each flag is one for a location if any provider's record meets the condition.

Block fiber indicator. One if any residential location in the 2010 block has a fiber offer, for BDC releases. For Form 477 filings, one if a provider reported consumer fiber in the block, the same holding company still reported it in June 2021, and the block indicator is one in the June 2022 BDC.

Weights. Residential locations in the block in the December 2025 BDC.

Cost tercile. Terciles of the FCC's reserve price per location within the sample, for RDOF and CAF II.

Other-federal exclusion. A location is dropped if the Funding Map records support for it from any federal program other than the one under study. The screen differs by chapter. RDOF removes locations funded by any other program except BEAD. CAF II removes losers with an RDOF authorization or funding from any program other than BEAD and CAF II. Enhanced A-CAM removes RDOF, CAF II, CPF, and other programs and keeps BEAD. CPF removes RDOF, CAF II, Enhanced A-CAM, and other programs from both groups and

keeps BEAD. Wisconsin removes blocks funded by any program other than BEAD from the comparison group only, and flags federal support in the treated group. New York removes blocks funded before 2025 by other programs and keeps BEAD. BEAD awards postdate every outcome window, so keeping them avoids selecting on the outcome.

Additional share. The December 2025 treatment coefficient divided by the change in the treated group's mean outcome from the reference period to December 2025.

Sample sizes by table

Each row gives the regression sample behind a table or figure: the number of blocks or other units, how many are treated, the clustering unit, and the census geography.

Table	Blocks or units in the regression	Of which treated	Clusters	Geography
3.1 all winners	488,441 blocks (486,649 in identifying cells)	324,056	2,758 counties, 49 states (2,733 counties, 47 states in identifying cells)	2010 blocks
B.2 fiber winners; wireless or hybrid winners	415,154; 234,929	251,000; 70,700	counties	2010 blocks
3.3 Starlink; LTD; all cancellations	263,940; 189,628; 486,649	336,051 authorized in the fiber panel	1,725; 1,171; 2,733 counties	2010 blocks
3.4 terciles	159,881; 161,833; 164,935		counties	2010 blocks
3.5; 3.6	486,649; 155,194	322,097 with a winner identifier	counties, 47 states	2010 blocks
4.1 gigabit; above baseline; baseline; Viasat	25,756; 45,185; 24,584; 20,149, each with 12,499 comparison blocks (115,590 locations, 46 percent with a BEAD award)		counties	2010 blocks
5.1	534,555 to 541,808	3,195,066 locations	605 carriers	2010 blocks
5.2 first four rows; served-location rows	534,555 to 541,808; 365,971		605; 552 carriers	2010 blocks
7.1	8,138 (8,140 before dropping singleton cells)	3,704	343 applications	2020 blocks
7 New York, main sample (BEAD kept)	16,744	7,189	counties	2010 blocks
7 New York, all awarded; excluding federally funded	27,449; 11,928	15,163	counties	2010 blocks
8.4, E.4	see the Table E.1 note			
3.8	5,443; 11,017; 42,200 block groups		counties	2020 block groups
Figure 3.3	4,000; 1,542; 23,306 tracts		counties	2020 tracts

Counts are regression samples from the saved result files, not the data coverage. The RDOF fiber difference-in-differences series (Table 3.3) uses blocks with or without December 2025 locations, so its counts differ from the access tables.

Code and data

The block availability panel covers 6.4 million blocks across eight BDC releases, the RDOF location panel 4.9 million locations across eight releases, and the block fiber series RDOF-eligible blocks across twenty

periods. Derived panels exist for CAF II, Enhanced A-CAM, CPF, Wisconsin, New York, and the twelve-state provider-level crowd-out test. A README in the data folder documents each table’s columns and build order.

Appendix tables A.1 (symmetric 100/100 offers), B.1 to B.4 (RDOF robustness), E.1 and E.2 (cost detail), C.1 (CAF II access detail), and D (Wisconsin and New York detail) follow.

Appendix tables

Appendix A. Symmetric 100/100 offers

The 100/20 threshold is the statutory one, but a growing share of policy discussion treats symmetric service as the target, and the BDC reports advertised upload speeds, so we can ask whether each program raised the share of locations with a 100/100 offer. Table A.1 reports the effect from June 2022 to December 2025 on each chapter’s sample and design, alongside the effect on a gigabit-download offer and on fiber. A symmetric 100/100 offer is close to a fiber indicator in practice, and the two columns move together in every program, so the table adds a check rather than a new finding. RDOF, CPF, and Wisconsin raised the 100/100 share by about as much as they raised fiber. CAF II’s pooled effect is small and marginal over this window, as it is on fiber, since the gigabit tier’s build predates the data. Enhanced A-CAM and New York show nothing, and the New York comparison starts from a large lead in the awarded blocks that the satellite blocks have been closing.

TABLE A.1
Effect on the share of locations with a symmetric 100/100 offer, June 2022 to December 2025

Program sample and design as in its chapter	100/100 share, funded 2022 to 2025, %	100/100 share, comparison %	Effect on 100/100 points (SE)	Effect on gigabit download points (SE)	Effect on fiber points (SE)	Blocks
RDOF	15 to 66	11 to 39	+19.1 (1.5)	+22.4 (1.5)	+21.7 (1.4)	449,438
CAF II, all winners	19 to 49	11 to 39	+3.7 (2.4)	+6.2 (2.2)	+4.5 (2.2)	101,620
Enhanced A-CAM	57 to 82	54 to 80	–2.6 (2.1)	–1.3 (1.7)	–1.6 (1.6)	541,808
Capital Projects Fund	2 to 51	3 to 42	+7.8 (1.4)	+5.6 (1.5)	+11.5 (1.4)	272,016
Wisconsin, unserved in 2022	0 to 81	0 to 36	+45.1 (4.5)	+47.1 (4.3)	+47.5 (4.3)	8,138
New York	48 to 72	17 to 39	–1.3 (3.1)	+3.0 (3.6)	+3.5 (2.5)	15,790

Shares are of each block’s December 2025 residential locations; offers count wireline and non-carrier licensed fixed wireless, as in the qualifying-access measure, without the latency condition. Standard errors clustered as in each chapter; Wisconsin uses the Chapter 7 sample (blocks with no qualifying 100/20 offer in June 2022, round and county effects, application clusters). RDOF is at the block level here, so it omits the location-level exclusion of other federal funding used in Table 3.1; its fiber effect matches Table 3.1 within a point.

Appendix B. RDOF robustness tables

Fixed effects, weights, and outcomes as in Table 3.1 unless a row says otherwise. Three notes carry detail the chapter tables no longer print. For Table 3.1, a county block bootstrap with 1,000 replications gives 95 percent intervals for the additional share of 30 to 39 percent on access and 41 to 50 percent on fiber, and resampling winning bidders gives 17 to 43 and 26 to 54 percent; the regression samples are 488,441 blocks for all winners, 415,154 for fiber winners, and 234,929 for wireless or hybrid winners; Table E.3 uses the reweighted samples of 2,533,402 and 436,476 locations. Including the 27,000 blocks whose

winners defaulted after authorization, the intention-to-treat definition, gives 15.4 (1.3) on access and 18.9 (1.3) on fiber; the tables use the surviving-authorized definition, on which the crowd-out, technology, and cost calculations rest, and blocks whose winners were authorized and later defaulted sit 5 points above never-funded cancellations, consistent with partial building before abandonment. For Table 3.3, on the BDC alone with June 2022 as the reference, the December 2025 block fiber effect is 19.6 (1.4) for all winners, 22.5 (1.5) for fiber winners, and -1.3 (1.9) for wireless or hybrid winners. For Figure 3.3, subscriptions per household come from bin midpoints, which add uncertainty the standard errors do not carry; every pre-auction coefficient from December 2015 to June 2020 on the any-speed series lies between -0.5 and 1.8 per 100 households with standard errors of 1 to 2, and in the widest sample, all tracts with any sample location, the 2015 to 2018 coefficients are +1.8 to +4.5 (SE 1.4 to 1.9); in December 2024, tracts with at least half their locations in the sample (1,542) give 0.7 (2.2) on any speed and 7.5 (2.3) on 25 Mbps or better, and all tracts with any sample location (23,306) give 4.5 (1.7) and 8.5 (1.8).

TABLE B.1

Standard errors for the Table 3.1 headline under alternative clustering

Clustering	Clusters	100/20 access, SE points	Fiber, SE points
County (as in Table 3.1)	2,758	1.3	1.3
State	49	2.1	2.3
Long-form applicant	422	1.6	2.0
Auction bidder	169	3.7	4.0
County and bidder, two-way	2,758 by 169	3.7	4.0
Wild cluster bootstrap by bidder, p-value	169	0.003	0.002

Coefficients are 16.9 points on access and 20.7 on fiber in every row. The bidder is the auction's winning bidder for each block; the long-form applicant splits consortium bidders into their members. The bootstrap imposes a zero effect and uses 9,999 replications with Rademacher weights; Webb weights give 0.007 and 0.005.

No single state drives the estimate. Dropping one state at a time moves the access effect between 0.159 and 0.180 and the fiber effect between 0.193 and 0.215. Dropping Minnesota and Colorado raises the access effect by half a point, and dropping the eight states that hold 88 percent of LTD's cancelled locations leaves it unchanged. The effect does differ across states, from -0.03 in Mississippi to 0.52 in Michigan among the ten largest states, and a test rejects equal effects across the 37 states with at least 20 counties ($p < 0.001$).

TABLE B.2

Sensitivity of the Table 3.1 headline to states, comparison groups, and winners

Sample	100/20 access points (SE)	Share	Fiber points (SE)	Share
Table 3.1	16.9 (1.3)	34%	20.7 (1.3)	46%
Leave one state out, lowest	15.9 (1.4)	33%	19.3 (1.3)	44%
Leave one state out, highest	18.0 (1.4)	37%	21.5 (1.4)	46%
Without Minnesota and Colorado	17.5 (1.4)	35%	21.2 (1.4)	47%
Without the eight LTD states	16.9 (1.6)	35%	20.1 (1.6)	44%
Starlink cancellations as comparison	18.0 (1.8)	36%	21.7 (1.8)	48%
LTD cancellations as comparison	16.1 (2.4)	33%	20.2 (2.3)	44%
Other cancellations as comparison	16.0 (2.3)	32%	19.7 (2.1)	44%
Charter's authorized blocks only	32.2 (2.1)	50%	38.8 (2.1)	59%
All winners except Charter	10.7 (1.4)	25%	13.4 (1.4)	37%
Fiber winners only	18.7 (1.4)	36%	24.1 (1.4)	47%
Wireless or hybrid winners only	4.2 (2.7)	13%	-3.3 (1.7)	—

The lowest and highest leave-one-state-out rows drop Wisconsin and Mississippi on access and Wisconsin and Illinois on fiber. The LTD states are Minnesota, Wisconsin, California, Missouri, Illinois, Indiana, Nebraska, and Oklahoma. Charter is CCO Holdings, LLC; the winner rows keep all cancelled blocks as the comparison. A block's winner technology is the technology with the most RDOF-funded locations in it; 711 of 333,454 funded blocks hold more than one technology and 105 are ties, and the technology rows move by up to a tenth of a point with the tie rule. Fiber winners hold 2.5 million authorized locations in 415,154 blocks and wireless or hybrid winners 437,000 in 234,929; the wireless share is of a 31.9-point gain in their areas (Table 3.6), and their fiber effect is negative.

Three checks on the sample each move the headline up by one to two points (Table B.3). The first restricts the fixed denominator to locations in the June 2022 Fabric, removing the 13.5 percent of authorized-area locations and 15.0 percent of cancelled-area locations added since; additions are more common in cancelled areas, especially Starlink's (18 percent), and most arrive with service, so they dilute the estimate. The second drops cancelled blocks near authorized blocks, and Chapter 3's spillover check (Table B.3) traces most of the extra gain near them to where those blocks sit. The third drops the 2023H1 authorization cohort, whose winner has barely built.

TABLE B.3

Sensitivity of the Table 3.1 headline to the sample

Sample	Blocks	100/20 access points (SE)	Share	Fiber points (SE)	Share
Table 3.1	488,441	16.9 (1.3)	34%	20.7 (1.3)	46%
Locations in the June 2022 Fabric only	473,020	18.2 (1.4)	39%	21.4 (1.4)	49%
Locations with a June 2022 terrestrial record only	457,500	18.3 (1.5)	39%	21.2 (1.4)	48%
Without cancelled blocks within 1 km of an authorized block	471,278	17.9 (1.4)	36%	21.8 (1.4)	48%
Without cancelled blocks within 2 km	463,277	18.3 (1.5)	37%	22.1 (1.4)	49%
Without cancelled blocks within 5 km	440,865	18.9 (1.6)	38%	22.3 (1.5)	49%
Without cancelled blocks within 2 km of a fiber winner's block	467,429	17.7 (1.5)	36%	21.4 (1.4)	47%
Without the 2023H1 authorization cohort	461,434	18.0 (1.3)	35%	21.8 (1.3)	46%

Distances run from a cancelled block's nearest location to the nearest location in an authorized block, with locations at the centers of their H3 resolution-8 cells; block centroids give 17.2, 17.6, and 18.7 on access at 1, 2, and 5 km. The within-2-km row drops 25,164 of 164,385 cancelled blocks and 19 percent of their locations. The Fabric rows keep December 2025 locations whose ID was issued by June 2022 or that a terrestrial provider reported in June 2022.

TABLE B.4

Wireless or hybrid winners versus cancelled awards, additional fixed wireless outcomes, June 2022 to December 2025

Outcome	Level, June 2022 winners' areas	Gain, winners' areas	Gain, cancelled	Effect points (SE)
Fixed wireless 25/3 from any non-carrier provider	58.4	15.0	6.2	6.4 (2.0)
The winner's own licensed fixed wireless 100/20, low latency	7.0	7.6	0	10.8 (1.9)
Providers other than the winner, 100/20	17.5	28.0	31.5	-2.1 (2.6)

155,194 blocks, as in Table 3.6. The first row counts licensed and unlicensed fixed wireless without the latency condition; the second applies the access definition's licensed-spectrum and low-latency conditions to the winner's own records.

Appendix C. CAF II access series detail

Chapter 4 reports years of earlier 100/20 access per funded location as the trapezoid integral, from June 2018, of the joined block-level access series in Figure 4.3, with the effect zero at the reference. Table C.1 splits that integral at the Form 477 to BDC seam and reports the series for all assigned winners, Viasat included, beside the terrestrial series the figure plots. The joined series for all assigned winners stands at +1 point in June 2021, +7 at the switch to the BDC in June 2022, +18 by June 2023, and 19 to 21 through 2025; within the BDC alone, with reference June 2022, it rises 12.7 (2.6) points by December 2025. Counted from June 2018, the pre-seam integral is negative (–0.05 years per funded location for terrestrial winners, –0.09 for all assigned), the seam segment adds 0.07 and 0.04, and the post-seam period adds 0.77 and 0.61. Net, all assigned winners get 0.56 years of earlier 100/20 access per funded location and terrestrial winners 0.79. Resampling counties puts the all-winner figures at 0.28 to 0.86 years and \$1,350 to \$4,180 per location-year, and the terrestrial figures at 0.42 to 1.17 years and \$1,160 to \$3,230. If any of the seam jump is a reporting artifact, the effect and the location-years are overstated, so the cost per location-year is a lower bound; only the years figure is an upper bound.

TABLE C.1

CAF II years of earlier 100/20 access per funded location, by segment of the joined series

Winner set	June 2018 to June 2021 Form 477	June 2021 to June 2022 seam	June 2022 to December 2025 BDC	Total years	Funded locations	Location-years	Support accrued through 2025 \$ millions	Cost per location-year
All assigned	-0.09	+0.04	+0.61	0.56	681,516	380,000	790	\$2,080
Terrestrial winners (no Viasat)	-0.05	+0.07	+0.77	0.79	537,000	424,000	728	\$1,720

Trapezoid integral of the joined 100/20 block indicator series (Form 477 through June 2021, BDC tn100 from June 2022), reference June 2018, state-by-cost fixed effects, December 2025 location weights, comparison group as in Table 4.1. Funded locations and support are the Table 8.1 bases; on the regression samples of 659,383 and 515,177 treated locations the costs would be 3 to 4 percent higher. Intervals in the text are 95 percent intervals from a county-cluster bootstrap with 1,000 draws (Table 8.1).

Appendix D. Wisconsin and New York detail

Wisconsin access effect, three runs. The text rounds the Table 7.1 access effect to 0.43; the table's file gives 0.428 (0.043) on 8,140 blocks, and the reweighted run Table E.3 uses gives 0.433 (0.044) on 8,574 blocks.

Wisconsin Form 477 pre-period at 25/3. The fiber pre-trend in the Chapter 7 sample is flat. A Form 477 pre-period on all terrestrial technologies at 25/3 is not quite. Within the unserved-at-2022 sample, unfunded application areas gained block-level 25/3 claims faster than funded areas from 2017 to 2020, with coefficients of about minus 0.04 (0.03 to 0.04) in each filing from December 2017 through June 2020, before the gap closed in 2021. Form 477 block claims in these blocks were far above what the BDC later found (75 to 83 percent at 25/3 in June 2021 against zero at 100/20 in June 2022), so most of that movement is fixed wireless and DSL block-level overstatement rather than fiber. It still means the comparison areas were the ones drawing new claims before the awards, which if anything biases the estimated effect downward. We report both series.

New York detail. The New York estimates in Chapter 7 use the 16,744 awarded blocks that exclude blocks funded by other programs before 2025 and keep BEAD blocks (Table 7.3, Figure 7.2, Appendix Table F.6). On all 27,449 awarded blocks the December 2025 block fiber effect is 34.6 (4.3) and the 100/20 effect 6.5 (1.5); excluding every federally funded block leaves 11,928 blocks and a fiber effect of 25.8, an additional share of 28 percent (Chapter 7).

Appendix E. Cost tables, all rows

TABLE E.1

Support per funded and per additional location, detail rows

Program and group	Support \$ millions	Funded locations	Effect points (SE)	Per funded location	Per additional location accrued (95% interval)	Per additional location full commitment
RDOF						
Surviving-authorized, fiber	1,821	2,985,000	21.4 (1.4)	\$610	\$2,850 (2,500 to 3,300)	\$8,100
Ever-authorized, 100/20 access	1,919	3,176,000	17.2 (1.4)	\$600	\$3,500 (3,000 to 4,200)	\$10,000
Lowest-cost tercile, access	339	1,157,000	17.8 (1.9)	\$290	\$1,650 (1,360 to 2,090)	\$4,700
Middle tercile, access	611	1,002,000	20.3 (1.8)	\$610	\$3,000 (2,560 to 3,660)	\$8,600
Highest-cost tercile, access	871	827,000	15.7 (2.2)	\$1,050	\$6,700 (5,300 to 9,300)	\$19,200
Fiber winners, access	1,615	2,533,000	21.4 (1.5)	\$640	\$3,000 (2,600 to 3,400)	\$8,300
Wireless or hybrid winners, access	197	436,000	-0.8 (2.9)	\$450	— ^a	—
CAF II						
Above baseline, 100/20 access from 2022	402	240,000	21.7 (4.3)	\$1,670	\$7,700 (5,600 to 12,500)	\$11,900
Baseline, 100/20 access from 2022	98	138,000	13.7 (4.2)	\$710	\$5,200 (3,200 to 12,700)	\$7,900
Viasat check, locations in blocks with fiber	39	144,000	16.1 (3.7)	\$270	\$1,700	\$2,600
Wisconsin						
All funded blocks, 100/20 access ^b	236	85,000	25.6 (2.5)	\$2,780	\$10,800 (9,100 to 13,400)	\$10,800
All funded blocks, fiber ^b	236	85,000	39.4 (2.8)	\$2,780	\$7,000 (6,200 to 8,200)	\$7,000
New York, terrestrial awards, state grants						
25/3 access	289	108,000	5.3 (5.9)	\$2,670	— ^a	—

Program and group	Support \$ millions	Funded locations	Effect points (SE)	Per funded location	Per additional location accrued (95% interval)	Per additional location full commitment
100/20 access	289	108,000	4.3 (2.0)	\$2,670	\$62,000 (33,000 to 700,000)	—

Bases as in Table E.3. a. Interval includes zero; not identified. b. Full-sample estimate with baseline-bin fixed effects, which Chapter 7 treats as confounded. New York 25/3 peaks at 11.6 points in 2020 (\$23,000 per additional location, 13,600 to 75,700); New York fiber peaks at 42.3 in 2021 (\$6,300); New York 100/20 peaks at 6.8 in 2021. RDOF dollars are each block's annual assigned support times years since authorization; CAF II annual support times 6.5 years; A-CAM two years of accepted offers; Wisconsin the state's one-time grants without match (PSC target locations 109,669; 85,000 are BDC locations inside funded polygons); New York \$472.6 million over 177,000 funded units without the federal CAF match; CPF Treasury's \$4,200 per location times 728,000 funded locations in the sample (\$5,021 million on the Funding Map basis of \$6,900).

TABLE E.2

Location-years of earlier service, all rows, with secondary series

Program and series	Support \$ millions	Funded locations	Years bought per funded location (95% interval)	Location-years (95% interval)	Cost per location-year (95% interval)
RDOF, 100/20 access	1,821	2,985,000	0.32 (0.27 to 0.38)	968,000 (806,000 to 1,125,000)	\$1,900 (1,620 to 2,260)
RDOF, fiber	1,821	2,985,000	0.37 (0.32 to 0.42)	1,100,000 (942,000 to 1,241,000)	\$1,650 (1,470 to 1,930)
CAF II, gigabit tier, block fiber (from 2018)	230	135,000	1.98 (1.54 to 2.43)	268,000 (208,000 to 329,000)	\$860 (700 to 1,110)
CAF II, above baseline and baseline tiers, block fiber	500	378,000	negative	negative	—
CAF II, all winners, 100/20 access (from 2018)	790	682,000	0.56 (0.28 to 0.86)	380,000 (189,000 to 586,000)	\$2,080 (1,350 to 4,180)
CAF II, terrestrial winners, 100/20 access (from 2018)	728	537,000	0.79 (0.42 to 1.17)	424,000 (225,000 to 627,000)	\$1,720 (1,160 to 3,230)
Wisconsin, blocks unserved in 2022, 100/20 access	91	33,000	0.97 (0.66 to 1.23)	32,000 (22,000 to 41,000)	\$2,850 (2,240 to 4,160)
Wisconsin, fiber	91	33,000	1.01 (0.70 to 1.27)	33,000 (23,000 to 42,000)	\$2,740 (2,170 to 3,960)
CPF, fiber, observed through 2025	3,056	1,137,000	−0.05 (−0.09 to −0.01)	−57,000 (−102,000 to −10,000)	—
CPF, 100/20 access, observed through 2025	3,056	1,137,000	−0.19 (−0.25 to −0.13)	−214,000 (−279,000 to −150,000)	—
CPF, fiber, projected to 2029	3,056	1,137,000	1.17 (1.12 to 1.22)	1,333,000 (1,275,000 to 1,390,000)	\$2,300 (2,200 to 2,400)
CPF, 100/20 access, projected to 2029	3,056	1,137,000	0.38 (0.31 to 0.45)	433,000 (355,000 to 509,000)	\$7,100 (6,000 to 8,610)
New York, 25/3 access (from 2015) ^a	289	108,000	0.51 (−0.21 to 1.23)	55,000 (−22,000 to 133,000)	\$5,300 (2,180 to no upper bound)
New York, 100/20 access (from 2015; net of years trailed) ^b	289	108,000	0.15	16,000	\$18,000
New York, block fiber (from 2015)	289	108,000	2.38 (1.89 to 2.87)	258,000 (204,000 to 310,000)	\$1,120 (930 to 1,420)

Bases and method as in Table 8.1; CPF rows are per location in funded blocks. a. Interval includes zero, so the cost has no upper bound. b. 0.32 years and \$8,400 counting only the years awarded blocks led; interval not computed. c. Ceiling artifact: both groups near universal 25/3 service; the area measure gives 0.5 years per funded location.

TABLE E.3

Support per funded and per additional location, headline rows

Program and measure	Support \$ millions	Funded locations	Effect points (SE)	Per funded location	Per additional location accrued (95% interval)	Per additional location full commitment
100/20 access						
RDOF, winners still authorized	1,821	2,985,000	18.0 (1.4)	\$610	\$3,400 (2,900 to 4,000)	\$9,700
CAF II, all winners, from June 2022	790	682,000	10.1 (2.6)	\$1,160	\$11,400 (7,900 to 22,300)	\$17,600
Enhanced A-CAM, two years of support	1,997	3,195,000	0.4 (1.2)	\$625	— ^a	—
CPF, blocks under 50 percent access in 2022 ^b	3,056	728,000	3.5 (1.3)	\$4,200	—	\$76,000 (45,000 to 280,000)
Wisconsin, blocks unserved in 2022	91	33,000	43.3 (4.4)	\$2,780	\$6,400 (5,300 to 8,000)	\$6,400
New York, terrestrial awards	289	108,000	4.3 (2.0)	\$2,670	\$62,000 (33,000 to 700,000)	\$62,000
Fiber						
RDOF, winners still authorized, location share	1,821	2,985,000	21.4 (1.4)	\$610	\$2,850 (2,500 to 3,300)	\$8,100
CAF II, gigabit tier, locations in blocks with fiber, from June 2018	230	135,000	36.9 (4.3)	\$1,710	\$4,600 (3,800 to 6,000)	\$7,100
CPF, location share ^b	3,056	728,000	11.0 (1.4)	\$4,200	—	\$24,500 (19,700 to 32,200)
New York, terrestrial awards, block indicator	289	108,000	32.0 (4.2)	\$2,670	\$8,300 (6,600 to 11,300)	\$8,300

Support accrued from authorization through December 2025 (RDOF, CAF II, A-CAM), one-time state grants (Wisconsin; New York state share only, before the federal CAF match), or Treasury's commitment (CPF). The CAF II all-winners row is the pooled Chapter 4 estimate on 101,620 blocks, with its interval from the county bootstrap of the additional share. The Wisconsin row is the reweighted run on 8,574 blocks, which fills blocks absent from the June 2022 release with a zero baseline; the Table 7.1 headline requires an observed baseline and uses 8,138 (effects 0.433 and 0.428). Effects are treated-weighted differences in the change in the share of locations with the outcome, on each row's own sample with comparison blocks reweighted, for RDOF, Enhanced A-CAM, and Wisconsin; the CAF II, CPF, and New York rows use the chapter regressions. a. Interval includes zero; the point estimate implies about \$139,000. b. Committed, not paid; 4 percent of funded locations reported complete. Additional locations are the effect times the 1,137,000 locations in funded blocks, of which 728,000 are CPF-funded. Dollar bases, terciles, alternative outcomes, and the Viasat check are in Table E.1.

TABLE E.4

Coverage leads: how much earlier subsidized areas reached the coverage they would have had without the subsidy

Program and series	Subsidized areas, Dec 2025 %	Counterfactual, Dec 2025 %	Observed lead years (95% interval)	Projected lead years (95% interval)
RDOF, 100/20 access	70	53	1.3 (1.0 to 1.5)	1.7 (1.4 to 2.2)
RDOF, fiber, location share	59	38	1.5 (1.3 to 1.7)	2.6 (2.2 to 3.2)
CAF II gigabit, block fiber	94	60	4.1 (3.5 to 4.6)	4.5 (2.6 to 8.0)
Wisconsin, 100/20 access, blocks unserved in 2022	81	38	2.2 (1.7 to 2.6)	4.1 (2.3 to 7.8)
Wisconsin, fiber	79	32	2.3 (1.9 to 2.7)	5.5 (3.0 to 10.9)
CPF, 100/20 access (about two months)	64	61	0.14 (0.04 to 0.24)	0.3 (0.1 to 0.5)
CPF, fiber, location share	49	38	0.4 (0.3 to 0.5)	1.1 (0.8 to 1.4)
New York, block fiber	96	64	5.2 (4.2 to 6.0)	7.2 (4.6 to 13.5)
RDOF, block fiber indicator (interval not computed)	69	45	1.8	2.9
CPF, block fiber indicator	66	51	0.6 (0.4 to 0.7)	1.3 (1.0 to 1.6)
New York, 25/3 access, block indicator c	100	94	6.0 (4.6 to 6.9)	not meaningful

Location-weighted levels. Observed lead: years before December 2025 at which subsidized areas reached the coverage their counterfactual path has now. Projected lead: years the counterfactual needs, at its 2024 to 2025 pace, to reach subsidized areas' current coverage; an order of magnitude, since that pace slows near the ceiling. Bootstrap intervals from 1,000 county draws. Resampling RDOF's bidders makes its intervals two to three times as wide. The block fiber indicator rows for RDOF and CPF and New York's 25/3 row are in Appendix Table E.2. The last three rows are the secondary series: RDOF block fiber indicator (interval not computed), CPF block fiber indicator, and New York 25/3 access, where the projected lead is not meaningful because both groups are near universal 25/3 service; draws in which the treated path never reaches the target drop out of the observed-lead interval, 6 of 1,000 for CPF access and 163 for New York 25/3.

TABLE E.5

Does more support per location buy a larger effect? Effects by support per funded location

Program and outcome	Effect at the mean support per location points (SE)	Change in the effect per \$1,000 more per location points (SE)	Effect, lowest quartile of support points (SE)	Second quartile	Third quartile	Highest quartile
RDOF, 100/20 access	16.9 (1.3)	-0.16 (0.13)	15.1 (1.9)	19.6 (1.7)	16.8 (1.6)	15.7 (1.8)
RDOF, Fiber	20.7 (1.3)	-0.09 (0.12)	18.6 (1.8)	23.8 (1.7)	20.6 (1.7)	19.5 (1.7)
CAF II, Block fiber (from 2018)	14.9 (3.0)	-0.15 (0.17)	17.9 (3.6)	11.7 (3.4)	13.6 (3.5)	17.9 (4.8)
CAF II, 100/20 access	10.9 (2.5)	-0.04 (0.10)	10.5 (2.9)	9.1 (3.0)	13.9 (3.2)	11.9 (3.4)
Wisconsin, 100/20 access	42.6 (4.4)	-0.09 (0.22)	35.9 (5.5)	41.2 (6.4)	61.4 (5.1)	30.3 (8.5)
Wisconsin, Fiber	47.2 (4.3)	-0.13 (0.22)	43.7 (5.0)	45.0 (6.3)	66.1 (5.0)	33.1 (8.5)

Each row is equation (3) of Chapter 2, the difference regression with treatment interacted with ten-year support per funded location (thousands of dollars, centered at the treated mean) or with quartile of support, with the chapter's fixed effects (Wisconsin: round and county effects, as in Table 7.1), weights, and clusters; comparison blocks have no support, so the interaction is identified among treated blocks. Support per location is the item's assigned support split across its blocks by December 2025 locations (RDOF, CAF II) or the award divided by the December 2025 locations in every block of the award polygon (Wisconsin), whether or not the block is in the analysis sample. An earlier specification charged each Wisconsin award to the unserved blocks alone and used a single round-by-county effect; it gave 36.9 points on access and 38.3 on fiber at the mean dose, with the same flat slope. Quartile means per location: RDOF \$355, \$1,206, \$2,349, \$5,051; CAF II \$347, \$1,452, \$3,013, \$7,039; Wisconsin \$567, \$1,868, \$3,855, \$9,824. Treated means: RDOF \$1,900, CAF II \$2,130, Wisconsin \$3,870. Samples: RDOF 488,441 blocks; CAF II 106,606 blocks (fiber) and 101,618 (access); Wisconsin 8,069 blocks unserved in June 2022, 71 fewer than Table 7.1 because their award polygon carries no award amount.

Appendix F. Regression results

The tables below report the main period-by-period series behind the figures in Chapters 3 through 7, with standard errors, so a reader can see the pre-period checks and the path of each effect in numbers rather than in a picture. Each table names the specification, the fixed effects, the clustering, and the sample; the chapters give the rest.

TABLE F.1

RDOF: authorized minus cancelled-award blocks, period by period

Period	100/20 access, location share since June 2022, points (SE)	Fiber, location share since June 2022, points (SE)	Block fiber indicator relative to June 2020, points (SE)
Dec 2015			-0.7 (0.6)
Jun 2016			-1.4 (0.7)
Dec 2016			-0.7 (0.6)
Jun 2017			-1.1 (0.7)
Dec 2017			-0.8 (0.5)
Jun 2018			-1.3 (0.7)
Dec 2018			-0.9 (0.5)
Jun 2019			-0.9 (0.4)
Dec 2019			-0.4 (0.2)
Dec 2020			+0.7 (0.4)
Jun 2021			+1.1 (0.6)
Jun 2022			+3.7 (1.0)
Dec 2022	+2.0 (0.5)	+2.3 (0.4)	+7.0 (1.1)
Jun 2023	+5.1 (0.9)	+6.2 (0.8)	+9.8 (1.3)
Dec 2023	+8.8 (1.0)	+9.4 (0.9)	+13.3 (1.3)
Jun 2024	+11.3 (1.1)	+12.1 (1.0)	+15.9 (1.4)
Dec 2024	+14.3 (1.2)	+15.8 (1.2)	+19.4 (1.4)
Jun 2025	+14.9 (1.3)	+17.6 (1.3)	+21.2 (1.5)
Dec 2025	+16.9 (1.3)	+20.7 (1.3)	+23.3 (1.5)

Columns 1 and 2: coefficients on authorization from the Chapter 2 difference regression at each BDC release, state by cost-tercile fixed effects, location weights, county clusters, 488,441 blocks (Figure 3.1). Column 3: event-study coefficients on the block fiber indicator, Form 477 through June 2021 and the BDC from June 2022, reference June 2020, block and state by tercile by period fixed effects, 486,649 blocks in 47 states (Figure 3.2, all winners). Standard errors in parentheses, clustered by county.

TABLE F.2

CAF II: assigned minus unassigned-bid blocks, period by period

Period	Block fiber, gigabit winners ref. June 2018, points (SE)	Block fiber, above baseline winners ref. June 2018, points (SE)	Block fiber, baseline winners ref. June 2018, points (SE)	Block fiber, Viasat winners ref. June 2018, points (SE)	100/20 block indicator, all winners joined series, ref. June 2018	100/20 block indicator, terrestrial winners joined series, ref. June 2018
Dec 2015	-7.8 (2.1)	+3.6 (2.1)	+4.5 (3.0)	-0.0 (1.9)	+3.8 (2.3)	+4.6 (2.7)
Jun 2016	-5.7 (1.9)	+3.7 (2.1)	+6.0 (2.8)	+0.5 (1.2)	+5.7 (2.4)	+6.6 (2.8)
Dec 2016	-6.7 (1.9)	+3.4 (2.1)	+6.1 (2.9)	+0.3 (1.2)	+8.0 (2.4)	+9.2 (2.8)
Jun 2017	-6.2 (1.7)	+2.5 (1.9)	+5.0 (2.8)	+1.4 (0.8)	+2.8 (1.9)	+3.9 (2.2)
Dec 2017	-2.7 (0.9)	+1.2 (0.8)	+1.6 (1.1)	+1.0 (0.5)	+1.0 (1.8)	+1.3 (2.1)
Jun 2018	+0.0 (0.0)	+0.0 (0.0)	+0.0 (0.0)	+0.0 (0.0)		
Dec 2018	+3.2 (1.7)	-0.4 (0.3)	-0.5 (0.5)	+0.3 (0.2)	-3.6 (1.8)	-3.4 (2.1)
Jun 2019	+4.3 (1.7)	-1.1 (0.7)	-1.5 (0.6)	-0.6 (0.4)	-4.7 (1.4)	-4.5 (1.6)
Dec 2019	+11.2 (2.5)	-1.6 (1.0)	-2.4 (1.6)	-1.8 (1.3)	-2.7 (2.0)	-2.0 (2.2)
Jun 2020	+16.4 (2.7)	-0.6 (1.8)	-3.0 (1.7)	-1.5 (1.7)	-2.3 (2.1)	+0.0 (2.4)
Dec 2020	+19.8 (3.0)	-0.9 (1.9)	-3.7 (1.7)	-1.9 (1.8)	-4.0 (2.8)	-2.3 (3.2)
Jun 2021	+27.4 (3.9)	-1.6 (2.2)	-6.2 (2.3)	-0.8 (1.9)	+0.7 (3.0)	+3.2 (3.6)
Jun 2022	+35.2 (4.2)	-6.6 (3.2)	-6.0 (3.6)	-0.4 (2.3)	+6.7 (3.3)	+10.3 (3.8)
Dec 2022	+37.6 (4.5)	-6.7 (3.3)	-5.9 (3.7)	-1.6 (2.8)	+10.1 (3.2)	+14.7 (3.8)
Jun 2023	+39.7 (4.6)	-1.8 (3.7)	-3.5 (4.0)	+0.4 (2.8)	+18.1 (3.1)	+23.1 (3.6)
Dec 2023	+39.4 (4.2)	-2.1 (4.0)	+1.1 (4.5)	+1.7 (2.9)	+19.4 (3.0)	+24.2 (3.5)
Jun 2024	+39.0 (4.3)	-4.2 (4.0)	-1.7 (4.6)	+1.9 (3.0)	+19.6 (3.0)	+24.9 (3.5)
Dec 2024	+37.9 (4.6)	-4.9 (4.1)	+2.2 (4.5)	+4.1 (3.2)	+20.8 (3.1)	+25.6 (3.6)
Jun 2025	+36.9 (4.7)	-6.3 (4.2)	+2.5 (4.5)	+5.9 (3.3)	+20.4 (3.2)	+25.1 (3.6)
Dec 2025	+34.2 (4.6)	-4.7 (4.3)	+3.3 (4.5)	+9.4 (3.3)	+19.3 (3.2)	+23.8 (3.6)

Columns 1 to 4: event-study coefficients on assignment by winner tier against the same comparison group, state by reserve-price tercile by period fixed effects, county clusters; blocks: gigabit 25,756, above baseline 45,185, baseline 24,584, Viasat 20,149 (Figure 4.2). Columns 5 and 6: the joined 100/20 block indicator, Form 477 through June 2021 and the BDC from June 2022, all assigned blocks (101,620 blocks) and terrestrial winners only (Figure 4.3). Points of blocks; standard errors in parentheses.

TABLE F.3

Enhanced A-CAM: accepting minus declining carriers, period by period

Period	100/20 access, location share ref. June 2023, points (SE)	Fiber, location share ref. June 2023, points (SE)	Block fiber indicator ref. June 2023, points (SE)
Dec 2015			+5.2 (2.9)
Jun 2016			+6.9 (2.8)
Dec 2016			+6.3 (2.7)
Jun 2017			+3.1 (2.3)
Dec 2017			+3.8 (2.9)
Jun 2018			+4.4 (2.8)
Dec 2018			+3.0 (2.8)
Jun 2019			+2.0 (2.6)
Dec 2019			+2.2 (2.2)
Jun 2020			+2.8 (2.0)
Dec 2020			+2.0 (1.8)
Jun 2021			+2.7 (1.4)
Jun 2022	+0.4 (1.1)	+0.9 (1.1)	+0.8 (0.9)
Dec 2022	+0.6 (0.7)	+0.9 (0.6)	-0.2 (0.4)
Dec 2023	+0.4 (0.5)	-0.6 (0.6)	-0.7 (0.5)
Jun 2024	+0.7 (0.7)	-0.8 (0.8)	-0.9 (0.8)
Dec 2024	+1.0 (0.8)	-0.9 (1.0)	-1.2 (0.9)
Jun 2025	+1.3 (1.0)	-1.6 (1.3)	-2.4 (1.2)
Dec 2025	+0.9 (1.0)	-1.2 (1.3)	-1.7 (1.1)

Coefficients on acceptance of the 2023 offer, every outcome differenced from June 2023, state by prior support mechanism fixed effects, clustered by carrier (605 carriers); 3,195,066 locations in accepting footprints and 3,372,276 in declining footprints (Figure 5.1). Standard errors in parentheses.

TABLE F.4

Capital Projects Fund: funded minus comparison blocks, period by period

Period	100/20 access, location share since June 2022, points (SE)	Fiber, location share since June 2022, points (SE)	Block fiber indicator since June 2022, points (SE)
Dec 2015			-0.2 (0.5)
Jun 2016			-0.3 (0.5)
Dec 2016			-0.2 (0.5)
Jun 2017			-0.2 (0.6)
Dec 2017			-0.3 (0.5)
Jun 2018			-0.3 (0.5)
Dec 2018			-0.5 (0.5)
Jun 2019			-0.5 (0.4)
Dec 2019			-0.6 (0.4)
Jun 2020			-0.6 (0.4)
Dec 2020			-0.6 (0.3)
Jun 2021			-0.9 (0.3)
Dec 2022	-7.8 (0.8)	-3.6 (0.4)	-2.4 (0.5)
Jun 2023	-9.2 (1.1)	-4.7 (0.6)	-3.2 (0.7)
Dec 2023	-9.7 (1.1)	-5.7 (0.7)	-2.5 (0.8)
Jun 2024	-7.8 (1.1)	-4.2 (0.8)	-0.7 (1.0)
Dec 2024	-4.5 (1.2)	-0.9 (1.0)	+3.2 (1.1)
Jun 2025	-0.5 (1.3)	+3.6 (1.1)	+8.6 (1.3)
Dec 2025	+3.5 (1.3)	+11.0 (1.4)	+14.9 (1.4)

Coefficients on CPF funding, county fixed effects, location weights, county clusters; both groups under 50 percent access in June 2022, 76,284 CPF blocks and 195,732 comparison blocks (Figure 6.1). Standard errors in parentheses.

TABLE F.5

Wisconsin: funded minus unfunded application areas, blocks unserved in June 2022, period by period

Period	100/20 access, location share since June 2022, points (SE)	Fiber, location share since June 2022, points (SE)	Block fiber indicator ref. June 2021, points (SE)
Dec 2015			+0.6 (0.6)
Jun 2016			+0.5 (0.6)
Dec 2016			+0.6 (0.6)
Jun 2017			+0.6 (0.6)
Dec 2017			+0.4 (0.6)
Jun 2018			+0.4 (0.6)
Dec 2018			+0.4 (0.6)
Jun 2019			+0.4 (0.5)
Dec 2019			+0.3 (0.5)
Jun 2020			+0.2 (0.4)
Dec 2020			+0.3 (0.4)
Jun 2022			+1.5 (0.9)
Dec 2022	+6.4 (3.4)	+6.7 (3.4)	+6.4 (3.7)
Jun 2023	+16.9 (3.9)	+16.5 (4.0)	+16.3 (4.4)
Dec 2023	+27.8 (4.1)	+28.0 (4.1)	+26.8 (4.3)
Jun 2024	+36.7 (4.3)	+37.2 (4.4)	+39.1 (4.9)
Dec 2024	+43.5 (4.3)	+45.4 (4.4)	+43.6 (4.8)
Jun 2025	+40.7 (4.2)	+43.8 (4.1)	+42.8 (4.5)
Dec 2025	+42.8 (4.3)	+47.3 (4.2)	+43.6 (4.7)

Columns 1 and 2: coefficients on funding at each BDC release, round and county fixed effects, location weights, clustered by application (Table 7.1). Column 3: event-study coefficients on the block fiber indicator, Form 477 through June 2021 and the BDC from June 2022, reference June 2021 (Figure 7.1). Standard errors in parentheses.

TABLE F.6

New York: terrestrial-award minus satellite-award blocks, period by period

Period	Block fiber indicator ref. Dec 2015, points (SE)	100/20 block indicator ref. Dec 2015, points (SE)	25/3 block indicator ref. Dec 2015, points (SE)
Jun 2016	+0.1 (0.1)	+0.1 (0.1)	+0.9 (0.6)
Dec 2016	+0.5 (0.3)	-4.3 (2.5)	+2.0 (1.0)
Jun 2017	+0.2 (0.4)	-1.7 (4.0)	+2.2 (1.0)
Dec 2017	+0.6 (1.0)	-2.2 (3.8)	-1.3 (2.3)
Jun 2018	+1.2 (1.5)	-12.2 (3.8)	-1.0 (2.0)
Dec 2018	+10.6 (4.2)	-12.4 (4.2)	-0.3 (2.4)
Jun 2019	+15.4 (4.8)	-1.4 (3.8)	+8.0 (3.4)
Dec 2019	+19.5 (4.9)	+0.3 (3.9)	+9.1 (3.5)
Jun 2020	+29.2 (5.0)	+4.7 (3.4)	+11.6 (4.1)
Dec 2020	+35.6 (5.2)	+5.4 (2.7)	+6.0 (5.1)
Jun 2021	+42.3 (5.9)	+6.8 (2.8)	+8.6 (4.9)
Jun 2022	+37.5 (4.6)	+6.7 (2.5)	+7.2 (5.9)
Dec 2022	+38.4 (4.2)	+5.4 (1.9)	+6.9 (5.7)
Jun 2023	+40.0 (4.1)	+5.4 (2.0)	+6.3 (5.6)
Dec 2023	+38.6 (4.4)	+5.5 (2.0)	+6.2 (5.7)
Jun 2024	+37.4 (4.3)	+5.1 (2.0)	+6.1 (5.8)
Dec 2024	+37.0 (4.4)	+4.8 (2.0)	+5.9 (5.8)
Jun 2025	+36.4 (4.4)	+4.9 (2.1)	+6.1 (5.8)
Dec 2025	+32.0 (4.2)	+4.3 (2.0)	+5.3 (5.9)

Event-study coefficients on a terrestrial award, county by period fixed effects, clustered by county, the chapter's main sample of 16,744 awarded blocks, which excludes blocks funded by other programs before 2025 and keeps BEAD (Figure 7.2, Table 7.3). Form 477 through June 2021 and the BDC from June 2022. Standard errors in parentheses.

Appendix G. Further work

The project asked whether subsidies crowd out private investment, whether the economics of rural deployment have changed, and whether we measure success correctly. Chapter 8 answers the first in coverage units, Chapter 9 takes up the second, and this appendix lists the work that remains, with the state data located so far.

State programs. State grant programs are both a confound and an opportunity. They funded some areas every federal chapter treats as unsubsidized, which biases every additional share downward; Chapter 3 nets out the grants it can locate in Virginia, Minnesota, and Wisconsin. Several states also publish the applications they rejected, the only credible comparison group we have found for a discretionary grant program, and Chapter 7 uses Wisconsin’s.

TABLE G.1

State program data located, September 2026

Usable for a rejected-applicant design	Program	Funded areas	Unfunded applicants	Geography	Years
✓ Yes, strongest case	Wisconsin Broadband Expansion Grant	Polygons, every round	Applicant polygons for FY2022, FY2022 ARPA, FY2023; scored dockets every round	Polygons	FY2014 to FY2026
✓ Yes, two rounds	Virginia VATI	Award map; project address points FY2022 to FY2023	Applicant lists every year; shapefiles FY2023 and FY2024 only	Polygons, 2023 to 2024	2017 to 2026
✓ Yes, two cycles, with digitizing	California CASF	Approved projects by resolution	Proposed project summaries and maps posted for challenge, 2023 and 2025	PDF maps	2008 to 2025
ⓘ Partly	New York Broadband Program	Awarded blocks with geometry	Losing bids not published; satellite awards serve as comparison	2010 blocks	2016 to 2018
? Uncertain	Louisiana GUMBO	Awards by parish and provider; BEAD round by location ID	Scored lists were public during protest windows; not verified	Parish; location IDs for 2025	2022 on
✗ Not without a records request	Minnesota Border-to-Border	Awarded areas in the state map	Names, counties, amounts by round; no geography	County	2014 to 2024

Virginia’s earlier rounds need a records request. New York predates the BDC and relies on Form 477. Louisiana needs the archived protest-window files.

Anticipation. The proposal’s second test, whether the promise of BEAD slows private deployment, has not been run. BEAD fixed its eligible locations with the 2023 BDC and its money arrives in 2026 and later, so if providers wait for the subsidy, deployment by non-BEAD providers should slow in eligible blocks from

2023 onward, relative to blocks that barely missed eligibility. Eligibility turned on the BDC version each state named, as amended by its challenge process, so the design needs state-specific dates and must stay close to the threshold. The RDOF cancellations give a first look from the other side. Cancelled-award areas were promised money, closed to other programs, then released, and gained 30 points of access anyway, which bounds how much the promise alone suppressed.

State policy. The third test concerns state policy. Pole attachment rules, permitting, rights of way, municipal broadband restrictions, and state matching funds vary across states and over time, and the national panel can ask whether unsubsidized deployment responds to them once a state policy database with dates exists. Building it is the largest remaining piece of data work.

Competition. The proposal treats low-earth-orbit satellite and fixed wireless as competitive shocks to wireline investment, but Starlink availability is near universal by 2023 and varies mainly with Starlink's own capacity choices, and fixed wireless is both an outcome and a competitor whose availability claims swing with providers' propagation models. The candidate instruments, spectrum holdings, tower locations, and Starlink's cell-level waitlist history, affect deployment directly or respond to local demand, and we will not report a competition result without a credible one. The subsidies' own effect on competition is separate, and Chapters 3 and 5 test it with the panel's second-provider flag.

Reliability of the availability data. Every result rests on provider filings, and the Ookla comparison in Chapter 3 is the only check on delivered performance. The FCC's challenge process data, the Measuring Broadband America panel, and the BDC's revision history, which flags the providers whose claims are least stable, disproportionately fixed wireless, would each extend it.

Order of work. 1. Disbursements, to replace the accrued support in Table E.3 and CPF's committed dollars, and a capital cost per location to price the displaced private investment. 2. Competition effects, with a third post-offer year for the A-CAM entry test and the RDOF second-provider test on the 2026 releases. 3. The crowd-out test for CPF, whose Funding Map records name each funded provider, and the missing 477 filings when the FCC opens them; the same provider-level extract would give the Capital Projects Fund and New York rows of Table 8.2. 4. Block-level grant areas for Virginia and Minnesota, to replace the county screen in Chapter 3. 5. Virginia's rejected-applicant design, then the states that need records requests. 6. The BEAD anticipation test, and what the comparison areas' pace implies for a program that fixed eligibility in 2023 and 2024 and pays from 2026: RDOF's cancelled areas gained about 8 points of access a year without a subsidy. 7. The bidder-selection tests in Chapter 3's problems list, an interval for the RDOF block fiber indicator row in Table E.2, a check of authorization cohort dates against notice release dates, and the open Wisconsin items. 8. State policy database and the third test. 9. Competition instruments, if any prove credible. 10. An access row that counts satellite offers, which needs the satellite records re-extracted from the BDC, to put a number on Chapter 9's claim that counting satellite takes every effect to near zero. 11. A value for a terrestrial location-year over satellite, from a willingness-to-pay study, to replace the bounds in Chapter 9. 12. The waiting-period design in Chapter 3's conclusion, costed from the report's own data: about half of cancelled-area locations were still unserved in December 2025. 13. Enhanced A-CAM's incremental cost over the legacy support the decliners kept. 14. Effects by recipient, since Charter's additional share was half and all other RDOF winners' a quarter, and price under RDOF's rate-comparability rule.

References

- Bourreau, M., L. Grzybowski, and Á. Muñoz-Acevedo. 2026. "State Aid for Broadband and Crowding Out of Private Investment: Evidence from the French Market." *International Journal of Industrial Organization* 104: 103240. <https://doi.org/10.1016/j.ijindorg.2025.103240>
- Broadband Breakfast. 2026. "With All BEAD Plans Approved, States and Territories Set to Spend \$18.2 Billion on Deployment." August 28. <https://broadbandbreakfast.com/with-all-bead-plans-approved-states-and-territories-set-to-spend-18-2-billion-on-deployment/>
- Briglauer, W., and M. Grajek. 2024. "Effectiveness and Efficiency of State Aid for New Broadband Networks: Evidence from OECD Member States." *Economics of Innovation and New Technology* 33(5): 672-700. <https://doi.org/10.1080/10438599.2023.2222265>
- CableTV.com. 2026. "Starlink Internet Plans 2026: Pricing, Speeds & Expert Advice." Accessed October 1, 2026. <https://www.cabletv.com/starlink/plans>
- CBO (Congressional Budget Office). 2003. *Does the Residential Broadband Market Need Fixing?* December. <https://www.cbo.gov/sites/default/files/108th-congress-2003-2004/reports/12-03-broadband.pdf>
- Dinterman, R., and M. Renkow. 2017. "Evaluation of USDA's Broadband Loan Program: Impacts on Broadband Provision." *Telecommunications Policy* 41(2): 140-153. <https://doi.org/10.1016/j.telpol.2016.12.004>
- Dunning, J., and D. Garner. 2025. "New Dataset Reveals Impact of RDOF Defaults on Each State." Benton Institute for Broadband & Society, February 18. <https://www.benton.org/blog/new-dataset-reveals-impact-rdof-defaults-each-state>
- Duso, T., M. Nardotto, and J. Seldeslachts. 2025. "A Retrospective Study of State Aid Control in the German Broadband Market." *Journal of the European Economic Association* 23(6): 2289-2337. <https://doi.org/10.1093/jeea/jvaf020>
- FCC (Federal Communications Commission). 2022. *Wireline Competition Bureau and Rural Broadband Auctions Task Force Announce the Availability of Connect America Fund Phase II Auction Deployment Data*. Public Notice, DA 22-391, April 8. <https://docs.fcc.gov/public/attachments/DA-22-391A1.pdf>
- FCC. 2026. *Connect America Fund Phase II Auction: Petition for Reconsideration and Petition for Waiver*. Order, DA 26-127, February 5. <https://docs.fcc.gov/public/attachments/DA-26-127A1.pdf>
- FCC. n.d. "Connect America Fund Phase II Auction (Auction 903)." Accessed September 29, 2026. <https://www.fcc.gov/auction/903>
- FCC OIG (Federal Communications Commission, Office of Inspector General). 2025. *Performance Audit over High-Cost Universal Broadband (HUBB) Portal Data*. Report 24-AUD-04-02, September 30. <https://www.oversight.gov/sites/default/files/documents/reports/2025-12/HUBB%20Portal%20Audit%20Final%20Report%209-30-25.pdf>
- Feamster, N., and J. Livingood. 2020. "Measuring Internet Speed: Current Challenges and Future Recommendations." *Communications of the ACM* 63(12). <https://doi.org/10.1145/3372135>
- Ford, G. S. 2021. "Form 477, Speed-Tests, and the American Broadband User's Experience." Phoenix Center Perspectives 21-03, March 31. <https://www.phoenix-center.org/perspectives/Perspective21-03Final.pdf>
- GAO (U.S. Government Accountability Office). 2014. *Recovery Act: USDA Should Include Broadband Program's Impact in Annual Performance Reports*. GAO-14-511, June 17. <https://www.gao.gov/products/gao-14-511>
- GAO. 2018. *Broadband Internet: FCC's Data Overstate Access on Tribal Lands*. GAO-18-630, September 7. <https://www.gao.gov/products/gao-18-630>
- GAO. 2020. *Telecommunications: FCC Should Enhance Performance Goals and Measures for Its Program to Support Broadband Service in High-Cost Areas*. GAO-21-24, October. <https://www.gao.gov/assets/720/710167.pdf>
- GAO. 2026a. *Broadband: Actions Needed to Strengthen Fragmented Federal Effort*. GAO-26-109297, July 22. <https://files.gao.gov/reports/GAO-26-109297/index.html>

- GAO. 2026b. *Broadband Deployment: Agencies Should Take Steps to Better Target Underserved Areas and Consider Sustainability*. GAO-26-107725, August 31. <https://files.gao.gov/reports/GAO-26-107725/index.html>
- Gillan, J. 2019. *Lessons from the CAF II Auction and the Implications for Rural Broadband Deployment and the IP Transition*. With a reaction by C. Matthey. National Regulatory Research Institute, April. <https://pubs.naruc.org/pub/9F958420-E885-F843-1AEC-4D290DC9A28E>
- Grubestic, T. H. 2012. "The U.S. National Broadband Map: Data Limitations and Implications." *Telecommunications Policy* 36(2): 113-126. <https://doi.org/10.1016/j.telpol.2011.12.006>
- Hauge, J., and J. E. Prieger. 2015. "Evaluating the Impact of the American Recovery and Reinvestment Act's BTOP on Broadband Adoption." *Applied Economics* 47(60): 6553-6579. <https://doi.org/10.1080/00036846.2015.1080810>
- Kandilov, I. T., and M. Renkow. 2020. "The Impacts of the USDA Broadband Loan and Grant Programs: Moving toward Estimating a Rate of Return." *Economic Inquiry* 58(3): 1129-1145. <https://doi.org/10.1111/ecin.12872>
- Kang, K., and M. Xiao. 2024. "Policy Deterrence: Strategic Investment in U.S. Broadband." Working paper, October 24. https://karamkang.github.io/files/kang_xiao_deterrence.pdf
- Matthey, C. 2019. "Reaction." In Gillan, *Lessons from the CAF II Auction and the Implications for Rural Broadband Deployment and the IP Transition*. National Regulatory Research Institute, April. <https://pubs.naruc.org/pub/9F958420-E885-F843-1AEC-4D290DC9A28E>
- Manda, H., V. Srinivasavaradhan, L. Koduru, K. Zhang, X. Zhou, U. Paul, E. Belding, A. Gupta, and T. N. Narechania. 2024. "The Efficacy of the Connect America Fund in Addressing US Internet Access Inequities." Proceedings of ACM SIGCOMM 2024.
- New York OSC (Office of the State Comptroller). 2022. *New NY Broadband Program*. Report 2020-S-19 (Empire State Development), July 1. <https://www.osc.ny.gov/state-agencies/audits/2022/07/01/new-ny-broadband-program>. Follow-up: Report 2024-F-10, September 25, 2024. <https://www.osc.ny.gov/state-agencies/audits/2024/09/25/new-ny-broadband-program-follow>
- Oh, S. 2021. "Using Reverse Auctions to Stretch Broadband Subsidy Dollars: Lessons from the Recovery Act of 2009." Technology Policy Institute, January. <https://techpolicyinstitute.org/wp-content/uploads/2021/03/Oh-Reverse-Auctions-Lessons-from-BTOP-Jan-2021.pdf>
- Paul, U., J. Liu, D. Gu, A. Gupta, and E. Belding. 2021. "The Importance of Contextualization of Crowdsourced Active Speed Test Measurements." Proceedings of the ACM Internet Measurement Conference (IMC 2021).
- Pender, J., J. Goldstein, and D. Mahoney-Nair. 2022. "Impacts of the Broadband Initiatives Program on Broadband Adoption and Home Telework." *Telecommunications Policy* 46(8): 102365. <https://doi.org/10.1016/j.telpol.2022.102365>
- Rivkin-Fish, Z. 2020. "FCC's Rural Digital Opportunity Fund Auction Was Supposed to Significantly Reduce America's Rural Broadband Gap." Benton Institute for Broadband & Society, December 21. <https://www.benton.org/blog/fccs-rural-digital-opportunity-fund-auction-was-supposed-significantly-reduce-americas-rural>
- Rivkin-Fish, Z. 2021. "Is the FCC's Reverse Auction Fatally Wounded or Just Bloodied?" Benton Institute for Broadband & Society, April 29. <https://www.benton.org/blog/fcc%E2%80%99s-reverse-auction-fatally-wounded-or-just-bloodied>
- Rosston, G. L., and S. Wallsten. 2013. "The Broadband Stimulus: A Rural Boondoggle and Missed Opportunity." Technology Policy Institute, November. <https://techpolicyinstitute.org/wp-content/uploads/2013/11/the-broadband-stimulus-a-rural-2007592.pdf> <https://techpolicyinstitute.org/wp-content/uploads/2013/11/the-broadband-stimulus-a-rural-2007592.pdf>
- Rosston, G. L., and S. Wallsten. 2020. "Increasing Low-Income Broadband Adoption through Private Incentives." *Telecommunications Policy* 44(9): 102020. <https://doi.org/10.1016/j.telpol.2020.102020> <https://doi.org/10.1016/j.telpol.2020.102020>

- Rosston, G. L., and S. Wallsten. 2023. "Should Satellite Broadband Be Included in Universal Service Subsidy Programs?" *Journal of Law & Innovation* 6(1): 135-158. <https://doi.org/10.58112/jli.6-1.6https://doi.org/10.58112/jli.6-1.6>
- Rosston, G. L., and S. Wallsten. 2024. "Overhauling the Universal Service Fund: Aligning Policy with Economic Reality." Technology Policy Institute, August 28. <https://techpolicyinstitute.org/publications/broadband/overhauling-the-universal-service-fund-aligning-policy-with-economic-reality/>
- Rosston, G. L., and S. Wallsten. 2025. "New BEAD Rules Enable Efficient Spending But Make It Pointless to Try." Technology Policy Institute, July 8. <https://techpolicyinstitute.org/publications/broadband/digital-divide/new-bead-rules-enable-efficient-spending-but-make-it-pointless-to-try/>
- Treasury OIG (U.S. Department of the Treasury, Office of Inspector General). 2025. *Termination Memorandum: Audits of the Department of the Treasury's Implementation of Pandemic Programs*. OIG-CA-26-006, December 4. <https://oig.treasury.gov/system/files/2025-12/OIG-CA-26-006-locked.pdf>
- Wallsten, S. 2000. "The Effects of Government-Industry R&D Programs on Private R&D: The Case of the Small Business Innovation Research Program." *RAND Journal of Economics* 31(1): 82-100. <https://econpapers.repec.org/RePEc:rje:randje:v:31:y:2000:i:spring:p:82-100https://econpapers.repec.org/RePEc:rje:randje:v:31:y:2000:i:spring:p:82-100>
- Wallsten, S. 2009. "Reverse Auctions and Universal Telecommunications Service: Lessons from Global Experience." *Federal Communications Law Journal* 61(2): 373ff. <https://www.repository.law.indiana.edu/fclj/vol61/iss2/4/>
- Wallsten, S. 2011. "The Universal Service Fund: What Do High-Cost Subsidies Subsidize?" Technology Policy Institute, February 23. <https://techpolicyinstitute.org/publications/broadband/the-universal-service-fund-what-do-high-cost-subsidies-subsidize/>
- Wallsten, S. 2013. "Two Cheers for the FCC's Mobility Fund Reverse Auction." *Colorado Technology Law Journal* 11(2): 369ff. <https://scholar.law.colorado.edu/ctlj/vol11/iss2/3/>
- Wallsten, S., and G. L. Rosston. 2023. "How to Fix the Universal Service Fund." Technology Policy Institute, May 10. <https://techpolicyinstitute.org/publications/broadband/digital-divide/how-to-fix-the-universal-service-fund/>
- Wallsten, S., and L. Gamboa. 2017. "Public Investment in Broadband Infrastructure: Lessons from the U.S. and Abroad." Technology Policy Institute, June 22. <https://techpolicyinstitute.org/wp-content/uploads/2017/06/Public-Investment-in-Broadband-Infrastructure.pdf>
- Whitacre, B., and R. Gallardo. 2020. "State Broadband Policy: Impacts on Availability." *Telecommunications Policy* 44(9): 102025. <https://doi.org/10.1016/j.telpol.2020.102025>
- Whitacre, B., S. Stover, and R. Gallardo. 2015. "How Much Does Broadband Infrastructure Matter? Decomposing the Metro-Non-Metro Adoption Gap with the Help of the National Broadband Map." *Government Information Quarterly* 32(3): 261-269. <https://doi.org/10.1016/j.giq.2015.03.002>
- Wisconsin LAB (Legislative Audit Bureau). 2022. *Certain Broadband Expansion Grant Programs*. Report 22-11, September. https://legis.wisconsin.gov/lab/media/5nvcyc4r/22-11summary_677873.pdf