PERSPECTIVES

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Rhetoric Aside: What the Data Actually Say About Broadband Deployment

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By December 2016, about 93% of all Americans had access to wireline or fixed-wireless broadband services with download/upload speeds of at least 25/3 Mbps.[1] Those lacking access to wireline broadband services are mostly in rural areas; at the end of 2016, nearly 98% of urban areas but only 69% of rural areas were covered.[2] This pattern of deployment is entirely unsurprising since the low population densities in rural areas make the economics of network deployment unfavorable.

Though short of ubiquity, these high availability rates are quite impressive. Still, since the second Bush Administration something near ubiquitous broadband coverage appears to be a national policy goal.[3] To that end, the Federal Communications Commission's ("FCC") Connect America Fund ("CAF") and the U.S. Department of Agriculture's grants and low-cost loan programs aim to improve deployment incentives, to the extent feasible, by closing the gap between revenues and costs in unserved areas using subsidies. The fruits of such labor are only now being seen.

Across the urban-to-rural continuum, there are places with multiple providers, places with few providers, places with one provider, and places with no providers. Some political advocacy groups bemoan both the lack of broadband and the lack of competitive choice in rural areas, often disparaging the broadband providers for serving areas unserved (and perhaps unservable) by others.[4] This critical commentary is perverse and mostly hysterical, unconstrained by either theoretical or empirical considerations. In fact, the criticism violates even common sense since one obvious method to stop being a sole provider is to stop providing service in such areas and leaving them unserved altogether.

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In this PERSPECTIVE, I analyze the FCC's Form 477 data from 2015 and 2016 to contribute to a more informed and less impassioned take on rural broadband deployment and single-provider markets. Three empirical facts emerge.

First, prices and speeds in single-provider markets belie the rhetorical "monopoly" characterization made by some advocacy groups; single-provider areas have the same prices as multiple-provider areas. Rather than being a "monopoly" problem, a better characterization of the market outcome is that at least one provider is bringing the full benefits of broadband to geographic areas that multiple providers have yet to serve.

Second, the deployment of cable broadband services between 2015 and 2016 is disproportionally focused on rural markets. This shift in deployment is encouraging.

Third, despite claims that the larger broadband providers seek to minimize competition between them, the vast majority of their service territories include another large provider of broadband.

I also briefly review a recent study by the American Action Forum ("AAF") that provides additional descriptive statistics on deployment in rural markets showing how deployment within rural areas is affected by population density and dominant economic activity.[5] These data may prove interesting for some purposes. Unfortunately, the *AAF Study's* statistical analysis of broadband's impact on economic outcomes is faulty and thus ignorable.

Basic Economics of Broadband Deployment

In large measure, broadband services are deployed in the U.S. by private firms. These firms deploy networks where they believe the revenues from the services provided will exceed the costs of producing them. As demonstrated by economic theory, when the ratio of market size to deployment costs is large, multiple firms may offer services in that market.[6] As this ratio declines, the number of providers will likewise shrink to the point of one provider and then to no provider finding it financially feasible to offer services. Population density is highly correlated with the broadband business case, so naturally more networks are deployed in urban rather than in rural areas.[7]

Since network deployment requires scarce resources and thus takes time, network deployment will follow a predictable, sequential pattern; network deployment and upgrades first appear where the ratio of market size to entry costs are most favorable. Over time, once the most profitable markets are served, providers shift their attention to more marginal markets, reflecting scarce deployment resources.

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For the same reasons, we expect that there will be more networks in areas where the conditions for entry are most favorable.[8] As governed by underlying economic factors, there will be places with multiple providers, places with few providers, places with one provider, and places with no providers. Despite attempts to label this as some sort of conspiracy by broadband providers, this pattern of deployment is familiar to all businesses. Montpelier, Vermont, the state's capital city (population 7,500), does not have a McDonalds restaurant.[9]

This basic economic description of the network deployment is supported by mountains of data. The FCC's *2018 Broadband Progress Report* indicates that at the end of 2016, 92.5% of Americans have access to a fixed terrestrial broadband service of at least 25/3 Mbps, with urban and rural areas having a 97.9% and 69.3% availability rate. Within rural areas, deployment rates are higher when the population is larger and geographically compact.[10] Other factors are

also relevant. As noted in that *Report*, households with broadband access

> … typically live in census block groups with a lower percentage of households living in poverty, and with higher average populations, population densities, per capita incomes, and median household incomes than Americans living in areas without access to these services.[11]

FCC data from 2014 showed that 38% of Americans had access to more than one provider of broadband service, 51% had access to one provider, and 10% had no access to broadband service.[12] While some advocates lament this condition, this pattern of deployment is not a market defect, as is sometimes claimed, but is entirely consistent with rational economic behavior.[13]

Uniform pricing within a provider's market footprint (or even across markets, as is commonly practiced) implies the customers in these alleged "monopoly" areas are actually reaping the benefits of the rivalry in the competitive areas. It is possible to evaluate the spatial issue by looking at prices, which are an indicator of (and key benefit of) competition.

Statistics computed from the FCC's Form 477 data showing areas with only one provider are sometimes interpreted as implying that these areas are subject to monopolistic supply. This characterization of the data is inaccurate. Calculations using the Form 477 data are based on census block data, which are tiny geographic areas. There are just over 11 million census blocks in the United States with populations of less than 30 persons, on average.[14] "Monopoly" is a market concept; census blocks are tiny geographic divisions located within a larger (franchise) market.

While the Form 477 data do not provide franchise area boundaries, it is sensible to expect that many of these single-provider census blocks are part of a larger market that includes multiple providers. Uniform pricing within a provider's market footprint (or even across markets, as is commonly practiced) implies the customers in these alleged "monopoly" areas are actually reaping the benefits of the rivalry in the competitive areas.[15] It is possible to evaluate the spatial issue by looking at prices, which are an indicator of (and key benefit of) competition.

Consider the prices of the two largest cable operators: Comcast and Charter. Using the Form 477 data and pricing data obtained from Broadbandnow.com, I compare prices between census blocks where the data indicate the two firms face a rival and where they do not (at the 25/3 Mbps level).[16] Comcast's footprint includes about 30% and Charter 38% of areas served only by the company. Table 1 summarizes the results.

Table 1. Price Comparison

Provider	Area with Rival	Area without Rival
Comcast		
Pop. Share	72.5%	27.5%
Prices	$45.49 (5.10)	$43.99 (5.03)
Charter		
Pop. Share	62.6%	37.4%
Price	$44.99 (0.00)	$44.99 (0.00)

Standard Deviation in Parenthesis. N = 20 in each cell.

As is apparent, the "monopoly" label assigned to these areas has no merit: the prices are the same in census blocks with and without a broadband rival. Charter, for instance, offers uniform pricing across most of its footprint (all the prices in the sample were the same). For Comcast, the average price in areas without

another provider are in fact a bit lower than the contested areas, but this difference is attributable to random variation.[17] Statistically, the prices are the same.

So, while areas served by a single provider are often pejoratively labeled "monopolies,"[18] an alternative and more accurate assessment of the data is that *the cable industry brings the benefit of competitive broadband pricing and speeds to over 60 million Americans living in areas no other provider is willing to serve*. With federal policy seeking to expand broadband availability to the unserved, Comcast and Charter (and other broadband providers not analyzed here) appear as broadband heroes, not villains.

Serving rural areas no other firm is willing to serve (as of December 2016) is not unique to the larger broadband providers. In many of the nation's rural areas, cooperatives offer broadband service. For these smaller providers, nearly 57% of their service territories (by population) are served only by the cooperative, a share nearly twice that of Comcast. Also, only 55% of the cooperatives customers have access to 25/3 Mbps broadband, where nearly all of Comcast's and Charter's footprint, and 90% of the cable industry generally, satisfies that level of service. As the cooperatives normally serve more rural markets than do the larger cable providers, these statistics are unsurprising and do not reflect poorly on these entities. However, these data reject the hypothesis that cooperatives are a "solution" and the larger broadband providers the "cause" of the availability gap.

Expanding Rural Deployment

The broadband networks of service providers, both big and small, are constantly being improved to meet current demands for speed. Likewise, the geographic footprints of broadband networks are regularly expanded. According to Form 477 data, between 2015 and 2016, the cable industry extended its broadband coverage by 3.8 million persons (about 1.4 million homes). While broadband providers are rationally attentive to urban markets, this increased deployment disproportionately focused on rural areas.

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In 2016, for instance, the cable industry reached 271.5 million Americans with 25/3 Mbps service, up from 271.3 million in 2015; an increase of 3.8 million. In 2015, 89% of these persons lived in urban areas and 11% in rural areas. A proportional increase in availability implies that 3.38 million of the new connections would be in urban areas and only about 258,000 in rural areas. Yet, urban deployment rose by only 2.3 million and rural deployment by 1.48 million. Rural deployment increased substantially more than did urban deployment in a proportional sense. The data indicate that the cable networks are pushing deeper into rural areas over time.

Recognizing the underlying economics of deployment, the FCC along with the U.S. Department of Agriculture are approaching deployment shortfalls in a rational manner by providing subsidies and low-cost loans in an effort to get quality broadband services in unserved areas. In the most rural areas, such programs face significant challenges. Recently, the U.S. Department of Agriculture's rural broadband funding program provided loans of $17 million to provide service 1,300 households

in South Dakota and $13.7 million to serve 1,063 homes in Missouri.[19] These efforts amount to a cost of $13,000 per (potential) subscriber, a deployment costs that almost certainly precludes profitability in any reasonable time frame.[20] Even if broadband was sold to all these homes at $100 per month, total revenues over ten-years (not gross profits, which is the more relevant measure) are only $12,000 per subscriber. From a purely financial perspective, these network builds are a hopeless endeavor and offer compelling evidence as to why unsubsidized private providers are unwilling to deploy networks in these areas.

[The FCC's CAF] program wisely aims to create a single provider where there is no provider today—an efficient use of subsidy dollars. The program does not subsidize multiple-firm supply because subsidizing competition is irrational; the gains from price competition to one group of subscribers is almost certainly swamped by the required taxes on subscribers to fund the subsidy.

The FCC's CAF program specifically targets unserved areas, offering funding for very specific geographic areas where no provider presently offers service. In fact, any area capable of supporting two broadband providers is denied subsidy dollars. This program wisely aims to create a single provider where there is no provider today—an efficient use of subsidy dollars. The program does not subsidize multiple-firm supply because subsidizing competition is irrational; the gains from price competition to one group of subscribers is almost certainly swamped by the required taxes on subscribers to fund the subsidy. Moreover, the social welfare function is declining at the market equilibrium number of firms, a condition that further illustrates to the senselessness of subsidized competition.[21]

Do Broadband Providers Minimize Head-to-Head Competition?

Recently, the Institute for Local Self-Reliance ("ILSR") issued a report entitled *Profiles of Monopoly: Big Cable and Telecom* authored by Christopher Mitchell.[22] Their short yet colorful *Report* presents a few summary statistics on the service territories of the six largest broadband providers.[23] Largely unrelated to these rudimentary calculations, the *ILRS Report* offers a catalog of rhetorical speculations about the domestic broadband market.[24]

Comcast faces competition from one of the six largest broadband providers at the 25/3 Mbps level in 74% of its territory where another provider offers service. *** Likewise, AT&T faces competition from another of the large providers of broadband across 81% of its broadband footprint at the 25/3 level…. If the large broadband providers are truly seeking to minimize competition with each other, then their actions should be considered careless rather than careful.

One of the *ILRS Report's* unsupported claims is that broadband providers "have carefully minimized head-to-head competition with each other."[25] In fact, the Form 477 data suggests exactly the opposite.

Consider Comcast, for instance. Comcast faces competition from one of the six largest broadband providers at the 25/3 Mbps level in 74% of its territory where another provider offers service. At the 10/1 Mbps level, Comcast faces competition from another large provider across 81% of its footprint. Likewise, AT&T faces competition from another of the large providers of broadband across 81% of its broadband footprint at the 25/3 level, and 88% at the 10/1 Mbps level. If the large broadband providers are truly seeking to minimize competition with each other, then their actions should be considered careless rather than careful.

Moreover, the *ILSR Report*'s statement that "large telecommunication companies invest mainly where they face cable competition" precisely conflicts with ILSR's claim that the broadband providers seek to avoid competition.[26] Telecoms companies cannot "invest mainly where they face cable competition" and try to avoid such competition at the same time.

A Finer Measure of Rural

In a recent study, the American Action Forum offered an analysis of rural broadband deployment using the FCC's Form 477 data.[27] The report, entitled *A Look at Rural Broadband Economics*, provides summary statistics on broadband availability using the Urban Continuum Code, an indicator that divides urban and rural areas into finer classifications that account for metropolitan status, adjacency to metropolitan areas, and so forth.

The analysis revealed exactly what would be expected: broadband is more heavily deployed in rural areas where the population is larger and geographically compact, and when the area is near a metropolitan area. Some results are summarized in Table 2. The *AAF Study*'s finer breakdown of the urban-rural distinction sheds additional light on the deployment gap.

Table 2. Urban/Rural Deployment

Rural Urban Continuum Code		% Without Broadband Access
Metro Counties		
1	Counties in metro areas of 1 million population or more	2%
2	Counties in metro areas of 250,000 to 1 million population	5%
3	Counties in metro areas of fewer than 250,000 population	9%
Nonmetro Counties		
4	Urban population of 20,000 or more, adjacent to a metro area	13%
5	Urban population of 20,000 or more, not adjacent to a metro area	11%
6	Urban population of 2,500 to 19,999, adjacent to a metro area	28%
7	Urban population of 2,500 to 19,999, not adjacent to a metro area	28%
8	Completely rural or less than 2,500 urban population, adjacent to a metro area	42%
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area	40%

Some deployment differentials were also observed based on the dominant economic activity of counties. The statistics are summarized in Table 3. Not surprisingly, farming and mining communities, where population density can be quite low, have the least access to broadband services. In contrast, counties relying on recreational activities for income have the most broadband coverage, which is sensible.

Table 3. Urban/Rural Deployment

County Industry Type	% Without Broadband Access
Non-Specialized	16%
Farming	21%
Mining	20%
Manufacturing	17%
Federal/State Government	17%
Recreation	13%

Less compelling is the *AAF Study*'s attempt to quantify the relationship between broadband deployment and economic outcomes (e.g., income). The *AAF Study* concludes, for instance,

that regression analysis shows that "the percentage of the population with access to 25/3 broadband doesn't explain the unemployment rate, median household income, the change in employment, or the rate of population change in rural regions." The *AAF Study's* regression model does not permit such a conclusion, however, as the regression model is poorly specified. Instead of broadband explaining economic outcomes, the *AAF Study's* regression model has the multiple outcomes explaining broadband availability.

The AAF Study concludes, for instance, that regression analysis shows that "the percentage of the population with access to 25/3 broadband doesn't explain the unemployment rate, median household income, the change in employment, or the rate of population change in rural regions." The AAF Study's regression model does not permit such a conclusion, however, as the regression model is poorly specified. Instead of broadband explaining economic outcomes, the AAF Study's regression model has the outcomes explaining broadband availability.

More formally, consider three economic outcomes y_1, y_2, and y_3 that may be related to broadband availability (b) and some other factors x_1, x_2, and x_3 for each y_i. We then have,

$$y_1 = f(b, x_1) + e_1 \quad , \qquad (1)$$

$$y_2 = f(b, x_2) + e_2 \quad , \qquad (2)$$

$$y_3 = f(b, x_3) + e_3 \quad , \qquad (3)$$

where the e are econometric disturbances terms that are likely correlated with each other. Rather than estimate these equations, the *AAF Study* estimates a single equation like the following:

$$b = f(y_1, y_2, y_3, x_1, x_2, x_3) + v. \qquad (4)$$

Here, the multiple economic outcomes are explaining broadband availability and doing so in the same regression equation. What the estimated coefficients from Equation (4) measure is unclear, but they are almost certainly not valid measures of the causal relationship between broadband and the economics outcomes.[28]

[T]he AAF Study does not even contemplate rendering plausibly casual results through a proper identification strategy. When it comes to policy, it is causality that matters. So, while the descriptive statistics in the AAF Study are likely useful to some degree, the regression analysis is unsound.

Also, without explanation, economic outcomes are also measured in levels in some instances (e.g., median income) and growth rates in others (e.g., employment). It is unclear why the same "model" would accurately predict both levels and changes.

Finally, the *AAF Study* does not even contemplate rendering plausibly casual results through a proper identification strategy. When it comes to policy, it is causality that matters. So, while the descriptive statistics in the *AAF Study* are likely useful to some degree, the regression analysis is unsound.

Conclusion

Despite its warts, the Form 477 data is often used to evaluate broadband deployment. In this PERSPECTIVE, I use these data to evaluate a number of unfounded characterizations of the broadband marketplace and find them to be without merit. For instance, in areas where consumers have access to a single provider, these customers reap the benefits of rivalry, typically involving larger broadband providers, in other areas in that they face the same prices. Also, private and unsubsidized investment in rural areas in increasing over time.

Unfortunately, no small part of the commentary on broadband service is emotionally—rather than data—driven. Policymakers and other interested parties must be careful to assess whether or not characterizations of the broadband marketplace, especially when laced with inflammatory rhetoric, can be supported by the data. Too often, they cannot. How broadband networks affect local economies also remains an open question because the available statistical analysis of the relationships is often faulty.[29]

There remains much work to do if ubiquitous broadband coverage is the goal. Ubiquity is not, however, the goal nor responsibility of unsubsidized broadband providers. Private providers will deploy when it is profitable to do so, and it is not profitable in many rural areas. Policymakers have set a ubiquity standard, not providers, and thus it is government that shoulders the blame for a lack of access. Universal coverage, however, comes at a very high cost, and any reasonable assessment of the benefits of deployment in some areas are unlikely to satisfy a cost-benefit standard. What is a broadband connection worth to society? This question remains unanswered by policymakers, though it is perhaps the most critical question of all.

NOTES:

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1 *In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion,* FCC 18-10, 2018 BROADBAND PROGRESS REPORT, __ FCC Rcd. __ (rel. February 2, 2018) (hereinafter "*2018 Broadband Progress Report*"). The FCC's *Broadband Progress Reports* are available at: https://www.fcc.gov/reports-research/reports/broadband-progress-reports. At the other definition of 10/1 Mbps, the data indicate that 94% of Americans had access to broadband services.

2 *Id.* at Table 1.

3 *See, e.g.,* D. McCullagh, *Bush: Broadband for the People by 2007,* CNET (April 26, 2004) (available at: https://www.cnet.com/news/bush-broadband-for-the-people-by-2007); Federal Communications Commission, CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, (2010) (available at: https://apps.fcc.gov/edocs_public/attachmatch/DOC-296935A1.pdf).

4 *See, e.g.*, C. Mitchell, *Profiles of Monopoly: Big Cable and Telecom*, Institute for Local Self-Reliance (July 2018) (available at: https://ilsr.org/monopoly-networks) (hereinafter "*ILSR Report*").

5 W. Rinehart, *A Look at Rural Broadband Economics*, AMERICAN ACTION FORUM, (August 14, 2018) (available at: https://www.americanactionforum.org/research/a-look-at-rural-broadband-economics) (hereinafter "*AAF Study*").

6 G.S. Ford, T.M. Koutsky and L.J. Spiwak, *Competition After Unbundling: Entry, Industry Structure and Convergence*, 59 FEDERAL COMMUNICATIONS LAW JOURNAL 331 (2007).

7 *See, e.g.*, Testimony of James W. Stegeman, President of CostQuest Associations, before the Subcommittee on Telecommunications and Technology, United States House of Representatives (March 21, 2017) (available at: https://www.costquest.com/uploads/pdf/03.21.17_testimony_stegeman.pdf).

8 *Competition After Unbundling, supra* n. 6.

9 M. Jones, *This is the Only US State Capital that Doesn't Have a McDonalds*, BUSINESS INSIDER (December 8, 2017) (available at: https://www.businessinsider.com/montpelier-doesnt-have-a-mcdonalds-2017-12).

10 *AAF Study*, *supra* n. 5.

11 *2018 Broadband Progress Report, supra* n. 1 at ¶ 60.

12 *See In the Matter of Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act,* FCC 16-6, 2016 BROADBAND PROGRESS REPORT, 31 FCC Rcd. 699 (rel. January 29, 2016) at Table 6. (available at: (http://www.fcc.gov/reports-research/reports/broadband-progress-reports/2016-broadband-progress-report).

13 *ILSR Report*, *supra* n. 4 at p. 1 ("the market is broken").

14 Available at: https://www.census.gov/geo/maps-data/data/tallies/tractblock.html.

15 For a formal analysis of such competition, *see* T.R. Beard, G.S. Ford, R.C. Hill, and R.P. Saba, *Fragmented Duopoly: A Conceptual and Empirical Investigation*, 78 JOURNAL OF BUSINESS 2377-2396 (2005) (available at: https://www.jstor.org/stable/10.1086/497051?seq=1#page_scan_tab_contents).

16 To do so, each census block in the Form 477 data is matched to a zip code (at the tract level), since broadband prices can be obtained by zip code. Price data is available at: http://www.broadbandnow.com. Zip code data is obtained from: https://www.huduser.gov/portal/datasets/usps/ZIP_TRACT_122010.xlsx. A random sample of prices from twenty zip codes from each area type and for each carrier is collected (80 prices in total). There are some important limitations to this analysis. First, the broadband data is from December-2016 but only current price information is available. Second, zip codes change over time. I use 2010 zip code/tract level data. Third, price data was not reported for the provider of interest for

NOTES CONTINUED:

some of the zip codes (in some cases, the provider was not listed as operating in the zip code). Only prices for zip codes where the provider of interest served at least half the market were included in the sample.

[17] The null hypothesis of a means-difference test is not rejected.

[18] Indeed, the unsupported claim of a looming cable "monopoly" has long-been a rallying cry for advocates of heavy-handed broadband regulation. *See, e.g.,* S. Crawford, CAPTIVE AUDIENCE: THE TELECOM INDUSTRY AND MONOPOLY POWER IN THE NEW GILDED AGE (Yale University Press 2013). Unfortunately, Professor Crawford's work suffers from as many, if not more, analytical flaws than the studies addressed in this PERSPECTIVE. *See, e.g.,* L.J. Spiwak, *Professor Susan Crawford and the Looming "Cable Monopoly"…,* @LAWANDECONOMICS BLOG (November 16, 2012) (available at: http://www.phoenix-center.org/blog/archives/899); G.S. Ford, *Sloppy Research Sinks Susan Crawford's Book…,* @LAWANDECONOMICS BLOG (January 18, 2018) (available at: http://www.phoenix-center.org/blog/archives/1075).

[19] USDA Rural Development, Telecommunications Loans and Community Connect Grants, U.S. Department of Agriculture (Aug. 1, 2018) (available at: https://www.rd.usda.gov/files/Telecom-CommunityConnectNewsReleaseCHARTAugust12018.pdf).

[20] In comparison, the City of Opelika borrowed $43 million to build a fiber network to 11,000 homes. The city's network has lost $14 million over the five-years the network has been in operation with no sign of breaking even by any meaningful financial measure. *See, e.g.*, G.S. Ford, *Financial Implications of Opelika's Municipal Broadband Network*, PHOENIX CENTER POLICY PERSPECTIVE No. 17-11 (August 24, 2017) (available at: http://phoenix-center.org/perspectives/Perspective17-11Final.pdf).

[21] G.S. Ford, *The Impact of Government-Owned Broadband Networks on Private Investment and Consumer Welfare*, State Government Leadership Foundation (April 6, 2016) (available at: http://sglf.org/wp-content/uploads/sites/2/2016/04/SGLF-Muni-Broadband-Paper.pdf).

[22] *ILRS Report, supra* n. 4.

[23] *Id.* at p. 1. The providers include Comcast, Charter, AT&T, Verizon, CenturyLink, and Frontier.

[24] As the ILSR has an expressly admitted bias against large corporations and private companies, it is perhaps unreasonable to expect the group to interpret the data in such an unbiased and dispassionate way. *See, e.g., About Us*, Institute for Local Self-Reliance (viewed August 6, 2018) (available at: https://ilsr.org/about-the-institute-for-local-self-reliance/approach) ("ILSR largely, although not exclusively, targets urban areas. That is where 80 percent of Americans (and half the world's population) live and work, and where significant political and financial authority resides."); *Accomplishments*, Institute for Local Self-Reliance (viewed August 6, 2018) (available at: https://ilsr.org/about-the-institute-for-local-self-reliance/accomplishments) ("ILSR was the first organization to systematically apply the concept of local self-reliance to urban areas.").

[25] *ISLR Report, supra* n. 4 at p. 1.

[26] *Id*. at pp. 1.

[27] *AAF Study*, *supra* n. 5.

[28] While the concept of "reverse regression" is contemplated in econometric research, the analysis does not consider a reverse regression on multiply dependent variables. *See*, *e.g.*, A.C. Cameron and P.K. Trivedi, MICROECONOMETRICS: METHODS AND APPLICATIONS (2005) at 26.3.1.

[29] *See*, *e.g.*, G.S. Ford, *Is Faster Better? Quantifying the Relationship Between Broadband Speed and Economic Growth*, TELECOMMUNICATIONS POLICY (forthcoming) (available at: https://www.sciencedirect.com/science/article/abs/pii/S0308596118300831; originally published as *Is Faster Better? Quantifying the Relationship between Broadband Speed and Economic Growth*, PHOENIX CENTER POLICY BULLETIN NO. 44 (February 2018), available at: http://www.phoenix-center.org/PolicyBulletin/PCPB44Final.pdf).