PERSPECTIVES

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES

Subsidizing Broadband: Price, Relevance, and the Digital Divide

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Introduction

With the COVID pandemic drawing increased attention to the nation's Digital Divide, many in Congress want to spend billions to bridge it.[1] In fact, a recent bill calls for $100 billion in new spending—on top of the billions the United States already spends annually to shrink the Divide—to enhance broadband adoption, which is a sizable spend of $5,400 per household not using broadband at home.[2] For new spending to shrink the Digital Divide, however, any new program must address the reasons some Americans do not subscribe to broadband at home.

At the highest level of categorization, there are two types of non-adopters. First, some households cannot subscribe because service is not available at the home. Extending networks to unserved areas, which some in Congress are proposing to fund and the FCC already spends billions on annually, addresses the "availability" reason for non-adoption and should increase adoption at the current adoption rate (or slightly below, since rural areas have adoption rates about 10% lower than do urban areas).[3] Second, for households that can purchase service, they do not for a variety of reasons, including the inability to pay the market price. For this second reason, several analysts and policymakers have proposed direct subsidies for home broadband service.[4] The FCC's Lifeline Program already provides some support ($9.25 per month) for low-income subscribers in this group, though almost all of these subsidies are used for mobile broadband.[5]

While direct subsidies for broadband service may address the adoption shortfalls of price-sensitive consumers, these trends suggest subsidies may not fully (and perhaps not materially) bridge the Digital Divide.

To shed some light on this important topic, in this PERSPECTIVE I use the largest surveys on Internet adoption available to study the reasons for non-adoption where service is available. This survey evidence, collected by the U.S. Census Bureau, spans two decades. Consistently, the U.S. Census Bureau surveys reveal that the primary cause for non-adoption is a lack of interest in what the Internet offers. A distant second reason is the expense of the service and/or the devices required to use it. Over the past two decades, a lack of interest has risen, and expense has fallen, in importance. While direct subsidies for broadband service may address the adoption shortfalls of price-sensitive consumers, these trends suggest subsidies may not fully (and perhaps not materially) bridge the Digital Divide.

Economic Fundamentals

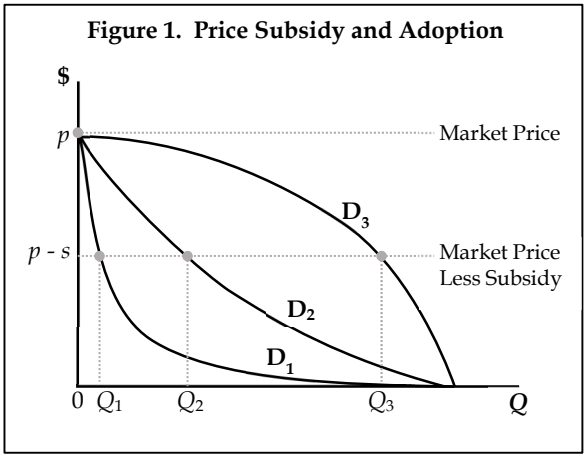
In the simplest format, a household subscribes to broadband service in home i when the expected

value of the service (v_i) exceeds the price (p), or $v_i \geq p$. We may take these values to be the present value of benefits and costs over some relevant time interval (monthly, yearly, and so forth). The cost of a device (computer, smartphone) may be relevant for some households. If the cost of a device is f, then adoption occurs when $v - p \geq f$ over relevant time. Plainly, as the price falls, this adoption condition is satisfied for more households and adoption rises, which is the basic argument for broadband subsidies. If the subsidy level is s, then the condition is $v_i \geq p - s_i$, where the subsidy may vary by household (e.g., income-based subsidies). The larger the subsidies, the more homes subscribe.

How much adoption rises for any subsidy (or general price reduction) depends on the distribution of values (the v_i), and the demand curve measures this distribution. If non-adopters are price sensitive, then the increase in adoption will be large. If non-adopters are not price sensitive, then the effect of a subsidy will be small.

Figure 1 illustrates the effect of a subsidy for non-adopters. I present three demand curves (D_1, D_2, and D_3) reflecting differences in the way a price reduction could affect adoption. The market price is p, where the effective demand for non-adopters is zero. The subsidized price is $p - s$ (where the subsidy is about half the retail price).

Figure 1. Price Subsidy and Adoption



As we move from demand curve D_1 to D_3, consumers are more sensitive to a price reduction (over the relevant range). For demand curve D_1, the subsidy level s increases the quantity of broadband purchased from zero to Q_1, a minor change. For demand curve D_2, the subsidy increases the quantity to Q_2, and for D_3 the subsidy increases the quantity to Q_3, the largest of effect of all.

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If we are to formulate expectations about how a direct subsidy will affect adoption, then having some idea about what the demand curve for broadband looks like is important. Does the demand curve look more like D_1 or D_2 or D_3? When data is available, analysts use econometric techniques to get a sense of the shape of the demand curve, say by estimating the own-price elasticity of demand (i.e., the percent change in Q demanded for a percent change in p). However, empirical estimates of the demand curve are valid only for the range of observed prices, so it is not always possible to trace out the demand curve for very large subsidies.

A few recent studies offer some evidence on the price-sensitivity of non-adopters. Rosston and Wallsten (2019) offer a crude estimate of the own-price demand elasticity based on Comcast's Internet Essentials program, which offers a $10 broadband service for qualifying households.[6] This discounted price is considerably below market prices for the typical home broadband service. Their estimates point to a demand elasticity of about 0.10, so a 50% drop in price increases subscriptions only by 5%. This analysis points to a demand curve such as D_1 as most plausible.

Using data from a large survey of non-adopters in 2011, Carare, McGovern, Noriega, and Schwarz (2015) estimate an own-price elasticity for non-adopters of 0.67, so 50% price drop increase adoptions by 33.5%. This study suggests the demand curve looks more like D_2 than D_1 or D_3. I am unaware of any study that suggests demand curve D_3 is representative, so sober expectations about the effectiveness of subsidies are warranted.

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As drawn, a subsidized price of $0 (a monthly subsidy of $50, as proposed) produces the same effect for all demand curves (adoption is complete). But these curves are merely illustrative, and the benefits of broadband may be negative for some homes (e.g., religious reasons, privacy concerns, and so forth). Targeting the subsidy to low-income households limits the impact. Also, there may be more to a subscription decision than just the price, such as computer ownership and maintenance, migration, lack of a stable household, and so forth). Still, a price of $0 should have a large effect, but at very high cost.

Survey evidence can shed some light on the issue, even if it does not permit the estimation of the demand curve. The largest and most reliable survey evidence are the U.S. Census Bureau's Computer and Internet Use Supplements to the Current Population Survey ("CPS"). Though the survey questions have changed over time, these surveys ask non-adopters to provide reasons they do not use the Internet at home, with responses, among others, including (1) not interested; (2) too expensive; (3) do not have a computer; and (4) not available. While multiple responses are permitted, these surveys also ask for the "main reason" for non-adoption (a single response). Also, the CPS asks non-adopters if they would use the Internet in the home if the price was lower, though the question unfortunately does not suggest how much lower.

Respondents who state they "don't need" or are "not interested" in Internet use at home suggest the value of the Internet (v_i) is low and possibly negative. Presumably, these consumers are relatively insensitive to a price reduction. A response that the service (and/or equipment) is "too expensive" points to price sensitivity. The larger the ratio of "don't need" responses to "too expensive" responses, the more likely the demand curve looks like D_1 rather than D_3 (and vice versa). The larger this ratio, the less effective a subsidy is at increasing adoption. A similar interpretation applies to the ratio of the share of non-adopters that say they *would not* subscribe at a lower price over the share that *would* subscribe at a lower price. Using summaries of the CPS data, I conduct such an analysis below.

As I have explained before, future surveys should ask directly how respondents would change behavior for *specific* price reductions.[7] For instance, the survey might ask "if the price was $10 lower" or "$20 lower" would you subscribe to an Internet connection at home? Or, the direct question "would you subscribe at $40 (or $30, or $20, and so forth)" allows researchers to trace out the demand curve. Responses to a "would you use the Internet at home if was free" provides good information about the lack of interest. We do not have that data today, however, so I will proceed with the survey evidence we do have.

Adoption Data

The National Telecommunications Information Administration's ("NTIA") Data Explorer provides descriptive statistics for the CPS surveys, though the micro-data is also available for all but the 2019 supplement, which is

forthcoming.[8] I focus on the question: *What is the MAIN reason that you don't have the Internet at home?* Data for years 2009 through 2019 are included in the analysis. There are eight surveys represented in the figure (2009, 2010, 2011, 2012, 2013, 2015, 2017, and 2019). Sample sizes for each supplement measure in the hundreds of thousands (though those not using the Internet at home are a small subset of these).

Since this analysis will look at the trends in responses over time, it is important to recognize that the CPS questions have changed. For instance, prior to 2015, "too expensive" was a response to the inquiry but beginning in 2015 the "too expensive" response was divided into "can't afford" and "not worth it" responses. The "too expensive" categorization in NTIA's Data Explorer sums these two responses. Also, surveys after 2015 include more responses to the "main reason" question in other ways; for example, the safety and privacy concerns were independent responses. These responses have low shares. Over time, these responses are not measuring necessarily the same thing. The responses (and the intent of the questions) are similar, but the caveat is worth noting.

Considering the low benefits available to persons who see no need for the Internet, and the cost of convincing them otherwise, universal adoption may be an unrealistic standard by which to judge successful broadband adoption policies.

A Look at the Data

The latest data from the CPS on Internet use are from the November-2019 supplement. Table 1 summarizes the responses for the *main reason* why the Internet is not used at home for the last three CPS. The most common response (by far) is "Don't Need It, Not Interested," with "Too Expensive" being a distant second. The other responses are infrequent. It would not be unreasonable to include "Privacy or Security Concerns," and maybe even "Can Use It Somewhere Else," in a broader "relevance" category with "Don't Need It, Not Interested," but I do not do so, in part for reasons discussed below (see Table 2). Likewise, "Use It Elsewhere" may be sensibly grouped with "Too Expensive," since Internet use is presumably valuable but perhaps insufficient for the household to pay for a home connection.

Table 1. Main Reason (%), No Internet at Home

	2015	2017	2019
Don't Need/ Not Int.	55.2	57.9	60.0
Too Expensive	23.5	21.2	18.8
Use It Elsewhere	2.1	2.3	2.9
Not Available in Area	2.4	2.4	3.2
No Computer/Inadequate	7.3	4.3	2.9
Privacy/Security	1.4	1.7	2.0
Other	8.9	10.2	10.2

Table 1 points to a general insensitivity to price reductions, suggesting the demand curve for broadband looks more like D_1 than it does D_3. Responses the question "*Would (you/your household) buy home Internet service if it were offered at a lower price?*" sheds additional light on these data. Table 2 shows the response rate to this question for the most common responses to the "main reason" question in 2017 (the 2019 micro data is not yet available).

Table 2. Buy at a Lower Price?
Year 2017

	Yes
Buy Home Internet at a Lower Price?	26.1%
Don't Need It, Not Interested	10.5%
Too Expensive	52.7%
Use It Elsewhere	53.0%
No Computer/Inadequate	29.3%
Privacy/Security	28.6%

In all, only 26.1% of non-adopters said they would subscribe to the Internet at home if the price was lower. For the most part, non-adopters do not appear to be price sensitive. That said, this low figure is largely due to the "Don't Need It" group (about 58% of the sample), with only about 10% of these respondents saying they would subscribe to the Internet at a lower price. These are not price-sensitive consumers. While far more price sensitive than the "Don't Need It" group, only about half of the "Too Expensive" group said they would subscribe to the service at a lower price.[9] The "Too Expensive" response, it appears, is not a strong indicator of price-sensitive consumers. The "Use It Elsewhere" group is about as price sensitive as the "Too Expensive" group. Other responses also exhibit some price sensitivity, though not as high as the "Too Expensive" group.

From both Tables 1 and 2, we see that the ratio of "Don't Need It" to "Too Expensive" is high (about 2.7 in 2017), as is the ratio of "would not buy at a lower price" to "would buy at a lower price" (about 2.8 in 2017). As the Internet becomes more-and-more a part of everyday life, we might expect that these ratios would shrink over time. They do not. Figure 1 illustrates the trends in three responses, including the 90% confidence bands, for a decade of surveys.

Figure 1. Trends in Main Reasons Why

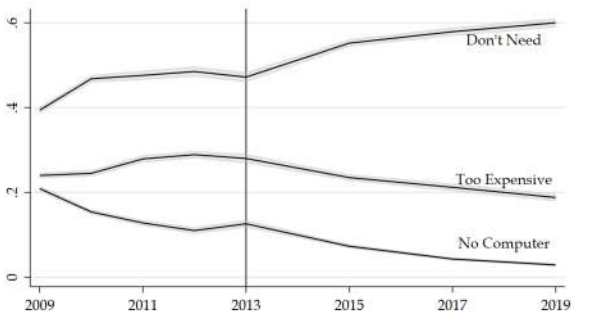

Figure 1 shows not only that a lack of interest is always more important than expense in determining the lack of Internet use in the home, but that the ratio of the two is rising over time, with "Don't Need It" rising and "Too Expensive" shrinking.[10] The lack of a computing device is also declining as a reason for no Internet use at home.

Should We Rely on the CPS?

The CPS, with its very large samples, provides the solid evidence on the reasons for non-adoption. Some advocates and researchers discourage reliance on the data, since "relevance" may have different meanings to different people.[11] Digging deeper into non-adoption is to be encouraged, but adding to the analysis the "buy at a lower price" question clarifies the meaning. Also, my review of the literature cited to lessen reliance (or even to discredit) the CPS is supportive of the Census Bureau's surveys.

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Take, for instance, a study by Reisdorf, Hampton, Fernandez, and Dutton (2018).[12] The study gathered survey responses (in 2017) from 525 persons living within (a few blocks of) Detroit's inner city; the survey response rate was 12.1%. The sample was not representative of the U.S. population (perhaps intentionally); for instance, 81% of respondents were female and 88% racially identified as Black. About 78% of respondents had Internet in the home, which is comparable to national figures in that year.

Only 116 respondents did not have Internet in the home. The most common reason given for not having Internet in the home was "Not Interested" (31.9%), with "Too Expensive" being a close second (30.2%). Note that the margin of error on these estimates is in the ballpark of ±9% (given the small sample), so the responses are statistically equal.[13]

It is unsurprising, to me at least, that the "Not Interested" rate from this survey is different (and lower) than that in the CPS. Small, unrepresentative samples do not offer reliable estimates of the population mean (the intent of the CPS). While I cannot entirely match up the Detroit survey's properties in the CPS, the range of the empirical distribution of the mean of "Don't Need" for 116 observations drawn from cities of similar size to Detroit is 35% to 65% (and the Detroit survey's 90% confidence interval is 23% to 41%). Respecting the differences in method and purpose, the Detroit survey's results are not wholly unlike the data in the CPS.

A lower price, while helpful, may not shrink materially the Digital Divide. Direct subsidies may be reasonable public policy, but sober expectations as to their influence on non-adoption is warranted.

Implications for Policy

These data are informative for policy formulation. While relevance may trump expense, price is important to a lot of Americans. Though a monthly subsidy for service does not target the primary reason for non-adoption, it targets a major one. According to the CPS, less than 20% of respondents say that the expense of broadband deters Internet use (about half responsive to a price reduction), and about 30% of non-adopters say a lower price might induce subscription. This is a sizable share, even if only one-third of that assigned to "relevance."

That said, these figures may be an overstatement of the potential target audience of a subsidy. Presumably, broadband subsidies will target low-income households. About 30% of American households qualify for Lifeline, though only about 25% of these participate in the program.[14] With about 30% of non-adopters saying a lower price would induce subscription, then a low-income subsidy targets only about 10% of price-sensitive non-adopters. A lower price, while helpful, may not shrink materially the Digital Divide. Direct subsidies may be reasonable public policy, but sober expectations as to their influence on non-adoption are warranted.

The bigger question, it seems to me, is what policies are available to address the segment of non-users who say they "Don't Need, or are Not Interested" in the Internet? Some analysts and policymakers believe that demand-side programs teaching digital skills will encourage home adoption by overcoming such perceptions. They may do so, but empirical evidence finds that such programs implemented as part of the Broadband Technology Opportunity Program ("BTOP") did not increase home broadband adoption on a measurable scale.[15] Considering the low benefits available to persons who see no need for the Internet, and the cost of convincing them otherwise, universal adoption may be an unrealistic standard by which to judge successful broadband adoption policies.

Conclusion

Throwing money at the Digital Divide, even billions, will not bridge it completely. Some Americans will remain offline, despite all efforts to the contrary, simply because they do not wish to be online. Many non-adopters will respond to broadband subsidies that tackle the expense of service subscriptions, but many more will not. Direct subsidy is one of several policy options, but sober expectations as to its effectiveness are warranted. A larger subsidy has a larger effect, but commensurately a larger budget.

NOTES:

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1 *House Democrats Release Text of H.R. 2, A Transformational Infrastructure Bill to Create Jobs and Rebuild America*, Press Release (Jun 22, 2020) (available at: https://energycommerce.house.gov/newsroom/press-releases/house-democrats-release-text-of-hr-2-a-transformational-infrastructure-bill) ("Delivers affordable high-speed broadband Internet access to all parts of the country by investing $100 billion to promote competition for broadband internet infrastructure in unserved and underserved communities, prioritizing those with persistent poverty.").

2 The NTIA's Data Explorer reports that 85.7% of Americans use fixed broadband Internet service in the home (https://www.ntia.doc.gov/data/digital-nation-data-explorer#sel=wiredHighSpeedAtHome&disp=map). There are approximately 128.58 million households in the U.S., and I have assumed the average person count is equal between homes with and without broadband service.

3 *See, e.g., Demand for Broadband in Rural Areas: Implications for Universal Access*, Congressional Research Service, CRS Report R46108 (December 9, 2019) (available at: https://fas.org/sgp/crs/misc/R46108.pdf) ("rural households' broadband adoption rate lagged that of urban households by 12-13 percentage points"). This difference is confirmed using the 2017 CPS Survey (author's calculations).

4 *See, e.g., Broadband Stimulus and Related Initiatives in the HEROES Act*, JDSUPRA (Akin Gump) (May 15, 2020) (available at: https://www.jdsupra.com/legalnews/broadband-stimulus-and-related-95540).

5 G.S. Ford, *A Fresh Look at the Lifeline Program*, PHOENIX CENTER POLICY PAPER No. 55 (July 2019) (available at: https://www.phoenix-center.org/pcpp/PCPP55Final.pdf).

6 G.L. Rosston and S. Wallsten, *Increasing Low-Income Broadband Adoption through Private Incentives*, Working Paper (August 2, 2019) (available at: https://ssrn.com/abstract=3431346).

7 G.S. Ford, *"Relevance" and "Price" as Determinants of Internet Non-Adoption: A Review of the Evidence*, PHOENIX CENTER POLICY BULLETIN No. 48 (April 2020) (available at: https://www.phoenix-center.org/PolicyBulletin/PCPB48Final.pdf).

8 The data are available at: https://www.ntia.doc.gov/page/download-digital-nation-datasets. The data are summarized at: https://www.ntia.doc.gov/data/digital-nation-data-explorer#sel=noInternetAtHome&disp=map, which is the source of data for this study. The summary data includes the November-2019 results, but the micro-data has yet to be released.

9 *"Relevance" and "Price"*, *supra* n. 7.

10 These changes in responses are not mere random variation across surveys. A test for a statistically significant change in the response rates is based on the following formula: $\left|y_t - y_{t-k}\right| / \sqrt{m_t^2 + m_{t-k}^2} > 1$, where y_t is the response rate in year t and m_t is the margin of error on that response rate (the latter of which embeds the t-statistic for the 90% confidence level) (see https://www.census.gov/programs-surveys/saipe/guidance/comparisons.html).

11 *Also see, e.g.*, C. Rhinesmith, A. Quan-Haase and M. Haight, *The Complexity of 'Relevance' as a Barrier to Broadband Adoption*, Benton Institute for Broadband & Society (January 6, 2016) (available at: https://www.benton.org/blog/complexity-relevance-barrier-broadband-adoption) (showing survey data from Canada in 2012 showing "relevance" as the primary cause of non-adoption). An op-ed by Blair Levin and Larry Downes in the WASHINGTON POST pointing to the CPS generated numerous responses. B. Levin and L. Downes, *Cities, Not Rural Areas, are the Real Interest Deserts*, WASHINGTON POST (September 13, 2019). Responses include thoughtful commentary (*see, e.g.,* B. Reisdorf and C. Rhinesmith, *Too Uneducated to Understand the Importance of Home Internet?*, Benton Institute for Broadband & Society (September 18, 2019) (available at: https://www.benton.org/blog/too-uneducated-understand-importance-home-internet)) and hysterics (*see, e.g., The Truth About the Digital Divide*, Free Press (September 25, 2019) (available at: https://www.freepress.net/our-response/expert-analysis/insights-opinions/truth-about-digital-divide)).

12 B.C. Reisdorf, K. Hampton, L. Fernandez and W.H. Dutton, *Broadband to the Neighborhood: Digital Divides in Detroit*, Quello Center, Michigan State University (January 16, 2018) (available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3103457).

NOTES CONTINUED:

[13] https://goodcalculators.com/margin-of-error-calculator.

[14] Data available at: https://www.usac.org/lifeline/learn/program-data.

[15] T.R. Beard, G.S. Ford, and M. Stern, *Bridging the Digital Divide: What Has Not Worked But What Just Might*, PHOENIX CENTER POLICY PAPER No. 56 (June 2020) (available at: https://www.phoenix-center.org/pcpp/PCPP56Final.pdf); J.A. Hauge and J.E. Prieger, *Evaluating the Impact of the American Recovery and Reinvestment Act's BTOP on Broadband Adoption*, 47 APPLIED ECONOMICS 1-27 (2015) (draft available at: https://ssrn.com/abstract=2591771); J. Manlove and B. Whitacre, *An Evaluation of the Connected Nation Broadband Adoption Program*, 43 TELECOMMUNICATIONS POLICY 101809 (2019) (available at: https://www.sciencedirect.com/science/article/abs/pii/S0308596118304269); An earlier version of the paper is J. Manlove, *An Evaluation of the Connected Nation Broadband Adoption Program*, Working Paper (March 15, 2018) (available at: https://ssrn.com/abstract=3141063 or http://dx.doi.org/10.2139/ssrn.3141063).