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Submitted Article

Eliciting Consumer Willingness to Pay for Home Internet Service: Closing the Digital Divide in the State of Indiana

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Abstract *The economic and societal benefits of broadband have been well documented, including increased access to education, civic engagement, political participation, and public education. However, there continues to be disparity between rural and urban areas regarding internet access/speed. With the second highest Midwestern rural population density, this analysis sought to quantify usage of internet services and estimate Indiana residents' willingness to pay (WTP) for home internet service. This analysis found the mean WTP for residents is between $0.06/Mbps and $0.10/Mbps per month for broadband. Age has a significant positive relationship with WTP for fiber optic internet; subscriber's employment also plays a significant role.*

Key words: broadband internet, fiber optic internet, rural internet, willingness to pay.

JEL codes: Q13, R11, C54.

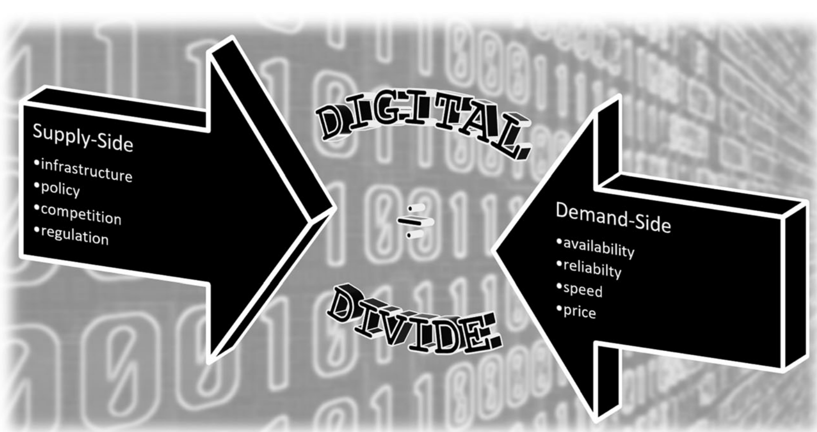
Introduction and Background

The economic benefits of broadband internet services have been well documented throughout existing literature at the macroeconomic level in terms of employment, number of firms, property values, and increased number of small businesses (Qiang, Rossotto, and Kimura 2009). Furthermore, there are a variety of societal benefits associated with broadband internet services in terms of economic opportunities, civic engagement, political participation, and public education (Mossberger, Tolbert, and McNeal 2007). In addition to education and economic benefits, access to broadband also has the potential to improve health, social relations, jobs, and general prosperity (Firth and Mellor 2005). Since the 2000s, the deployment of broadband has provided many consumers with access to a data transmission rate that federal regulators have defined as 25 megabits per second (Mbps) download and 3 Mbps upload (Federal Communications 1996) for broadband service. However, there continues to be a disparity between rural and urban areas; in rural areas, approximately 39% of Americans (23 million people) do not have access to broadband as defined by the Federal Communications Commission (FCC). By contrast, only 4% of the urban population lacks access to broadband service. These disparities are even larger for Americans living on tribal lands or U.S. territories (FCC Wireline Competition Bureau 2016).

In rural communities, availability and adoption of broadband with higher download speed contributes to economic growth through higher median household income, lower unemployment, and positive impacts for rural businesses (Whitacre, Gallardo, and Strover 2014). These factors are particularly important because they can significantly increase the stability of rural economies (Smith 1990; Aldrich and Kusmin 1997). Thus, broadband internet service is critical for future economic development (Dickes, Lamie, and Whitacre 2010) and "can be the ultimate economic, educational and medical growth engine for rural America" (Powell and Federal Communications 2004).

While new product adoption (in general) has proven to be extraordinary in comparison to historical precedent, adoption rates for the internet and broadband have nevertheless fallen short of expectations (Modis 2005). Numerous studies have discussed the advantages afforded by the broadband services specifically in rural areas, including reduced depopulation (Gregg et al. 2007), enhanced home businesses (Anderson, Wallace, and Townsend 2016), and higher farm sales and profits (Kandilov et al. 2017). On the supply side of this phenomenon, low adoption rates may be due to few efforts to deploy infrastructure to rural areas. On the demand side, the drivers of broadband adoption include speed and reliability (Rosston, Savage, and Waldman 2011), as well as technical and customer support (LaRose et al. 2007). There is also an important distinction many consumers make in their purchasing behaviors related to bundling (Horrigan 2010): In rural areas, adoption significantly increases when video is included as part of a service package (Glass 2006). Addressing both sides of this problem can help close the gap that makes up the digital divide (figure 1).

Figure 1 Supply and demand gap creates a digital divide among rural and urban communities



Perceptions of broadband services by individuals with various demographics are not well understood. Many residents, both rural and urban, may not understand the level of service or reliability that is associated with broadband fiber optic services or perceive the cost to be prohibitive. Greater support may need to be offered to customers, as well as other value-added products through bundling, to successfully engage the latent demand for high-speed internet access. The objective of this empirical analysis is to determine what perceptions consumers hold of broadband internet and estimate their willingness to pay (WTP) for such an offering from service providers. The goal of this research was to allow industry stakeholders to make sound business decisions that increase the deployment of broadband internet services and enhance service options in rural communities, thereby increasing accessibility to the economic benefits of broadband services. Notably, the intent of this work is not to assess the actual coverage of existing broadband service providers, although the findings may increase awareness about access and/or provide educational programs for small and emerging rural communities that seek to attract local broadband service improvements.

The Case for Indiana Residents

In 2016, the imperative to offer broadband access was acknowledged by the Indiana Economic Development Corporation, the Indiana State Department of Agriculture, and the Indiana Office of Community and Rural Affairs. These institutions introduced a plan to significantly advance statewide economic development through broadband technology, emphasizing rural areas (ISDA 2016). Later, as part of the United States Department of Agriculture (USDA) Rural Development's Telecommunications Program, $60 million in loans were made available in 2017 to build infrastructure and equipment to deliver broadband, distance learning, and telemedicine services in rural areas (USDA 2017). With the second highest rural population density in the Midwest, Indiana could experience marked improvements in the stability of rural communities if broadband services were more uniformly available and provided the bundle of attributes that consumers seek most. Since the time of data collection for this study, continued attention on delivering broadband has spurred efforts to help communities gain an understanding of their current broadband conditions and needs, create a long-term vision of broadband in communities, and identify options for achieving that vision. The Indiana Office of Community and Rural Affairs has also begun piloting programs to provide $50,000 in funding to support broadband readiness in several communities based on location, geography, population density, unserved/underserved, and previous efforts in digital inclusion (Indiana Office of Community and Rural Affairs 2018).

To ascertain whether broadband customers and Indiana residents would subscribe to high-speed internet access, Tipmont REMC (TREMC), an electrical cooperative located in Linden, Indiana, funded[1] this study on subscribers' valuation of the internet services provided by utility companies. In funding this study, TREMC recognized that residents within various areas of the state are likely to ascribe different values to different telecom services. Thus, it was important to understand the relative value of internet services to enhance

[1]*The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*

decision making among managers and the targeted distribution of broadband services. This meant that recognizing the heterogeneity of preferences was necessary across state residents with respect to varying internet service packages offered and their associated subscription prices.

As of 2016, 17% of all Indiana residents lacked access to broadband (FCC Wireline Competition Bureau 2016). Of those lacking access to broadband service, about 20% lived in urban areas while the remaining 80% resided in rural areas. There were sixteen counties where at least 80% of the rural population lacked access in 2016. Most of these counties were concentrated in the southern half of the state—an area that is a mixture of farmland, forest (Hoosier National Forest), and hilly topography. The lack of broadband deployment has been attributed to lower population densities, which implies higher costs per household for the proliferation of broadband compared to urban communities (Federal Register 2011).

Similar research has been conducted on WTP for broadband deployment. Savage and Waldman (2009) compared the WTP for broadband internet between rural and urban consumers. They found that urban consumers were willing to pay $19.04 per month for more reliable service, and rural consumers were willing to pay $18.02 a month for more reliable service (Savage and Waldman 2009). Interestingly, Rosston et al. (2010) found that WTP for reliability and speed increased with experience. They hypothesized that exposing households to broadband experience or supporting the initial take-up of broadband would increase the WTP for such services and increase overall broadband penetration in the US. Carare et al. (2015) surveyed only those who did not have broadband at the time of the survey. They found that younger households, households that own a computer, minority households, households with children, and rural households were more likely to report willingness to subscribe to broadband at a rate they deemed acceptable. Jeffcoat, Davis, and Hu (2012) concluded that among farmers in Kentucky, the level of WTP in the form of a one-time increase in property taxes used to support broadband infrastructure ranged from $0.20 to $171 and that public investment would be necessary to offset expenses such as building infrastructure. This work contributes to existing literature by examining consumer preferences and WTP for internet services encapsulating speed, reliability, service, and bundling. Furthermore, this work will evaluate the relationship between WTP for internet speed and select demographics.

Survey and Method

Survey Instrument

A statewide questionnaire was distributed between March 29, 2017 and April 20, 2017 to collect Indiana residents' preferences for internet subscription products, general internet usage characteristics and needs, and perceptions towards fiber optic services. The sample used in this study was targeted to be representative of the Indiana state population census statistics (U.S. Census Bureau 2012b) for age, gender, income (U.S. Census Bureau 2012a), and economic region (US Places 2012). Indiana is divided into twelve separate economic growth regions consisting of individual counties, and the sample was targeted to be representative at the economic growth region level. To participate, survey respondents were required to be residents of Indiana and 18 years or older. In total, 1,423 individuals entered the survey. Survey takers that did not meet minimum age requirements, did not complete the survey, or were screened out based on demographic quotas were removed from the sample, leaving a final total of 855 completed responses and obtaining a completion rate of 60%. Additional demographic information was collected including education, primary occupation, and preferences on internet usage.

Willingness to Pay Choice Experiment

To closely mirror the purchasing choices faced by a consumer, a choice experiment was used to provide hypothetical but realistic choice scenarios. Choice experiments are rooted in consumer demand theory with emphasis on consumer behavior theory (Lancaster 1966b; Rosen 1974) and rely on the assumption that consumers derive utility from a good through its attributes. The advantages of choice experiments compared to other traditional econometric analyses of consumer preferences are well documented (e.g., Ben-Akiva and Lerman 1985; Lusk and Schroeder 2004). Furthermore, estimation results from hypothetical choice experiments do not significantly differ from results found using revealed preference data from actual choice experiments (Adamowicz et al. 1998; Carlsson and Martinsson 2001). A potential issue with choice experiments is that their hypothetical nature may result in people making choices that differ from that of real decision-making scenarios, often resulting in overstatement of WTP from choice experiments, referred to as hypothetical bias (Lusk 2003). Following Lusk (2003), the choice experiment respondents were shown the following statement (often referred to as the "cheap talk statement") before answering the discrete choice experiment questions to reduce hypothetical bias: "The experience from previous similar surveys is that a person often states a higher WTP than what one actually is willing to pay for the good. It is important that you make your selections like you would if you were actually facing these choices to subscribe to an internet package, noting that an allocation of funds to these products means you will have less money available for other purchases."

In designing the choice experiment to study internet subscription preferences, consumers were shown multiple sets of alternative combinations of attributes—or characteristics of the internet subscription package—and were then asked to select the alternative they preferred. Bundling, servicing, speed, and price were attributes of internet service provided in the choice experiments for all survey respondents. Prior to making selections within the choice scenarios, respondents were provided with definitions and levels of the attributes included in the study. Bundling was defined as internet subscription packaging that included any number of additional services (e.g., television, home phone, etc.). Servicing was defined as the internet subscription package including customer and technical support (e.g., allowing customers to call in when they have a question on their bill or a problem with the internet subscription service). Speed was defined as the internet speed level of the subscription package (measured in Mbps). Reliability was defined as the overall up-time of the internet service. And price was defined as the total cost of the subscription per month. Since internet service reliability has historically been a problem, survey respondents were divided between two different choice experiments. One experiment contained reliability as an attribute in the description of the internet service package; the other did not mention reliability.

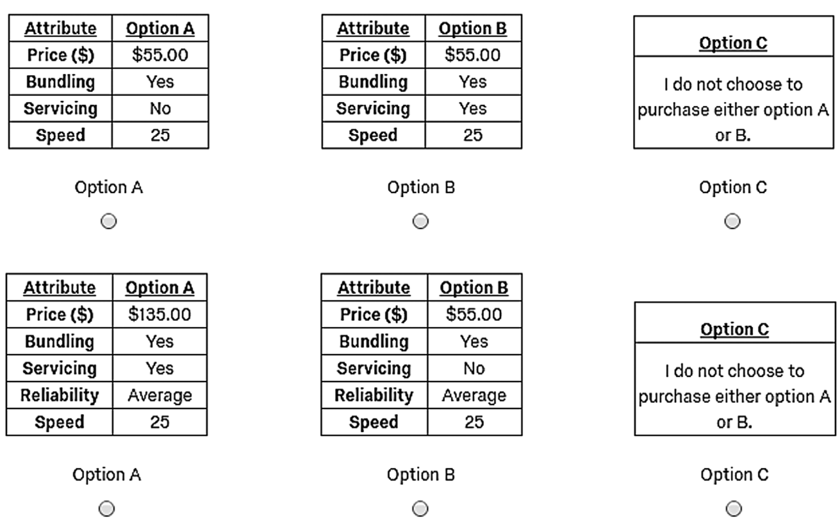
Using a full factorial experimental design, which contains every possible combination of the multilevel attributes, would be impractical; thus a fractional factorial design was obtained using the OPTEX Procedure in SAS Version 9.4. The D-efficient optimal design included eighteen choice scenarios with the reliability attribute excluded and thirty-six choice scenarios with the reliability attribute included (SAS 2018). Blocking specifications were used to limit the number of questions respondents answered in order to reduce respondent fatigue resulting from making a large number of choices. The choice experiment with reliability was split into two blocks with nine choice scenarios each, while the choice experiment without reliability was split into four blocks also with nine choice scenarios each—thus respondents were shown the same number of choice scenarios regardless of the block or presence of the reliability attribute. Each respondent was randomly assigned to answer one of the choice experiment blocks.

Figure 2 presents an example of the choice scenarios which were presented to respondents, both with and without reliability in the experimental design. In each choice scenario, the consumer was asked to consider two different internet subscription offerings, with an additional option to purchase nothing at all. Here, the choices of each individual are assumed to be made based on the characteristics of the good (i.e., the internet subscription package). Therefore, random utility theory befits the modeling strategy used in this analysis.

Theoretical Framework and Modeling Willingness to Pay

Individual economic agents, such as our respondents, seek to maximize their own expected utility with respect to their choice options, as is central to random utility theory. Following Lancastrian consumer theory (Lancaster 1966a), the choice experiment in this analysis is modeled on attributes of a good or service, in this particular case broadband internet. That is, the good or service is a composite of separate utilities for each attribute (Lancaster 1966a). In the face of incomplete information, individual utility is considered a random variable as discussed by Manski (1977). The theory of random utility holds such that utility from the choice of alternative i in a situation at time

Figure 2 Sample of choice scenario without reliability (top) and with reliability (bottom)



t from the finite set of all possible choices C is equivalent to the utilities based on the deterministic alternative attributes of utility (V_{it}), in addition to the utility component that is stochastic, ε_{it}. The stochastic component is assumed to be independent and identically distributed on every alternative and choice situation. Thus, the utility function may be expressed as

$$U_{it} = V_{it} + \varepsilon_{it}. \tag{1}$$

It is assumed that each economic agent in situation t will select the alternative i that provides the highest level of utility. Therefore, if the utility of selecting alternative i in situation t is greater than the utility of selecting alternative j in time t for all i not equal to j (expressed as: $U_{it} > U_{jt}\ \forall\ i \neq j$) then the probability of selecting alternative i is of the form:

$$P_{it} = P\left(V_{it} + \varepsilon_{it} > V_{jt} + \varepsilon_{jt}, \forall i \neq j, \forall j \in C\right). \tag{2}$$

The probability that alterative i is selected can also be expressed as:

$$P_{it} = \frac{e^{\mu V_{it}}}{\sum j \in C^{\mu V_{jt}}}. \tag{3}$$

The scale parameter μ, which is assumed to be equal to one, is also inversely related to the error term's variance (Lusk, Roosen, and Fox, 2003). The general model (with the assumption that V_{it}, the systematic portion of utility, is linear in parameters) is expressed as:

$$V_{it} = \beta_1 \boldsymbol{x}_{it} + \beta_2 \boldsymbol{x}_{it} + \cdots + \beta_k \boldsymbol{x}_{it}, \tag{4}$$

where $\boldsymbol{x}_{it}$ is a vector of the attributes found in the alternative i, and the β's are the parameters associated with the i^{th} alternative's attributes.

Past research suggests that models that account for heterogeneous preferences, such as the random parameters logit (RPL), are appropriate, given likely distribution of consumer preferences (Schulz and Tonsor, 2010; Olynk, Tonsor, and Wolf 2010; Lusk, Roosen, and Fox 2003; Tonsor et al. 2005; McKendree et al. 2013; Olynk Widmar and Ortega 2014; Alfnes 2004)[2]. The RPL model was used to estimate parameters associated with the attributes while accounting for heterogeneity in consumer preferences. Thus, utility for individual n selecting alternative i in time t is equal to the systematic portion of utility (v_{nit}) and the sum of the error term distributed normally over individuals and attributes (u_{ni}) and the I.I.D. stochastic error term ε_{nit} (distributed over individuals, attributes, and choice sets) which is written as:

$$U_{nit} = v_{nit} + \left[u_{ni} + \varepsilon_{nit}\right]. \tag{5}$$

The model for the systematic portion of utility (v_{it}) is of the form for model 1 without reliability

[2] *The most common, and simple, model employed for CE data is often the multinomial logit (MNL), although the MNL model assumes homogenous preferences for product attributes across consumers and performs poorly if consumers possess heterogeneous preferences.*

$$v_{it} = \beta_1 \, Price_{it} + \beta_2 Bundling_{it} + \beta_3 \, Service_{it} + \beta_4 \, Speed_{it} + \beta_5 \, OptOut_{it}, \tag{6}$$

for model 2 with reliability

$$\begin{aligned} v_{it} = {} & \beta_6 \, Price_{it} + \beta_7 Bundling_{it} + \beta_8 \, Service_{it} + \beta_9 \, Speed_{it} \\ & + \beta_{10} \, Reliability_{it} + \beta_{11} \, OptOut_{it}, \end{aligned} \tag{7}$$

where $Price_{it}$ is the price total cost of the subscription per month, $Bundling_{it}$ is whether the subscription package included any number of services, $Service_{it}$ is whether the subscription package included customer and technical support, and $Reliability_{it}$ is the overall up-time of the internet service (only included in model 2).

The coefficients of the estimated model cannot be directly interpreted, so mean WTP estimates are calculated as follows:

$$\mathrm{WTP}_k = -\left(\frac{2 \times \beta_k}{\beta_{price}}\right) \tag{8}$$

where β_{price} is the coefficient estimate of price and β_k is the coefficient estimate of an attribute[3]. Commonly used methods to estimate confidence intervals and statistic variability for the WTP estimates include the delta method, Krinsky and Robb (1986), and Fieller (1954). According to Hole (2007), these methods all provide reasonably accurate and similar results, implying that any one method used is sufficient and no one particular method is preferred. This analysis employed the Krinsky and Robb (1986) method to construct 95% confidence intervals for the WTP estimates.

Attribute Nonattendance

When estimating discrete choice experiments, it is assumed that all of the attributes included in the experiment are being equally considered when respondents are making choices. However, many studies in the choice experiment literature indicate some respondents may simplify choices by ignoring information or attributes, often referred to as attribute nonattendance (ANA) (Hensher and Greene 2010; Hole 2011; Scarpa et al. 2012). One commonly used approach to account for ANA is stated ANA (SANA) (Hole 2011). In this approach, respondents are asked in a follow-up question to indicate which attributes they did not consider when making their choices (Hole 2011). Ideally, accounting for ANA should result in estimates that more accurately reflect the consumer's true WTP, so a SANA question was included immediately following the series of choice scenarios. This stated attribute nonattendance information was used to exclude the individual's utility parameter estimation, and the original models and SANA models were statistically compared using the complete combinatorial method by Poe, Giraud, and Loomis (2005).

[3] *Effects coding of the attribute,* k, *necessitates multiplication of the WTP ratio by 2 (Lusk, Roosen, and Fox 2003).*

Ordinary Least Square Model to Explain Willingness-to-Pay Estimates

To further examine the WTP for speed, ordinary least squares (OLS) was used to analyze the relationship between WTP and select demographic characteristics of survey respondents, by using the WTP values obtained from RPL-3 and RPL-4 (both models with SANA accounted for) as the dependent variable and demographic variables as explanatory variables. The OLS model for WTP for speed (*SpeedWTP*) was estimated as:

$$SpeedWTP = \beta_a Age44 + \beta_b Gender + \beta_c Work1 + \beta_d Work2 + \beta_e Work3 + \beta_f Work4 + \beta_g Work5 + \beta_h Work6 + \varepsilon$$

where *Age44* is an indicator variable which takes on the value of '0' for a survey respondent under the age of 44 and '1' for ages 44 and greater. Gender takes on the value '0' if the respondent is female and '1' for a male respondent. Six indicator variables were used to divide occupations into six categories: *Work1* (professional), *Work2* (business owner), *Work3* (clerical/office/sales), *Work4* (service worker), *Work5* (skilled trade), and *Work6* (other).

Results and Discussion

Table 1 details the demographics of the sample of n = 855 Indiana residents. Age, gender, income, and economic region of residence were all within 5% points of the Indiana census (U.S. Census Bureau 2012a, U.S. Census Bureau 2012b, US-Places.com, 2012). Females represented 53% of the sample, while males were 47%. The survey respondents aged 18–24 years constituted 9% of the sample, 25–44 years 36% of the sample, 45–64 years 37% of the sample, and respondents aged 65 years or older represented 18% of the sample. Respondents were able to choose from among seven different categories to indicate their household income level and, in this analysis, those smaller categories were aggregated into lower income (less than $50,000) medium income ($50,000–$74,999) and higher income (above $74,999). Participants were also asked about their highest level of education attainment, which was presented to respondents in six categories. The largest category comprised of college graduates with bachelor's degrees and accounted for 28% of the sample, followed by high school and college with no degree earned, 22% each. These results are very similar to what was reported by the U.S. Census Bureau 2010 American community survey. Of Indiana residents ages 25–64, 34% were high school graduates, 22% had some college no degree earned, and 16% had a bachelor's degree (U.S. Census Bureau 2011).

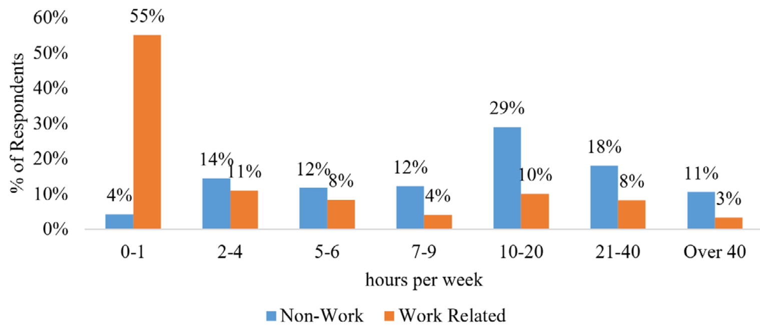
The survey also sought information on respondents' internet usage characteristics. A large percentage of respondents (49%) connect to the internet through a cable line. DSL (23%) and fiber optic (18%) were the second and third primary connection type most often indicated by respondents. Respondents also connected to the internet via satellite (4%), fixed wireless/microcell (4%), dial up (1%), and other methods (1%). The breakdown of service type is similar to that found in the 2013 U.S. Census, with 42.8% of Americans using a cable modem, 33.1% using mobile broadband, 21.2% using DSL connection, and less than 1% using dial-up internet connection (Fil and Ryan 2014).

Table 1 Demographics Information for Both Models, and the IN Census

Demographic	% of respondents (N = 855)	% of respondents who participated in choice experiment without reliability included (n = 428)	% of respondents who participated in choice experiment with reliability included (n = 427)	% of US census (IN)
Age				
18–24	9%	8%	10%	13%
25–44	36%	36%	35%	34%
45–64	37%	38%	36%	35%
65+	18%	18%	19%	18%
Gender				
Male	47%	47%	46%	51%
Female	53%	53%	54%	49%
Income				
Less than $25,000	24%	24%	23%	25%
$25,000 to $34,999	11%	9%	14%	12%
$35,000 to $49,999	15%	14%	15%	16%
$50,000 to $74,999	19%	22%	16%	20%
$75,000 to $99,000	13%	13%	13%	12%
$100,000 to $149,999	12%	11%	13%	10%
$150,000 or more	6%	6%	7%	5%
Economic growth region of Indiana				
Region 1	13%	13%	13%	13%
Region 2	9%	9%	8%	9%
Region 3	12%	11%	14%	12%
Region 4	8%	9%	7%	8%
Region 5	16%	15%	16%	15%
Region 6	6%	6%	6%	5%
Region 7	4%	5%	3%	3%
Region 8	5%	5%	4%	5%
Region 9	4%	4%	4%	5%
Region 10	4%	4%	4%	4%
Region 11	7%	7%	7%	7%
Region 12	14%	14%	15%	14%

The 2013 U.S. Census reported that Indiana had statistically lower computer ownership and high-speed internet use (Fil and Ryan 2014). According to Broadbandnow, 95.7% of Indiana residents have access to wireline service, 90.6% have access to DSL service, and 83.2% have access to cable service (Reese and Anderson 2018). When asked to select their top two primary uses for the internet from a provided list of uses, using the internet for social media was selected by 28% of the sample. Shopping and gathering product information (18%) was the second most frequently selected use of the internet. These most frequent usages were followed by gathering information for personal needs (17%), entertainment (15%), work/business (11%), communication with others (not including email) (6%), and education (5%). In a national sample, 47% of adults indicated they used social networking sites, which is likely to

Figure 3 Internet use frequency for work and non-work related purposes (N = 855) [Color figure can be viewed at wileyonlinelibrary.com]



grow when considering the heavy use by American teens (73%) (Lenhart et al. 2010). When asked about the frequency of internet usage for nonwork-related activities, 29% of the sample responded they spend between 10 and 20 hours using the internet per week (figure 3). In regard to using the internet for work, 55% of the sample indicated using the internet for up to 1 hour per week.

To gauge respondents' willingness to change internet connection type, respondents were asked if they would switch internet connection type and under what conditions. A very large proportion, 84% of residents, reported they would switch to fiber if it was offered in their area. Of the 84% of respondents who would consider switching to fiber in the sample, 65% would switch if the service was offered by their current internet service provider and the remaining would switch if it was offered by a competitor. However, the greatest concern with home internet service was the cost, as indicated by 45% of respondents. Home internet speeds and reliability were also major issues as reported by 25% and 13% of residents, respectively. A large proportion—nearly two thirds—of residents surveyed reported that they were very familiar or extremely familiar with fiber optic internet service. Twenty-eight percent indicated that they were "Very Familiar" and 33% indicated that they were "Extremely Familiar." The remaining respondents were either "Moderately Familiar" (21%), "Slightly Familiar" (12%), or "Not Familiar at All" (6%). This could suggest that educating the public on symmetrical gigabit internet connections may not be the greatest issue faced by promoters of fiber optic internet service. Furthermore, deploying high-fidelity infrastructure to allay the concerns of residents over reliability seemed to be more important than other aspects of broadband.

Most consumers were either "Extremely" (23%) or "Moderately Satisfied" (42%) with their current internet service provider. Only 13% of respondents indicated that they were "Slightly Satisfied" and 9% felt that they were "Neither satisfied nor dissatisfied." The remaining respondents indicated that they were "Slightly Dissatisfied" (7%), "Moderately Dissatisfied" (4%), or "Extremely Dissatisfied" (3%). It is possible that respondents are anchoring their level of satisfaction with their current provider to experiences with previous providers. Although beyond the scope of the current study, further research comparing the satisfaction of work versus home providers, or previous providers that have changed due to moving or personal choices may provide more information regarding consumer satisfaction. There are many definitions/measures of customer satisfaction and the coveted customer loyalty in the literature. One definition is the customer's willingness to continue or increase business with the company (Yang and Peterson 2004). Most respondents were either extremely or moderately satisfied with their internet provider; only 35% of the 84% of respondents who would switch to fiber would do so if they had to switch to a competitor of their current internet provider.

Homburg, Koschate, and Hoyer (2005), found that satisfied customers had higher WTP, which may be important to internet providers who are considering expanding their services to an already happy consumer base. Very few respondents (2%) indicated there were no other internet service provider options for their home. About 26% of respondents reported that they had one other option, 37% had two other options, and 23% had three other options available to choose an internet service provider. The remaining 12% of respondents had four other options for internet service to choose from. Still, lack of internet provider choices is an issue for the U.S. population in general; however, the number of providers varies depending on the internet speed capabilities the consumer is purchasing. Fifty-six percent of U.S. consumers have access to at least three providers who provide speeds of 56 Mbps or greater. The percentage steadily decreases as the internet speeds increase. Only 28% of U.S. consumers have access to three or more providers at speeds of 10 Mbps, and 1% of U.S. consumers have access to three or more providers with speeds of 100 Mbps or greater. Forty-one percent of U.S. consumers have no services available at speeds of 100 Mbps or greater (Beede 2014).

The availability of broadband access for rural Indiana residents varies greatly by county. In sixteen Indiana counties, which account for seven of the twelve economic growth regions, over 80% of rural residents lack broadband access (table 1[4]). The number of counties per region ranges from five to twelve, with an average of eight counties per region. Although not everyone wants to adopt high-speed internet, those who are willing and able to pay for the product cannot do so unless they have access to the service. Due to complications with terrain and other factors, providers may not provide access due to beliefs that it would not be profitable in rural areas (Sylvester and McGlynn 2010). It is possible that misconceptions regarding rural inhabitants' potential rate of adoption and WTP for high-speed internet may contribute to the lack of access from providers. In a nationally representative study conducted between 2002 and 2008, it was found that the digital divide has increased with urban residents being 40% more likely than rural residents to have access to the internet. Similarly, a college graduate is about seven times more likely to have internet access than those with less than high school education and a person of higher income was 60% more likely to have internet access than those with lower income (Talukdar and Gauri 2011). Lack of reliable internet also has unexpected consequences. Those who do not have access to the internet are statistically less likely to participate in politics, such as contacting their representative, even though phone and letter writing are still options for participation, which means a segment of the population may be underrepresented (Sylvester and McGlynn 2010). The lack of competition at higher internet speeds, which require better infrastructure, could force consumers to accept the technological offerings (and service) as given in their area and increase/reinforce the digital divide. This could exacerbate the problem of firms investing little in infrastructure upgrades or customer support.

Estimated Willingness-to-Pay for Home Internet Service

Although the literature indicates increasing internet access and speed has positive effects, especially for underserved areas such as rural areas, internet

[4]*Appendix available upon request*

businesses would not be able to expand if consumers are not willing to pay. Therefore, WTP models were employed to examine consumer's WTP for various internet attributes. The multinomial logit model was initially estimated and served as a starting point to computationally aid the estimation of a subsequent random parameter logit model. While the results from this initial estimation provide baseline marginal utility values, the underlying assumptions of the model are often too restrictive and provide sparse pragmatic economic interpretations. Thus, greater focus is placed on the RPL, which assumes more realistic heterogeneous preferences across respondents. Table 2 shows the estimation results for all four RPL models, including the original models as described in the methods and the SANA corrected versions of those models. RPL-1 represents the model without the reliability attribute while RPL-2 is the model with the addition of the reliability attribute. RPL-3 and RPL-4 both have information processing applied using the SANA data collected. RPL-3 excludes the reliability attribute while RPL-4 includes the attribute. As expected, the coefficient estimations for *Price* and *Opt Out* are both negative for all models. Negative coefficients indicate that as price for the internet service package increases, utility decreases for the consumers; similar disutility is experienced when consumers are forced to walk away from a purchase—that is, when they would choose none of the available choices (Olynk, Tonsor, and Wolf 2010).

For RPL-1, consumers were asked to consider the attributes: *bundle*, *service*, and *speed*. The results show that *Service* in the form of customer and technical support has the greatest WTP value of $40.60 per month. The WTP for *Bundle* is $24.14 which indicates that consumers are willing to pay for adding on additional services to the same bill. Lastly, the WTP for *Speed* is estimated to be $0.05/Mbps per month. Comparing this model to RPL-2 where the *Reliability* attribute is considered, the WTP for *Bundle* and *Service* drops significantly. In RPL-2, the WTP for *Bundle* and *Service* is $14.35 and $25.81, respectively. The WTP for *Speed* increases by $0.03/Mbps per month for a total WTP of $0.08/Mbps. *Reliability* has a WTP of $19.10. This provides evidence that consumers are willing to pay to have an internet connection with little occurrence of downtime. Currently in Indiana there are 72 fiber broadband providers, which covers only 17.3% of the state (Reese and Anderson 2018). When considering installing fiber internet, the internet provider has a large upfront cost of installation, without a guarantee on the number of people who will purchase the service. Although determining if consumer WTP for various speeds of fiber internet are enough to cover the costs of implementation are beyond the scope of this study, these numbers do provide an important starting point for investors in fiber broadband.

An interesting pattern emerges when examining the models which have stated attribute attendance information processing applied. Using the complete combinatorial test proposed by Poe, Giraud, and Loomis (2005) the differences between the full-attendance models and the SANA-corrected models were tested statistically. Consumers who did not have the reliability attribute to consider, either RPL-1 for the original model or RPL-3 for the SANA-corrected, had statistically significant differences in WTP for service and speed once heuristics were accounted for. For both service and speed the respondents were willing to pay more in the SANA-corrected model. The increased disutility from being forced to Opt Out was also statistically significant. These results show that consumers who are strongly considering internet service packages, without SANA, have a higher WTP for attributes such

Table 2 Estimation Results for Random Parameter Logit Models (n = 855)

	Random parameter logit models											
	(RPL-1)Reliability attribute not included			(RPL-2) Reliability attribute included			(RPL-3) No reliability w/ SANA correction			(RPL-4) Yes reliability w/SANA correction		
	Coefficient (std. err.)	Std. dev. (std. err.)	WTP	Coefficient (std. err.)	Std. dev. (std. err.)	WTP	Coefficient (std. err.)	Std. dev. (std. err.)	WTP	Coefficient (std. err.)	Std. dev. (std. err.)	WTP
Price	−0.013	–		−0.047	–		−0.014	–		−0.046	–	
	0.001	–		0.002	–		0.001	–		0.002	–	
Opt Out	−0.405	2.396	$ (30.72)***	−2.199	2.806	$ (46.80)	−0.365	2.366	$ (26.07) ***	−1.588	3.128	$ (34.76)
	0.165	0.145		0.197	0.170		0.161	0.144		0.191	0.175	
Bundle	0.159	0.487	$ 24.14	0.337	0.728	$ 14.35***	0.239	0.459	$ 34.19	0.504	0.747	$22.06***
	0.051	0.076		0.057	0.073		0.056	0.088		0.068	0.084	
Service	0.268	0.186	$ 40.60***	0.606	0.527	$ 25.81**	0.313	0.174	$ 44.73***	0.615	0.480	$26.94**
	0.039	0.105		0.052	0.069		0.041	0.118		0.055	0.072	
Speed	0.000	0.001	$ 0.05***	0.002	0.002	$ 0.08	0.000	0.001	$ 0.06***	0.002	0.002	$ 0.09
	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	
Reliable				0.449	0.634	$ 19.10				0.425	0.618	$ 18.61
				0.057	0.078					0.056	0.078	

Note: *Using the complete combinatorial test as outlined by Poe, Giraud, and Loomis (2005), the original and SANA-corrected models were statistically tested. **indicates the models were different at 0.05 level and *** < 0.001 level. Model RPL-1 was tested against RPL-3 and RPL-2 was tested against RPL-4.*

as customer service, technical support, and higher internet speeds. With reliability in consideration, RPL-2 for the full-attendance model and RPL-4 for the SANA corrected, the differences in WTP for Speed and Opt Out and Reliability were not statistically significant. Conversely, the WTP for bundle and service were statistically higher in the SANA corrected model compared to the original model. The WTP for Bundle and Service attributes are of critical importance however, as consumers had a higher WTP of and additional $7.71 per month (22.06 total) and $1.13 per month (26.94 total), respectively in the SANA corrected model. As show in figure 4, the mean WTP with reliability and corrected for ANA from RPL-4 varies slightly among the economic regions in Indiana ranging between $0.06 to $0.10/Mbps, which may be important to internet provided who are considering expanding fiber optic broadband services.

To further explore the relationship between respondent demographics and WTP for internet speed, two OLS models (table 3) were evaluated with the same demographic variables for both the SANA corrected models with and without reliability. For the model not including reliability, only *Age* is a statistically significant predictor of WTP. Respondents who are over the age of 44 have a $0.042 increase in WTP for internet Speed (Mbps). However, in the model with reliability included, in addition to the age of the respondent, the occupation of the respondent becomes statistically significant. Similar to the model without reliability, respondents who are over the age of 44 have a $0.037 increase in WTP for speed (Mbps). WTP for speed increases the greatest for consumers who are involved in skilled trade ($0.060/Mbps). This is followed by service workers (0.050) and business owners ($0.042/Mbps). It is possible that these occupations require fast home internet service for their work and are therefore willing to pay more for speed in an internet package.

Figure 4 Average WTP for speed ($/Mbps) by Indiana economic growth region (1–12) with *Reliability* and corrected for SANA [Color figure can be viewed at wileyonlinelibrary.com]

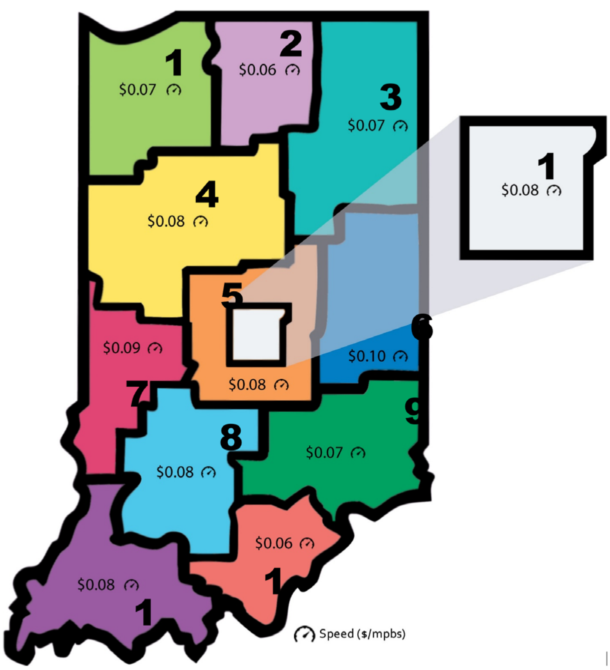


Table 3 OLS Model of Willingness to Pay for Speed and Demographics (n = 855)

	Ordinary least squares models			
	SANA w/o reliability		SANA w/ reliability	
	Coefficient std. error	Confidence interval	Coefficient std. error	Confidence interval
Gender	0.007	(−0.014, 0.027)	0.007	(−0.002, 0.017)
	0.012		0.006	
Professional	0.018	(−0.017, 0.053)	0.035***	(0.019, 0.051)
	0.021		0.010	
Business owner	0.021	(−0.029, 0.072)	0.042***	(0.016, 0.067)
	0.031		0.015	
Clerical/office/sales	0.030	(−0.007, 0.067)	0.032***	(0.013, 0.051)
	0.022		0.011	
Service worker	0.039	(−0.008, 0.085)	0.050***	(0.032, 0.068)
	0.028		0.011	
Skilled trade	0.013	(−0.042, 0.069)	0.060***	(0.026, 0.094)
	0.034		0.020	
Other	−0.005	(−0.034, 0.023)	0.041***	(0.028, 0.055)
	0.017		0.008	

*** *denotes statistical significance at 1%.*

Conclusions and Implications

The digital divide is prevalent in the literature due to the positive impact internet has not only on the individual, but communities. Many rural communities in the state of Indiana have few, or potentially no, options for internet providers and often struggle with the reliability and speed of their internet service. However, most consumers surveyed were satisfied with their current service provider and would purchase higher internet speeds delivered via fiber broadband if it was made available by their current provider. The results from this analysis show that many consumers across Indiana are willing to pay for internet subscription packages and are particularly interested in a few key attributes, namely that bundled services added value, along with features such as customer and technical support. Furthermore, reliability of the internet connection is crucial as this aspect has historically been a point of contention among subscribers, and especially rural customers.

This analysis found that the mean WTP for residents in all economic growth regions is between $0.06–$0.10/Mbps per month for broadband internet service. Lower connection speed offerings (less than broadband) by internet service providers would likely need to depend on superior performance from bundling, servicing and providing reliability attributes of their products in order to compete with broadband offerings from others. For providers of broadband internet services to successfully engage the latent demand for high-speed internet access, particular attention may need to be placed strategically on specific regions of Indiana. While age has a significant positive relationship with WTP for fiber optic internet, the subscriber's type of employment also plays a significant role—especially those involved in operating their own business, service work, or skilled trade, who have the greatest magnitude of effect on WTP.

Some of the issues on the supply side of the digital divide could be alleviated through policymaking, greater competition, infrastructure improvements, and regulations. In the future, policymakers may need to emphasize infrastructure resilience in telecommunications policy to help reduce the urban–rural digital divide. Residents in urban areas will likely continue to experience more competitive offerings based on price, as well as internet speeds, relative to rural counterparts and further drive the urban–rural digital divide. Internet service providers that are considering building new infrastructure should consider the introduction of redundant cabling to reduce downtime and increase network reliability, as well as take advantage of network redundancy strategies such as link aggregate (combining multiple network connections in parallel) to negate impacts of failures at a single point. New technologies, such as non-fixed satellite-based connections, could bring broadband into difficult to reach areas (for example, where mountainous terrain is more common) or poorly served communities and may also provide an opportunity to bridge collaborations between the public and private sector. Efforts such as these can reduce digital exclusion and increase reliable access to information and communication.

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