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Broadband's Relationship to Rural Housing Values

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Broadband's Relationship to Rural Housing Values

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Abstract

Using data for remote rural U.S. counties (n=887) we estimate the impact of broadband Internet access on median housing value. We account for spatial dependencies in the joint determination of investments in broadband access and housing values using a modified version of the feasible generalized spatial two stage least squares (FGS2SLS) estimator suggested by Kelejian and Prucha (1998). The data support the central hypothesis that remote rural housing values are positively impacted by higher access. Our estimates suggest that there are declining returns to speed availability, with access to at least some type of Internet being more valuable than having only a very high-speed connection accessible.

Broadband's Relationship to Rural Housing Values

Introduction

Since the turn of the millennium, perhaps no technology has impacted rural America more than the availability of high-speed (or "broadband") Internet. Its presence allows rural citizens to enjoy many of the amenities historically available only to residents of more urban locations, such as browsing / purchasing from a wide variety of stores, socially engaging with diverse networks, and participating in a multitude of educational and entertainment options. Recent research has demonstrated that access to broadband is important for economic activity in rural areas, including firm location decisions (Kim and Orazem, 2017) and household income growth (Whitacre, Gallardo, and Strover, 2014).

Broadband adoption rates have gone from negligible to nearly 70% for U.S. households between 2000 and 2015, and roughly two-thirds of Americans indicate that *not* having a high-speed connection at home would be a major disadvantage for items like finding a job or accessing key information (Horrigan and Duggan, 2015). Broadband infrastructure, however, is not uniformly distributed across rural America, and lagging availability is an important contributor to the rural – urban 'digital divide' in broadband adoption rates (Whitacre, Strover, and Gallardo, 2015). Much like the rural electrification efforts of the Roosevelt New Deal initiative, when it became understood that having access to electricity went from a luxury to a necessity, access to broadband has become a necessary piece of the infrastructure puzzle.

As the Internet becomes pervasive in American life, rural households without broadband access might find the value of their property negatively impacted. Popular press articles have provided anecdotal evidence that the presence of broadband Internet access is an important factor for home purchasing decisions (Brodkin, 2015; Knutson, 2015; Picard, 2016). Since housing and neighborhood characteristics are essential contributors to the quality of life in rural areas (Sirgy and Cornwell, 2002; Maynard et al. 1997), an empirical assessment of the value of a broadband connection for rural households is an important avenue of research for the economic development community.

Broadband availability and quality varies dramatically across rural parts of the country. Recent data indicate that while nearly 100% of Americans have access to connection speeds of 3 megabytes per second (MBPS) download and 768 kilobytes per second (KBPS) upload, 31% of rural Americans lack access to the official Federal Communications Commission (FCC) definition of "broadband" access (25 MBPS download / 3 MBPS upload) (NTIA, 2015; FCC, 2018). This nearly ubiquitous 3 MBPS access, however, is driven by the widespread availability of wireless (cellular) networks. These networks are generally limited to connection speeds of up to 10 MBPS (via 4G LTE technology), typically come with monthly data caps, and have been criticized as not being as useful as their wired counterparts (Anderson and Horrigan, 2016). Wired technology (through cable Internet, Digital Subscriber Lines (DSL) via the phone company, or fiber optic connections) are generally required to have "uncapped" access and to meet the official FCC broadband definition. It is this wired access that we are interested in here: do rural houses served by traditional Internet providers experience a housing premium, and does the speed of that access play a role?

While 44% of urban Americans have access to more than one provider of wired broadband, only 13% of rural Americans do (FCC, 2016b). Similarly, the existence of *no* wired providers is essentially a rural phenomenon – only 3% of urban households do not have access to a cable / DSL / fiber provider, versus 38% of rural. As more Americans (and businesses) become everyday users of high-speed connections, the availability and quality of such access will be important for rural communities looking to offer amenities of value to visitors or potential residents.[1] This holds across several activities typically associated with rural development, including tourism opportunities, business attraction efforts, and migration decisions. This study seeks to quantify the value of wired broadband access for "remote rural" residences, using data for remote nonmetropolitan counties (i.e. not adjacent to metropolitan areas) from the FCC and the 2016 five year average American Community Survey, and incorporates a variety of econometric techniques that attempt to deal with both potential

[1] Perrin (2015) notes that 73% of Americans go online on a daily basis and that 20% are online "almost constantly." Of 18-29 year-olds, over one-third (36%) are online "almost constantly."

endogeneity and spatial dependency. We focus on remote rural, defined as nonmetropolitan counties that are not adjacent to a metropolitan county, because these are the communities that are struggling with access: they are simply too isolated to draw the attention of service providers. The bulk of these counties are in the Great Plains, pockets of Appalachia, the upper Midwest and the norther parts of the Mountain West.[2] The results consistently demonstrate that there is a premium associated with broadband access for rural housing values and that the resulting elasticity is in the range of 0.01 to 0.07.

Literature Review

There is a growing consensus that broadband matters for local economies. Cross-country comparisons have uncovered positive effects, with Koutroumpis (2009) using a panel of OECD countries to estimate that broadband infrastructure accounted for roughly 10% of annual economic growth during 2002–2007. Similarly, Czernich et al. (2011) employed an instrumental variable approach for OECD countries to find that a ten percentage point increase in broadband penetration resulted in a one percentage point increase in GDP per capita between 1996 and 2007. Results using U.S. data are increasing in number and scope, and generally support the idea that there are significant spillovers associated with broadband access and use. Positive relationships have been found between broadband availability and employment rates (Atasoy, 2013; Jayakar and Park 2013), population and employment growth (Kolko, 2012), number of businesses (Gillet et al., 2006), locations of specific categories of firms (Mack and Grubesic, 2009; Mack and Rey, 2014; Tranos and Mack, 2015), and sector-specific output (Crandall, Lehr, and Litan, 2007; Shideler, Badaysan, and Taylor, 2007). Holt and Jamison's (2009) review of the U.S. literature suggests that there typically has been local economic growth after increases in broadband infrastructure, but that endogeneity issues make claims of causality difficult.

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[2] From a technical perspective, one must take care not to confuse remote counties and remote places. It is possible to have places located within an adjacent nonmetropolitan county that are remote by any reasonable standard that are excluded from our analysis. For example, large swaths of rural Maine, which could be considered remote, are removed from our analysis because they are adjacent to metropolitan counties. Thus, one could consider our sample of counties as the most rural remote.

Specifically, are broadband providers making investments in growing markets or are those investments resulting in growth? There is likely an interdependent feedback mechanism.

The spatial distribution of broadband availability has been extensively explored in the literature. In particular, Grubesic and Murray (2004) note the dramatic differences in broadband Internet competition between rural and urban areas, while Grubesic (2008) identifies core and periphery regions of broadband. Others have suggested that the diffusion of Internet infrastructure may serve to reduce income inequality (Celbis and Crombrugghe, 2016). Spatial econometric techniques have commonly been applied in this arena, since acknowledging the spatial nature of broadband is an important component of developing an appropriate theoretical model.

Additional work has explored the impact of broadband Internet explicitly for rural areas. Whitacre, Gallardo, and Strover (2014a) find that non-metro counties with high levels of broadband adoption had faster income growth and slower unemployment growth during the 2000s. These authors also demonstrated that a positive relationship exists between broadband adoption and the number of employees and firms in non-metro counties (Whitacre, Gallardo, and Strover, 2014b). Mack (2014) finds a link between broadband speed and the number of agricultural and rural establishments, and suggests that high-speed infrastructure is a vital component for rural economic vitality. Other studies have demonstrated positive relationships between broadband availability and domestic in-migration in rural counties (Mahasuweerachai et al., 2010), which in turn can impact housing markets, and between civic engagement and broadband adoption (Whitacre and Manlove, 2016).

More recently, Kim and Orazem (2017) find positive effects of broadband availability in the location decisions of rural firms as the technology was rolled out during 2000 – 2002. Although they only include two states (Iowa and North Carolina), their analysis benefits from a low level of geographic detail (ZIP code) and from a focus on newly-entering firms (who would likely be most sensitive to the presence or lack of broadband). Their difference-in-difference modeling approach generates counterfactual estimates from the early 1990s, before broadband was available anywhere, and is aimed at controlling for endogeneity which, as Holt and Jamison (2009) note, is largely ignored in much of the relevant literature.

One area of interest to the broadband and rural economic development discussion is how policy efforts to improve availability have fared. The two primary federal programs for bringing high-speed service into rural communities have been (1) the Universal Service Funds (USF) under the Federal Communications Commission (FCC) and (2) the broadband grant and loan programs under the United States Department of Agriculture (USDA) (Kruger, 2016). The FCC programs include the ongoing High Cost / Connect America Fund; programs for schools, libraries, and rural health facilities; and Lifeline (which provides $9.25 monthly subsidies to low-income households for broadband access). There have been few formal evaluations of these programs, and those that do exist suggest the need to demonstrate impact (GAO, 2014).

The USDA programs, on the other hand, have been the subject of several peer-reviewed studies. Kandilov and Renkow (2010) found that pilot loans made under the program during 2002-2003 had a positive impact on employment, payroll, and number of business establishments five years later. Their results, however, demonstrate that communities within metropolitan areas drove most of the positive impacts, with few impacts for communities in truly rural locations. A later evaluation of this program (Kandilov et al., 2017) found that both the pilot program and later versions had positive (and causal) impacts on farm sales and profits in rural counties. This time, results were limited to those counties adjacent to metropolitan areas. The USDA loan program has been evaluated to see if it accomplished its goal of increasing broadband provision in rural areas. Dinterman and Renkow (2017) find that it did, and report that ZIP codes receiving program funds between 2002 and 2007 could be expected to have one additional broadband provider (on average) over a ten-year period than they would have if the program never existed. In Dinterman and Renkow's analysis, the results were larger for rural non-adjacent counties, suggesting that the program was particularly helpful for the most remote locations.

One other federal program of note is the Broadband Technologies and Opportunities Program (BTOP), funded as part of the American Reinvestment and Recovery Act. The National Telecommunications and Information Administration (NTIA) provided $4B in funding during 2009 and 2010 as part of this effort. A matched-sample analysis suggests that broadband availability increased two percentage points higher for recipient counties during 2011 to 2013

(ASR Analytics, 2014). Hauge and Prieger (2015), however, found that BTOP funds awarded specifically for "sustainable adoption" work did not increase broadband adoption levels any higher than what would have been expected in their absence.

There are strikingly few studies focusing explicitly on the impact of broadband availability on housing values. Perhaps the most relevant is Molnar (2013), who investigated the impact of fiber-based broadband services on real estate values as of 2011. Molnar's work constructs a hedonic valuation model using 20,500 real estate transactions across nine counties of three MSAs in New York – and thus does not contain any rural observations. His analysis found that a fiber connection (which was available for 68% of the transactions) resulted in a housing value increase of three to four percent - similar to that for the inclusion of a pool on the property. This work was extended by Molnar, Savage, and Sicker (2015) to include additional years of analysis (2011 to 2013) and to cover real estate transactions in all 50 states. Again, the hedonic model suggests a value-added of about three percent for access to a fiber connection. Further analysis suggests that access to higher-speed connections (>1 GB) have transaction prices over seven percent greater than similar households with only a 25MB connection. Their initial specification did not employ an instrumental variable approach and may have issues of endogeneity, but robustness checks using both two-step models that accounted for selection on unobservables and difference-in-difference estimators found similar results. They include measures of household density, length of roads, and number of road intersections in their analysis, but do not specifically break out rural versus urban transactions.

Similar work by Ahlfeldt et al. (2014) uses property prices from England between 1995 and 2010 to suggest that upgrading from a dial-up connection to an 8 MBPS connection increases the property value by 2.8%. They also attempt a cost-benefit analysis and find that, as expected, rural areas are the most problematic. They estimate that the benefits that would accrue to rural housing values on the basis of a potential speed upgrade would only account for roughly 15% of the associated costs of actually laying the infrastructure.

In perhaps the only study on this topic focusing exclusively on rural households, Kashian and Zenteno (2014) obtained survey responses on Internet availability from 225 full and part-time residents in non-metropolitan Door County, Wisconsin. This county of 27,000 is heavily dependent on tourism and part-time residents, and the authors hypothesized that seasonal homes with broadband connections would have a significantly higher value. The survey data were meshed with county assessor information on the assessed value and structural characteristics of the homes surveyed. Slightly less than half (45%) of the homes surveyed did not have Internet access available to them, and roughly 80% were seasonal homes. The simple hedonic model suggested that Internet access increased the average value of seasonal property by 2.7%, which is in line with the estimates from Molnar et al. and Ahlfeldt et al.

Models and Methods

Following the logic of Holt and Jamison (2009), when modeling the interplay between broadband and economic activity - including housing values - the potential for joint determination is high: Internet service providers are likely to target higher income areas, which in turn reflects higher housing values; similarly, housing values are likely higher in areas with good broadband access. We can express this interplay more formally as:

$$MHV = f(BB, X) \quad \text{and} \quad BB = g(MHV, Z)$$

where MHV is median house value within the region of analysis, and BB is the availability of broadband within the region. In this setup, the vector X captures the relevant control variables that influence regional housing values and Z represents factors that broadband service providers consider when making investment decisions. Here the explicit joint determination of housing values and broadband access is acknowledged.

At the same time, the clear spatial patterns of these investment decisions argue that the interplay between broadband and housing values has a strong spatial dimension. Broadband providers tend to ignore political, or in our case county, boundaries and think more regionally when making the decision to invest in an area, and focus on larger geographical factors such as terrain and probable demand. Further, spatial dependency across geographic housing markets has been well established within the hedonic literature (e.g., Can 1992; Geoghegan, Wainger, and Bockstael 1997; Anselin and Le Gallo 2006; Cohen and Coughlin 2008; Small and Steimetz

2012; Baltagi, Bresson and Etienne 2015). This is particularly true in rural areas where county-independent geographic and amenity characteristics can be a major influence.

To address this spatial interplay we adopt a methodology originally suggested by Kelejian and Prucha (1998; 2004), refined by Drukker, Egger and Prucha (2012) and Yang and Lee (2017), and applied by Jeanty, Partridge and Irwin (2010) in a study of migration and housing values, Fischer and Pfaffernayr (2017) to explore migration and regional income convergence across Europe, and Delgado-Garcia, de Quevedo-Puente and Blanco-Mazagatos (2017) to study how the reputation of Spanish cities influence economic performance. Modified versions of the method have been adopted by Wu and Gopinath (2008) in a study of spatial disparities in rural U.S. economic development, as well as Cochrane, Grimes, McCann and Poot (2017) to study the interplay between economic growth and traditional infrastructure investments.

Cochrane et.al. (2017) use a slightly modified three step estimation approach. First, a nonspatial two stage least squares (2SLS) estimator is used to account for endogeneity and contemporaneous correlation. Then the residuals from the 2SLS estimation are tested for spatial autocorrelation using traditional tests such as the Moran's I. If spatial autocorrelation is present in the data, then a spatial lag structure is explicitly introduced into the model and the system of equations is re-estimated using 2SLS. As noted by Cochrane et.al. (2017) this is analogous to estimating a spatial autoregressive (SAR) model in the single equation context.

We employ a slightly different approach where we use a spatial autoregressive 2SLS estimator and rely on the significance of the SAR-like spatial parameter as opposed to a Moran's test of the nonspatial errors. If the spatial parameter is not significant we return to the nonspatial 2SLS estimator. Because we are interested in exploring the differences in the broadband and housing value interplay across several broadband speed categories this more direct approach significantly reduces the volume of results to be reported and discussed.

More explicitly, the simple structural model can be re-expressed as

$$MHV = f(W \cdot MHV, BB, X) \quad \text{and} \quad BB = g(W \cdot BB, MHV, Z)$$

where W is a spatial weight matrix capturing the spatial proximity of individual counties where more proximate counties are given higher weight than more distant counties. In practice, we use a distance-based spatial weight matrix to reduce the number of observations that lack neighbors.[3] As a simple robustness check we estimate the models using three spatial estimators: (1) a simple spatial lag (WOLS) where the endogenous interplay between housing values and broadband is ignored, (2) a spatial lag two stage least squares estimator (W2SLS), and (3) the full spatial three stage least squares introduced by Kelejian and Prucha (2004) and modified by Cochrane et al. (2017) (W3SLS). The latter is what Kelejian and Prucha (2004) refer to as the feasible generalized spatial three stage lease squares (FGS3SLS) estimator. By comparing and contrasting the key elasticity of interest, the impact of broadband on housing values, across the W2SLS and W3SLS we can gain insights into the efficiency and stability of the estimate. Generally, the W3SLS will be more efficient than the W2SLS, particularly with larger sample sizes and multiple equations, but if the model is misspecified the W2SLS will be preferred to the W3SLS results.

Beyond the issues of endogeneity and spatial dependency within the data there are two additional methodological challenges. The first is the definition and empirical measurement of broadband access (BB) and the second is the specification of the two blocks of control variables (X and Z) in such a way to ensure that the system of equations is properly identified. The FCC provides numerous ways to measure broadband access, ranging from a simple count of the number of service providers within a county, to the share of the population with various upload and download speeds, to the share of the population with access to a particular technology such as fiber, cable, or DSL. For this research we focus on the share of population with access to a variety of speeds (0.2MBPS, 4MBPS, 10 MBPS, 25 MBPS, 100 MBPS, 250 MBPS, and 1000 MBPS) via any fixed terrestrial technology, noting that consumers are more likely to care about available speeds as opposed to technology type. We note that the 25 MBPS threshold is the minimum broadband download speed as defined by the FCC – specifically, levels below 25

[3] Note that because we use only counties classified as rural and remote, it is possible that "holes" exist in a contiguity-based spatial weight matrix such as a rook or queen – with some observations lacking neighbors. Using a distance-based spatial weight matrix can reduce such observations.

MBPS are not considered to be broadband.[4,5] It is unclear, however, that there are noticeable differences to consumers across speeds (Singer, 2017).[6] Ford (forthcoming) demonstrates that there has been no economic payoff for 1,000 U.S. counties that had 25 MBPS speeds as of 2013 when compared to otherwise similar ones with only 10 MBPS service. Thus, we focus on the impact to rural housing values across various speeds – perhaps having some connection available is more valuable than having only extremely high speed (and more costly) access.

The broadband data we use are from December 2016 and come from the FCC's Broadband Map. These data are collected from Form 477 that is required of all facilities-based broadband providers, and are compiled at the county level via the FCC's Area Table. We include any type of fixed terrestrial service, which includes technologies such as cable, DSL, and fixed wireless but excludes satellite. Previous versions of broadband data typically came from the National Broadband Map (NBM), which was gathered by a different entity in each state, and was subject to a variety of critiques. These critiques included that measurement errors and sample selection bias could cause problems (Ford, 2011) and that some claimed areas of coverage extended beyond the normal technological limits of the provider (Grubesic, 2012). These critiques focused on the earliest versions of the NBM and did not necessarily prove that the data were inaccurate.[7] One goal of the NBM data was to improve collection quality over

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[4] The FCC's broadband threshold is based on the statutory definition of "advanced telecommunications capability", which includes enabling users to "originate and receive high-quality voice, data, graphics, and video telecommunications. (FCC, 2018)"

[5] Satellite, in particular, is not included in the 25 MBPS measure because it could not provide this speed in 2014. This has changed as of 2016, with satellite providers now able to offer such speeds (FCC, 2018). We do not include satellite in our analysis.

[6] Additionally, some (including U.S. Senators) have argued that the FCC's threshold is arbitrary, with 24 MBPS (for example) not noticeably different in performance (Engebretson, 2016).

[7] For example, it is possible that access multipliers were used to extend DSL coverage areas.

time (FCC, 2014),[8] and the number of records listed increased dramatically between 2010 and 2014 (Whitacre, Wheeler, and Landgraf, 2015). The FCC's version of the broadband map builds on the lessons learned from the NBM and, because it is collected by a single government entity as opposed to a variety of organizations across states, is likely an improvement over those datasets.

As noted by Batholomew and Ewing (2011) the set of control variables incorporated into basic hedonic models, or the matrix X in $MHV = f(BB, X)$, is composed of two types: (1) those that describe the housing stock itself and (2) the characteristics of the broader market. De Bruyne and Van Hove (2013) use the framework of real estate characteristics, such as the average age of housing, and socio-economic variables, such as income, to characterize the factors affecting housing prices. For this county-level analysis the block of control variables, drawn primarily from the U.S. Census American Community Survey (the 2012-2016 five-year averages), include: [9]

- Percent of Occupied Housing: Single Family Detached
- Ratio of Owner Occupied to Renter Occupied
- Percent of Occupied Housing: Mobile Home or Other
- Percent of Occupied Housing: Built in 2010 or Later
- Percent of Occupied Housing: Built in 1939 or Earlier
- Percent of Occupied Housing: Eight Rooms or More
- Percent of Occupied Housing Classified as Recreational or Seasonal Use
- Population to Employment Ratio
- Growth Rate in Per Capita Income 2006-2016
- Growth Rate in Employment 2006-2016
- Distance to Metropolitan County with 250K Population

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[8] The FCC (2014) notes that ratings of broadband providers are made available to the entity that collects data in each state so that they "can use them to validate and improve data in future updates."

[9] We note that the Dec 2016 broadband data is not an ideal match for the 2012-16 ACS variables, since housing values from this period may not reflect the broadband situation as of 2016. However, we believe the FCC data is an improvement from the NBM and that it provides a more realistic picture of broadband access in the county.

We follow convention and model the dependent variable (median house value) in logarithmic form. Single family detached housing is generally more expensive, and a higher share is expected to increase housing values for the region. The ratio of occupied housing units that are owned versus rented is included to distinguish the characteristics of the ownership and rental markets (DiPasquale and Wheaton 1992); a higher ratio is expected to increase overall housing values. The share of occupied housing units that are classified as a mobile home or similar is a simple proxy for the quality of the housing stock, and we expect a higher constituency of mobile homes in the housing stock will place downward pressure on housing values (Hansen, Formby and Smith 1994). We also control for housing age where an older housing stock, measured by the share of occupied houses built in 1939 or earlier should place downward pressure on values. Alternatively, a higher share of newer houses (built in 2010 or later) and share with eight or more rooms should reflect a growing community and higher housing values. These age and characteristic-related variables are often used in the hedonic literature. The concentration of seasonal and recreational houses is a proxy measure for natural amenities. Remote rural regions, the focus of this study, that are endowed with significant natural amenities have been found to have stronger economies than other rural areas (Deller, Tsai, Marcouiller and English 2001; Green, Deller and Marcouiller 2005; Chi and Marcouiller 2011). A higher stock of seasonal and recreational housing has further been shown to be an important part of that amenity and growth relationship (Winkler, Deller and Marcouiller 2015), particularly in terms of understanding retirement migration patterns (Jensen and Deller 2007).

We also include three socioeconomic characteristics of the remote rural county including the growth rate of per capita income, the growth rate of employment, and the distance of the community to the nearest metropolitan county with at least 250,000 population. The per capita income rate is aimed at capturing overall demand for housing within the county market. Another potentially influential measure is the employment growth in the county, which also relates to housing demand given that it reflects new or lost jobs. Finally, distance to a major metropolitan area is widely recognized as important for rural communities (Glavac et al., 1998; Davidson and Rickman, 2011; Partidge et al., 2008; Partridge and Rickman, 2008), since proximity to amenities associated with urban areas (retail options, cultural events) may be factored into rural housing prices.

The ecological, or regional, modeling of broadband investment is less developed than the empirical housing hedonic literature; however, a growing body of work does exist. Most studies on the topic attempt to indirectly model the investment decisions of broadband service providers by comparing and contrasting regions or communities where investments have been made and not made. Early work found that cable and DSL infrastructure investments were primarily made in higher income, higher density markets (Gillett and Lehr, 1999; Gabel and Kwan, 2000); other studies found that these two dominant initial sources of broadband were substitutes for one another (Rappoport et al., 2003). In a study of Ohio, Grubesic (2003) finds similar results for the impact of population density and income on high-speed infrastructure provision, but also documents that an area's education level is a factor. In particular, places with higher percentages of residents with a college degree are more likely to have broadband investments. Flamm's (2005) analysis of zip code-level broadband availability generally agrees with these determinants; he also emphasizes the importance of geophysical variables such as landcover.

While most of these studies focused on factors affecting broadband *availability*, additional work has looked into household *demand* for such service. Chaudhuri et al. (2005) find income and education to be strong predictors of general internet demand, while Flamm and Chaudhuri (2007) obtain similar results specifically for broadband. Whitacre and Mills (2007) concur, and in fact argue that differences in these characteristics drove the early rural-urban 'digital divide' in broadband adoption. Prieger and Hu (2008), in their study of census track data from four Midwestern states find similar results to Chaudhuri et al. (2005) but also document strong influences of the racial composition of the community. Controlling for several traditional factors like education and income levels, Prieger and Hu (2008) find that a higher share of the population that is nonwhite reduces broadband demand. As outlined above, the rural-urban gap in broadband access, particularly for remote rural areas, remains an issue. But Savage and Waldman (2009) in a study of household demand, find that rural residents are simply less willing to pay a premium for an improvement in bandwidth. Thus, a sizable body of evidence exists from which to build a model of broadband investment.

In this model, service providers may be making a rational economic choice not to invest in rural areas for three basic reasons. First, the customer density is not sufficient to offset the fixed costs of making the investment. Second, rural areas may not have the socioeconomic and demographic characteristics that are attractive to service providers. Finally, even if rural residents are able to pay for access, they simply may not be willing to pay the premium required to cover the initial investment costs. Irrespective of these results, there is a sufficient literature foundation to base our empirical modeling as it pertains to $BB = g(MHV, Z)$. Our specific county-level control variables (Z) include:

- Growth Rate in Per Capita Income 2006-2016
- Growth Rate in Employment 2006-2016
- Education Index
- Age Index
- Percent of Population African-American
- Percent of Population Latino/a
- Total Area in Square Miles (000)
- Population Density
- Distance to Metropolitan County With 250K Population
- Percentage of County Surface Area Covered by Water
- Median Household Income ($000)

Note that several variables in (Z) coincide with those in (X); this is done because they likely influence both dependent variables of interest and since such overlap is required in order to appropriately identify the model. These overlapping variables include growth rates in per capita income and employment (building on the positive relationship between broadband provision and level values of these variables established in the literature) and the distance to a metropolitan county. Income and employment growth rates are simple measures as to whether or not the county economy is growing, stagnant or declining. It is a relatively straightforward hypothesis to suggest that service providers will be drawn to growing rural counties. Distance to metropolitan areas is a proxy for the ability of the service provider to tap into the existing infrastructure. In addition, rural counties closer to larger metro markets may have access to a larger pool of potential broadband service providers to draw upon.

The other (non-overlapping) variables in Z are drawn from prior work on this topic. The income, education, and age profiles are used in several studies on broadband availability (Prieger, 2003; Flamm, 2005; Grubesic, 2006; Kolko, 2010; Wood, 2008). The education and age indices are based on the third moment of the distribution across educational attainment levels and age categories, respectively. A positive value of each index means that educational attainment is skewed toward lower levels and the population tends to be skewed toward younger people. A negative value means education is skewed toward more education and age is skewed toward older people. We expect that higher income and education levels should see higher levels of broadband access. We also expect an age distribution skewed toward younger people to have higher levels of broadband access while older populations would see lower levels of access. Race and ethnicity variables are also included, based on prior research showing unequal availability across some categories (Prieger, 2003; Greenstein, 2005; Grubesic, 2010). Population density reflects the ability to draw sufficient customers to cover the fixed costs of making the initial broadband investment. The total land area in square miles is intended to complement the broader population density measure. A rural county that has denser population centers surrounded by sparsely populated area could be more attractive to service providers than a county where residents are scattered across the countryside. Similarly, remote counties with large total land mass will be more difficult for providers to cover. Finally, we include the percentage of the county surface area covered by water; as the amount of surface water increases it becomes more difficult, and expensive, to lay the broadband infrastructure. We expect a positive impact of population density, but negative impacts for total land area and the percent covered by water.

Sources and summary statistics for all relevant variables are displayed in Table 1. All variables are at the county level. The average median housing value across the 887 remote rural counties is $101,831, with median household income values of $44,070. Very few houses are built after 2010 (<2%) but over 34% are classified as seasonal / recreational. Recall the nature of the education and age indices: a positive education index is skewed towards lower formal education; while a positive age index is skewed towards a younger population. The statistics suggest (as expected) that our remote rural population is less formally educated and older than the national averages. In terms of broadband access, we focus on the seven speed thresholds discussed earlier (0.2 MBPS - 1000 MBPS). As we would predict, the percentages of households with access declines as speeds increase. 94% has access to at least the lowest level of speed considered (0.2 MBPS), 63% has access to speeds of 25 MBPS or greater (the official FCC threshold), and only 9% has 1 GBPS access. The remaining control variables demonstrate a significant amount of variation across the sample.

[Table 1 about here]

Empirical Results

Our central question focuses on the relationship between broadband speed availability and rural housing values. As such, we construct models that use the share of county population with access to the seven different download speed thresholds shown in Table 1. We estimate all 42 separate models (two equation models estimated using three methods across seven different speed categories). For brevity, we report only the two results for the share of households with access to at least 25 MBPS (the official FCC broadband threshold). The results for other speed thresholds are noted in our elasticity estimates and the discussion of their meaning and implications that follows.

The results of the influence of broadband on housing value model are provided in Table 2 (for 25 MB) and the results of the broadband access model are provided in Table 3.[10] For the housing model, the results are generally consistent with economic theory. First, the spatial parameters in the models are highly statistically significant, pointing to the appropriateness of the spatial estimators. The consistency of this result suggests that the nonspatial estimator results from the first step of the Kelejian and Prucha (1998, 2004) method are biased and inconsistent and are, thus, not reported. Further, these results suggest that our approach of directly estimating the spatial models and using the spatial parameter as our test of spatial dependency is a reasonable alternative tactic. Second, based on the Hausman test comparing the WOLS and W2SLS results, we can

[10] The additional models using other speed thresholds provide similar results across the control variables. Typically, only the parameter on the speed variable in the housing model varies from the results reported in Table 2. These speed-specific coefficients are reported in Table 4.

conclude that our simple two-equation system that explicitly reflects the joint determination on housing values and broadband access is preferable. In addition, the Hausman test comparing the W2SLS and W3SLS results suggests that the W3SLS is preferable. But when we compare the individual estimated coefficients across the W2SLS and W3SLS estimates, the differences are very modest and we find no contradictory results. Third, the results of the Basmann (1960) identification test suggest that the models are over-identified, which for our purposes, does not pose any difficulties. Finally, although the WOLS results are to be discounted, the R^2 suggests that the model explains almost 74% of the variance in median house values.

Several control variables are consistent predictors of median housing values in remote rural counties, regardless of estimator. As expected, the share of housing stock that is classified as seasonal or recreational has a consistently positive impact on housing value, and the share of occupied housing classified as mobile homes has the hypothesized negative effect. Older housing stock (built before 1939) has a negative impact on housing values, while newer houses (built after 2010) have a positive impact. The population to employment ratio has a negative association with the log of median house value, suggesting that a higher ratio (fewer people employed per capita) negatively affects housing prices. The distance to a metropolitan area also displays a negative sign, suggesting a premium on metro proximity. Each of these results is as expected.

Other control variables either lack statistical significance or are inconsistent in their significance across specifications. These include the ratio of owner-occupied to renter-occupied housing, and the 2006-2016 growth rates for per capita income and employment. The only variable with a counterintuitive sign is the percentage of single family housing, which is consistently negative in our models. This may be due to multicollinearity with other housing variables such as the presence of eight rooms or more.

[Table 2 about here]

While the results for the broadband access models (Table 3) are less robust than the housing value models, several factors that that hold with our theoretical expectations seem to be driving the results. As expected, population density has a positive and highly significant impact on the likelihood of broadband access, as does the log of median household income. As discussed above, a positive education index suggests a population that is skewed towards less formal education. As such, the negative coefficient makes intuitive sense – broadband provision may be less likely in counties with lower formal education levels, given that education is a strong predictor of adoption (Whitacre and Mills, 2007). The other control variables are largely insignificant – in fact none show statistical significance across all three models (WOLS, W2SLS, and W3SLS) we explore. This includes the log of median house value, which is only significant at the p=0.08 level, and only for the W2SLS model. Based on these results it appears that broadband service providers look at three things: population density, higher levels of education, and general income levels. This makes intuitive sense in that a more densely populated area allows for a given level of infrastructure investment to cover more potential customers, higher income increases ability to pay for the service, and higher levels of education drives user demand. Other county characteristics play a minor or no role in service providers' investment decisions.

[Table 3 about here]

Most relevant to the central question of this study is the relationship between broadband access and housing values. We hypothesized that remote rural counties that have higher housing values should be more attractive to broadband providers. The results of the broadband access models suggest, however, that this does not hold: median housing values generally have no impact on broadband access. The more interesting result, however, is the impact of broadband access on housing values (Table 2) and here we find strong consistent positive relationships: higher access to broadband, regardless of the specific estimator used, has a positive impact on remote rural housing values. The estimated elasticities for each of the seven broadband thresholds across the three spatial estimators are provided in Table 4. As expected, the estimated elasticities for the W2SLS and W3SLS are similar, but are noticeably larger than the simpler WOLS where potential endogeneity between broadband access and housing values is ignored. The statistically significant elasticities range from less than 0.010 to 0.065, with higher values associated with lower speed thresholds. Table 4 also provides the resulting increase in mean housing values that would occur given a 10% increase in coverage for each threshold. Focusing on the preferred W2SLS specification, a ten percent increase in coverage of at least 0.2MBPS results in the median house value increasing by $661. The remaining speed impacts ramp down as speed cutoffs increases, to $232 for at least 25MBPS, and becoming non-significant for speeds over 100 MBPS. Thus, the data strongly support the central hypothesis that access to broadband Internet has a positive impact on remote rural housing prices; however, they also suggest that as of 2016 there was no such relationship for extremely fast speeds. Interestingly, the largest impacts are seen for categories with the lowest speed thresholds, suggesting that having *at least some* higher-speed access is highly valued by rural county residents but that higher speeds are discounted.

[Table 4 about here]

Discussion / Conclusions

As Internet access becomes pervasive in everyday life, it has become clear that individuals value the ability to stay connected. Rural areas – particularly those in more remote regions – are disadvantaged by space, and stand among those with the most to gain from higher-speed access. Using recent county-level data from the U.S., we test the hypothesis that a premium exists for housing values in remote rural areas with fixed terrestrial Internet availability. We incorporate a series of spatial models, building to a theoretically viable W2SLS approach that controls for the possible endogeneity between housing values and broadband access. Our estimated simultaneous models mostly generate expected signs and significance levels for the control variables suggested by the empirical literature.

For the models predicting broadband availability, it becomes clear that population density, education, and income levels are the primary determinants, with housing values and racial / age characteristics mostly negligible. This suggests that providers servicing these rural locations focus on passing as many houses as possible in a given area, with some consideration of education and income levels but less emphasis on other underlying demographic characteristics. This makes sense in that broadband service providers can spread more of their initial fixed costs over a greater number of customers, and may cater to households that are more likely to subscribe to their services (given the well-established link between broadband adoption and education / income levels).

The models predicting housing value are even more consistent in their findings, with more seasonal and larger houses increasing median values and an older housing stock / distance from metropolitan areas acting to lower them. After controlling for these factors, we find a positive and statistically significant impact of broadband availability on housing value. The positive relationship holds across five of the seven speed categories we consider, disappearing for very-high-speeds (250 MB or greater) which have only recently been introduced. Elasticities from the W2SLS model range from 0.010 to 0.065. An interesting point of discussion is the differences in results across speed thresholds. Our estimates demonstrate that the elasticity associated with the slowest threshold (0.2MBPS) is nearly three times that for the faster, official broadband measure (25 MBPS) – a result some may consider counterintuitive. Previous research has found that in urban areas, the availability of a faster Internet connection can command up to a 7% housing premium in comparison to a slower one (Molnar, Savage, and Sicker, 2015). Recall that the FCC definitions are for speeds of *at least* the threshold in question. Thus, residents of counties with at least a 0.2MBPS connection are likely experiencing a variety of speeds, depending on their particular provider situation. Alternatively, residents in counties with 10 MBPS or 25 MBPS do not have speeds lower than those thresholds available to them – and the corresponding prices may be higher. The premiums associated with such access are still positive, but not as high as those for the lower-threshold 0.2MBPS access. This can be interpreted as housing values reflecting the impact of *some* type of fixed Internet availability (which may include faster speeds). Notably, the coefficients (and thus elasticities) associated with 250 MBPS and 1000 MBPS are not statistically significant in the housing value model, suggesting that the availability of these higher speeds does not translate into higher housing prices in this data. As these faster-speed networks become more prevalent, this may change.

While our model is not, strictly speaking, a purely hedonic one and does not speak to the specific value added for an individual house, our use of county-level data can lead to broader statements about broadband's contribution to rural property assessments. For example, our main finding – that a ten percent increase in Internet speeds at the county level leads to average increased housing values from $230 to $661 – can be used by local governments to assess increases in property tax collections that might result from broadband investments. Using the average number of households in our sample of remote rural counties (8,545), the total increase in property value associated with a hypothetical 10% increase in various speeds can be determined (Table 5). Then, applying a typical mill rate of .0115, the resulting increases in property tax revenues can be estimated. If the spatial simulations equation-based elasticity estimates are the most appropriate, then for the typical county in our sample, a 10% increase in the number of houses with access to speeds of at least 4 MBPS could result in an increase in property tax revenues of about $25,000 annually. Given that 12 percent of rural America lacks 4 MBPS fixed terrestrial coverage (FCC, 2018), documenting the financial incentives that come along with improved coverage can be helpful to making a viable case for expansion.

[Table 5 about here]

This main finding of higher rural property values is consistent with the limited existing research on the topic, which has been mostly driven by urban analysis. It is also consistent with anecdotal evidence from county extension educators and those familiar with the real estate environment in the more remote regions of the country. Previous research has found that broadband contributes to a wide variety of rural quality-of-life factors, such as business location decisions, income growth, agricultural sector profits, and migration decisions (Kim and Orazem, 2017; Whitacre et al., 2014a; Kandilov et al., 2017; Mahasuweerachai et al., 2010). In extending the property value findings to rural locations, this study continues to make the case that "broadband matters" for remote areas.

Since the dawn of the Internet era, the reality that rural America was being left behind has been met with significant interest in promoting access for all. Researchers and policymakers understood early on that the "digital divide" was an important issue with repercussions for quality of life and economic development (NTIA, 1995; Compaine, 2001). Bringing broadband to rural areas is not cheap, with Zager (2011) estimating that the per-home cost of building a fiber connection increases by roughly $13,000 for each mile of build-out. Increases in availability across the country have been driven by both private and public investments. Rural broadband advocates have recently promoted municipally-owned networks, rural cooperatives, and smaller fixed wireless services as ways to reach localities that are still unserved by traditional providers (Dworin, 2017; Pitman and Kluz, 2017; Settles, 2017). Concerns exist about the financial viability, however, of both municipally-owned networks (Yoo and Fenninger, 2017) and rural cooperatives (Schmit and Severson, 2017). Legislative battles continue to be fought over whether municipally-owned networks are legal (Koebler, 2015). These types of efforts are still both new and relatively uncommon, and our 2016 data do not speak to their impact on the remote rural counties of interest.[11]

As connectivity becomes prevalent, the question will likely switch from quantifying the value-added by broadband to focus on the disadvantage of *not* being connected. Indeed, many businesses and individuals would choose not to locate in an area where a reliable connection is unavailable. For now, the case continues to be made that broadband adds quantifiable benefits to rural life. This study adds one more data point to that growing body of evidence.

[11] The FCC Form 477 data only differentiates access by technology (DSL, cable, fiber) and does not break out municipally-owned or cooperative-driven projects.

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Table 1: Summary Statistics

	House Value	Broadband	Mean	Standard Deviation	Source
Median House Value (log)		Yes	11.52	0.41	American Community Survey 2016 (5 Year Average)
Broadband Measure (Below)	Yes				(See Below)
Percent of Occupied Housing Detached	Yes		76.07	9.39	American Community Survey 2016 (5 Year Average)
Ratio of Owner Occupied to Renter	Yes		2.87	1.07	American Community Survey 2016 (5 Year Average)
Percent of Occupied Housing Mobile or Other	Yes		13.15	8.97	American Community Survey 2016 (5 Year Average)
Percent of Occupied Housing Built 2010 or Later	Yes		1.94	1.64	American Community Survey 2016 (5 Year Average)
Percent of Occupied Housing Built 1939 or Earlier	Yes		17.74	11.64	American Community Survey 2016 (5 Year Average)
Percent of Occupied Housing with Eight Rooms or More	Yes		21.42	8.15	American Community Survey 2016 (5 Year Average)
Percent of Housing Seasonal, Recreational or Occasional Use	Yes		34.64	24.17	American Community Survey 2016 (5 Year Average)
Population - Employment Ratio	Yes		1.89	0.58	BEA-REIS
Per Capita Income Growth Rate (2006-2016)	Yes	Yes	45.02	23.90	BEA-REIS
Employment Growth Rate (2006-2016)	Yes	Yes	2.74	14.20	BEA-REIS
Median Household Income	Yes	Yes	44070.70	9952.38	American Community Survey 2016 (5 Year Average)
Education Index		Yes	0.95	0.43	American Community Survey 2016 (5 Year Average): Calculation by Authors
Age Index		Yes	-0.15	0.69	American Community Survey 2016 (5 Year Average): Calculation by Authors
Percent of the Population African-American		Yes	5.83	13.21	American Community Survey 2016 (5 Year Average)
Percent of the Population Latino/a		Yes	9.01	14.68	American Community Survey 2016 (5 Year Average)
Total Area in Square Miles (000)		Yes	1232.21	1468.91	USDA National Outdoor Recreational Inventory
Population Density		Yes	24.42	29.62	USDA National Outdoor Recreational Inventory
Distance to Metropolitan County With 250K Population	Yes	Yes	83.45	124.09	Partridge, Rickman, Ali and Olfert (2008)
Percent of Land Area Covered by Water		Yes	3.53	10.70	USDA National Outdoor Recreational Inventory
MB0.2 (0.2MBPS Download)	Yes		0.9362	0.10	FCC Form 477 - Dec. 2016
MB4 (4 MBPS Download)	Yes		0.8872	0.16	FCC Form 477 - Dec. 2016
MB10 (10 MBPS Download)	Yes		0.8307	0.20	FCC Form 477 - Dec. 2016
MB25 (25 MBPS Download)	Yes		0.6338	0.30	FCC Form 477 - Dec. 2016
MB100 (100 MBPS Download)	Yes		0.3668	0.36	FCC Form 477 - Dec. 2016
MB250 (250 MBPS Download)	Yes		0.1557	0.28	FCC Form 477 - Dec. 2016
MBGB1 (1 GBPS Download)	Yes		0.0868	0.22	FCC Form 477 - Dec. 2016
Sample size = 887					

Table 2: The Impact of Broadband (Download MBPS25 or More) on Housing Value

	WOLS	W2SLS	W3SLS
Spatial Parameter ρ	1.035062 ***	1.021654 ***	1.037217 ***
	(0.0001)	(0.0001)	(0.0001)
MBPS25	***0.040797***	***0.417788 ******	***0.381253 *****
	(0.1141)	***(0.0001)***	***(0.0002)***
Percent of Occupied Housing: Single Family Detached	-0.002580 *	-0.003420 *	-0.004760 **
	(0.0588)	(0.0836)	(0.0134)
Ratio of Owner Occupied to Renter Occupied	-0.004620	0.008303	0.004189
	(0.5938)	(0.4003)	(0.6587)
Percent of Occupied Housing: Mobile Home or Other	-0.007930 ***	-0.005540 **	-0.007770 **
	(0.0001)	(0.0273)	(0.0015)
Percent of Occupied Housing: Built in 2010 or Later	0.030910 ***	0.026327 ***	0.025056 ***
	(0.0001)	(0.0001)	(0.0001)
Percent of Occupied Housing: Built in 1939 or Earlier	-0.011220 ***	-0.008990 ***	-0.009770 ***
	(0.0001)	(0.0001)	(0.0001)
Percent of Occupied Housing: Eight Rooms or More	0.010902 ***	0.005893 **	0.006323 ***
	(0.0001)	(0.0005)	(0.0001)
Percent of Housing Classified as Recreational or Seasonal Use	0.001500 ***	0.001544 **	0.001215 **
	(0.0001)	(0.0004)	(0.0042)
Population: Employment Ratio	-0.093290 ***	-0.106960 ***	-0.106350 ***
	(0.0001)	(0.0001)	(0.0001)
Growth Rate in Per Capita Income 2006-2016	-0.001290 **	-0.000960 **	-0.000830 **
	(0.0004)	(0.0182)	(0.0403)
Growth Rate in Employment 2006-2016	0.000818	0.000916	0.000790
	(0.2088)	(0.2107)	(0.2772)
Distance to Metropolitan County With 250K Population	-0.000390 ***	-0.000410 ***	-0.000430 ***
	(0.0001)	(0.0001)	(0.0001)
Hausman Specification Test (χ^2)		73.06 ***	48.34 **
		(0.0001)	(0.0049)
Basmann Identification Test (F)		42.05 ***	
		(0.0001)	
R^2	0.7394		
Sample size	887		

Marginal significance (p-values) in parentheses.

***: Significant at or above the 99.9% level.

**: Significant at the 95.0% level.

*: Significant at the 90.0% level.

Table 3: The Impact of Housing Value on Broadband (Download MBPS25 or More)

	WOLS		W2SLS		W3SLS	
Spatial Parameter ρ	0.719412	***	1.187980	***	1.035620	***
	(0.0001)		(0.0001)		(0.0001)	
ln(Median House Value)	***0.000056***		***-0.018370***	*****	***-0.014250***	
	(0.9931)		***(0.0796)***		***(0.1663)***	
Growth Rate in Per Capita Income 2006-2016	-0.000220		-0.000530		-0.000490	
	(0.5833)		(0.2354)		(0.2676)	
Growth Rate in Employment 2006-2016	-0.000940		-0.000290		-0.000700	
	(0.1969)		(0.7164)		(0.3795)	
Education Index	-0.080380	**	-0.090170	**	-0.098170	***
	(0.0006)		(0.0003)		(0.0001)	
Age Index	-0.008850		-0.018360		-0.018330	
	(0.5209)		(0.2172)		(0.2003)	
Percent of Population African-American	-0.000120		0.000823		0.000658	
	(0.8689)		(0.3344)		(0.4254)	
Percent of Population Latino/a	0.000780		0.001141	*	0.000608	
	(0.2165)		(0.0931)		(0.3520)	
Total Area in Square Miles (000)	-0.000004		0.000006		0.000001	
	(0.5007)		(0.4586)		(0.9423)	
Population Density	0.002804	***	0.002448	***	0.002450	***
	(0.0001)		(0.0001)		(0.0001)	
Distance to Metropolitan County With 250K Population	0.000159	**	0.000081		0.000082	
	(0.0391)		(0.3481)		(0.3402)	
Percent of County Surface Area Covered by Water	0.001141		0.000730		0.000927	
	(0.1592)		(0.3968)		(0.2673)	
Median Household Income	0.000004	**	0.000002	*	0.000004	**
	(0.0010)		(0.0833)		(0.0035)	
Hausman Specification Test (χ^2)			73.06	***	48.34	**
			(0.0001)		(0.0049)	
Basmann Identification Test (F)			10.73	***		
			(0.0001)			
R^2	0.3256					
Sample size	887					

Marginal significance (p-values) in parentheses.

***: Significant at or above the 99.9% level.

**: Significant at the 95.0% level.

*: Significant at the 90.0% level.

Table 4: Elasticities and Potential Impacts

	WOLS		W2SLS		W3SLS	
			Coefficients			
MB0.2	0.320690	***	0.807550	**	0.780844	**
MB4	0.180015	**	0.333969	**	0.317887	**
MB10	0.147076	***	0.339398	**	0.324245	**
MB25	0.040797		0.417788	***	0.381253	**
MB100	0.058130	**	0.261094	**	0.253302	**
MB250	0.048651	*	0.222789		0.224748	
MB1000	0.050513		-0.320670		-0.348330	
			Elasticities			
MB0.2	0.026061	***	0.065626	**	0.063456	**
MB4	0.013864	**	0.025720	**	0.024482	**
MB10	0.010605	***	0.024473	**	0.023381	**
MB25	0.002244		0.022983	***	0.020973	**
MB100	0.001851	**	0.008312	**	0.008064	**
MB250	0.000657	*	0.003010		0.003037	
MB1000	0.000381		-0.002416		-0.002625	
			10% Increase in Coverage			
MB0.2	$262.57	***	$661.20	**	$639.33	**
MB4	$139.68	**	$259.14	**	$246.66	**
MB10	$106.85	***	$246.58	**	$235.57	**
MB25	$22.61		$231.56	***	$211.31	**
MB100	$18.64	**	$83.74	**	$81.24	**
MB250	$6.62	*	$30.33		$30.60	
MB1000	$3.83		-$24.34		-$26.44	

***: Significant at or above the 99.9% level.

**: Significant at the 95.0% level.

*: Significant at the 90.0% level.

Table 5: Simulated Impact of a 10% Increase in Broadband on Property Taxes

	WOLS	W2SLS	W3SLS
Total Property Value Increase (8,545 houses assumed)			
MB0.2	$2,243,663	$5,649,912	$5,463,067
MB4	$1,193,564	$2,214,334	$2,107,705
MB10	$913,049	$2,106,984	$2,012,914
MB25	$193,217	$1,978,664	$1,805,632
MB100	$159,319	$715,591	$694,235
Annual Property Taxes (0.0115 mill rate assumed)			
MB0.2	$25,802	$64,974	$62,825
MB4	$13,726	$25,465	$24,239
MB10	$10,500	$24,230	$23,149
MB25	$2,222	$22,755	$20,765
MB100	$1,832	$8,229	$7,984