Measuring Broadband and Job Loss: Population or Income?

New research by **Broadband Communities** finds a clear relationship between broadband access and median family income but no clear causality.

By Steven S. Ross / *Broadband Communities*

Since 2014, I have been studying the effects of poor or nonexistent broadband access on population loss in all 3,144 U.S. counties. This research was motivated by the fact that since 2010, rural population levels have been falling for the first time since the Civil War. In a series of articles in **Broadband Communities**, I have shown that at least a quarter and as much as half of all population loss in rural counties has been due to lack of broadband access.

- "Bad Broadband Equals Low Population Growth," November-December 2014, reported a clear relationship between population loss from 2010 to 2013 and the percentage of each county's population that has access to at least 25 Mbps service, as indicated by the National Broadband Map. But correlation is not causality. Did the population loss come first, discouraging broadband deployments, or did the lack of broadband cause the population loss?
- "New Evidence on Muni Broadband," May-June 2015, showed that lack of broadband access caused population loss in a quarter to half of the counties. We distinguished between the 20 states that restricted municipalities from building their own networks and the 30 states that did not. The restriction states suffered four times the rural population loss rate of the nonrestriction states even though their overall population growth rates were higher. The restriction states also strongly tended to have a much larger digital divide between have and have-not counties. By threatening to build their own networks, municipalities could force national carriers to provide at least some improved service. Those in states that did not allow these threats were at a severe disadvantage.
- "Broadband: The Key Ingredient for Rural Economic Development," November-December 2016, disaggregated counties by dominant economic activity as determined by the Department of Agriculture (farming, retirement, mining, manufacturing and so forth) and showed that the original correlations held up extremely well whether the counties were rural or near-urban. The one exception was for mining counties, whose population trends depended more on world commodity prices than on broadband availability.

In all cases, I used population rather than income as the proxy for economic health. No job? Move to the city! Those who use population as a key variable note that it is measured more accurately than income and that its error limits (confidence intervals) are well known and are considerably smaller and more predictable than those for income.

In addition, people who live in rural areas tend to cite population loss as an indicator of economic distress. They say, "Our kids go off to college, and they don't come back."

But what would happen if I used income – specifically median family income as measured by the Census Bureau's American Community Survey (ACS)? In the raw ACS data, error limits for median family income are often as much as 10 times (on a percentage basis) greater than those for population – and sometimes much more. In part this is because

- The ACS studies most urban areas every three months, but it surveys rural areas as seldom as once every three years.
- ACS estimates "hidden" income on the basis of bank deposits, but people don't always deposit money in the counties where they live. Much income from the "casual" off-the-books economy never even reaches a bank.
- Income measured by ACS includes benefits – everything from the earned-income tax credit and SNAP benefits to disability payments. Residents do not have full discretion

as to where to spend that income. Some, but not all, can be used to buy broadband services.

- Those who cannot find jobs tend to have lower incomes. When they leave their home counties, their low income disappears with them, and median income can rise as a result. This is why some economists find no income differences at all between low- and high-broadband counties.
- Unlike population loss, which measures an exact phenomenon, medians are tricky. Often a median masks a bimodal distribution. For example, say a population has a lot of individuals earning $30,000 a year and many making $60,000. The median might be $45,000, even though few actually have that income. I checked scattergrams to guard against that possibility. The scattergrams reproduced with this article show that medians tend to have large error limits but, at least in rural counties, not to be bimodal.
- The value of the median as a measure of family well-being is further blurred by age distribution and family size. It also is affected by group living – in college dorms, prisons (which tend to be rural), agricultural bunk houses and so forth. Group living can affect "family" size.

Finally, because of privacy laws, medians cannot be disaggregated into individuals or even individual households. One cannot obtain a smaller error limit (again, confidence interval) by calculating a median of medians, an average of medians, or an average of averages. A true meta-analysis combining multiple counties to reduce the error limit would require data on every individual.

All that said, I did find a clear relationship between median family income and quality of broadband access (Table 1). Counties in the top 10 percent of their own states for broadband access had median family incomes of $53,000 in 2015 (expressed in 2010 dollars); top-half counties, $47,000; bottom half, $42,000; bottom 10 percent, $41,000.

Broadband Quality Ranking	All Counties	Restriction	Non-Restriction
Top 10%	$ 53,080	$ 54,525	$ 51,738
Top half	$ 47,269	$ 47,706	$ 46,681
All Counties	$ 44,370	$ 44,360	$ 44,390
Bottom half	$ 42,382	$ 41,988	$ 42,754
Bottom 10%	$ 40,773	$ 40,976	$ 40,719

Table I. There is a strong relationship between a county's median income and the quality of its broadband service, but causality is not established, as there is very little difference in terms of income between states that do and don't restrict municipal broadband. People who can't make a living leave, so population loss does not necessarily change the median income, at least in the short five-year period studied. However, restriction states add to the glitter of their cities, the top 10 percent in state access rankings. In other words, income may have a large role in broadband use, but it has only a small role in broadband access. Finally, the numbers in the table overstate the precision. All this data should really be rounded to the nearest 1,000. Source: ACS, 2010–2015, incomes expressed in 2010 dollars.

The compression at the bottom end of the scale was also expected, as the bottom 10 percent (almost all rural) tends to have zero or near-zero broadband access, and the bottom half (which includes the bottom 10 percent) is typically not much better. At the top of the scale, many urban areas boast near-universal or universal 25 Mbps.

The broadband access rankings are derived from National Broadband Map data, which are riddled with uncertainties. The uncertainties are larger in rural areas, which often feature easy-to-deploy towns next to rural areas with very low premises density.

Urban areas do tend to have bimodal population types – more seniors, more young families with at most one child, more one-person households, as compared with rural areas. They also have more full-time working members among adults.

INCOME VERSUS POPULATION

Because there is no direct connection between income for restriction and nonrestriction states, the income data itself cannot be considered evidence for causality. To test for causality, I regressed the income data for each county against the population data. I know the population data well enough, again, to be sure that at least 25 percent of all rural job loss (as measured by population loss), and as much as 50 percent is due to lack of good broadband access. In exercises of this type, considering the uncertainties in the data itself, a regression R^2 (coefficient of determination, or measure of causality) greater than 0.10 is considered a strong score.

For all U.S. counties together, the R^2 between restriction states is 0.14, a quite strong showing. For nonrestriction states, it is 0.11. This suggests that about $2,000 of the $13,000 income gap between the top broadband "haves" and the bottom broadband "have-nots" is due to relative lack of broadband access.

For rural farming counties (counties whose dominant economic activity is farming and that are not part of a metropolitan statistical area), the regression coefficient, R^2, is 0.16. There is no similarly strong relationship for the relatively few counties that practice agriculture close to an urban area.

In contrast, urban retirement communities show a rather strong regression coefficient, $R^2 = 0.24$, and rural retirement counties (the dominant economic mode in the South; see the November-December 2016 article noted at the start of the story) are at 0.11.

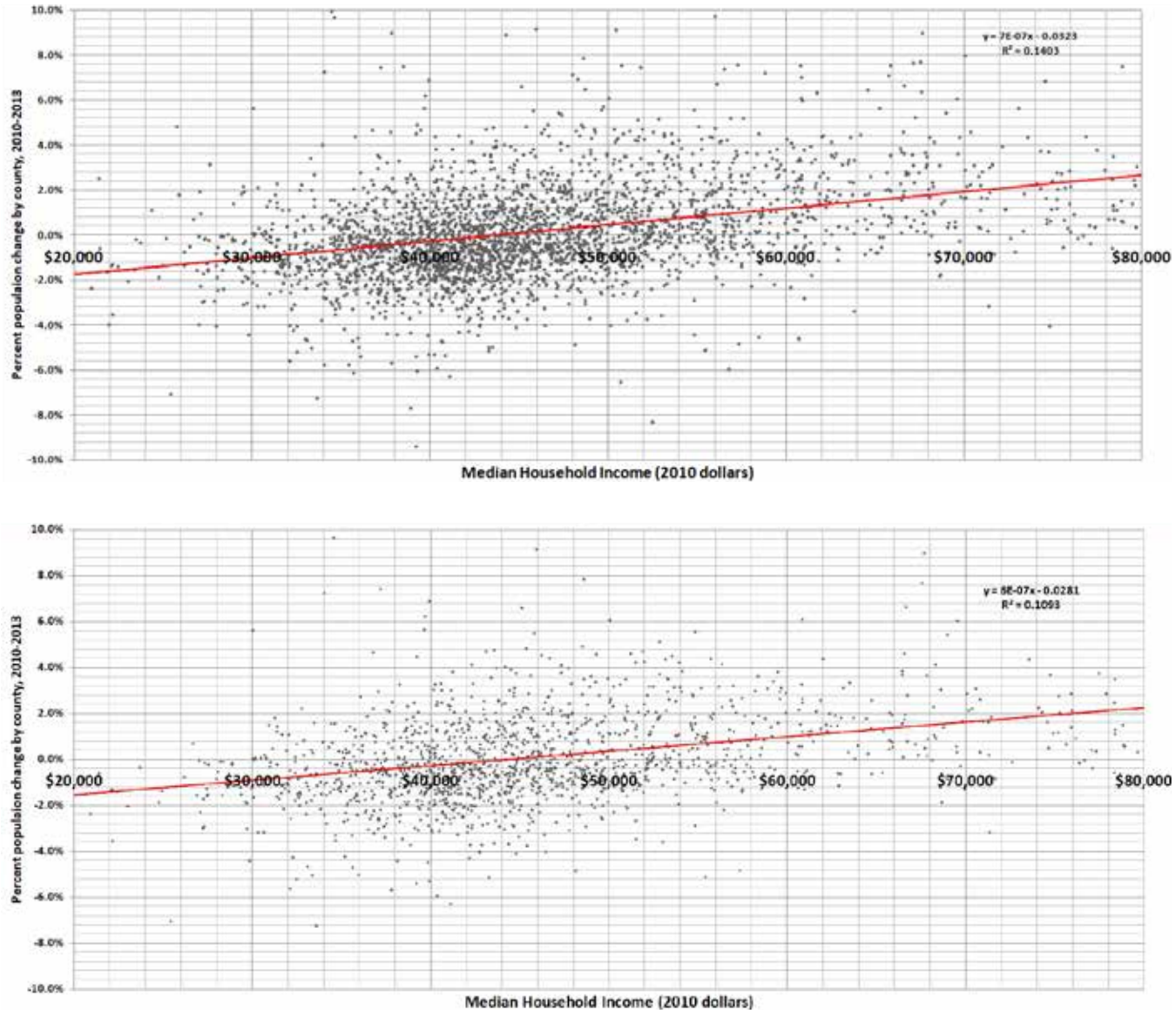

Figure 1. The regression coefficient between population loss and income is 0.11 (top image, for counties in nonrestriction states) to 0.14 (lower image, for counties in restriction states) – a good result, considering uncertainties in the underlying data collected by the Census Bureau. This suggests that median income does rise with broadband access and fall with lack of access. Note that median household income is not strongly bimodal but is quite diverse, county to county. In these charts, note income where trend line crosses into positive population growth.

Finally, many economists say population itself attracts jobs. That's especially so for service jobs in retail, restaurants and medical facilities. The real estate industry is fond of saying that construction itself brings jobs. But in rural areas especially, few real estate developers would build large subdivisions on spec. So this effect is limited to fairly slow growth.

Nor do rural residents believe that population increase causes job growth. Polling shows high antipathy toward immigrants, based on a belief that immigrant populations, rather than creating jobs, crowd out native-born Americans and depress wages.

Others say jobs bring population. That would certainly be true for large industrial establishments. Locate a new automobile plant in a rural area, and its population will obviously grow. But those types of plants are uncommon.

One thing is clear. Years ago, the Census Bureau calculated that as baby boomers age and die, all net population growth after 2021 will be due to immigration. Without population growth to pay for the next generation's Social Security and for the nation's defense needs, the country's best days may be over. That effect will be most severe in rural areas. ❖

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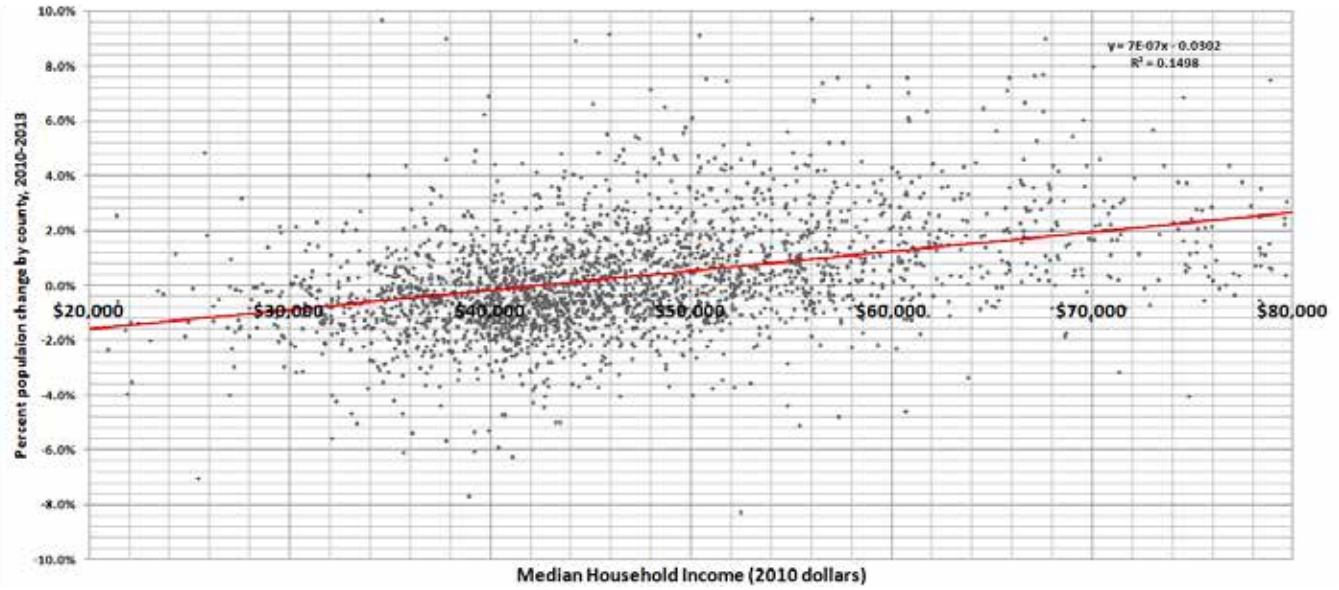
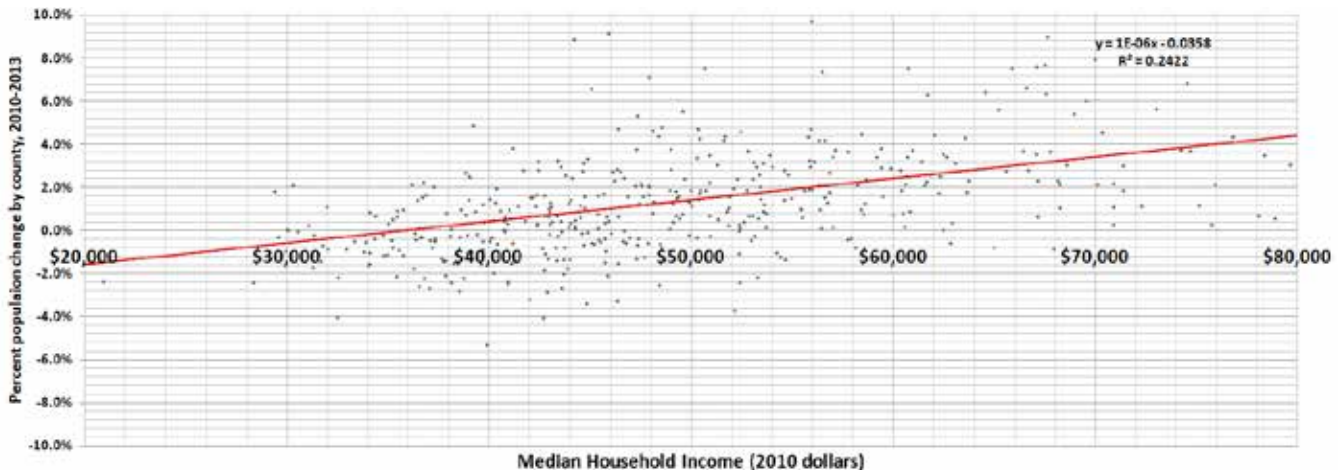


Figure 2. There is a fairly strong relationship between income and population loss in rural farming counties, a regression coefficient of 0.16. Note that median household income is not strongly bimodal but is quite diverse, county to county.



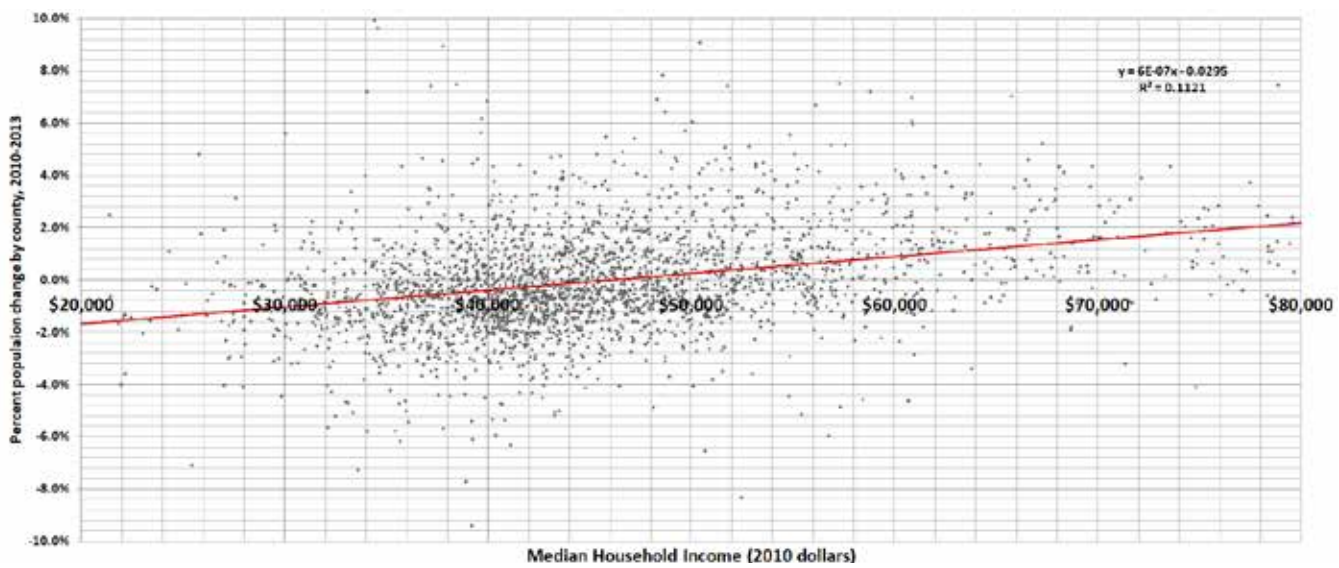


Figure 3. For retirees in urban areas (top), the regression coefficient is a strong 0.24, reflecting the fact that the households have more uniformity than in rural areas (lower image), where it is 0.11. Note that median household income is not strongly bimodal but is quite diverse, county to county.