Human Development & Technology in US Counties:

Technology Quality & Accessibility Considerations for Policy Makers

This study expands the scope of our previous research using the Human Development & Technology Index (HDTI) to assess geographic trends in the access to and the quality of broadband technology across all US counties.

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PRIMACY of PLACE

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Introduction

The development of a "digital society" over the last quarter century has witnessed a fundamental shift in methods of communication and interaction affecting households, government, and commerce. People and businesses across the globe are increasingly interconnected through internet-enabled devices like mobile phones, wearable gadgets, laptops, PDS, and other internet devices. This digital connectivity is creating new innovations and service delivery in education, healthcare, entertainment, business, and government services, and has changed the scope and location of economic activity of households, businesses, and governments (Burton and Hicks, 2005).

In the digital society, broadband connectivity to high-speed internet is not only increasingly important to facilitate communication between individuals, households, businesses, and governments, but also impacts access to government websites, documents, licenses and tax records, entertainment, healthcare, education, economic development, and social inclusion. In turn, digital connectivity is important for promoting open governance, transparency, and the increased participation of citizens in democratic governance. A strong broadband connectivity rate can also generate positive externalities in sociocultural enrichment, empowerment, and political engagement (Katz, 2012).

According to the technologist and internet experts, quality broadband has a download speed of at least 3 Mbps, which allows citizens to tap into e-government services and participate in civic life more effectively, and with greater ease.[1] However, a 2016 report by the FCC (2016) finds that 10 percent of the US population still lacks access to high-speed broadband, and there is a significant disparity in high-speed broadband access between rural and urban populations.

Thirty-nine percent of the population in rural areas lacks access to high-speed broadband, versus only 4 percent in urban areas.[2] However, the broadband adoption rates are similar across rural and urban places (28 percent versus 30 percent, respectively). Around 41 percent schools in the country still lack the FCC's short-term goal of having 100 Mbps per 1,000 students/staff, and a 2013 report finds that the current broadband infrastructure in school is not adequate to deliver effective education.[3]

Current Study

This study builds off our previous research that first introduced and then employed a new Human Development Index (HDI) that includes technology quality and access—the Human Development & Technology Index (HDTI) (Devaraj, et al., 2017; Devaraj, et al., 2015; Devaraj, et al., 2014). The maps in this study expand the scope of our research beyond Indiana to all US counties and include the following indices at the county-level:

- *Figure 1:* The **Human Development Index (HDI)**, constructed from health, education, and living standard data
- *Figure 2:* The **Technology Index (TI)**, which measures internet access connections per 1,000 households over varying upload and download speeds, and the share of population with access to the Internet
- *Figure 3:* The **Human Development & Technology Index (HDTI)**, a combined index of HDI and TI constructed from the geometric mean of each component
- *Figure 4:* The **change in HDI** by the inclusion of the Technology Index

Details of our methodology can be found in Devaraj, et al., 2014 and 2015.

1. See https://speedmatters.org/e_government_civic_participation
2. See https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2016-broadband-progress-report
3. See http://www.setda.org/wp-content/uploads/2013/09/SETDA_BroadbandImperative_ May20Final.pdf

Results

Although HDI generally follows expected patterns, technology access and quality yield several surprising results. The addition of technology to the HDI in the HDTI increases human development in some historically low HDI regions, while lowering it in others. Access to high quality broadband appears to be particularly important to low-density/rural counties, and a lack of access exacerbates existing inequalities.

County-level HDI follows well-known and anticipated patterns. See *Figure 1*. The highest levels of HDI are concentrated around large metropolitan centers, particularly in the mid-Atlantic and the Northeast regions, and in California, with scattered pockets throughout the West and the upper Midwest. HDI is generally lower in rural counties, particularly in the Appalachian region, in the South, and in states with large Native American reservations (e.g. New Mexico, Montana, and South Dakota). Rural residents generally, and particularly those in the South, have worse outcomes than urban residents in all three components of the HDI—health, education, and living standards.

A lack of adequate health care has long been a concern in rural areas (Berry, 2014), and life expectancy is not only lower in these counties, but it has been decreasing in recent years (Dwyer-Lindgren, et al., 2016; Xu, et al., 2016). Likewise, educational attainment is lower in rural communities (Byun, Meece, and Irvin, 2012; Roscigno and Crowle, 2001), and the poverty rate is higher (Crandall and Weber, 2004; Farrigan, 2017).

The use and quality of technology, as captured by the Technology Index, appears to roughly correspond to population density. See *Figure 2*. As with the HDI, TI is highly concentrated around large metropolitan areas and along the coasts. In general, TI is weakest throughout the West and the Southwest, where counties are much larger and populations are more sparse. This is not surprising; given that the deployment of telecommunications faces significant fixed costs across all geographies, population

Figure 1: Human Development Index by County

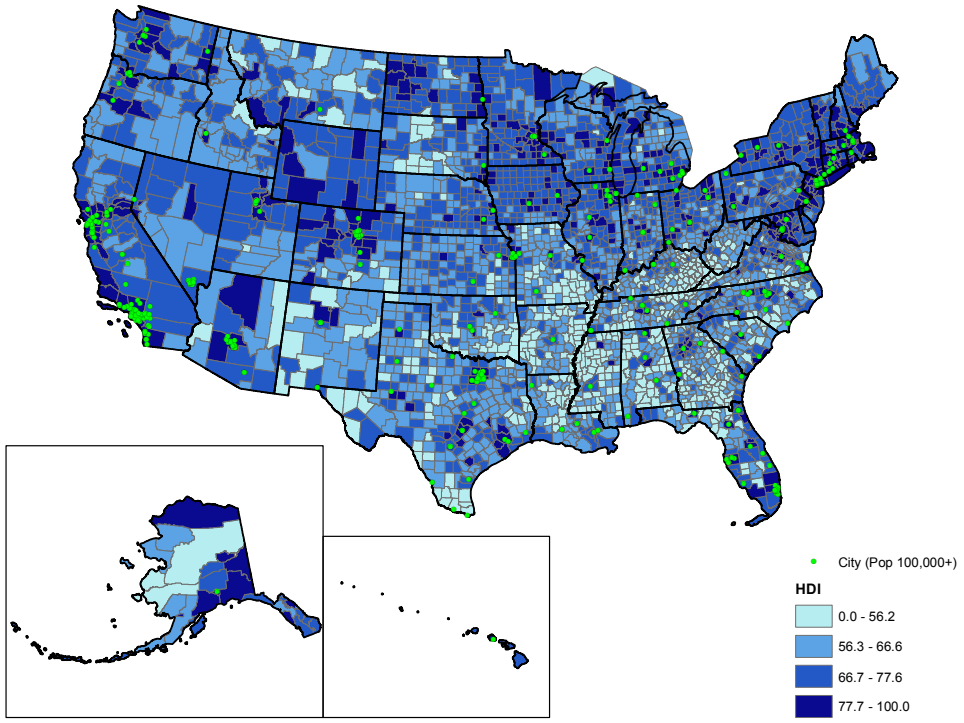
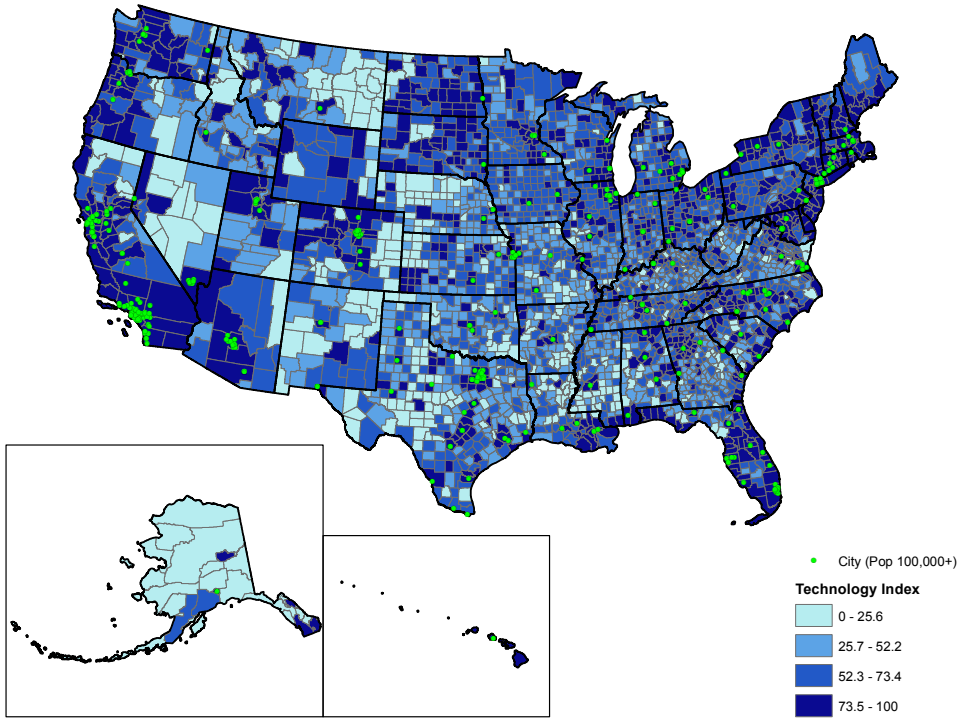


Figure 2: Technology Index by County



density and topography play a significant role in the feasible construction of broadband networks.

The most notable exceptions to these trends are North and South Dakota. Although these states have two of the lowest population densities in the country—beaten only by Montana, Wyoming, and Alaska—they both have very high TI scores. Similarly, though not as dramatically, the cluster of high TI in Wyoming, Colorado, and Utah is somewhat incongruous with population density.

In the eastern part of the country, the inclusion of technology in the HDI appears to largely smooth the differences between rural and urban counties. See *Figure 3*. While metropolitan centers and their surrounding counties have the highest HDTI, the surrounding rural areas are somewhat more consistent than in the HDI maps. Alternatively, rural areas throughout the western states have lower levels of human development when technology is considered.

Difference in Rankings

Importantly, the HDTI offers a way to view broadband access and quality in the context of other dimensions of human development. *Figure 4* shows differences in county rankings between HDI and HDTI in order to assess whether technology mitigates or exacerbates the other human development measures.

The counties in red saw their HDI scores decline because of a relatively lower Technology Index, whereas counties in blue saw their HDI increase owing to relative technology scores. The counties in gray did not change their rankings.

Several important preliminary conclusions can be drawn from this map. First, we see that many urban cities and their surrounding counties improved their HDI when access to and quality of broadband are considered. However, where improvements occurred, they were largely marginal (lightest shade of blue). Second, this map indicates strong regional differences in the impact of technology on human

Figure 3: Human Development & Technology Index by County

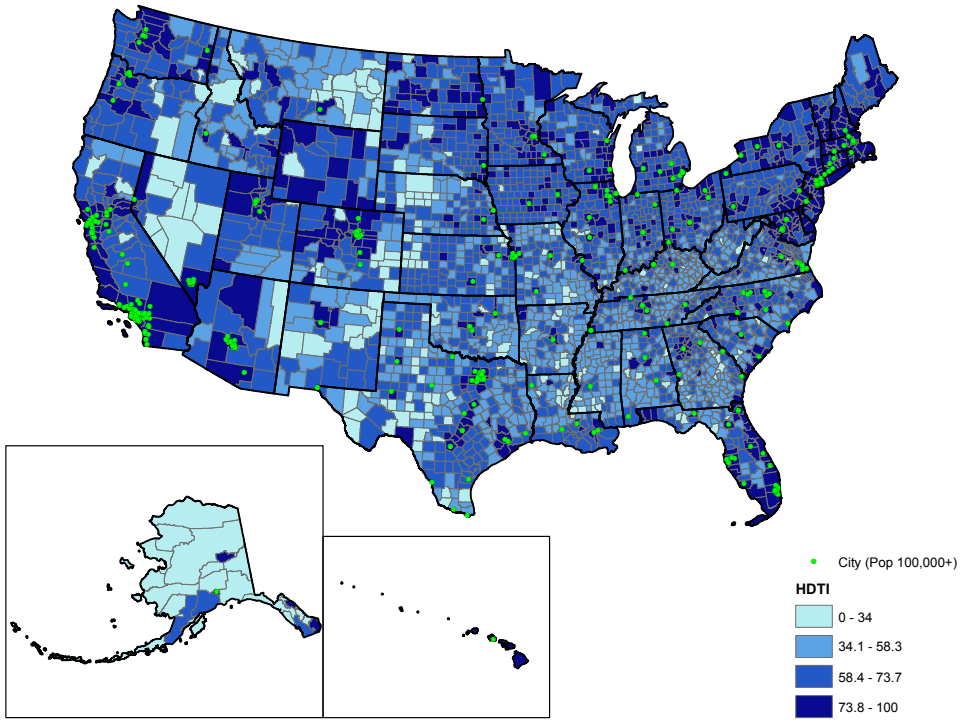
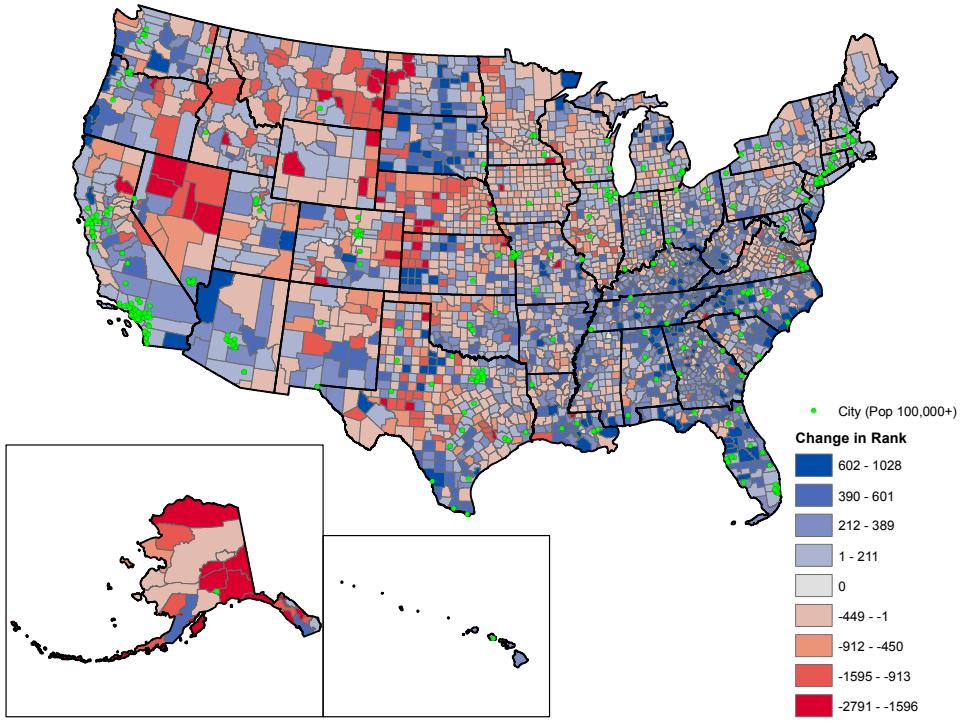


Figure 4: Change in Human Development Index by Inclusion of Technology Index, by County



> *The lack of access to broadband technology and/or the poor quality of technology in rural areas exacerbates existing inequality in human development between rural and urban places.*

development. While technology clearly had a widespread, positive impact on human development in the Dakotas, Appalachia, and parts of the South, the lack of access and lack of quality broadband hurt counties throughout the Midwest and West. Alternatively, the upper Midwest saw overall declines in their rankings, despite consistent HDI and TI in the previous figures. While this may simply be a reflection of the increase in rankings in the other regions, it may also indicate that technology plays a different role in human development in this region. Third, with the exceptions already mentioned, the inclusion of technology in our understanding of human development negatively impacts rural counties. This suggests that the lack of access to broadband technology and/or the poor quality of technology in rural areas exacerbates existing inequality in human development between rural and urban places.

Summary and Discussion

Strong broadband connectivity provides a vehicle to connect households to businesses, to each other, and to the wider world. An abundant literature documents the contribution of effective broadband connectivity to economic and social development in communities. Unfortunately, inequality in broadband connectivity, most obvious across urban and rural areas, appears to accentuate inequality, rather than to mitigate it. This phenomenon is called "the digital divide" and remains a troubling concern of policymakers and researchers worldwide.

By superimposing the Technology Index on HDI to form the Human Development & Technology Index (HDTI), the findings of this study indicate that there is a wide digital divide across the country. The digital disparity is most notable between high-density and low-density counties, but there are also disparities by region. These maps clearly show that large urban centers and their surrounding counties are better off in terms of HDI, and that technological access and quality enhances that advantage. These maps also show the potential positive impact of technology in areas with historically low HDI, in places such as Appalachia, the South, and the Dakotas. In all three areas, the TI was relatively high, indicating that access to broadband is widespread and of high quality, which offset their low HDI. Alternatively, regions with relatively high HDI throughout the West saw their HDI lowered when a lack of access to technology was introduced.

> *Large urban centers and their surrounding counties are better off in terms of HDI, and that advantage is enhanced by technological access and quality.*

However, these maps only tell part of the story of technology in the US. Additional research would allow us to consider the regional and rural/urban differences observed here in greater detail. Additionally, technology may have a different impact on the various components of the HDI, which additional research would be able to uncover. In particular, understanding the role of state telecommunications policy, the effect of regional economic development programs like the Appalachian Regional Commission, and state support for broadband development in local public facilities are all interesting policy research questions.

Likewise, it will also be important to understand the role of a number of factors as they relate to broadband adoption:

- Education-specific interventions at the K-12 level
- Demographic factors and household composition
- Development within and across US counties

Finally, evaluation of broader policies and programs, such as state technology requirements, at state and local levels may help us to understand the variation in technology access and quality, and allow for policy suggestions going forward.

Credits

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The RUPRI Center for State Policy at Ball State is a join initiative between Ball State's Indiana Communities Institute and the University of Iowa's Rural Policy Research Institute, which leads a national network of academics. The Center for State Policy examines the unique positions of rural communities across the nation and provides policy recommendations at state and federal levels.

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