



Research & Policy INsights

Digital Divide in Indiana

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Advancing Collaboration : Energizing Regions

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■ **Executive Summary**

This report attempts to define and measure the digital divide and provide a greater understanding of its impact on demographics, jobs and establishments throughout Indiana.

Digital Divide Statistics

- A Digital Divide Index (DDI) is introduced consisting of two components: broadband infrastructure/adoption and socioeconomic characteristics known to impact technology adoption.
- In 2015, about 7.3 percent of Hoosiers resided in counties where the digital divide was higher, and of these, 47.2 percent lived in rural counties (see Figure 3).
- As of 2015, 16.5 percent (just over one million Hoosiers) did not have access to fixed broadband of at least 25 Megabits per second (Mbps) download and three Mbps upload. The majority of these lived in neighborhoods outside urban cores clearly depicting an urban-rural divide (see Figure 1).
- Using DDI quartiles, the majority of Indiana counties with the lowest digital divide are concentrated in the northwest and central portions of the state while those with the highest DDI are located in the west, south, and southwest part of the state (see Figure 2).

Impacts of the Digital Divide

- Counties with the highest digital divide lost total and prime working age (25 to 54) populations between 2010 and 2015 (see Figure 4). Likewise, the labor force participation rate of persons of prime working age was lowest in counties with a higher digital divide (see Figure 5).
- Job and establishment growth between 2010 and 2015 was substantially lower in counties with the highest digital divide; establishments with paid employees declined in counties with the highest digital divide while establishments with no employees barely grew compared to the state and nation (see Figures 6 & 7).
- Digital economy industries—identified as one of the fastest growing group of industries in the nation—and associated jobs increased in the state (though at a lower rate compared to the nation) and in three out of the four digital divide groups between 2010 and 2015 (see Figure 8).
- Digital economy establishments—of which 55.6 percent were nonemployers—increased in the state (10.8 percent) and across all digital divide categories. In fact, the largest percent change in digital economy establishments between 2010 and 2015 took place in counties with the highest digital divide (see Figure 9).

Policy Recommendations

- Economic and community development efforts need to be refined to target and support the digital economy entrepreneurs emerging throughout the state. Robust strategies should not only focus on updating broadband infrastructure, but also on increasing awareness and digital literacy knowledge to effectively leverage and maximize these technologies.
- Collaboration and partnerships among Indiana assets—schools, libraries, nonprofits, Purdue Extension, regional planning commissions, think tanks, faith-based, among others—should be strengthened in order to effectively tackle the negative effects of the digital divide. Reducing the digital divide in the state represents a viable strategy for diversifying the state economy.



■ Introduction

Digital technologies and applications are transforming the way we access information, search/apply and work, engage with the government, communicate with friends and relatives, obtain quality education, and access quality health care. In other words, digital applications are affecting our quality of life in a variety of ways. The assumption is that, with access (including affordability) to the technology (specifically broadband) and knowledge to leverage these digital applications, society benefits.

Academic research has documented the impact of broadband in economic development, civic engagement, telehealth, and agriculture, among other

sectors¹. However, what happens if the access and/or knowledge are lacking? This digital divide does not bode well in an age where information and computing technologies are the primary means of producing content and knowledge². In that case, businesses, individuals, governments, and communities trail behind in this rapidly changing landscape, leading to a widening of the digital divide.

The digital divide is between those that have access, can afford, and apply knowledge to leverage the technology to improve their quality of life versus those that do not have access, cannot afford, or lack knowledge. The digital divide is the critical issue of the 21st century.

This report attempts to measure the digital divide with an innovative measure called the Digital Divide Index (DDI). The DDI examines the impact on demographics, jobs, and establishment trends of Indiana counties. The DDI is a descriptive and pragmatic tool, designed to promote awareness and more importantly, jumpstart critical discussions of ways to address the issues it raises.



Measuring the Digital Divide

Although multiple measurements of the digital divide exist—DIDIX, Network Readiness Index, and the Digital Access Index, to name a few—they tend to focus on national trends or on neighborhoods situated in metropolitan areas³. Some efforts to explore the issue at the county level have begun, including a recent study that defined the digital divide by examining three broadband-related indicators and linking it with a human development index⁴.

¹ (Gallardo, Whitacre, & Grant, 2018)

² (Rogers, 2016)

³ (Tomer, Kneebone, & Shivaram, 2017)

⁴ (Devaraj, Sharma, Wornell, & Hicks, 2017)

This report looks at the digital divide at the census tract (neighborhood) and county-level. The DDI has two components. The first includes broadband infrastructure and adoption indicators, such as access to fixed broadband of at least 25 Megabits per second (Mbps) downstream and three Mbps upstream (25/3 for short), residential connections of at least 10 Mbps down and 1 Mbps up, and average advertised download/upload speeds. The second component incorporates socioeconomic characteristics known to affect technology adoption such as age, poverty, educational attainment and any kind of disability⁵.

Together, these two components produce an overall DDI score. The scores of the overall DDI, as well as the infrastructure/adoption and socioeconomic components, were normalized to a 0 to 100 range, where a higher score denotes a higher divide. Table 1 summarizes the DDI variables.

Table 1. DDI Variable Summary

Description	DDI Component	Source
Percent Population without access to fixed 25/3	Infrastructure/Adoption	FCC Form 477
Residential connections of at least 10/1	Infrastructure/Adoption	FCC Form 477
Average Maximum Advertised Download Speed	Infrastructure/Adoption	FCC Form 477
Average Maximum Advertised Upload Speed	Infrastructure/Adoption	FCC Form 477
Percent Population Ages 65 and over	Socioeconomic	ACS 5-Year
Individual Poverty Rate	Socioeconomic	ACS 5-Year
Percent Pop. 25 and over with less than high school	Socioeconomic	ACS 5-Year
Percent Noninstitutionalized population with disabilities	Socioeconomic	ACS 5-Year

The DDI produces three different scores that can help guide strategic decisions by local leaders. For example, if a particular county has a substantially larger infrastructure/adoption score compared to the socioeconomic score, efforts should focus on upgrading the broadband infrastructure. On the other hand, if a particular geography has a substantially larger socioeconomic score compared to the infrastructure/adoption score, efforts should target improving digital literacy. For more information on the methodology of the DDI please visit <http://pcrd.purdue.edu/ddi>⁶.

Geography of the Digital Divide in Indiana

Before the DDI in Indiana is mapped, it is worth noting the percent of population without access to 25/3 fixed broadband as of 2015. While the digital divide is more complex than broadband access only, it does help identify areas that are behind in broadband infrastructure. Figure 1 delineates Indiana neighborhoods (Census tracts), based on their percent of total population, lacking access to 25/3 fixed broadband.

⁵ (Perrin & Duggan, 2015)

⁶ Also available are printer-friendly DDI profiles for each Indiana county

Figure 1

2010 Census Tracts - Population without access to fixed 25/3 broadband⁷

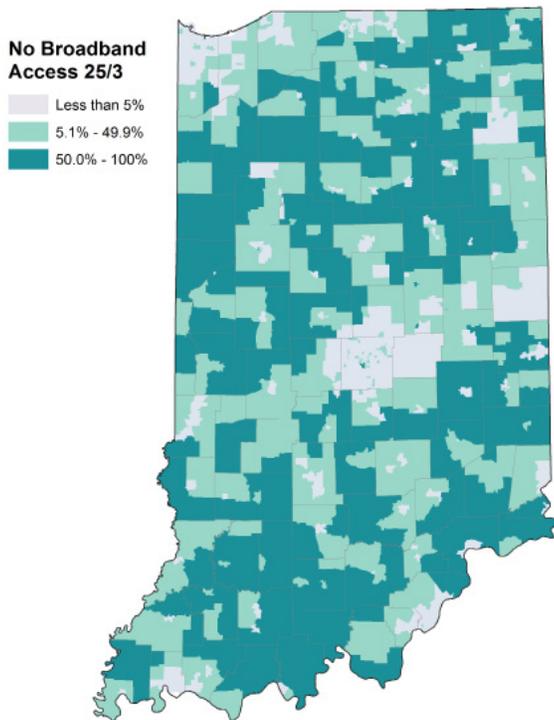


Figure 1 shows a clear urban-rural divide when it comes to access to 25/3. The darker the color, the higher share of population without access to 25/3. Dark census tracts indicate 50 percent or more of the population lacking access to 25/3 as of broadband deployment data for 2015. Most county seats and urban areas have a lower share of their population without access to 25/3 while rural neighborhoods have a higher share.

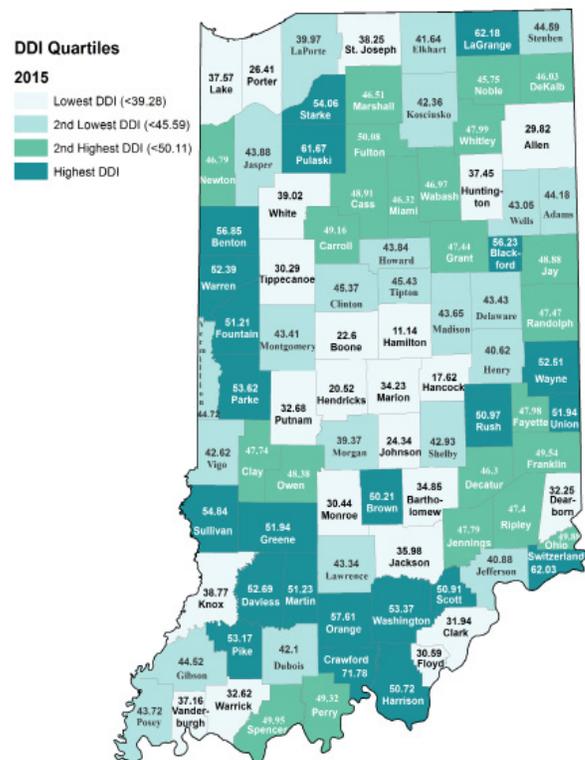
To put it into perspective, the total 2010 population residing in dark census tracts numbered nearly 866,000 or 13.4 percent of Indiana’s overall population.

Shifting gears from neighborhoods to counties, all 92 counties were divided into four equal groups or quartiles based on their DDI score. The DDI score for each county was calculated based on the average of all other counties in the nation. Figure 2 shows Indiana counties by DDI quartile. The scores for Indiana counties ranged from 11.14 (Hamilton County) to 71.78 (Crawford County).

As shown in Figure 2, the majority of Indiana counties with the lowest digital divide or DDI score are concentrated in the northwest and central areas while those with the highest DDI are located in the southern and western part of the state. The distribution of these counties on their metropolitan status: metropolitan, small city (micropolitan), and rural (noncore)⁸, are highlighted in Table 2 and Figure 3, including the 2015 population and percent population by county type and DDI quartile.

Figure 2

Indiana Counties by DDI Quartiles



⁷ 2010 figures were used because broadband availability is reported at the block level and only the decennial census provides block level population. Although the figures refer to 2010, the December 2015 availability of broadband was used.

⁸ (USDA Economic Research Service, 2013)

Figure 1 Source: Purdue Center for Regional Development; FCC Form 477 December 2015 v2

Figure 2 Source: Purdue Center for Regional Development DDI



Table 2 and Figure 3 show that while 29.5 percent of the 2015 population in the group of counties with the highest digital divide lived in metropolitan areas, 47.2 percent lived in rural counties. On the other hand, 96.5 percent of residents in counties with the lowest digital divide resided in metropolitan areas versus only 0.6 percent in rural counties. When all is said and done, about 4 million Hoosiers—or 61.4 percent of the 2015 population—lived in counties with the lowest digital divide versus 483,442 (or 7.3 percent) in counties with the highest digital divide.

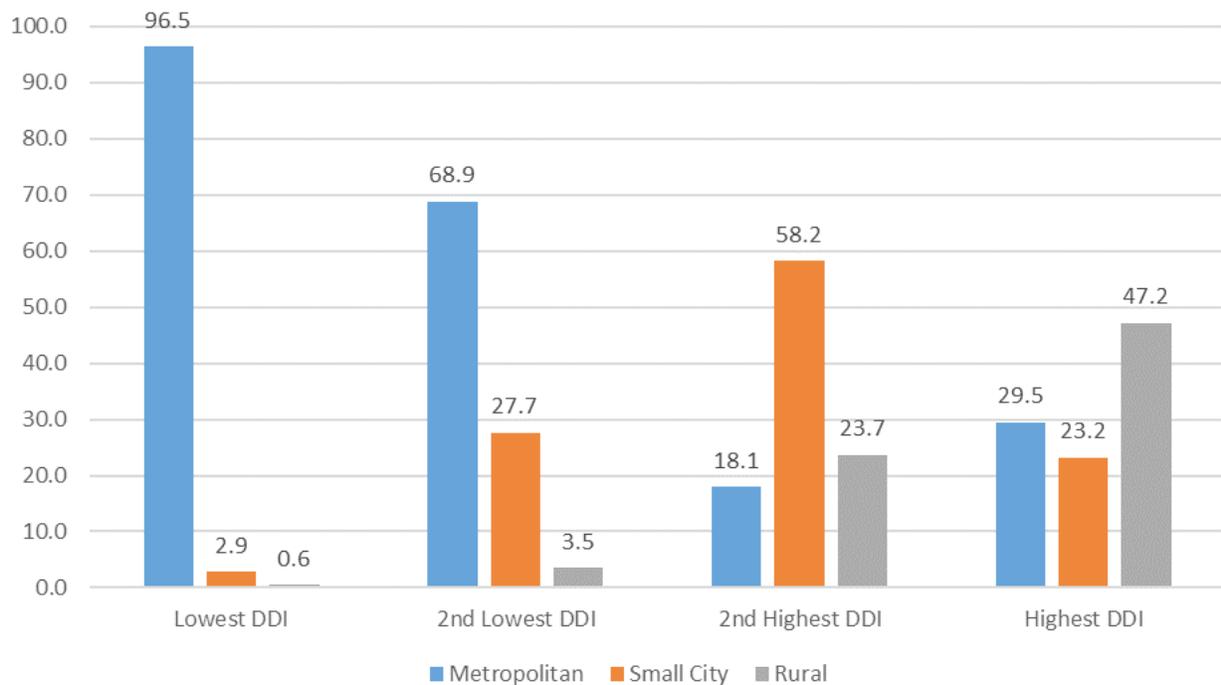
Table 2. 2015 Population by County Type and DDI Quartile

Type	Lowest DDI	% of Total	2nd Lowest DDI	% of Total	2nd Highest DDI	% of Total	Highest DDI	% of Total
Metropolitan	3,915,664	96.5	966,499	68.9	120,517	18.1	142,782	29.5
Small City	118,439	2.9	388,124	27.7	388,551	58.2	112,296	23.2
Rural	24,224	0.6	49,054	3.5	158,254	23.7	228,364	47.2
Total	4,058,327	61.4	1,403,677	21.2	667,322	10.1	483,442	7.3

Source: Purdue Center for Regional Development DDI; Census Bureau

Figure 3. Percent 2015 Population by County Type and DDI Quartile

Source: Purdue Center for Regional Development DDI; Census Bureau

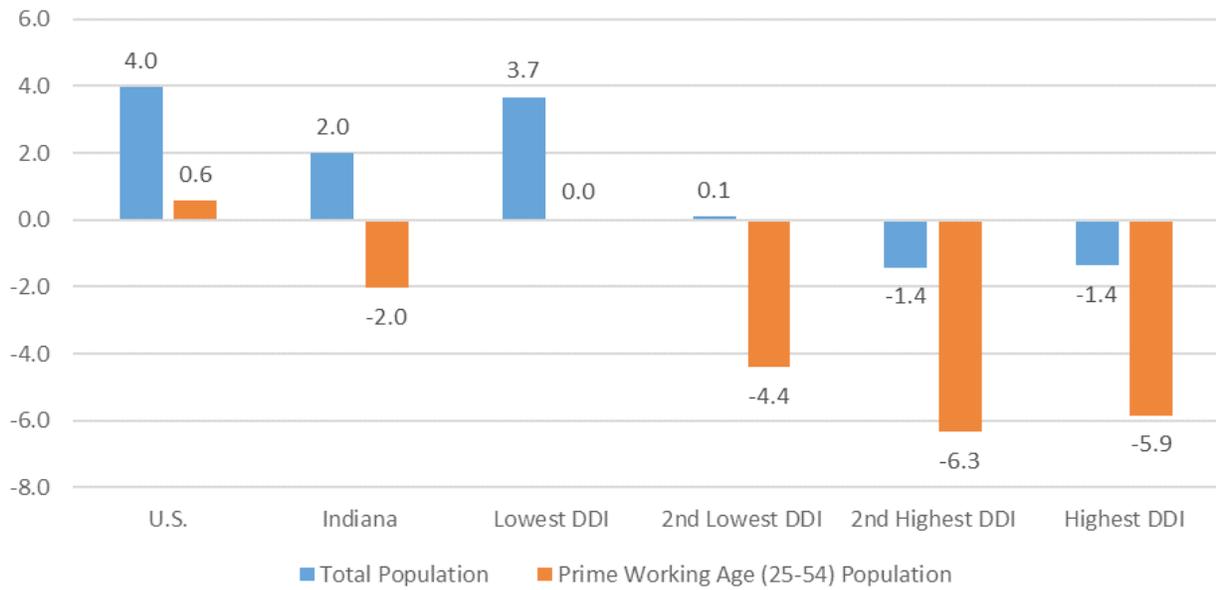


Impact of Digital Divide in Indiana

What are the socioeconomic characteristics of counties positioned in different quartiles on the digital divide index? Figure 4 displays changes in the 2010-2015 overall population and those of prime working age (ages 25 to 54) by DDI quartiles.

Figure 4. 2010-2015 Percent Change: Total and Prime Working Age Population by DDI Quartiles

Source: Purdue Center for Regional Development DDI; Census Bureau; ACS 5-Year

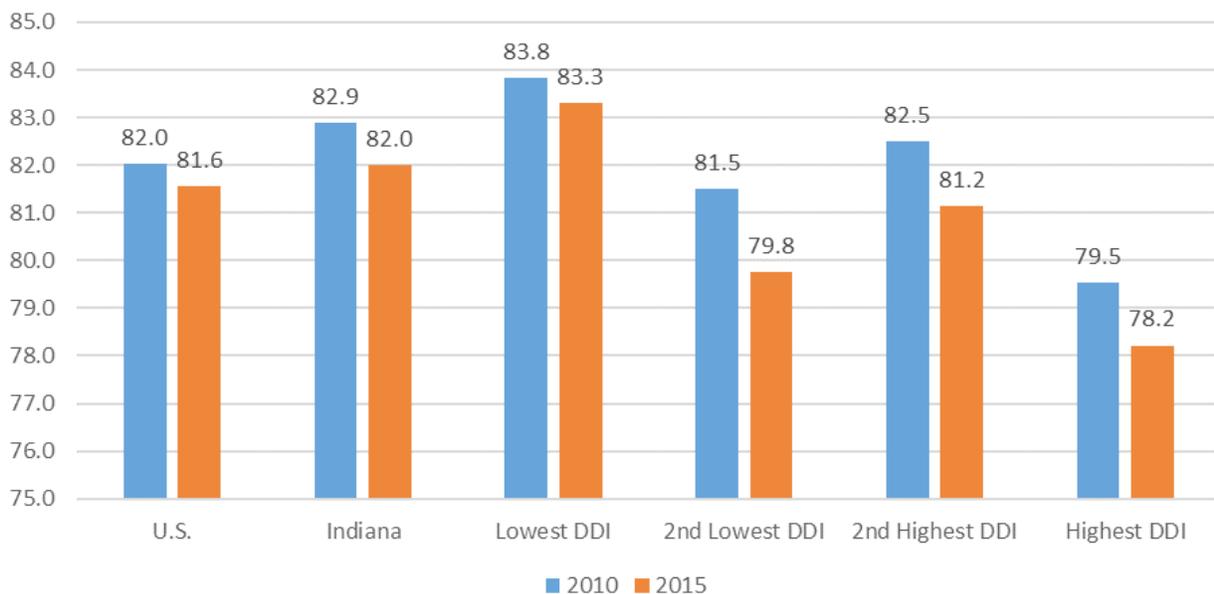


Overall, the state experienced a 2 percent gain in total population, from about 6.48 million in 2010 to 6.61 million in 2015. However, the state suffered a 2 percent loss in the number of prime age working population—from 2.62 million in 2010 to 2.57 million in 2015, or about 53,000. More than half of this decrease occurred in counties where the digital divide was higher (second highest and highest groups).

Regarding prime working age labor force participation rate (LFPR), Figure 5 shows that counties with a higher digital divide experienced a lower LFPR in both 2010 and 2015. Worth noting is that the prime working age LFPR between 2010 and 2015 decreased in the nation, state and digital divide quartiles.

Figure 5. Prime Age Workers Labor Force Participation Rate 2010 & 2015

Source: Purdue Center for Regional Development DDI; Census ACS 5-Year



As for jobs and establishments, Figure 6 shows the percent change between 2010-2015 in total number of jobs and establishments⁹. Again, the trend is clear: as the digital divide increases, proportional changes in jobs and establishments suffer a decline.

Figure 6. 2010-2015 Percent Change in Jobs and Total Establishments

Source: Purdue Center for Regional Development DDI; EMSI; County Business Patterns; Nonemployer Database

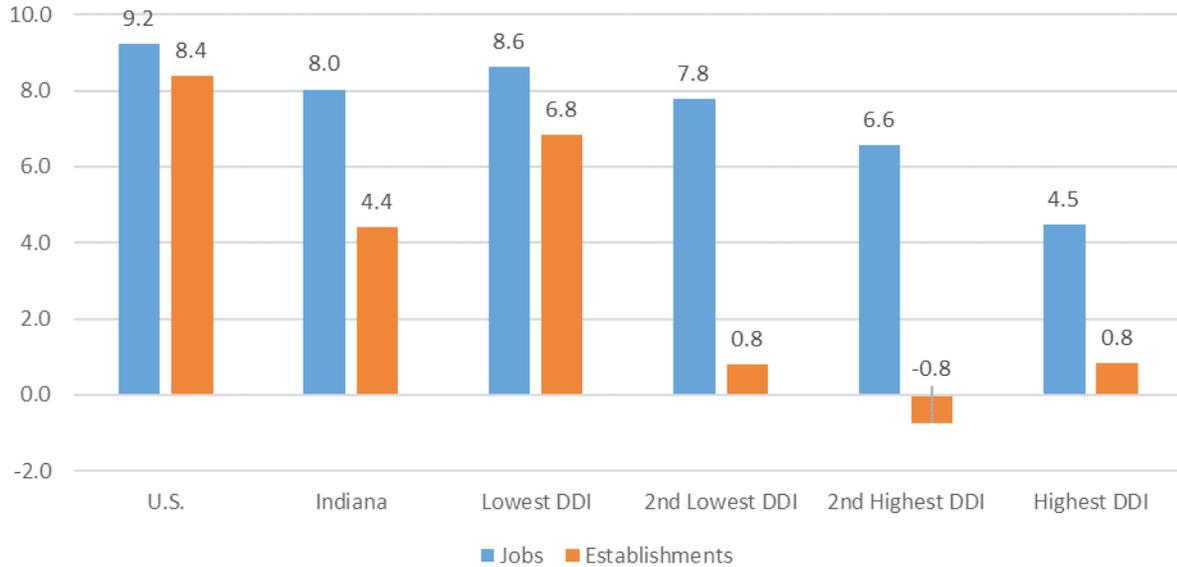
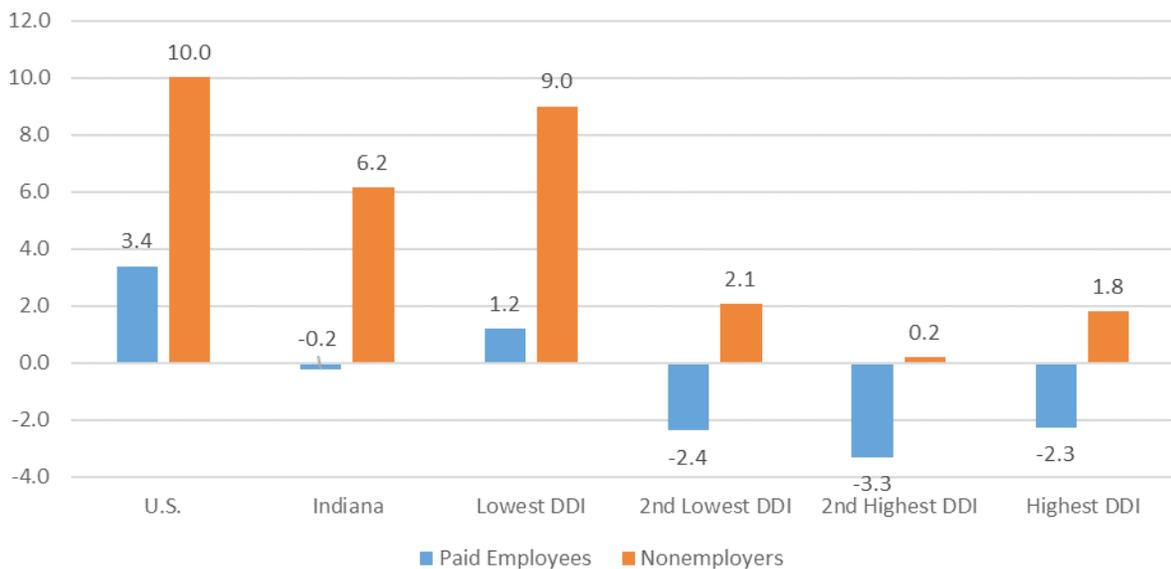


Figure 7 highlights the 2010-2015 percent change in establishments with paid employees and those that are nonemployers by their county's DDI quartile placement. While establishments with paid employees suffered declines moving from counties with the lowest to the highest DDIs, the trend for nonemployer establishments was less clear.

Figure 7. 2010-2015 Percent Change in Establishments with Paid Employees and Nonemployers

Source: Purdue Center for Regional Development DDI; County Business Patterns; Nonemployer Database



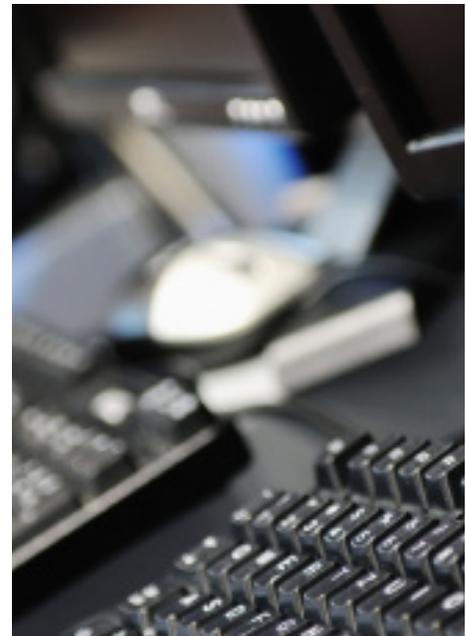
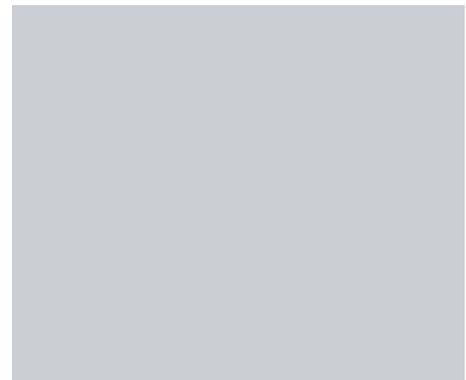
⁹ Establishments include those with paid employees and those denominated nonemployers (paid federal taxes but reported no employees).

Specifically, nonemployer enterprises grew in all four quartiles between 2010 and 2015, with the largest rate of growth occurring in counties in the lowest DDI quartile and third best in counties in the highest DDI quartile. This suggests that the growth of the self-employed/entrepreneurs is not constrained, at least initially, by the nature of their county's digital divide score. Left unanswered is whether the type of establishments launched in the highest DDI counties are fundamentally different from those being started in the lowest DDI counties.

As such, aside from distinguishing between paid employees and nonemployers, it is also important to look at establishments by type of industry. Recent reports have identified a group of industries closely related to the digital age growing at a faster pace compared to other industries^{10 11 12}. We shall refer to these as “digital economy” industries¹³. Figure 8 shows the 2010-2015 percent change in digital economy establishments and jobs, while Table 3 shows the actual numbers.

What Figure 8 reveals is that digital economy jobs in the state increased overall and across all DDI quartiles, with the largest increase—37.1 percent—in counties with the lowest digital divide, an expected pattern.

Something worth noting, however, is that while most digital economy establishments increased both on an overall basis and across DDI quartiles (with the exception of the group of counties in the second lowest digital divide group), the largest proportional increase—17.8 percent—occurred in counties with the highest digital divide. Granted, the numeric change was only 44 establishments, but an increase nonetheless. While this finding is counterintuitive and unexpected, it sheds light on an unknown characteristic of digital economy establishments that is worthy of future investigation.



¹⁰ (Mandel, 2017)

¹¹ (Muro, Kulkarni, & Hart, 2016)

¹² (Siwek, 2015)

¹³ Digital economy industries: 454111 Electronic Shopping; 454112 Electronic Auctions; 4931 Warehousing and Storage*; 51121 Software Publishers; 51711 Wired Telecommunications Carriers; 51721 Wireless Communications Carriers; 51791 Other Telecommunications; 51821 Data Processing, Hosting, and Related Services; 51913 Internet Publishing and Broadcasting and Web Search Portals; 54151 Computer Systems Design and Related Services

Figure 8. 2010-2015 Percent Change in Digital Economy Jobs and Establishments

Source: Purdue Center for Regional Development DDI; EMSI; County Business Patterns; Nonemployer Database

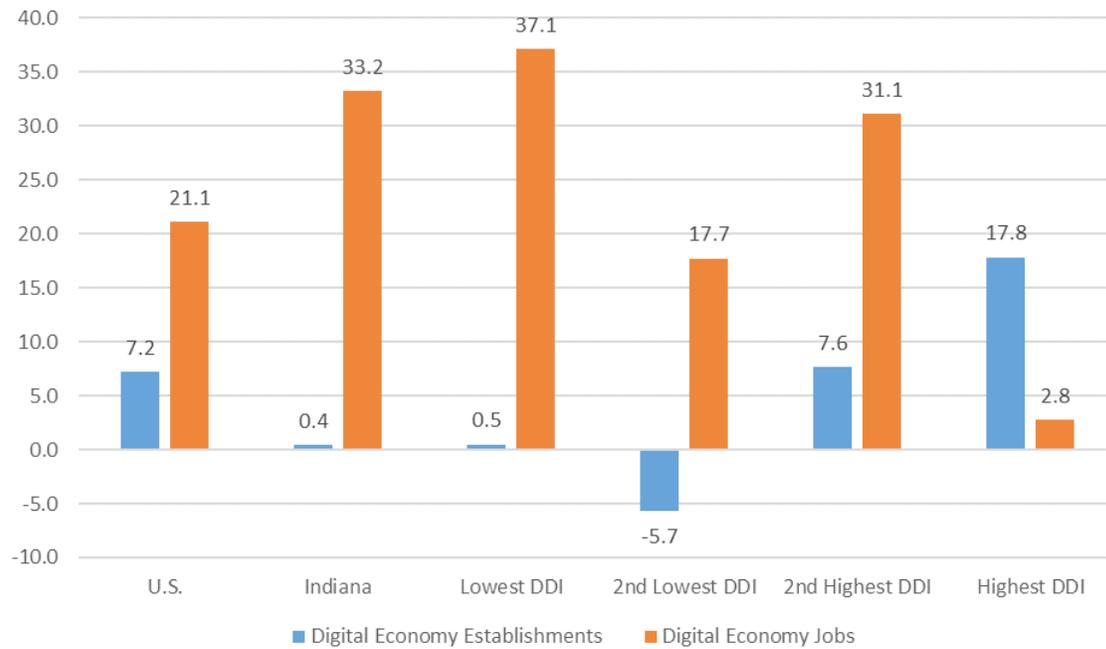


Table 3. 2010, 2015 Digital Economy Jobs and Establishments

Digital Economy	Establishments				Jobs			
	2010	2015	# Ch.	% Ch.	2010	2015	# Ch.	% Ch.
U.S.	576,629	618,039	41,410	7.2	4,387,325	5,313,075	925,749	21.1
Indiana	8,283	8,320	37	0.4	68,594	91,366	22,772	33.2
Lowest DDI	6,371	6,401	30	0.5	53,452	73,290	19,838	37.1
2nd Lowest DDI	1,233	1,163	-70	-5.7	9,253	10,892	1,639	17.7
2nd Highest DDI	423	465	33	7.6	3,986	5,227	1,241	31.1
Highest DDI	247	291	44	17.8	1,903	1,956	53	2.8

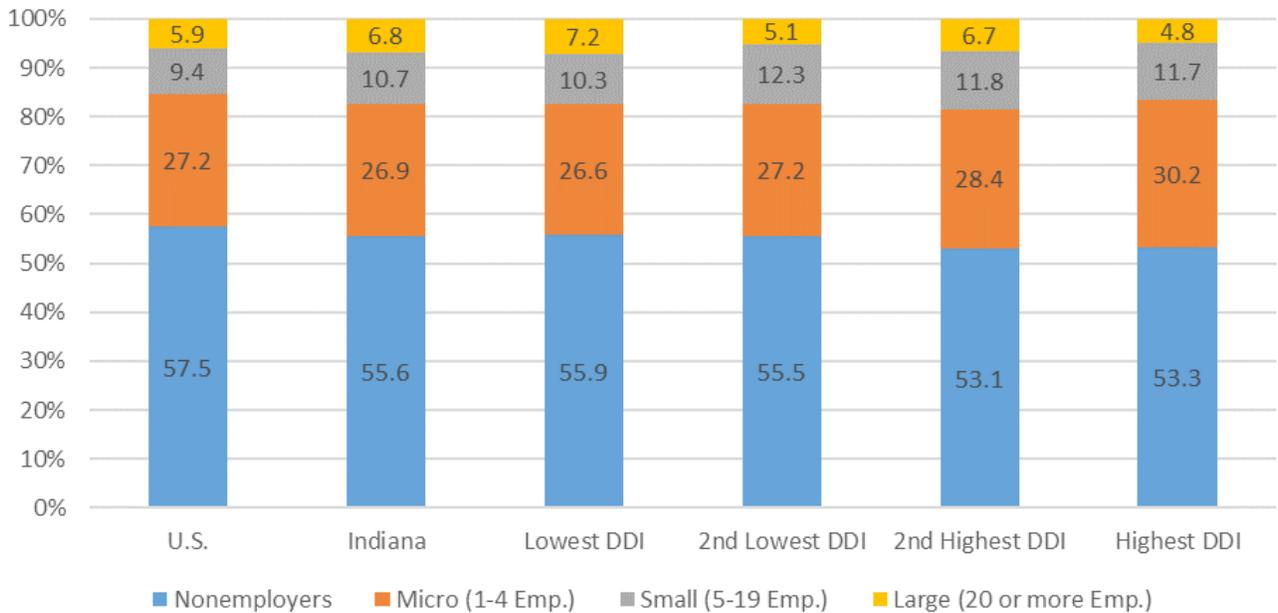
Source: Purdue Center for Regional Development DDI; EMSI; County Business Patterns; Nonemployer Database)

How is it possible that digital economy establishments grew at a faster pace in counties with the highest digital divide while simultaneously suffering overall population declines and losses in the cohort of prime working age population? While the exact reasons for this unexpected finding go beyond the scope of this research, Figure 9 may help shed some light by exploring the composition of digital economy establishments by their number of employees.

More than half of the digital economy establishments in Indiana were nonemployers in 2015. On the other hand, nearly 27 percent had one to four employees while less than seven percent had 20 or more employees. This could partially explain why nonemployer establishments grew even though the county's prime working age population decreased in counties with the highest DDI. Note how the distribution of establishments by number of employees is very similar for the U.S., the state, and across DDI quartiles.

Figure 9. Digital Economy Establishments by Size, 2015

Source: Purdue Center for Regional Development DDI; County Business Patterns; Nonemployer Database)



These local entrepreneurs may be strategically leveraging digital platforms for their businesses minimizing costs, increasing efficiency and reaching new markets. This apparently has allowed them to “break free” of the otherwise limited labor force and market in their more than likely small communities. On top of that, they emerged in an adverse context—from the digital divide perspective.

If this is the case, what can be done to (1) spur more of these businesses and (2) further sustain them? Answering these questions has implications for community and economic development policy as discussed in the next and final section.

■ ■ **Conclusions**

The digital divide is one of the most important challenges facing communities and counties that want to be full participants in the 21st century society and economy. Efforts to bridge or minimize this divide are vital to the long-term economic health of communities and businesses in Indiana.

Public policy 101 dictates that agreement and measurement on a problem is the first crucial step before even discussing potential solutions. This report intends to define and measure the problem via the use of the Digital Divide Index. The hope is that the DDI can jumpstart meaningful conversations regarding the right set of policy and program strategies that result in substantive improvements in broadband access and uptake across the state's urban and rural landscape.

Although a relatively lower percent of Indiana's population resides in counties with the highest digital divide (7.3 percent in 2015), the issue should be a priority to address since commuting patterns and intertwined regional economies carry its impact throughout the state.

More importantly, economic development strategies should be fine-tuned to target local entrepreneurs and smaller businesses. Although digital economy establishments are indeed emerging in areas with a high digital divide, efforts should be made to nurture these businesses and make sure they remain in business and even grow in this highly competitive digital age. If they remain in a high digital divide context, they may not expand or even survive.

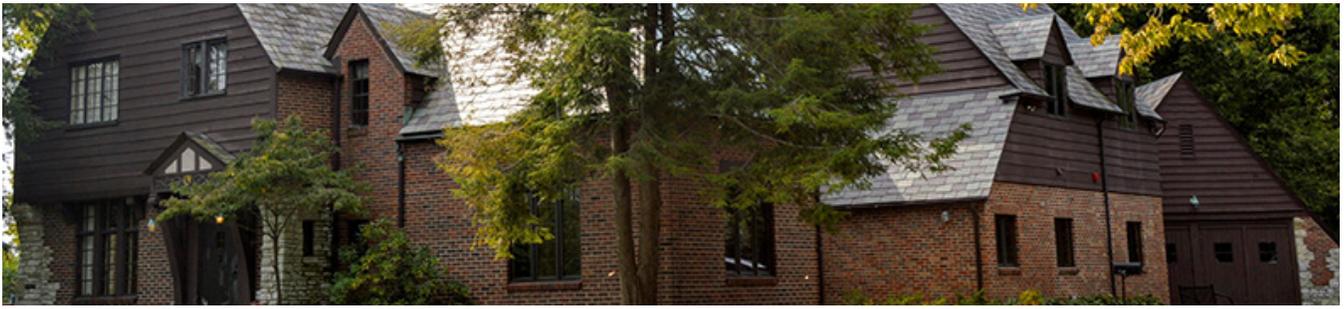
As a thought exercise, consider the following: in 2015, there were about 4,600 digital economy nonemployer establishments in the state. Imagine if half of those created one job: about 2,300 additional jobs would be created. More importantly, because these are homegrown businesses, the possibilities of them staying in the state are much higher.

From a quality of life perspective, reducing the digital divide will bring benefits to the state. Aside from the benefits to the business sector, a bridged digital divide would allow local governments to leverage digital platforms that would be more effective in responding to residents and take advantage of telework, telehealth, and other broadband applications that will continue to transform the Hoosier landscape.

A coordinated, robust effort should be made to improve broadband infrastructure throughout the state while at the same time increasing digital literacy and knowledge among residents, elected officials and businesses. Existing assets such as libraries, Purdue Extension, nonprofits and schools should collaborate further to effectively tackle this issue. In the end, Hoosiers will be better poised to reap the benefits of this unfolding digital age.

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Center for Regional Development
Advancing Collaboration : Energizing Regions

PCRD seeks to pioneer new ideas and strategies that contribute to regional collaboration, innovation and prosperity. Founded in 2005, the Center partners with public, private, nonprofit and philanthropic organizations to identify and enhance the key drivers of innovation in regions across Indiana, the U.S. and beyond. These drivers include a vibrant and inclusive civic leadership, a commitment to collaboration, and the application of advanced data support systems to promote sound decision-making and the pursuit of economic development investments that build on the competitive assets of regions.



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