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The Impact of Remote Work

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Roberto Gallardo is the Vice President for Engagement, Director of the Purdue Center for Regional Development and an Associate Professor in the Agricultural Economics Department. He holds an electronics engineering undergraduate degree, a master's in economic development, and a Ph.D. in Public Policy and Administration. Gallardo has worked with rural communities over the past decade conducting local & regional community economic development, including use of technology for development.

He has authored more than 100 articles including peer-reviewed and news-related regarding rural trends, socioeconomic analysis, industrial clusters, the digital divide, and leveraging broadband applications for community economic development. He is also the author of the book "Responsive Countryside: The Digital Age & Rural Communities," which highlights a 21st century community development model that helps rural communities transition to, plan for, and prosper in the digital age. Dr. Gallardo is a TEDx speaker and his work has been featured in a WIRED magazine article, a MIC.com documentary, and a RFDTV documentary.

The Impact of Remote Work

Abstract

Working from home became necessary during the COVID-19 pandemic. According to a survey done by the Stanford Institute for Economic Policy Research[1] during May of 2020, 42% of all U.S. workers worked from home and accounted for two-thirds of the nation's gross domestic product. Therefore, work from home has become a feasible economic development strategy at the onset of COVID-19. This study gauges the contribution of workers from home in Indiana in 2021 by using the Regional Economic Modeling, Inc. (REMI) general equilibrium model. Results indicate that the roughly 222,000 workers from home in the state contributed to a little more than 493,000 jobs across more than 10 industries. In addition, these workers added close to $54 million to the state's GDP that year. To fully maximize the impact of these workers, some strategies may include communities adapting work from home incentives, better and more affordable broadband, adequate facilities for workers from home (like co-working spaces), matching employers with workers from home, and offering work from home-related skills through training and certifications.

Background

Remote work[2] has been discussed as a feasible economic development strategy even before the COVID-19 pandemic. Work from home has a positive impact on local communities and regions, urban and rural. However, access to affordable and reliable internet is a critical element for remote workers and for this reason has tremendous implications for digital equity and community and economic development.

As part of our efforts to better understand the digital equity landscape in the state of Indiana, it is important to also understand the impact that workers from home have on the state. This should help further elevate the need to build affordable and reliable broadband networks throughout the state, benefiting urban and rural communities. Ubiquitous, more affordable, and reliable networks will sustain and expand this economic development strategy.

To estimate the impact of remote workers in the state of Indiana, REMI's general equilibrium model was utilized. The number of remote workers—obtained from the American Community Survey (ACS) 2017-2021—across 13 industries were used as policy inputs for regions as defined by the Indiana Office of Community and Rural Affairs (OCRA). See **Figure 1**.

Figure 1. *OCRA Regions**

* Marion County is included in the West Central region.

[1] How working from home works out | Stanford Institute for Economic Policy Research (SIEPR)

[2] Note that the terms remote workers and work from home are used interchangeably in this report.

Data & Methods

After consulting with REMI specialists, the number of remote workers as reported by the U.S. Census American Community Survey (ACS) 2017-2021 for each of the six regions in the state were used as policy inputs. However, because the REMI PI+ industry data is more detailed (70 industries) than the Census remote worker data by industry (13 industries), the shares of total jobs within each Census industry was calculated and applied to the appropriate REMI industry or industries within the work from home group. This resulted in 420 policy inputs (70 industries in each of the six regions).

Tables 1 & 2 show the process followed and how the REMI industries were grouped to match the Census industries. For example, there were a total of six industries in REMI (see left column in Table 1) that matched the Census industry of agriculture, forestry, fishing and hunting, and mining which had 868 workers from home in the northwest region. The share of total jobs for each of the REMI industries in that Census industry is shown in the third column. To assign the number of workers from home to each REMI industry to input in the model, its share of total jobs in the Census industry was multiplied by the total number of workers from home. The column on the right in Table 1 shows the number of remote workers according to the Census in each REMI industry. This process was repeated for all Census industries and each of the six regions.

Table 1. *Calculation of Workers from Home by REMI PI+ Industry and Sub-Industries*

REMI Industry Group Equivalent to Census Industry	Total Number of Working from Home by Census ACS Industry	Share of Total Jobs by REMI Industry (%)	Number of workers from home by REMI Industry
Forestry and Logging; Fishing, hunting, and trapping	868	2.2	19
Support activities for agriculture and forestry		14.2	124
Oil and gas extraction		0.2	1
Mining (except oil and gas)		2.8	24
Support activities for mining		0.0	0
Farms		80.6	699

Table 2. *Census and REMI PI+ Industry Categories Alignment*

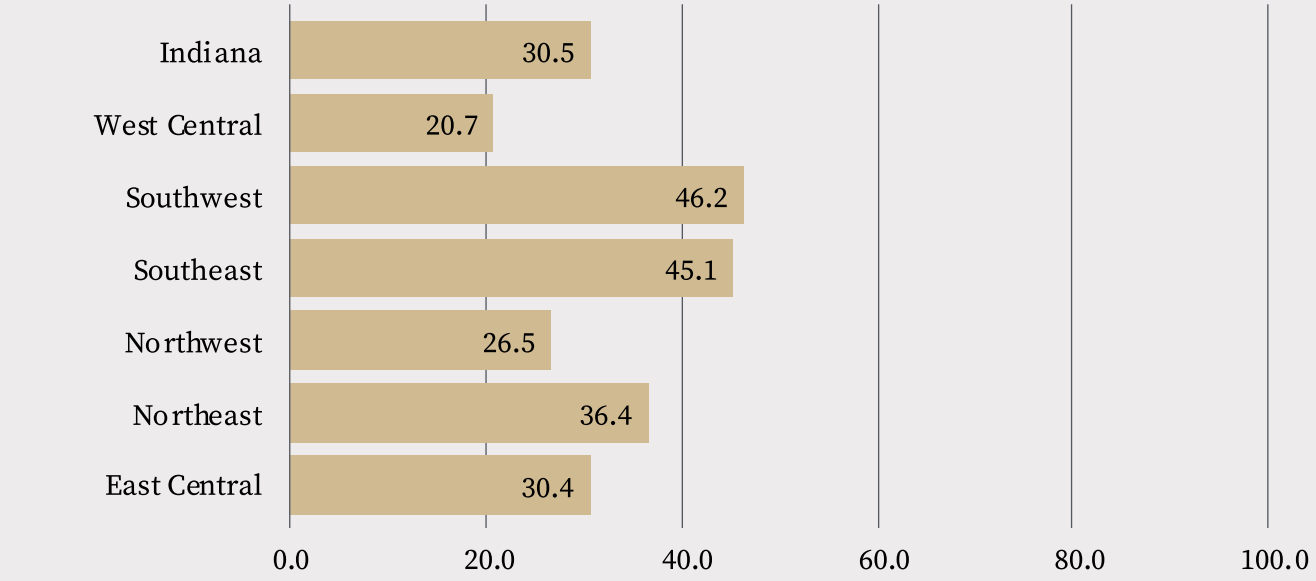
ACS 5-Year 2017-2021 Industry	REMI PI+ Industry Group
Agriculture, forestry, fishing and hunting, and mining	• Forestry, fishing, and hunting (includes 2 industries) • Mining (includes 3 industries) • Farms
Construction	• Construction
Manufacturing	• Manufacturing (includes 20 industries)
Wholesale trade	• Wholesale trade
Retail trade	• Retail trade
Transportation and warehousing, and utilities	• Utilities • Transportation and warehousing (includes 9 industries)
Information	• Information (includes 5 industries)
Finance and insurance, real estate, rental, and leasing	• Finance and insurance (includes 3 industries) • Real estate and rental and leasing (includes 2 industries)
Professional, scientific, and management and administrative and waste management services	• Professional, scientific, and technical services • Management of companies and enterprises • Administrative, support, waste management, and remediation services (includes 2 industries)
Educational services, and health care and social assistance	• Educational services; private • Health care and social assistance (includes 4 industries)
Arts, entertainment, and recreation and accommodation and food services	• Arts, entertainment, and recreation (includes 3 industries) • Accommodation and food services (includes 2 industries)
Other Services (except public administration)	• Other services (except public administration) (includes 4 industries)
Public administration	• Local Government • State Government • Federal Civilian

Source: Census ACS 2017-2021; REMI PI+

Regional Characteristics

Before we discuss the impact of remote workers in the state and each of the OCRA regions, it is important to understand specific socioeconomic and demographic characteristics of these regions. **Figure 2** shows the share of population by OCRA region that reside in rural areas based on the 2020 Census. Three of the six regions had a higher share of rural population compared to the state with the southwest and southeast regions having close to half of their population residing in rural areas.

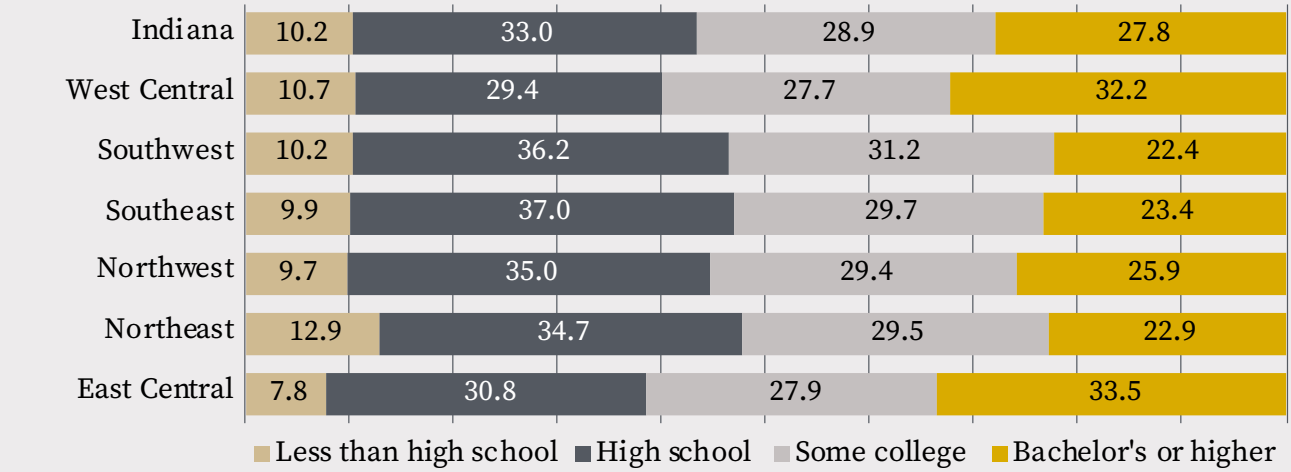
Figure 2. *Percent Rural Population by OCRA Region*



Source: 2020 Census

Figure 3 shows the educational attainment breakdown for the population ages 25 or older in each of the OCRA regions. The east central and west central regions were the most educated with roughly one-third of their population having a bachelor's degree or higher compared to the southwest region where a little more than one-fifth of its population age 25 or older had a bachelor's degree or higher.

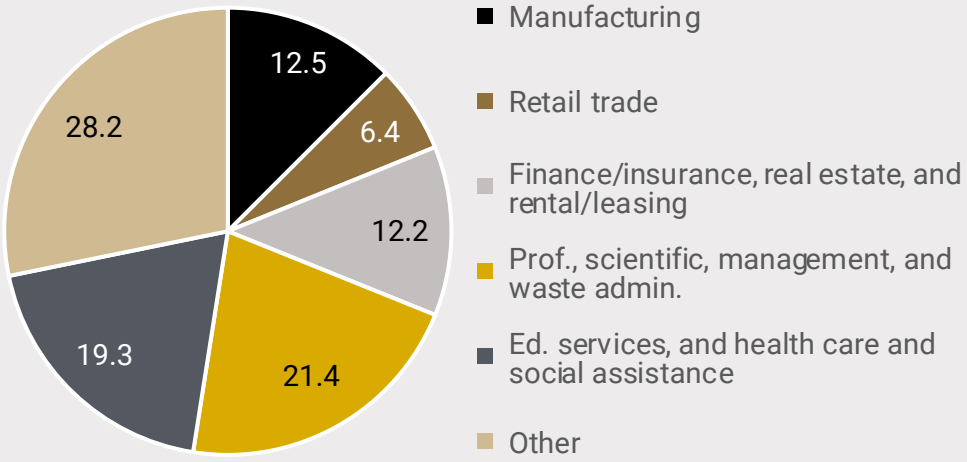
Figure 3. *Educational Attainment for the Population Age 25 or Older*



Source: 2017-2021 American Community Survey

According to the 2017-2021 ACS, there were 222,777 remote workers in Indiana (not including armed forces), or about 7% of total workers aged 16 or older in the state. As shown on **Figure 4**, more than one-fifth worked in the professional, scientific, and management, and administrative and waste management service industries (21.4%) followed by educational services, and health care and social assistance industries with 19.3%. About 28% of remote workers were scattered across eight industries.

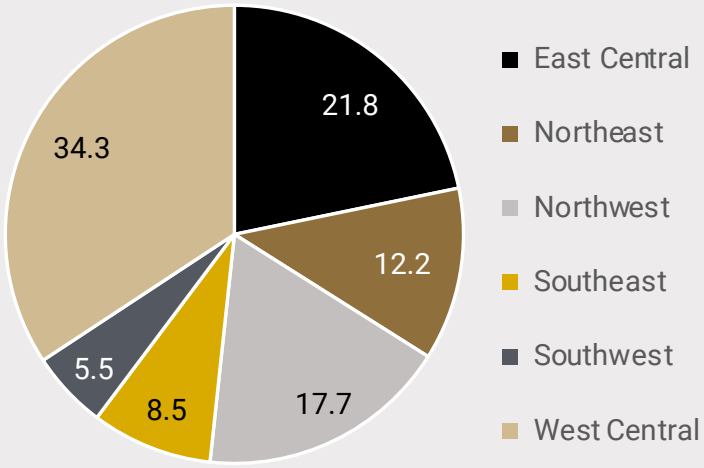
Figure 4. *Top 5 Industries with Share of Working from Home*



Source: 2017-2021 American Community Survey

Figure 5 shows the share of workers from home per OCRA region. The west central region (which includes Marion County) had the highest with 34.3% followed by the northeast region with 21.8%. The southwest region of the state had the lowest share with 5.5%.

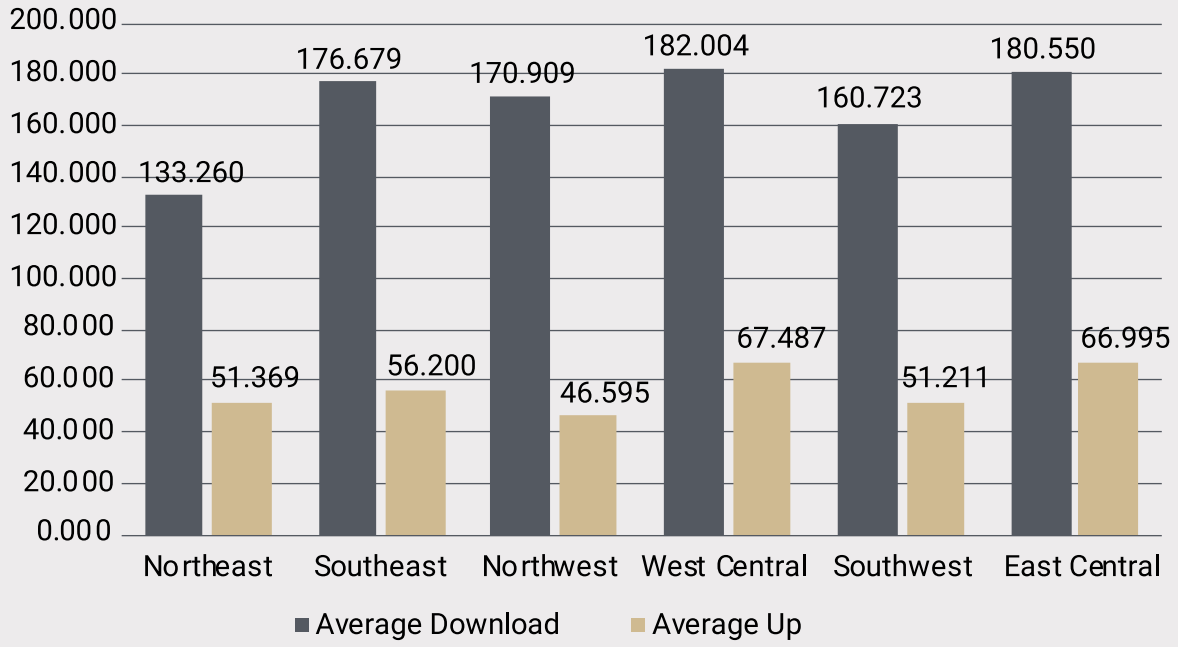
Figure 5. *Share of Workers from Home by OCRA Region*



Source: 2017-2021 American Community Survey

Figure 6 shows the average download/upload speeds in megabits per second (Mbps) by OCRA region based on Ookla speed tests results. The west central region had the highest average download/upload speeds while the northeast had the lowest download and the northwest the slowest average upload speeds. Reliable high-speed internet is critical for remote workers.

Figure 6. *Average Download/Upload Speeds in Megabits per Second (Mbps)*



Source: Speedtest® by Ookla Global Fixed Network Performance Maps; annual weighted average

Results

About 222,777 Indiana workers aged 16 or older, or 7% of the state's workforce, worked from home across 13 different industries in 2021. Their jobs contributed to a total of 493,790 jobs and 149,444 residents across the state—of which 1,510 of the latter were due to natural growth and 147,934 to economic migrants—and added 129,377 workers to Indiana's labor force. Furthermore, their work contributed $53.7 million to the state's gross domestic product (GDP) or roughly $2,499 to real disposable personal income per capita for that year. **Table 3** summarizes the economic impact of Indiana's remote workers. For regional tables, please refer to **Appendix A**.

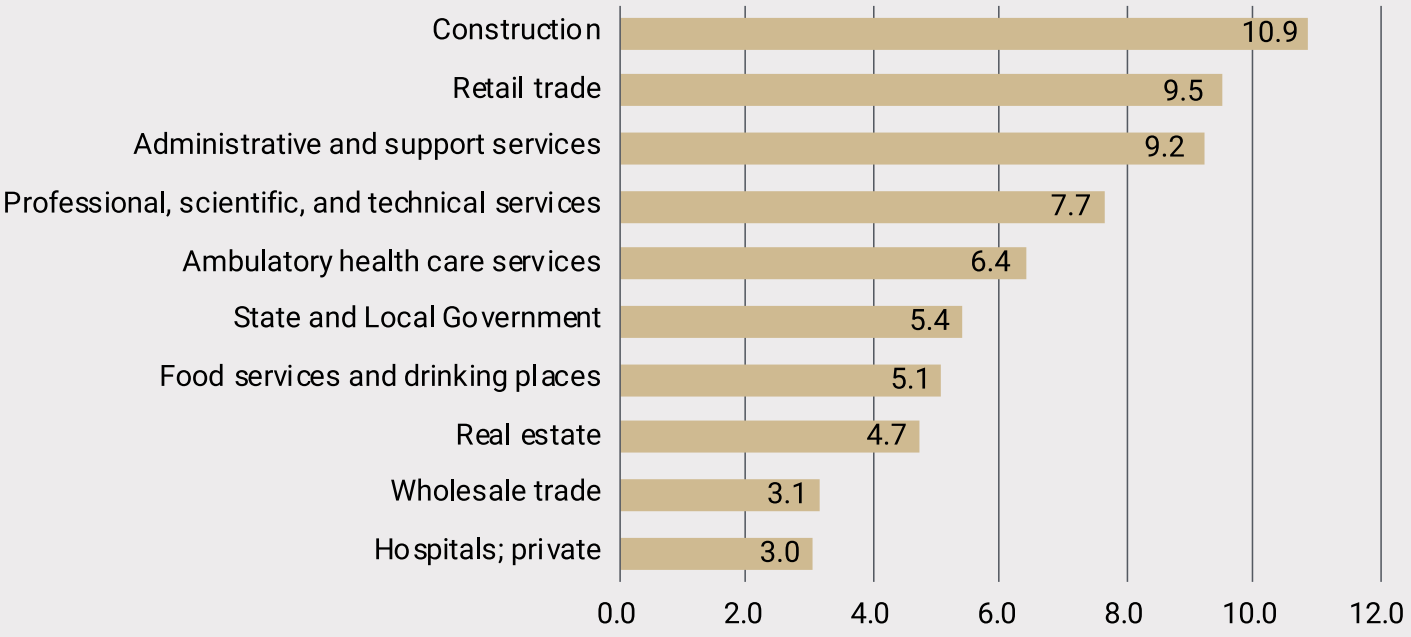
Table 3. *Economic Impact Summary of Remote Workers in Indiana*

Item	2021
Total Employment	+493,790
Population	+149,444
Labor Force	+129,377
Value-Added to the GDP (millions)	+$53.7
Real Disposable Personal Income Per Capita	+$2,499

Source: REMI PI+; 2017-2021 ACS

Figure 7 shows the top ten industries' share of jobs contributed by workers from home. These ten industries account for close to two-thirds of the close to half a million jobs added. Note the diversity of industries impacted.

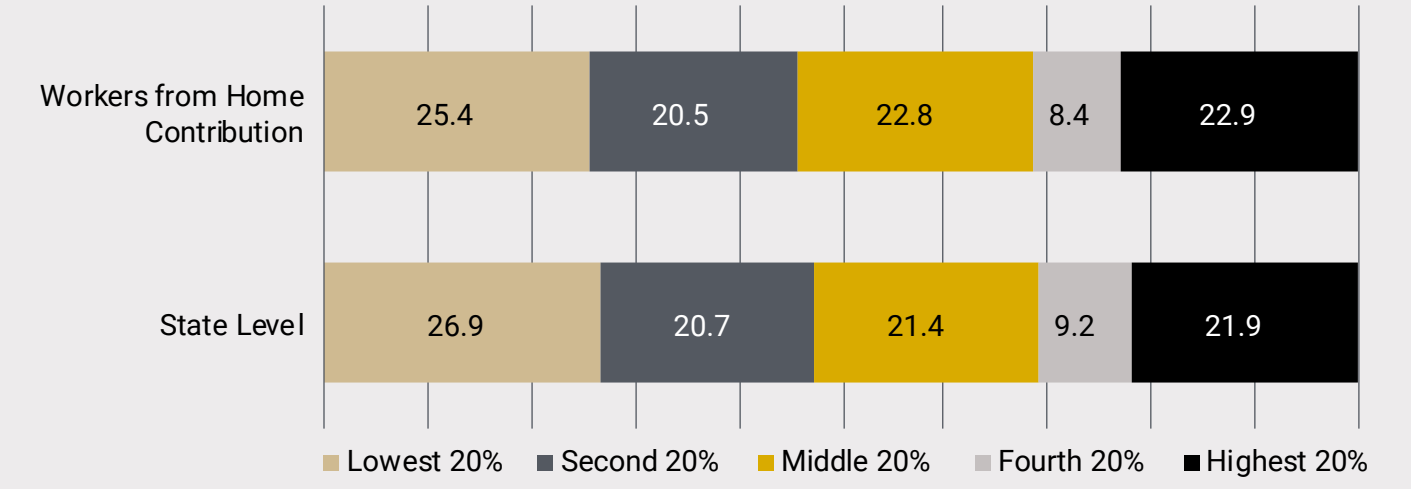
Figure 7. *Top Ten Share of Added Jobs by Industry*



Source: REMI PI+; 2017-2021 ACS

Of the close to half a million jobs workers from home contributed in 2021, **Figure 8** shows the distribution by earning quintiles based on all occupations. A little more than one-fifth were in the highest earning quintile (22.9%) compared to 21.9% of the state's distribution. A similar difference is seen among the share of jobs in the lowest earning quintile, where the share of the contribution from workers from home is lower compared to the state's (25.4% versus 26.9%).

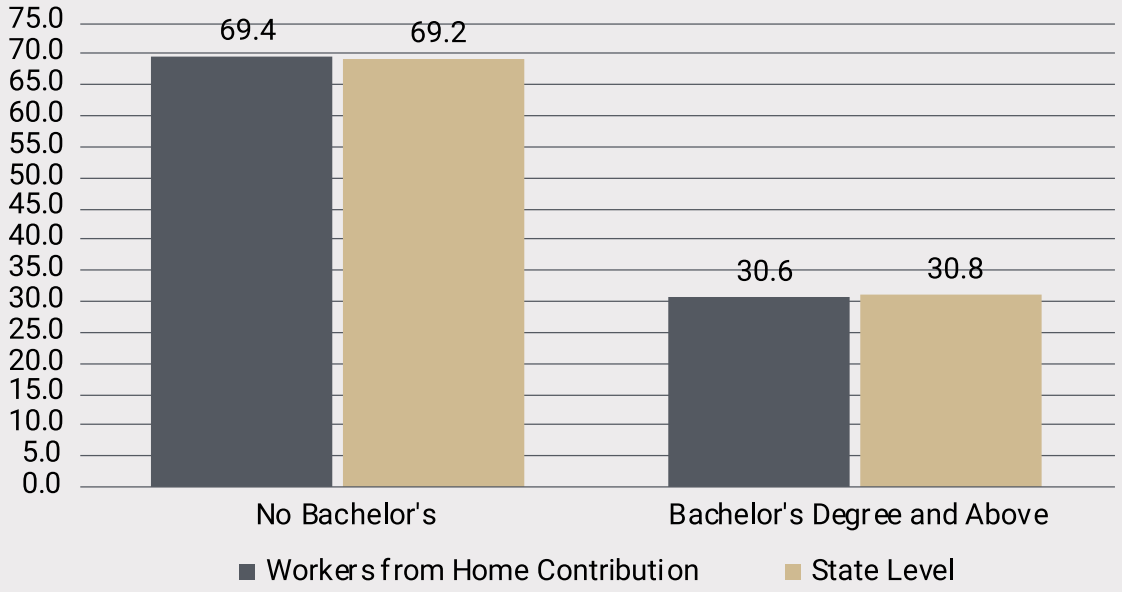
Figure 8. *Share of Jobs by Earning Quintiles*



Source: REMI PI+

Regarding educational attainment, a similar share of the jobs contributed by workers from home required a bachelor's degree or higher compared to the overall state share (30.6% versus 30.8%) as shown in **Figure 9**.

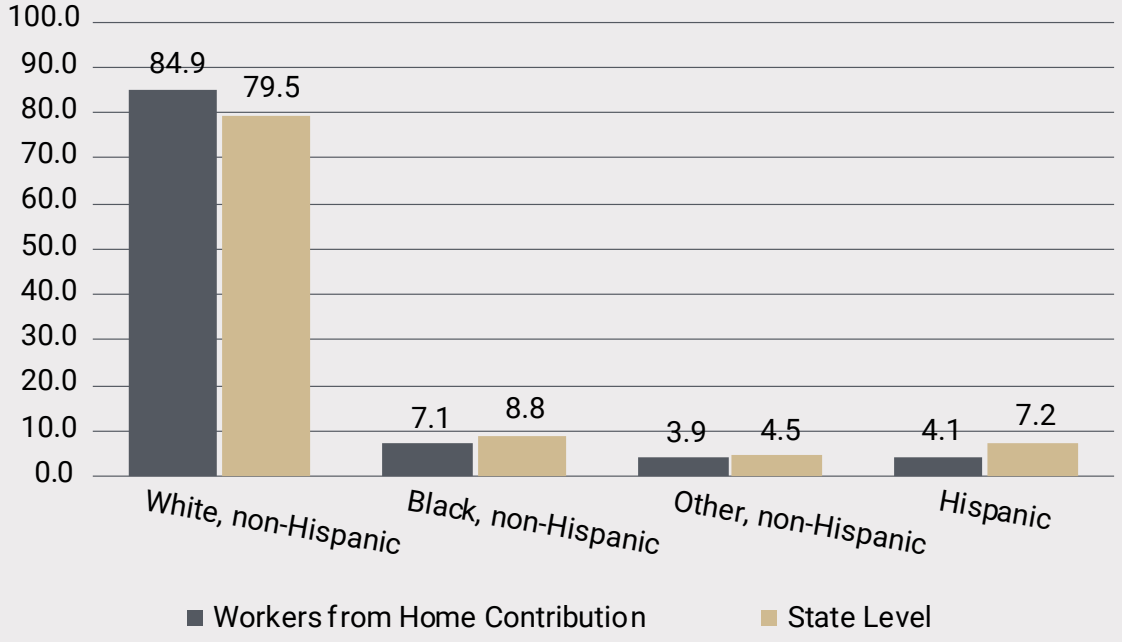
Figure 9. *Share of Additional and State Overall Jobs by Educational Attainment*



Source: REMI PI+

Finally, **Figure 10** shows that the share of white non-Hispanic labor force workers from home contributed was higher compared to the state's level. On the other hand, the share of minority labor force groups was lower compared to the state's level, especially among Hispanics.

Figure 10. *Share of Additional Labor Force by Race/Ethnicity*



Source: REMI PI+

Conclusions

Studies suggest that better broadband can lead to more workers from home, increased self-employment, and benefits for women and high-skilled workers[3,4,5]. With roughly 7% of workers aged 16 or older working from home in Indiana, the impacts of these workers are important. As discussed above, these workers added more than half a million jobs to the state in 2021 and increased the state's population and labor force.

However, work remains to be done to ensure that those who can work from home include a diverse group of individuals. And while ubiquitous, reliable, and affordable broadband networks are a critical element, it is not the only one. Creating a diverse pipeline of workers from home is also important to ensure a digital equitable landscape is leveraged. Some strategies may include communities adapting remote work incentives, better and more affordable broadband, adequate facilities to conduct remote work (like co-working spaces), matching employers with workers from home, and offering remote work-related skills through training and certifications.

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[3] Houngbonon, G., & Liang, J. (2021). Broadband Internet and Income Inequality. *Review of Network Economics*, 20, 55 - 99. https://doi.org/10.1515/rne-2020-0042

[4] Han, L. (2021). Broadband, Self-Employment, and Work-from-Home — Evidence from the American Community Survey. *Econometric Modeling: Microeconometric Models of Household Behavior eJournal*. https://doi.org/10.2139/ssrn.3936667

[5] Billari, F., Giuntella, O., & Stella, L. (2019). Does broadband Internet affect fertility?. *Population Studies*, 73, 297 - 316. https://doi.org/10.1080/00324728.2019.1584327

Appendix A

Table A1. *Economic Impact Summary of Remote Workers in the Northwest Region*

Item	2021
Working from Home	39,526
Total Employment	77,097
Population	22,352
Labor Force	22,865
Value-added GDP (millions)	$7.644
Real Disposable Personal Income Per Capita	$1,444

Source: REMI PI+; 2017-2021 ACS

Table A2. *Economic Impact Summary of Remote Workers in the Northeast Region*

Item	2021
Working from Home	27,175
Total Employment	54,697
Population	18,161
Labor Force	12,229
Value-added GDP (millions)	$5.344
Real Disposable Personal Income Per Capita	$1,451

Source: REMI PI+; 2017-2021 ACS

Table A3. *Economic Impact Summary of Remote Workers in the East Central Region*

Item	2021
Working from Home	48,477
Total Employment	102,836
Population	33,748
Labor Force	29,925
Value-added GDP (millions)	$10.333
Real Disposable Personal Income Per Capita	$3,653

Source: REMI PI+; 2017-2021 ACS

Table A4. *Economic Impact Summary of Remote Workers in the West Central Region*

Item	2021
Working from Home	76,334
Total Employment	200,303
Population	56,227
Labor Force	48,954
Value-added GDP (millions)	$24.222
Real Disposable Personal Income Per Capita	$3,930

Source: REMI PI+; 2017-2021 ACS

Table A5. *Economic Impact Summary of Remote Workers in the Southeast Region*

Item	2021
Working from Home	19,036
Total Employment	33,780
Population	10,591
Labor Force	8,285
Value-added GDP (millions)	$3.491
Real Disposable Personal Income Per Capita	$1,354

Source: REMI PI+; 2017-2021 ACS

Table A6. *Economic Impact Summary of Remote Workers in the Southwest Region*

Item	2021
Working from Home	12,229
Total Employment	25,078
Population	8,366
Labor Force	7,119
Value-added GDP (millions)	$2.647
Real Disposable Personal Income Per Capita	$1,236

Source: REMI PI+; 2017-2021 ACS