Remote Work and People with Disabilities

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Abstract

This paper investigates the heterogeneous effect of access to remote work on the labor market outcomes of people with disabilities. I use a two-way fixed effects strategy exploiting the quasi-random variation in broadband access across the United States and industry-specific shocks in the demand for remote workers. I find that remote work access increases employment, hours worked, hourly wages, and earnings of people with disabilities. This paper sheds light on how expanding remote work opportunities could play a crucial role in improving economic outcomes for people with disabilities.

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1 Introduction

As internet usage has become more widespread at home and in the workplace, the proportion of workers who telecommute regularly has risen steadily as well. Between 2000 and 2019, the share of adults with high-speed broadband service at home in the United States grew from 1 percent to 73 percent according to surveys conducted by Pew Research Center.[1] In 2000, approximately 4.2 million Americans, or 3.3 percent of the workforce, worked from home. By 2019, that number had risen to nearly 9 million, even before the COVID-19 pandemic rapidly sped up the proliferation of remote work.

The benefits of remote work are straightforward to understand—for firms, remote work reduces overhead costs associated with maintaining office space, and for workers, remote work reduces commuting costs. Though the labor market effects of remote work before the pandemic have received limited attention,[2] even less research has focused on a group with potentially significant gains from this shift—people with disabilities, who face unique barriers in traditional workplaces. Remote work can provide accessibility benefits by reducing physical and social barriers, such as the need to commute, inflexible schedules, and workplace stigma, making it a particularly impactful option for this group.

People with disabilities constitute one of the largest minority groups in the United States, comprising approximately 12.7 percent of the population. Despite their significant presence, they are severely underrepresented in the labor force. In 2019, their labor force participation rate was only 27.3 percent, while the rate for people without disabilities was 70.8 percent. This disparity extends to employment likelihood. In the same year, the employment-to-population ratio for people with disabilities stood at 24.7 percent, compared to 67.8 percent for people without disabilities. Even among those employed, individuals with disabilities tend to experience substantial earnings gaps. In 2019, their median earnings were

[1] The rates can be found here: https://www.pewresearch.org/internet/fact-sheet/internet-broadband.

[2] For papers that examine the effects of remote work during or after the pandemic, see, for example: Barrero et al. (2021), Bonacini et al. (2021), Choudhury et al. (2024), Gibbs et al. (2021).

approximately $25,000, significantly lower than the $37,000 median earnings for individuals without disabilities. Taken together, these figures seem to imply persistent structural barriers to equitable labor market opportunities for people with disabilities

For people with disabilities, the commuting cost reduction from remote work is potentially considerably larger than for those without, since it may allow them access to job opportunities that they would not have had previously. For example, Liu and Quinby (2024) find that between 2018 and 2022, remote work contributed to a 10-percent increase in the employment rate of older people with disabilities. In particular, remote work encouraged some older people with disabilities to reenter the labor force and allowed others to switch jobs instead of exiting work. In another concurrent paper, Bloom, Dahl, and Rooth (2024) make use of variation in the share of workers who work from home across occupations to examine its impact on disability employment in the post-pandemic context. They find that a one percentage point increase in work from home rate in an occupation leads to a 1.1% increase in full-time disability employment. Similarly, Gentry (2025) shows that the introduction of Uber leads to better labor market and social outcomes for people with disabilities. Their employment increases by 1.4 percentage points and marriage rates increase by 1.7 percentage points, highlighting how reducing commuting barriers, whether through access to remote work or to on-demand transportation services, can promote economics inclusion of people with disabilities.

In this paper, I analyze the labor market effects of access to remote work, with a particular focus on its differential impact on people with disabilities in the pre-pandemic setting. To do this, I exploit the variation across metro areas over time in access to broadband internet and demand for remote workers and estimate their differential effects for individuals with disabilities. I find that access to remote work increases the probability of employment for people with disabilities, as well as their hours worked, hourly wage, and earnings. These results, which remain robust even when older individuals are excluded from the sample, highlight the potential of remote work to narrow longstanding labor market disparities faced by people with disabilities.

To identify the differential effects of access to broadband and demand for remote workers, I employ a two-way fixed effects model that exploits quasi-random variation in the rollout of broadband internet across the United States and the industry-specific shocks in the demand for remote workers. My analysis uses two measures of Consistent Public Use Microdata Area (CPUMA)-level exposure to remote work in a given year: i) the broadband adoption rate, and ii) a remote work shock in the style of Bartik (1991). The broadband adoption rate serves as a supply-side measure indicating workers' access to the technological means to work remotely, while the Bartik shock provides a measure of demand for remote workers. This approach estimates the intent-to-treat effect of increased remote work opportunities on an individual's labor market outcomes.

The identification strategy depends on the assumption that variation in the timing of broadband adoption and industry-specific remote work demand shocks are orthogonal to pre-existing trends in the labor market outcome gaps between people with and without disabilities. Broadband rollout decisions can be influenced by technical, logistical, and regulatory factors that varied independently of local labor market trends. For example, places with rugged geography often experienced delays in broadband deployment due to increased logistical complexity, making the timing quasi-random with respect to employment trends.

The Bartik-style measure captures industry-level remote work demand shocks driven by national trends, such as technological changes or shifts in industry productivity, rather than local characteristics. This national-level variation makes it unlikely that these demand shocks are systematically correlated with trends in labor market disparities for people with disabilities. The focus on differential impacts strengthens the validity of the identification strategy. Factors that affect both groups equally, such as general local labor market conditions or broad economic shocks, do not pose a threat to identification, as they do not influence the relative gap between the two groups.

Using microdata from IPUMS American Community Survey (Ruggles et al., 2024) from 2008 to 2019, I show that a one standard deviation increase in remote work demand increases the probability of employment of people with disabilities by up to 2.1 percentage points, compared to those without disabilities. In particular, it increases self-employment of people with disabilities by 0.6 percentage points, or about 16.7 percent from the mean self-employment rate of people with disabilities. Moreover, access to remote work also increases hours worked per week for self-employed and full-time workers with disabilities. Lastly, access to remote work is associated with an increase in the hourly wage by 5.7 percent and earnings by 20.5 percent for people with disabilities.

This paper contributes to the literature on the effects of broadband access by documenting the differential effects for a population continues to face labor market challenges. A growing number of studies have linked broadband internet to a number of socioeconomic outcomes, including electoral turnout (Falck et al., 2014; Poy & Schüller, 2020), academic achievements (Dettling et al., 2018; Grimes & Townsend, 2018; Vigdor et al., 2014), health outcomes (Billari et al., 2019; DiNardi et al., 2019; Van Parys & Brown, 2024), and economic growth (Czernich et al., 2011; Kolko, 2012). Among them, my paper is most related to those that explore the labor market effects of broadband internet. Previous research generally finds a positive effect on employment (Atasoy, 2013; Hjort & Poulsen, 2019; Zuo, 2021), labor force participation (Dettling, 2017; Kusumawardhani et al., 2023), and wages and income (Akerman et al., 2015; Whitacre et al., 2014).

This paper also adds to the ongoing discussion of the prevalence and consequences of remote work. Mas and Pallais (2017) find that workers are willing to give up 8 percent of their wages to work remotely. Bloom, Liang, et al. (2015) find that working from home leads to a 13 percent performance increase among call center workers in a Chinese travel agency. Harrington and Kahn (2023) document the impact of the rise of work-from-home (WFH) jobs on motherhood employment gap. In particular, they find that a ten percent increase in WFH is associated with a 0.94 percent increase in mothers' employment relative to that of other women.

Lastly, this paper is related to a large body of literature that examines the effectiveness of different interventions to improve the labor market of people with disabilities. For example, DeLeire (2000) and Acemoglu and Angrist (2001) both provide assessment on the labor market effects of the Americans with Disabilities Act of 1990 (ADA). Autor, Duggan, et al. (2016) look at the Disability Compensation (DC) program on veterans' labor force participation and earnings. Many of these papers, as mentioned in Section 2.1, have documented unintended labor market effects of these public interventions. My paper highlights the potential of how expanding access to remote work could serve as an alternative policy tool to improve the labor market situation of people with disabilities.

2 Background

2.1 Laws and Public Assistance Programs for People with Disabilities

As mentioned in Section 1, people with disabilities generally have worse labor market outcomes than people without disabilities. In response to the large disparities, the Americans with Disabilities Act was signed into law in 1990. The purpose of this law is to remove barriers to employment for people with disabilities by banning discrimination against disability in wage determination, hiring, and firing and requiring employers to provide reasonable accommodations to their employees. A reasonable accommodation is a change in the work environment that results in an equal employment opportunity for a person with a disability. For example, an employer may be required to change existing facilities, restructure jobs, modify work schedules, or provide special equipment or assistance for their employee with a disability.

Though the accommodation mandate may make it easier for people with disabilities to work more comfortably and more efficiently, thereby improving their employment prospects and wages, these mandates impose additional costs on firms to employ people with disabilities. Previous studies generally find that the Americans with Disabilities Act has a negative or zero impact on the labor market outcomes of people with disabilities. DeLeire (2000) finds that the employment of men with disabilities decreases by about 7 percentage point after the law was passed. Similarly, Acemoglu and Angrist (2001) find that the enactment of the law decreased the weeks worked for disabled men. Neither of these papers found a wage effect, but Beegle and Stock (2003) found negative impacts on labor force participation rate and earnings.

In addition to the ADA, the Social Security Disability Insurance (SSDI) is an income support program that insures workers against the loss of income due to disabilities. The amount of the monthly payment is determined by a worker's prior earnings, and disability is defined by the inability to engage in substantial gainful activity. In 2019, this allowed that a non-blind individual to make at least $1,220 per month ($2,040 for a statutorily blind individual), which creates a disincentive for people to work. Numerous papers have documented negative impacts of the Disability Insurance on employment and earnings: Autor and Duggan (2003), Bound (1989), French and Song (2014). Most papers agree that structure of the SSDI program itself (how the amount of benefit is calculated) is the main culprit for the unintended consequence of the decline in employment and earnings, but there is little consensus on the magnitude of the impact (Maestas et al., 2013).

3 Descriptive Statistics on People with and without Disabilities

3.1 IPUMS American Community Survey

The American Community Survey (ACS) is an annual nationally-representative survey conducted by the Census Bureau. It provides information on the social, economic, demographic, and housing characteristics of the U.S. population. Due to availability of the broadband data, I start my analysis from 2008 and end it at 2019 to avoid any COVID-related impacts. I also restrict my sample to individuals between the ages of 16 and 64 who are not living in group quarters, not on active duty in the U.S. Armed Forces, and not in school at the time of the survey.

Demographics

The ACS collects information on six types of disabilities: i) cognitive, ii) ambulatory, iii) independent living, iv) self-care, v) vision, and vi) hearing. Throughout this paper, I classify individuals as having a disability if they report at least one of these conditions.[3] as disabled. Using this definition, approximately 11% of the population in my sample are identified as having a disability. Table 1 shows the distributions of different demographic characteristics among people with and without disabilities. For example, for people without a disability, 49.58 percent are male, and 50.42 percent are female. People with disabilities tend to be older, as the likelihood of developing a disability increases with age. They are also less likely to hold a Bachelor's or an advanced degree, indicating lower educational attainment compared to people without disabilities.

[3] The specific questions can be found in Appendix A.

Table 1: Distribution of Demographic Characteristics by Disability Status

	Percent of non-disabled	Percent of disabled
Gender		
Male	49.58%	49.74%
Female	50.42%	50.26%
Age		
Age 16-24	9.05%	5.85%
Age 25-34	22.69%	12.22%
Age 35-44	23.47%	15.75%
Age 45-54	24.11%	27.59%
Age 55-64	20.67%	38.59%
Marital status		
Married	56.48%	41.15%
Separated/Divorced	13.55%	24.16%
Widowed	1.59%	4.23%
Never married	28.38%	30.45%
Educational attainment		
Less than HS	11.24%	21.64%
HS	28.10%	35.81%
Some college/associate degree	28.79%	29.43%
Bachelor's degree	20.60%	8.88%
Master's/professional/doctoral degree	11.27%	4.24%
Race and Hispanic origin		
Hispanic	17.23%	13.04%
White, non-Hispanic	63.21%	65.23%
Black, non-Hispanic	11.37%	15.76%
Other, non-Hispanic	8.18%	5.97%
Citizenship status		
Native	81.39%	90.63%
Naturalized citizen	8.19%	5.01%
Not a citizen	10.42%	4.36%
Number of observations	17,076,771	2,135,235

Notes: This table summarizes distributions of demographic characteristics among people with and without disabilities. Data are from the 2008-2019 American Community Survey (ACS). The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school.

Labor Market Outcomes

Table 2 summarizes the labor market outcomes of people with and without disabilities. The differences are striking. Not only are people with disabilities severely underrepresented in the labor market, they are not earning as much as well. The median wage and salary income for workers without disabilities is $38,972. For workers with disabilities, it is $28,490, which is about 27 percent lower. This is partly due to the fact that over 25 percent of workers with a disability are only working part-time. Additionally, workers with a disability earn about $4.50 less on a per hour basis.

Table 2: Labor Market Outcomes by Disability Status

	Without a disability	With a disability
Civilian population		
Employment-to-population ratio	78.40%	35.47%
Labor force participation rate	83.70%	41.53%
Number of observations	17,076,771	2,135,235
Employed civilian population		
Full-time/Part-time worker†		
Full-time worker	84.56%	74.03%
Part-time worker	15.44%	25.97%
Usual hours worker per week†		
Full-time worker	43.91	44.03
Part-time worker	23.39	21.23
Hourly wage‡	$26.71	$22.27
Median wage and salary income‡	$38,972.39	$28,490.80
Number of observations	13,390,896	762,600

Notes: This table summarizes labor market outcomes of people with and without disabilities. Data are from the 2008-2019 American Community Survey (ACS). The sample in the top panel consists of civilian population aged 16-64, who are not living in group quarters and not in school. The sample in the bottom panel is restricted to those who are employed. † Full-time is defined as working 35 or more hours per week and part-time is defined as working less than 35 hours. ‡ All wages are converted to 2019 dollars using the Consumer Price Index for All Urban Consumers Retroactive Series (CPI-U-RS) from the Bureau of Labor Statistics. Hourly wages are calculated by dividing annual wage and salary income by the product of weeks worked last year and usual hours worked per week.

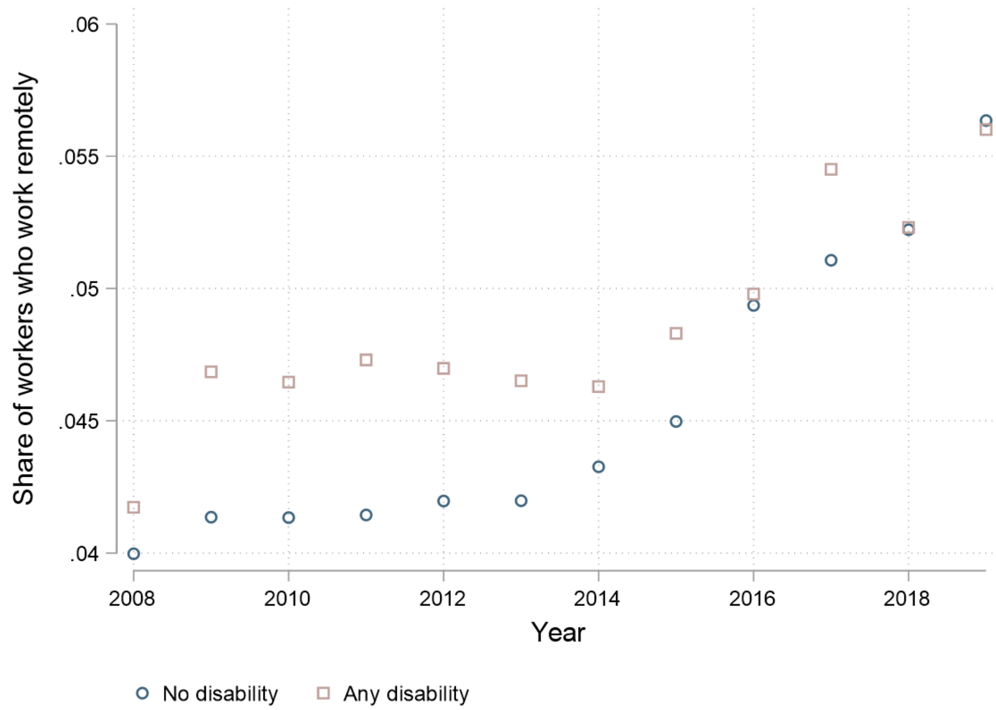
Remote Work

In the ACS, respondents are asked how they usually commuted to work during the week prior to the survey. I define an individual's remote work status based on their response to this question. Specifically, I code a person as a remote worker if they selected "Worked at home" as their primary mode of commuting. Because the ACS question[4] instructs respondents to report the mode of transportation used "for most of the distance," this category primarily captures individuals who worked entirely from home during the reference week. Hybrid workers who spent a majority of the week working from home but also commuted to a workplace less frequently are likely to report their usual commuting mode rather than "Worked at home" (Buckman et al., 2025). Consequently, the ACS measure should be interpreted as reflecting the incidence of fully remote work, and it likely understates the broader prevalence of remote and hybrid work arrangements.

Figure 1 shows the share of workers with and without disabilities who worked remotely in the United States from 2008 to 2019. Over this time period, the remote work share increases by 30-40 percent for both groups. While the percentage of remote workers in both groups increases steadily over the years, there is a consistent gap where workers with disabilities have a higher likelihood of working remotely than workers without disabilities throughout the majority of this period. Additionally, starting around 2014, the adoption of remote work accelerates for both populations, suggesting a growing adoption of remote work practices. This figure suggests that remote work has been particularly important for people with disabilities, who may benefit from the flexibility and accessibility it offers. It also reflects a broader trend toward remote work over time, which accelerated in more recent years.

[4]Specifically, this question asks: **How did this person usually get to work LAST WEEK?** *Mark (X) ONE box for the method of transportation used for most of the distance.*

Figure 1: Share of U.S. Workers who Work Remotely by Disability Status, 2008-2019



Notes: This figure illustrates the share of workers with and without disability who work remotely between 2008 and 2019 in the United States. Data are from the 2008-2019 American Community Survey (ACS).

4 Empirical Framework

4.1 Data

To measure the effect of the access to remote work on the workers' labor market outcomes, I combine individual-level IPUMS data derived from samples of the American Community Survey (Ruggles et al., 2024) with broadband data from Form 477 published by the Federal Communications Commission (FCC, 2024) and census-tract-level population estimates from the Surveillance, Epidemiology, and End Results (SEER) Program at the National Cancer Institute (NCI, 2022). In this subsecsection, I describe the adoption and population estimate data and the process to combine them with the ACS.

FCC Form 477

The broadband internet measure in this paper comes from the FCC's Form 477. Twice a year since 2008, the FCC publishes residential fixed broadband adoption rates at the census tract level.[5] The adoption rate data is reported as the number of connections per thousand households by census tract.

One limitation of this adoption rate data is that, while the FCC reports internet adoption rates for faster speeds in more recent years, information on services that are over 200 kilobits per second (kbps) in at least one direction is the only one that is available throughout my research period. However, the FCC data is the only source of information on broadband internet nationwide, so it is still widely used in the literature.

SEER Census Tract Population Estimates

To merge the census-tract-level Broadband adoption rate data from the FCC with the ACS data, I make use of population estimates from the NCI. The SEER Program publishes yearly census tract population estimates. These estimates are often used to calculate the expected number of cancer cases across different demographic groups in each census tract in order to identify cancer clusters. The data are derived from a combination of sources, including the decennial Census and the ACS, supplemented by statistical techniques.

Merging the FCC data with the ACS data

The Public Use Microdata Area (PUMA) is the most detailed geographic unit available in the public-use ACS data. To maintain confidentiality, each PUMA contains a minimum population of 100,000, and its boundaries are redrawn every decade based on updated population estimates from the decennial census.

[5] Fixed internet service refers to any type of internet service that terminates at a specific end-user premises. Common types of fixed broadband technologies include: cable, digital subscriber line (DSL), fiber, satellite, and terrestrial fixed wireless.

Aggregating the FCC's tract-level broadband adoption data to the PUMA level may seem like a natural choice for merging it with ACS data. However, as discussed in Section 4.3, my research design requires a consistent spatial unit across time. This presents a challenge because PUMA boundaries change over time, leading to substantial mismatches in many areas.

To address this issue, the IPUMS project at the Minnesota Population Center developed the Consistent PUMA (CPUMA) geography (Ruggles et al., 2024). Each CPUMA is defined to correspond exactly to a set of 2010 PUMAs while also closely aligning with a set of 2000 PUMAs. This makes CPUMA the lowest level of geography that can be consistently identified throughout the public-use ACS in the 2000s and 2010s, ensuring comparability over time.

To crosswalk the tract-level FCC data to the CPUMA level, I first standardize the 2008–2010 data, originally reported using the 2000 tract definitions, to the 2010 tract definitions. This step is necessary because each 2010 PUMA is constructed from a specific set of 2010 census tracts, whereas 2000 PUMAs were defined using a mix of counties, tracts, minor civil divisions, or incorporated places. As a result, many 2000 PUMA boundaries do not align neatly with either 2000 or 2010 tract boundaries, complicating longitudinal geographic comparisons.

To address this misalignment, I use the crosswalk tool developed by Logan et al. (2014), which enables the standardization of any tract-level data to the 2010 tract boundaries. Once the FCC data are converted to the 2010 tract definitions, I aggregate them first to the 2010 PUMA level and then to the CPUMA level, weighting by SEER census-tract population estimates. This approach assumes that individual broadband adoption rates mirror household adoption rates reported in Form 477.

Figure 2 shows the changes in the percentage of households having an internet connection of at least 200 kbps one way in each CPUMA between 2008 and 2019.[6] In 2008, several CPUMAs in the southern United States had adoption rates below 40 percent, indicating limited access to broadband. In contrast, the Northeast exhibited relatively higher adoption rates. By 2019, broadband adoption had increased significantly, with over 60 percent of households in most CPUMAs having access to broadband internet. This shows a notable expansion of broadband availability, especially in previously underserved areas.

One drawback of using the CPUMA is that it is about twice as big in terms of population compared to PUMAs, so to analyze the labor market effect at a more granular level, I use a subsample of individuals in the ACS, whose county of residence can be identified. Since county information is not included in the public-use ACS data, a county can only be identified if it shares the same boundary as a PUMA, or if a PUMA sits completely inside a county. About 60 percent of individuals in my sample live in an identifiable county. One thing to note is that since a PUMA must have at least 100,000 people and it often contains several counties when the population of each county is small. As a result, rural counties are underrepresented when using this subsample with county information.

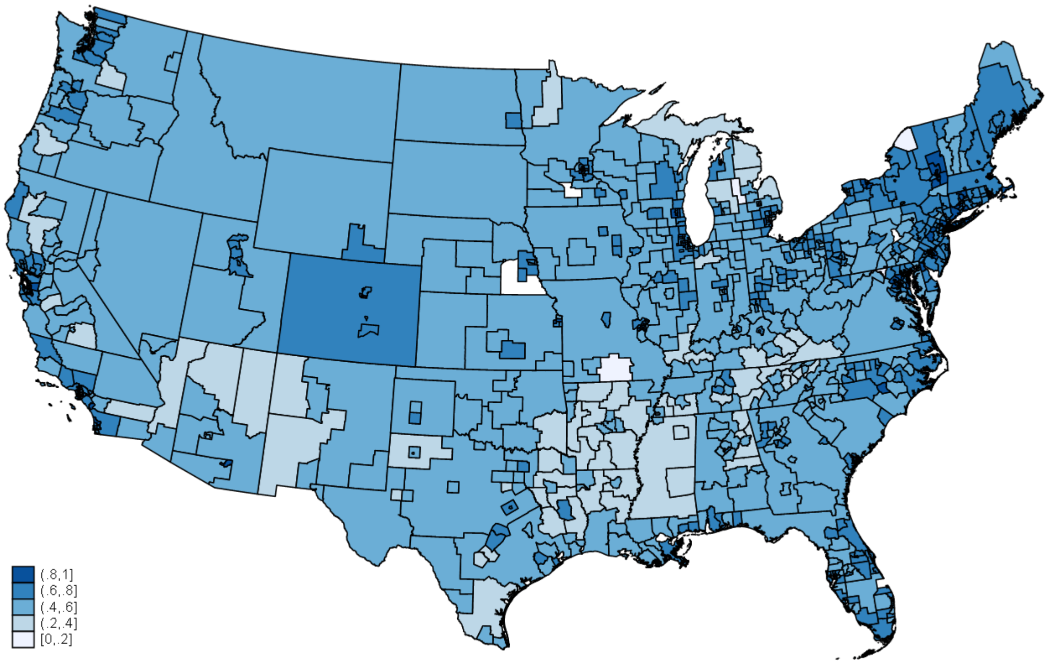
4.2 Estimating Equation and Identification

To assess the heterogeneous effects of access to remote work on the labor market outcomes of people with disabilities compared to those without disabilities, I employ a two-way fixed effects model. Specifically, I estimate the following model for each individual i residing in CPUMA c in year t:

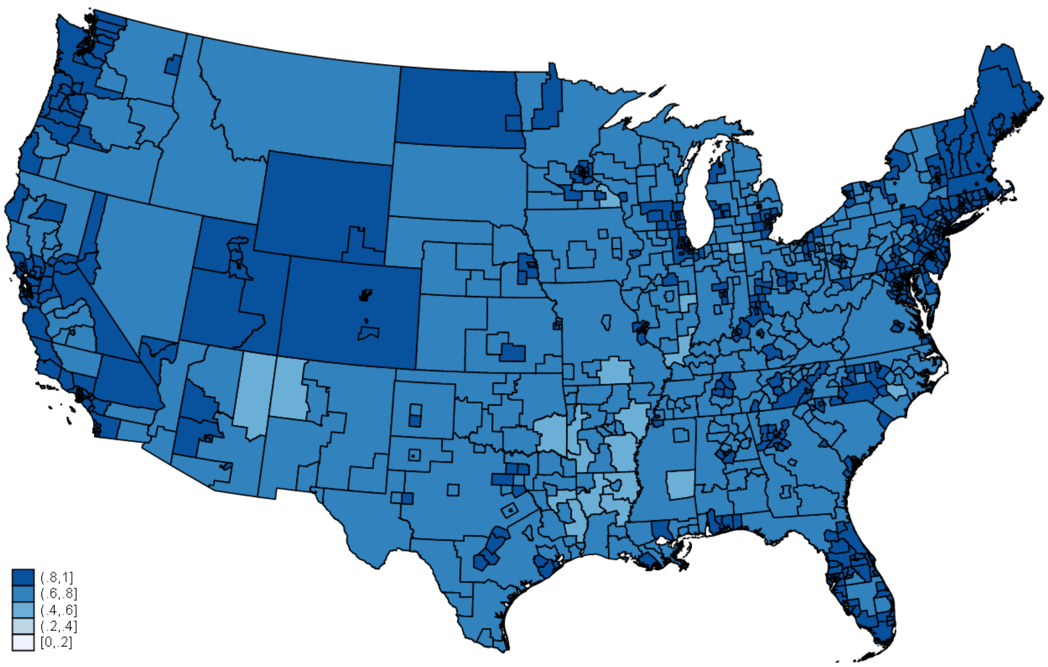
$$\begin{aligned} y_{ict} = {} & \beta BB_{ct} + \beta_D (BB_{ct} \times \mathbb{1}\{D\}) + \gamma RWD_{ct} + \gamma_D (RWD_{ct} \times \mathbb{1}\{D\}) \\ & + X'_{ict}\delta + \tau_{c,D(i)} + \lambda_{t,D(i)} + \epsilon_{ict} \, , \end{aligned} \tag{1}$$

[6] The changes in county-level adoption rates can be found in Figure B1.

Figure 2: Changes in Residential Broadband Adoption Rate by CPUMA



(a) 2008



(b) 2019

Notes: This figure shows the residential fixed broadband adoption rate by Consistent Public Use Microdata Area (CPUMA) in 2008 (Panel (a)) and 2019 (Panel (b)). Data are from the Federal Communications Commission's Form 477 from 2008 to 2019. Fixed broadband is defined as having a connection of over 200 kilobits per second (kbps) in at least one direction, and include all technologies except terrestrial mobile wireless.

where y_{ict} is the labor market outcome. I focus on four outcome variables: employment status, hours worked, hourly wage,[7] and earnings. Access to remote work is measured by two variables: BB_{ct}, which is the percentage of households with access to broadband internet, captures the level of broadband penetration in each CPUMA in year t, and RWD_{ct}, a Bartik-style measure of demand for remote worker (Bartik, 1991), captures remote work intensity. Both broadband and Bartik demand shock variables are interacted with the disability indicator, $\mathbb{1}\{D\}$. They are also standardized to have a mean of zero and a standard deviation of one to ensure comparability. Details of these variables are explained below. X_{ict} is a vector that includes demographic controls such as gender, age, and educational attainment. This model includes CPUMA fixed effects, $\tau_{c,D(i)}$, to control for time-invariant geographic heterogeneity, and year fixed effects, $\lambda_{t,D(i)}$, to control for national economic shocks. Both fixed effects are specific to individual i's disability status, $D(i)$. The error term is indicated by ϵ_{ict}. The model is weighted by the ACS person weight and the standard errors are clustered at the CPUMA×year level.

The key explanatory variables capturing access to remote work are twofold: i) broadband access serves as a supply-side measure of whether workers have the technological means to work remotely and ii) Bartik-style remote work shock measure represents a demand-side measure of access to remote work. Remote work typically requires a stable and fast internet connection to handle tasks like video conferencing, file sharing, and accessing cloud-based applications. If broadband adoption is high in a region, it signals that the necessary infrastructure is in place, making remote work possible. While broadband adoption is a strong proxy for technical access, it does not account for other factors, such as whether the types of jobs available in that region are conducive to remote work or if workers have the necessary skills. Therefore, I include a second measure that captures the demand-side factor

[7] Hourly wages are not reported in the ACS, so I calculate them by dividing annual wage and salary income by the product of weeks worked last year and usual hours worked per week. The annual weeks worked variable is recorded in intervals, so I use the midpoint of each interval as the weeks worked value for each respondent.

of remote work.

The Bartik-style measure of demand for remote work is given by:

$$RWD_{ct} = \frac{\sum_a \frac{E_{ac,08}}{E_{a,08}} \times RW_{at}}{E_{c,08}}, \tag{2}$$

where $E_{ac,08}/E_{a,08}$ is the share of total employment in industry a that is located in CPUMA c in the base year 2008. The number of remote workers in industry a is represented by RW_{at}. In other words, the numerator estimates the intensity of remote work in a place by allocating the national industry-specific shocks in the demand for remote workers across CPUMAs, weighted by the employment concentration in the baseline period. This estimate is then scaled by the total working population in CPUMA c in 2008. This demand-side variable helps capture the availability of remote work opportunities driven by industry-specific trends, which may vary significantly across regions and industries.

It is worth noting that the coefficients of interest, β_D and γ_D, capture the intent-to-treat (ITT) effects of providing access to remote work opportunities, rather than the treatment-on-the-treated (TOT). These coefficients reflect the impact of making broadband available or increasing demand for remote work on employment outcomes, regardless of individual adoption or engagement. This is particularly insightful from a policy standpoint, as the extent to which a policy intervention (such as broadband rollout) leads to effective usage depends on adoption rates, usage frequency, and the ways in which the technology is utilized—factors that are outside the direct control of policymakers, as pointed out by Dettling et al. (2018). Additionally, ITT captures the potential peer effects, which are often empirically difficult to separate from the actual treatment effects. Thus, ITT estimates provide an easy-to-interpret measure of the overall impact of a policy intervention.

4.3 Identifying Assumption and Supportive Evidence

My identification strategy takes advantage of two sources of quasi-random variation. First, the gradual rollout of broadband internet across geographies provides a quasi-random variation in the availability of technological infrastructure necessary for remote work. The diffusion of broadband internet was influenced by factors such as difficult terrain and local regulations, which were not directly related to labor market conditions. For example, Kolko (2012) shows that slope of terrain is negatively associated with broadband availability. The Telecommunication Act of 1996 gave municipal jurisdiction over public rights-of-way utilized by telecommunications providers. This created significant variation in the degree to which municipalities could impose fees on internet service provider entering the local market (Day, 2001; Lelkes et al., 2017). The second source of variation comes from industry-specific remote work shocks. Since the Bartik meausre is driven by national trends rather than local labor market conditions, it also provides a source of exogenous variation in access to remote work opportunities.

The identifying assumption is that variation in the timing of broadband adoption and the demand for remote work are orthogonal to pre-existing trends in the gaps in the labor market outcome between people with and without disabilities. This assumption could be violated if, for example, the rollout of broadband is driven by places with growing industries that favor workers without disabilities.

Additionally, since my focus is on the differential impact of access to remote work on the labor market outcomes of people with disabilities relative to people without disabilities, unobserved factors that impact both groups equally would not necessarily threaten the identification strategy.

To provide some support for the identifying assumption, I analyze the relationship between pre-period changes in the labor market outcome gaps and remote work accessibility.

Specifically, I estimate

$$\Delta gap_{c,05-07} = \alpha + \beta \Delta BB_{c,08-19} + \gamma \Delta RWD_{c,08-19} + \epsilon_c\,, \tag{3}$$

where $\Delta gap_{c,05-07}$ is the changes in the disability labor market outcome gap in CPUMA c between 2005 and 2007.[8] I regress the changes in the outcome variable on changes in the broadband adoption rate ($\Delta BB_{c,08-19}$) and Bartik demand shock ($\Delta RWD_{c,08-19}$) between 2008 and 2019. The results, summarized in Table 3, show that the coefficients on the Bartik remote work demand or broadband adoption rate are small in magnitude and statistically insignificant across all labor market outcomes. These findings lend credibility to the identifying assumption that variation in the timing of broadband adoption and the demand shock are unrelated to pre-existing trends in the disability labor market outcome gaps.

Table 3: Pre-Period Labor Market Outcome Gaps and Remote Work Accessibility

	Employment	Hours	asinh(hourly wage)	asinh(wage)
ΔBartik$_{08\text{-}19}$	0.006	-0.085	-0.004	0.009
	(0.006)	(0.298)	(0.026)	(0.068)
ΔBroadband$_{08\text{-}19}$	0.002	-0.009	0.006	0.011
	(0.006)	(0.205)	(0.018)	(0.054)
Clustering level	State	State	State	State
Observations	1,074	1,074	1,074	1,074

Notes: The dependent variable is changes in the CPUMA-level disability labor market outcome gap between 2005 and 2007. It is regressed on changes in the Bartik-style remote work demand and broadband adoption rate between 2008 and 2019. Standard errors adjusted for clustering at the state level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Rotemberg Weights

Goldsmith-Pinkham et al. (2020) show that a Bartik estimator is numerically equivalent to a generalized method of moments (GMM) estimator with local industry shares as instruments

[8] For example, the disability employment gap in CPUMA c in 2007 is given by $emp^{D}_{c,07} - emp^{noD}_{c,07}$, where emp is the employment rate. Superscripts D and noD denote any disability or no disability, respectively.

and a specific weight matrix constructed from national growth rates. As it combines many instruments, estimation can feel like a black box, because it is hard to tell which instruments drive the estimate. Therefore, they recommend decomposing the Bartik estimator into a weighted sum of just-identified instrumental variable estimators that use each industry share as a separate instrument. The weights, which sum to one, are called Rotemberg weights.

Table 4 shows that industries with the highest Rotemberg weights account for over 60 percent of the overall estimate, emphasizing their relevance in explaining the variation in Bartik remote work measure. These industries are measured at the 2-digit North American Industry Classification System (NAICS) level. There are 20 2-digit NAICS sectors.

Table 4: Summary of Rotemberg Weights

Industry Name	$\hat{\alpha}_a$	g_a	$\hat{\beta}_a$	Ind Share (%)
Professional, Scientific, and Technical Services	0.329	27,345.59	0.013	7.011
Finance and Insurance	0.126	10,425.14	0.017	4.953
Agriculture, Forestry, Fishing and Hunting	0.070	6,142.10	0.008	1.316
Construction	0.058	6,138.43	0.022	7.187
Retail Trade	0.049	8,832.05	0.029	10.643

Notes: This table reports the top five industries according to Rotemberg weights. See Goldsmith-Pinkham et al. (2020) for details. All the statistics are aggregated across my research period, 2008-2019. $\hat{\alpha}_a$ is the estimated Rotemberg weight in industry a. g_a is the national remote work employment in each industry. $\hat{\beta}_a$ is the coefficient from the just-identified regression. Ind share is the percent of employment in the industry. The industries are based on the 2-digit North American Industry Classification System (NAICS) code. There are 20 2-digit sectors in NAICS.

To address the identification concern that the composition of industries in a region may be systematically related to trends in disability labor market gaps, Table 5 examines the relationship between industry shares in 2005 and trends in disability employment gaps from 2005 to 2007 at the CPUMA level. Most coefficients on trends in the disability employment gaps are small and insignificant. These findings suggest that industry shares of those that are most important for identifying the effect of the remote work demand shocks are uncorrelated with pre-trends in the disability employment gaps, lending support to the identifying assumption.

Table 5: Relationship between CPUMA-level Industry Shares and Characteristics

	Sci	Fin	Ag	Cons	Ret
ΔDisability Emp Gap$_{05\text{-}07}$	0.000	0.006	0.022***	0.006	0.005
	(0.007)	(0.007)	(0.008)	(0.007)	(0.006)
Clustering level	State	State	State	State	State
Adj. R^2	0.834	0.498	0.361	0.459	0.349
Observations	1,078	1,078	1,078	1,078	1,078

Notes: Each column reports a separate regression. The dependent variable is CPUMA-level industry share of the indicated industry in 2005. It is regressed on trends in the disability employment gap between 2005 and 2007 and CPUMA-level characteristics in 2005. Standard errors adjusted for clustering at the state level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5 Results

5.1 Effects on Employment

Table 6 presents the estimated effects of access to remote work on employment status, using the specification in Equation (1). The first three columns report the overall effects on employment, while the last three columns examine whether these effects are primarily driven by self-employed, full-time, or part-time workers. In Column 1, access to remote work is measured solely by the Bartik-style remote work demand measure, RWD. Column 2 instead uses broadband adoption rate (BB) as a measure of access to remote work. Columns 3-6 combine both measures. The Bartik and broadband measures are at the CPUMA×year level.[9] Rows 1 and 3 show the overall effects while Rows 2 and 4 highlight the differential impact on people with disabilities.

Focusing first on the first three columns, the coefficients on remote work demand are positive and statistically significant across all specifications. This indicates that higher demand for remote work improves employment prospects for the general population. For individuals with disabilities, the interaction term in Row 2 suggests that higher remote

[9]Results obtained using the county×year measures are in Table B1.

work demand disproportionately benefits this group. Specifically, a one standard deviation increase in the Bartik measure increases the probability of employment by 2.1 percentage points, compared to those without disabilities.

Similarly, the coefficients on the broadband measure in Row 3 are consistently positive and significant, indicating that higher broadband adoption is linked to greater employment overall. However, the interaction term in Row 4 is either negative or not statistically significant, implying that while broadband expansion raises employment in general, it does not confer additional benefits to people with disabilities.

Comparing the results across the first three columns, the effects of Bartik remote work demand and broadband adoption are both robust and complementary. This suggests that they address distinct dimensions of remote work access and may jointly contribute to narrowing the disability gaps in these key labor market outcomes. Therefore, Column 3, which includes both measures, is the preferred specification.

The last three columns explore whether the employment effects are driven by particular subgroups. This is implemented by interacting the employment status variable with an indicator variable for whether an individual is a self-employed, full-time, or part-time worker. Using the preferred specification, the differential effects of remote work demand remain positive and significant, with the largest gains observed for full-time employment. This pattern suggests that improved access to remote work increases employment for people with disabilities, and more importantly, it enables them to transition into stable, full-time positions. The differential effect on self-employment, though smaller in absolute terms (0.6 percentage points), represents an increase of approximately 16.7% relative to the mean, as only 3.6% of individuals with disabilities engage in self-employment.

In contrast, the differential effects of broadband adoption are mostly small and imprecisely measured. The only significant interaction is observed for self-employment, where the coefficient is negative and statistically significant, suggesting that people with disabilities may be less likely to pursue self-employment in areas with high broadband adoption.

Overall, these results suggest that while access to remote work—both in terms of demand for remote workers and broadband infrastructure—plays an important role in increasing employment for the overall population, increasing demand for remote workers would be more helpful in closing the disability employment gaps.

Table 6: Effect of Access to Remote Work on Employment Status

	Employed			Self-employed	Full-time	Part-time
Bartik	0.003***		0.004***	-0.001**	0.003***	0.001*
	(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
Bartik×D	0.020***		0.021***	0.006***	0.016***	0.005**
	(0.003)		(0.003)	(0.001)	(0.003)	(0.002)
Broadband		0.001**	0.002***	0.002***	0.000	0.001***
		(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Broadband×D		-0.001	0.001	-0.001*	0.002	-0.001
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
D dep var mean	0.355	0.355	0.355	0.036	0.263	0.092
Year × D FEs	Y	Y	Y	Y	Y	Y
CPUMA × D FEs	Y	Y	Y	Y	Y	Y
Adj. R^2	0.174	0.174	0.174	0.028	0.174	0.026
Observations	19,212,006	19,212,006	19,212,006	19,212,006	19,212,006	19,212,006

Notes: The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school. The dependent variable in Columns 1-3 is an indicator variable for whether an individual is employed. In Columns 4-6, it is interacted with another indicator variable for whether the individual is a self-employed, full-time ($\geq$ 35 hours), or part-time worker. In all specifications, I control for gender, age, age squared, race/ethnicity, education, marital status, house ownership, number of own children in the household, household size, and citizenship. Bartik and broadband measures are both at the CPUMA×year level. Standard errors adjusted for clustering at the CPUMA×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.2 Effects on Hours

Access to remote work not only affects an individual's probability of being employed, it can also influence the number of hours they work. Table 7 summarizes the effect of access to remote work on hours worked per week. In the first three columns, I show that effect on the overall population is robust to whether the other measure for access to remote work is included or not, similar to Table 6. Then, in the last three columns, the hours worked variable is interacted with whether or not a person is self-employed, a full-time worker, or a part-time worker, respectively.

In terms of the overall impact of remote work demand on hours worked (Row 1), most coefficients are positive and significant, showing that an increase in the demand for remote worker increases hours worked of the general population.

People with disabilities experience stronger positive effects of the remote work demand shock on hours worked relative to people without disabilities. In Row 2, it shows that a one standard deviation in the Bartik measure is associated with an increase of 50 minutes per week, or 5% relative to the average hours worked for people with disabilities.

The effects of access to remote work measured by broadband adoption tell a different story. For people without disabilities, the effects of broadband access, for the most part, are somewhat noisy. While the increase in self-employed and part-time hours are positive and statistically significant, the overall impact is attenuated. For people with disability, broadband adoption exhibits similar patterns but with smaller effects than remote work demand. A one standard deviation increase in broadband adoption increases hours worked of people with disabilities by nine minutes per week relative to those without disabilities.

These findings highlight that access to remote work influences work intensity differently across employment types and for individuals with disabilities. While the Bartik remote work demand positively impacts hours worked overall, it particularly benefits individuals with disabilities, especially in full-time roles. Broadband adoption, while not exhibiting a differential effect on the likelihood of employment, it does increase the amount of hours worked, especially for those who work full-time.

Overall, the results suggest that broadband infrastructure and demand for remote workers can play an important role in closing labor market gaps for individuals with disabilities, particularly by increasing their ability to work full-time hours.

Table 7: Effect of Access to Remote Work on Hours Worked per Week

	Hours worked			Self-employed	Full-time	Part-time
Bartik	0.138***		0.135***	-0.065**	0.083*	0.052***
	(0.042)		(0.044)	(0.028)	(0.051)	(0.018)
Bartik×D	0.771***		0.838***	0.268***	0.762***	0.076
	(0.137)		(0.139)	(0.058)	(0.144)	(0.051)
Broadband		-0.024	-0.006	0.105***	-0.032	0.025**
		(0.023)	(0.023)	(0.014)	(0.027)	(0.010)
Broadband×D		0.076	0.155**	-0.044*	0.143**	0.012
		(0.059)	(0.061)	(0.025)	(0.062)	(0.024)
D dep var mean	15.681	15.681	15.681	1.363	13.126	2.554
Year × D FEs	Y	Y	Y	Y	Y	Y
CPUMA × D FEs	Y	Y	Y	Y	Y	Y
Adj. R^2	0.210	0.210	0.210	0.031	0.188	0.029
Observations	19,212,006	19,212,006	19,212,006	19,212,006	19,212,006	19,212,006

Notes: The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school. The dependent variable in Columns 1-3 is the number of hours an individual usually works per week. In Columns 4-6, it is interacted with an indicator variable for whether the individual is a self-employed, full-time ($\geq$ 35 hours), or part-time worker. In all specifications, I control for gender, age, age squared, race/ethnicity, education, marital status, house ownership, number of own children in the household, household size, and citizenship. Bartik and broadband measures are both at the CPUMA×year level. Standard errors adjusted for clustering at the CPUMA×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.3 Effects on Hourly Wages and Earnings

The effects of access to remote work on earnings and hourly wage are summarized in Table 8. Both variables are transformed using the inverse hyperbolic sine (asinh) function, which is similar to a log transformation but allows for the inclusion of zero wages (Bellemare & Wichman, 2020; Burbidge et al., 1988).

Hourly Wages

The coefficients on the Bartik measure are positive and statistically significant across all specifications, indicating that higher demand for remote work leads to increased hourly wages. A one standard deviation increase in the Bartik is associated with a 5.2% increase in hourly wages (Column 3). For people with disabilities, the Bartik interaction term in Row 2 suggests an additional 4.2% increase, reflecting that the benefits of increased remote work demand are particularly pronounced for this group. This finding aligns with the hypothesis that remote work reduces barriers such as workplace accessibility or transportation costs, leading to wage gains for people with disabilities.

In contrast, the broadband measure exhibits a slightly negative relationship with hourly wages for the overall population (-0.7%), but the differential impact is positive and statistically significant effect (1.5%) for individuals with disabilities.

Earnings

The effects on earnings (Columns 4-6) show a similar pattern. A one standard deviation increase in the Bartik demand shock is associated with a 10.4% increase for the general population and an additional 16.3% for people with disabilities.

The broadband measure, while having a negative main effect, shows a strong positive differential effect (4.2%) for people with disabilities.

When comparing the coefficients in Rows 2 and 4, notice that both Bartik and broadband have larger differential impacts on earning than on hourly wages. This shows that the increase in earnings is due to both an increase in pay rates and an increase in work intensity or hours worked.

5.4 Exploring Mechanisms: Remote Work Participation

A natural question arising from the main results is how increased access to remote work improves labor market outcomes for people with disabilities. One potential mechanism is that it enables them to actually take up remote jobs. To explore this channel, I examine the effect of remote work access on the likelihood of an individual being a remote worker.

Table 8: Effect of Access to Remote Work on Hourly Wages and Earnings

	asinh(hourly wage)			asinh(earnings)		
Bartik	0.056***		0.052***	0.112***		0.104***
	(0.004)		(0.004)	(0.011)		(0.011)
Bartik×D	0.036***		0.042***	0.145***		0.163***
	(0.012)		(0.012)	(0.035)		(0.035)
Broadband		-0.014***	-0.007***		-0.032***	-0.018***
		(0.002)	(0.002)		(0.006)	(0.006)
Broadband×D		0.012**	0.015***		0.030*	0.042***
		(0.005)	(0.005)		(0.015)	(0.015)
D dep var mean	1.368	1.368	1.368	4.177	4.177	4.177
Year × D FEs	Y	Y	Y	Y	Y	Y
CPUMA × D FEs	Y	Y	Y	Y	Y	Y
Adj. R^2	0.211	0.211	0.211	0.183	0.183	0.183
Observations	19,212,006	19,212,006	19,212,006	19,212,006	19,212,006	19,212,006

Notes: The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school. Earnings refer to an individual's annual wage and salary income. Hourly wages are calculated by dividing earnings by the product of weeks worked last year and usual hours worked per week. Both earnings and hourly wages are converted to 2019 dollars using the Consumer Price Index for All Urban Consumers Retroactive Series (CPI-U-RS) from the Bureau of Labor Statistics. In all specifications, I control for gender, age, age squared, race/ethnicity, education, marital status, house ownership, number of own children in the household, household size, and citizenship. Bartik and broadband measures are both at the CPUMA×year level. Standard errors adjusted for clustering at the CPUMA×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Column 1 of Table 9 presents the results where the dependent variable is an indicator for whether an individual works remotely. The estimates show that while both the Bartik-style remote work demand measure and broadband adoption are positively associated with the overall likelihood of an individual being a remote worker, there is no statistically significant differential effect for individuals with disabilities. This finding likely reflects measurement limitations in the ACS, where "worked at home" captures only individuals who worked fully remotely in the reference week and excludes hybrid arrangements. As a result, the ACS measure may underestimate the extent to which people with disabilities engage in remote work to some degree.

To address this limitation, Columns 2-4 turn to an alternative outcome based on industry-level remote work potential. Specifically, I use the remotable share index developed by Dingel and Neiman (2020) that measures the share of jobs within an industry that can be performed entirely at home. I estimate whether people with disabilities are more likely to work in industries above the 25^{th}, 50^{th}, or 75^{th} percentiles of this index. The results show a positive and significant differential effect at the lower and middle thresholds, suggesting that individuals with disabilities are more likely to work in moderately remotable industries.

Overall, these findings reveal that while improved access to remote work primarily benefits people with disabilities by expanding employment opportunities in moderately remote-friendly industries, even though they are not more likely than those without disabilities to work in a fully remote capacity.

Table 9: Effect of Access to Remote Work on Remote Work Participation

		Remotable Share		
	RW	$\geq 25^{th}$ percentile	$\geq 50^{th}$ percentile	$\geq 75^{th}$ percentile
Bartik	0.008***	0.006***	0.011***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)
Bartik×D	-0.000	0.013***	0.007**	-0.004**
	(0.001)	(0.003)	(0.003)	(0.002)
Broadband	0.001***	0.001	-0.000	-0.000
	(0.000)	(0.001)	(0.001)	(0.000)
Broadband×D	0.000	0.001	-0.000	-0.000
	(0.000)	(0.001)	(0.001)	(0.001)
D dep var mean	0.016	0.279	0.196	0.068
CPUMA × D FEs	Y	Y	Y	Y
Year × D FEs	Y	Y	Y	Y
Adj. R^2	0.014	0.152	0.151	0.127
Observations	19,212,006	19,212,006	19,212,006	19,212,006

Notes: The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school. The dependent variable in Column 1 is an indicator variable for whether an individual is a remote worker. In Columns 2-4, it is whether an individual works in an industry with a remotable share that exceeds the 25^{th}, 50^{th}, or 75^{th} percentiles of the industrial remotable index by Dingel & Neiman (2020). In all specifications, I control for gender, age, age squared, race/ethnicity, education, marital status, house ownership, number of own children in the household, household size, and citizenship. Bartik and broadband measures are both at the CPUMA×year level. Standard errors adjusted for clustering at the CPUMA×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.5 Robustness

Table 10 assesses the robustness of the differential effects reported in Tables 6–8. Column 1 replicates the baseline results from the preferred specification for comparison. Column 2 excludes self-employed individuals to ensure that the findings are not disproportionately influenced by individuals who are more likely to work from home. In Column 3, workers in the Agriculture, Forestry, Fishing, and Hunting industry are excluded, as this is the only industry among the top five in terms of Rotemberg weights where trends in the disability employment gaps from 2005 to 2007 are systematically tied to industry share. Column 4 adds Agriculture, Forestry, Fishing and Hunting×year fixed effects to the baseline specification to account for industry-specific time trends. Finally, Column 5 excludes individuals aged 51 and older to ensure that the results are not primarily driven by older workers, as documented in Liu and Quinby (2024), who find that remote work significantly contributed to employment gains for older individuals with disabilities.

Across all specifications, the coefficients remain consistent, suggesting that the results are robust to these exclusions and additional controls. This indicates that the observed effects are not driven by any particular subgroup or industry but rather reflect broader labor market dynamics.

5.6 Heterogeneous Effects: Disability Type

Different disability type may affect an individual's capacity to work in distinct ways. For example, people with ambulatory disabilities may face challenges with jobs requiring physical movement, while those with hearing impairments may have difficulty in jobs that involve frequent phone communication. These differences suggest that the benefits of remote work could vary substantially across disability types. Therefore, I examine whether the differential effects of remote work access depend on the nature of the disability.

To do this, I restrict the sample to people with only one type of disability and those

Table 10: Robustness: Differential Effects of Access to Remote Work on Labor Market Outcomes

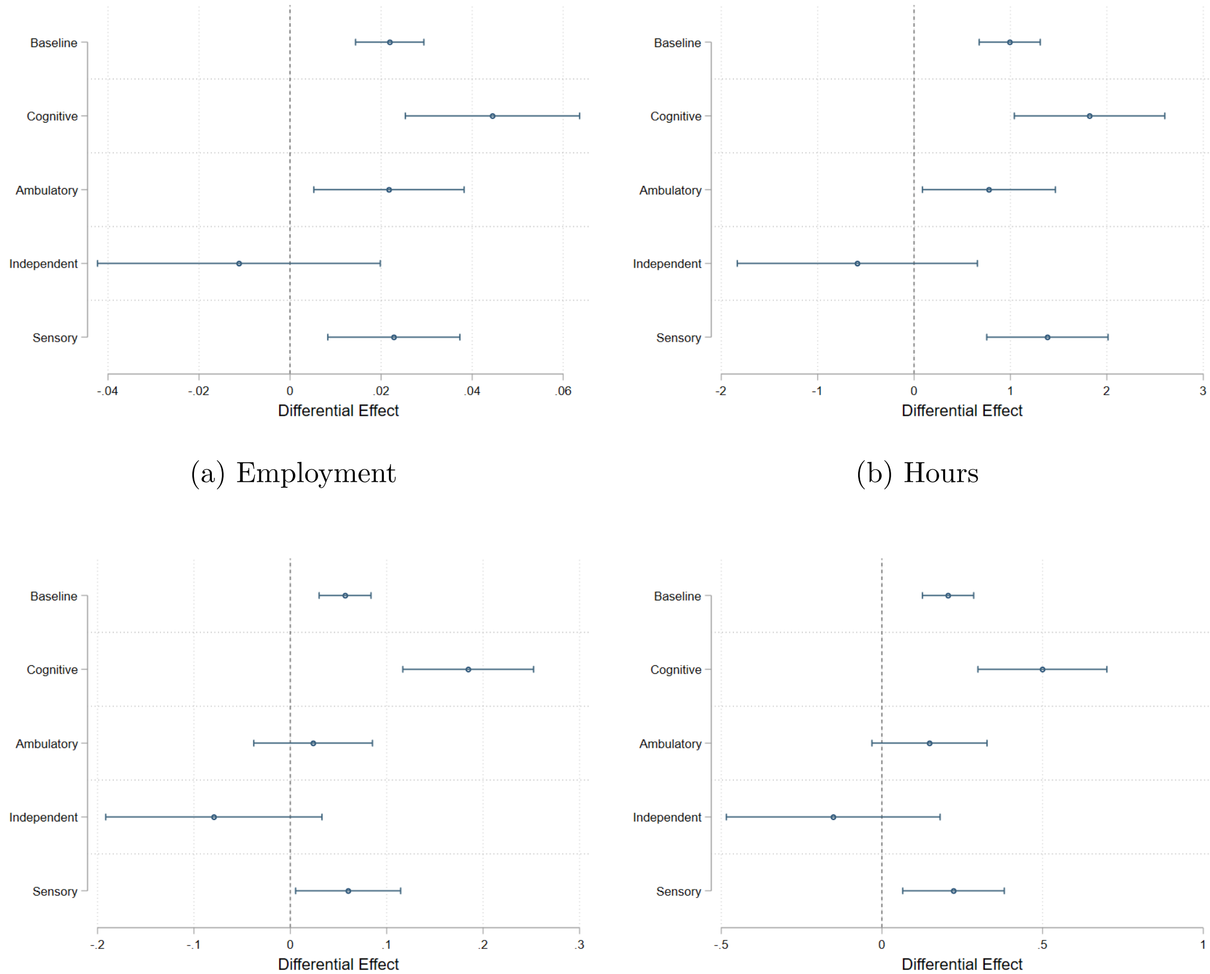
	Baseline	Exclude Self-Emp	Exclude Ag	Ag×year FEs	Exclude Age 51+
Panel A: Employment Status					
Bartik×D	0.021***	0.019***	0.020***	0.021***	0.024***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)
Broadband×D	0.001	0.001	0.001	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Observations	19,212,006	17,743,514	18,988,800	19,212,006	12,013,811
Panel B: Hours Worked per Week					
Bartik×D	0.838***	0.773***	0.810***	0.833***	0.877***
	(0.139)	(0.139)	(0.139)	(0.139)	(0.204)
Broadband×D	0.155**	0.146**	0.147**	0.153**	0.183**
	(0.061)	(0.061)	(0.061)	(0.060)	(0.089)
Observations	19,212,006	17,743,514	18,988,800	19,212,006	12,013,811
Panel C: asinh(hourly wage)					
Bartik×D	0.042***	0.044***	0.041***	0.041***	0.048***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.017)
Broadband×D	0.015***	0.013**	0.015***	0.015***	0.020***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)
Observations	19,212,006	17,743,514	18,988,800	19,212,006	12,013,811
Panel D: asinh(earnings)					
Bartik×D	0.163***	0.170***	0.160***	0.159***	0.176***
	(0.035)	(0.036)	(0.035)	(0.035)	(0.052)
Broadband×D	0.042***	0.036**	0.042***	0.042***	0.055**
	(0.015)	(0.016)	(0.016)	(0.015)	(0.023)
Observations	19,212,006	17,743,514	18,988,800	19,212,006	12,013,811

Notes: This table checks the differential effects reported in Tables 6–8 for robustness. Columns 1 presents the baseline results from the preferred specification. Column 2 excludes self-employed individuals. Column 3 excludes individuals in the Agriculture, Forestry, Fishing and Hunting industry. Column 4 includes Agriculture, Forestry, Fishing and Hunting×year fixed effects. Column 5 excludes individuals above age 51. Bartik and broadband measures are both at the CPUMA×year level. Standard errors adjusted for clustering at the CPUMA×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

without any disability. I then replace the disability indicator ($\mathbb{1}\{D\}$) in Equation (1) with a categorical variable indicating disability type. Individuals with independent living and self-care difficulties are combined into a broader category, labeled as having an independent living disability, while those with vision or hearing difficulties are grouped as having a sensory disability. The results are summarized in Figure 3.

People with cognitive disabilities experience the largest improvements in employment, hours, hourly wage, and earnings, suggesting that the flexibility and autonomy of remote work could directly address the barriers they face in traditional workplaces, such as the stress of commuting, overstimulation in office environments, and limited ability to pace or structure work independently. However, most of these effects are too imprecisely measured to conclude whether they are significantly different from the baseline estimates.

Figure 3: Sum of Bartik and Broadband Differential Effects by Disability Type



(a) Employment

(b) Hours

(c) asinh(hourly wage)

(d) asinh(earnings)

Notes: This figure shows the differential effects of remote work access on employment status, hours worked, hourly wage, and earnings by disability type. Each dot represents the sum of Bartik and broadband differential effect coefficients. The lines around the dot represent the 95% confidence intervals. Row 1 shows the baseline result from the preferred specification. Rows 2-4 show the differential effect for people with the type of disability indicated on the y-axis.

5.7 Heterogeneous Effects: Terrain Ruggedness

Transportation challenges are often amplified for people with disabilities, especially in areas with rugged terrain. These geographic obstacles can increase the cost and difficulty of commuting, making remote work an even more valuable option in such regions. To examine whether the differential effects of remote work accessibility vary with terrain ruggedness, I estimate the baseline specification separately for two subsamples: individuals living in areas classified as “level or nearly level terrain” and those living in “slightly or more rugged terrain,” based on the Road Ruggedness Scale (RRS) by the U.S. Department of Agriculture, Economic Research Service (USDA ERS, 2023).

The RRS categorizes topographic variation along roads within census tracts into five groups: i) level, ii) nearly level, iii) slightly rugged, iv) moderately rugged, and v) highly rugged. For this analysis, I group the first two categories as “level or nearly level terrain” and the latter three as “slightly or more rugged terrain.”

Table 11 reveals notable geographic heterogeneity in the effects of access to remote work. In areas with flat or nearly flat terrain, the differential effects of the Bartik remote work shocks on employment status, hours worked, hourly wage, and earnings are all positive, statistically significant at the 1% level, and slightly larger than the baseline estimates. This suggests that in such regions, broader industry opportunities and economic structures are well-aligned with remote work adoption. The differential effects of broadband, while generally positive, are less consistently estimated. These patterns suggest that broadband access alone might not drastically alter labor market outcomes in regions where transportation and commuting challenges are relatively easy.

In contrast, in more rugged terrains, where transportation barriers are more pronounced, the differential effects of the Bartik demand shocks are weaker compared to the baseline, potentially reflecting fewer opportunities in industries compatible with remote work. Interestingly, the differential effects of broadband access are much stronger, particularly for employment. This indicates that broadband availability plays a critical role in overcoming geographic constraints, enabling individuals with disabilities to access work opportunities that would otherwise be unavailable due to mobility limitations.

These findings provide evidence that accessibility is the key mechanism driving the differential impact of remote work on people with disabilities. Individuals with disabilities benefit even more from remote work in rugged terrains than in flatter areas due to the higher commuting costs and mobility barriers associated with difficult terrain. The results also underscore the importance of broadband infrastructure in bridging economic disparities in geographically challenging regions. Policies aimed at expanding remote work opportunities should account for these spatial differences—while remote job growth benefits individuals in all areas, broadband expansion is particularly crucial in rugged terrains where physical mobility constraints are more binding.

Table 11: Effects of Access to Remote Work on Labor Market Outcomes by Terrain Ruggedness

	Baseline	Level/Nearly level	Slightly or more rugged
Panel A: Employment Status			
Bartik×D	0.021***	0.023***	0.018**
	(0.003)	(0.004)	(0.008)
Broadband×D	0.001	-0.000	0.009**
	(0.001)	(0.002)	(0.004)
Observations	19,212,006	15,993,697	3,218,309
Panel B: Hours Worked per Week			
Bartik×D	0.838***	0.949***	0.621**
	(0.139)	(0.156)	(0.315)
Broadband×D	0.155**	0.112*	0.381**
	(0.061)	(0.065)	(0.172)
Observations	19,212,006	15,993,697	3,218,309
Panel C: asinh(hourly wage)			
Bartik×D	0.042***	0.058***	-0.002
	(0.012)	(0.013)	(0.027)
Broadband×D	0.015***	0.009	0.041***
	(0.005)	(0.006)	(0.015)
Observations	19,212,006	15,993,697	3,218,309
Panel D: asinh(earnings)			
Bartik×D	0.163***	0.201***	0.073
	(0.035)	(0.039)	(0.081)
Broadband×D	0.042***	0.027	0.116**
	(0.015)	(0.017)	(0.045)
Observations	19,212,006	15,993,697	3,218,309

Notes: This table reports differential effects by terrain ruggedness. Terrain ruggedness is based on the Road Ruggedness Scale (RRS) published by Economic Research Service (ERS) of United States Department of Agriculture (USDA). Columns 1 presents the baseline results from the preferred specification. Column 2 restricts the sample to individuals living in level or nearly level terrain for road travel (categories 1 and 2 of RRS). Column 3 restricts the sample to individuals living in at least slightly rugged terrain (categories 3-5). Bartik and broadband measures are both at the CPUMA×year level. Standard errors adjusted for clustering at the CPUMA×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusion

In this paper, I provide empirical evidence on the differential impact of access to remote work on the labor market outcomes of people with disabilities, compared to those without disabilities. I merge demographic data from the ACS, internet adoption rate data from the FCC, and census tract population estimates from the NCI. I also identify both the supply-side (broadband adoption) and demand-side (Bartik-style measure of demand for remote work) factors that influence remote work access. I employ a two-way fixed effects strategy and exploit the quasi-random variation that arises from the staggered rollout of broadband internet in the United States and from the Bartik-style demand measure. The findings suggest that remote work can serve as a significant tool for improving labor market situation among people with disabilities.

Increasing remote work opportunities is shown to reduce disparities in key labor market outcomes like employment, hours worked, hourly wage, and earnings between people with and without disabilities, particularly among those who are self-employed and full-time workers. These results underscore the role of remote work in facilitating more flexible and accessible employment opportunities for those who may face greater physical or social barriers in traditional work environments. While the differential impact of broadband internet is not as clear-cut on employment, it does offset the negative main effect on hours worked, hourly wage, and earnings for individuals with disabilities.

This paper highlights the potential of expanding access to remote work as a policy tool to improve the labor market inclusion of people with disabilities. By reducing barriers to employment and offering more flexible work arrangements, remote work could help address longstanding disparities in labor market outcomes for this population. Future research could build on these findings by examining the specific mechanisms through which remote work affects people with different types of disabilities. In addition, exploring how particular job characteristics and different forms of remote work arrangements influence labor market outcomes could provide a deeper understanding of how remote work can best promote inclusion and equitable labor market opportunities.

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Appendices

A American Community Survey Disability Questions

The American Community Survey (ACS) currently uses six questions to determine if a respondent has a disability. These questions are:

- **Cognitive:** Because of a physical, mental, or emotional condition, does this person have serious difficulty concentrating, remembering, or making decisions?
- **Ambulatory:** Does this person have serious difficulty walking or climbing stairs?
- **Independent Living:** Because of a physical, mental, or emotional condition, does this person have difficulty doing errands alone such as visiting a doctor's office or shopping?
- **Self-Care:** Does this person have difficulty dressing or bathing?
- **Vision:** Is this person blind or does he/she have serious difficulty seeing even when wearing glasses?
- **Hearing:** Is this person deaf or does he/she have serious difficulty hearing?

B Additional Tables and Figures

Table B1: Effect of Access to Remote Work on Employment Status: County Subsample

	Employed			Self-employed	Full-time	Part-time
Bartik	0.002*		0.003*	-0.002***	0.002	0.001
	(0.001)		(0.001)	(0.001)	(0.002)	(0.001)
Bartik×D	0.013***		0.014***	0.005***	0.008*	0.006**
	(0.004)		(0.004)	(0.002)	(0.004)	(0.003)
Broadband		0.000	0.000	0.001***	-0.000	0.001
		(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Broadband×D		0.001	0.002	-0.001	0.002	0.000
		(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
D dep var mean	0.364	0.364	0.364	0.036	0.268	0.095
Year × D FEs	Y	Y	Y	Y	Y	Y
County × D FEs	Y	Y	Y	Y	Y	Y
Adj. R^2	0.160	0.160	0.160	0.027	0.164	0.024
Observations	10,413,206	10,413,206	10,413,206	10,413,206	10,413,206	10,413,206

Notes: The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school. The dependent variable in Columns 1-3 is an indicator variable for whether an individual is employed. In Columns 4-6, it is interacted with another indicator variable for whether the individual is a self-employed, full-time ($\geq$ 35 hours), or part-time worker. In all specifications, I control for gender, age, age squared, race/ethnicity, education, marital status, house ownership, number of own children in the household, household size, and citizenship. Bartik and broadband measures are both at the county×year level. Standard errors adjusted for clustering at the county×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B2: Effect of Access to Remote Work on Hours Worked per Week: County Subsample

	Hours worked			Self-employed	Full-time	Part-time
Bartik	0.098		0.079	-0.120***	0.045	0.034
	(0.068)		(0.069)	(0.037)	(0.079)	(0.028)
Bartik×D	0.503***		0.539***	0.199***	0.376**	0.164**
	(0.181)		(0.184)	(0.073)	(0.191)	(0.066)
Broadband		-0.048	-0.038	0.054***	-0.047	0.009
		(0.033)	(0.034)	(0.020)	(0.041)	(0.018)
Broadband×D		0.021	0.077	-0.043	0.038	0.039
		(0.078)	(0.079)	(0.033)	(0.082)	(0.031)
D dep var mean	15.902	15.902	15.902	1.336	13.284	2.617
Year × D FEs	Y	Y	Y	Y	Y	Y
County × D FEs	Y	Y	Y	Y	Y	Y
Adj. R^2	0.199	0.199	0.199	0.029	0.179	0.026
Observations	10,413,206	10,413,206	10,413,206	10,413,206	10,413,206	10,413,206

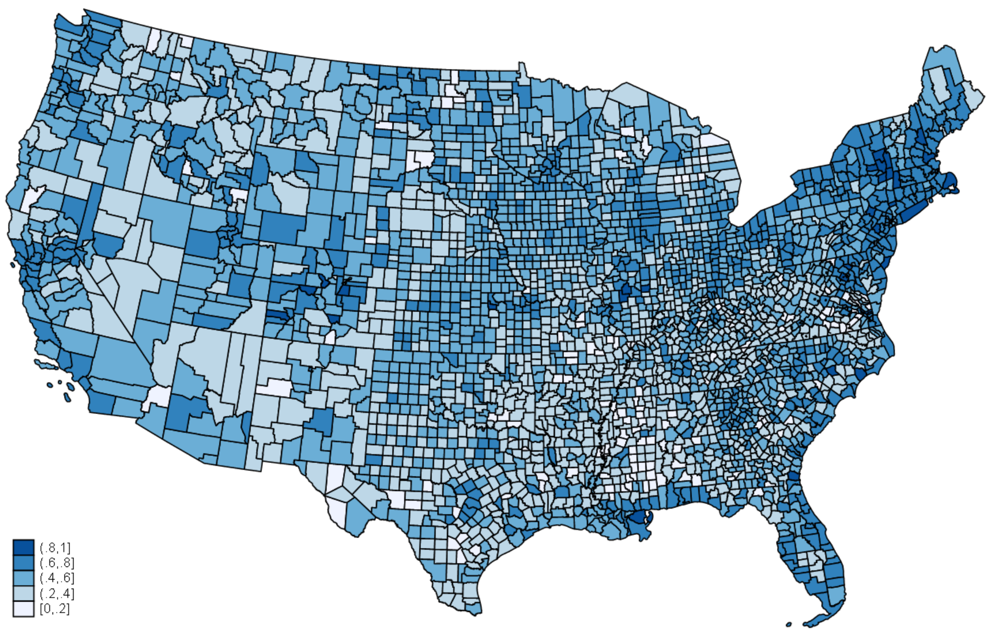
Notes: The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school. The dependent variable in Columns 1-3 is the number of hours an individual usually works per week. In Columns 4-6, it is interacted with an indicator variable for whether the individual is a self-employed, full-time ($\geq$ 35 hours), or part-time worker. In all specifications, I control for gender, age, age squared, race/ethnicity, education, marital status, house ownership, number of own children in the household, household size, and citizenship. Bartik and broadband measures are both at the county×year level. Standard errors adjusted for clustering at the county×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B3: Effect of Access to Remote Work on Hourly Wages and Earnings: County Subsample

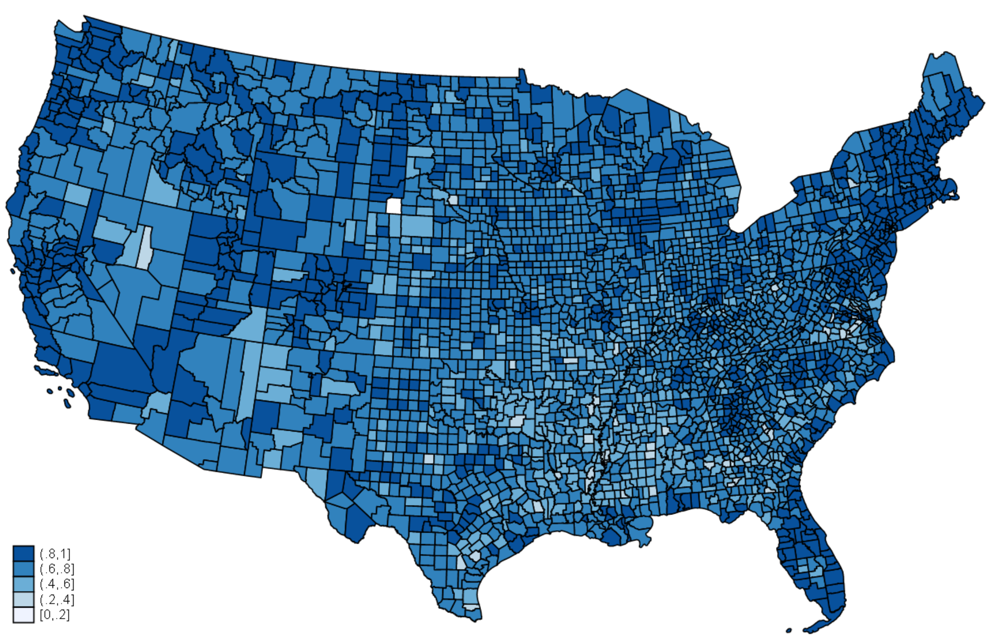
	asinh(hourly wage)			asinh(earnings)		
Bartik	0.057***		0.053***	0.108***		0.100***
	(0.007)		(0.007)	(0.017)		(0.017)
Bartik×D	0.015		0.022	0.081*		0.101**
	(0.015)		(0.015)	(0.045)		(0.045)
Broadband		-0.014***	-0.006**		-0.031***	-0.017**
		(0.004)	(0.003)		(0.009)	(0.009)
Broadband×D		0.014**	0.015**		0.034*	0.042**
		(0.007)	(0.007)		(0.021)	(0.021)
D dep var mean	1.420	1.420	1.420	4.296	4.296	4.296
Year × D FEs	Y	Y	Y	Y	Y	Y
County × D FEs	Y	Y	Y	Y	Y	Y
Adj. R^2	0.205	0.205	0.205	0.174	0.174	0.174
Observations	10,413,206	10,413,206	10,413,206	10,413,206	10,413,206	10,413,206

Notes: The sample consists of civilian population aged 16-64, who are not living in group quarters and not in school. Earnings refer to an individual's annual wage and salary income. Hourly wages are calculated by dividing earnings by the product of weeks worked last year and usual hours worked per week. Both earnings and hourly wages are converted to 2019 dollars using the Consumer Price Index for All Urban Consumers Retroactive Series (CPI-U-RS) from the Bureau of Labor Statistics. In all specifications, I control for gender, age, age squared, race/ethnicity, education, marital status, house ownership, number of own children in the household, household size, and citizenship. Bartik and broadband measures are both at the county×year level. Standard errors adjusted for clustering at the county×year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure B1: Changes in Residential Broadband Adoption Rate by County



(a) 2008



(b) 2019

Notes: This figure shows the residential fixed broadband adoption rate by county in 2008 (Panel (a)) and 2019 (Panel (b)). Data are from the Federal Communications Commission's Form 477 from 2008 to 2019. Fixed broadband is defined as having a connection of over 200 kilobits per second (kbps) in at least one direction, and include all technologies except terrestrial mobile wireless.