Does Broadband Technology Affect Social Security Applications?

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Abstract

Recently, policymakers have directed significant attention toward broadband connectivity in the United States, allocating approximately $65 billion for high-speed internet. However, over 42 million Americans still lack internet access, contributing to a persistent 'digital divide' primarily in rural areas and low socioeconomic households. This paper evaluates whether the expansion of broadband affects the likelihood of applying for, appealing to, or receiving Supplemental Security Income (SSI) and Social Security Disability Insurance (SSDI) benefits among older adults (50+ age). Leveraging a quasi-experimental staggered rollout of broadband and employing individual panel data, I exploit spatial and temporal as well as individual-level variations in broadband availability and employ the latest difference-in-differences (DID) estimator. I find that broadband rollout significantly increased the probability of SSDI application, appeal, or receipt among older adults by about 21%. Moreover, the findings reveal notable racial and regional disparities. These estimations underscore the benefits of broadband expansion and carry significant policy implications for SSDI and broadband expansion policies.

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1 Introduction

There are extensive administrative burdens for applying for Social Security benefits, including understanding eligibility and submitting paperwork and medical records. There could be an ambiguous effect of increasing these administrative burdens — only the people in dire need will apply for the benefits or opt-out due to the high costs. Such administrative burdens are distributive, i.e., they affect some groups more than others, creating structural barriers (Herd and Moynihan, 2019). Studies in behavioral economics suggest that these costs may discourage needy applicants (Bertrand *et al.*, 2004). Especially for older adults (50+), these frictions could be a cornerstone for individuals deciding whether to apply for Social Security benefits.

We have made enormous technological progress in recent decades, providing access to computers, the Internet, and smartphones; however, significant disparities still remain in access to these technologies. In 2000, about half (52%) of U.S. adults were using the Internet, and 1% of adults had home broadband, but by 2023, 95% of U.S. adults use the Internet, with 80% of adults reporting that they have broadband at home.[1] Importantly, broadband availability for older adults is also increasing. For instance, the availability of high-speed broadband for the 65+ population in 2010 was about 45 percent, but by 2018, it had become about 60 percent (Gawai, 2023). However, more than 42 million Americans still lack access to broadband services, and significant geographical and socioeconomic disparities remain in broadband access (Busby *et al.*, 2021). Federal agencies like the Social Security Administration (SSA) encourage applicants to use the Internet to apply for benefits (Kauff *et al.*, 2011).[2] One key reason for the focus on older adults is that the likelihood of individuals receiving SSDI increases by over two-fold between the ages of 40 and 50 and similarly doubles between ages 50 and 60 (CBPP). Figure 1 suggests that the percentage of people filling out online SSDI applications has been relatively consistent from 2014 onward, even after the

[1] Refer to the Pew Research Center report.

[2] See SSA official website.

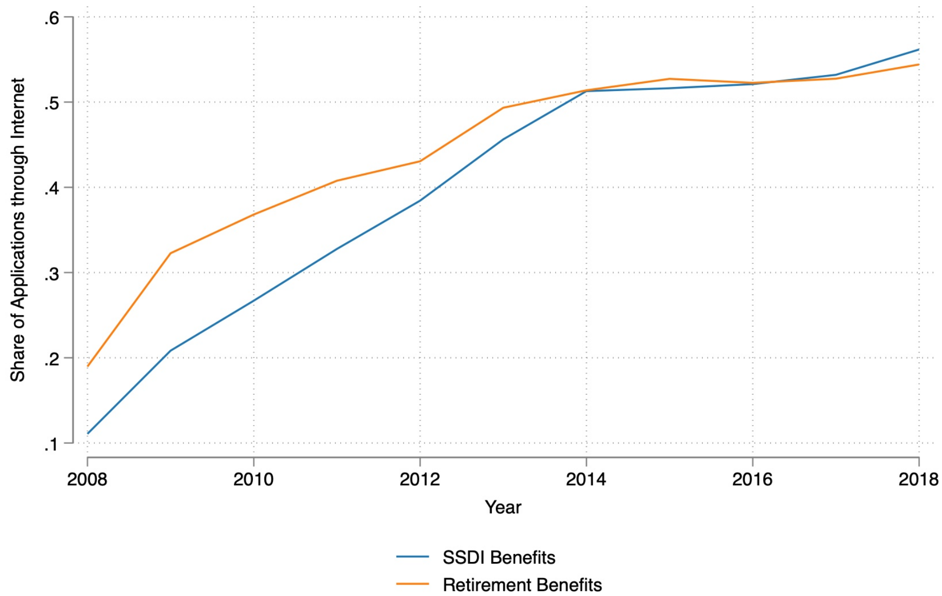
increase in broadband technology. The COVID-19 period highlighted the urgent need for internet connectivity for employment, business, and other essential activities. Recent policies to expand broadband access, mainly in rural areas and low-income households, suggest stark disparities in technology access based on geography and income. More importantly, SSA applications on the internet have expanded from minimal internet speed sufficient for sending emails, web browsing, and online shopping to the requirement of higher speeds and larger bandwidths used in streaming video, online gaming, and, lately, video conferencing, telehealth, and remote learning (Butrica and Schwabish, 2022). However, it is unclear in the literature whether high-speed broadband availability increases the SSI or SSDI application rate, especially among older adults.

This study provides causal evidence on whether better broadband expansion affects the process of applying, appealing, or receiving SSI and SSDI benefits among older adults in the US.[3] Specifically, I study whether broadband improves production efficiency and reduces the friction of applying SSI and SSDI benefits at an extensive margin. The paper employs a quasi-experimental design, using the staggered introduction of high-speed 'fiber broadband' in census tracts. I use the biennial waves from individual panel data of the Health and Retirement Study (HRS), a nationally representative study of individuals aged 51+. The analysis period is from 2010 to 2018, with over 39,000 person-year observations. The key dependent variable in my regressions is an indicator equal to one if the HRS respondent reports that they applied, appealed, or received the SSI or SSDI benefits (separately) during the survey year. I use two yearly data sets on broadband at the census tract level from 2010 to 2018. Merging individual panel HRS data with the broadband data at the census tract and year level allows me to exploit the spatial, temporal, and, importantly, individual-level variation in the staggered introduction of high-speed fiber broadband to estimate the intent to treat (ITT) effect. The new staggered difference-in-differences (DID) treatment estimator developed by Borusyak *et al.* (2021) forms the basis for my primary estimations because

[3] This paper is the extension of (Gawai, 2023), which studies the effect of broadband on mental health among older adults.

it addresses the negative weighting problems and does not rely on the strict assumption of homogeneity as commonly found in two-way-fixed-effects (TWFE) estimators.

FIGURE 1: Share of Applications through Internet



Note: This figure shows the share of total applications that are filled online using the publicly available data from the Social Security Administration.

The net effect of Broadband expansion on the SSI or SSDI application rates could be ambiguous. On the one hand, one may expect a reduction in the application costs, including the distance and time to visit SSA offices in person. For remote areas, these costs might be higher. So, the benefits of better internet might be saturated in rural areas. Broadband access may be even more critical to reduce distance and time when SSA offices are not nearby. These costs might differ based on broadband availability and the ability to use those technologies. Studies document that broadband technology does not help 40 percent of older adults, and about 60 percent of individuals with less than a high school education or residents of rural areas do not use the internet (Herd and Moynihan, 2019). This is important to address the technological divide between urban and rural areas. On the other hand, the digital divide may exacerbate structural barriers among geographic locations with poor broadband connectivity and households with low socioeconomic status who might need access to these technologies, including training in internet literacy. Studies document that in-person assistance matters for low-income and low-education levels, even in online applications (Deshpande and Li, 2019).

This study finds that introducing high-speed fiber broadband technology positively affects the likelihood of applying, appealing, or receiving SSDI benefits among older adults; however, it does not affect the SSI process. On average, I find a 21% increase in the likelihood of applying, appealing, or receiving SSDI benefits. I, however, find the existence of the racial and regional barriers, with no effect for the non-White and rural dwellers. These findings emphasize the need for policies that promote broadband expansion and more investments to understand other structural barriers involved in online applications for SSI and SSDI benefits.

This paper contributes to the growing literature on evaluating the effect of broadband by applying the latest methodological advances and improving precision by more accurately measuring the treatment exposure. One of SSA's primary goals is to deliver services to the public effectively and efficiently and understand the role of technology like broadband and internet on the social security benefit application rates. The causal evidence of whether broadband technology helps in this goal is unclear in the economics literature. Butrica and Schwabish (2022) document the correlation between broadband and disability insurance awards, suggesting that counties with a high proportion of DI beneficiaries have less access to broadband and the internet. The only recent study I could find suggests that better internet access increases SSDI applications by about 1.6 percent and benefits rural areas more after the introduction of iClaim, an innovation in the online applications process (Foote *et al.*, 2019). Most of these studies, however, are either correlational or suffer from challenges due to two-way-fixed-effects (TWFE), lack individual panel data, and conduct analysis at the broader geographic level (e.g., county). I improve the literature by using the latest DID estimator developed by Borusyak *et al.* (2021), which accounts for the treatment-effect heterogeneity. Similarly, I use the individual panel of HRS data to observe the same individuals over time and their precise geographic locations at the census tract level. This panel nature of the data allows for the identification to come from the within-individual changes in the access to high-speed broadband. Similarly, the precision of measuring the treatment at the census tract level helps reduce bias in the estimation.

Secondly, this paper contributes to the growing literature on information and the take-up of social benefits by evaluating a staggered introduction of high-speed internet through fiber technology. Research documents low enrollment rates among eligible recipients across various programs due to the need to be more aware of program availability and rules, which are barriers to taking up (Chetty *et al.*, 2013). The information could be translated through peers (Dahl *et al.*, 2014). The internet is a valuable tool for information, and evidence suggests that providing information increases the likelihood of enrollment in various welfare programs (Barr and Turner, 2018). Several recent studies suggest that informing likely-eligible individuals increases program enrollment (Armour, 2018, Barr and Turner, 2018, Bhargava and Manoli, 2015, Finkelstein and Notowidigdo, 2019). On the other hand, the complexity involved in using the internet or the lack of cognitive ability required to process online applications may discourage some applicants and create friction in the take-up of social benefit programs (Bhargava and Manoli, 2015).

2 Background

2.1 Eligibility for SSI and SSDI

Supplemental Security Income (SSI) is a federal initiative that is accessible to individuals who have disabilities, are visually impaired, or are 65 years and older. SSI benefits are determined not by work history but by income and assets within specified limits.[4] One can also get SSI if a medical condition prevents employment and is anticipated to persist for at least one year or result in death. For instance, the standard monthly SSI payment remains

[4]All the information in this section is from the SSA official website.

consistent nationwide in 2024 at $943 for an individual and $1,415 for a couple. However, payment amounts can vary. Residents of states supplementing the federal SSI payment may receive more, while those with additional household income may receive less. Moreover, the amount of your SSI payment is influenced by factors such as one's living arrangements and household composition. Total federal spending for disbursements within the SSI program during the calendar year 2022 amounted to $57.1 billion.

Eligibility for SSDI is stringent. The applicant must have worked for at least one-fourth of their adult life and five of the last ten years to be insured for disability benefits; have severe, medically determinable physical or mental impairment expected to last at least 12 months or result in death, based on clinical findings; should be inability to engage in substantial gainful activity, defined as earning $1,550 per month ($2,590 for blind individuals) regardless of job availability or location. For older, severely impaired applicants unable to change careers, lack of education and skills are considered, unlike younger applicants. Most SSDI beneficiaries are older and contend with serious physical or mental impairments. The typical recipient is in their 50s, with over 75% falling into this age group, and more than 40% are aged 60 or above.[5] In October 2023, approximately 7.4 million individuals received disabled worker benefits through Social Security. Additionally, payments extended to 89,000 spouses and 1.1 million children of beneficiaries. Funding for SSDI benefits mainly comes from a portion of the Social Security payroll tax, amounting to about $143 billion in 2022. This sum represents roughly 2 percent of the federal budget and less than 1 percent of GDP. However, only 1 in 3 SSDI applicants are awarded benefits at the end of the application and appeal process.

The process of applying for SSI and SSDI typically begins with the initial application, where the applicant submits their medical records and other relevant documentation to the Social Security Administration (SSA). In the case of SSI applications, applicants have to submit documents related to their financial situation. After submission, the application un-

[5] Disabilities among recipients are diverse; musculoskeletal conditions such as osteoarthritis and scoliosis are common among those over 50, while severe mental disorders like schizophrenia and bipolar disorder prevail among those under 50.

dergoes review by SSA staff to determine if the applicant meets the eligibility criteria for disability benefits or SSI benefits based on income, resources, disability status, or both. If the initial application is denied, which is common, the applicant can request reconsideration within a certain timeframe. During reconsideration, the application undergoes another review by different SSA staff. If denied again, the applicant can appeal the decision and request a hearing before an administrative law judge.

3 Data

3.1 Broadband Data

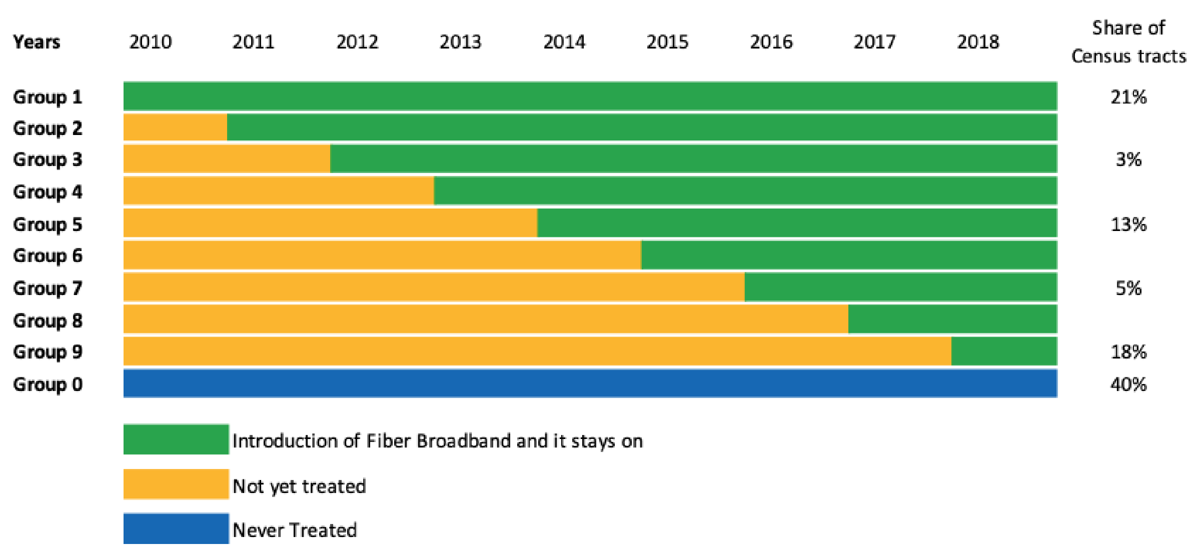
The empirical analysis draws upon panel data from two sources: the Federal Communications Commission (FCC) Form 477 spanning 2014 to 2018, and the National Telecommunications and Information Association's National Broadband Map (NBM) covering 2010 to 2013. This dataset encompasses crucial information, including the number of broadband providers, transmission technology (such as DSL, fiber, cable, or satellite), maximum download and upload speeds measured in Mbps, and whether the provider offers residential service at the census tract level. To ensure comprehensive coverage, broadband providers must submit data biannually, specifically in June and December, demonstrating their ability to deliver internet service with speeds surpassing 200 Kbps in at least one direction. The census tract, comprising smaller geographic units compared to counties, offers a finer granularity of analysis. With 84,414 census tracts in the United States, each ideally accommodating approximately 4,000 residents (Census Report). The census tract provides precise geographic treatment of broadband instead of aggregating at the county level, which has been done in the related literature. To ensure the most recent and reliable broadband data, the analysis primarily relies on the December dataset for each year.

3.1.1 Definition of the Broadband Providers

The key treatment variable is an indicator of whether the fiber broadband had been introduced in a given census tract during a survey year. This binary variable takes the value of 1 in the year of introduction and persists as such in subsequent years. Conversely, for census tracts where fiber broadband has not been extended, the variable remains at 0 throughout the observation period, thus constituting the never-treated group. This research design effectively captures the staggered implementation of the treatment. The inclusion of FCC data from 2014 onwards is primarily motivated by the need to address measurement issues present in earlier years. Grubesic *et al.* (2019) documents some of the limitations of FCC data. Nevertheless, FCC data are the best publicly available records of broadband providers in the US (Mack *et al.*, 2021).

3.1.2 Expansion of Fiber Broadband

FIGURE 2: Fiber Broadband Expansion Groups



Note: This figure shows the fiber broadband expansion in different census tracts in the US, using the HRS data merged with the broadband data. For instance, cohort 1 received fiber broadband in 2010, and cohort 0 did not receive fiber broadband (never treated). The figure is adapted from Gawai (2023).

Figure 2 categorizes the Health and Retirement Study (HRS) sample into different cohorts based on their exposure to fiber broadband expansion. Six distinct cohorts are identified, five corresponding to each year of introduction of fiber broadband, namely 2010, 2012, 2014, 2016, and 2018, and a sixth cohort representing individuals who never received fiber broadband during the study period. The selection of these specific years aligns with the biannual nature of the HRS data, which serves as the primary source for outcome measurements. By focusing on these time points, the analysis captures the dynamics of broadband adoption and its potential effects on mental health within the HRS sample.

3.2 Health and Retirement Study

The Health and Retirement Study (HRS) is a nationally representative panel study surveying approximately 20,000 individuals aged 51 and older. The core HRS has been conducted annually since 1992, transitioning to a biennial format from 1996 onwards. This comprehensive survey collects demographic, health, relationship, income, and occupation-related information. Importantly, HRS also captures data on internet use, electronic devices within households, and the use of electronic technologies like health apps. Furthermore, the restricted HRS files contain information concerning respondents' geographic residence locations. I use five HRS waves from 2010 to 2018 (biennial) and merge them with the broadband data using the census tract of the resident and the survey year.

3.2.1 Key Outcome Variables

Since HRS does not include the respondents' SSI or SSDI eligibility, I calculate the potential eligible individuals in the following way. HRS includes several separate questions on whether the respondents applied, appealed, denied, or received SSI or SSDI benefits and the year they applied or appealed in the past. For SSDI benefits, an additional condition I use is the age of the respondent is below 62 since people will be more likely to enroll in the OASI program. Similarly, for SSI benefits, the age group should be 65+. I define an individual as eligible if they responded to the above questions based on their past and current activities related to SSI and SSDI benefits. Further, conditional on the eligibility, the primary outcome variables are whether the respondent applied, appealed, or received the SSI and SSDI benefits during the current survey year. The first key reason to combine these variables is that, with the exposure to broadband, we might expect the effects on several activities of the processes and not just on the applications of the benefits. Another key reason is that I do not have the administrative data from SSA. While HRS reports SSI and SSDI applications, receipt or appeals are lower than the administrative records, and individual misreports are common, even though both the sources have similar trends by survey wave, cohort, and age (Hyde and Harrati, 2023).[6]

3.3 Descriptive Statistics

Table 1 shows the sample characteristics of the treated and never-treated groups. Most of the individual characteristics of the treated groups are similar to those of the never-treated group.[7] One may note that rural areas are less likely to receive fiber broadband than urban areas. Respondents who reported that they ever applied, appealed, or received the SSDI or SSI benefits are the same across these two groups. However, in some cases, a higher share of respondents received or appealed for SSI benefits in the treated groups compared to the never-treated group. Figure 3 shows the share of the nationally representative sample of older adults who applied for SSI and SSDI benefits from 2010 to 2018. The application for SSDI declines after around 63 years, potentially due to OASI (Old-Age and Survivors Insurance) enrollment.

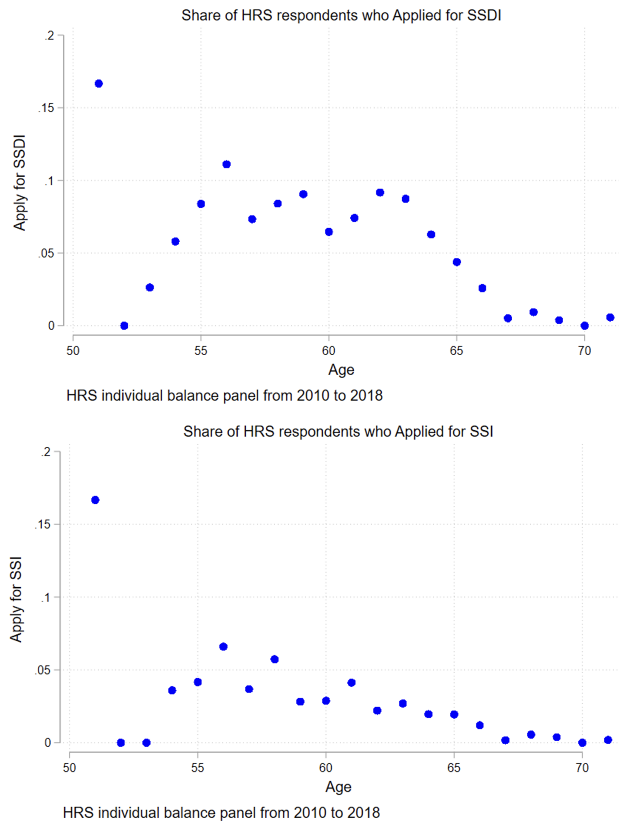
4 Method

I first estimate a difference-in-differences (DID) regression using the following equation:

[6] I am in the process of obtaining the administrative data from the SSA office, which will be used for future research.

[7] Note that the identification is not merely through comparing these two groups since every treated group was treated at different periods, so the identification also accounts for the pre-and post-period of the treated groups.

FIGURE 3: Share of older people who apply for SSDI and SSI



Note: This figure shows the distribution of the HRS respondents who applied for the SSDI and SSI benefits using the HRS waves from 2010 to 2018.

$$Y_{icgt} = \beta_0 + \beta Fiber_{gt} + \delta_i + \gamma_{gt} + \epsilon_{igct}. \quad (1)$$

Here, Y_{igct} is the outcome for individual i, living in census-tract c, belonging to the fiber expansion group g of census tracts, and surveyed in HRS survey year t. $Fiber_{ct}$ takes the value 1 if the fiber was available at census tract c in survey year t, and 0 otherwise. δ_i is individual fixed effects that control for the time-invariant characteristics of individuals and allow identification to come from within-individual changes in fiber availability.[8] I also include the group-year fixed effects γ_{gt}, to account for shocks that affect all the individuals in a given group of census tracts to which fiber was expanded in a given year. I estimate the

[8]Here, I cannot include both group and individual fixed effects at the same time. One of them must be dropped because there is no between-group movement for individuals. Therefore, I restrict the sample to individuals who did not migrate from their census tracts of residence during the study period of 2010-2018.

TABLE 1: Descriptive Statistics

Variables	Mean (Treated Groups)	Mean (Never-Treated Group)
Ever applied, appealed, received SSDI Benefits	0.91	0.91
Ever applied, appealed, received SSI Benefits	0.96	0.96
Applied, appealed, received SSDI this wave	0.08	0.08
Applied, appealed, received SSI this wave	0.04	0.03
Applied SSDI this wave	0.02	0.02
Applied SSI this wave	0.01	0.01
Received SSDI this wave	0.06	0.06
Received SSI this wave	0.03	0.02
Appealed SSDI this wave	0.54	0.54
Appealed SSI this wave	0.36	0.28
Self-Reported Good Health	0.73	0.73
Age	70	70
Male	0.42	0.42
Above High School	0.48	0.45
White	0.72	0.78
Rural	0.15	0.27
Medicare	0.52	0.54
Medicaid	0.08	0.08
Gets Pension	0.20	0.22
Working for Pay	0.33	0.31
Mortality	0.02	0.02
Income through SSI/SSDI	$686.19	$677.93
Currently Married	0.52	0.52
Maximum Download Speed (Mbps)	398.00	279.31
Maximum Upload Speed (Mbps)	291.94	48.95
N Respondents	37,564	18,421

Note: The data are the balanced panel of HRS respondents merged with broadband data using the geographical unit as census tracts and year and show the descriptive statistics of the treated groups (groups 1,3,5,7,9) and a never treated group (group 0). Self-reported good health is 1 if the reported health is either 'excellent,' 'very good,' or 'good.' and 0 if 'fair' or 'poor'.

equation using one of the recent DID estimators provided by Borusyak *et al.* (2021).

The DID model specified above estimates the static treatment effect. My preferred estimate is the dynamic version of the DID estimator, as suggested by Borusyak *et al.* (2021), to test for parallel trends and estimate the dynamic effect of the introduction of high-speed fiber broadband on SSI and SSDI benefits applications. By incorporating time-varying treatment effects, this estimator provides valuable insights into the evolving impact of broadband expansion over time and allows for a more comprehensive analysis of the causal relationship between broadband access and SSDI reception.

I use Equation 2 for the dynamic treatment effects as follows.

$$y_{igct} = \delta_i + \gamma_{gt} + \sum_{\tau=-3,\tau\neq-1}^{3} \beta_\tau Fiber_{\tau(gt)} + \epsilon_{igct}. \tag{2}$$

Recent advancements in the DID literature suggest that the conventional two-way fixed effects (TWFE) estimator provides consistent estimates under the assumption of treatment effect homogeneity (Sun and Abraham, 2021, De Chaisemartin and d'Haultfoeuille, 2022b). However, it is plausible to expect that introducing highspeed fiber broadband may result in a heterogeneous treatment effect, given the varying adoption rates among different economic agents, potentially influencing SSDI reception among older adults differently. Moreover, treatment effects may vary across individuals, exhibiting interesting heterogeneity based on various demographic characteristics. To capture this heterogeneity in treatment effects over time and across treated units, I employ the event study methodology proposed by Borusyak *et al.* (2021), which allows for the heterogeneous treatment effect of fiber broadband introduction. Finally, I include the person weights in the estimation and will replace them with the SSA weights after the data is available.

5 Results

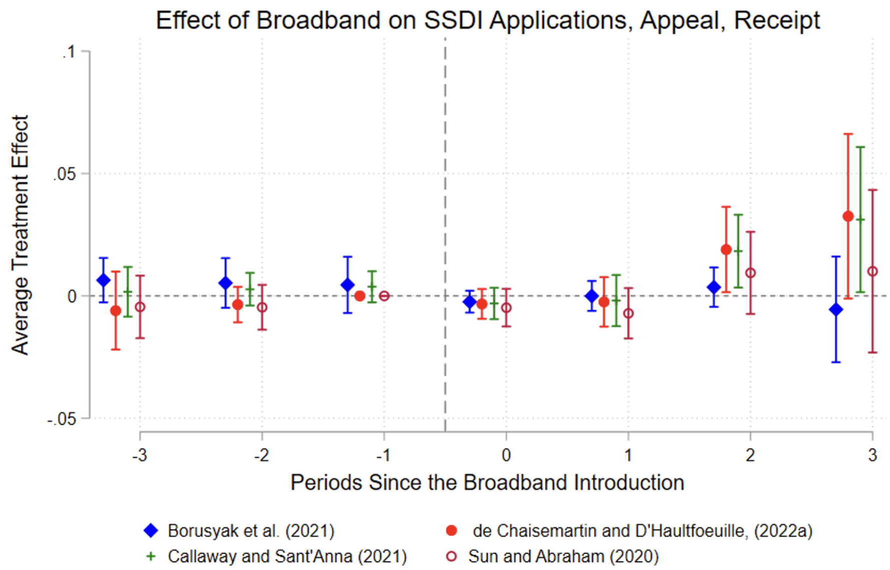
Table 2 shows the average treatment effect of the fiber broadband expansion using Eq. 1 and estimating with the estimator provided by Borusyak *et al.* (2021). Columns 1 to 3 show the effects of the outcome of the process of SSI benefits (applied, appealed, or receipt). Columns 4 to 6 show the effects of the outcome of the process of SSDI benefits (applied, appealed, or receipt). Columns 1 and 4 include the broadband expansion year fixed effects and the individual fixed effects. In Columns 2 and 5, I include the time-varying individual controls, and in Columns 3 and 6, I include the census tract fixed effects. Estimates from columns 1 to 3 suggest that the broadband expansion does not affect any process related to the SSI benefits. However, columns 4 to 6 suggest that the broadband expansion significantly improves the application, appeal, or receipt of the SSDI benefits among older adults. Specifically, the preferred specification in column 4 suggests that fiber broadband expansion increased the likelihood of the application, appeal, or receipt of the SSDI benefits by about 20% from the baseline. This result is also consistent with the literature (Foote *et al.*, 2019).

TABLE 2: Effect of Broadband on the Process of SSI and SSDI benefits

	Applied, Appealed, Received SSI			Applied, Appealed, Received SSDI		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Post Fiber	0.001	0.000	0.002	0.017***	0.013***	0.014**
	[0.002]	[0.002]	[0.003]	[0.004]	[0.004]	[0.005]
Observations	40,221	40,221	40,208	39,222	39,222	39,186
Expansion Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes		Yes	Yes	
Controls		Yes			Yes	
Census-Tract Fixed Effects			Yes			Yes
Mean of Outcome at baseline	0.035	0.035	0.035	0.078	0.078	0.078

Note: This table shows the average treatment effects of the staggered introduction of the fiber broadband on an indicator of whether the respondents applied, appealed, or received the SSI and SSDI benefits among older adults conditional on their eligibility using Eq. 1 and estimating with the estimator provided by Borusyak *et al.* (2021). The sample is a balanced panel of Health and Retirement Study (HRS) respondents for biennial waves from 2010 to 2018. The treatment variable is equal to one if fiber is available to census tract residents in survey year t and zero otherwise. The individual controls include whether the individual receives a pension, is currently married, and works for the pay. I also include the HRS person weights in the estimation. Standard errors in square brackets are clustered at the census tract level. *** p<0.01, ** p<0.05, * p<0.10.

FIGURE 4: Dynamic Effect of Broadband on the Application, Appealed, and Receipt of SSDI



Note: This figure shows the dynamic effects plots conditional on their eligibility using Equation 2, estimating with the estimator provided by De Chaisemartin and d'Haultfoeuille (2022a), Borusyak *et al.* (2021), Sun and Abraham (2021) and Callaway and Sant'Anna (2021). The sample is a balanced panel of Health and Retirement Study (HRS) respondents for biennial waves from 2010 to 2018. The treatment variable is equal to one if fiber is available to census tract residents in survey year t and is zero otherwise. The individual controls include whether the individual receives a pension, is currently married, and works for the pay. I also include the HRS person weights in the estimation. Standard errors in square brackets are clustered at the census tract level. The bars show the 95-percent confidence interval.

There could be several reasons that the effects are significant for the SSDI process but not for the SSI process. The eligibility criteria for SSDI and SSI differ significantly. SSDI primarily considers an individual's work history and earnings record, while SSI focuses on financial need and disability status, and the average SSDI applicant is in their 50s. On the other hand, there is a lack of effect on SSI since the majority of the applicants are in the 65+ age group, are blind, or disabled with stringent financial eligibility and lower access to broadband. It's possible that the expansion of broadband access disproportionately affected individuals who were more likely to qualify for SSDI based on work history, earnings, and higher-tech savviness, leading to an increase in SSDI applications and appeals.

Finally, Figure 4 shows the dynamic treatment effect using Equation 2 and estimated using various DID estimators proposed by De Chaisemartin and d'Haultfoeuille (2022a), Borusyak *et al.* (2021), Sun and Abraham (2021) and Callaway and Sant'Anna (2021). Figure 4 suggests that the likelihood of applying, appealing, or receiving SSDI benefits increases after introducing high-speed fiber broadband. The dynamic effect becomes statistically significant over time, suggesting that potential strategic complementarities, characterized by waiting for others to adopt, may play a role. Figure 4 also suggests that the estimates before introducing the fiber broadband (period -2 and -3) are closer to zero and insignificant. I consider this evidence to have no pre-trends and to be consistent with the parallel trend assumption.

6 Heterogeneity

In this section, I explore the effect of broadband differences based on gender, race, region, or education level. Firstly, understanding heterogeneity in the effect of broadband expansion based on gender can shed light on potential disparities in access to and utilization of technology among older individuals. Gender-specific differences in internet usage patterns and familiarity with online platforms may affect how individuals interact with SSDI application processes, affecting application, appeal, and receipt outcomes. Notably, women are more likely to use the internet for purposes such as emails and accessing information (Pew Research). Secondly, examining the effect of broadband expansion across racial groups is essential for identifying and addressing disparities in access to disability benefits. Historically marginalized communities face unique barriers, such as digital literacy gaps or structural inequalities in internet infrastructure, which could influence the effectiveness of broadband in facilitating SSDI applications and appeals. Thirdly, regional variations in broadband availability and quality can significantly impact older adults' access to online resources and support services related to SSDI. For instance, Table 1 suggests that the broadband expansion was slower in rural areas. Studying regional heterogeneity allows policymakers to target interventions and resources more effectively, ensuring equitable access to SSDI benefits across different geographic areas. Finally, educational attainment is crucial in shaping individuals' digital literacy skills and ability to navigate online platforms. Examining the effect of broadband expansion across education levels can provide insights into how educational disparities intersect with technological advancements, affecting older adults' engagement with SSDI application processes.

TABLE 3: Heterogenous Treatment Effect on SSDI Processes

	Outcome Variable: Applied, Appealed, Received SSDI benefits in this wave							
Sample	(1) Men	(2) Women	(3) White	(4) non-White	(5) Rural	(6) Urban	(7) High School and Above	(8) Below High School
Post Fiber	0.015**	0.018***	0.017***	0.017	0.010	0.017***	0.014***	0.018**
	[0.006]	[0.005]	[0.004]	[0.012]	[0.011]	[0.004]	[0.004]	[0.007]
Observations	16,475	22,747	29,245	9,853	7,743	31,466	18,479	20,743
Expansion Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table shows the average treatment effects of the staggered introduction of the fiber broadband on the SSDI benefit application, appeal, or receipt among older adults conditional on their eligibility using Eq. 1 and estimating with the estimator provided by Borusyak *et al.* (2021). The sample is a balanced panel of Health and Retirement Study (HRS) respondents for biennial waves from 2010 to 2018. The treatment variable is equal to one if fiber is available to census tract residents in survey year t and zero otherwise. I also include the HRS person weights in the estimation. Standard errors in square brackets are clustered at the census tract level. *** p<0.01, ** p<0.05, * p<0.10.

Estimates in Table 3 suggest that the broadband expansion increased the likelihood of application, appeal, or receipt of the SSDI benefits in almost all the subgroups, except for the non-Whites and rural dwellers. These estimates highlight the racial and regional disparities in the benefits of broadband expansion. The estimates on different subgroups are consistent between 0.14 to 0.18, which echos the main estimates in Table 2.

7 Robustness

I provide robustness of the main results of the SSDI processes. First, in Table 2, I provide the results with different specifications, including the individual fixed effects, controls, and census tract fixed effects. The magnitude and the significance are consistent across different specifications. Secondly, in Figure 4, I provide the results with different DID estimators relevant to the binary and staggered treatment. These estimates also suggest that the effect of broadband on the SSDI process is consistent across different DID estimators. Further, I include the migrants and show estimates in Table 4, which suggests similar estimates and significance as in Table 2.

TABLE 4: Effect of Broadband on the Process of SSI and SSDI benefits- Including Migrants

Variables	SSDI (1)
Post Fiber	0.013***
	[0.004]
Observations	44,824
Expansion Year Fixed Effects	Yes
Individual Fixed Effects	Yes

Note: This table shows the average treatment effects of the staggered introduction of the fiber broadband on the SSDI process among older adults (migrants and non-migrants) conditional on their eligibility using Eq. 1 and estimating with the estimator provided by Borusyak *et al.* (2021). The sample is a balanced panel of Health and Retirement Study (HRS) respondents for biennial waves from 2010 to 2018. The treatment variable is equal to one if fiber is available to census tract residents in survey year t and zero otherwise. I also include the HRS person weights in the estimation. Standard errors in square brackets are clustered at the census tract level. **** p<0.01, ** p<0.05, * p<0.10.

Further, mortality selection bias may exist if there is a differential likelihood of individuals with certain characteristics (in this case, possibly related to health status) being included in or dropping out of the sample due to death. For instance, individuals with poorer health who are more likely to apply, appeal, or receive SSDI benefits are also more likely to die before the broadband expansion can affect their application behavior. This could lead to an underestimation of the true effect of broadband expansion on application and benefit receipt, as the most vulnerable individuals are not included in the analysis due to mortality. Table 5 shows that the broadband expansion significantly declines individual-level mortality.

TABLE 5: Effect of Broadband on Mortality

Variables	SSDI (1)
Post Fiber	-0.011***
	[0.001]
Observations	39,183
Expansion Year Fixed Effects	Yes
Individual Fixed Effects	Yes
Mean of Outcome Var	0.02

Note: This table shows the average treatment effects of the staggered introduction of the fiber broadband on mortality among older adults conditional on their eligibility for SSDI using Eq. 1 and estimating with the estimator provided by Borusyak *et al.* (2021). The sample is a balanced panel of Health and Retirement Study (HRS) respondents for biennial waves from 2010 to 2018. The treatment variable is equal to one if fiber is available to census tract residents in survey year t and zero otherwise. I also include the HRS person weights in the estimation. Standard errors in square brackets are clustered at the census tract level. **** p<0.01, ** p<0.05, * p<0.10.

8 Conclusion

This study contributes to the existing literature by examining the causal relationship between the rollout of high-speed broadband technology and the likelihood of application, appeal, or receipt of benefits through SSI and SSDI among older adults. The findings demonstrate that expanding broadband significantly increases the chances of applying, appealing, or receiving SSDI benefits. Specifically, the fiber broadband expansion improved the SSDI likelihood of the SSDI process by over 21%. These effects are robust to alternative specifications and DID estimators for binary and staggered treatment, including migrants and mortality selection. The positive effects are consistent across different subgroups, including for men and women and applicants with more than a high school education or lower than a high school education. However, the effects are primarily driven by the Whites and dwellers from the urban areas, highlighting the significant racial and regional disparities.

An important caveat of this study is the absence of data delineating whether survey respondents have fiber broadband access at their residences. Given the possibility of internet utilization in diverse settings such as homes, workplaces, coffee shops, or public libraries, the estimates herein primarily capture intent-to-treat effects. Nonetheless, these findings hold significance for policymakers aiming to grasp the plausible access to the social security benefits from broadband expansion among older populations.

9 Policy Implications

The estimates in this paper bear considerable importance for several reasons. First, a young entrant into the workforce has a one-in-three probability of mortality or meeting the eligibility criteria for SSDI before attaining Social Security's full retirement age (CBPP). Secondly, the global population is aging, with an increase in challenges of awareness or dealing with the process of applications or receipt of social security benefits among older adults. At the same time, there has been a significant increase in the availability and adoption of the Internet adoption, with roughly 63% of the global population engaging with the Internet in 2021, a stark contrast to the mere 7% in 2000. More importantly, Internet access and use are also increasing among the older population. This paper finds that whether these technologies mitigate access issues has mixed evidence, with significant benefits for the SSDI-related process and no effect for the SSI-related processes with stark racial and regional disparities. These findings contribute important insights to the literature, informing policymakers and stakeholders about the implications of broadband expansion for the well-being of older adults. In future research, it will be crucial to understand what type of SSI/SSDI applications get affected. For instance, broadband services might not significantly impact the applications for issuing a new card since these applications may require in-person contact. On the other hand, the applications for benefits can be made entirely online and may have a significant impact. Similarly, I will extend this research by adding the distance to the SSA office to understand whether the broadband helped the SSDI process through the distance channel.

References

Armour, P. (2018). The role of information in disability insurance application: An analysis of the social security statement phase-in. *American Economic Journal: Economic Policy*, **10** (3), 1–41.

Barr, A. and Turner, S. (2018). A letter and encouragement: Does information increase postsecondary enrollment of ui recipients? *American Economic Journal: Economic Policy*, **10** (3), 42–68.

Bertrand, M., Mullainathan, S. and Shafir, E. (2004). A behavioral-economics view of poverty. *American Economic Review*, **94** (2), 419–423.

Bhargava, S. and Manoli, D. (2015). Psychological frictions and the incomplete take-up of social benefits: Evidence from an irs field experiment. *The American Economic Review*, **105**, 3489–3529.

Borusyak, K., Jaravel, X. and Spiess, J. S. (2021). Revisiting event study designs: Robust and efficient estimation. *arXiv preprint arXiv:2108.12419*.

Busby, J., Tanberk, J. and Cooper, T. (2021). Broadbandnow estimates availability for all 50 states; confirms that more than 42 million americans do not have access to broadband. *URL https://broadbandnow. com/research/fcc-broadband-overreporting-by-state (accessed 7.9. 21)*.

Butrica, B. A. and Schwabish, J. (2022). *Technology and Disability: The Relationship between Broadband Access and Disability Insurance Awards*. Tech. Rep. 2022-13, Center for Retirement Research, Boston College, Boston, MA.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, **225** (2), 200–230.

Chetty, R., Friedman, J. N. and Saez, E. (2013). Using differences in knowledge across neighborhoods to uncover the impacts of the eitc on earnings. *American Economic Review*, **103** (7), 2683–2721.

Dahl, G. B., Løken, K. V. and Mogstad, M. (2014). Peer effects in program participation. *American Economic Review*, **104** (7), 2049–2074.

De Chaisemartin, C. and d'Haultfoeuille, X. (2022a). *Difference-in-differences estimators of intertemporal treatment effects*. Tech. rep., National Bureau of Economic Research.

— and — (2022b). *Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey*. Tech. rep., National Bureau of Economic Research.

Deshpande, M. and Li, Y. (2019). Who is screened out? application costs and the targeting of disability programs. *American Economic Journal: Economic Policy*, **11** (4), 213–248.

Finkelstein, A. and Notowidigdo, M. J. (2019). Take-up and targeting: Experimental evidence from snap. *The Quarterly Journal of Economics*, **134** (3), 1505–1556.

Foote, A., Grosz, M. and Rennane, S. (2019). The effect of lower transaction costs on social security disability insurance application rates and participation. *Journal of Policy Analysis and Management*, **38** (1), 99–123.

Gawai, V. P. (2023). Does high-speed internet access affect the mental health of older adults?

Grubesic, T. H., Helderop, E. and Alizadeh, T. (2019). Closing information asymmetries: A scale agnostic approach for exploring equity implications of broadband provision. *Telecommunications Policy*, **43** (1), 50–66.

Herd, P. and Moynihan, D. P. (2019). *Administrative Burden: Policymaking by Other Means*. Russell Sage Foundation.

Hyde, J. S. and Harrati, A. (2023). The alignment between self-reported and administrative measures of disability program application and benefit receipt in the health and retirement study.

Kauff, J., Sama-Miller, E., Rowe, G., Thomas, C. and Makowsky, L. (2011). Promoting public benefits access through web-based tools and outreach. *Final Report. Mathematica Policy Research*.

Mack, E. A., Helderop, E., Ma, K., Grubesic, T. H., Mann, J., Loveridge, S. and Maciejewski, R. (2021). A broadband integrated time series (bits) for longitudinal analyses of the digital divide. *PloS one*, **16** (5), e0250732.

Sun, L. and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, **225** (2), 175–199.

Appendices

A Heterogeneity

TABLE 6: Heterogenous Treatment Effect on SSI Applications

	Outcome Variable: Applied for SSI since last wave							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	Men	Women	White	non-White	Rural	Urban	High School and Above	Below High School
Post Fiber	0.003	-0.000	0.002	-0.002	-0.006	0.002	0.000	0.002
	[0.003]	[0.003]	[0.002]	[0.008]	[0.008]	[0.002]	[0.002]	[0.004]
Observations	16,874	23,347	30,267	9,834	8,120	32,088	18,699	21,522
Expansion Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table shows the average treatment effects of the staggered introduction of the fiber broadband on the SSI applications among older adults conditional on their eligibility using Eq. 1 and estimating with the estimator provided by Borusyak *et al.* (2021). The sample is a balanced panel of Health and Retirement Study (HRS) respondents for biennial waves from 2010 to 2018. The treatment variable is equal to one if fiber is available to census tract residents in survey year t and zero otherwise. The individual controls include whether the individual receives pension, is currently married, and works for the pay. I also include the HRS person weights in the estimation. Standard errors in square brackets are clustered at the census tract level. *** p<0.01, ** p<0.05, * p<0.10.