Unintended Effects of Broadband Grants on Bank Branches

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Abstract

The Community Connect Grant (CCG) Program was created in 2002 to provide financial assistance for the provision of broadband service in rural areas. Although it aimed to strengthen the rural economy, it is possible that an increase in internet usage due to the program could have induced bank branch closures, which could have had unintended effects on the economy. This paper discusses the mechanism by which the program affects bank branches and estimates the magnitude of its effects using an event study model and find that receiving benefits from this program decreases the number of bank branches.

Keywords: Community Connect Grant, Broadband grants, Bank branch, Event study
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1 Introduction

It is now difficult to imagine a day without the internet. Anyone with an access to the internet can engage in various activities online – shopping, browsing, banking, and so forth. As the internet has become an essential part of our life, the federal government created a program that subsidizes the establishment of broadband service in rural areas. Created in 2002, the Community Connect Grant (CCG) Program offers financial assistance to eligible internet service providers that will construct, improve, or expand broadband networks in rural areas (U.S. Department of Agriculture, 2019).

The grant program has been justified by the fact that broadband deployment in rural areas can have a significant effect on economic development. Kuttner (2016) argues that rural broadband companies contributed $24.1 billion to the economies of the states in which they operated in 2015. However, since rural communities do not have sufficient populations and exist in isolated locations, the private sector often does not have an incentive to operate broadband services in rural areas. This may cause a "digital divide" between urban and rural areas, which is the reason that the government should intervene through the broadband grant program.

While the CCG program is aimed at promoting economic development in rural areas, the growth of online banking and the lower operating costs associated with it has led to bank branch closures in some areas. The closure of bank branches can have a significant impact on local credit supply and economic development. As more consumers are using online banking to access their accounts and the operating costs of online banking are lower than those of bank branches, banks are strategically closing their branches. Recently, in 2016, the largest banks in the US closed hundreds of branches as consumers shifted to self-served digital channels, mobile, online, and ATM (Insider, 2016).

In this paper, we examine the effect of the CCG program on the number of bank branches in rural areas. Before attempting to answer this research question, we need to first answer the following question: do communities still need bank branches? According to the Federal Deposit Insurance Corporation's (FDIC) recent survey (Federal Deposit Insurance Corporation, 2018), 24.3% of households regard bank tellers as their primary method for accessing their bank accounts. This becomes more evident when we examine the responses by income. Households with lower incomes (less than $15,000) are more likely to cite bank branches as their primary means of accessing their accounts than households with higher incomes (at least $75,000), with the corresponding percentages being 38.8% and 13.3%, respectively. Nguyen (2019) also argues that branch closings can significantly decrease the local credit supply. These results support the fact that consumers still need bank branches and that a reduction in the number of bank branches can have a significant impact on the economic development of a community.

Therefore, it is possible that the grant program may have had an unexpected impact on economic development by inducing branch closures. The main goal of this paper is to examine how the Community Connect Grant Program affected the number of bank branches in rural areas. We develop an event study model to answer our research question.

There are three groups of literature that this paper relies on. First, this paper is directly related to the literature on the effect of broadband penetration on bank branches. Calzada and Martínez-Santos (2022) use the panel data with broadband penetration and the number of bank branches in the US between 2000 and 2020 and conclude that tracts with higher broadband penetration rate were more likely to experience more bank branch closures. Kim (2022) develops a structural model presenting that banks close more branches in a county with higher broadband penetration until the penetration rate reaches a certain threshold of 80%, which means that more than 80% of households have broadband available at their home. Outside the US, Galardo et al. (2021) estimate the probability a branch closes and show that banks were more prone to close branches in areas where the diffusion of the broadband was greater in Italy.

Moreover, by estimating the effect of the broadband grants on the number of bank branches, we can use the results to determine whether online banking is a substitute or a complement to bank branches. Xue et al. (2011) shows that higher local internet penetration is associated with faster adoption of internet banking. This implies that the broadband grant program will stimulate bank customers' internet banking adoption, so how the broadband grants affect the number of branches will show the relationship between online banking and bank branches. There have been conflicting results on this issue. DeYoung et al. (2007) uses the data from 1999 to 2001 and presents that online banking complements branches for small community banks. A more recent paper using the Italian banking industry data, Di Febo and Angelini (2022) highlight that higher internet penetration leads to more branch closures from 2011 to 2016.

Lastly, there exist various papers discussing the economic impact of the CCG program. Kandilov and Renkow (2010) analyze the impact of U.S. Department of Agriculture (USDA) broadband programs on wage, employment, and business establishments. Kandilov and Renkow (2020) also estimate the return of USDA broadband programs and find that the Community Connect Grant Program does not have a significant effect on wages. Although this paper is not focusing at the macroeconmic effect of broadband grant programs, the impact on bank branches can be considered as a part of economic impact of the program.

The paper makes two important contributions to the literature. First, it highlights an issue that was not addressed during the implementation of the broadband grant program. Specifically, while expanding broadband service in rural communities is important, it may have unintended consequences on economic development by reducing the number of bank branches. This can be a concern for consumers who still rely on physical bank branches[1].

Second, in this paper, we go a step further and instead of discussing the direct effect

[1]However, it should be acknowledged that the argument that this paper raises is not trying to argue against using the broadband subsidy on rural areas. Our intention is to broaden the research range when estimating the impact of various broadband grant programs.

of the broadband grant on the economy, we use the broadband grant as the exogenous positive shock on the internet usage. Even though Federal Communication Commission (FCC) presents the Internet penetration data, there is insufficient data on the internet usage in small level of regions. Since the Community Connect Grants require to provide two years of free internet use, it can be used as a proxy for the internet usage in the area. Moreover, there have been only a handful of studies on how the internet affects the banking industry and this paper can be used to predict how the internet will change the future of bank branches in rural areas.

The rest of the paper is organized as follows. Section 2 presents background information on the Connect Community Grant Program and the history of bank branches and online banking. In Section 3, we discuss the mechanism by which the grant program affects the number of bank branches. Section 4 presents the data and develops an event study model that explains the dynamic effect of the grant program on the number of bank branches. In Section 5, we provide the estimation results. Section 6 concludes.

2 Background

In this section, we review the background of the Connect Community Grant Program and other federal broadband grant programs and the history of bank branching and online banking. We also examine the expected effects of the grant program on bank branches.

2.1 Connect Community Grant Program[2]

The Community Connect Grant Program (CCG) was created as a pilot program in 2002 to provide financial assistance in the form of grants to eligible applicants that will provide broadband service. The fiscal year 2002 agriculture appropriation bill allocated $20

[2]This section relies on the Community Connect Grants website by USDA (`https://www.rd.usda.gov/programs-services/community-connect-grants`, Accessed: 2020-03-02).

million to a pilot broadband grant program (Congress Research Service, 2019). It was transformed into an annual competitive grant program in fiscal year 2004 (U.S. Government Accountability Office, 2017), and as of 2016, the grant program has funded approximately 253 projects across the nation.

As the CCG is intended to fund broadband deployment into rural communities, only rural areas are eligible to apply for the grant. A rural area is defined as any area not located within a city, town, or incorporated area that has a population greater than 20,000 inhabitants or an urbanized area contiguous and adjacent to a city or town that has a population of greater than 50,000 inhabitants (U.S. Department of Agriculture, 2019). Potential applicants include most state and local governments, federally recognized tribes, nonprofits, and for-profit corporations. Summary reports with awardees from the USDA compiled each year show that most awardees are small towns and internet service providers who could provide broadband service to rural areas with the grant (U.S. Department of Agriculture, 2016).

The CCG provides $100,000 at minimum and $3,000,000 at maximum to organizations or local governments that will provide high-speed internet to eligible rural areas. This is a competitive grant program where applicants with the highest scores win the grant. Before the fiscal year 2013, applicants could receive up to 100 points, and the points were broken into 3 scoring components: the rurality of the project (up to 40 points), the economic need of the project's service area (up to 30 points), and the "community-oriented connectivity" benefits derived from the proposed service (up to 30 points). On May 3, 2013, the Rural Utilities Services (RUS) issued a new final rule for the CCG and the final rule simplified the scoring criteria has been simplified to needs (50 points), stakeholder involvement (40 points), and management experience (10 points)(Congress Research Service, 2019).

When a project is selected as an awardee, it can use the grant to construct, acquire, or lease facilities used to deploy broadband to all residents and businesses. It is also possible to use the grant to improve or construct a community center that can be provided as an internet access point. The project must provide free broadband service for at least two years at all essential community facilities, which includes the community center, public schools, public libraries, public hospitals, and other public facilities.

The CCG had defined the broadband grant speed, the speed that the awardee should deliver, be defined as 200kbps downstream and 100kbps upstream. After the revision of the rules for the CCG in 2013, the RUS removes this definitions of broadband grant speed(Congress Research Service, 2019), and the broadband grant speed was presented in annual Notice Funding Availability (NOFA) every year as summarized in Table (1). From 2013 to 2015, the broadband grant speed was defined as 5Mbps downstream and 5Mbps upstream, and in 2016, it increased to 10Mbps downstream and 1Mbps upstream. There was another increase to 25Mbps downstream and 3Mbps downstream in 2018, and it has been maintained the same since then.

Table 1: Definition of Broadband Grant Speed

Year	Downstream	Upstream
2002-2012	200kbps	200kbps
2013-2015	5Mbps	5Mbps
2016-2021	10Mbps	1Mbps

Table 2 presents the number of projects and the total grant amount awarded in each year. The number of projects was higher in the 2000s, and the grant amount varies across years. The average dollar amount was lower in the 2000s and has been increasing since 2011. Grant amounts also differed by area, as shown in Figure 1, which presents the total grant amounts by state. Oklahoma received the largest amount with approximately 24 million dollars, followed by Virginia, which received 16 million dollars, from 2002 to 2016.

Table 2: Connect Community Grant Program projects and grant amounts

Year	Projects	Total amount	Average amount
2002	33	18,130	549
2003	34	11,307	333
2004	16	8,865	554
2005	19	9,011	474
2006	21	9,442	450
2007	19	10,308	543
2008	25	15,489	620
2009	22	13,386	608
2011	18	13,527	751
2012	7	5,489	784
2013	14	20,259	1,447
2014	8	13,686	1,711
2015	4	11,025	2,756
2016	13	15,605	1,200
Total	253	175,527	694

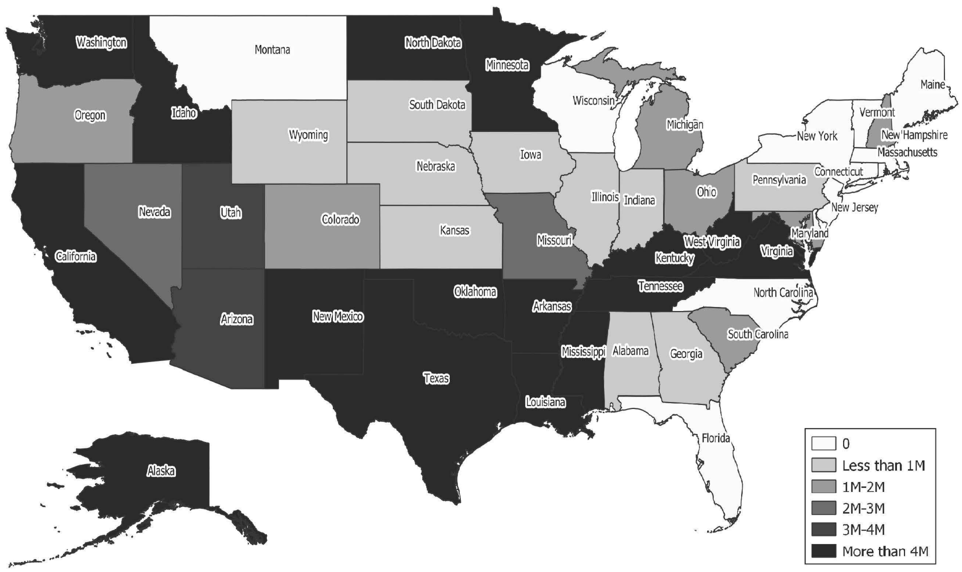
Note: Amounts are in thousands of dollars, and no grants were awarded in 2010. Average amount is the average grant amount per project.
Source: U.S. Department of Agriculture (2016)

2.2 Other federal broadband grant programs

This section compares the Community Connect Grant (CCG) Program to other federal broadband grant programs. In 2009, President Obama signed the American Recovery and Reinvestment Act of 2009 (Recovery Act) into law, which initiated two programs to support expanding broadband communication services in the US–the Broadband Initiatives Program (BIP) and the Broadband Technology Opportunities Program (BTOP). The Rural Utility Service (RUS), who is in charge of the CCG, also operated the BIP. Both programs were temporary programs awarded between 2009 and 2010 to as a part of economic recovery from the Great Recession.

The BIP focused on rural communities and required that 75% of a funded area be in a rural area that lacks access to high-speed broadband service, similar to the CCG. Unlike the CCG, which provides grants to entities, the BIP supported awardees through

Figure 1: Connect Community Grant amounts by state



Note: Grant amounts are total amounts from 2002 to 2016 by state. Only the continental U.S. is presented.

100% loans, 50% loans/50% grants, and 100% grants. The National Telecommunications and Information Administration (NTIA) in the Department of Commerce led the BTOP, which also had the same way of supporting awardees, but it had broader purposes than the BIP or the CCG. The BTOP not only supported building broadband infrastructure, but it also had three categories available - broadband infrastructure, public computer centers, and sustainable broadband adoption.

The ReConnect Program, which was introduced in 2018, aims to close the digital divide and expand broadband deployment in rural areas, similar to the CCG. The RUS, which also runs the CCG, is responsible for the ReConnect program. However, unlike the CCG, the ReConnect program provides loan, loan/grant, and grant options, like the BIP and BTOP. In comparison to the CCG, the ReConnect program has higher standards for the buildout project speed, which is 100Mbps upstream and 20Mbps downstream (100/20Mbps), while the CCG requires 25/3 Mbps in 2021. Additionally, the CCG requires that applicants provide free broadband service to essential community facilities, while the ReConnect program does not include this requirement (Congressional Research Service, 2022).

The most recent addition to federal broadband grants is Broadband Equity, Access, and Deployment (BEAD) Program. After the COVID-19 pandemic increased the necessity of universal broadband, in November 2021, President Joe Biden signed the Infrastructure Investment and Jobs Act including the BEAD Program. It aims to close the access gap for unserved areas (those below 25/3 Mbps) and underserved areas (those below 100/20 Mbps). The BEAD has the largest funding of 42.5 billion dollars. State governments are eligible to apply and can receive 100 million dollars each at minimum (National Telecommunications and Information Administration, 2022).

The CCG has the longest history of the grant program, and has funded 253 project from 2002 to 2016 with 175 million dollars during the same period. This is a larger amount compared to the 2.4 billion dollars of the BIP and the 1.6 billion dollars of the BTOP. The ReConnect program and the Bead program are relatively new with a short history. Since the bank branch opening decision is usually a long-term decision, focusing on the program with the longest history would be a reasonable choice to examine the impact on the number of bank branches, although it would be interesting to expand the discussion to other programs in the future.

The literature on the economic impact of the BTOP and the BIP is diverse. The first category of literature focuses on their effect on broadband adoption. Hauge and Prieger (2015) suggest that the impact of BTOP spending on broadband adoption is uncertain and that it may be nonlinear and nonmonotonic. In contrast, Pender et al. (2022) find that the BIP increases broadband adoption. Another area of research examines the impact of these programs on other economic variables of the awardees. For instance, Bai et al. (2022) demonstrate that the BIP increases farm productivity in the short-term, while Pender et al. (2022) observe a positive impact of the BIP on telework adoption. Katz and Suter (2009) estimate the impact of the BTOP and the BIP on employment, including the network externalities on other industries resulting from the deployment of broadband infrastructure. Lastly, some papers focus on the challenges encountered during program implementation, such as Rosston and Wallsten (2013) on the BTOP and Jackson and Gordon (2011) on both the BTOP and the BIP. Since the ReConnect program has not been in effect for an extended period, there exist only reports that provide an overview of its history and expected impact (Congress Research Service, 2019).

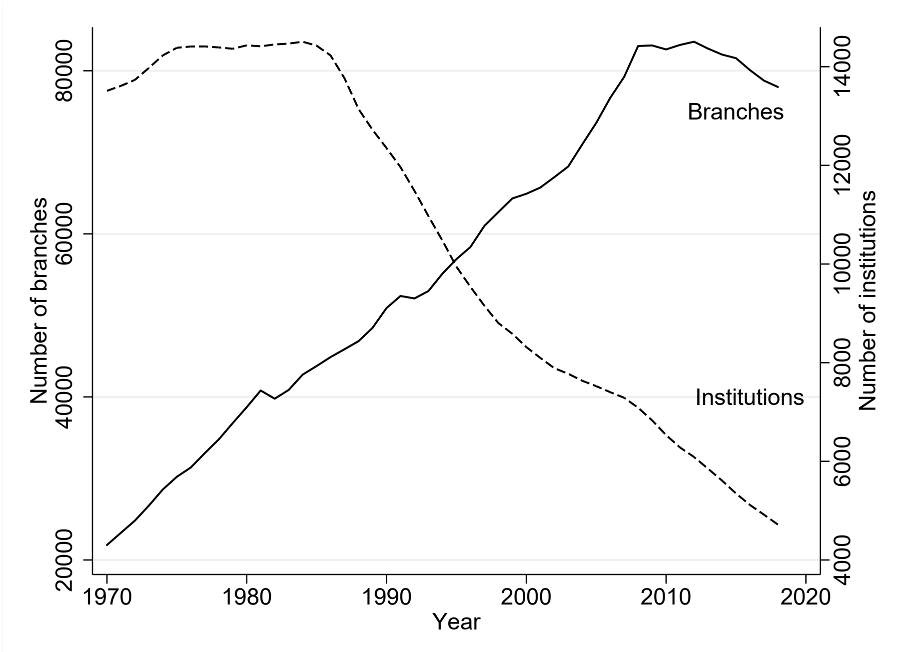
2.3 History of bank branching and online banking

Regulations on bank branches have been removed over the past three decades. In the 1970s, many individual states mandated that retail banks have only a single branch, and interstate banking was prohibited (Cohen and Mazzeo, 2007). Then, states gradually relaxed restrictions on intrastate branching and interstate ownership (Kroszner and Strahan, 2014). The constant increase in the number of bank branches during the 1970s and 1980s, as presented in Figure 2, reflects this gradual deregulation. Maine allowed interstate branching in 1978, followed by Alaska and New York in 1982, and state deregulation of interstate banking was almost complete by 1992 (Kroszner and Strahan, 2014). This means that banks can acquire other banks outside the state, reducing the number of institutions, in contrast to increasing the number of branches.

Then, in 1994, the Riegle-Neal Interstate Banking and Branching Efficiency Act lifted the regulation on interstate branching, passed and gradually became effective. Banks began to expand nationwide thereafter, and bank branching has become an important part of bank business strategy. In Figure 2, the number of branches increased until the financial recession in approximately 2008. In contrast, the number of institutions decreased due to increases in mergers and acquisitions across states.

Another significant change in bank branching has been introduced as the online channel has been added to the banking industry. The Stanford Credit Union was the first financial institution in the U.S. to provide an online banking website in 1994 (US Bank, 2019). Only 20% of national banks offered online banking in 1999, but banks offering online banking accounted for almost 85% of all deposit accounts under $100K in the national banking system, implying that most consumer accounts are at banks with online banking (Furst et al., 2000). Online banking grew rapidly as more consumers gained access to the internet in the 2000s. The 2004 Survey of Consumer Finances finds that 46.5% of families used the internet as a source of financial services, tools, or information (Bucks et al., 2006). According to Fox (2013), in 2013, 61% of internet users also used online banking.

Figure 2: The number of bank branches and institutions



Source: Federal Deposit Insurance Corporation (2020)

However, even in the internet era, bank branches remain essential in the retail banking industry. According to the American Bankers Association Survey (American Bankers Association, 2017), more than 93% of new bank deposit accounts were opened in bank branches in 2016. Another survey[3] shows that consumers prefer a branch over other communication channels for a lengthy topic (77%) and investment advice (63%). This

[3]Survey: Branches Persist as Preferred Channel for Big Conversations (`https://bankingjournal.aba.com/2018/06/survey-branches-persist-as-preferred-channel-for-big-conversations`, Accessed: 2020-03-02).

implies that a bank branch still acts as an active channel for inducing consumers, especially new consumers looking for a financial product.

Banking authorities are also aware of the fact that branch closures can affect customers, especially in low-income areas. The Federal Deposit Insurance Act SEC. 42. *Notice of branch closure* includes regulations on branch closures. It requires an insured depository institution to notify its customers of the proposed closing by mailing a notice to the customers of the branch proposed to be closed at least 90 days prior to the proposed closing[4]. Especially when an interstate bank is closing a branch in low- or moderate-income areas, the closing notice should include the mailing address of the appropriate federal banking agency and a statement that comments on the proposed closing of such a branch may be mailed to such agency.

3 Expected effects of the grant program on bank branches

We now discuss the possible mechanism whereby the CCG program affects bank branches. First, the CCG program increases internet connections in rural areas. The grant program increases internet connections in rural areas by providing funding to areas where broadband service is not available. Broadband service is defined as internet service with a speed of 10 megabits per second for downloading and 1 megabit per second for uploading. The grant should be used to deliver broadband service at higher speed, the broadband grant speed, which is 25 Mbps downstream and 3Mbps downstream currently. Therefore, consumers in the eligible areas that participate in the grant program will be able to enjoy higher internet speeds than before.

With the benefits of increased internet speed and connections, bank branches will be affected by internet users. To examine this effect, we look at the effect of the internet on the retail industry, which has already been widely discussed. Duch-Brown et al. (2015)

[4]FDIC Law, Regulations, Related Acts (https://www.fdic.gov/regulations/laws/rules/5000-3830.html, Accessed: 2020-03-09)

distinguish two effects of adding online channels. First, there can exist diversion effects whereby consumers move from brick-and-mortar stores to online distribution channels, which will reduce traditional sales at stores. However, the internet can also induce a market expansion effect by activating new consumers, which will affect traditional sales in the opposite direction.

The banking industry will be affected in a similar way. If bank consumers stop visiting bank branches and switch to online banking, this will decrease a branch's profit and reduce the number of bank branches. On the other hand, online banking can attract new customers who did not have an account with a bank because a branch did not exist nearby, increasing a bank's profits.

Additionally, the internet has other effects on bank branches. The internet lowers search costs, making it easier for consumers to compare prices and putting downward pressure on prices for similar products (Goldfarb and Tucker, 2019). This is also true in the banking industry, as consumers can easily compare different savings accounts online and choose the one that guarantees the highest deposit rate. Another effect of the internet on bank branches is that an increase in online shopping allows consumers to hold less cash in hand, reducing the need to visit bank branches for cash withdrawal.

Considering the various effects of the internet on bank branches, we develop a model that examines the effect of the broadband grant program on bank branches.

4 Data and research design

In this section, we introduce the data set and develop a model to examine the effect of the CCG program on the number of bank branches.

4.1 Data

Our goal is to estimate the effect of the CCG program on the number of branches. It requires three elements of data for this goal. First, we need data on the markets that received broadband grants that can be found in the "Community Connect Broadband Grant Program Award Summaries" reports provided by the USDA. Second, data on bank branches are acquired from "Summary of Deposits (SOD)" by the FDIC. Third, characteristics for each market come from "Zip Business Patterns" by the Census Bureau.

Before describing the details of each data set, we first define a market as a zip code area. As mentioned above, many areas that received the grants were a small town or internet service providers who could cover a small town with the grant, which is similar to a zip code area. Therefore, we define a market as a zip code area that is close to the recipients, and this makes it possible to add other control variables from census data. We limit attention to zip code areas with populations less than 20,000 in 2000 because rural areas with populations less than 20,000 are eligible to apply for the grant.

The "Community Connect Broadband Grant Program Award Summaries" reports from the USDA summarize the projects supported each year, including the recipient's name, the covered area, the amount of the grant, and a description of the project. We manually match all areas that received grants to a zip code area and construct a panel data set with zip codes and the amount of the grant. It is possible for an area to be matched with multiple zip codes if the area covers more than one zip code. In this case, we divide the number of grants by the number of zip code areas covered.

For variables on bank branches, we use the list of bank branch offices in the U.S. from 1994 to 2016 available from FDIC. The "Summary of Deposits (SOD)" survey is the annual survey of branch office deposits as of June 30 for all FDIC-insured institutions (FDIC, 2017). This survey covers all banks that offer deposits, as all institutions with branch offices are required to submit the survey. The data set consists of every branch office insured by the FDIC, including location, establishment date, and total deposits for each bank branch office.

To control for other economic aspects of the region, the study also uses "Zip Business Patterns" data from the Census Bureau, which provides the number of business establishments and employment during the week of March 12 at the zip code level.

The study covers the time period from 1994 to 2016, with the "Summary of Deposits" survey starting in 1994 and the Community Connect Grant Program starting in 2002. Table 3 provides summary statistics for the treatment and control groups. The treatment group consists of zip code areas that received grants at least once during the period 1994–2016, while the control group consists of areas that never received grants.

In this regard, we provide a detailed account of how the control group was constructed. We eliminated zip code areas from the control group that added broadband during the period, but did not receive the CCG. We employed two criteria to achieve this. First, we utilized the USDA's "Protected Broadband Borrower Service Areas dataset," which encompasses service areas that received grants, loans, or a combination of both under the Telecommunications Infrastructure loan, Farm Bill Broadband loan, Broadband Initiatives Program (BIP), or ReConnect Program grant, loan, or combination award during or after Fiscal Year 2000. (U.S. Department of Agriculture, 2022). Second, we excluded zip code areas that had no internet providers but experienced an increase in the number of providers, using the zip-code level "Form 477 Broadband Deployment Data" from the Federal Communication Commission. This assumption implies that such areas did not receive any grants but private broadband providers invested in the broadband infrastructure.

Table 3: Summary statistics for treatment and control groups

	Treatment		Control	
Branches	1.266	(2.254)	1.500	(2.592)
By size				
Large	0.082	(0.356)	0.201	(0.731)
Medium	0.053	(0.350)	0.123	(0.484)
Small	0.841	(1.601)	0.962	(1.700)
By type				
Full-service	1.199	(2.119)	1.436	(2.465)
Limited-service	0.066	(0.287)	0.064	(0.313)
Population	3.371	(4.199)	4.385	(5.045)
Deposit	0.386	(0.897)	1.069	(20.271)
Employments	0.719	(1.768)	1.484	(4.549)
Establishments	65.006	(123.812)	104.710	(212.933)
Obs.	4,900		618,993	

Note: Population and employment are in thousands, and deposits are in millions of dollars. Values in parentheses are standard deviations.

Comparing population and establishments shows that zip code areas that benefited from the CCG are generally smaller areas, as only rural areas with no broadband service can apply for the grant program.

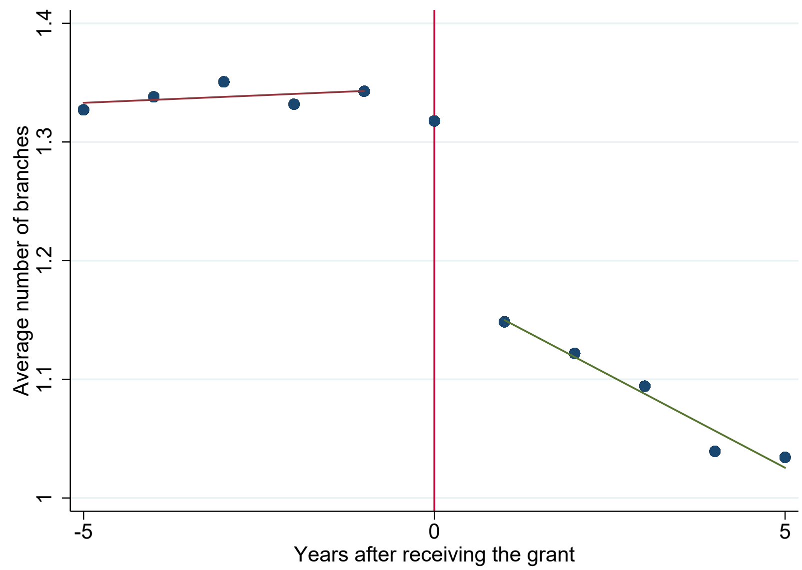
We examine the number of bank branches in greater detail. The SOD survey provides information on whether a bank branch is a full-service or limited-service branch. Not surprisingly, areas with grant recipients have more limited-service branches than the control group[5]. When dividing the branches by size, the control group has more branches owned by large- and medium-sized banks but a similar number of small bank-owned branches relative to the treatment group[6].

Figure 3 shows that the average number of bank branches decreased after the receipt of grants, comparing the average number of bank branches before and after grants were

[5]Refer to Section 5.2 for the definition of full-service and limited-service branches.

[6]Large banks are banks with market share larger than 3%, medium banks are those with 1∼3%, and small banks are those with less than 1%. Details on the definitions are provided in Section 5.3.

Figure 3: The number of bank branches before and after receiving grants



Note: Average number of bank branches is calculated across markets within the treatment group.

received. There exists a clear discontinuity around the time when a market received a grant.

4.2 Research design

We develop an event study model to assess the dynamic effects of the CCG program on the number of bank branches. An event study model is a panel data model that uses year indicators to capture the effects of an event, including both lead and lag indicators. It is a generalized form of the difference-in-difference (DID) method, which only uses a single treatment indicator. Since there are no randomized control trials available to investigate the impact of broadband establishment on bank branch openings and closures, an event study that uses the natural experiment of broadband grants can be a useful tool to estimate the effect of the policy (Marcus and Sant'Anna, 2021). Additionally, this approach allows us to estimate the evolution of the effects over time.

Let i be a market and t be a year, and denote by $branch_{it}$ the number of bank branches in market i and year t. We include J lag indicators and K lead indicators for the event of receiving the grant as below[7]:

$$
\begin{aligned}
(\text{Lag } J)_{it} &= \mathbb{1}(t \leq grantyear_i - J) \\
(\text{Lag } j)_{it} &= \mathbb{1}(t = grantyear_i - j) \text{ for } j \in \{1, \cdots, J-1\} \\
(\text{Lead } k)_{it} &= \mathbb{1}(t = grantyear_i + k) \text{ for } k \in \{1, \cdots, K-1\} \\
(\text{Lead } K)_{it} &= \mathbb{1}(t \geq grantyear_i + K) \qquad (1)
\end{aligned}
$$

where $grantyear_i$ is the first year that market i received a grant. If market i does not receive the grant for the entire period, all lag and lead indicators will be zero.

We also include other control variables, denoted as $\mathbf{x}_{it}$, that affect a bank's decision on the number of bank branches, including bank deposits, employment, and the number of business establishments. Banks generate profits primarily from service fees and loan interest, and the size of their deposits can reflect these sources of revenue. Since bank branches offer services to both consumers and businesses in the market, we included two control variables to capture the market size for each area of operation. Employment can serve as a proxy for market size in the consumer banking sector, while the number of business establishments can capture the demand for business banking in the market.

The variable μ_i denotes market fixed effects, and λ_t represents year fixed effects. To consider state regulations and differences in trends, we include a state-specific trend denoted by $\delta_{s(i)}t$. We denote a market as $i = 1, \ldots, N$, year as $t = 1, \ldots, T$, and state as

[7]We follow notations from Clarke and Schythe (2020). In Appendix, we included a table how each indicator is defined following Table 1 in Clarke and Schythe (2020).

$s = 1, \dots, S$. Formally, the model can be written as:

$$branch_{it} = \sum_{j=2}^{J} \beta_j (\text{Lag } j)_{it} + \sum_{k=0}^{K} \gamma_k (\text{Lead } k)_{it}$$
$$+ \mathbf{x}_{it}' \mathbf{\Gamma} + \mu_i + \lambda_t + \delta_{s(i)} t + u_{it}. \quad (2)$$

Since all indicators, $(\text{Lag } j)_{it}$ and $(\text{Lead } k)_{it}$, sum to one for each market i, the model will be underidentified when we include both all lag and lead indicators and year fixed effects. We follow the convention of normalizing the coefficient of one lag period β_1 to be zero. The parameter of interest will be γ_k for $k = 1, 2, \dots, K$, and each γ_k represents the average effect of the grants after k years across markets relative to the average pre-treatment effect on the year before the event.

Lag indicators allow for the inspection of the temporal nature of treatment effects, for example, any dynamics in the appearance of effects (Clarke and Schythe, 2020), and their coefficients, β_j for $j = 2, 3, \dots, J$, describe the evolution of the number of branches in treatment group before the treatment net of changes in untreated counties after controlling for other covariates. Insignificant coefficients on the lag indicators indicate the absence of a pre-treatment trend in the data, supporting the parallel trend assumption (Cunningham, 2021). On the other hand, significant coefficients on the lead indicators indicate the presence of effects after the treatment. This is further supported by the figure below, which shows that the confidence intervals for the lag indicator coefficients cross the zero line, suggesting their insignificance, while the lead indicator coefficients are all significantly different from zero.

Before we conclude the section, we discuss the possibility of estimating the effect of the internet on the number of branches briefly. As discussed above, we can regard the grant program as a positive shock that increases the number of internet users. This provides another possibility of estimating how the increase in the internet connections can affect the number of branches using the grant program as an instrumental variable.

We provide the additional estimation results in Appendix B.

5 Estimation results

5.1 Baseline results

The estimation results are reported in Table 4. Each column sets both L and U to values of 2, 3, 4, and 5. The length of the event window is the number of years that are considered affected by the grant program. In every length of the event window, the event indicators before and at the time of receiving grants were insignificant. Then, it becomes negative and significant starting from one year after the event. The magnitudes are similar across different specifications. Column (4) shows that participating in the grant program decreases the number of bank branches by 0.145. Since the average number of branches in the treatment group is 1.266, participating in the grant program reduces the number of bank branches in a market by 11.5% on average.

The other control variables in the model, such as bank deposits, employment, and the number of business establishments, are also found to have the expected signs and magnitudes. For instance, the results show that a million-dollar increase in total deposits leads to an increase in branches by 0.038, indicating that demand for bank branches is positively related to the level of deposits. Similarly, more employment and business establishments are associated with an increase in the number of bank branches.

The dynamic impact of the grant program over time is illustrated in Figure 4. The figure shows that the coefficients for the years leading up to the grant year are not significant, while the coefficients for the years after the grant year become negative and significant. The lines represent the 95% confidence intervals. Overall, these results suggest that the effect of the CCG program on the number of bank branches is persistent over time, with the negative impact becoming more pronounced in the years following the receipt of the grant.

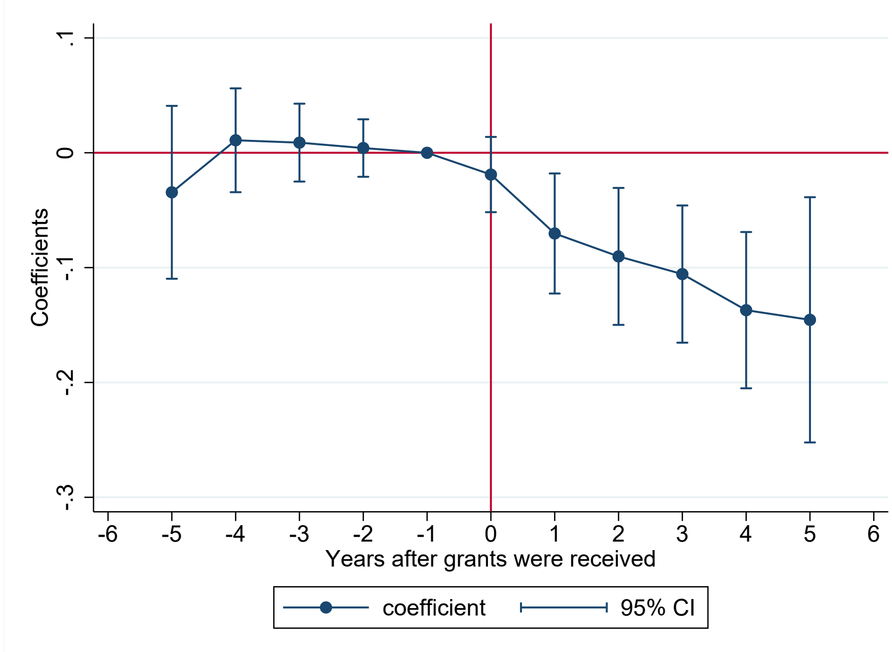
The coefficients on the lead indicator for year k in the treatment in the model would be interpreted as the average effect of receiving grant after k years. So, the increasing coefficient on the average number of branches show that the average number of branches decreases after k years, and it would be showing the cumulative effect of the treatment on bank branch closures for k years. It is also possible that there exist time lag between receiving the grants and more consumers using the internet causing bank branch closures, so the effect becomes larger as years pass after the treatment.

Table 4: Effects of Community Connect Grant Program on bank branches

Dep.var	Event window							
	(1)		(2)		(3)		(4)	
#Branches	4 years		6 years		8 years		10 years	
-5							-0.034	(0.038)
-4					-0.029	(0.036)	0.011	(0.023)
-3			-0.026	(0.033)	0.009	(0.017)	0.009	(0.017)
-2	-0.023	(0.030)	0.004	(0.013)	0.004	(0.013)	0.004	(0.013)
0	-0.019	(0.017)	-0.019	(0.017)	-0.019	(0.017)	-0.019	(0.017)
1	-0.071***	(0.027)	-0.070***	(0.027)	-0.070***	(0.027)	-0.070***	(0.027)
2	-0.134***	(0.045)	-0.091***	(0.030)	-0.090***	(0.030)	-0.090***	(0.030)
3			-0.140***	(0.047)	-0.106***	(0.031)	-0.106***	(0.030)
4					-0.145***	(0.051)	-0.137***	(0.035)
5							-0.145***	(0.054)
Deposit	0.375***	(0.064)	0.375***	(0.064)	0.375***	(0.064)	0.375***	(0.064)
Employment	24.504***	(8.062)	24.504***	(8.062)	24.503***	(8.062)	24.503***	(8.062)
Establishments	0.011***	(0.000)	0.011***	(0.000)	0.011***	(0.000)	0.011***	(0.000)
Obs.	623,893							
Time period	1994∼2016							

Note: Employment is in millions, and deposits are in 10 millions of dollars. Values in parentheses are standard errors clustered by zip code area. All specifications include market and year fixed effects and state-specific trends. Significance levels are presented as ***p<1%, **p<%, *p<10%.

Figure 4: Dynamic impact of Community Connect Grant Program on bank branches



Nguyen (2019) estimates the impact of bank branch closings during the 2000s on local access to credit and finds that annual originations fall by $453,000 after a branch closing. We use this number to estimate the monetary value of the reduction in credit supply caused by the CCG program. Using the results in Column (4) in Table 4, we multiply this number by the coefficient on the indicator for 5 and more years after the grant. The results imply that participating in the grant program reduces credit supply for small businesses by $65,685.

Many banks only focus on certain parts of the U.S. For example, U.S. Bank is a national bank, but it focuses on the west and midwest part of the U.S. and does not have any branch on the northeast coast. To investigate whether the CCG program had different effects in different parts of the U.S., we add two more specifications that consider the effects by census region and division. The census region divides the U.S. into the Northeast, Midwest, South, and West, and census divisions include New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific. In columns (1) and (3) in Table 5, we add fixed effects for census region and division, and in columns (2) and (4), we also include the interaction between year and census region/division fixed effects. We use the five-year event window for all other specifications.

Table 5: Effects of Community Connect Grant Program on bank branches with census fixed effects

Dep. Var	Census Region				Census Division			
#Branches	(1)		(2)		(3)		(4)	
-5	-0.032	(0.038)	-0.034	(0.038)	-0.032	(0.038)	-0.022	(0.039)
-4	0.013	(0.023)	0.009	(0.023)	0.013	(0.023)	0.011	(0.023)
-3	0.010	(0.017)	0.007	(0.017)	0.010	(0.017)	0.009	(0.018)
-2	0.005	(0.013)	0.004	(0.013)	0.005	(0.013)	0.004	(0.013)
0	-0.020	(0.017)	-0.019	(0.017)	-0.020	(0.017)	-0.019	(0.017)
1	-0.075***	(0.027)	-0.075***	(0.027)	-0.075***	(0.027)	-0.077***	(0.027)
2	-0.096***	(0.030)	-0.095***	(0.030)	-0.096***	(0.030)	-0.096***	(0.030)
3	-0.113***	(0.030)	-0.110***	(0.030)	-0.113***	(0.030)	-0.112***	(0.030)
4	-0.145***	(0.034)	-0.142***	(0.035)	-0.145***	(0.034)	-0.144***	(0.035)
5	-0.163***	(0.054)	-0.158***	(0.054)	-0.163***	(0.054)	-0.161***	(0.055)
Deposit	0.372***	(0.064)	0.373***	(0.065)	0.372***	(0.064)	0.375***	(0.065)
Employment	24.830***	(8.160)	24.771***	(8.144)	24.830***	(8.160)	24.581***	(8.123)
Establishments	0.011***	(0.000)	0.011***	(0.000)	0.011***	(0.000)	0.011***	(0.000)
Census region fe	Yes		No		No		No	
Year x Census region fe	No		Yes		No		No	
Census division fe	No		No		Yes		No	
Year x Census division fe	No		No		No		Yes	
Obs.	623,893							
Time period	1994–2016							

Note: Employment is in thousands, and deposits are in millions of dollars. Values in parentheses are standard errors clustered by zip code area. All specifications include market and year fixed effects and state-specific trends. Significance levels are presented as ***p<1%, **p<%, *p<10%.

The results do not change compared to the previous results, and only the magnitude of effects has decreased for the first year and increased for the subsequent years. When we include census division effects, the impact on the year of grants is not significant but the grant still decreases the number of branches from the next year, as seen in Columns (3) and (4).

5.2 By bank branch type

When consumers switch to online banking and demand for bank branches decreases, banks can not only close a branch but also change the branch type from a full-service branch to a limited-service branch. A limited-service branch includes administrative offices, drive-through facilities, loan production offices, consumer credit offices, and mobile/seasonal offices[8]. The SOD data from FDIC also provide information on the types of bank branches, so we now change the dependent variable to the number of full-service branches and limited-service branches. Table 6 reports the results that the grant program affected the number of full-service branches but had no significant effect on the number of limited-service branches. This implies that participating in the grant program decreased the number of full-service branches but did not shift them to limited-service branches.

[8]For details on the definition of limited-service branches, refer to the SOD variable definition file in Federal Deposit Insurance Corporation (2020).

Table 6: Effects of Community Connect Grant Program on bank branches by branch type

Dep. Var	Full-service		Limited-service	
#Branches	(1)		(2)	
-5	-0.032	(0.036)	-0.003	(0.013)
-4	0.002	(0.023)	0.009	(0.010)
-3	0.010	(0.018)	-0.001	(0.007)
-2	0.005	(0.014)	-0.001	(0.007)
0	-0.006	(0.016)	-0.013	(0.008)
1	-0.050	(0.024)	-0.021	(0.010)
2	-0.074***	(0.029)	-0.016	(0.011)
3	-0.093***	(0.029)	-0.012	(0.012)
4	-0.119***	(0.033)	-0.018	(0.013)
5	-0.121***	(0.043)	-0.025	(0.021)
Deposit	0.253***	(0.068)	0.122***	(0.040)
Employment	17.944**	(7.779)	6.559**	(2.596)
Establishments	0.011***	(0.000)	0.000***	(0.000)
Obs.	623,893			
Time period	1994~2016			

Note: Employment is in thousands, and deposits are in millions of dollars. Values in parentheses are standard errors clustered by zip code area. All specifications include market and year fixed effects and state-specific trends. Significance levels are presented as ***p<1%, **p<%, *p<10%.

5.3 By bank size

Large banks were the first to add online channels to their retail banking for customers. Since they have large branch networks, it would be easier for them to move their branches to other markets or close branches with some scrap value. Therefore, there might be a heterogeneous effect of the grant program on the number of branches by bank size.

Table 7: Effects of Community Connect Grant Program on bank branches by size

Dep. Var	Large banks		Medium banks		Small banks	
#Branches	(1)		(2)		(3)	
-5	0.021	(0.019)	-0.026	(0.028)	-0.043	(0.043)
-4	0.015	(0.010)	-0.042	(0.031)	0.036	(0.032)
-3	0.009	(0.010)	-0.037	(0.031)	0.033	(0.026)
-2	-0.003	(0.008)	-0.006	(0.009)	0.013	(0.017)
0	-0.010	(0.005)	-0.002	(0.010)	-0.012	(0.016)
1	-0.031***	(0.008)	0.004	(0.019)	-0.062	(0.032)
2	-0.042***	(0.011)	0.000	(0.019)	-0.065	(0.035)
3	-0.054***	(0.012)	-0.013	(0.013)	-0.049	(0.030)
4	-0.059***	(0.011)	0.005	(0.030)	-0.094*	(0.048)
5	-0.053**	(0.031)	-0.030	(0.020)	-0.068	(0.061)
Deposit	0.416***	(0.067)	0.206***	(0.034)	-0.188***	(0.041)
Employment	11.970**	(5.835)	5.535	(3.790)	3.301	(8.452)
Establishments	0.004***	(0.000)	0.001***	(0.000)	0.006***	(0.000)
Obs.	623,893					
Time period	1994∼2016					

Note: Employment is in thousands, and deposits are in millions of dollars. Values in parentheses are standard errors clustered by zip code area. All specifications include market and year fixed effects and state-specific trends. Significance levels are presented as ***p<1%, **p<%, *p<10%.

Table 7 shows the results for each subsample divided by bank size. We calculate the market share for each year and find the maximum market share for each bank during the data period. Then, we define large banks to be those with a maximum market share larger than 3%, medium banks to be those with a share of 1∼3%, and small banks to be those with a share less than 1%. The estimation results show that large banks led in branch closings after the grant program. After 5 years of a market participating in the program, the number of large bank branches decreases by 0.053. There was no effect on medium-sized banks, but there was also a short-term effect on small bank branches.

6 Conclusion

This paper examines the effect of the Community Connect Grant Program on bank branches. We developed an event study model to examine the effects of the Community Connect Grant Program on the number of bank branches over the period 1994–2016. The estimation results show that participating in the grant program decreased the number of bank branches in rural areas, and this effect lasted beyond five years. The results remained unchanged when we controlled for census region and division fixed effects. Additional analysis results imply that these effects were mostly found in full-service bank branches and in large banks. There is no evidence that full-service bank branches shifted to being limited-service bank branches. We also show that the grant program can be considered a positive shock to internet usage, and its effect on bank branches can be interpreted as how the internet can replace brick-and-mortar bank branches.

We would also like to emphasize that we are not trying to argue against broadband grant programs, our results should be considered as a complementary effect on other positive effects of the programs discussed in the previous literature. It is evident from our results that the broadband grants increase the internet connectivity but it causes additional effect on bank branches which is estimated in our paper that may affect consumers in other aspects.

Based on our findings, several policy implications can be drawn, particularly in light of the Broadband Equity, Access, and Deployment (BEAD) Act, a new federal broadband funding program launched in 2022. Firstly, grant programs for broadband infrastructure should consider the unintended effects of potential bank branch closures. As low-income households often rely on physical branches to access their accounts, it is likely that they will be disproportionately impacted. To mitigate this negative effect, banks, communities, and local governments should provide adequate education and services to assist customers who are less familiar with online banking.

Secondly, policymakers should consider the potential impact of branch closures on banking deserts in rural areas, particularly small businesses, as previously suggested by Nguyen (2019). Before granting funds to build new broadband infrastructure, it is essential to investigate the potential consequences of decreased credit access.

Overall, this paper sheds light on banks' strategies for opening and closing bank branches and operating broadband grant programs in rural areas by expanding the scope of the issues to be investigated during the program.

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A Event study model indicators

Table 8 below shows how each lag and lead indicator in Equation (1) is defined. Zip code 1 is in treatment group which received the grant during the data period and Zip code 2 is in control group.

Table 8: Event Study Model Indicators: Example

Zip code (i)	Year (t)	Event	Time to event	Lag 5	Lag 4	Lag 3	Lag 2	Lag 1	Lead 0	Lead 1	Lead 2	Lead 3	Lead 4	Lead 5
1	2000	2007	-7	1	0	0	0	0	0	0	0	0	0	0
1	2001	2007	-6	1	0	0	0	0	0	0	0	0	0	0
1	2002	2007	-5	1	0	0	0	0	0	0	0	0	0	0
1	2003	2007	-4	0	1	0	0	0	0	0	0	0	0	0
1	2004	2007	-3	0	0	1	0	0	0	0	0	0	0	0
1	2005	2007	-2	0	0	0	1	0	0	0	0	0	0	0
1	2006	2007	-1	0	0	0	0	1	0	0	0	0	0	0
1	2007	2007	0	0	0	0	0	0	1	0	0	0	0	0
1	2008	2007	1	0	0	0	0	0	0	1	0	0	0	0
1	2009	2007	2	0	0	0	0	0	0	0	1	0	0	0
1	2010	2007	3	0	0	0	0	0	0	0	0	1	0	0
1	2011	2007	4	0	0	0	0	0	0	0	0	0	1	0
1	2012	2007	5	0	0	0	0	0	0	0	0	0	0	1
1	2013	2007	6	0	0	0	0	0	0	0	0	0	0	1
2	2000	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2001	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2002	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2003	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2004	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2005	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2006	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2007	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2008	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2009	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2010	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2011	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2012	-	-	0	0	0	0	0	0	0	0	0	0	0
2	2013	-	-	0	0	0	0	0	0	0	0	0	0	0

Note: This table format is adapted from Clarke and Schythe (2020)

B Two-step estimation using county-level data

This section presents the effect of the internet on the number of branches using the grant program as an instrument for the internet. Ideally, if we want to estimate the effect of the internet on bank branches, we would need the number of internet connections or users as an independent variable. However, unfortunately, the best data available for broadband in rural areas is Form 477 County Data on Internet Access Services provided by the Federal Communications Commission (FCC) which is available at the county level from 2008 to 2016[9]. Therefore, throughout the paper, we used the grant program to present the effect of the internet on bank branches.

However, to claim that the grant program can indeed be used to capture the increase in internet connections, we need to see how the grant program changes internet access and hence the number of bank branches. We first provide details on the data we used for the internet connections mentioned above. Form 477 County Data maps each county into an index from 0 to 5 according to the number of fixed residential connections over 200 kbps per 1,000 households. The criteria are presented in Table 9.

Table 9: Form 477 County Data on Internet Access Services

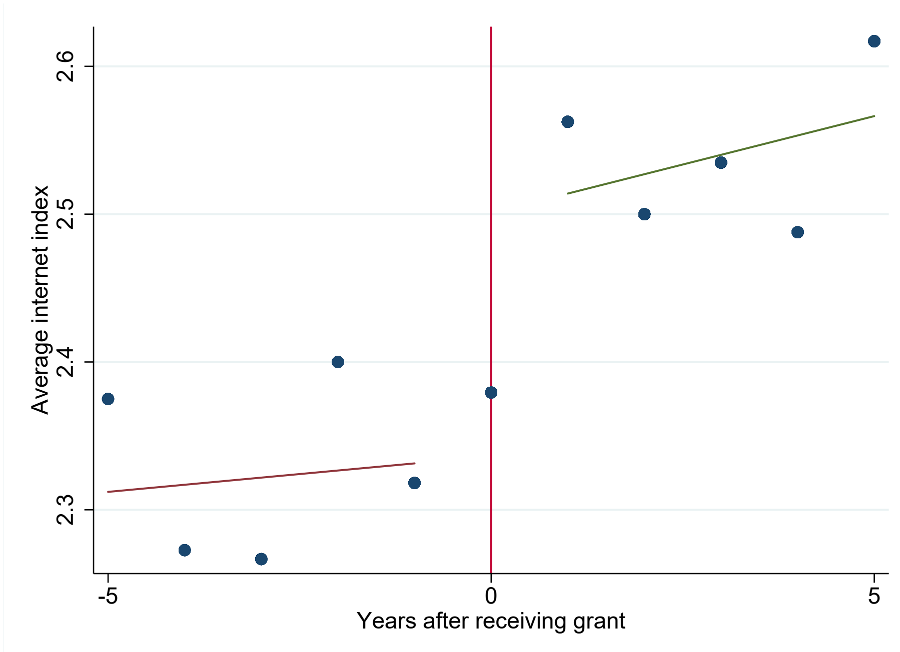
Connections per 1,000 Households	Index
0	0
$0 < x \leq 200$	1
$200 < x \leq 400$	2
$400 < x \leq 600$	3
$600 < x \leq 800$	4
$800 < x$	5

Note: Connections per 1,000 households refer to residential fixed high-speed connections over 200 kbps in at least one direction per 1,000 households.
Source: Federal Communications Commission (2019)

[9] Similar data are also available at the zip code level prior to 2008, but these only provide the number of internet service providers, and when there are fewer than four providers, they are all denoted as "*", so it is difficult to distinguish whether there was indeed a change in internet connections in a zip code area, especially in rural areas that are our interest.

As a preliminary analysis, we construct Figure 5 to see how the internet index changed after grant receipt. Figure 5 presents the average internet index against years after when the treatment group wins a grant. It shows a discontinuity between the years before and after receiving a grant. This implies that after receiving the grants, counties experienced an increase in internet connections.

Figure 5: Average internet index before and after the Connect Community Grant Program



Note: Average internet index is the average internet index across counties.

We now use the data available to estimate the effect of the internet using two-step estimation. First, we estimate an ordered probit model for the internet index $k = 0, 1, \ldots, 5$.

$$\begin{aligned}\Pr(internet_{it} = k) &= \Pr(k < internet_{it} < k+1) \\ &= \Pr(k < \delta_1 grant_{it} + \mathbf{x'_{it}}\boldsymbol{\beta}_1 + \mu_{1,i} + \alpha_{1,t} + \gamma_{1,s(i)}t + v_{it} + \epsilon < k+1)\end{aligned}$$

where *internet* is the index for internet connections ($k = 0, 1, \ldots, 5$) and *grant* is defined as

$$grant_{it} = \begin{cases} 1 & \text{if county } i \text{ received grants in or before year } t \\ 0 & \text{otherwise.} \end{cases}$$

Other control variables $\mathbf{x_{it}}$ are the same as our main model in the text, which are deposits, employment, and the number of business establishments. We also include fixed effects – μ_i, α_t, and $\gamma_{s(i)}t$ are county and year fixed effects and state-specific trends, respectively. We assume that the error term ϵ follows the standard normal assumption.

Then, using the fitted values from the above equation as an instrument for the internet variable, we estimate the effect of the internet index on the number of bank branches. Specifically, the first- and second-stage equations for a county i in state s in year t are as follows:

$$\begin{aligned} \text{First stage :} \quad & Pr(internet_{it} = k) = f(\delta_1 grant_{it} + \mathbf{x'_{it}}\boldsymbol{\beta}_1 + \mu_{1,i} + \alpha_{1,t} + \gamma_{1,s(i)}t + v_{it}) \\ \text{Second stage :} \quad & branch_{it} = \delta_2 internet_{it} + \mathbf{x'_{it}}\boldsymbol{\beta}_2 + \mu_{2,i} + \alpha_{2,t} + \gamma_{2,s(i)}t + u_{it} \end{aligned}$$

Table 10: Effects of Internet Connections on bank branches

	First-stage		Second-stage	
	(1)		(2)	
Dep. Var	Internet		#Branches	
Grant	1.768***	(0.651)		
Internet			-0.535*	(0.290)
Deposit	0.717	(2.660)	9.329***	(0.441)
Employment	0.409*	(0.215)	0.015	(0.026)
Establishments	0.002	(0.007)	0.002***	(0.001)
Time period	2008–2016			
Obs.	4,542			

Note: Employment is in thousands, and deposits are in millions of dollars. Values in parentheses are standard errors. All specifications include market and year fixed effects and state-specific trends. Significance levels are presented as ***p<1%, **p<5%, *p<10%.

Table 10 reports the estimation results. The signs of coefficients are as expected. In the first stage, if a county participates in the grant program, it is 1.8 times more likely to have a higher internet index, which means it is 1.8 times more likely that there will be approximately 20% increase in the percentage of households with internet index. The second stage results imply that the increase in internet connections decreases the number of bank branches, which is consistent with the results presented in Table 4. The results show that the grant is indeed increasing internet access and can be used as a proxy for internet access to estimate the effect of the internet on bank branches.