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Supporting Digital Entrepreneurship in Low- and Moderate-Income Communities: Evidence from the CDBG Program

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Abstract

Digital technologies are reshaping the geography of entrepreneurship, expanding opportunities for business formation beyond traditional tech hubs. Yet, spatial gaps in digital entrepreneurship persist, particularly in low- and moderate-income communities. Using geolocated data on Community Development Block Grant (CDBG) investments and commercial domain registrations, this study examines how local use of flexible grant funds supports digital entrepreneurship in targeted ZIP codes. The analysis finds that CDBG investments in areas with robust broadband adoption are positively associated with digital entrepreneurial activity. The results further suggest that the type of investment matters, with varying associations for activities relating to infrastructure, public services, and business services. These findings contribute to research on place-based policies and inclusive economic development in the digital age.

Keywords

digital entrepreneurship, place-based policy, inclusive economic development

Widespread digitalization has fundamentally reshaped how goods and services are produced, distributed, and consumed, transforming the landscape of entrepreneurship. These trends have created new pathways for economic growth and participation, expanding the capabilities of existing businesses and empowering new ventures and industries to emerge (Belitski et al., 2021; Nambisan et al., 2019; OECD, 2019). This shift has given rise to the concept of "digital entrepreneurship," broadly defined as the process of "identifying and exploiting opportunities through digital technologies, resulting in new and flexible ways of conducting business and creating value" (Yáñez-Valdés & Guerrero, 2024, p. 4).

Today, the use of digital technologies is increasingly essential for firm survival and growth, and for the strength of local economies. Yet, spatial gaps in business technology use persist, particularly in low-income neighborhoods (Mossberger et al., 2022). This raises important questions about how local policies can address these disparities and better support entrepreneurs in the digital age.

Geolocated data on the Community Development Block Grant (CDBG), a long-standing federal program that funds a range of local development activities, offers an opportunity to explore these dynamics. Drawing on ZIP-code level CDBG activity data alongside commercial data on over 20 million domain-name hosts, this study examines how local investment strategies in low- and moderate-income (LMI) communities influence digital entrepreneurial activity. Surveys reveal that three out of four domain name hosts are used for commercial purposes, with over 90% supporting online microbusinesses that have less than 10 employees (Venture Forward, 2022). These data are available monthly at the ZIP-code level, and in the aggregate, provide a unique measure of digital entrepreneurial activity. By influencing key drivers of digital entrepreneurship such as access to capital, information and communication technology infrastructure, and skills training, eligible CDBG activities have the potential to improve business participation in the digital economy.

Using panel data on nearly all U.S. ZIP codes and two-way fixed-effects methods, this study provides evidence that targeted CDBG activities are positively associated with digital entrepreneurial activity, particularly in areas with widespread broadband use. Additionally, the study's findings suggest that the type of place-based investment matters for digital entrepreneurship, with varying relationships for

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activities relating to infrastructure, public services, and business services.

This paper begins with a discussion of spatial gaps in digital entrepreneurial activity and the role of flexible intergovernmental grant programs like the CDBG. This is followed by a discussion of the study's theoretical framework, research design, and findings. The paper concludes with implications for local policy makers and practitioners.

Literature Review

Spatial Gaps in Digital Entrepreneurial Activity

Measures of the digital economy have traditionally relied on metrics such as e-commerce spending or the proportion of the economy in the information sector (Jackson et al., 2018; Moretti, 2012). However, these indicators fail to capture the breadth of digital engagement across different sectors and business types. For instance, they miss the adoption of digital marketing and communication strategies by brick-and-mortar stores, as well as the online activities of platform-based and microbusinesses often overlooked in government survey data. The use of commercial data, such as domain names, enables more comprehensive measurement of digital entrepreneurial activities. Domain names are governed by the global Internet Corporation for Assigned Names and Numbers (ICANN;, 2012) and function as the "underlying address book of the internet" (Mossberger et al., 2022).

Research using geolocated domain name data first appeared in the 1990s (Kolko, 1999; Moss & Townsend, 1997) and has seen a resurgence in the 2020s with the availability of proprietary data sets from the domain registrar, GoDaddy (Mossberger et al., 2022; Mossberger et al., 2023). Alongside these data, customer surveys conducted by GoDaddy provide additional insights into how domains are used and by whom. These surveys indicate that registered domains are primarily used for commercial purposes, with most supporting the online presence of small and microbusinesses (e.g., websites, email, SSL). Because these firms are overwhelmingly sole proprietorships or small LLCs, domains and formal business registration are often tied to the entrepreneur's home address. Surveys also confirm that many of these businesses operate directly from the home, conducting sales, bookings, customer communication, and marketing through their website or social media, while a smaller share maintain a brick-and-mortar presence (Venture Forward, 2024).

In the aggregate, domain data provide a unique measure of digital entrepreneurial activity across space, revealing hot spots as well as disparities within regions. The drivers of these digital divides are contextual and multifaceted, with factors spanning technology access, literacy and skills, and trust (Helsper, 2021; van Deursen et al., 2017). Bridging these gaps often requires holistic investments that extend beyond the provision of digital infrastructure. Bengali and Yu's (2021) study of online microbusiness formation, for instance, observed greater digital entrepreneurial activity in areas equipped not only with broadband, but with access to training, skilled labor, and capital. Similarly, Bergholz et al. (2024) found digital entrepreneurship to emerge in both rural and urban areas when digital infrastructure and highly skilled human capital are present.

Historically, place-based interventions have been the primary mechanism through which local governments address economic and social disparities within specific geographic areas. These place-based policies range from direct business assistance and tax incentives to broader social and infrastructural improvements, all aimed at revitalizing distressed and stagnant areas and improving living conditions for residents (Bartik, 2020; Neumark & Simpson, 2015; Shambaugh & Nunn, 2018). In the wake of the COVID-19 pandemic, new attention has been brought to the importance of digital inclusion for accessing essential services and supporting local economies and is increasingly becoming a key feature of local development strategies (Anderson et al., 2021; Mossberger et al., 2021b). As such, it is crucial to understand how local conditions and policy interventions can support digital economic participation in communities. The CDBG program, one of the longest-running place-based intergovernmental grant programs, presents an opportunity to explore how local investments can support digital entrepreneurial activity.

Community Development Block Grant Program

Established under the Housing and Community Development Act of 1974, the CDBG was designed to reduce redundancy in existing categorical development programs and provide local governments with more flexibility in addressing their specific development needs. Each fiscal year, CDBG funds are appropriated by Congress and allocated by the Department of Housing and Urban Development (HUD) to "entitlement communities" based on factors such as population, housing stock, and concentration of poverty. Entitlement communities include cities with at least 50,000 residents and counties with populations of 200,000 or more. Additionally, state governments receive a portion of CDBG funds to distribute to "non-entitlement communities" whose populations fall below these thresholds (HUD, 2023).

While local governments establish their own funding priorities, the use of CDBG funds must meet the following criteria: 1) benefit low- and moderate-income (LMI) individuals, 2) eliminate or prevent slum and blight conditions, or 3) meet other urgent needs such as natural disasters. Additionally, seventy percent of CDBG funds must meet LMI objectives, with funded activities serving areas where at least 51% of the population earn less than 80% of the Area Median Income (AMI; HUD, 2007). Eligible CDBG activities span six broad categories, including 1) property and land acquisition/demolition, 2) economic development, 3) housing rehabilitation, 4) public services, 5) public improvements, and 6) administration.

Early scholarship on the CDBG focused primarily on program implementation and the political dynamics shaping local spending decisions. Tensions between local discretion and federal oversight and questions of "who benefits" have been core controversies of the CDBG program, motivating much of the initial research on the program (Rosenfeld et al., 1995). While there is extensive literature on the politics and implementation of the CDBG program, few studies have examined its measurable economic and social impacts in targeted communities (Galster et al., 2004; Walker et al., 2002). These studies have found positive effects in terms of property values (Galster et al., 2004; Overton & Stokan, 2023; Pooley, 2014; Stokan & Overton, 2020), mortgage amount and approval rates (Galster et al., 2004; Walker et al., 2002), and number of businesses and number of jobs in neighborhoods (Galster et al., 2004; McCullough, 2024; Zuo, 2020). Additionally, these studies suggest that impacts often take several years to emerge, with observable effects anywhere from 3 years (Galster et al., 2004; Stokan & Overton, 2020) to 10 years after a CDBG activity occurred (Pooley, 2014; Zuo, 2020). Further, prior research suggests that the magnitude of the impact depends on the size of CDBG investment and the socioeconomic characteristics of the service area. For instance, Galster et al. (2004), Pooley (2014), and Zuo (2020) found greater economic returns when CDBG investments are above median in expenditures and Zuo (2020) and McCullough (2024) found greater job creation and business development in less disadvantaged areas, respectively.

While prior evaluations of the CDBG program suggest that place-based investments can stimulate economic activity in targeted neighborhoods, they largely focus on traditional business and housing outcomes. Rapid digital transformation of the economy, however, highlights the need to understand the program's role in supporting digital entrepreneurial activity in targeted communities and the conditions in which this impact is likely to occur.

To address this gap, this paper investigates the following research questions:

1. What are the impacts of CDBG investments on digital entrepreneurial activity at the ZIP-code level?
2. What are the impacts of different types of CDBG investments on digital entrepreneurial activity at the ZIP-code level?
3. How does broadband adoption condition the impact of CDBG investment on digital entrepreneurial activity at the ZIP-code level?

Theoretical Framework

This study draws on multiple literatures to investigate the relationship between place-based investments and digital entrepreneurial activity in LMI communities, including scholarship on digital entrepreneurial ecosystems, resource-constrained entrepreneurship, and digital inequality.

Beginning in the 1980s, entrepreneurship scholarship shifted away from individual, personality-based research toward more holistic, ecosystem perspectives that emphasize the role of local actors, institutions, and resources in shaping business development (Stam & van de Ven, 2021). The proliferation of digital technologies and their use for economic activities further advanced this perspective, leading to frameworks such as the digital entrepreneurial ecosystem (DEE) that reimagine entrepreneurial environments in a digital context.

The DEE, introduced by Sussan and Acs and later refined by Song (2019), suggests that the creation and sustainability of digital entrepreneurial activity depend upon four factors: Digital User Citizenship, Digital Infrastructure Governance, Digital Entrepreneurship, and Digital Marketplace. Digital User Citizenship refers to the participation of digital users who partake in online activities, including both business owners and customers (Song, 2019). Digital Infrastructure Governance reflects the provision of physical infrastructure as well as institutional policies that support digital economic exchange (Sussan & Acs, 2017).

Digital Entrepreneurship encompasses "any agent that is engaged in any sort of venture be it commercial, social, government, or corporate that uses digital technologies" (Sussan & Acs, 2017, p. 66). This definition includes both Schumpeterian-style entrepreneurs who create innovative digital products as well as entrepreneurs who leverage digital technologies for routine business processes. Digital Marketplace, later reconceptualized as digital multisided platforms (Song, 2019), refers to "intermediaries or matchmakers" who reduce transaction costs by connecting customers with businesses (e.g., websites, apps, e-commerce platform). Taken together, Digital Entrepreneurship and Marketplace reflect entrepreneurial activity and participation in online economic exchange. In this study, domain density, measured as commercial domains per 100 residents, serves as the primary outcome. Registering a commercial domain capture both the presence of a digital business and its participation in the online marketplace where transactions occur.

Supporting DEEs Through Place-Based Investments

DEEs are marked by both global and local spatial dimensions. Although digitalization has broadened the geographic bounds of entrepreneurship, business development and digital access remain local phenomena (Song, 2019). Local environments matter for digital economic activity, and participation can vary significantly across neighborhoods and regions. Even with gains in broadband access and technology use (Pew Research Center, 2021), disparities in business participation in the digital economy persist in both urban and rural settings, particularly in low-income communities (Mossberger et al., 2021a, 2021b).

Beyond overcoming the liability of being small and new, entrepreneurs in low-income neighborhoods often confront non-business pressures and an absence of a safety net. Simultaneously, these entrepreneurs must adeptly navigate a complex digital landscape to stay competitive (Hui et al., 2018; Morris, 2020). These conditions make local institutions especially important for supporting DEEs in LMI areas.

Place-based investments, particularly through flexible programs such as the CDBG, can support DEEs by addressing barriers that constrain local business development. Although Digital Infrastructure Governance is often examined at the national or state level (e.g., regulation, broadband policy), CDBG investments represent a localized form of governance as it can improve the social, economic, and infrastructure foundations on which digital economic activity depends. As such, I expect greater domain name density in ZIP codes with higher CDBG investment.

> H1a: Higher levels of CDBG investment are associated with higher levels of domain name density.

Additionally, the flexible design of the CDBG allows investments across categories such as infrastructure, business services, and public services. These channels may differ in how effectively they foster digital entrepreneurship, but each has the potential to contribute to higher domain density.

> H2a: Higher levels of CDBG-funded infrastructure investment are associated with higher levels of domain name density.

> H3a: Higher levels of CDBG-funded business service investment are associated with higher levels of domain name density.

> H4a: Higher levels of CDBG-funded public service investment are associated with higher levels of domain name density.

Finally, Digital User Citizenship highlights the community of users who engage in online activities as entrepreneurs or consumers (Song, 2019). In this study, broadband adoption serves as a measure of Digital User Citizenship, as it reflects both access to digital infrastructure and its use by the local population. Consistent with the DEE framework, higher levels of broadband adoption should strengthen both the demand- and supply-side conditions for digital entrepreneurship. Accordingly, the positive relationship between CDBG investments and domain name density is expected to be stronger in ZIP codes with higher broadband adoption.

> **H1b-H4b**: The positive association between CDBG investments—in total, and across infrastructure, business services, and public services—and domain name density will be stronger in ZIP codes with higher broadband adoption.

Research Design

To examine the relationship between CDBG investment and digital entrepreneurial activity, I rely on publicly available data from the HUD and proprietary data from domain registrar, GoDaddy, between the years 2019 and 2022. Although GoDaddy has provided domain data to researchers on a quarterly basis since 2019, these years were selected to ensure a balanced data set, accounting for reporting lags in HUD and U.S. Census data at the time of analysis. While census-tract level data would be preferable in capturing neighborhood effects, privacy considerations limit domain data released to researchers to the ZIP code level.

Dependent Variable

The primary dependent variable in this study is ZIP-code domain-name density, which is measured as the number of registered domain names and their redirects (e.g., SSL, email) per 100 residents in a ZIP code. Domain name data are gathered from the domain registrar, GoDaddy, and are geolocated to customer ZIP codes. Nationally representative customer surveys[1] as well as machine learning analyses conducted by GoDaddy indicate that approximately three out of four domains are used for commercial purposes (Mossberger et al., 2022).

For the analysis, GoDaddy provided the total number of active domain name hosts in each ZIP code, recorded monthly over the study period. To construct the annual dependent variable, the median monthly count of active domains is normalized by population (domains per 100 residents) and log-transformed using the $\ln(x + 1)$ transformation to mitigate skewness and accommodate zero values (Burbidge et al., 1988).[2]

Independent Variable

The primary independent variable in this study is CDBG investment, which is measured as total annual CDBG expenditures per 100 residents in a ZIP code. The relationship between CDBG investment and domain name density is examined for total CDBG expenditures, and for specific CDBG activities within three categories, which include infrastructure, business services, and public services.

CDBG investment data are gathered from the HUD's Community Development Block Grant Activity database.[3] This data set contains information on over 300,000 CDBG activities that have occurred since the 1990s. Each activity is geocoded to the address where the project took place and includes information on the date the activity was completed, the type of activity, and the level of expenditure.

To allow for a 2-year lag in the analysis, CDBG activity data between the years 2017 and 2022 are used. For each ZIP code in the sample, CDBG expenditures are aggregated by year and activity type and adjusted for inflation. Like the dependent variable, CDBG spending is normalized by population (dollars spent per 100 residents) and log transformed using the $\ln(x+1)$ transformation (Burbidge et al., 1988).

For this study, activities in this CDBG are assigned to three categories, including physical infrastructure, business services, and public services. The infrastructure category includes activities such as street improvement, water/sewer improvement, and commercial/residential rehabilitation. The business services category includes activities such as training and technical assistance and microenterprise grants. The public services category includes activities such as transportation services, housing services, and employment training. To simplify the analysis, some similar activity types were consolidated (e.g., youth facilities and youth services are "youth services and facilities"). For the full list of activities and their assigned categories, see Table 1A in the supplementary online appendix.

Control Variables

Control variable data for this study are gathered from the U.S. Census American Community Survey 5-year estimates and are included to account for time-varying factors unique to each ZIP code that may affect digital entrepreneurial activity. Community characteristics such as employment, education, and income level of residents have been found to influence domain density (Bengali & Yu, 2021; Moss & Townsend, 1997; Mossberger et al., 2023) and are standard controls in previous research utilizing domain data. As such, this study controls for socioeconomic factors such as median income, and the percentage of the population who are unemployed, living below the poverty level, hold a bachelor's degree, and identify as part of a racial or ethnic minority group. Additionally, variables relating to technology are used, including the percentage of the population employed in the information technology sector and percentage of households with a broadband subscription.

Summary of Models

This study employs a two-way fixed effects (TWFE) model to examine the relationship between CDBG investment and domain name density in a ZIP code. This approach is consistent with recently published studies of the CDBG program (McCullough, 2024; Overton & Stokan, 2023). The panel data used in this analysis are balanced, meaning that each ZIP code is observed for every year within the study period (2019 to 2022). Fixed effects and/or random effects models are a standard econometric approach when analyzing longitudinal data (Cunningham, 2021).

The models used in this analysis include both unit and time fixed effects as well as lagged effects in the key independent variables. Unit fixed effects control for unobserved time-invariant characteristics unique to each ZIP code that may affect domain density. Year fixed effects control for variables that are constant across all ZIP codes but vary over time. A two-way fixed effects strategy was chosen over a traditional difference-in-differences model given continuous treatment variables as well as variation in treatment status and timing among ZIP codes in the sample (Angrist & Pischke, 2009; Bertrand et al., 2004; Cunningham, 2021; Overton & Stokan, 2023; Wing et al., 2018).

Consistent with prior studies of the CDBG program, lagged effects are included as it is assumed that block grant activities may not always have an immediate effect (Galster et al., 2004; McCullough, 2024; Overton & Stokan, 2023; Stokan & Overton, 2020; Zuo, 2020). For example, direct financial assistance to entrepreneurs may generate more immediate impacts by providing the capital needed to cover start-up costs and establish their operations. In contrast, projects aimed at improving broader social conditions (e.g., healthcare services and housing) may take longer to show measurable outcomes as their relationship to economic growth is more indirect and gradual (Anthony, 2022; Penghui et al., 2022; Wardrip et al., 2011). Following the lag structure used by Overton and Stokan (2023), both contemporaneous and 2-year lagged effects are incorporated into the models. While multicollinearity between these lags could be a concern, variance inflation factor (VIF) tests indicated a low level of multicollinearity, with all VIF values below 2.

Last, all models are in log-log functional form and use robust standard errors clustered at the ZIP code level. Clustered standard errors are used to address potential heteroskedasticity and autocorrelation issues that can arise when using longitudinal data (Cunningham, 2021). Formally, the models used in this study are expressed as:

Model 1:

$$ln(DomainDensity_{it}) = + ln(\beta_3 TotalCDBG_{it-2}) + \gamma X_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

Model 2:

$$ln(DomainDensity_{it}) = + ln(\beta_2 TotalCDBG_{it}) + ln(\beta_3 Broadband_{it}) + \gamma X_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

Model3:

$$ln(DomainDensity_{it}) = + ln(\beta_3 PublicServices_{it}) + ln(\beta_4 Infrastructure_{it}) + ln(\beta_5 BusinessServices_{it}) + \gamma X_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

Model 1 estimates the impact of total CDBG investment on domain name density in a ZIP code in the immediate, first, and second year after CDBG investment occurred. Ln(DomainDensity) is the log of domain names per 100

Table 1. ZIP Code Summary Statistics.

Median Values	All ZIP Codes	Treated	Not Treated
CDBG expenditures per 100 residents	$0	$924	$0
Domains per 100 residents	1.98	3.93	1.75
Population	2,626	16,415	1,926
Income	$67,467	$67,266	$67,498
Percent below poverty	7.5	9.7	7.2
Percent bachelors	14.4	17.3	14
Percent unemployed	2.8	3.6	2.6
Percent white alone	89	73	90.8
Percent broadband subscriptions	83.1	85.1	82.8
Percent employed in IT	1.1	1.6	1

Note: CDBG expenditures and income are inflation-adjusted to 2023 dollars.

residents in ZIP code i in year t and ln(TotalCDBG) is the log of total CDBG expenditures per 100 residents in ZIP code i in year t, $t\text{-}1$, and $t\text{-}2$. γX_{it} represents ZIP code control variables, α_i represents fixed ZIP code effects, λ_t represents year fixed effects, and ε_{it} is the error term. Model 2 estimates the interactive effect of total CDBG investment and broadband subscriptions on domain name density, as well as the individual effects of CDBG and broadband. Model 3 estimates the interactive effect of specific CDBG activity types and broadband subscriptions on domain name density, controlling for the individual effects of broadband and other activity categories.

Summary Statistics

Median values are presented in Table 1 for the primary independent, dependent, and control variables in the entire sample of ZIP codes. The panel data set includes 129,528 observations of CDBG investment and domain name hosts in 36,501 ZIP code areas. With 41,683 ZIP codes as of 2022, this represents nearly 90% of all U.S. ZIP code areas. For each year in the study period, an average of 4,264 ZIP codes receive CDBG investment, making up approximately 12% of the sample. As expected, treated ZIP codes display higher poverty and unemployment rates. Consistent with McCullough (2024), treated ZIP codes also exhibit higher levels of educational attainment, broadband adoption, and IT employment. This likely reflects the concentration of CDBG investments in urban areas, where populations tend to be socioeconomically mixed and supported by greater infrastructure. Additional descriptive statistics are available in supplementary online Appendix Tables 2A and 3A.

Results

Empirical results are presented in Tables 2, 3, and 4. Addressing RQ1, Column 1 in Table 2 shows a negative but insignificant relationship between total CDBG expenditures and domain density in a ZIP code within the first 3 years of investment. Tables 3 and 4 address RQ2, examining the relationship between different types of CDBG spending and digital entrepreneurial activity. Among broader categories in Table 3, a positive and significant relationship is observed for infrastructure spending within 1 year of investment at the 10% significance level. No significant relationship was found for overall public service spending, while business service spending showed a negative and significant relationship within 3 years of investment.

While overall CDBG spending shows no significant association with domain name density, this may be due to the aggregated nature of the data obscuring activity-specific effects (Stokan & Overton, 2020). Column 1 in Table 4 provides a more nuanced picture, with specific CDBG-funded projects, including commercial infrastructure improvements, residential improvements, security deposits, and direct financial assistance to businesses, demonstrating a positive association with digital entrepreneurial activity in LMI communities.

Table 2. CDBG Expenditures and Domain Density.

Fixed Effects (within) Regression Group variable: ZIP	Total CDBG per 100 Residents	Total CDBG Per 100 Residents * % Population with Broadband
Domain name hosts per 100 residents	(1)	(2)
Year *n*	−.000149	.000084***
Year *n* - 1	−.000095	.000003
Year *n* - 2	−.000138	.000005
Controls		
% white alone	−.000449**	−.00044**
% bachelors	.000877*	.00088*
% unemployed	−.005296***	−.00528***
% below poverty	−.001817***	−.00178**
% IT employed	−.001733*	−.00174*
Median income	−.000001***	−.000001***
% broadband	.000494**	.00029*
Total CDBG per 100 residents	–	−.00732
Year fixed effect	–	–
2020	.001967	.002170
2021	.004396**	.004495**
2022	.021363***	.021514***
Observations	129,528	129,528
Sample size	36,501	36,501
R^2 (within)	.0163	.0166
R^2 (between)	.0528	.0509
R^2 (overall)	.0511	.0504
F-statistic	89.31	84.35
ρ	.985	.985

Note. All regressions are weighted by average ZIP code population and standard errors are clustered at the unit level. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

Table 3. CDBG Expenditures and Domain Density by CDBG Category.

Fixed Effects (within) Regression Group variable: ZIP	Total CDBG per 100 Residents	Total CDBG Per 100 Residents * % Population with Broadband
Domain name hosts per 100 residents	(1)	(2)
Total infrastructure (Year *n*)	.00059*	.000103***
Year *n* −1	.00006	.000004
Year *n* −2	−.00011	.000003
Total public services (Year *n*)	−.0005717	.0000961**
Year *n* −1	−.0003376	−.000000206
Year *n* −2	−.0005703	.00000037
Total business services (Year *n*)	−.0010314*	−.0000288
Year *n* −1	.0000392	.0000007
Year *n* −2	.0006592	.0000112
Observations	129,528	129,528
Sample size	36,501	36,501
Control variables	Yes	Yes

Note. All regressions are weighted by average ZIP code population and standard errors are clustered at the unit level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < .01$.

Addressing RQ3, Column 2 of Table 2 introduces an interaction term between CDBG spending and broadband subscriptions in a ZIP code. The coefficient on this interaction is positive and statistically significant at the 1% level in the first year, indicating that the marginal effect of CDBG spending on domain density increases as broadband adoption rises. In practical terms, areas with higher broadband subscription rates experience a stronger increase in domain density from increases in CDBG investments, while areas with lower adoption see a more limited effect.

Similarly, when examining the interactive effects of different types of CDBG investments with broadband (Column 2 in Tables 3 and 4), the positive impact of infrastructure spending remains significant at the 1% level, and public services become significant at the 5% level. However, overall spending on business services is insignificant for all 3 years. In addition to the specific activities highlighted in Table 4, the relationship between investments in health services and youth services and digital entrepreneurial activity strengthens as broadband adoption increases. Overall, these results provide partial support for all hypotheses, particularly across specific CDBG activity types, and reinforce the central premise of the DEE framework that the interaction of digital, physical, and institutional factors shape digital entrepreneurial activity.

Robustness Checks

Additional tests were conducted to examine the robustness of the results in relation to spatial spillovers as well as different geographic, economic, and temporal contexts. Spatial spillovers occur when the economic dynamics of one area influence outcomes in neighboring areas and are an important consideration in local economic development (Capello, 2009). To account for potential spatial spillover effects between ZIP codes, standard errors were clustered at the city level (Abadie et al., 2022; Cameron & Miller, 2015). The results remained largely consistent, showing no significant effect of overall CDBG investment on domain density, but a positive and significant effect of the interaction between CDBG expenditures and broadband subscriptions on domain density in year 1. Similarly, the results were stable when examining the relationships across different CDBG activity categories and domain density. For full results, see Table 4A in the supplementary online appendix.

To assess the stability of the results across different geographic contexts, the models were rerun separately for urban, suburban, and rural ZIP codes.[4] The results in Table 5 indicate that overall CDBG investment is insignificant across all geographic areas, consistent with the primary model that included all ZIP codes. The only exception is lag 1 in urban areas, where CDBG investment shows a marginally significant negative relationship.

The interaction between CDBG investments and broadband adoption remains positive and significant in year 1, but only in urban ZIP codes. This suggests that CDBG investments and broadband have a stronger, more measurable impact in urban environments, likely due to better market conditions and agglomeration effects. However, when examining infrastructure investments in areas with higher broadband adoption, the relationship is positive across all geographic types, indicating that this combination can have an impact regardless of urbanization.

Additionally, while business services investments show no significant relationship across all ZIP codes, a significant and positive association is observed in suburban areas. These findings indicate that while urban areas exhibit the strongest overall response to CDBG and broadband investments, specific types of CDBG activities (such as infrastructure and business services) may have meaningful impacts on digital entrepreneurship in suburban and rural areas as well.

An additional concern is that the estimated effects of CDBG on digital economic activity might simply reflect preexisting neighborhood trajectories or a bias toward higher-income ZIP codes. Because GoDaddy began publishing geolocated domain data in 2019, pre-treatment data are limited for this analysis. To account for baseline economic conditions, all models include unit fixed effects and a set of socioeconomic controls. To further address this concern, ZIP codes were segmented both by pre-2019 income trajectory and by poverty concentration. The trajectory analysis distinguishes declining (bottom third) and upward-trending (top third) areas based on changes in median income between 2017 and 2019, while the poverty segmentation follows The Pew Charitable Trusts (2016) categories of low, moderate, and high poverty areas.

Table 4. CDBG Expenditures and Domain Density by CDBG Activity.

Activity		(1) CDBG Alone	(2) CDBG X Broadband
Infrastructure	Acquisitions		
	Asbestos		
	Brownfield Cleanup		
	Code Enforcement		
	Historic Commercial Improvements		
	Commercial Improvements	+*	+*
	Commercial Rehab.		
	Flood Facilities		
	Misc. Improvements		
	Neighborhood Facilities	−*	
	Neighborhood Cleanup		
	Parking	−*	−*
	Parks and Recreation		
	Residential Improvements	+*	+*
	Sidewalks		
	Street Improvements		
	Tree Planting	−**	−*
	Utilities	−***	−**
	Water Improvements		
Public services	Childcare		
	Crime Prevention		
	Disabled Services	−*	−*
	Downpayment Assistance		
	Employment Training		
	Fair Housing		
	Fire Stations		
	Food Banks		
	Health Services		+*
	Homeless Facilities		
	Housing Counseling Services	−**	−*
	Lead Paint	−**	−***
	Legal Services		
	Mental Health Services		−*
	Nonprofit Assistance	−**	−*
	Security Deposits	+**	+**
	Senior Services		
	Transportation Services		
	Subsistence Payments		
	Youth Services		+*
	Other Public Services	+*	+*
Bus.	Business Financial Assistance	+*	+*
	Business Technical Assistance	−*	
	Microbusiness Assistance	−*	−*

Note. A positive (+) or negative (−) sign indicates a significant relationship between the activity and domain density in at least one of the three years in the study period. Empty cells indicate no significant relationship. The interaction term (CDBG×Broadband) reflects how broadband use modifies the impact of CDBG expenditure on domain density. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

Results in Table 6 show that the interaction of CDBG and broadband adoption is positive and statistically significant in both upward trending and declining ZIP codes, with larger effects in declining areas. When segmented by poverty concentration, the effect is strongest in moderately impoverished ZIP codes and insignificant in low- and high-poverty areas (Table 7). Taken together, these findings suggest that CDBG investments are associated with higher domain density across different neighborhood trajectories when broadband adoption is robust but are most effective in moderately impoverished areas that have both economic need and capacity for uptake (McCullough, 2024; Zuo, 2020).

Finally, this study period included the major economic shock of the COVID-19 pandemic, characterized by widespread business closures and unemployment (Fairlie, 2020). At the same time, economic and social activities rapidly shifted online, accelerating ongoing digitalization trends. To test whether the pandemic altered the relationship between

Table 5. CDBG and Domain Density by ZIP Code Urban, Suburban, and Rural Status.

	CDBG Alone			CDBG×Broadband Subscriptions		
Domain density	Urban (1)	Suburban (2)	Rural (3)	Urban (4)	Suburban (5)	Rural (6)
Total CDBG	−.00083	.00019	.00015	.00011**	.00005	.00001
L1	−.00135*	.00021	.00074	−.00001	.00001	.00001
L2	−.00083	.00008	.00004	.000003	.00001	.000002
Infrastructure	.00139**	.00035	.00059	.00012**	.00011***	.00002
L1	−.00082	.00019	.00138*	−.000005	.000004	.00002**
L2	−.00066	.00009	.00022	−.000003	.000004	.00001
Public services	−.00124*	−.00021	.00074	.00009	.00003	.00007
L1	−.00067	−.00023	.00013	−.000003	.00000003	.0000007
L2	−.00085	−.00039	−.00087	.0000003	.0000007	−.00001
Business services	−.00173**	−.00032	−.00111	−.00006	−.00011	.00005
L1	−.00061	.00097	−.00046	−.00001	.00001	−.00001
L2	−.00002	.00159*	−.00002	.00001	.00002*	−.000003
Observations	13,030	38,358	72,659	13,030	38,358	72,659
Sample size	4,224	11,080	19,217	4,224	11,080	19,217
Control variables	Yes					

Notes. All regressions are weighted by average ZIP code population and standard errors are clustered at the unit level. *$p < 0.10$, **$p < 0.05$, ***$p < .01$.

broadband-enabled CDBG investment and domain name density, Model 2 was re-estimated with an interaction between CDBG × broadband adoption and a COVID-period indicator (2020–2021). Results show that the broadband–CDBG effect was modestly smaller during the pandemic yet remained positive and statistically significant in both periods. This suggests that while the pandemic reduced the strength of the association, CDBG investment in broadband-enabled areas continued to be linked to higher digital economic activity even during this economic disruption. Full estimates are reported in supplementary online Appendix Table 5A.

Limitations and Directions for Future Research

While the regression results suggest that CDBG investments support digital entrepreneurial activity under certain conditions, a few limitations should be noted. First, while ZIP codes are better suited to capture neighborhood change than city- or county-level data, they are not entirely stable geographic units as their boundaries may change over time and can be added or removed at the discretion of the U.S. Postal Service. However, given the relatively short study period between 2019 and 2022, I do not anticipate significant changes in ZIP code boundaries. Additionally, the use of domain data does not capture digital businesses that operate entirely on platforms, like Amazon or Etsy, for instance.

Table 6. CDBG and Domain Density by Change in Income.

Fixed Effects (within) Regression Group variable: ZIP	CDBG×Broadband Subscriptions	
Change in median income 2017-2019	Decreased	Increased
Domain density	(1)	(2)
Year *n*	.0001**	.00007*
Year *n* – 1	.000001	.000002
Year *n* – 2	.000007	.000004
Observations	38,014	38,437
Sample size	9,865	9,876
Control variables	Yes	

Notes. All regressions are weighted by average ZIP code population and standard errors are clustered at the unit level. *$p < 0.10$, **$p < 0.05$, ***$p < .01$.

Table 7. CDBG and Domain Density by Level of Poverty.

Fixed Effects (within) Regression Group variable: ZIP	CDBG×Broadband Subscriptions		
Poverty level	Low Poverty	Moderate Poverty	High Poverty
Domain density	(1)	(2)	(3)
Year *n*	−.000125	.0000856**	.0000186
Year *n* – 1	−.000006	.000007	−.0000002
Year *n* – 2	.000002	.000003	.0000265
Observations	45,860	76,858	6,810
Sample size	17,283	26,308	3,293
Control variables	Yes		

Notes. All regressions are weighted by average ZIP code population and standard errors are clustered at the unit level. *$p < 0.10$, **$p < 0.05$, ***$p < .01$. Poverty status based on The Pew Charitable Trusts (2016) classification. Low poverty ZIP codes have poverty concentrations of 5 percent or less. Moderate poverty neighborhoods have poverty concentrations between 5.01% and 24.99%. High poverty neighborhoods have poverty concentrations of 25% or more.

Additionally, while CDBG investments are allocated based on LMI census tracts, this study uses ZIP codes as the spatial unit of analysis to align with available domain data. Although ZIPs do not perfectly match tract boundaries, they generally capture comparable socioeconomic conditions, particularly in urban areas where tracts and ZIP codes overlap closely (McCullough, 2024; University of Central Florida Libraries, 2023). This spatial mismatch may introduce some measurement error but could also capture realistic spillover effects when CDBG investments in eligible tracts stimulate entrepreneurial activity or attract outside investment in adjacent areas (McCullough, 2024). Such mismatch would only bias results if increases in domain density at the ZIP code level were driven by unrelated factors in non-treated tracts within the same ZIP. Given the national scope of the data set and the consistent effects observed across a range of geographic and economic contexts, any potential bias is likely minimal.

Last, the causal interpretations of two-way fixed effect models have been criticized in recent years, particularly when treatment effects are heterogeneous. (de Chaisemartin & D'Haultfœuille, 2020; Goodman-Bacon, 2021; Imai & Kim, 2021). While new methods to overcome these limitations have been proposed (Baker et al., 2022; Callaway & Sant'Anna, 2021), these solutions remain an active area of research and debate (Chiu et al., 2025; Huntington-Klein, 2022). Alternative estimators, such as the Callaway and Sant'Anna approach, generally assume that once a unit is treated, it remains treated (Wang et al., 2024; Wooldridge, 2025). This condition does not always align with the fluctuating nature of CDBG funding and the various types of CDBG projects. Additionally, most of these methods require a binary treatment indicator, which limits their applicability in studies like this one, where interaction terms, continuous treatment variables, and lagged effects are used. The use of a continuous treatment variable, as well as the additional robustness checks, may partially mitigate some concerns about heterogenous treatment effects (Callaway et al., 2024; Varadhan & Seeger, 2013). Nevertheless, the findings from this analysis should be considered as more exploratory, not confirmatory, of causal relationships.

Discussion and Conclusions

This study builds on a growing body of research examining how place-based policies influence local economic development. Specifically, it examines how flexible, locally targeted investments, such as those funded by the CDBG program, support digital entrepreneurship in LMI areas. The results show that tailored CDBG activities can enhance digital entrepreneurial activity by increasing domain density within communities. These findings align with the DEE theoretical framework, where digital economic activity is enabled through the interaction of digital, physical, and social factors, and highlight the importance of Digital User Citizenship. When digital infrastructure is broadly available and residents actively participate online, CDBG investments are more likely to translate into meaningful digital entrepreneurial outcomes.

Additionally, the study's findings demonstrate that the type of place-based investment matters in fostering digital growth. Infrastructure investments, particularly commercial and residential improvements, show consistently positive relationships with domain density, while other categories such as public services and business services exhibit more variable associations. Within public services, security deposits, health services, and youth services are positively related to digital entrepreneurial activity. As highlighted by Morris (2020), housing insecurity is a common non-business pressure among low-income entrepreneurs, one that frequently overlaps with gaps in digital connectivity (NAHRO, 2024; The Pew Charitable Trusts, 2023). Efforts to improve both housing stability and broadband accessibility may be key in boosting digital entrepreneurship in LMI communities, as it provides a reliable foundation for the growth of these businesses that are often home-based and rely on a stable Internet connection.

Though business service investments showed an inconsistent relationship with domain density overall, segmenting by geography suggests that business services may have a greater effect in suburban ZIP codes. Looking at specific types of business services, direct financial assistance showed a consistently positive relationship to domain density with and without the interaction of broadband adoption. With financial capital being a key resource for new and small businesses, this relationship was expected. The negative relationship between microbusiness assistance and domain density, however, was unexpected, given that digital businesses are often micro in size (Mossberger et al., 2022). This relationship may stem from variations in how these programs are administered locally and reflect broader criticisms of inefficiencies in CDBG program delivery (Malanga, 2017). Further, survey data indicate that many digital business owners, particularly those from low-income backgrounds, often underutilize public assistance programs designed to support their businesses (McCullough, 2025; Venture Forward, 2022).

Finally, it is important to acknowledge the relatively short study period used in this analysis. Previous studies evaluating the CDBG over longer time horizons have found that impacts often take years to materialize (Galster et al., 2004; Pooley, 2014). The absence of significant relationships from certain investments is therefore not surprising. However, the presence of early positive relationships, though small in magnitude, is notable. The use of domain data in this study, which captures the digital presence of both nascent and established firms, brings new insights about a sector of the economy previously underexplored in CDBG studies.

This study suggests that targeted investments can catalyze digital entrepreneurship in low- and moderate-income areas when supported by strong digital infrastructure. In an era of rapid digital transformation, flexible programs like the CDBG represent an essential policy tool for communities seeking inclusive economic growth and participation.

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Ethical Approval

This study did not involve human participants, animals, or personally identifiable data.

Author Contribution

The author is solely responsible for conceptualization, data analysis, interpretation of results, and writing of this manuscript.

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Declaration of Conflicting Interests

Proprietary, de-identified data were provided to the author by GoDaddy. The author independently determined all research questions, methods, and interpretation of the findings. The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data Availability

GoDaddy granted the author limited access to de-identified ZIP-code level domain data for the purpose of this study. Quarterly domain data at the CBSA level are available publicly on GoDaddy's Small Business Research Lab website: https://www.godaddy.com/research/microbusiness-datahub/. CDBG activity data are available publicly through the U.S. Department of Housing and Urban Development's Office of Policy Development and Research: https://hudgis-hud.opendata.arcgis.com/datasets/HUD::community-development-block-grant-activity/about

Supplemental Material

Supplemental material for this article is available online.

Notes

1. Survey administered by marketing firm Advanis and developed in collaboration with GoDaddy, Arizona State University, and the University of Iowa
2. As a robustness check, the models were re-estimated using the inverse hyperbolic sine (IHS) transformation (Bellemare & Wichman, 2020). Results were consistent, except for the CDBG infrastructure category on its own, which lost statistical significance under the IHS specification.
3. https://hudgis-hud.opendata.arcgis.com/datasets/HUD::community-development-block-grant-activity/about
4. Kolko (2015) ZIP code classification into urban, suburban, and rural. https://jedkolko.com/datasets/.

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