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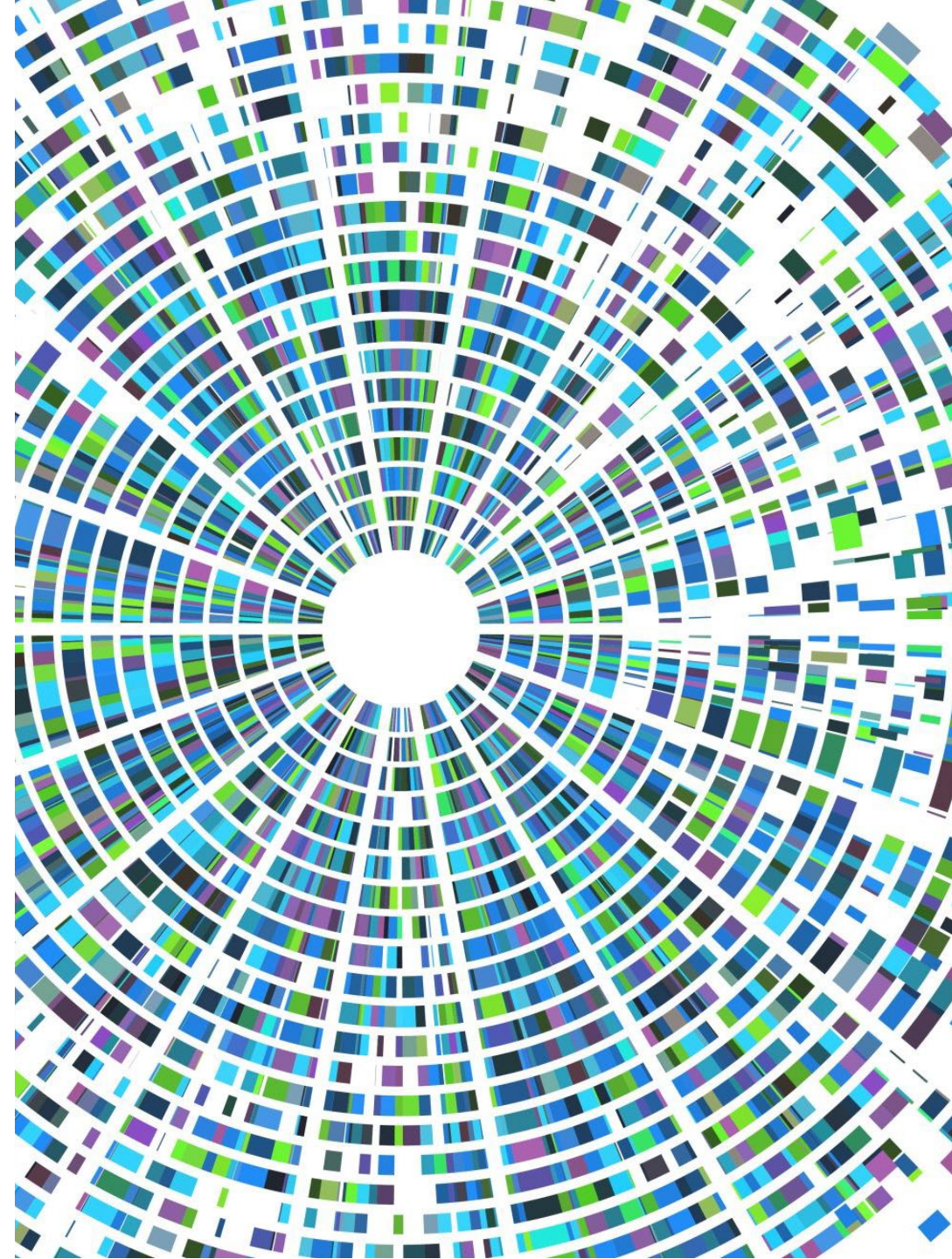
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Broadband Use and Inclusive Prosperity in Black Communities

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Persistent Inequalities and Pandemic

- Disparities in broadband access, use visible during pandemic
- Have long affected individuals and communities
- What will this mean for inclusive prosperity going forward, with accelerated digital transformation in economy?
- Gaps follow race, ethnicity, income, as well as segregation, poverty of place
(Mossberger, Tolbert & Gilbert 2006; Mossberger, Tolbert & Anderson 2017; Fishbane & Tomer 2020)
- Affordability gap, place-based digital poverty in metros overshadow infrastructure gap in rural areas (Tomer et al. 2017; Fishbane & Tomer 2020; Siefer & Callahan 2020)

Impacts in Black Communities

- Can increased technology use by residents and businesses create economic benefits in Black communities?
 - Where segregation and concentrated poverty have been most prevalent?
- Black businesses hit hardest in pandemic (Fairlie 2020)
- New business starts surged after pandemic shock
- Fastest rates of growth in Black zip codes (Fazio et al. 2021)
- Implications for infrastructure act (IIJA), small business development (ARPA) and more?
- Potential implications for other marginalized communities, though contexts/barriers may differ?

Measuring Broadband Use and Disparities at Scale

- Prior research shows technology use (adoption & business uses) positively related to income, employment, wages, productivity, prosperity in counties or metros (Mossberger, Tolbert & LaCombe 2021; Mossberger, LaCombe & Tolbert 2021; Gallardo et al. 2020; Whitacre et al. 2014; Forman et al. 2012)
- Have lacked precise/granular data to examine *broadband use* and its impacts, variation within regions or counties
 - Adoption, use matter more than availability for economic outcomes
- Impacts for marginalized, low-income communities obscured
- Recent broadband subscription data from ACS, commercial data on digital economic activity, 2021 population data on family income from Catalist facilitate new analysis

Measuring General and Economic Use in Black Zip Codes

- First research on Black zip codes and technology use – broadband subscriptions and digital businesses
- Broadband subscriptions/adoption (ACS)
 - General measure of use, digital human capital, for skills, jobs, entrepreneurship, information
 - Only data on broadband availability/providers in past for zip codes or below (FCC Form 477)
- Digital economic activity
 - More specific broadband uses; should be even more predictive of economic benefits
 - Density of domain name sites/digital businesses include microbusinesses, sole proprietors
 - Prior research on business uses limited to large firms/not sufficiently granular

Broadband Subscriptions in Black Zip Codes

Average broadband adoption (not including cell phone only)

- All zip codes 69%
- Zip codes 50% or more Black – drops to 54%.
- Zip 60% Black or more - drops further to 52%

Digital Economic Activity in Black Zip Codes

- Average density of digital businesses (domain name websites) per 100 population
- All zip codes - 5.7
- Zip codes 50% or more Black - 3.6 (nearly 50% drop)

Segregation & Concentrated Poverty

- 1 in 4 Black Americans lives in high-poverty census tract, 40%+ poverty
- 1 in 6 Latinos, 1 in 13 non-Hispanic whites
- Middle-class Black households more likely to be in low-income communities (Jargowsky 2015)
- % of Black county population, % of Black businesses = 0.94 (Kramer Mills and Battisto 2020)

Black Businesses

- 96% sole proprietorships, compared with 80% nationally (Perry et al. 2021)
- Lack of personal wealth, capital constrains startup, growth (Fairlie 2018)
 - Redlining, little home equity for entrepreneurs or personal networks (Mitchell & Franko 2018)
 - More likely to be denied loans (Bd. Of Gov., Fed Reserve 2017)
- Yet important source of services, employment for surrounding community, underutilized resource for growth (Bates et al. 2018)

Ecosystems: Place, Technology & Entrepreneurship

- Local environment as entrepreneurial ecosystem – resources, institutions, networks (Malecki 2018)
- For “digital entrepreneurship” includes broadband use by residents and use by businesses (Sussan and Acs 2017; Song 2019)
- More use by business in more-connected communities?
 - Demand from local customers, informal learning?
- Spillovers from local networks? (Andersson & Larsson 2016)
 - Density of digital businesses in zip code – informal learning, idea exchange, competition?

Hypotheses

H1: Increases in broadband subscriptions will be positively related to economic outcomes for zip codes, including higher income growth. This effect will occur nationwide and in high Black zip codes.

H2: Increases in the density of digital businesses (domain name hosts & redirects) will have an even stronger positive relationship with economic outcomes for zip codes, specifically income growth. This effect will occur nationwide and in high Black zip codes.

H3: The density of digital businesses (domain name websites & redirects) and broadband subscriptions in a zip code may interact in affecting economic outcomes and income for high Black zip codes.

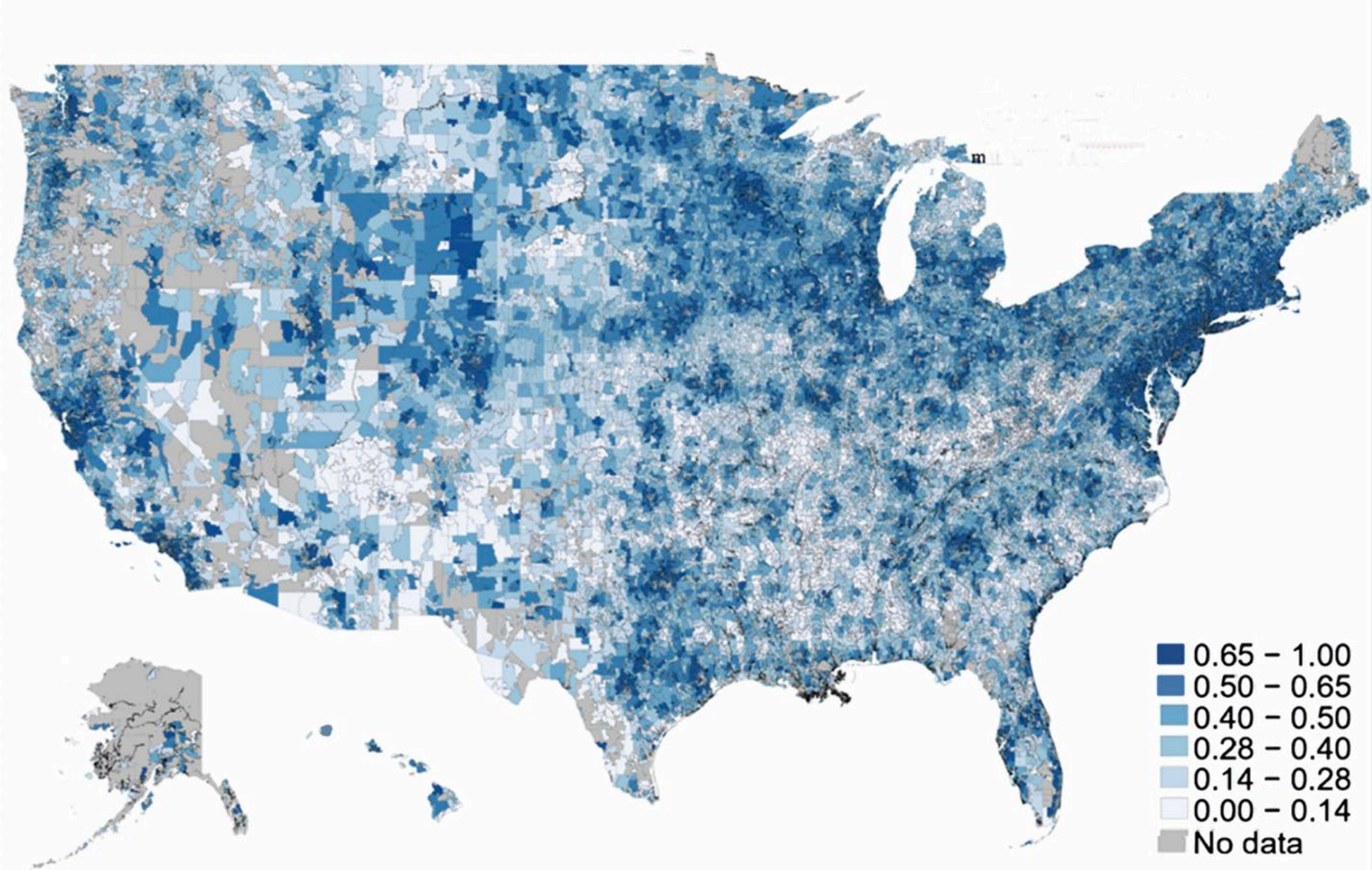
Data—Zip Codes

- Density of digital businesses and broadband subscriptions
- 30,000 inhabited U.S. zip codes and subsamples of predominantly Black zip codes
- Zip codes necessary to measure trends and outcomes for racial populations that tend to live in highly concentrated geographic areas
- Most previous research has not measured the impact of broadband subscriptions on economic outcomes for such small area geographies, instead focusing on counties or metros.

Data—Census and Population Data, Commercial Sources

- Zip code level data on broadband connectivity from the 5-year American Community Survey (2018)
 - Lagged one to three years from outcome variable
- Density of digital businesses, domain name websites and their redirects (2018)
 - Used as a proxy for digital commercial activity (see below) also a more general measure of internet use
- Outcome variables—change in household/family income (Census 2018-2019, or Catalist 2021, lagging income 2019)
- Family income in 2021 using population data for all 280 million US adults from a national voter file (Catalist)
- Figure 1 - % of population with family income \$60,000 or more (ie. above median) by zip code, based on the full US adult population

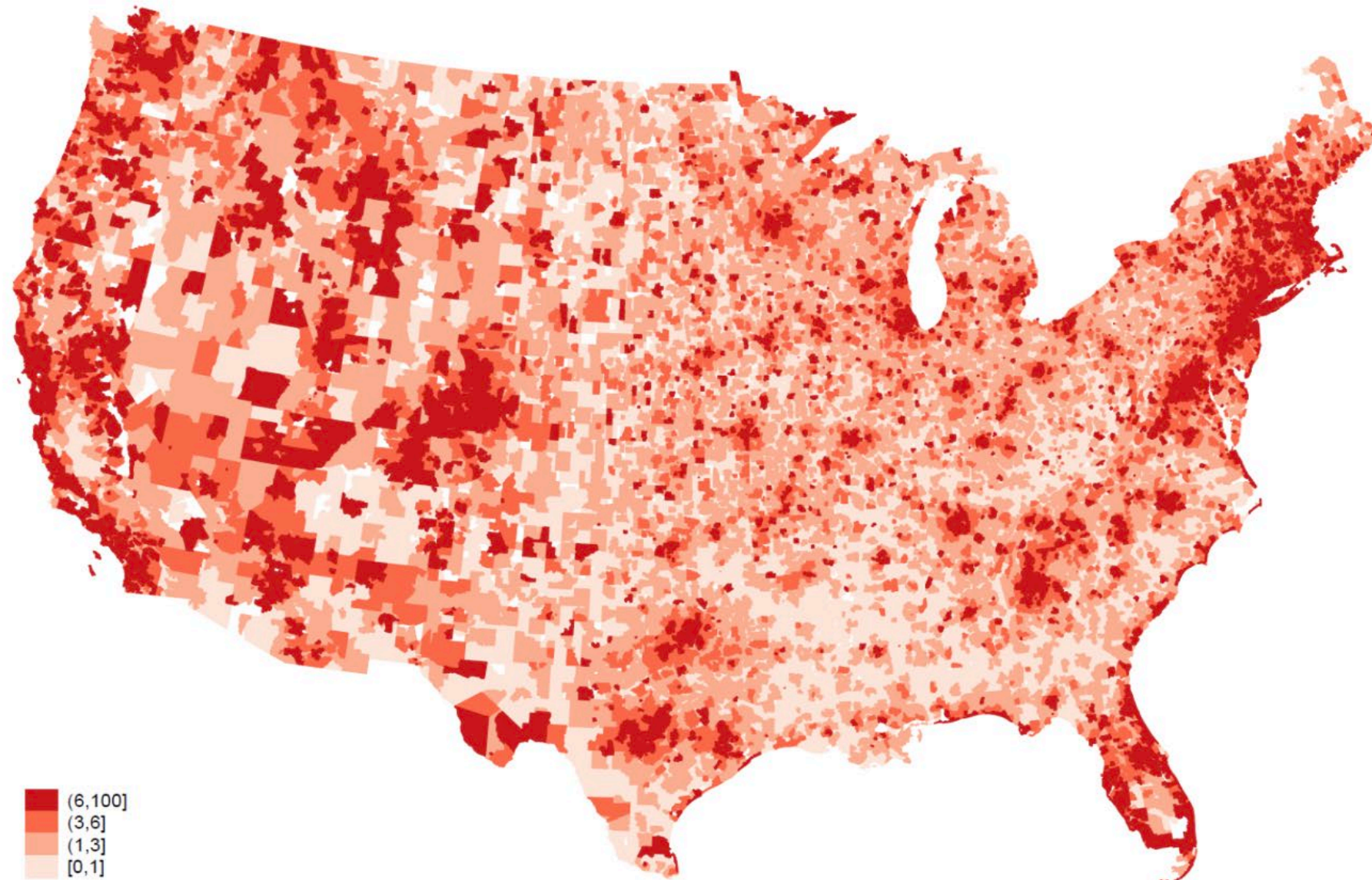
Figure 1: Percent of the Population with Family Income of 60K or Higher in 2021 by Zip Code—280 Million US Adults (Catalist)



Data—Commercial Sources

- Unique to this study - a measure digital commercial activity
 - Number of domain websites per zip code divided by population (18 years+) to create a density measure
- Data on 20 million domains and their redirects
 - Represent over half of all domain websites in the US (GoDaddy customer data)
- Monthly customer level data aggregated to zip codes provided to authors
- Surveys – 92% microbusinesses (10 or fewer employees), 55% sole proprietors
- Figure 2 - density of domain name websites/100, US zip codes, 2018
 - Counties and metros obscure socioeconomic variation within, zip codes approximate urban neighborhoods, smaller communities

Figure 2. Density of Digital Microbusinesses--Domain Name Hosts and their Redirects per 100 People, by Zip Code



Method I

- Multivariate regression models estimated, all zip codes in US metropolitan areas & subsamples defined by % Black population
 - 40-49%, 50-59%, 60-69%, 70-79% and 80% or more
- Bootstrap like technique, to test whether inclusive technology use helps the overall population as well as Black communities
- Using subsamples for predominantly Black zip codes akin to statistical/spatial matching
 - These zip codes are more homogeneous across many other demographic factors, including poverty rates.

Method II

- To further reduce heterogeneity, the sample is restricted to the approx. 20,000 zip codes in US metropolitan areas
 - Most Black businesses are in metropolitan areas (Kramer Mills and Battisto 2020)
 - Standard errors clustered by metropolitan area, nesting the zip code in a region
- Models include standard controls for demographic factors, industry and occupation, etc.
- Other controls include # of small business establishments with 100 or fewer employees/100 population
 - Census Zip Code Business patterns for businesses with paid employees

The effect sizes are larger for Black communities than for the nation overall.

Adding one digital business per 100 people, all else equal, is associated with a change in median household income by an average of \$30 across all metro zip codes.

But it is related to an increase of \$124 in median income for zip codes with a 40-49% percent Black population, and \$99 increase for zip codes with between 60-69% Black.

For zip codes 80-89% Black population, adding one digital business per 100 people is associated with \$253 more in median income over the two years, holding other factors constant.

Table 1: Impact of Broadband Subscriptions & Digital Businesses on Change in Income (2018-2019)

	(1) All	(2) Black 40+	(3) Black 50+	(4) Black 60+	(5) Black 70+	(6) Black 80+
Broadband subscriptions	10.647 (5.845)	21.669 (11.151)	22.055* (9.441)	18.387 (11.242)	11.773 (15.796)	5.292 (16.485)
Density digital microbusinesses	29.671** (11.080)	124.212** (41.311)	79.201** (27.768)	98.848** (37.643)	63.778 (40.881)	253.417** (91.135)
Small Business per 100	-27.940** (9.984)	-51.375** (22.493)	-27.856 (18.230)	-55.639** (23.074)	-39.962* (21.510)	-61.104* (32.837)
Percent Ag	12.222 (12.695)	16.013 (45.362)	49.451 (49.639)	-58.862 (50.243)	-48.233 (75.522)	-167.810 (100.471)
Percent Construction	26.958 (17.014)	-1.132 (42.478)	-3.927 (35.259)	2.508 (46.178)	-38.455 (92.657)	-27.235 (45.611)
Percent Wholesale	35.488 (40.336)	-100.096 (61.251)	-81.778 (59.797)	-121.476** (60.033)	-279.685** (81.089)	-208.002** (77.592)
Percent Retail	-31.435 (20.531)	-2.265 (38.439)	-74.921** (31.569)	-101.996** (44.639)	-130.112** (55.348)	-132.676** (51.889)
Percent Transportation	15.978 (21.696)	37.267 (29.116)	36.944 (27.723)	35.851 (26.687)	29.343 (25.491)	37.286 (33.099)
Percent Information	-20.360 (42.470)	-69.280 (119.177)	-181.466* (108.115)	-147.174 (136.097)	84.308 (136.533)	129.918 (144.961)
Percent Finance	30.535 (29.161)	-61.364 (56.187)	-44.857 (47.738)	-41.636 (63.311)	-7.698 (86.347)	20.771 (97.478)
Percent Education	46.272* (16.272)	5.527 (16.272)	60.122 (16.272)	21.222 (16.272)	22.222 (16.272)	122.222** (16.272)

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Hypotheses (Census Data)

- H1: Increases in broadband subscriptions will be positively related to economic outcomes for zip codes, including higher income growth. This effect will occur nationwide and in high Black zip codes. **Mixed**
- H2: Increases in the density of digital economic activity (domain name hosts) will have an even stronger positive relationship with economic outcomes for zip codes, specifically income growth. This effect will occur nationwide and in high Black zip codes. **Supported**
- H3: The density digital microbusiness (domain name websites) and broadband subscriptions in a zip code may interact in affecting economic outcomes and income for high Black zip codes. **Not supported**

Figure 1: Percent of the Population with Family Income of 60K or Higher in 2021 by Zip Code—280 Million US Adults (Catalist)

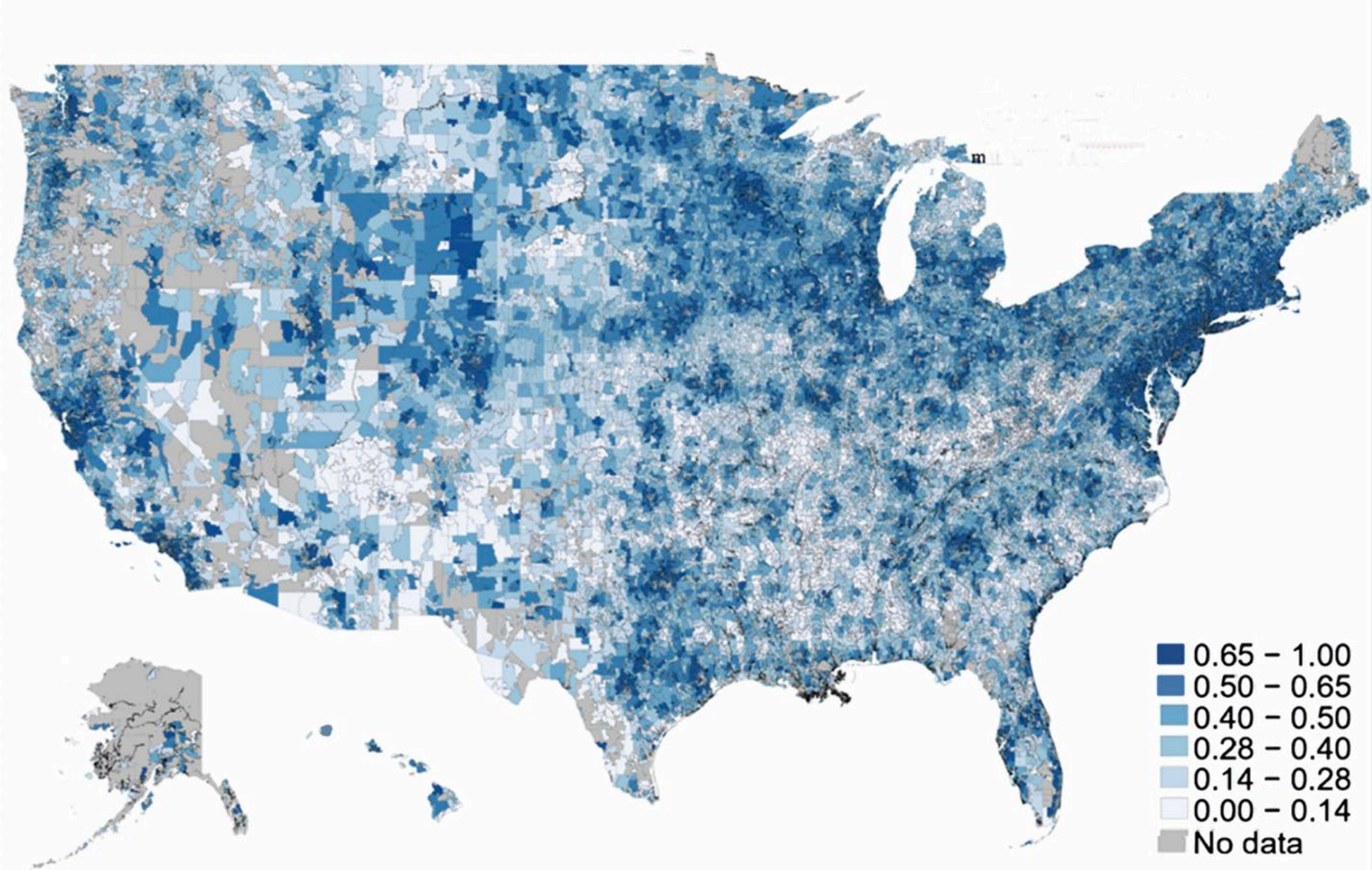


Table 2: Modeling Change Percent Family Income 60k+ in 2021 (Catalist Data), with 2019 Household Income, Zip Codes

	(1) All	(2) Black 40+	(3) Black 50+	(4) Black 60+	(5) Black 70+	(6) Black 80+
Broadband Subscriptions	0.634**	0.174**	0.052	0.054	0.034	0.094
	(0.029)	(0.068)	(0.075)	(0.080)	(0.110)	(0.186)
Density digital microbusinesses	0.008**	0.005**	0.004**	0.003**	0.005*	0.006
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.004)
2019 Median Household Income	0.000**	0.001**	0.001**	0.001**	0.001**	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Small Business per 100	-0.427**	-0.132**	-0.063	-0.017	-0.092	-0.066
	(0.048)	(0.050)	(0.042)	(0.050)	(0.080)	(0.093)
Percent Agriculture	-0.192**	-0.107	-0.121	0.056	-0.009	0.048
	(0.041)	(0.087)	(0.076)	(0.116)	(0.109)	(0.198)
Percent Construction	0.206**	0.047	0.070	0.076	0.089	0.064
	(0.055)	(0.076)	(0.082)	(0.081)	(0.101)	(0.164)
Percent Wholesale	0.237**	-0.097	-0.017	-0.211*	0.099	-0.171
	(0.088)	(0.124)	(0.138)	(0.120)	(0.168)	(0.227)
Percent Retail	-0.026	0.054	0.042	0.029	0.031	-0.064
	(0.032)	(0.060)	(0.082)	(0.071)	(0.092)	(0.148)
Percent Transportation	-0.034	-0.151*	-0.101	-0.120	-0.152*	-0.252**
	(0.058)	(0.077)	(0.085)	(0.081)	(0.089)	(0.124)
Percent Information	-1.01**	-0.369	-0.296	-0.090	-0.666	-0.506

Hypotheses (Catalist Data)

- H1: Increases in broadband subscriptions will be positively related to economic outcomes for zip codes, including higher income growth. This effect will occur nationwide and in high Black zip codes. **Mixed**
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- H2: Increases in the density of digital economic activity (domain name hosts) will have an even stronger positive relationship with economic outcomes for zip codes, specifically income growth. This effect will occur nationwide and in high Black zip codes. **Support**
-
- H3: The density of digital economic activity and broadband subscriptions in a zip code may interact in affecting economic outcomes and income for high Black zip codes. **Supported**

Summary of Findings

- Black zip codes disadvantaged in technology use as well as economically – low rates of broadband subscriptions and digital businesses
- But broadband subscriptions and digital businesses are positive and significant for median income, family income (change, lagged models)
- Gains for digital businesses greater in Black zip codes than zip codes overall (median income, family income)
- Broadband x Digital Businesses significant for family income in zip codes 60% Black or more

Policy and Future Research

- Historic investments (\$65 billion) in broadband, IJJA, ARPA
- American Connectivity Program - \$30 vouchers/greater affordability
- A window to promote adoption by residents and businesses?
 - Outreach, devices, vouchers and training for residents
 - Websites and other technology uses infused in small business development
- Context and outcomes for other marginalized, low-income zip codes can be explored in the future
 - Are there differences in technology use and its impacts?