Internet Access and Independent Contracting Through the 2010s: A Varied Tale How Uptake and Returns Differ Across Demographics, Income Levels, and Time

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The internet led to the proliferation of platforms that connect workers to individuals and firms seeking assistance and significantly increased independent contractor rates across the income and skill spectrum. Consequently, communities that adopted the internet earlier or at higher rates may have higher rates of contracting. Using data from the FCC on mobile and broadband internet rates, I examine their relationship with business earnings reported to the IRS from 2010 to 2019. Local race and ethnicity characteristics interact with internet measures and show that counties with higher minority concentrations have a higher correlation between internet expansion and growth in independent contractors. However, they do not reap as high growth rates in contractor earnings as predominantly white counties. Further, results show the relationship between growth in independent contractor earnings shifts mid-decade, with declines in growth observed post-internet expansion in the latter half of the 2010s.

Keywords: internet, mobile internet, independent contractor, gig work, participation, income

INTRODUCTION

The advent and growth of the internet paved the way for a multitude of online platforms that connect workers with businesses and individuals in need of their services. This trend has ushered in an era where informal contracts and alternative modes of income generation have proliferated. This is exemplified by independent contractors, who leverage popular digital marketplaces like Uber, Doordash, Instacart, and Taskrabbit; skilled freelancers on Fivver or Amazon Turk; artistic focus, like Etsy, and households seeking to monetize real estate capital with platforms like Airbnb or VRBO. Internet sales eased entry for many individuals interested in multilevel marketing companies, such as Avon and Lularoe. Further, sole proprietors that offer services like home repair, cleaning, tutoring, or pet care can advertise for themselves more efficiently and use platforms, such as Thumbtack and Angie's List, to aid in their business development.

Although how to quantify those in alternative work arrangements or working in the "gig economy" varies by study, all studies show a rise in earnings in these informal sectors over the last few decades (Farrell et al., 2018; Katz & Krueger, 2019). The increase in independent contractors and those working in online platform economies, or "OPEs" as referenced in Collins et al. (2019), is correlated with the proliferation of intermediary platforms.[1] Collins et al. (2019) find that the rise in independent contractor tax filings is primarily from a rise in labor participation in OPEs and that much of this rise in participation is as a secondary income stream and not as a replacement for wage earnings.

The number of individuals participating in online platforms is probably correlated with the rate of internet usage and platform adoption within the community. Counties with a higher rate of internet platform use by consumers likely have higher earnings potential for their labor participants. The number of users of sites and platforms on the internet is widely known to affect other individuals' utility of these same services. Many of the platforms on the internet are subject to network externalities (Lin & Lu, 2011; McGee & Sammut-Bonnici, 2015), with the uses and benefits of the technology expanding as more people use it. Additionally, the value of building business sites or advertising independent services increases as more people in the local economy engage with the internet and use it to seek information and services. Consequently, counties that are more densely populated or that had earlier internet adoption may reap higher benefits than less dense counties or late adopters (Sarkar & Khare, 2019; Wu et al., 2020). Consistent with this theory, Metro areas had faster uptake rates of platform-based gig employment, reaching double-digit growth rates in almost all the largest 50 metropolitan areas between 2000 and 2014 (Muro, 2016). I seek to determine how internet uptake in a local economy is related to people's earnings in alternative employment throughout the 2010s. Specifically, I analyze the relationship between the the count of individuals who report non-wage business earnings on annual tax returns and the total amount of those business earnings across metro and non-metro on the length of time a county has had high levels of internet adoption, both hardwired and mobile.

I utilize detailed data sources from the FCC to measure county-level internet and data from the IRS on all tax returns filed in a county from 2010 to 2019. Lastly, I explore the heterogeneous effects across racial concentrations and income tax brackets. Specifically, I interact internet measures with county-level measures of minority and immigrant concentrations to see if tax returns in counties with more minority workers respond differently to expanded internet. Additional regressions are run on the reported earnings of those whose total adjusted gross income is $25,000 or below a year to see if the participation and income reported for low-income workers varied with internet adoption at a different rate than observed at the average.

The findings suggest that increased internet access positively correlates to increases in the growth rate of the count of people reporting some independent or sole proprietorship earnings. Counties with higher rates of foreign-born or Black populations exhibited higher levels of small-scale entrepreneurial behavior post-internet expansion. Mobile internet tended to be more significant for Black communities versus hardwired broadband; however, they appear to have lower growth rates in earnings as independent contractors relative to earnings reported in counties with a higher concentration of white workers post-internet adoption. Additionally, specifications for just the latter half of the decade show that the expansion of the internet between 2015 and 2019 tended to inspire different impacts than the 5-years previous. In later years, a lower return to expanded mobile internet and a decline in income growth rate from independent contracting were observed after years of mobile expansion.

LITERATURE

While much of the gig economy is visual on the internet, with services of transportation of individuals or products (Lyft, GrubHub, or Postmates), other types of work (TaskRabbit or Handy), or selling of goods and leasing of property (eBay, Etsy, Swimply, or Airbnb), the tracking of labor participation is less transparent. By 2020, there were more than 100 digital platforms facilitating the buying and selling of services or goods with independent contractors (Shultz, 2020). In addition to these online platform economies, the internet has helped individuals expand their direct-to-consumer businesses or sole proprietorships through easily accessible advertising pages and online review systems. All of this work would be done by those classified as independent contractors or sole proprietorships, which the BLS defines as "Someone who obtains customers on their own to provide a product or service."

The rate of independent contracting has been on the rise since 2000 (Collins et al., 2019; Farrell et al., 2018, Katz & Krueger, 2019). However, which workers are increasing participation in non-traditional markets and why is less conclusive. While more individuals claim self-employment earnings, there was a minimal increase in those who claimed to be full-time self-employed from 1995-2015 (Collins et al., 2019).

Much of the increase in earnings is from workers along the intensive margins by changing where individuals are working and providing secondary means of earnings rather than in changing who is working. The earnings from independent contracting work for OPEs represent a major source of income for families when members are participating, but most are only active a few months out of the year (Farrell et al., 2018). This temporary gig work can occur due to a seasonal interest or during a life disruption, like temporary job loss or a large, unexpected expense. Consequently, the phrasing of survey questions or the duration of the period studied has been shown to affect the reported rates of independent contracting.[2]

Researchers have also found disproportionate rates of independent contracting across race and income levels. Hispanics have had a rising participation in the alternative work sector over the last few decades (Katz & Krueger, 2019). Minorities may have a greater tendency towards pursuing entrepreneurial ventures as an alternative to traditional labor markets where they may experience discrimination. Additionally, due to lower average wages, minorities might be compelled to hold multiple jobs concurrently to fulfill their financial needs and maintain living standards (Kmec, 2003). Previous research has shown that minorities are more likely to hold multiple jobs and that migrants are more likely to be entrepreneurs than natives (Lofstrom, 2013). Consequently, counties with greater concentrations of Hispanics, Blacks, and migrants may respond differently to increased access to online platforms.

Lastly, it is important to remember that the relationship between internet expansion, online platform economies, and traditional wage earnings has varied over time. Muro (2016) found that increases in online-platform earnings began to be correlated with declines in standard wage earnings in the late aughts, reversing a previous trend where both earnings grew in expanding industries. This changing correlation may be due to changes in use of the technology and/or changes in the underlying markets in industries that were early adopters of gig work. The internet itself is not static and our uses of this technology change over time; as such, it is important to consider not just adoption rates but the duration of adoption.

I contribute to this literature by incorporating measures of mobile internet adoption and duration of internet adoption and by estimating multiple heterogeneous relationships. Regression models utilize a dynamic measure of the duration of internet use in estimating its impact on local participation in, and earnings from, independent contracting. By allowing for differing effects by urban density, racial and ethnic demographics, and income tax bracket, I draw a more complete and nuanced picture of how internet uptake and use affect those participating in local digital economies.

DATA

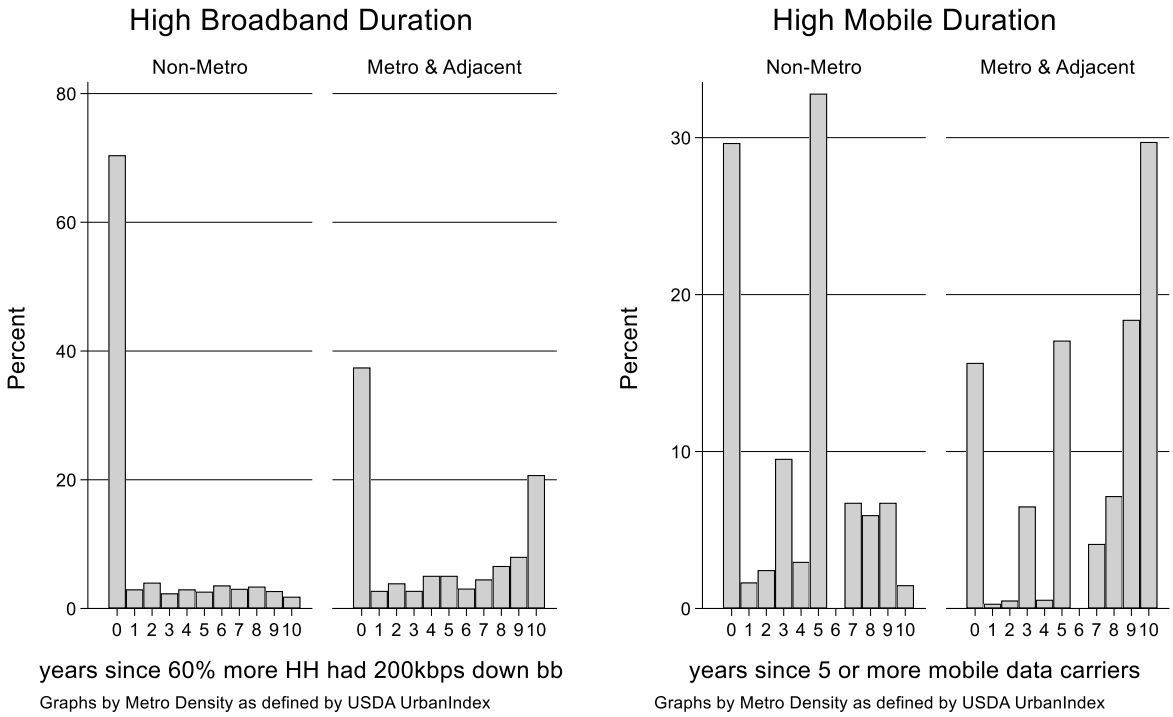
I combine three sources to build a detailed panel data set of all counties in the continental United States from 2010 to 2019.[3] My dependent variables of interest come from IRS annual tax reports. The total count and amount of personal income taxes filed are reported annually at the county level. Reports provide both the count and income claimed under different income sources, or those taken in deduction, and the corresponding amounts. These variables are measured in aggregate and by income groups. I focus on the total number and amount of tax earnings filed for all tax filers and those with an adjusted gross income of $25,000 and below.

Utilizing tax data means that anyone who met minimum earnings thresholds for reporting contractor income over the span of a year will be captured.[4] The longer period is beneficial to capture all participation, as surveys that reflect on only short periods of time tend to find lower participation rates than those that use a longer reflection period (Farrell et al., 2018). As the core of my sample is defined by tax data, I technically study the tax workforce, or all who have some tax reporting to conduct, whether wage employment, capital earnings, or independent contractors (Collins et al., 2019)

The independent variables of interest are taken from the Federal Communications Commission (FCC), 477 form data submitted by providers on high-speed internet connections, defined as a minimum of 200 kbps in each direction.5 The FCC publishes data on connections per 1,000 households in quintile-based categories. The FCC also tracks the number of cell phone providers in each county offering mobile data plans above 200kbps, which I use as a proxy for cell phone usage and market saturation. Household internet data is ideal for this study as OPEs mostly focus on person-to-person connections, and therefore, local

company uptake or maximum speeds are less important. Mobile data is key to this analysis, as much of the connections with the online platform economies are conducted over smartphones, with many websites optimized for mobile users (PwC, 2011).

FIGURE 1
YEARS SINCE 2010 COUNTIES HAVE HAD "HIGH" INTERNET AS OF 2019



Mobile data plans were on the rise during the aughts, with increasing infrastructure, competition among firms, and more variety of features, prices, and service quality available (Villas-Boas, 2018).[6] This period captures a crucial phase of internet uptake and expansion of online platforms. The 2011 release of the iPhone for non-exclusive sale and the widescale uptake of "smart" phones increased the number of internet users and their frequency of use (Anderson, 2015).[7] The number of mobile providers has been shown to increase consumer uptake at statistically significant rates (Gruber, 2001; Lee et al., 2011). Greater competition in the telecommunications industry improves the quality and speed of service and lowers costs, which are all significant in mobile uptake, particularly for consumers who exclusively use mobile internet connections (Höffler, 2007; Manlove & Whitacre, 2019). Therefore, measuring the number of carriers in the county can be a reasonable proxy for consumer demand.

Finally, because the internet is subject to network externalities (Lin & Lu, 2011; McGee & Sammut-Bonnici, 2015), I measure the length of time a county has had relatively high saturation rates, specifically 60% or higher household uptake and 5 or more mobile data carriers.[8] Figure 1 shows the years since high thresholds were reached, measured in 2019, for urban areas, or counties in large and small MSAs or those adjacent to them, and rural counties. Although metropolitan counties hit high levels of adoption earlier than their rural counterparts, there is still a great deal of variation across urban areas. Consistent with previous researchers, who find higher rates of OPE participation in metropolitan areas, I distinguish between metropolitan and non-metropolitan counties (Liao et al., 2016; Manlove & Whitacre, 2019; Prieger, 2013; Whitacre et al., 2015).

The metro classifications are based on the USDA urban density index, and the control variables are based on the IRS and the American Community Survey (ACS). USDA's rural-urban continuum is used to distinguish metro and nonmetro counties based on population size, urbanization, adjacency to a metro area,

and rural status.[9] IRS measures of the count of tax returns that claim wage earnings and the total amount of wage earnings are used as controls, along with ACS measures of economic conditions, like employment rates and the gini coefficient. Additionally, the ACS provides measures of the population, educational attainment, and minority and migrant population rates.[10]

In the early 2000s, internet access and adoption growth were slower in nonmetro areas compared to metro ones (Kruger, 2009; Kruger & Gilroy, 2016; Preiger, 2013). Urban consumers had more income, and cities had more educated workforces and higher concentrations of computer-oriented companies (Höffler, 2007; Lee et al., 2011). Private telecommunications companies prioritized these more profitable markets and made greater capital investments in metropolitan areas (Höffler, 2007; Lee et al., 2011). Given the virtuous cycle of the internet, these metropolitan counties with earlier rollout may have experienced different returns than counties with later internet adoption with viable platforms for shorter periods of time (Sarkar & Khare, 2019; Wu et al., 2020).

Table 1 shows descriptive statistics of key tax data, including the count of all returns, those that report wages, those that report business earnings, and the total amount of earnings in each category. US-wide statistics show that the number of people filing taxes reporting 1099 earnings or personal business income from independent contracting is approximately 5,300 per-county, with approximately $70,000 total dollars claimed in business earnings.[11] There are higher counts and average total income reported in metropolitan counties, with an average of 7,750 independent contractors filing a total of $100,000 in average business earnings. Non-metropolitan areas have an average of approximately a thousand business tax filers with an average total reported income of $12,000. Approximately 35% of those who are filing returns are filing returns with a total adjusted gross income below $25,000.

In the lower panel of Table 1, the average total count of returns claiming wage earnings as well as the total amount of wage earnings are shown. These variables are vital to hold constant, as the internet may have provided income growth through pathways not related to independent contractors that may have spillover into the amount of business and prices contractors can charge. The ratio of those filing returns that claim business earnings to those that claim wage earnings is approximately 18% in metropolitan counties and 20% in non-metro. Although participation rates in independent contracting work are quite high, they represent a relatively small amount of total earnings relative to total wage earnings reported. They are a mere 4% in metro areas and 5% in non-metro counties.

Urban counties have a higher concentration of internet adopters, along with a longer period since reaching 60% broadband adoption or reaching 5 mobile carriers. In 2015, over 43% of metropolitan counties had reached high broadband, with an average length of adoption of 4.5 years for adopters and 5 or more mobile carriers 3.7 years previous, while most rural counties had yet to meet these thresholds.[12] In contrast, only 14% of non-metro counties had a broadband adoption rate of 60% or more, and they had reached high mobile access only 3.2 years prior.

TABLE 1
DESCRIPTIVE STATISTICS FOR TAX FILLINGS AND INTERNET IN 2015

	USA	Metro Counties	Rural Counties
Observations	3,014	1,908	1,106
Sample as % of total Counties	100	63.30	36.70
Sample as % of total Population	100	92.33	7.67
VARIABLES	mean	mean	mean
Dependent Variables			
Count of Returns -Business Income all agi	5,309.884	7,751.363	1,098.002
	(11,247.520)	(13,519.440)	(1,210.509)
Total Reported Income - Business all agi	70,000.910	103,656.300	11,940.820
	(159,636.200)	(192,337.100)	(17,702.950)
Count of Returns -Business Income <25,000 agi	1,900.647	2,774.240	393.581
	(4,842.717)	(5,904.312)	(438.790)
Total Reported Income - Business <25,000 agi	13,079.620	19,195.460	2,528.948
	(35,750.620)	(43,719.670)	(3,211.318)
Independent Variables			
High Broadband = 1	0.322	0.431	0.135
60% or more of HH have BB	(0.468)	(0.495)	(0.342)
Years Since High Broadband (conditional on High BB)	4.277	4.462	3.255
	(1.803)	(1.767)	(1.653)
High Mobile Data= 1	0.506	0.507	0.505
5 or more Cell Phone Data Carriers	(0.500)	(0.500)	(0.500)
Years Since High Mobile (conditional on High mobile)	3.139	3.715	2.146
	(2.091)	(2.114)	(1.630)
IRS Tax Based Controls			
Count of Returns- Wage Income all agi	28,565.62	41,982.55	5,419.59
	(58,189.71)	(69,554.01)	(6,057.27)
Total Reported Income - Wage all agi	1,594,240	2,377,888	242,340
	(3,578,846)	(4,302,455)	(296,476)
Count of Returns- Wage Income <25,000 agi	10,065.05	14,697.79	2,072.93
	(20,524.58)	(24,575.72)	(2,309.44)
Total Reported Income - Wage <25,000 agi	132,892	194,086	27,325
	(275,809)	(330,807)	(30,683)

All data measured in 2015, with geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars.
Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the American Community Survey

In Table 2, the means and standard deviations of other control variables and statistics on the subgroups that will be used for interaction terms are presented. On average, there are higher minority percentages and

concentrations in metropolitan counties. Metro areas have approximately 0.05% of the population is foreign-born and 11% Black, with non-metro means of 0.03% and 8%, respectively. Both metro and non-metro have an average of approximately 8% Hispanic citizens. To aid our county-level analysis, I created and interacted dummy variables to capture counties with a high concentration of minorities, or those that were in the 75th percentile or higher of the percent foreign-born, Hispanic, or Black.[13]

TABLE 2
DESCRIPTIVE STATISTICS FOR CONTROLVARIABLES IN 2015

	USA	Metro Counties	Rural Counties
Population Measures & Interaction Terms			
Percent of Population - Foreign Born	0.043	0.049	0.033
	(0.050)	(0.052)	(0.046)
Percent of Population - Hispanic	8.522	8.811	8.025
	(13.368)	(13.029)	(13.926)
Percent of Population - Black	9.035	10.470	6.560
	(14.446)	(14.427)	(14.146)
High Foreign Born Population (75th percentile=1)	0.250	0.302	0.160
	(0.433)	(0.459)	(0.367)
High Hispanic Population (75th percentile=1)	0.250	0.267	0.220
	(0.433)	(0.443)	(0.415)
High Black Population (75th percentile=1)	0.250	0.306	0.153
	(0.433)	(0.461)	(0.360)
Demographic & Economic Controls			
Percent College Grad & Above	19.972	21.253	17.761
	(8.486)	(9.307)	(6.256)
Labor Force Participation Rate (20 to 64)	73.326	73.751	72.593
	(8.784)	(7.559)	(10.533)
Gini Coefficient	0.442	0.441	0.443
	(0.034)	(0.033)	(0.035)
Total Population	73,477.390	107,169.900	15,353.190
	(143,307.800)	(170,887.900)	(16,098.680)
Population Density per Sq Mile	190.976	287.059	25.220
	(893.285)	(1,111.162)	(39.337)

All data measured in 2015, with geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars.
Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the American Community Survey

Metro areas hold a higher percentage of these counties on average across all minority groups than non-metro counties. There are almost twice as many high foreign-born concentration and high Black concentration counties in metro areas than in rural areas on average. Metro areas are also characterized by higher rates of education, with a more significant percentage of residents aged 25 years or higher reporting

their highest level of education is a Bachelors degree or higher. Labor force participation rates and overall inequality are approximately the same across metro and non-metro counties.

All variables are measured at the county–year level. The dependent variables of interest are the logged count of tax returns that report personal business earnings (or completed a 1099 form) and the logged total of personal business earnings reported. While 1099 earnings compose independent contracting, sole proprietorships, and some limited partnership reporting, I will refer to it as independent contracting throughout the paper for consistency.

Regressions are estimated in log-level format, and coefficients are interpreted as growth rates. This is a conservative modeling technique, as it does not require that each county have the same marginal effect in terms of the number of participants or dollar amount of earnings. Instead, the marginal effects are interpreted as percent changes from the counties' previous rates and earnings.

METHODOLOGY

The regression equation estimates the relationship between number of tax filers with personal business earnings and the total earnings reported on the duration of high internet adoption rates. Regressions are estimated separately for rural and metropolitan areas for all tax reporters and for only those with adjusted gross income below $25,000.

$$\ln\left(Business\ Tax\ Outcome\right)_{c,y} = \alpha + \beta_1\, BB_{HighTime_{c,y}} + \beta_2 Mobile_{HighTime} + Race_{Concentration}{}'\gamma_{1\,c,y} + X'\delta_{1_{c,y}} + County + Year + \varepsilon \quad (1)$$

Examining the growth rate in the count of returns or the total amount reported of independent contractor earnings without controlling for changes in the labor market could provide biased results. If the internet increases all employment opportunities, independent and firm-related, examining only business returns may overinflate the returns to the internet on independent contracting. If the internet also increases wages in the local economy, this may spill over into demand for contractors and the average prices they charge. Consequently, I include controls for the log of the count of tax returns that report wage earnings and the log of the total wage earnings reported. Therefore, the change in the growth of business rates is estimated while holding the growth in employment participation and wages constant.[14]

The key independent variables of interest are years since 60% or more of households adopted broadband and years since the county had access to five or more mobile data providers. Years are modeled linearly and entered as a count of years since high adoption. A vector of race and ethnicity controls includes three dummy variables that indicate high concentrations (75th percentile and above) of Hispanic, Black, and foreign-born citizens. These measures are interacted with the time since high broadband and mobile access to examine heterogenous returns across counties with different minority concentration rates. While race is measured with dummy variables for concentration and time is measured linearly, robustness tests to these choices, which allow for continuous measures of race and non-linear modeling of time, are discussed in the Robustness sections and results provided in Appendix Tables A1-A3.

Vector X measures additional control variables from the ACS, including the percentage of college-educated workers, prime-age labor force participation, population density, and age distributions. Each specification also includes county-level fixed effects and standard errors clustered at the county level. County-level fixed effects demean annual growth in business return and earnings at the county level, year dummies demean national-level annual averages in these growth rates and clustered standard errors allow for correlation in errors of a county over time. The fixed effects strategy assumes that counties that experienced gains in internet availability and those that did not would have the same trending labor market outcomes, net controls, without broadband.

However, counties with higher broadband adoption may have had trends prior to the sample period that increased participation in alternative labor markets and may have driven broadband uptake. Infrastructure investment was driven by private industries in the US, seeking to provide maximum profit. Internet rollout

was far from random in the US and was correlated with labor market conditions.[15] Consequently, the results cannot be interpreted as causal. Despite this, the trends and dynamic nature of the relationship between the Internet and labor market outcomes across different populations are still informative for industry and policy leaders alike.

RESULTS

In Table 3, I examine the log of the count of tax returns that claim business earnings on the duration of broadband and mobile internet uptake. In columns (1)-(3), un-interacted models show the average relationship across all counties in their respective samples. Column (1) shows that both types of internet are positively associated with increases in the growth rate of people claiming independent contractor earnings on a national level.

TABLE 3
REGRESSIONS OF CONTRACTOR RETURNS ON DURATION OF INTERNET (2010-2019)

Y= ln(Count Business Filings)	(1) usa	(2) metro	(3) nonmetro	(4) usa	(5) metro	(6) nonmetro
Years Since High BB	0.004***	0.003***	0.001	0.003***	0.003***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Years Since High Mobile	0.005***	0.004***	0.004***	-0.002***	-0.003***	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
BB time * Foreign Born Concentration				0.003**	0.003***	-0.002
				(0.001)	(0.001)	(0.002)
Mobile Time * Foreign Born Concentration				0.003**	0.002*	0.005*
				(0.001)	(0.001)	(0.002)
BB time * Hispanic Concentration				-0.001	-0.002	0.005*
				(0.001)	(0.001)	(0.002)
High Mobile Time * Hispanic Concentration				0.005***	0.005***	0.005*
				(0.001)	(0.001)	(0.002)
BB time * Black Concentration				-0.000	0.001	-0.004
				(0.001)	(0.001)	(0.004)
High Mobile Time * Black Concentration				0.016***	0.014***	0.021***
				(0.001)	(0.001)	(0.002)
Constant	1.332*	1.919***	0.987	1.089+	1.404***	0.790
	(0.658)	(0.296)	(1.229)	(0.643)	(0.261)	(1.209)
county-year observations	30,137	19,097	11,040	30,137	19,097	11,040
Rsqd	0.390	0.502	0.254	0.465	0.592	0.303
County observations	3,059	1,925	1,134	3,059	1,925	1,134

clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars.
Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS.
Race and Population measures from from the American Community Survey

Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density

While both types of internet are significant in metropolitan counties, as estimated in column (2), only mobile internet affected growth in contractor rates in nonmetro counties, column (3). The number of years since the county reached 60% or more broadband adoption rates increases the growth rate of the number of tax returns that report business earnings in metropolitan by approximately 0.3% per year, where a one standard deviation increase in years of high broadband adoption would increase growth by approximately 0.53% and a one standard deviation increase in years of mobile would further increase real income by 0.86%.[16] Metro areas drive this identification with similar coefficients and significance; however, in nonmetro areas, mobile internet has a higher return rate than hardwired broadband, with a significant coefficient four times the magnitude.

In interacted models in columns 5-8, a "typical" majority white county sets the baseline estimates for each year post-high internet adoption, with additive effects of being in a county with a high concentration of foreign-born, Hispanics, or Blacks shown in the lower panel. There are minimal to no heterogenous relationships of broadband adoption, except for in counties with high concentrations of foreign-born. However, the positive relationship between mobile internet access and the percentage of people reporting business earnings seems solely driven by minority-heavy communities, with typical counties having a negative correlation. Counties with a high concentration of Hispanic or Black residents have significant additional marginal effects of mobile, with Hispanics having a gross increase of 0.2 and black-concentrated counties a gross 1.4% increase in growth rates of independent contracting. Further, while a" typical" rural county observed a statistically significant -0.2% contracting in growth per year of high mobile access, nonmetro counties with higher concentrations of Black residents grew at an added rate of 2.1%, giving a gross return of 1.9%, while holding the growth in wage participation and wage earnings constant.

In Table 4, the dependent variable of interest is the log of total business earnings reported per county. The results in Table 4 show a considerably greater and more statistically significant relationship between internet uptake and growth in business earnings, holding growth in wage earnings constant. Broadband is significant across all geographies and mobile internet has minimal relationship to growth in earnings. Each additional year of high broadband adoption is associated with 1.7% to 0.9% higher growth rates in independent contractor income.

In columns (4)-(6), the coefficients in the first few rows again show estimates for a "typical" county (i.e., a county in the bottom 75th percentile of foreign-born, Hispanic, or Black percent of the population). These results show positive relations and similar magnitudes for broadband. However, mobile internet is now associated with positive and statistically significant gains in growth in independent contractor earnings. The interactions show minimal to no statistical significance in the heterogeneous associations across high minority concentration counties, while rural counties with high rates of foreign-born or Black residents show a lower to an overall negative impact on the growth of income in rural areas. These results are in sharp contrast to those observed in Table 3. While high minority communities appeared to respond to internet uptake with increased participation in contract work, they earn less from this participation than communities with lower minority rates. Nationally, counties in the top 25th percentile of the percent of Black residents have a overall gross association of (1.0-1.4) = -0.4% contraction, while counties with high concentrations of Black residents also see an overall contraction in growth rates of business earnings with each additional year post high mobile internet, with an overall gross contraction of -1.7%. In rural areas this difference is even more pronounced with a marginal difference of -4.3% per year of high mobile for non-metro counties with high concentrations of black residents

TABLE 4
REGRESSION OF CONTRACTOR EARNINGS ON DURATION OF INTERNET (2010-2019)

Y= ln(Total Business Earnings)	(1) usa	(2) metro	(3) nonmetro	(4) usa	(5) metro	(6) nonmetro
Years Since High BB	0.015***	0.017***	0.009**	0.010***	0.012***	0.003
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Years Since High Mobile	0.000	-0.001	-0.002	0.009***	0.008***	0.005+
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
BB time * Foreign Born Concentration				0.005+	0.005+	-0.002
				(0.003)	(0.003)	(0.008)
Mobile Time * Foreign Born Concentration				-0.004	-0.005	-0.008
				(0.003)	(0.003)	(0.007)
BB time * Hispanic Concentration				0.000	0.001	0.009
				(0.003)	(0.003)	(0.009)
High Mobile Time * Hispanic Concentration				-0.003	-0.004	0.002
				(0.003)	(0.003)	(0.007)
BB time * Black Concentration				0.014***	0.008*	0.027**
				(0.003)	(0.003)	(0.010)
High Mobile Time * Black Concentration				-0.026***	-0.021***	-0.043***
				(0.003)	(0.003)	(0.008)
county-year observations	30,032	19,046	10,986	30,032	19,046	10,986
Rsqd	0.173	0.202	0.159	0.184	0.214	0.171
County observations	3,057	1,925	1,132	3,057	1,925	1,132

Clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars.
Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS.
Race and Population measures from from the American Community Survey
Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density

DIFFERENTIAL EFFECTS BY INCOME LEVEL AND YEARS

I re-run the original specifications in this section, focusing on subsamples of tax filers and years. The IRS reports the number of tax filers and the total amount filed by income brackets, and I use the number of returns and total earnings claimed by those with an adjusted gross income between $1 and $25,000. Table 5 only shows interacted results (those comparable to columns (4)-(6) on Tables 3 and 4). Columns (1) – (3) of Table 5 show that broadband is significantly related to participation in contracting for tax filers claiming adjusted gross income below $25,000 in a typical county at a national level. However, columns (4)-(6) show that broadband is also not significant for growth in independent contractor income for those earning below $25,000 a year. Mobile internet is significant and negatively correlates with growth in participation in independent contracting for those earning below 25,000 in “typical”, or non-racially concentrated counties. In contrast, mobile internet positively correlates with growth in total income earned by independent contractors filing low-income taxes in “typical” counties.

TABLE 5
REGRESSION OF TAX OUTCOMES FOR THOSE WITH AGI < $25,000 FROM 2010-2019

Sample = only filers with AGI <25,000	Y=ln (Count Business Returns)			Y= ln (Total Business Earnings)		
	(1)	(2)	(3)	(4)	(5)	(6)
	usa	metro	nonmetro	usa	metro	nonmetro
Years Since High BB	0.004***	0.003**	0.000	0.002	0.000	0.007
	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.005)
Years Since High Mobile	-0.005***	-0.006***	-0.004*	0.005*	0.008***	0.002
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)
BB time * Foreign Born Concentration	0.005***	0.006***	0.002	-0.003	0.002	-0.018*
	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.008)
Mobile Time * Foreign Born Concentration	0.005**	0.003*	0.007+	0.002	-0.000	-0.003
	(0.001)	(0.001)	(0.004)	(0.003)	(0.003)	(0.009)
BB time * Hispanic Concentration	-0.003	-0.007**	0.008+	0.002	-0.000	0.010
	(0.002)	(0.002)	(0.004)	(0.004)	(0.003)	(0.010)
High Mobile Time * Hispanic Concentration	0.010***	0.012***	0.007*	0.006+	0.009**	0.006
	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)	(0.008)
BB time * Black Concentration	-0.002	-0.001	-0.008	0.015***	0.015***	0.023+
	(0.002)	(0.002)	(0.010)	(0.004)	(0.004)	(0.014)
High Mobile Time * Black Concentration	0.019***	0.018***	0.021***	-0.030***	-0.029***	-0.035***
	(0.001)	(0.001)	(0.003)	(0.004)	(0.004)	(0.008)
Constant	1.541***	0.242	2.311***	8.706***	9.411***	7.962***
	(0.320)	(0.343)	(0.451)	(0.611)	(0.790)	(0.837)
county-year observations	24,068	15,276	8,792	23,896	15,192	8,704
Rsqd	0.225	0.398	0.157	0.144	0.240	0.097
County observations	3,048	1,920	1,128	3,043	1,918	1,125

Clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars. Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the American Community Survey

Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density

Heterogenous patterns appear to be greater than those observed in earlier regressions on all income levels. Counties with a high percentage of foreign-born and Black residents are again more likely to have growth in participation post-mobile adoption, with coefficients of higher magnitude than those observed for all income levels. It appears that part of what is driving the participation trend observed in the aggregate is low-income foreign-born and Black residents earning below $25,000 a year. Also consistent with previous results, total contractor income claimed by low-income residents experienced a decline in the growth rate of between - 0.6% and -1.4%. per year of mobile access in counties with high concentrations of Black or Hispanic residents. This indicates that low-income workers in minority-concentrated counties did not gain as much as others from higher Internet access.

In Table 6, I further relax linear assumptions of time, and test if the return to the Internet varies throughout the decade by estimating two separate regressions for the sample years 2010-2014 and 2015-2020. To conserve table space, I only show coefficients on metro and non-metro areas, with columns (1)-(2) and (3)-(4) showing changes across the decade in the relationship between growth in participation in

independent contracting.[17] The coefficient on years since broadband adoption is consistently positive in metro areas in both portions of the decade, but is not a significant determinant of growth in independent contractor participation in nonmetro areas. Mobile internet is significantly correlated with growth in business returns in the first half of the decade but becomes negatively related in the second half for non-racially concentrated counties; it is positive at a higher magnitude for counties with high concentrations of foreign-born or Black residents. This positive additive effect in racially concentrated counties is of greater Magnitude in 2015-2019 than the early part of the decade.

TABLE 6
REGRESSION OF TAX OUTCOMES FOR 2010-2014 AND 2015-2019

	Y= ln (Count Business Returns)				Y= ln (Total Business Earnings			
	2010-2014		2015-2019		2010-2014		2015-2019	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	metro	nonmetro	metro	nonmetro	metro	nonmetro	metro	nonmetro
Years Since High BB	0.003***	0.000	0.003**	0.001	0.013***	0.018**	0.013***	0.008+
	(0.001)	(0.004)	(0.001)	(0.001)	(0.003)	(0.006)	(0.003)	(0.005)
Years Since High Mobile	-0.001	0.003	-0.005***	-0.003*	0.010***	0.014*	-0.001	0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.006)	(0.003)	(0.004)
BB time * Foreign Born Con	0.002+	0.001	0.002**	-0.003	0.005	-0.018	0.003	-0.007
	(0.001)	(0.006)	(0.001)	(0.002)	(0.004)	(0.019)	(0.003)	(0.006)
Mobile Time * Foreign Born Con	0.004**	0.002	0.003**	0.004+	-0.003	-0.021	0.003	-0.001
	(0.001)	(0.005)	(0.001)	(0.002)	(0.005)	(0.015)	(0.003)	(0.006)
BB time * Hispanic Con	0.003+	0.004	-0.005***	0.004+	-0.010*	0.017	-0.004	-0.009
	(0.001)	(0.006)	(0.001)	(0.003)	(0.005)	(0.019)	(0.005)	(0.009)
High Mobile Time * Hispanic Con	-0.002	-0.004	0.009***	0.006**	0.011*	0.006	0.002	0.011+
	(0.001)	(0.005)	(0.001)	(0.002)	(0.005)	(0.015)	(0.005)	(0.006)
BB time * Black Con	0.001	-0.008	0.002	0.002	-0.002	0.007	0.010*	0.024
	(0.002)	(0.011)	(0.001)	(0.004)	(0.005)	(0.025)	(0.005)	(0.023)
High Mobile Time * Black Con	0.010***	0.021***	0.015***	0.017***	-0.006	-0.022+	-0.035***	-0.048***
	(0.001)	(0.005)	(0.001)	(0.002)	(0.004)	(0.013)	(0.005)	(0.011)
Constant	4.339***	-1.229	0.578+	2.555***	-0.035	-1.938	-2.051	0.546
	(0.444)	(1.545)	(0.298)	(0.364)	(1.562)	(1.610)	(1.277)	(1.383)
Observations	9,552	5,489	9,545	5,551	9,542	5,471	9,504	5,515
R-squared	0.268	0.444	0.588	0.134	0.086	0.102	0.111	0.097
Number of fips	1,924	1,127	1,914	1,125	1,924	1,126	1,912	1,120

Clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars. Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the American Community Survey

Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density

The right-hand panel of Table 6 shows the coefficients on growth in reported contractor earnings during the first half of the decade in columns (5)-(6) and the later half in columns (7)-(8). Results show that while both broadband and mobile were associated with a statistically significant increase in the growth in reported business earnings in the first half of the decade for a non-racially concentrated county, only broadband remains significant in metro areas in the latter half. The heterogeneous relationship with the return to the duration of mobile internet across racially concentrated counties grows in magnitude and significance over

the decade. The latter half showed a decline in growth rates of business earnings by up to -3.5% in metro areas and 4.8% in nonmetro counties with a high concentration of Black residents between 2015-2019.

These results combined are relatively intuitive, with growth in participation occurring in the later half of the decade as online platform economies expanded.[18] However, as these platforms grew and more people began to work in the "gig" economy, the earnings and returns from such work began to fall. These findings are consistent with both Muro (2016) and Collins et al. (2019) in showing that the relationship between independent contracting and traditional earnings has a varying and dynamic relationship across time.

ROBUSTNESS

The significant role of time when attempting to model the internet's relationship with independent contractor participation correctly and earnings is further confirmed through robustness testing. Robustness tests were conducted on all researcher choices regarding racial concentration and modeling of time. Appendix Table A1 shows the interaction between the continuous percentage of minority residents instead of racial concentration dummies. Results are similar to those observed in the paper, with frequently high statistical significance than the concentration dummies. Different measures of non-linear time are also tested, including using the squared duration of internet uptake and dummy variables that capture discrete years of adoption (1-3 years, 4-6 years, and 7-10 years) versus not yet reaching high thresholds. The duration of the mobile internet squared is consistently significantly related to growth rates of participation and earnings growth rates, as shown in Appendix Table A2. Flexible dummy variable modeling, shown in Appendix Tables A3 and A4, shows monotonically increasing magnitude over time with the coefficients on dummy variables for 4 to 6 years and 7 to 10 years consistently greater in magnitude than 1 to 3-year coefficients, which is consistent with and supports the linear modeling used in the primary specifications.

CONCLUSION

These findings affirm a positive association between expanded internet access and growth in independent contracting earnings. Counties with heightened internet adoption rates experienced growth in residents who claimed independent contracting activities on their taxes. This relationship is particularly pronounced amongst counties with high concentrations of foreign born or Black residents. Moreover, the temporal dimension of internet usage supports that sustained internet access correlates with increased participation in alternative work arrangements. Mobile internet is a significant determinant of growth in participation, particularly in nonmetro counties and amongst minority communities.

However, the relationship between internet expansion and total earnings claimed by independent contractors is less consistent. Mobile access exhibited mixed or negative associations with business earnings relative to hardwired broadband access, which demonstrated a relatively consistent positive or neutral correlation. Notably, the relationship between the duration of internet and growth in earnings from independent contracting reverses itself through the 2010s, with longer internet uptake becoming a factor associated with a decline in business earnings growth. This negative correlation was more pronounced for counties with a high concentration of Black residents and low-income tax filers with a total AGI of $25,000 or below.

The findings highlight the significance of internet infrastructure, specifically mobile internet, as the technological adoption can be a catalyst for fostering diverse economic opportunities. However, the lower rates of return in minority-rich communities reflect challenges that minorities encounter when seeking economic opportunities across employment frameworks. As independent contractors do not qualify for certain safety net features, like unemployment or matched social security benefits, the knowledge that low-income and minority-concentrated communities may be disproportionally affected by the declining return to online platform economies is essential for workers, financial advisors, and policymakers alike.

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ENDNOTES

[1] Collins et al. (2019)'s definitions focus "on non-traditional work arrangements that substitute for the traditional employer-employee relationship. More specifically we examine activities that are firm-facing or firm-mediated in nature" (pg. 5).

[2] Alternative work categories as defined by Katz & Krueger (2019), Independent Contractors, On Call workers, Contract Firm Workers, Temporary Help Agency workers, Digital Marketplace / Online Platform Workers

[3] I exclude 2020-2023 from my sample due to changing dynamics in the labor market from the Covid pandemic, which drastically shifted employment, consumption methods, internet use , and real estate patterns.

[4] For 1099-misc the threshold for reporting earnings during the decade for the majority of filers was $600 (https://www.irs.gov/forms-pubs/about-form-1099-misc), and for 1099-k, a reporting document filed for those that receive money from payment processing companies (such as paypal or visa) the threshold was $20,000 or 200 transactions (https://www.irs.gov/forms-pubs/about-form-1099-k), this threshold changed to $5,000 in 2023.

[5] This has became an outdated definition with many providers offering higher speeds. Despite the FCC formally changing their definition of broadband in 2010 to a higher threshold (4 mbps download), they continued to collect the 200 kbps data from providers (Cooper, 2003). As of 2016, the FCC began publishing retroactive data with alternate measures of higher speed, such as 5mbps, 10 mbps, and 25 mbps. The drawbacks are that the measures are noisier as the high rate must only be available within a census block and not across the entire county to qualify, and they omit individuals who have broadband, but at speeds below these higher thresholds (Morris, 2018; Pressgrove, 2021). Since I are interested in analyzing gig economy work, the 200kbps speed definition enables me to use the broadest and least noisy measure of broadband.

[6] Mobile Network Operators (MNOs), like Verizon, AT&T, T-Mobile, Sprint, and US Cellular, maintain the infrastructure and deliver services directly to consumers. For more information, see https://en.wikipedia.org/wiki/List_of_mobile_network_operators_of_the_Americas#United_States. Mobile Virtual Network Operators (MNVOs) lease access to the network services from MNOs and repackage them for sale to consumers. In 2016, there were 139 MVNOs operating within the US, such as Cricket, Metro, Boost Mobile, Wireless, and Walmart Family Mobile. For more information, see: https://en.wikipedia.org/wiki/ mobile_virtula_network_operator.com . Increases in carriers provide consumers with more choices in their cell phone plan such as minutes, data limits and speeds, hotspot streaming, international options, and family and pre-paid plans, allowing a greater number of consumers to find a carrier that fits their needs (Villas-Boas, 2018).

[7] Apple had an exclusive contract with AT&T, in June 2007. when the iPhone was released. It remained in place until iPhone4 became available with Verizon (02/2011), Sprint (10/2011), Cricket (05/2012), and Tmobile (04/2013) (Lewis, 2007; CBS News, 2011; Reardon, 2013). The first Android-enabled device was released at Tmobile in January of 2009, followed by the Samsung Galaxy broadly in late 2009 (Cha, 2009; Herrman; 2009).

[8] The FCC's discrete reported categories, where each 20% adoption is coded from 1 to 5, are noisy. Movements on the margin can drive changes in the index that are not necessarily equal to 20% or the full range of a reported category. By collapsing data to a binary measure, we minimize the potential influence of minor changes on the margins of the index. Further, a binary measure allows me to interact the term with measures of racial diversity and have a clear interpretation of coefficients. A sixty percent threshold was selected as it provides the most identification across both time periods; a threshold of 40% has no variation in metropolitan areas in 2016, with all counties reaching 40% or above, and a threshold of 80% has almost no rural identification in 2012. Robustness checks at these other threshold levels are available upon request from the authors and show coefficients with similar patterns and signs but larger standard errors.

[9] Metropolitan areas are defined by the USDA categories as of 2013, and include those with populations from below 250,000 to 1 million and urban areas adjacent to a metropolitan area with populations between 2.5 and 20 thousand. Nonmetro counties are those that are urban counties with populations between 2.5 and 20

thousand that are not adjacent to a metropolitan area and non-urban rural counties with populations below 2,500.

[10] For a complete country-wide sample, the 5-year estimates must be used. They are the only interval that captures nonmetro areas. ACS data is suppressed for counties with populations under 65,000 (Bureau, 2009)

[11] Other earnings beyond wage and independent contracting include (but are not limited to): investment, property, inheritance, social security and unemployment.

[12] Due to the compacted nature of FCC reporting the Data is particularly sensitive to small changes in internet uptake on the margins of each discrete 20% grouping. For example, a movement from 3 to 4 on the index, could be a change from 58 to 62% households or from 42% to 78%. As such, the binary variables that measure if high broadband or high mobile thresholds have been met are coded to remain equal to 1 if in a single year, they drop to the lower reported percentile but do not continue to decline and/ or do not remain in the lower percentile for more than a year. A limited number of observations (32) were dropped in the analysis due to high variance in reporting with counties moving multiple categories in short intervals of time or reporting a percentile two above or below the previous category without the level being maintained.

[13] The results are robust to using a continuous measure for the percent of foreign-born, Hispanic, or Black people in lieu of a dummy variable indicating being in the top 75th percentile. These results are shown in Appendix Table A1.

[14] Another potential way to demean this relationship would be to use a ratio of returns that claim business earnings to the count of tax returns that claim wage earnings and the ratio of the total business earnings over total wage earnings claimed. However, this method is less intuitive to interpret, as the numerator or denominator may be changing. Consequently, it is not as intuitively interpreted as estimating changes in business returns or earnings while holding wage participation and totals. Results for Table 3 estimated instead from the ratio of: (# Business returns / # wage returns), show similar trends to those reported in this paper. Results are available from the author upon request.

[15] When high-speed Internet first began to expand, some researchers were able to quantify potentially causal impacts utilizing sources for instrumental variables capable of predicting hardwired broadband adoption. Some examples include housing patterns (Dettling, 2017), steepness of terrain (Ivus & Boland, 2015; Kolko, 2012), previous period's concentration of technology firms (Forman et al., 2012), historical telephone patterns (Czernich et al., 2011), and distance to infrastructure (Fabritz, 2013; Forman et al., 2012; Larose et al., 2011). However, these techniques are only valid for hardwired internet access and tended to work best in early periods of internet adoption, when many faced binding constraints to adoption. While these strategies had explanatory power in early periods of hardwired internet adoption (pre 2010), they became less powerful with greater broadband penetration and expansion of mobile access. By 2015, desktop computer ownership had plateaued, and mobile internet plans and devices became a prominent substitute for hardwired internet (Anderson, 2015). To date, there are no known instruments for predicting mobile internet access. Despite this lack of exogeneity, including measures of mobile internet is important for capturing true access and use of the internet, as mobile Internet is both a substitute for and a complement to hardwired internet (Horrigan & Duggan, 2015).

[16] Log level regression interpretation: ((0.003)*(100)*(1.767) = 0.53%), ((0.004)*(100)*2.14=0.856%))

[17] The non-interacted and US wide results are available from the author upon request.

[18] While many online platforms had launched before 2010; such as, Amazon Turk opening in 2005, AirBnB in 2008, taskrabbit, Uber, and Fiver in 2009. But sites didn't truly proliferate to a few years into the 2010s, with expansions such as: Lyft and Cavier launched in 2012, Door Dash and Upwork in 2013, Uber eats in 2014, and Wag in 2015.

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APPENDIX

TABLE A.1
REGRESSION OF TAX OUTCOMES WITH CONTINUOUS RACE MEASURES (2010-2019)

	Y=ln (Count Business Returns)			Y= ln (Total Business Earnings)		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	usa	metro	nonmetro	usa	metro	nonmetro
Years Since High BB	0.0034***	0.0025**	0.0018	0.0085***	0.0092***	0.0041
	(0.0007)	(0.0008)	(0.0013)	(0.0020)	(0.0025)	(0.0040)
Years Since High Mobile	-0.0040***	-0.0045***	-0.0050***	0.0157***	0.0153***	0.0105**
	(0.0006)	(0.0008)	(0.0010)	(0.0024)	(0.0032)	(0.0038)
BB time * Foreign Born %	0.0101	0.0086	-0.0459	0.1129**	0.1044*	0.1483
	(0.0144)	(0.0160)	(0.0281)	(0.0412)	(0.0503)	(0.1050)
Mobile Time * Foreign Born %	0.0269*	0.0202	0.0485*	0.0123	0.0483	-0.0731
	(0.0126)	(0.0142)	(0.0226)	(0.0453)	(0.0546)	(0.0808)
BB time * hispanic%	-0.0001	-0.0001	0.0003*	-0.0003	-0.0000	-0.0005
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0003)
High Mobile Time * hispanic%	0.0002***	0.0001*	0.0003***	-0.0004*	-0.0006**	0.0001
	(0.0000)	(0.0000)	(0.0001)	(0.0002)	(0.0002)	(0.0003)
BB time * Black%	0.0002***	0.0002***	0.0001	0.0002	0.0000	-0.0001
	(0.0000)	(0.0000)	(0.0003)	(0.0002)	(0.0002)	(0.0007)
High Mobile Time * Black%	0.0005***	0.0005***	0.0006***	-0.0012***	-0.0011***	-0.0014***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0003)
Constant	0.6095	0.7972**	0.5029	-4.5658***	-6.3915***	-2.3952*
	(0.6208)	(0.2828)	(1.1913)	(0.6787)	(0.8326)	(1.1215)
Observations	30,137	19,097	11,040	30,032	19,046	10,986
R-squared	0.4836	0.6126	0.3243	0.2068	0.2485	0.1835
Number of fips	3,059	1,925	1,134	3,057	1,925	1,132

Clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars. Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the American Community Survey

Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density

TABLE A.2
REGRESSION OF TAX OUTCOMES WITH DURATION SQUARED INCLUDED (2010-2019)

	Y=ln (Count Business Returns)			Y= ln (Total Business Earnings)		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	usa	metro	nonmetro	usa	metro	nonmetro
Years Since High BB	-0.0017+	-0.0032**	0.0010	0.0076**	0.0085**	0.0045
	(0.0009)	(0.0010)	(0.0020)	(0.0027)	(0.0029)	(0.0058)
(Years Since High Broadband)^2	0.0006***	0.0006***	0.0000	0.0004	0.0005+	-0.0002
	(0.0001)	(0.0001)	(0.0003)	(0.0003)	(0.0003)	(0.0007)
Years Since High Mobile	-0.0040***	-0.0057***	0.0003	0.0082**	0.0091**	0.0029
	(0.0009)	(0.0011)	(0.0015)	(0.0028)	(0.0031)	(0.0053)
(Years Since High Mobile)^2	0.0003**	0.0003***	-0.0003+	0.0001	-0.0001	0.0003
	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0003)	(0.0006)
BB time * Foreign Born Con	0.0017	0.0050**	-0.0050	0.0169**	0.0172**	-0.0010
	(0.0018)	(0.0018)	(0.0053)	(0.0052)	(0.0054)	(0.0155)
(BB time)^2 * Foreign Born Con	0.0000	-0.0003	0.0005	-0.0015**	-0.0015**	-0.0001
	(0.0002)	(0.0002)	(0.0006)	(0.0005)	(0.0006)	(0.0022)
Mobile Time * Foreign Born Con	0.0029	0.0010	0.0087*	-0.0100	-0.0126+	-0.0195
	(0.0018)	(0.0018)	(0.0044)	(0.0073)	(0.0073)	(0.0169)
(Mobile Time)^2 * Foreign Born C	-0.0000	0.0001	-0.0005	0.0007	0.0009	0.0018
	(0.0002)	(0.0002)	(0.0006)	(0.0007)	(0.0007)	(0.0019)
BB time * Hispanic Con	0.0009	-0.0017	0.0067	-0.0099+	-0.0081	-0.0036
	(0.0020)	(0.0022)	(0.0053)	(0.0059)	(0.0064)	(0.0163)
(BB time)^2 * Hispanic Con	-0.0002	0.0000	-0.0003	0.0013*	0.0010	0.0018
	(0.0002)	(0.0002)	(0.0007)	(0.0006)	(0.0006)	(0.0026)
Mobile Time * Hispanic Con	0.0061***	0.0053**	0.0044	0.0056	0.0017	0.0193
	(0.0018)	(0.0020)	(0.0038)	(0.0070)	(0.0070)	(0.0157)
(Mobile Time)^2 * Hispanic Con	-0.0002	-0.0001	0.0001	-0.0011	-0.0007	-0.0026
	(0.0002)	(0.0002)	(0.0005)	(0.0007)	(0.0007)	(0.0017)
BB time * Black Con	0.0019	0.0034	0.0116	0.0126+	0.0005	0.0082
	(0.0021)	(0.0021)	(0.0102)	(0.0071)	(0.0073)	(0.0278)
(BB time)^2 * Black Con	-0.0001	-0.0001	-0.0018+	-0.0000	0.0008	0.0013
	(0.0002)	(0.0002)	(0.0010)	(0.0008)	(0.0008)	(0.0028)
Mobile Time * Black Con	0.0222***	0.0205***	0.0221***	-0.0328***	-0.0213**	-0.0683***
	(0.0016)	(0.0016)	(0.0037)	(0.0074)	(0.0077)	(0.0186)
(Mobile Time)2 * Black Con	-0.0008***	-0.0008***	-0.0002	0.0008	0.0001	0.0041+
	(0.0002)	(0.0002)	(0.0005)	(0.0008)	(0.0009)	(0.0021)
Constant	1.0632	1.3798***	0.7822	-5.4042***	-7.1405***	-2.8163**
	(0.6496)	(0.2609)	(1.2098)	(0.5563)	(0.7420)	(0.9966)
Observations	30,137	19,097	11,040	30,032	19,046	10,986
R-squared	0.4687	0.5979	0.3044	0.1846	0.2153	0.1725
Number of fips	3,059	1,925	1,134	3,057	1,925	1,132

Clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars. Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the American Community Survey
Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density

TABLE A.3
REGRESSION OF CONTRACTOR COUNT WITH DISCRETELY DURATION BINS
(2010-2019)

	Y=ln (Count Business Returns)				Y=ln (Count Business Returns)		
	(1)	(2)	(3)		(1b)	(2b)	(3b)
VARIABLES	usa	metro	nonmetro		usa	metro	nonmetro
Years Since High BB 1to3	-0.006***	-0.011***	-0.000	BB time 1to3 * Hispanic Con	0.008+	0.000	0.023*
	(0.002)	(0.002)	(0.004)		(0.005)	(0.005)	(0.010)
Years Since High BB 4to6	-0.001	-0.011***	0.008	BB time 4to6* Hispanic Con	0.004	-0.003	0.020
	(0.003)	(0.003)	(0.006)		(0.006)	(0.006)	(0.013)
Years Since High BB 7to10	0.010**	-0.001	0.003	BB time 7to10 * Hispanic Con	0.005	-0.003	0.043**
	(0.004)	(0.005)	(0.010)		(0.007)	(0.008)	(0.016)
Years Since High Mobile 1to3	-0.010***	-0.016***	-0.002	Mobile tm1to3* Hispanic Con	0.021***	0.021***	0.015*
	(0.002)	(0.002)	(0.003)		(0.004)	(0.005)	(0.007)
Years Since High Mobile 4to6	-0.022***	-0.030***	-0.012*	Mobile tm4to6 * Hispanic Con	0.028***	0.028***	0.024*
	(0.003)	(0.003)	(0.004)		(0.005)	(0.006)	(0.010)
Years Since High Mobile 7to10	-0.027***	-0.037***	-0.029***	Mobile tm7to10* Hispanic Con	0.043***	0.044***	0.048**
	(0.004)	(0.005)	(0.007)		(0.007)	(0.007)	(0.015)
BB time1to3 * Foreign Born Con	-0.001	0.006	-0.015	BB time 1to3* Black Con	0.001***	0.001***	0.001
	(0.004)	(0.004)	(0.011)		(0.000)	(0.000)	(0.001)
BB time4to6* Foreign Born Con	0.005	0.012*	-0.013	BB time 4to6 * Black Con	0.002***	0.002***	0.000
	(0.005)	(0.005)	(0.013)		(0.000)	(0.000)	(0.002)
BB time7to10* Foreign Born Con	0.007	0.013*	-0.013	BB time 7to10* Black Con	0.003***	0.003***	0.002
	(0.006)	(0.006)	(0.014)		(0.000)	(0.000)	(0.002)
Mobile tm1to3 * Foreign Born Con	0.007	0.001	0.019*	Mobile tm1to3 * Black Con	0.002***	0.002***	0.001***
	(0.004)	(0.005)	(0.008)		(0.000)	(0.000)	(0.000)
Mobile tm4to6 * Foreign Born Con	0.019***	0.012*	0.028*	Mobile tm4to6 * Black Con	0.003***	0.003***	0.003***
	(0.005)	(0.005)	(0.011)		(0.000)	(0.000)	(0.000)
Mobile tm7to10 * Foreign Born Con	0.027***	0.020**	0.038*	Mobile tm7to10 * Black Con	0.004***	0.004***	0.005***
	(0.007)	(0.007)	(0.017)		(0.000)	(0.000)	(0.000)
Constant					0.699	0.848**	0.640
					(0.630)	(0.259)	(1.204)
Observations					30,137	19,097	11,040
R-squared					0.476	0.606	0.315
Number of fips					3,059	1,925	1,134

Clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars. Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the

Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density

TABLE A.4
REGRESSION OF CONTRACTOR EARNINGS WITH DISCRETE DURATION BINS
(2010-2019)

	Y= ln (Total Business Earnings)				regression results continued		
	(1)	(2)	(3)		(1b)	(2b)	(3b)
VARIABLES	usa	metro	nonmetro		usa	metro	nonmetro
Years Since High BB 1to3	0.023***	0.026***	0.020	BB time 1to3 * Hispanic Con	-0.016	-0.020	0.006
	(0.007)	(0.007)	(0.013)		(0.014)	(0.015)	(0.033)
Years Since High BB 4to6	0.041***	0.051***	0.015	BB time 4to6* Hispanic Con	-0.017	-0.020	0.044
	(0.010)	(0.011)	(0.018)		(0.018)	(0.019)	(0.038)
Years Since High BB 7to10	0.086***	0.105***	0.024	BB time 7to10 * Hispanic Con	-0.008	-0.013	0.058
	(0.014)	(0.016)	(0.028)		(0.023)	(0.023)	(0.084)
Years Since High Mobile 1to3	0.021**	0.032***	0.010	Mobile tm1to3* Hispanic Con	-0.007	-0.011	0.003
	(0.007)	(0.007)	(0.011)		(0.017)	(0.018)	(0.032)
Years Since High Mobile 4to6	0.056***	0.056***	0.042*	Mobile tm4to6 * Hispanic Con	-0.016	-0.024	0.015
	(0.010)	(0.011)	(0.017)		(0.021)	(0.022)	(0.040)
Years Since High Mobile 7to10	0.094***	0.092***	0.060*	Mobile tm7to10* Hispanic Con	-0.050*	-0.053*	-0.023
	(0.013)	(0.015)	(0.024)		(0.024)	(0.025)	(0.050)
BB time1to3 * Foreign Born Con	0.023	0.033*	-0.020	BB time 1to3* Black Con	-0.000	-0.001	-0.002
	(0.014)	(0.015)	(0.034)		(0.001)	(0.001)	(0.002)
BB time4to6* Foreign Born Con	0.049**	0.055***	-0.008	BB time 4to6 * Black Con	0.000	-0.001	-0.001
	(0.016)	(0.016)	(0.040)		(0.001)	(0.001)	(0.004)
BB time7to10* Foreign Born Con	0.047*	0.053*	-0.007	BB time 7to10* Black Con	-0.001	-0.002	0.001
	(0.020)	(0.021)	(0.075)		(0.002)	(0.002)	(0.005)
Mobile tm1to3 * Foreign Born Con	-0.022	-0.029	-0.014	Mobile tm1to3 * Black Con	-0.004***	-0.004***	-0.004***
	(0.018)	(0.018)	(0.035)		(0.001)	(0.001)	(0.001)
Mobile tm4to6 * Foreign Born Con	-0.038+	-0.046*	-0.051	Mobile tm4to6 * Black Con	-0.006***	-0.005***	-0.007***
	(0.022)	(0.023)	(0.044)		(0.001)	(0.001)	(0.002)
Mobile tm7to10 * Foreign Born Con	-0.023	-0.036	-0.017	Mobile tm7to10 * Black Con	-0.009***	-0.009***	-0.010***
	(0.024)	(0.026)	(0.052)		(0.001)	(0.001)	(0.002)
Constant					-4.607***	-5.844***	-2.385*
					(0.549)	(0.735)	(1.006)
Observations					30,032	19,046	10,986
R-squared					0.200	0.235	0.182
Number of fips					3,057	1,925	1,132

Clustered standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

geography defined by the USDA rural-metro index. All dollars measured in 2019 inflation adjusted dollars. Internet and cell phone measures taken from the Federal Communications Commission. Tax data reported by IRS. Race and Population measures from from the American Community Survey

Additional controls include : Foreign concentration, Hispanic Concentration, Black Concentration, log of the count of taxes claiming wage earnings, total amount of wage earnings claimed, labor force participation rates, unemployment rates, gini coefficient, percent of 25 plus aged population with a college education or above, population, and population density