Digital Denied:

The Impact of Systemic Racial Discrimination on Home-Internet Adoption

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December 2016

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ABSTRACT

In this report, we demonstrate that communities of color find themselves on the wrong side of the digital divide for home-internet access – both in terms of adoption and deployment – in a manner that income differences alone don't explain. Once we control for other economic and demographic factors that contribute to this divide, the data illustrate persistent broadband adoption and deployment gaps for people of different races and ethnicities.

We find that several personal and household characteristics are associated with home-internet adoption, including race and ethnicity, along with family income, educational attainment, and use of the internet at work or school. There are however large differences in some of these factors depending on a person's race or ethnicity. For example, Whites are far more likely to report going online while at work than are Hispanic or Black employees, even when they hold similar jobs.

We note that systemic racial discrimination impacts home-internet adoption in communities of color, because such systemic discrimination impacts income inequality and causes other disparities. Structural discrimination exacerbates market failures in the broadband market, adding additional barriers to internet adoption in communities of color. We find, however, that contrary to one popular narrative, people of color who do not adopt home internet have a very high demand for it. This means they would benefit greatly from lower prices and more choices for service.

We also find that, despite the persistence of a digital divide for wired internet-access connections, the relatively higher levels of competition and choice in the mobile market have largely closed such divides in mobile internet and cellphone adoption. These are product markets in which, for example, some low-income households of color have equal or higher levels of adoption than low-income White households do. This absence of racial or ethnic gaps in mobile-service adoption derives in part from increased competition, which in turn contributes to the lower prices for these services. Mobile providers are willing to offer prepaid and resold services too, also as a result of the higher levels of competition in this market, and that willingness likewise makes service more affordable and more accessible to people in typically marginalized communities.

All of this stands in stark contrast to high-speed wired-internet access, a market that is a duopoly at best. Wired providers have failed to offer resold or prepaid services, and generally have required potential customers to undergo credit checks or make cash deposits – practices that contribute to the digital divide by exacerbating existing racial disparities in credit scoring, housing and other economic sectors.

We conclude that public policies aimed at closing the digital divide must focus on correcting these and other failures endemic to the home-internet market, such as supra-competitive pricing, provider cross-subsidization, and the lack of a functioning resale/wholesale market. Confronting these market failures would increase the ability of people in marginalized communities to access advanced telecommunications services and purchase those services in an equitable manner.

EXECUTIVE SUMMARY

America has a home-internet digital divide. People of color and people with lower incomes are far less likely to have internet access at home, even when we count either a fixed connection or a mobile wireless-internet subscription in the household as "home" access. This divide persists despite nearly two decades of attention to this problem, and despite the increasing necessity of home internet access. And it means more and more that even when they do have a home subscription, many people of color rely on inferior mobile-wireless services as their sole method of getting online and connecting with the world.

Public policy intended to address the digital divide has largely failed to close the gap. It has failed to address directly the problems caused by an inadequate number of broadband choices and a lack of competition to provide home-internet services. It has also failed to address the ways in which these types of market failures combine with other structural factors to depress adoption in communities of color.

In this report, we first go beneath the surface of the broadband-adoption data to understand the contours of the digital divide, and to examine how the effects of structural discrimination may depress internet adoption in communities of color.* Income inequality, created in large part by systemic racism and racial bias, is a significant contributor to the digital divide. However, we find that there are adoption and deployment gaps beyond those attributable merely to differences in income or to other factors such as educational attainment of people in different racial/ethnic groups. We then identify a few key deployment gaps that compound the structural factors that depress high-speed home-internet adoption in communities of color. Last, we suggest policies that would help offset the impacts of structural racism in other sectors that contribute to the digital divide, while also facilitating the goal of equitable internet access and better functioning broadband markets.†

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* Note on Census Bureau Demographic Data and Terminology: We rely throughout this report on the data collected by the U.S. Census Bureau – and thus, necessarily, on the terminology the Census Bureau utilizes to collect and describe it. We recognize that the Census Bureau's racial and ethnic categories may be problematic. Perhaps chief (but by no means alone) among the complex issues reduced to simple categories by the U.S. Census are the definitions used to self-identify and classify people on Census instruments as "Hispanic," and then as either "White" or "non-White" members of that group. While we would otherwise be glad to embrace richer terminology, we must of necessity rely on the terms people are able to choose on Census surveys in order to maintain the integrity of the statistics and the analysis. (For example, the population of individuals who might identify as being of "Hispanic" origin does not overlap completely with the population that might identify as "Latino," as the latter likely would include a diverse group of people including many descended from non-Spanish speaking countries in North, Central, and South America.)

Throughout this report, unless specified otherwise or the context requires, we generally use the term "Hispanic" to refer to what the Census categorizes as "Hispanic" people of any race. We generally use the term "White" to refer to what the Census classifies as "non-Hispanic Whites." In the bulk of the figures and graphics illustrating this report, however, we retain the Census terminology in its entirety for the sake of clarity. While the data does not utilize the terminology used by many people to describe themselves today, it nevertheless paints a vivid picture of the broadband adoption and deployment gaps faced by people in predominantly non-White population centers and demographic groups.

† Note on Competition and Markets for Internet Access Services: We acknowledge at the outset that commercially provided internet access service is by no means the only form of access, nor will it necessarily be the best option for some communities today or in the future. Nevertheless, commercial providers are today far and away the chief suppliers of this communications service so essential for the functioning of our democracy, society, economy, education, and free expression. For that reason, we speak often and urgently about the need to improve market outcomes by promoting competition and facilitating more affordable options. We focus as well on markets and market failures in the broader economic sense of the term, focusing not solely on current commercial offerings but on instances in which services are not allocated efficiently – and as this report illustrates, not equitably – based on the persistent racial component of the digital divide. As indicated above, we propose public policies in the communications realm to address these inequities and structural barriers. Yet we recognize as well the contributions made to these market failures by structural racism and barriers outside the jurisdiction and expertise of federal communications policymakers.

Key Findings

Millions of People in America Remain on the Wrong Side of the Digital Divide, Even as Internet Access Has Become a Necessity.

Home-Internet Adoption Is High but Is Still Well Below the Adoption Rates and Levels for Other Technologies, and Has Not Grown in Recent Years.

- As of mid-2015, 73 percent of U.S. households had home-internet access. By contrast, 96 percent of households had telephone access; 81 percent had cellphone access; and 80 percent subscribed to pay-TV.

- This level of home-internet adoption – as measured by the U.S. Census Bureau's July 2015 Current Population Survey ("CPS") – has actually declined in recent years. Home-internet adoption stood at 75 percent of households in 2012.

Income Impacts Home-Internet Adoption.

- Only 49 percent of households with annual family incomes below $20,000 have internet in the home, compared to nearly 90 percent of households with incomes above $100,000.

- Even among those with home internet, there is a strong relationship between income and the type of technology used. Internet-adopting households in the bottom-income quintile are twice as likely as those in the top quintile to live in a home with only mobile internet access (29 percent vs. 15 percent).

People in Many Communities of Color Continue to Lag Behind, Even After One Accounts for Income Differences.

- Based on the racial and ethnic categories in which census takers can choose to self-identify, and the data available in the July 2015 CPS and other sources, we observe significant gaps in home-internet adoption among different populations.

- While 81 percent of Whites and 83 percent of Asians have home internet, only 70 percent of Hispanics, 68 percent of Blacks, 72 percent of American Indian/Alaska Natives, and 68 percent of Native Hawaiian/Pacific Islanders are connected at home.

- The median household income of Whites ($62,950) and Asians ($77,166) is far higher than that of Hispanics ($45,148) and Blacks ($36,898). <u>However, these differences in income across race and ethnicity do not explain the entirety of this digital divide.</u>

    - There is still a racial/ethnic digital divide even among persons in the lowest income quintile. Among those with annual family incomes below $20,000, 58 percent of these low-income Whites have home-internet access, versus just 51 percent of Hispanics and 50 percent of Black people in the same income bracket.

    - This adoption gap exists between people of these races and ethnicities in all income strata, but the gap is largest among the poorest people in America.

- There are differences in home-internet adoption across a variety of other demographic factors discussed below. But even after accounting for such differences in income, age, education, and other factors, many racial and ethnic groups continue to lag behind Whites in home-internet adoption. This gap persists despite a host of other data demonstrating high demand for internet access in non-adopting households of color. This suggests that structural racial discrimination contributes to the digital divide.

Age, Education, Geography, Household Composition, and Internet use at Work or School Also Impact Home-Internet Adoption.

- Older Americans have lower levels of home-internet adoption. Young people have very high demand for internet access, even though they tend to have lower incomes. And even though adoption among the young is high, there are still gaps in adoption between people in different race and ethnicity categories in every age group.
    - For example, 81 percent of people in America under age 50 have internet at home, versus 71 percent of those ages 50 and above. However, a majority in every age group has home internet access, with the exception of those ages 85 and above.
    - People in typically marginalized and under-served racial and ethnic communities lag Whites in home-internet adoption in every age group. For example, 86 percent of Whites under age 50 have home internet, versus 72 percent of Hispanics and 74 percent of Blacks in that age group. This sizable gap is seen in middle-aged groups as well. Home-internet adoption is 80 percent for Whites between ages 50 and 70, versus just 66 percent for Hispanics and 59 percent for Black people in this age group.
    - Among the poorest people in America, there is a gap in home-internet adoption between races/ethnicities across all age groups. For example, home-internet adoption is 74 percent for Whites under age 25 with annual family incomes below $20,000, but just 57 percent for Hispanics and 63 percent for Blacks in this age and income group. The adoption gap among poorer populations, even for young demographics with higher demand for access, again suggests structural factors contributing to the racial/ethnic digital divide.
- Persons with high levels of educational attainment adopt home internet at higher levels (though with little difference between those with bachelor's degrees and those with more advanced degrees). Only 51 percent of those age 25 and above without a high-school diploma or equivalent have internet at home, versus 88 percent of those age 25 and above with a bachelor's degree or higher.
    - Hispanic and Black individuals trail behind Whites in home-internet adoption across almost all educational-attainment levels, with this gap largest for Black people at the lowest levels of educational attainment. For example, only 37 percent of Blacks age 25 and above without a high-school diploma have home internet, versus 51 percent of Whites in this educational category. There is a smaller adoption gap between people of different races and ethnicities for those age 25 and up with bachelor's degrees or higher, but a gap remains. Nearly 89 percent of Whites at this educational level report having home internet, versus 84 percent of Hispanics and 81 percent of Blacks.
    - Income partly drives these results. Even within given education strata, Whites tend to have higher average incomes than people of color. That earnings gap widens at lower educational levels. However, Black people with low educational attainment and low incomes still have significantly lower levels of home-internet adoption than Whites in this same education/age/income cohort. Only 35 percent of Blacks age 25 and above, with a high-school diploma or lower educational level and a family income below $20,000, have home internet. But 42 percent of Whites in this same cohort have home-internet access. This again suggests that structural factors depress home-internet adoption in ways that income differences do not completely explain – even though there is ample evidence of high demand for the internet in these non-connected communities of color.

- Internet use at work is highly correlated with home-internet adoption. Nearly 95 percent of employed individuals who go online at work have home internet, compared to just 66 percent of employed individuals who do not use the internet at their jobs.

    - Moreover, exposure to the internet at work varies greatly by race/ethnicity. For example, among employed persons, 61 percent of Whites go online at work, versus just 38 percent of Hispanics and 47 percent of Blacks.

- Internet use at school is highly correlated with home-internet adoption. Among school-age minors and adults enrolled in college/university, 94 percent of those who go online at school have home internet, compared to 70 percent of those who do not use the internet while at their school or college.

    - However, exposure to the internet in school is not equitable across all races/ethnicities. For example, while 50 percent of school-age or university-enrolled Whites go online at school, only 44 percent of Hispanic students and 46 percent of Black students access the internet while at their school or college.

There Is a Troubling Inequity in Connection Quality.

- Low-income households and people of color are less likely to have home-internet connections. But if they do connect at home, they are more likely to rely solely on mobile wireless.

- Mobile-only households do not have access to the full benefits of fixed broadband connections. Fixed connections typically offer far greater speeds and higher data caps (or no caps). Furthermore, a mobile connection may not always be available to everyone in the household if the primary account holder takes the only mobile device with them when they leave the home.

- Among those who do have home-internet access of any type, those with lower incomes are more likely to use only mobile internet than are people with higher incomes.

    - While 29 percent of low-income internet-connected households are mobile-only, just 15 percent of households earning more than $100,000 are mobile-only.

- While only 18 percent of White households that have home internet connect via mobile only, 28 percent of Hispanic and Black internet-connected homes connect using only mobile cellular data services.

    - This gap persists among the poorest households. One quarter of low-income White households that have home internet connect using only mobile cellular data services, but 36 percent and 37 percent, respectively, of low-income Hispanic and Black internet households are mobile-only.

- Affordability concerns partly drive the over-reliance by Hispanic and Black internet households on mobile service. Individuals surveyed in these racial and ethnic groups report internet-affordability concerns more often than do members of other demographic communities. As we explain below, the higher level of competition in mobile and the widespread availability of prepaid mobile services both contribute to making such services more affordable. These factors contribute to low-income populations and people of color over-indexing on mobile.

There Is a Significant Racial/Ethnic Divide in Home-Internet Adoption and Wired-Broadband Use, Even After One Accounts for Differences in Income and Other Demographic Factors.

For many people of color, the level of home-internet adoption (of all types, treating wired and mobile subscriptions both as types of "home" internet) is far below the expected value. To determine the size of this digital divide, we compare actual home-internet adoption by people of different races and ethnicities to the level of adoption one would expect based solely on their income, or based on their income combined with other demographic factors (*e.g.*, their age, education, location in a metropolitan area or not, home-ownership levels, household size, and presence of household members who use the internet at work and/or school).

These findings, coupled with evidence from other telecom markets, suggest that structural discrimination (and the market failures it exacerbates) depresses internet adoption among people of color.

- Based on income alone, we should expect 69 percent of Hispanic households and 68 percent of Black households to have home internet. Their actual levels of adoption are 66 percent and 62 percent respectively. By contrast, White households have a home-internet adoption level close to the expected value based on income (76 percent actual versus 75 percent expected).

- After controlling for income, education, age, and other factors, the marginal impact of race/ethnicity on household-internet adoption is -5.6 percentage points for Hispanics, -8 percentage points for Blacks, and -5.5 percentage points for American Indian/Alaska Natives, relative to Whites.

- Likewise, the level of wired home-internet adoption for certain racial/ethnic demographic groups is far below the expected value based on income and other demographic factors.

    - For example, based on income alone, we should expect 51 percent of Hispanic and 50 percent of Black households to have wired home internet, but the actual values are only 45 percent and 43 percent respectively. White households slightly outperform their income-expected value for wired home-internet adoption. The expected value for such adoption, based on income, is 58 percent – compared to an actual 60-percent adoption rate for wired connections by White households.

    - After controlling for income, education, age, and other factors, the marginal impact of race/ethnicity on household wired-internet adoption (conditional on home-internet adoption; i.e. the gap amongst households who've decided to adopt any form of service) is -5.2 percentage points for Hispanics and -6.0 percentage points for Blacks, relative to Whites.

Our econometric models that account for the impact of race and ethnicity along with these other demographic factors indicate persistent gaps in home-internet adoption between people of different races and ethnicities. Why do such gaps exist? There are numerous possibilities, which are not mutually exclusive. As we discuss below, however, the answer is not that Hispanics and Blacks simply have a lower overall demand for internet access. Indeed, the data indicate that members of these communities who are on the wrong side of the digital divide have a high demand for internet access, but do not subscribe largely due to cost concerns.

The Digital Divide Is Smaller or Even Absent for Mobile, Compared to the Divide We See in Wired Home-Internet Access, Because the Mobile Markets Are More Competitive and Feature Providers Marketing to People in Low-Income Communities.

- Cellular phone and mobile-internet access adoption rates for people of color are the same as or close to the adoption rates for Whites. In fact, among households in the bottom-income quintile, the cellular-telephone and mobile-internet adoption and usage rates are actually higher for Hispanics and Blacks at that income level than for Whites in the same income bracket. Overall, Hispanics and Blacks have cellular- and smartphone-adoption levels slightly above what one would predict based on income alone.

- Some 65 percent of White households use mobile internet (either in or outside the home). By comparison, 62 percent of Hispanic households and 59 percent of Black households report adopting mobile internet.

- This small gap in the raw numbers is also seen for cellular use. Some 82 percent of White households use cellular service in or out of the home, compared to 80 percent of Hispanic and Black households.

- While cellular-phone and mobile-internet use rates are slightly higher for White households, this difference is entirely explained by income differences. And as mentioned above, among low-income populations, the use rates are actually higher for Hispanics and Blacks than for Whites.

    - Low-income Hispanic (70 percent) and Black households (72 percent) have higher cellular-adoption levels than low-income White households (67 percent). Low-income Hispanic (46 percent) and Black households (44 percent) also have higher mobile-internet adoption levels than low-income Whites (41 percent).

- The lack of any significant racial or ethnic divide for cellular-telephone and mobile-internet services, and particularly the lack of such a divide among low-income households, is likely due to the existence of a more competitive and better-functioning market. There are many resellers that specifically seek to serve low-income customers and that do not subject such customers to credit checks. These results also reflect the fact that low-income households headed by people of color in particular tend to adopt mobile as their only home-internet service in response to the participation barriers they face in the wired market.

- This finding does <u>not</u> suggest that wired high-speed home-internet service and mobile-internet service are perfect substitutes for one another at this time. It also does not suggest (let alone prove) that there is no divide between people who choose to adopt wired service and those who choose to (or can only afford to) adopt mobile as their sole means of access. But when we analyze the cellular-telephone and mobile-internet markets in their own right, there is no persistent racial or ethnic divide that is unexplained by income, or that is comparable to the digital divide in wired high-speed home-internet adoption.

- The mobile market – even with four national carriers and a handful of regional carriers and resellers – is far more competitive than the wired home-internet market. One consequence of this higher degree of competition is the existence of a vibrant resale market. Facilities-based wireless carriers have sold bulk capacity to resellers (such as Tracfone) who in turn offer lower-priced prepaid services that do not require customers to undergo a credit check or pay a deposit before taking service. This higher level of competition has also produced (in recent years) a vibrant facilities-based prepaid market (*e.g.*, Sprint's Boost and Virgin brands) in which some carriers cater specifically to market segments that others eschew.

- In contrast, there is no functioning resale or prepaid market for wired home-internet service. This market failure directly contributes to the digital divide. It not only denies potentially affordable services to people with less income, it also likely exacerbates and replicates in the internet-access market any discrimination at play in the credit system.

    - Incumbent wired-broadband ISPs typically impose credit checks on customers, and require cash deposits for customers to obtain service.

- Due to systemic racial biases in credit-scoring practices, the typical ISP requirement that prospective wired home-internet customers pass a credit check or make a cash deposit before obtaining service disproportionately harms broadband adoption in communities of color. This credit-check practice for wired-home internet is likely a key reason that low-income Hispanics and Blacks adopt it at lower rates than low-income Whites but do not lag in cellular/smartphone adoption.

There Are Small but Statistically Significant Differences in Broadband Deployment That Perpetuate Digital Divides Based Solely on Race and Ethnicity.

Chronically underserved racial and ethnic communities – in both urban and rural areas – have inferior internet-access options compared to those that Whites have. These observations hold in rural areas even when we account for income differences.

Our analysis of home-internet adoption data thus suggests the possibility of supply-side problems that disproportionately impact communities of color. There are high levels of demand for home-internet services in these communities, but adoption gaps remain even after one accounts for income and other demographic differences.

The first and most obvious question, then, is whether there are differences in broadband deployment that contribute to such digital divides. To answer this question, we examined Federal Communications Commission (FCC) broadband-deployment data in conjunction with U.S. Census demographic data. This rich data set on broadband deployment and demographics, down to the granular level of census blocks and census tracts, enables analysis of broadband deployment and potential competition – and, in turn, analysis of how service and competition levels differ in locations inhabited by people in different racial and ethnic groups.

People of Color Have Fewer Choices for Broadband Providers at Every Speed; They Are More Likely to Live in an Unserved or Monopoly Area; and They Are Less Likely to Have Access to the Latest-Generation Broadband Technologies.

- There are small but statistically significant differences in the average number of wired-service providers offering particular speeds in areas inhabited by people of different races and ethnicities.
    - Hispanics, Blacks, American Indians, and Native Hawaiian/Pacific Islanders who reside in urban areas have fewer available choices for wired service at every speed than Whites and Asians do. For example, Whites living in urban census blocks have an average of 2.03 wired ISPs offering service at downstream speeds of 3 Mbps and higher, compared to 1.97 such ISPs for urban Hispanics, 1.98 for urban Blacks, and 1.85 for urban American Indian/Alaska Natives. At 25 Mbps and higher, urban Whites have an average of 1.36 wired ISPs, compared to 1.26 for urban Hispanics, 1.23 for urban Blacks, and 1.2 for urban American Indian/Alaska Natives.
    - A similar gap persists in rural areas. Whites living in a rural census block have on average 1.29 wired ISPs offering service at downstream speeds of 3 Mbps and higher, compared to 1.04 such ISPs for rural Hispanics, 1.22 for rural Blacks, and 0.78 for rural American Indian/Alaska Natives. At 25 Mbps and higher, rural Whites have an average of 0.71 wired ISPs, compared to 0.57 such ISPs for rural Hispanics, 0.66 for rural Blacks, and just 0.38 for rural American Indian/Alaska Natives.
- These same underserved racial and ethnic groups are more likely than Whites to have just one wired-internet provider available to them or no wired options at all. This gap is particularly significant in rural areas.
    - Hispanics, Blacks and Native Americans/Alaska Natives in urban areas are more likely than members of other racial/ethnic groups to have no wired provider available at a particular speed.

- The unserved problem is particularly acute for members of these same racial/ethnic groups living in rural areas.

    - While 19.7 percent of the rural White population has no available wired provider at downstream speeds of just 3 Mbps or higher, 32.3 percent of rural Hispanics, 21.8 percent of rural Blacks and 43.2 percent of rural American Indian/Alaska Natives are completely unserved by any wired ISP even at that relatively low speed.

    - At downstream speeds of 25 Mbps and higher, 40.3 percent of the rural White population is unserved by a wired provider, compared to 52.1 percent of the rural Hispanic population, 44.6 percent of the rural Black population, and 67.1 percent of the rural American Indian/Alaska Native population.

- Hispanics, Blacks and Native Americans/Alaska Natives are also more likely than Whites to live in a wired monopoly area.

    - For example, 87.9 percent of Whites in urban areas have two or more wired ISPs offering 3 Mbps and higher downstream speeds. Only 85.6 percent of urban Hispanics, 86.3 percent of urban Blacks, and 78.5 percent of urban American Indian/Alaska Natives are served by two or more such providers. At the 25 Mbps downstream threshold, 36.5 percent of urban Whites have two or more wired ISPs, compared to 28.8 percent of urban Hispanics, 31.7 percent of urban Blacks, and 28.1 percent of American Indian/Alaska Natives residing in urban areas.

    - The monopoly problem is once again disproportionately larger for members of these same racial/ethnic groups in rural areas. While 43.3 percent of the rural White population has two or more wired providers at downstream speeds of 3 Mbps and higher, only 32.9 percent of rural Hispanics, 40 percent of rural Blacks and an exceedingly low 18.5 percent of rural American Indian/Alaska Natives have two or more such providers. At downstream speeds of 25 Mbps and higher, 10.8 percent of the rural White population has two or more wired ISPs, compared to 8.4 percent of the rural Hispanic population, 9.9 percent of the rural Black population, and 5.3 percent of the rural American Indian/Alaska Native population.

Areas With a Higher Proportion of People of Color Have Fewer Wired ISPs and Are More Likely to Be Completely Unserved.

- There is a statistically significant relationship between broadband deployment and a census block's proportion of people of color. In both urban and rural areas, the number of wired providers (at ≥3, ≥10, and ≥25 Mbps) decreases as the percentage of a census block's population made up of people of color increases. Conversely, the number of wired providers at these speeds increases as the block's White population increases.

- In both urban and rural areas, the percentage of the population that has no provider (at ≥3, ≥10, and ≥25 Mbps) increases as the percentage of a block's population made up of people of color increases. Conversely, the percentage of the population that is unserved decreases as a block's White-population percentage increases.

- Though the overall population in rural areas is relatively small for these chronically underserved and unserved racial and ethic groups, the deployment gap between areas they inhabit and areas inhabited by higher proportions of Whites is much larger than the gap in urban areas. For example, 63 percent of the people living in rural blocks in which people of color make up 90 percent or more of the total population have no wired provider offering 25 Mbps or higher downstream speeds. But only 39 percent have no

provider at this speed threshold in rural blocks where the population is more than 90 percent White. (In urban areas, this gap persists for these same cohorts, but it's just 4.6 percent versus 3.8 percent).

Higher-Income Areas Have More and Better Broadband Options, but the Income Gap Does Not Fully Explain the Observed Racial/Ethnic Broadband-Deployment Gap in Rural Areas.

- Census Bureau data on median household incomes at the census-tract level (which is two levels higher than the census-block level, in terms of area and population) shows differences in deployment. The higher the median-household income in a census tract, the more likely it is to have: service at every speed level; multiple providers at every speed level; and, in most cases, service of every technology type.

- In urban areas, income differences appear to explain these observed differences in deployment (though the power of our analysis is greatly reduced by the need to aggregate block-level deployment data with tract-level income data). However, we find that in rural areas, after controlling for income and population, the number of wireline ISPs offering downstream speeds of 3 Mbps or higher decreases as the area's non-White population percentage increases. This also holds true for the number of ISPs in rural areas offering 10 Mbps or higher, and those offering 25 Mbps or higher.

Policymakers Must Ensure Basic Access While Closing Advanced-Service Adoption and Deployment Gaps.

- Effective public-policy choices of the past – such as anti-redlining franchising rules and universal-telephone service supports – have resulted in widespread basic broadband-infrastructure availability. However, the data suggest a small but significant problem in deployment that is mostly, but not completely, related to income differences.

- All of this once again suggests that structural factors may be at play. First and foremost, it's certain that economic inequality impacts ISPs' deployment decisions. Higher-income areas are more profitable to serve. But the same structural factors that impact adoption by people of different races and ethnicities could also impact deployment. For example, housing discrimination could create clusters of populations that are more likely to be unserved or underserved, suggesting not just that internet access providers choose to serve more lucrative areas but explaining why some areas are less lucrative.

- Though most of these differences in deployment based on an area's racial and ethnic makeup are small, they are significant enough to exacerbate the digital divide. If people of color on average have fewer available ISPs, and are more likely to live in a monopoly area, this lower level of service and competition could lead to higher prices – both initially and after any promotional prices have expired. Higher prices depress demand in these areas, and ultimately contribute to gaps in broadband adoption.

Efforts to Reduce the Price of Home-Internet Access and Boost Equitable Participation Would Greatly Improve Adoption by People of Color.

People of Color Without Home-Internet Service Are More Likely to Care About Its Cost.

- While the majority of home internet non-adopters cite "not interested" or "don't need it" when responding to Census Bureau questions about why they do not subscribe, a large number of non-users cite price and other reasons related to affordability and value.

- Black and Hispanic households without home internet are far more likely to cite affordability and far less likely to cite "don't want"/"don't need" than are White households without access. For example, 39 percent of non-internet Hispanic households and 35 percent of non-internet Black households cite "can't

afford it" as a reason for not subscribing, compared to just 21 percent of White households without internet.

- This racial/ethnic gap in affordability concerns is also seen among low-income populations. While 44 percent of low-income Hispanic households without internet and 41 percent of low-income Black households without internet cite "can't afford it" as a reason for not subscribing, only 29 percent of low-income White households cite that reason for not adopting home internet.

People of Color Without Home-Internet Service Are More Likely Than White Households to Say They Would Subscribe at a Lower Price.

- The Census Bureau asks home-internet non-adopters if they would buy service offered at a lower price. Nearly a quarter (23 percent) of non-adopting households say they would subscribe at a lower price, a result that did not vary significantly between high-income and low-income non-adopters.

  - Despite the similar willingness across income strata to subscribe at lower prices, there is a large difference between people of different races or ethnicities. While only 18 percent of non-adopting White households say they would subscribe at a lower price, 33 percent of non-adopting Hispanic households and 28 percent of non-adopting Black households say they would.

  - This race/ethnicity difference in willingness to adopt home internet at a lower price is also seen among the poorest Americans. Only 16 percent of low-income non-adopting White households say they would subscribe to home internet at a lower price, compared to 27 percent of low-income Black and 26 percent of low-income Hispanic non-adopting households.

People of Color Without Home-Internet Service Are More Likely to Compensate by Going Online Elsewhere.

- To better understand the digital divide, it's important to examine whether and how home-internet non-users go online outside the home, via some route other than a wired or wireless subscription at the household. It's also essential to know the reasons they do not subscribe at home. People with budget constraints may forgo internet use at home but still connect at other locations. They presumably are familiar with the internet and ready to use it, but don't subscribe due to high cost either exceeding their ability to pay or their willingness to pay based on their perceived value from subscribing. Where and how they connect is also important. An office worker without children may fulfill most of their online needs at work, but a child without home internet can't necessarily use the library as a full replacement.

- There are only small differences in internet use elsewhere across income strata for home-internet non-adopters. But Black and Hispanic non-adopting households are more likely to have a member using the internet via some access method other than a home subscription. While only 20 percent of White households without home internet have a household member or members using the internet elsewhere, this figure is 26 percent for non-adopting Hispanic and 27 percent for non-adopting Black households.

  - This difference also holds for home-internet non-subscribers with family incomes below $20,000. In that income category, 16 percent of non-adopting White households have a member who uses the internet elsewhere. This is far below the level for Hispanic households (24 percent) and Black households (25 percent) in that same income category without home internet.

- Because Hispanic and Black people who do not subscribe to home internet are more likely to go online outside the household than White non-subscribers are, the size of the digital divide closes slightly when we consider such use. There is a gap of 10 percentage points between White and Hispanic households, and a gap of 14 percentage points between White and Black households, for persons with home-internet

access. That closes to 6 points for Hispanic people and 8 points for Black people using the internet anywhere, via any access method.

- The data suggest that Hispanics and Blacks, especially those with lower incomes, are particularly concerned about the cost of internet access. Hispanic and Black people partially compensate for the lack of home-internet access by using the internet outside of the home, more so than Whites do. Public institutions such as schools and libraries are an important access method, particularly because people of color are less likely to use the internet at work.

- This indicates that use elsewhere is an important access method for people priced out of the home-internet market, and suggests that these home non-adopters are "internet-ready." All of this information makes it clear that reducing the price of home internet – and increasing people's ability to participate equitably in the market for it – will especially improve home-internet adoption in communities of color.

People of Color Who Use the Internet Are Particularly Concerned About the Cost of Service.

Home-Internet Users View Reliability, Speed and Price as Most Important, But Low-Income Users Focus on Price.

- Reliability, speed and affordability are by far the most important factors internet-adopting households consider when purchasing their service (listed by 38 percent, 29 percent, and 26 percent of Census respondents, respectively). But each demographic group weighs these factors differently.

    - Compared to high-income home-internet users, low-income users place more emphasis on affordability, mobility, and data caps, and put less emphasis on reliability and speed. For example, 36 percent of households in the bottom-income quintile with home internet listed affordability as their top concern, but only 17 percent of such households in the top-income quintile did.

    - Hispanic and Black households with home internet rank service affordability as their top concern (at 31 and 32 percent, respectively), compared to only 25 percent of White internet-adopting households. This is true for both wired home-internet users and those who rely solely on mobile access.

    - Low-income Hispanic and Black home-internet households are more concerned with service affordability than are low-income White households (though all low-income home-internet households cited affordability as the top factor). Forty percent of low-income Hispanic and Black home-internet households cited affordability as the most important factor regarding their service, compared to 34 percent of low-income White home internet households.

People of Color Are More Likely to Watch Video, Stream Music and Search for Jobs Online.

- More than two-thirds of internet users ages 15 and above, including those who use the internet via a home subscription or elsewhere, watch online video. However, low-income internet users are less likely to do so (63 percent of those in the bottom-income quintile versus 74 percent in the top-income quintile).

    - Despite this online video-consumption gap based on income, Hispanic and Black internet users are more likely than White internet users to watch online video (73 percent of Hispanic users, 67 percent of Black users and 65 percent of White users).

    - Low-income Black and Hispanic internet users are also more likely to watch online video than are low-income White internet users. Sixty-eight percent of low-income Hispanic internet users and 64

percent of low-income Black internet users do, versus 60 percent of low-income White internet users.

- Low-income internet users ages 15 and above are less likely than higher-income users to stream or download audio (50 percent of those in the bottom-income quintile versus 63 percent in the top quintile).

    - Despite this online streaming-audio gap based on income, Hispanic and Black internet users are more likely than White internet users to stream or download audio (60 percent of Hispanic users, 57 percent of Black users and 52 percent of White users do).

    - Low-income Black and Hispanic internet users are more likely to stream/download audio than are low-income White internet users. Fifty-seven percent of low-income Hispanic users and 55 percent of low-income Black users do, versus 44 percent of low-income White users.

- Low-income internet users ages 15 and above are more likely than high-income users to search for a job via the internet (35 percent of those in the bottom-income quintile versus 24 percent in the top quintile).

    - Hispanic and Black internet users are more likely than White internet users to use the internet for job searches (31 percent of Hispanic users, 36 percent of Black users and 25 percent of White users).

    - Among low-income internet users, Blacks (41 percent) are more likely than Whites (31 percent) to use the internet to search for jobs.

Structural Discrimination Exacerbates Market Failures, Adding More Barriers to Broadband Adoption in Communities of Color.

The digital divide persists despite years of discussion and some changes in public policy. It does so at a time when internet access is a necessity for full participation in American society. All evidence suggests that the high price of internet access (particularly wired-internet access) is the primary reason for the digital divide. And due to rampant income inequality, high prices disproportionately impact communities of color.

But the data also show racial/ethnic internet-adoption gaps even after accounting for income differences. Low-income Whites have a significantly higher rate of home-internet adoption than non-Whites with similarly low incomes. This suggests that other structural factors contribute to the digital divide.

These structural barriers to full participation are myriad, with some factors closer to the internet-access market than others. For example, consider two populations of equal income in two different neighborhoods, one primarily White and one primarily Black. Discriminatory credit and lending practices can result in credit scores for low-income persons of color that overstate their true risk when compared to Whites with the same income. When this structural difference in credit scores is combined with the widespread practice of wired ISPs requiring credit checks for potential subscribers, it can result in lower adoption levels in communities of color.

The issue of how structural racism impacts the efficiency of consumer markets is so complex that it can paralyze policymakers. The FCC is not equipped to tackle all of the problems pertaining to income inequality, employment discrimination or credit discrimination, even if each of these issues impacts the agency's mission to make communications connections available to everyone. But the FCC *can* address the impact of structural racism on the digital divide by examining how these structural problems distort the internet-access market – and then working to prevent those impacts. It's within the agency's power to work toward remedies for internet-access market failures when demand and supply do not meet in an efficient manner.

Policy Recommendations

Policies That Increase Competition and Improve Overall Functioning of the Home-Internet Market Can Reduce the Impact of Structural Factors That Contribute to the Digital Divide.

Dealing directly with all of the consequences of structural discrimination must be a top priority for policymakers and elected representatives. Agencies such as the FCC can better examine how they might correct market failures that exacerbate the direct and indirect impacts of such structural discrimination. In the case of telecommunications services, inadequate choice and competition among providers is one of the factors that results in entire market segments and demographic groups being underserved or unserved at a reasonable price.

Interventions both small and large can combine to help eradicate the digital divide. Our analysis indicates the following top goals for the FCC and other policymakers.

- Correct the wired home-internet market failure: Foster the creation of resold and prepaid wired home-internet services and stop market-power abuses.

  - The U.S. high-speed wired-broadband market is, at best, a weak duopoly. At higher speeds, it's a cable company-dominated monopoly for a substantial majority of the people in America. One hundred years of experience suggests that new facilities-based entry will not be widespread, and that natural monopoly economics will always dominate. The FCC must acknowledge the lack of wired home-internet competition and the existence of ISP market power, and make safeguarding against monopoly abuses a top priority.

  - This monopoly impacts not only the wired home-internet market, but the home-communications market more generally – especially for multichannel and online video. Because of video's importance in people's overall communications purchases, the FCC must stop vertically integrated ISPs from using their market power in broadband to impact the video market. This action could take many forms. For example, while some home-internet providers offer broadband on a standalone basis, others will not sell it unless the customer purchases other services. And while most cable ISPs sell standalone broadband, they often price it in a manner that incentivizes customers to bundle it with the providers' video services. This happens only because cable ISPs have market power in the home-internet market, and are able to cross-subsidize their video businesses with the inflated profits earned from their monopoly-broadband services. This cross-subsidization harms both internet adoption and video-market competition, and the FCC must use its authority under the Communications Act to ensure that standalone broadband is available to all at a fair price.

  - Public-policy efforts to encourage facilities-based wired-home internet entry and competition are welcome and should continue, but the FCC and other policymakers must accept that the vast majority of Americans will continue to face a monopoly or duopoly for wired broadband. Therefore, the FCC must take steps to encourage the development of a robust resale market for wired home-internet services. Resale by companies like Cricket and Tracfone developed in the cellular market absent regulatory intervention, in part because of the higher number of facilities-based carriers that had incentives to sell wholesale capacity instead of letting it lie fallow. The existence of a facilities-based wired-internet market that is at best a duopoly does not create the same incentives to resell, even as the market matures and DSL carriers lose customer share to cable ISPs. Thus, while the FCC should examine all methods for encouraging the development of robust resale of home-internet access, it will likely need a regulatory solution to this most basic of market failures.

- The FCC should take action to encourage the development of a robust prepaid wired home-internet service market. One of the primary benefits of creating a robust resale market would be the likely development of a prepaid market. While ISPs may want to hedge against the costs resulting from customer non-payment by requiring credit checks and cash deposits, many customers who are not a material risk are denied services because of their inability to pass a credit check or offer a cash deposit. Resellers in the wireless market have been more than willing to shoulder this risk, and it has resulted in higher earnings for the facilities-based providers as well as more equitable adoption opportunities for those who might otherwise be shut out entirely due to poor credit. As it takes steps to correct the failures in the wired home-internet resale market, the FCC must ensure that facilities-based wired ISPs offer prepaid services on just and reasonable terms.

- The FCC must ensure that ISPs are not using credit scores to discriminate unreasonably on terms and services they offer; it must also ensure that ISPS are not using credit checks to generate revenue. While the practice does not appear to be widespread, one cable company (Cable One) recently indicated that it might offer customers with lower credit scores a lower quality of customer care. The Washington State attorney general recently sued another cable company (Comcast) for many customer-service failings, including obtaining deposits from customers with high credit scores, improperly running credit checks on customers who paid deposits to avoid credit checks, and improperly collecting deposits from customers who were not required to pay deposits. The Communications Act has specific requirements that telecommunications services such as broadband internet access be offered on a reasonable and nondiscriminatory basis, and the FCC must be vigilant in enforcing these requirements.

- Correct the wired home-internet market failure: Where possible, encourage new fiber-optic services and overbuilding, while ensuring the benefits of new deployment are available to more than people living in wealthy areas.

  - The vast majority of the United States may never see fiber or cable overbuilding, no matter what basket of incentives local, state and federal lawmakers offer (or the supposed "red tape" regulators manage to cut). See, for example, recent news regarding Google Fiber's pause in deployment. However, any such efforts to promote overbuilding can bring new competition to select areas. Policymakers must ensure that overbuilding does not benefit only the privileged and wealthy.

    - Though there is a small but statistically significant gap in broadband deployment to communities of color, local franchising rules against redlining have ensured that a basic level of service is available to almost the entirety of the urban population. Local and state regulatory agencies must continue to prohibit redlining and encourage widespread and equitable deployment.

    - Because the racial/ethnic broadband-deployment gap is largest in rural areas, the FCC and other agencies that oversee universal service funds must ensure that this money is not used merely to bring broadband to the richest rural areas, or solely to predominantly White rural areas.

    - State and federal legislators should encourage equitable overbuilding through tax incentives and other incentives that encourage new entrants to deploy services across diverse neighborhoods.

- Close the functionality gap between wired and wireless home-internet services by promoting greater competition as the wireless market evolves to higher-capacity fifth-generation technologies.

    - Low-income communities and communities of color are disproportionately more reliant on mobile-internet services. This has led to a third distinct phase in the evolving digital divide: Users in these communities typically have basic access, but it's inferior to the options in other communities. This is similar to the second phase divide between dial-up and broadband access. In this manner, the digital divide may shift over time without ever closing.

    - The impacts of this divide are myriad, given the limitations of mobile internet – particularly when it comes to children's use for schoolwork. There is ample reason to expect that wired providers will always dominate the home-internet market, simply because coaxial and fiber-optic cables will offer far-higher quality of service and far-greater capacity than wireless technologies for the foreseeable future. However, fifth-generation wireless technologies ("5G") promise to close some of this functionality gap, particularly in urban areas where network densities are higher. Thus, the FCC's efforts to promote 5G development should ensure that ample spectrum is not only allocated, but allocated equitably among carriers, and between licensed and unlicensed use. Robust 5G wireless competition and greater opportunity for nonprofit ISPs are critical components to closing the digital divide in the face of a monopoly wired-ISP market.

    - The FCC must protect the resale market in the face of potential wireless-industry consolidation. In recent years, the wireless market has undergone consolidation, with national facilities-based providers purchasing resellers and smaller prepaid carriers (*e.g.*, Sprint's acquisition of Virgin Mobile, AT&T's purchase of Cricket Mobile and T-Mobile's purchase of MetroPCS). Further consolidation – particularly involving any of the four national facilities-based carriers – would likely result in disproportionate harm to prepaid wireless users. The FCC should therefore be vigilant in its efforts to promote wireless competition and should oppose any further national consolidation.

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Important Notes on Data Sources and Methodology

This report is based on two primary raw sources of data: the U.S. Census Bureau's July 2015 Current Population Survey ("July 2015 CPS") Computer and Internet Use Supplement,[1] and the FCC's Form 477 Broadband Deployment Data.[2] These are rich sources of raw information concerning broadband adoption and deployment, though each has minor issues that necessitate caveats as to how the data are aggregated, and how the results are interpreted.

Description of Data Sources – U.S. Census Bureau Current Population Survey

The Computer and Internet Use Supplement ("Supplement") is a large-scale survey that the Census Bureau has administered 13 times between 1994 and 2015. The broader CPS collects data on individual and household traits, including age, sex, race, Hispanic origin, family income, education, household size and composition, employment status and other labor-force traits. The Supplement collects information from all eligible CPS household members age 3 and above. The specific questions the Supplement asks have changed over time, but the survey generally asks questions concerning an individual's and their household's computer and internet use at home and outside of the home in the prior year and includes questions posed to home-internet non-users. A subset of home-internet adopters is also asked additional questions about their internet use.[3]

The Supplement is a survey with a very large sample size of approximately 53,000 households and 124,000 persons age 3 and older. This sample size enables statistically meaningful analysis across demographic groups of interest.[4] The 2015 Supplement included approximately 86,000 non-Hispanic Whites (hereinafter generally shortened to "Whites," unless specified otherwise or the context requires otherwise); 18,000 Hispanics; 14,000 Blacks; 1,400 American Indian/Alaska Natives; 6,000 Asians; 600 Native Hawaiian/Pacific Islanders; and 2,400 persons of two or more races. The sample size of most of these races/ethnicities is in many instances large enough to allow for meaningful comparisons across races/ethnicities in a variety of population sub-samples. For example, the 2015 Supplement included 10,000 Whites; 4,000 Hispanics; and 4,000 Blacks with family incomes in the bottom quintile.[5]

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[1] *See* "Current Population Survey, July 2015, Computer and Internet Use File: Technical Documentation, CPS-15" (2016) ("July 2015 CPS Technical Documentation"); *see also* Computer and Internet Use Files from prior releases (2003; 2007; 2009; 2010; 2011; 2012; and 2013).

[2] *See* Federal Communications Commission, "Form 477 Broadband Deployment Data – December 2014 (version 2)" (Mar. 16, 2016).

[3] The 2015 Supplement asked an additional 17 questions concerning the types of online activities of internet users (at home or away from home) age 15 and above. The sample size for these additional questions was approximately 42,000 persons, or approximately one third of the larger Supplement sample. These additional questions were presented to approximately 29,000 of the 53,000 "reference persons" or primary householders in the CPS sample.

[4] In figures presented in this report we illustrate 95 percent confidence intervals calculated using successive difference replication standard error values based on replicate weights included in the CPS, and note differences that are statistically significant at $p<0.05$ (or at $p<0.1$ in some instances). *See* Minnesota Population Center, University of Minnesota, "Replicate Weights in the Current Population Survey" (last visited Nov. 30, 2016); United States Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau, "Estimating Current Population Survey (CPS) Household-level Supplement Variances Using Replicate Weights" (2012); United States Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau, "Estimating Current Population Survey (CPS) Person Level Supplement Variances Using Replicate Weights" (2012).

[5] The sample size for persons in the lowest income quintile from other races/ethnicities in the July 2015 CPS is generally too small to allow for meaningful comparisons. The sample sizes for low-income individuals are approximately 500 American Indian/Alaska Natives, 600 Asians, 100 Native Hawaiians, and 400 persons of two or more races).

The Supplement's large sample size and broad range of questions makes it by far the most valuable resource on broadband-adoption trends in the United States. There are several caveats, however, that somewhat limit the data's utility. First, while the Census Bureau has administered the survey periodically since 1994 (and has added useful questions over time), there are considerable gaps in time between some of the surveys. Second, because the questions have changed over time, this limits comparability of certain results across years. The most glaring example of such a change is how the Supplement asks users what type of home-internet technology they use. The July 2015 questionnaire lumped all wireline technology (cable, DSL, fiber) into a single response, while earlier versions allowed respondents to indicate which type of wired technology they used (and whether they used more than one). Third, some other important questions were inexplicably dropped over time, such as those asking users how much they paid for standalone internet service or internet service in a bundle.

Fourth, some of the Supplement's results are puzzling and stand in contrast to other data, though it's unclear whether additional questions could address some of these issues. For example, the Supplement results indicate that the number of households subscribing to (one or more) wired-internet service(s) decreased by 6.75 million from July 2013 to July 2015, a time when the total number of households increased by 2.67 million.[6] This decline in wireline households is very difficult to square with other available data (*e.g.*, FCC data, SEC filings and industry-analyst reports) showing substantial growth in the residential wireline-broadband market during similar time periods, with residential cable-modem lines increasing by approximately 5 million during this two-year period.[7] By all accounts, there is a gap of some 15 to 17 million "missing" wired connections between what the Supplement results indicate and what numerous public and private data sources indicate.[8]

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[6] The July 2013 CPS Supplement indicated 76.9 million householders reporting a wired home internet connection, which had declined to 70.1 million in the July 2015 CPS Supplement.

[7] *See, e.g.*, Ian Olgeirson and Chris Young, "2016 broadband forecast driven by cable gains," *SNL Kagan* (May 9, 2016) (showing year-end 2013 to year-end 2015 growth in residential cable internet subscribers of 6.1 million, which equates to 5.25 million additional cable internet subscribers from mid-2013 to mid-2015, assuming linear growth during these years). Cable of course accounts for the substantial majority of reported growth in the U.S. wireline broadband market, as telcos continue to lose DSL customers, and those losses are not fully offset by growth in telco fiber customers. *See, e.g.*, Leichtman Research Group, "About 295,000 Add Broadband in The Second Quarter of 2013," (Aug. 20, 2013); Leichtman Research Group, "About 360,000 Added Broadband in 2Q 2015," (Aug. 18, 2015) (showing that the growth in the number of wired connections of the top cable and telcos was more than 6.1 million between mid-2013 and mid-2015, though this figure includes business lines). The FCC's most recent public data release indicates that from the end of June 2013 to the end of December 2014, the number of residential wired connections (Either Asymmetric DSL ("ADSL"), Symmetric DSL ("SDSL"), cable modem, fiber-to-the-premise, and other wireline technologies) increased by 3.36 million lines, which if linear would equate to 4.48 million new residential lines added from mid-2013 to mid-2015.

[8] *See id.* While none of these sources allows for apples-to-apples comparisons with the Supplement data, they each show substantial growth as well as far larger absolute subscriber and/or line counts than the CPS shows. For example, the SNL Kagan data indicates that the number of residential broadband lines increased from 85 million to 91.8 million during the two-year period between mid-2013 to mid-2015 (assuming linear annual growth). The SNL Kagan data is for residential "subscribers," but does include wireless-only households, fixed wireless households and satellite households. However, these non-wired subscribers accounted for just 4 percent of the total residential subscriber base, which equates to 6.5 million new residential wired lines from mid-2013 to mid-2015, or nearly 88 million residential wired subscribers as of mid-2015. Leichtman's data indicates that the total U.S. wired market grew from 88.5 million lines in mid-2013 to 92 million in mid-2015 (normalized results accounting for Leichtman's analysis suggest that their reported totals represent 94 percent of the entire U.S. market). This data includes some business lines, but assuming 93 percent of the total are residential (figure derived from SNL Kagan article cited above), this would equate to a change from 82 million to 86 million residential lines during the two-year period of interest. The FCC's most recent data from year-end 2014 showed growth of 3.36 million wired lines during the 18 months following June 30, 2013, to a total of 86.5 million residential connections. If this growth were assumed to be linear, it would equate to 87.4 million residential connections as of mid-2015.

There's simply no good explanation for why the CPS total for wired connections is substantially lower than the data from other sources on wired connections. One possibility is that CPS produces a number of households connected to the internet via wired technology, while some of the other sources are reporting the number of lines. Thus, if a sizable number of households subscribe to more than one wired technology, this could explain the differences. However, while the recent changes to the CPS questionnaire make it more difficult to account for multiple wired-line households, there's simply no plausible reason to believe that such households account for the 15–17 million missing lines.[9] It's clear that something changed between 2013 and 2015, but it's not clear what changed.[10]

Note on Differences Between Results from Current Population Survey and Pew Research Poll

Finally, it's important to note the differences between the July 2015 CPS Supplement results and those reported by the Pew Research Center, one of the most-cited sources of U.S. internet-adoption data.[11] The primary difference in the two surveys is the sample universe: Pew surveyed over 6,000 adults (*i.e.*, persons age 18 and older), while the July 2015 CPS Supplement's sample comprises nearly 150,000 persons age 3 and above. Unless otherwise noted, in this report we present results from the CPS for households or all persons age 3 and above (though below we present CPS results for adults to compare to Pew's results). The other major difference is that the questions Pew and the Census Bureau ask differ in important ways, which may explain why two surveys administered at nearly the same time diverged in some instances.[12]

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[9] The 2015 Supplement lumps subscribers to cable modem, DSL, and fiber optic service into one single answer, while the 2013 Supplement allowed respondents to indicate each separately. Our analysis indicates that approximately 4 million households in 2013 reported subscribing to 2 or more non-mobile internet services at home, compared to just 2 million in 2015. We believe this decline is due in part to the 2015 Supplement combining three technologies into one single answer: that is, a small proportion of the total number of respondents select more than one type of home internet technology, even though they don't actually have multiple non-mobile services. The reduction of possible non-mobile responses from six to four also may have reduced the prevalence of reporting multiple non-mobile lines of access. While it's surely possible that some households subscribe to multiple non-mobile internet services, the Supplement indicates that the incidence of reporting multiple non-mobile lines is uniform across all income brackets. (For example, in 2013, 3.2 percent of households with annual family incomes between $15,000 and $20,000 reported multiple non-mobile internet services at home, compared to 3.4 percent of households with incomes between $100,000 and $150,000). This strongly suggests that the level of over-reporting inflates this total well above what it's in reality.

[10] The gap between public data and CPS data in 2013 was much lower: approximately 5.5 million missing lines. (There was a 6.3 million gap between FCC and CPS, 4.7 million gap between SNL Kagan and CPS, and 5.4 million gap between Leichtman and CPS). While the number of multiple non-mobile internet line households was higher in 2013 (approximately 4 million), that doesn't explain the new gap of 15 to 17 million "missing" wired lines; and as explained in the footnote immediately above, there's ample reason to believe this figure of 4 million households with multiple non-mobile internet lines was vastly overstated.

[11] John B. Horrigan and Maeve Duggan, "Home Broadband 2015" *Pew Research Center* (Dec. 21, 2015).

[12] The Supplement asks the following about all persons age 3 and above: "I am going to read a list of ways that people access the Internet from their homes. Keep in mind that some people connect from home in more than one way. At home, (do you/does anyone in this household) access the Internet using: [Mobile Internet service or a data plan for a cellular phone, smartphone, tablet, laptop, or other device?/High-speed Internet service installed at home, such as cable, DSL, or fiber-optic service?/Satellite Internet service?/Dial-up service?/Some other service?]" By contrast, Pew asked adults the following series of questions: "Do you currently subscribe to internet service at home?/Do you subscribe to dial-up internet service at home...? Or do you subscribe to a higher-speed broadband service such as DSL, cable, or fiber optic service?" Pew then separately asked respondents who had a cellphone, "Some cellphones are called 'smartphones' because of certain features they have. Is your cellphone a smartphone such as an iPhone, Android, Blackberry or Windows phone, or are you not sure?" It then asked smartphone owners who previously indicated they did not have broadband at home, "You said that you [IF SMART1=YES, SMARTPHONE, INSERT: have a smartphone, but] do not have a high-speed internet connection at home. Did you EVER at some point in the past have a broadband internet subscription at home?"

For example, Pew reports that as of mid-2015, 67 percent of adults have broadband at home. This figure excludes those who are mobile-only, however. Pew found that 13 percent of all adults have a smartphone but do not have any wired home-broadband service. These two values combined equate to 80 percent of adults reporting to Pew some form of home-internet access (beyond dial-up). Compare this to the July 2015 CPS Supplement, which found that 76 percent of persons age 18 and above report having some form of home-internet access (beyond dial-up).

With a difference of four percentage points, these two values for all forms of home-internet access (excluding dial-up) are close to each other, though outside the Pew survey's margin of error.[13] They diverge even more when Pew's home "broadband" and smartphone-only results are compared to the comparable metrics from the Supplement. Our analysis of the 2015 Supplement indicates that 15 percent of all adults live in a household where a mobile subscription provides the only internet connection, and 61 percent of adults reside in a household with a non-mobile/non-dial-up internet connection. While the two surveys' findings for mobile-only adults are close, the values for non-mobile/non-dial-up are not. It's possible that these differences are primarily due to the rise of smartphone use and user confusion as to what the surveys are actually asking, along with the potential that some respondents may not understand what services other members of their household purchase. There may be no single method that is best suited to asking people what type of internet service they have at home, though our preference is for greater specificity, which the Supplement's four answer prompts offer.

Pew's results for racial/ethnic groups also differ from those in the Supplement. For example, Pew reports home broadband-adoption levels of 72 percent for White adults, 54 percent for African American adults and 50 percent for Hispanic adults. However, the Supplement indicates corresponding non-mobile/non-dial-up home-internet adoption levels of 65.3 percent for White adults, 48.5 percent for Black adults, and 49.9 percent for Hispanic adults. While the difference in the Black/African American result might be due to the smaller sample size in the Pew study (over 700 respondents, compared to 14,000 in the 2015 Supplement), the largest difference is found in the White population. Given that Pew surveyed more than 4,500 White adults, this divergence in results is perplexing.

Finally, the July 2015 CPS and Pew results for the change in home-internet use between mid-2013 and mid-2015 also differ in important ways. If we combine Pew's home-broadband and smartphone-only result, we see an increase from 78 percent of adults with some form of non-dial-up home-internet access in 2013 to 80 percent of adults in 2015. The Supplement shows 76.8 percent of adults having some form of non-dial-up home-internet access in 2013, declining slightly to 76.2 percent of adults in 2015.[14]

This divergence in the observed two-year change is also seen in the race/ethnicity results. In 2013, Pew's combined results for people with either wired broadband or smartphone-only access were 80 percent of White adults, 72 percent of Hispanic adults and 72 percent of African American adults. In 2015, these values in the Pew survey were 82 percent, 73 percent and 73 percent, respectively. The 2013 Supplement found that for adults, home-internet adoption levels (excluding dial-up) were 81 percent for Whites, 66 percent for Hispanics and 65 percent for Blacks. The values from the July 2015 CPS Supplement were 79 percent, 69 percent and 66 percent, respectively. Thus, not only do the absolute values of the results differ

[13] Pew's results are based on individual surveys and a combination of these surveys. Its home broadband survey from July 2015 has a sampling error of +/- 2.5 percentage points (at 95 percent confidence level), while the combined sample (which includes smartphone-only results) has a sampling error of +/- 1.3 percentage points. The error of the Supplement studies are generally below one percentage point, due to the very large sample size.

[14] The Supplement's overall decline in non-mobile/non-dial-up home internet use for adults was 8.5 percentage points, compared to a 3 percentage point decline found by Pew.

between the Pew and CPS surveys, but the direction of change over time does as well – for the adult population as a whole, and for the White population specifically.[15]

The differences between the Pew and CPS survey results illustrate the research challenges in this area. Each source has its strengths and weaknesses. In this report, we rely largely on CPS Supplement data given its far larger sample size and its richer demographic data and other sources of information. However, whether the data comes from Pew or from the CPS, it's clear there is a very large gap in broadband use between Whites on one side of the divide and people of different races and ethnicities on the other. It's also clear that people of color are increasingly reliant on mobile broadband as their only mode of internet access. Understanding the reasons for these differences, and how public policy can eradicate such digital divides, is the aim of this report.

Description of Data Sources – FCC Form 477 Broadband Deployment Data

As part of the American Recovery and Reinvestment Act, the National Telecommunications and Information Administration ("NTIA") created the "State Broadband Initiative" and began collecting (via state-designated collectors) semiannual broadband-deployment data from every ISP at the census-block level. The NTIA published this data in aggregated and raw form as "The National Broadband Map." It transferred administration of this data collection to the FCC in 2014. The FCC subsequently published block-level deployment data at the end of 2014 and in mid-2015. This report uses the FCC's revised end-of-2014 data.

The FCC's raw data consist of each ISP's reporting on Form 477 at the block level. For each ISP in a block, there are entries consisting in part of the ISP's name, its holding-company's name, the ultimate parent-company's name, the types of technology it offers in a given block, the maximum downstream and upstream speeds, and whether the service is available to businesses or residential users.

This raw Form 477 data required substantial attention before it was fit for analysis. Small errors include many holding/parent company typographic errors. Larger issues include several instances of over-reporting. For example, a tiny block in Iowa had 17 wired ISPs listed as offering service. We examined this block and these ISPs in the NTIA's June 2014 release and found these ISPs correctly reported there (*i.e.*, each ISP offered service in the state, but in non-overlapping geographic areas; whereas in the FCC's data, these ISPs that are actually located hundreds of miles apart are listed as serving the same small area of one town).

The most problematic aspect of the FCC's Form 477 data is the apparent issue of competitive local exchange carrier ("CLEC") and wireless internet service provider ("WISP") over-reporting. According to the FCC's raw data, some of the largest ISPs in the United States in terms of blocks served are CLECs and WISPs. But closer examination of these carriers suggests that certain CLECs list all areas where they could offer T-1 quality speeds (to businesses or consumers), not where they actually do so. Similarly, it appears that some WISPs list all blocks in areas they could theoretically serve. Comparing the subscriber totals that incumbent ISPs report against FCC Form 477's aggregated subscriber totals strongly suggests that deployment by these CLEC and WISPs is vastly overstated in the FCC's raw data. While we did not remove any data prior to our analysis, we addressed the issue of over-reporting by restricting our deployment analysis to wired ISPs offering services at or above 3 megabits per second ("Mbps"). This removes WISPs from the analysis and greatly reduces the CLEC over-reporting problem.

[15] Pew also indicated that wired home broadband adoption levels declined by 2 percentage points for White adults, 6 percentage points for Hispanic adults, and 8 percentage points for African American adults from mid-2013 to mid-2015. The Supplement showed similar declines to Pew in non-mobile/non-dial-up home internet use between 2013 and 2015 for Hispanic adults and Black adults (8.5 percentage point and 7.6 percentage point declines respectively) – but a much larger decline for Whites than Pew showed. The Supplement's decline for White adults was in line with that seen in the Supplement for non-White adults (8.4 percentage points).

PART I

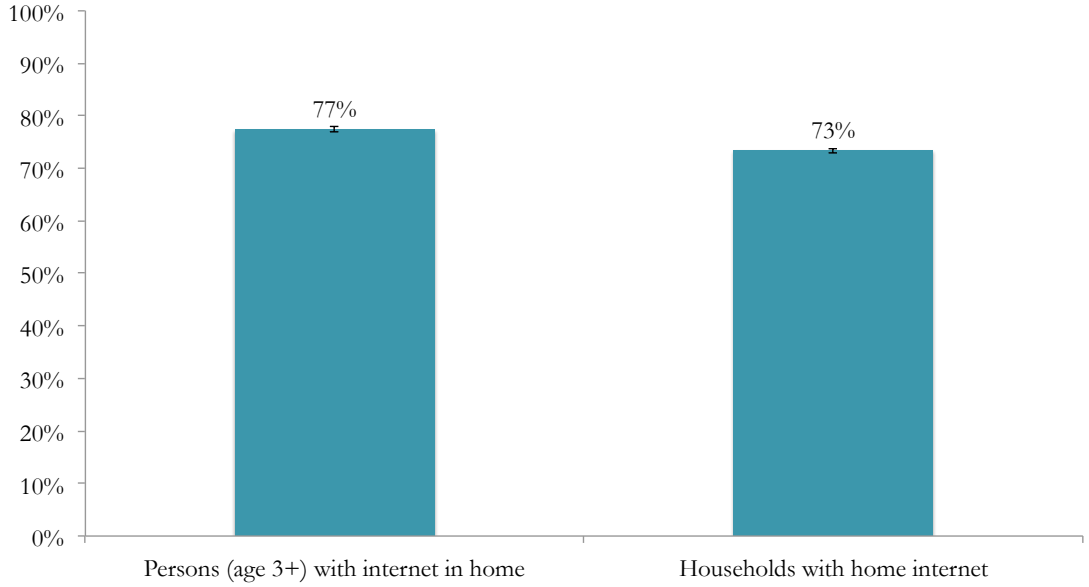
THE OVERALL STATE OF HOME-INTERNET ADOPTION IN AMERICA

Home-Internet Adoption Is High, but It's Still Well Below the Adoption Rates and Levels for Other Technologies, and It Has Not Grown in Recent Years.

As of mid-2015, 77 percent of people in America age 3 or older live in a home with internet access (*see* Figure 1). By contrast, as of this same time and for that same age group, 97 percent of individuals live in a home with telephone access and 84 percent live in a home with cellphone access.[16]

This internet adoption figure for individuals is slightly higher than the figure for households because multiple individuals may live at a single connected residence, and the distribution of the population within households may differ for the internet-connected and non-connected.[17] As of mid-2015, 73 percent of U.S. households have home internet connections, while nearly 80 percent of occupied U.S. housing units subscribe to a traditional multichannel pay-TV service.[18]

Figure 1:
Home-Internet Adoption by Households and Persons age 3 and Above (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

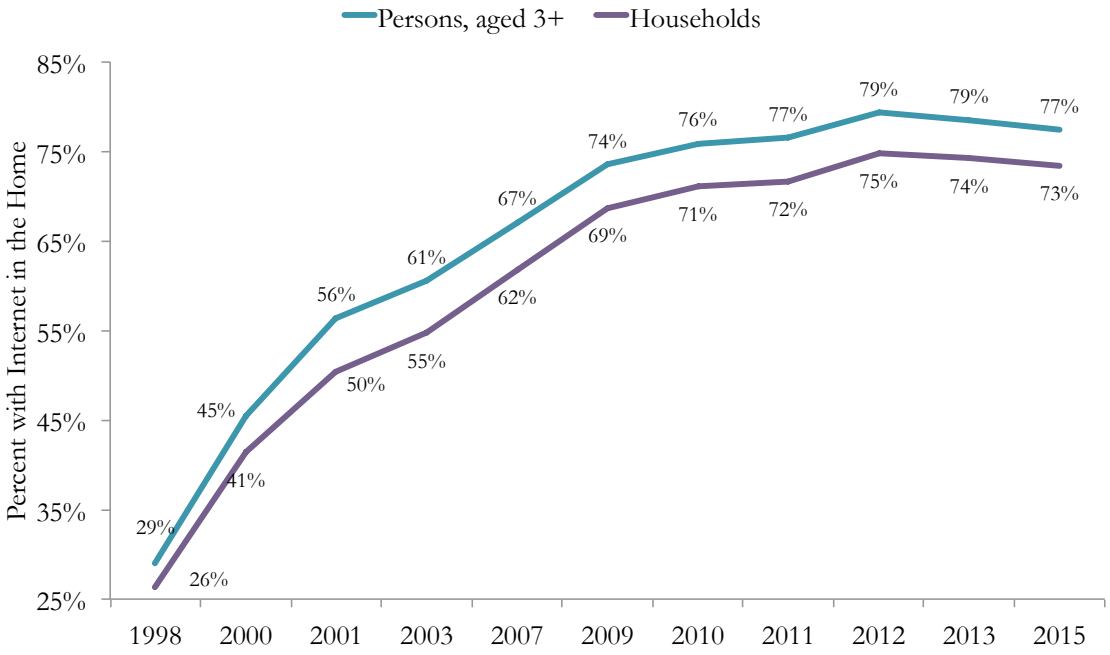
[16] Values for telephone and cellphone adoption calculated from July 2015 CPS.

[17] Throughout this report we will use the terms "household," "householder," and "home" interchangeably when referring to results of questions posed to "householders" by the CPS. As the Census Bureau explains, "the householder refers to the person (or one of the persons) in whose name the housing unit's owned or rented (maintained) or, if there is no such person, any adult member, excluding roomers, boarders, or paid employees. If the house is owned or rented jointly by a married couple, the householder may be either the husband or the wife." Thus, results presented at the household-level will differ from results presented at the population level, because some households have more individuals residing in them than others, and there are differences in household composition across different demographics. *See* July 2015 CPS Technical Documentation, *supra* note 1.

[18] *See* Ian Olgeirson, "Subscribers pressured in US multichannel video forecast to 2020," *SNL Kagan* (June 21, 2016) (showing that at the end of 2014, 80 percent of occupied residential housing units subscribed to multichannel video service, a value that had dropped to 78.5 percent by the end of 2015).

This level of home-internet adoption – as measured by the July 2015 CPS – has actually declined in recent years, from 75 percent of households in 2012 to this 73 percent figure in 2015 (*see* Figure 2).

Figure 2:
Home-Internet Adoption by Households and Persons (1998–2015)



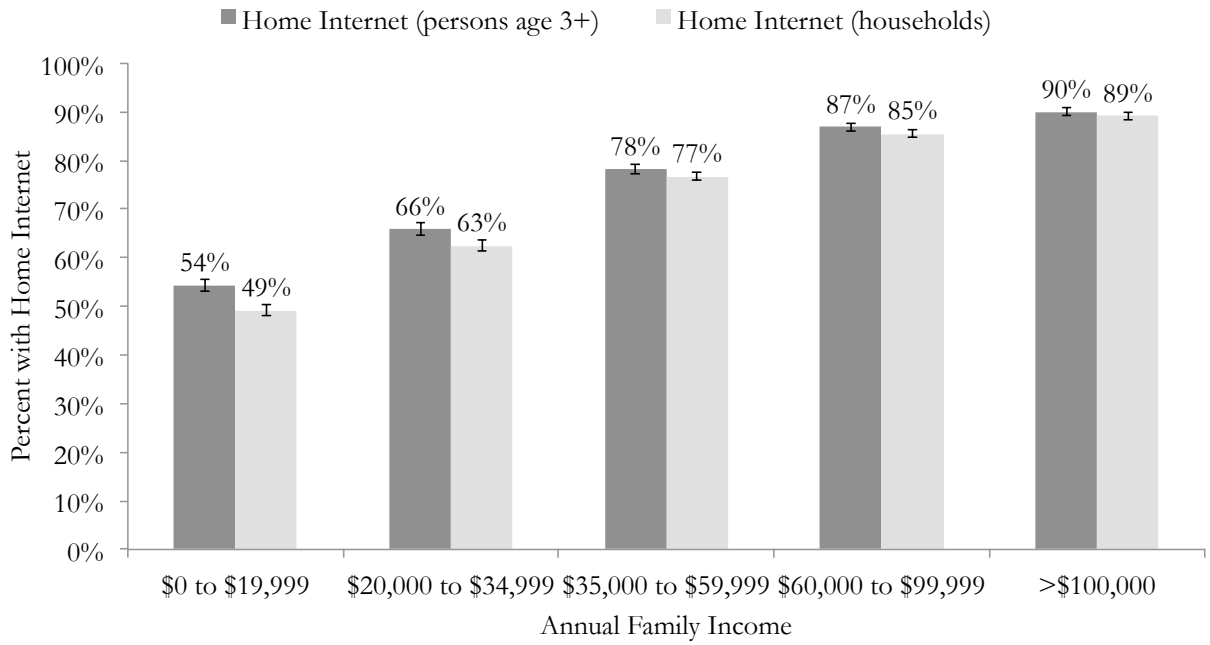
Source: Current Population Survey Computer and Internet Use Supplements.

Income Is a Key Factor Impacting Home-Internet Adoption.

Not surprisingly, income is a key factor impacting home-internet adoption. Only 49 percent of households with annual family incomes below $20,000 have internet in the home, compared to nearly 90 percent of households with incomes above $100,000 (*see* Figure 3).[19] A similar gap exists between high- and low-income households for wired home-internet adoption (*see* Figure 4).

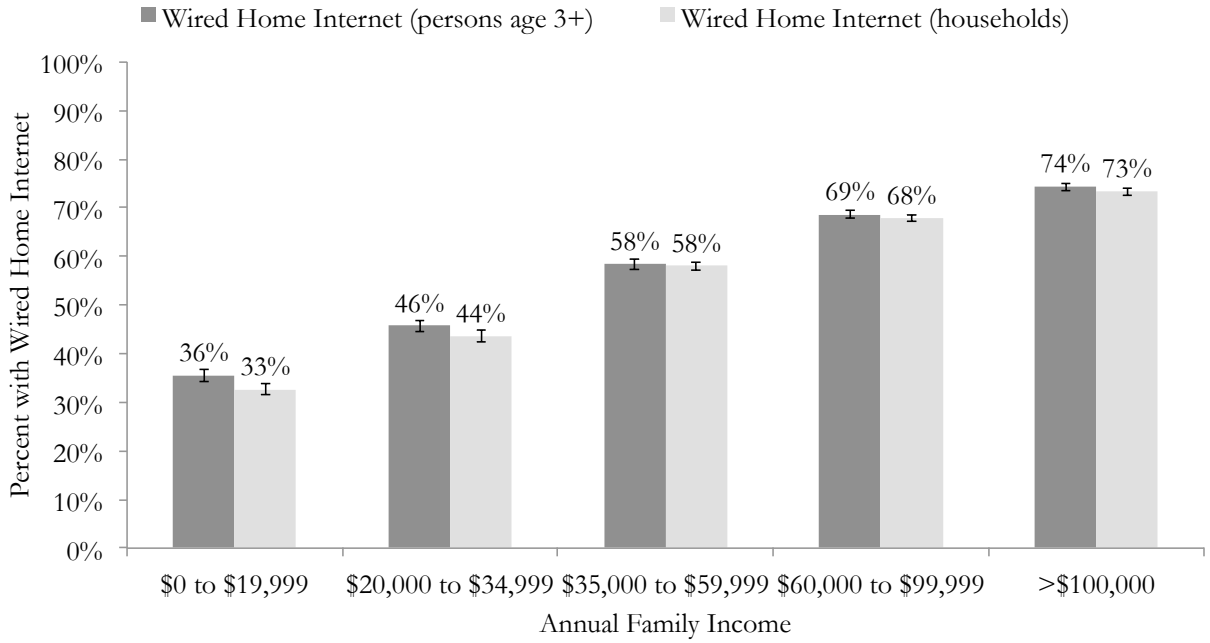
[19] The CPS asks respondents to report their family's annual income, and records these answers in one of 16 possible brackets (*e.g.*, bracket 1 is less than $5,000; bracket 16 is $150,000 or more). Because of this method and the irregular sizes of the brackets, it's not possible to use the CPS to report median or average family incomes; nor is it possible to precisely fit respondents into income quintiles. We chose five groupings to best represent the actual lowest and highest quintiles (as reported by the Census Bureau for 2014) while maintaining quintiles of approximate size. Our five quintiles from low to high contain 19 percent, 18 percent, 22 percent, 21 percent, and 20 percent of the households, respectively, in the July 2015 CPS sample; and 15 percent, 16 percent, 22 percent, 23 percent, and 24 percent of the persons in the July 2015 CPS. *See* United States Census Bureau, "Income and Poverty in the United States: 2014," (Sept. 2015) ("Households in the lowest quintile had incomes of $21,432 or less in 2014. Households in the second quintile had incomes between $21,433 and $41,186, those in the third quintile had incomes between $41,187 and $68,212, and those in the fourth quintile had incomes between $68,213 and $112,262. Households in the highest quintile had incomes of $112,263 or more."). In September 2016, the Census Bureau released 2015 median incomes, which show notable increases. "Households in the lowest quintile had incomes of $22,800 or less in 2015. Households in the second quintile had incomes between $22,801 and $43,511, those in the third quintile had incomes between $43,512 and $72,001, and those in the fourth quintile had incomes between $72,002 and $117,002. Households in the highest quintile had incomes of $117,003 or more." *See* United States Census Bureau, "Income and Poverty in the United States: 2015" (Sept. 2016).

Figure 3:
Home-Internet Adoption by Family Income – Households and Persons (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between each income strata are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) NOTE: Census Bureau urges caution when using answers for family income, due to approximately 20 percent allocation rate.

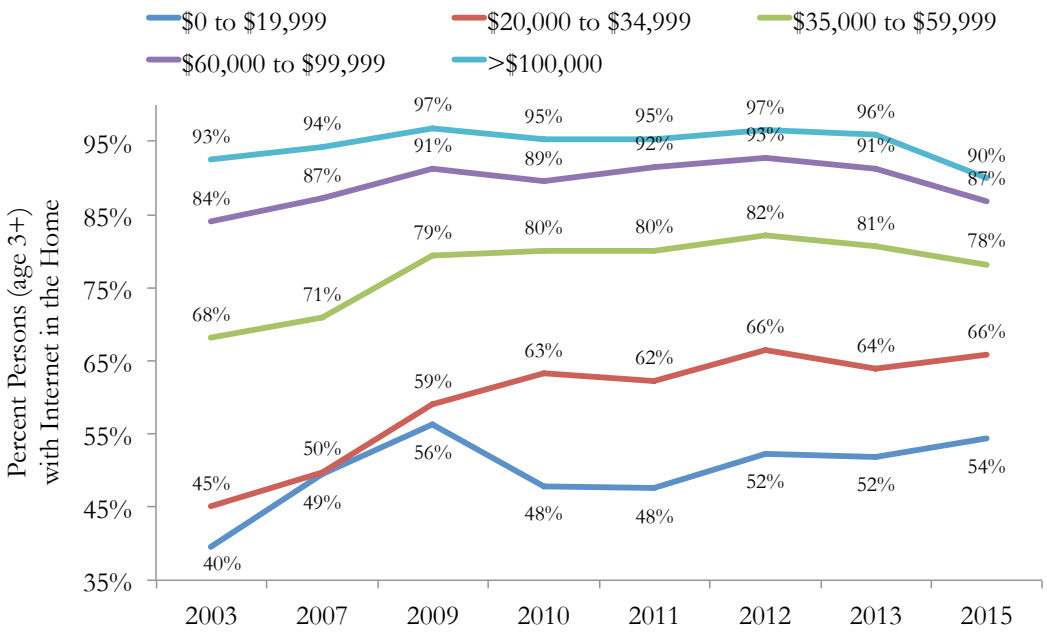
Figure 4:
Wired Home-Internet Adoption by Family Income – Households and Persons (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between each income strata are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) NOTE: Census Bureau urges caution when using answers for family income, due to approximately 20 percent allocation rate.

The size of the home-internet adoption gap between persons age 3 and above in the highest- and lowest-income families is now slightly smaller than it was in years prior. This is due both to an observed decline in home adoption among individuals in higher-income families, and a slight increase observed for those in lower-income families (*see* Figure 5). The time series data in Figure 5 represent adoption levels at nominal income values, so it's possible that inflation accounts for a portion of the narrowing gap, as people/households move out of lower nominal income brackets into higher brackets.[20] But the observed two-year decline from 2013 to 2015 suggests other factors beyond inflation.

Figure 5:
Home-Internet Adoption by Family Income (2003–2015; nominal income values)



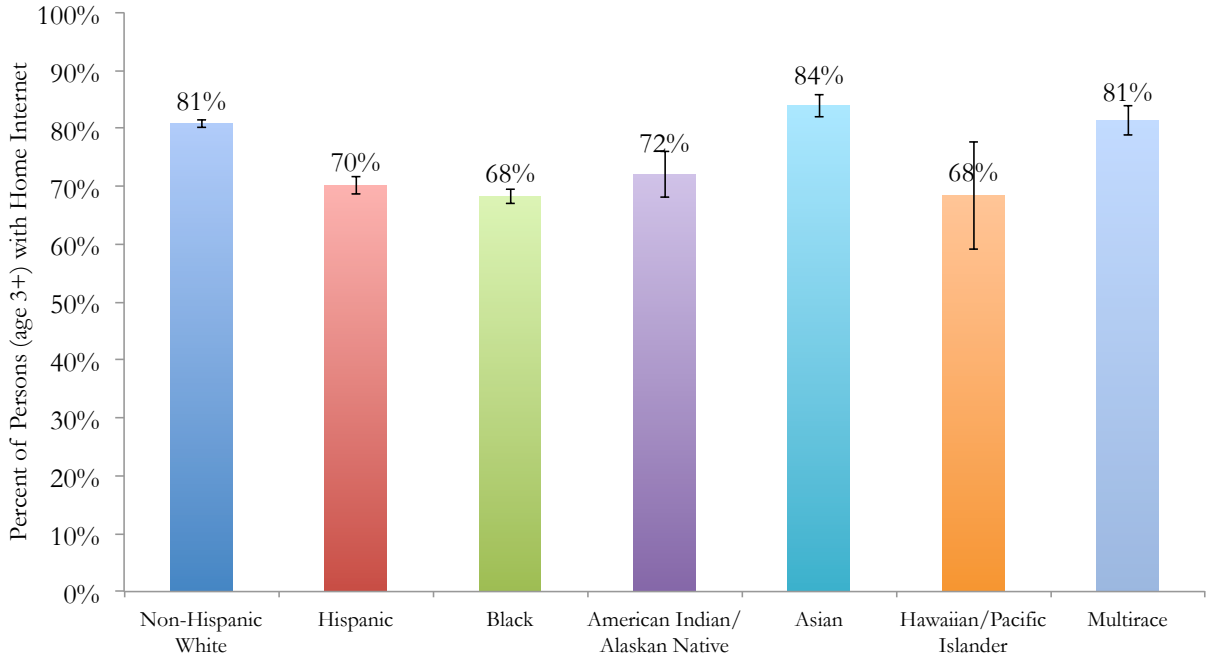
Source: Current Population Survey Computer and Internet Use Supplements. NOTE: Census Bureau urges caution when using answers for family income, due to approximately 20 percent allocation rate.

Hispanics, Blacks, American Indians/Alaska Natives and Native Hawaiian/Pacific Islanders Continue to Lag Behind in Home-Internet Adoption.

Using the demographic groupings reported in the Census, based on the racial and ethnic categories in which Census takers can choose to self-identify, we observe significant gaps in home-internet adoption among different populations. While 81 percent of Whites and 84 percent of Asians have home internet, only 70 percent of Hispanics, 68 percent of Blacks, 72 percent of American Indian/Alaska Natives, and 68 percent of Native Hawaiian/Pacific Islanders are connected at home (*see* Figure 6). These gaps are similar when we examine household-level internet adoption (*see* Appendix Figure A1). Wired adoption levels also are lower for households reporting in these same four racial/ethnic categories, and the magnitude of the gaps between Whites and members of these other races/ethnicities is even greater for wired access than it is for general home internet access. (*See* Figure 7; *see also* Appendix Figure A2 for household-level data.)

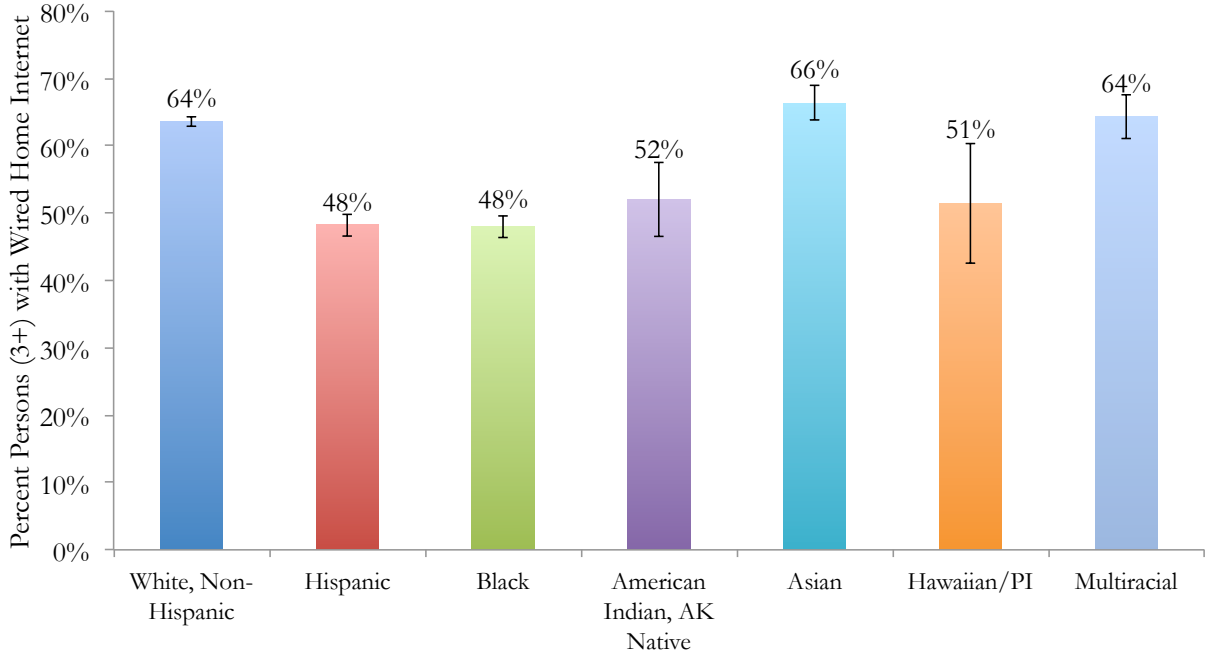
[20] For example, in 2015, 15 percent of people (19 percent of households) had family incomes below $20,000, and 24 percent of people (20 percent of households) had family incomes above $100,000. By contrast, in 2010, 19 percent of people (22 percent of households) had family incomes below $20,000, while just 18 percent of people (15 percent of households) had family incomes above $100,000.

Figure 6:
Home-Internet Adoption by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and other races/ethnicities (except multiracial) are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

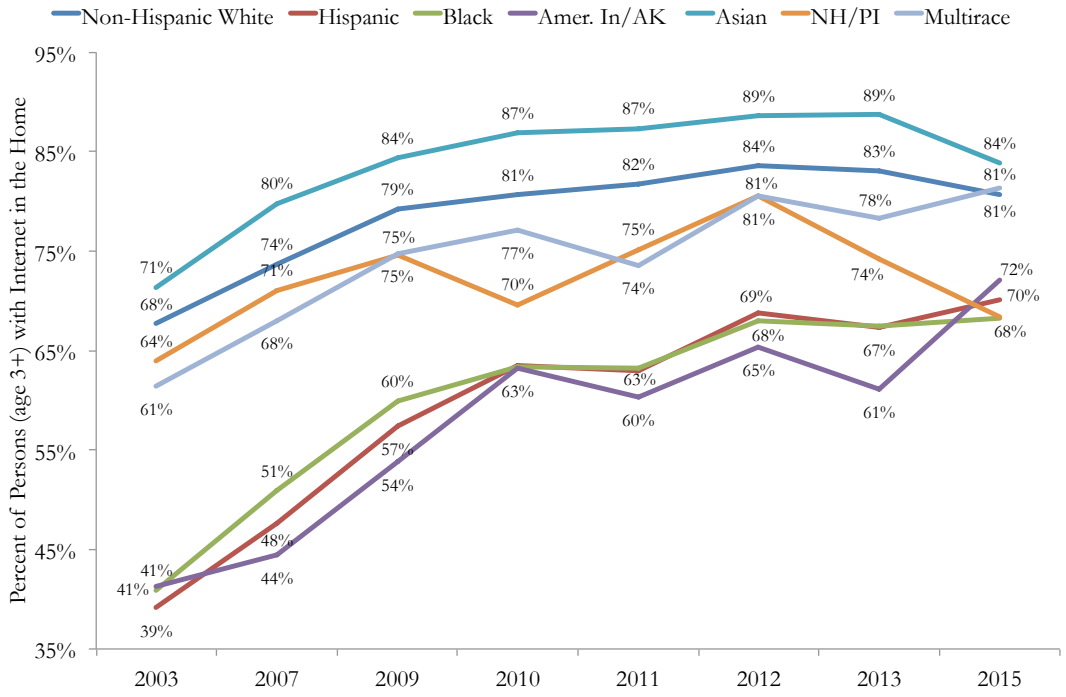
Figure 7:
Wired Home-Internet Adoption by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and other races/ethnicities (except for Hawaiian/Pacific Islander and multiracial) are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

The Census data indicate that people identifying as Hispanic, Black, or American Indian/Alaska Native have narrowed the gap with Whites in home-internet adoption (*see* Figure 8). However, as we discussed above, these findings stand in stark contrast to those published by Pew for changes between 2013 and 2015 in home broadband adoption by adults. We've offered possible explanations for why these two data sets diverge, but we emphasize that the short-term directionality of home-internet adoption matters much less than the continued existence of a divide. The issue of the racial/ethnic digital divide is the central focus of this report. Below we take a deeper look at the data demonstrating it, the possible causes for it, and policies that can help close this gap.

Figure 8:
Home-Internet Adoption by Race/Ethnicity (2003–2015)



Source: Current Population Survey Computer and Internet Use Supplements.

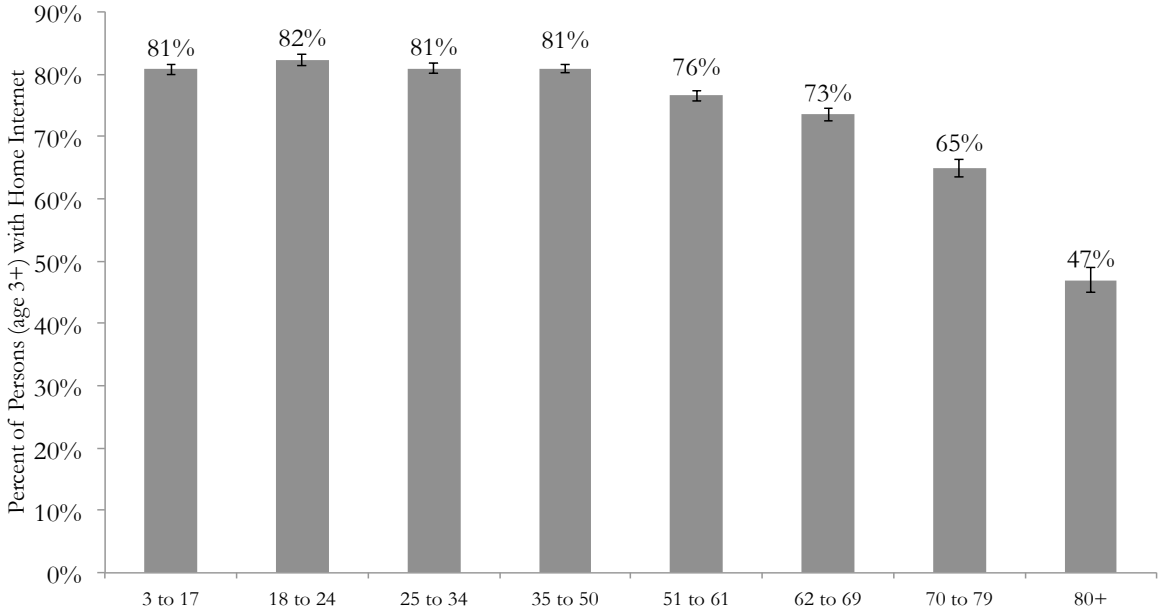
Other Factors Besides Race/Ethnicity, Such as Age, Education, Geography, Household Composition and Internet Use at Work or School, Impact Home-Internet Adoption.

Age impacts home-internet adoption, with seniors reporting substantially lower levels of home-internet adoption than younger persons do. Young people have very high demand for internet, even though they tend to have lower incomes.[21] And as we discuss below, even though adoption among the young is high, there are still gaps in adoption between people in different racial/ethnic categories in every age group.

[21] According to the Bureau of Labor Statistics ("BLS"), in the second quarter of 2016 the median weekly earnings for employed persons age 16 to 24 years was $492, compared to $753 for employed persons age 25 to 34, $943 for employed persons age 35 to 44, $948 for persons age 45 to 54, and $928 for employed persons age 55 and older. *See* U.S. Bureau of Labor Statistics, "Usual Weekly Earnings of Wage and Salary Workers: Second Quarter 2016," USDL-16-1492 (July 19, 2016). Unemployment is also much higher among the young. BLS data from 2014 indicated that 13.4 percent of persons age 16 to 24 in the labor force were unemployed, compared to 5.2 percent for persons age 25 to 54 in the labor force, and 4.4 percent for persons 55 and older in the labor force. *See* U.S. Bureau of Labor Statistics, BLS Reports, "Labor Force Characteristics by Race and Ethnicity, 2014" (Nov. 2015) ("BLS 2014 Labor Force Characteristics").

The drop-off in adoption by older individuals only manifests over the age of 50. For example, 81 percent of people in America under age 50 have internet at home, and that number is consistent for all age groups under 50. Yet only 71 percent of people age 50 and above have internet at home. Nevertheless, a majority in every age group has home internet access, with the exception of those age 80 and above (*see* Figure 9). This delineation at age 50 may be partly related to the age of these cohorts when the internet became a widely used technology in high schools and colleges. The full privatization of the internet (and its subsequent growth) were well under way in 1994, but by then people now over 50 were well beyond typical college age.[22]

Figure 9:
Home-Internet Adoption by Age (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The four lowest age brackets are not statistically significantly different from each other at p<0.05, while the four highest age brackets are statistically significantly different from each other and the four lower age brackets at p<0.05 (error bars represent 95 percent confidence interval calculated using successive difference replication standard error values).

Persons with more education adopt home internet at higher levels (*see* Figure 10). However, there's a clear demarcation between people with college and higher-level degrees, and those without any college education (*i.e.*, there's no statistically significant difference in home-internet adoption between holders of bachelor's degrees and holders of more advanced degrees). This gap is most acute for persons age 25 and above who did not complete high school, only 51 percent of whom have internet at home, versus 88 percent in that age range with a bachelor's degree or higher. People with more education also have higher levels of exposure to internet at work,[23] but the observed differences in home-internet adoption are also likely impacted by the substantially lower incomes typical for individuals with less than a high school diploma.[24]

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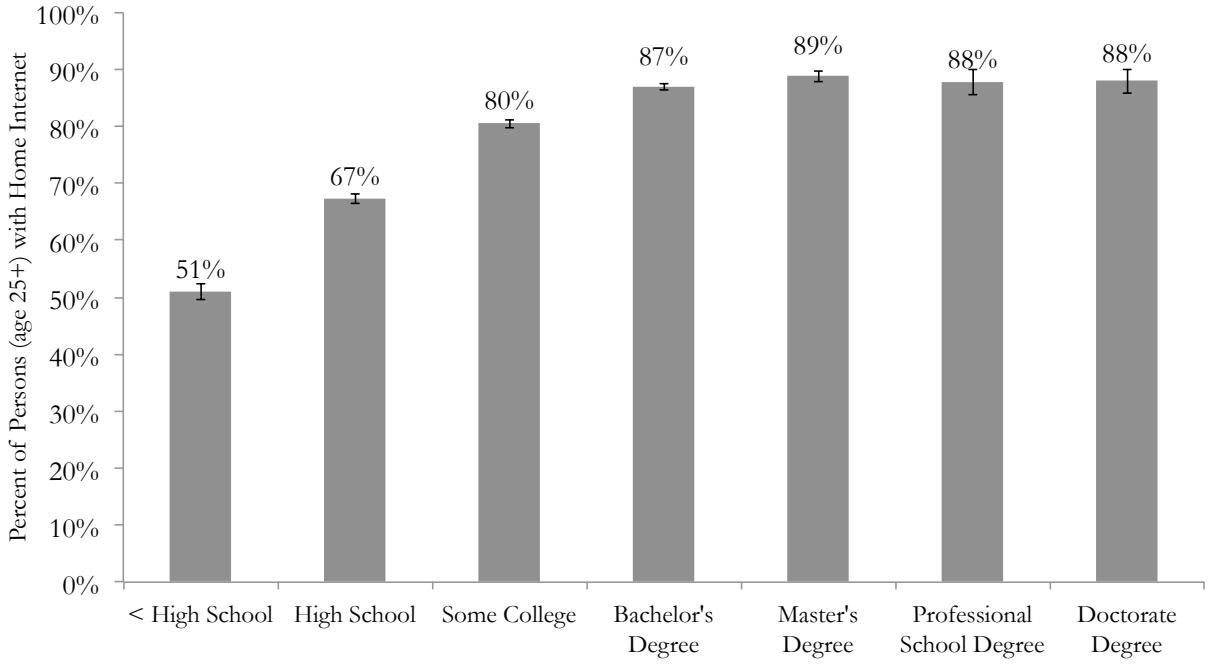
[22] *See* Peter H. Lewis, "U.S. Begins Privatizing Internet's Operations," *New York Times* (Oct. 24, 1994).

[23] For example, only 8 percent of persons who are age 25 and older but who have less than a high school degree reported going online at work, compared to 22 percent of individuals in that age group with a high school degree, 39 percent with some college, and 55 percent with a bachelor's or higher degree. See below for further discussion of differences in exposure to the internet at work, and the relationship of such differences to home-internet adoption.

[24] During the second quarter of 2016, full-time workers age 25 and over without a high school diploma had median weekly earnings of $499, compared with $690 for high school graduates (no college); $1,155 for those holding a bachelor's degree; and $1,425 for persons with advanced degrees. *See* U.S. Bureau of Labor Statistics, "Usual Weekly Earnings of Wage and Salary Workers: Second Quarter 2016," USDL-16-1492 (July 19, 2016).

Figure 10:
Home-Internet Adoption by Educational Attainment for Persons Age 25 and Older (2015)



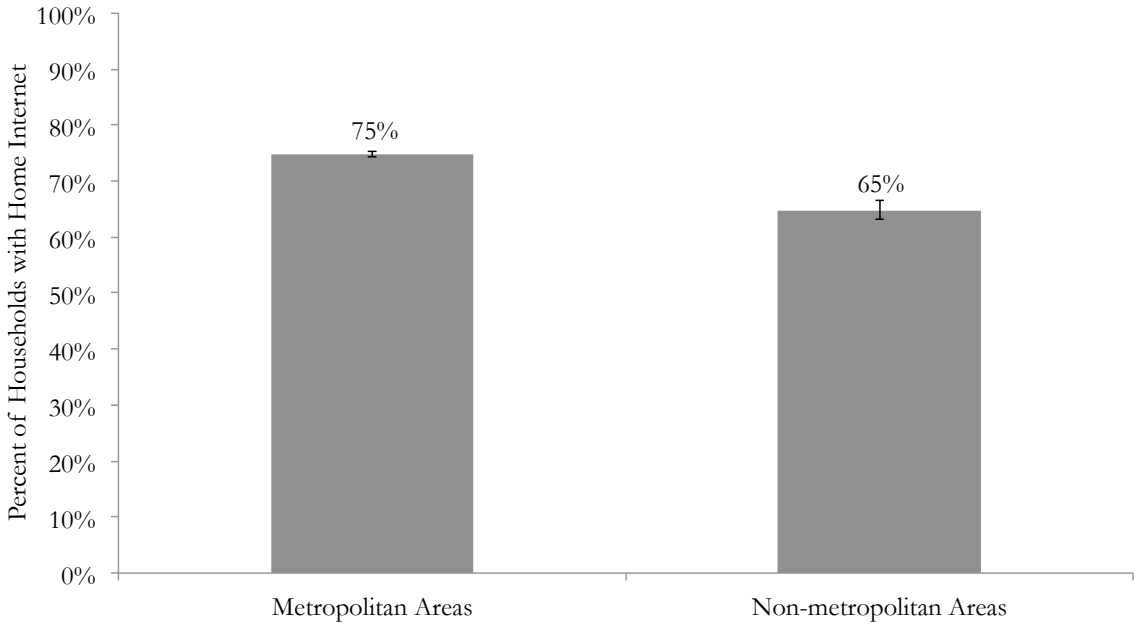
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Each of the three lower educational categories are statistically significantly different from all other categories at p<0.05, while the four highest education categories are not statistically significantly different from each other at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Not surprisingly, home-internet adoption is higher for households located in metropolitan areas (75 percent) than for those located outside these areas (65 percent; *see* Figure 11). However, this overall metro/non-metro adoption gap is <u>not</u> primarily driven by differences between metro and non-metro areas in basic availability – meaning availability of internet access at any speed whatsoever – even if the range of speeds available may typically be slower in non-metropolitan areas.[25] Internet services of at least some type and speed are available to 99 percent of the U.S. rural population,[26] and only 6 percent of non-adopters living outside of metropolitan areas cite lack of availability as a reason for non-adoption (*see* Figure 62 in Part V below for discussion of survey data on the non-adopting population).

[25] The CPS data, unlike the FCC and NTIA broadband deployment data, does not allow us to distinguish between rural and non-rural areas. Metropolitan areas contain some rural census blocks, which is why our analysis of the deployment data indicates that 19 percent of the population lives in rural blocks, while our analysis of the July 2015 CPS data indicates that only 14 percent of the population lives in non-metropolitan areas.

[26] According to the June 30, 2014 National Broadband Map data, 99.1 percent of the rural population in the U.S. had access to non-satellite internet access services offering downstream speeds at or above 768 kilobits per second. At speeds above 1.5 Mbps, 99 percent of the rural population still was served by one or more such providers. And even at 10 Mbps, 96 percent of the rural population had one or more such available ISPs. The widespread deployment of mobile wireless data services is largely responsible for closing the basic deployment gap between rural and urban America. As of mid-2014, mobile wireless data services were available to 97.9 percent of the rural population, while DSL and cable modem were only available to 72 percent and 54.1 percent of the rural population respectively. *See* National Telecommunications and Information Administration, "Broadband Statistics Report: Broadband Availability in Urban vs. Rural Areas" (March 2015). Our analysis of the December 31, 2014 FCC Form 477 deployment data indicates that 80 percent of the rural population was served by one or more wired providers at speeds at or above 3 Mbps.

Figure 11:
Home-Internet Adoption by Metropolitan Location (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The difference in home-internet adoption between metro and non-metro areas is statistically significantly at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Income is then a possible explanatory factor for this metro/non-metro adoption gap, as income is lower on average in non-metropolitan areas (though this is partially offset by higher costs of living in metro areas).[27] And though internet access is widely available in rural areas, the number of competitors is fewer and the quality of services available is lower than in urban locations. (For instance, in a number of rural locations the only available services are mobile, satellite or wired services offering downstream speeds below 3 Mbps).

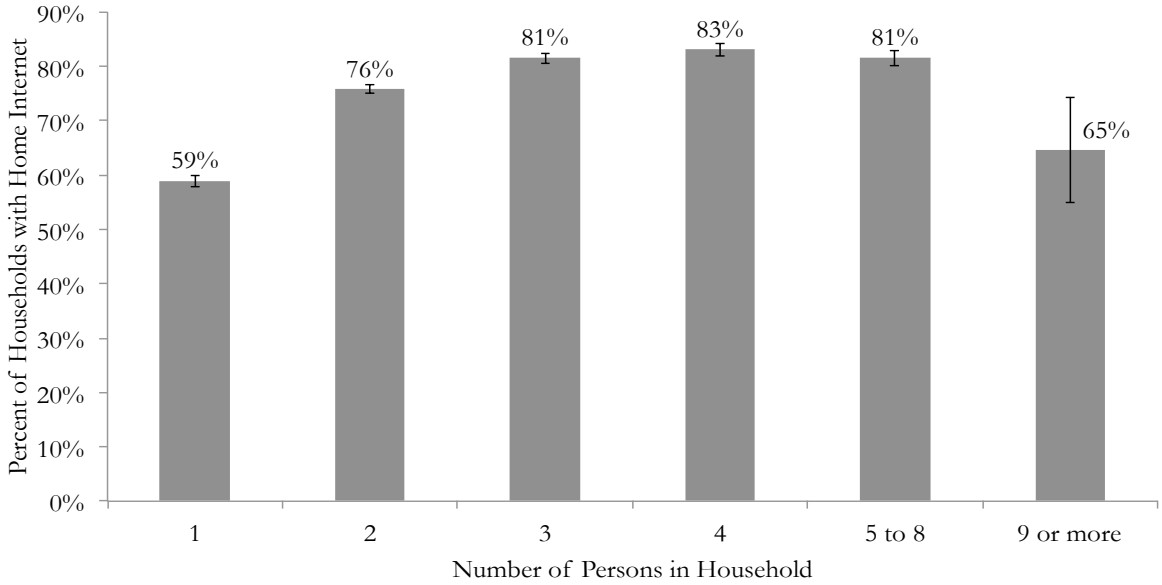
This lower level of competition may lead to higher prices, and in turn depress demand in these areas that already have lower average incomes. The lower level of availability of higher-speed wired services in non-metro areas also may result in lower demand for home internet in these areas.[28] Also, as we discuss in depth below, the deployment levels and number of competitive choices available to people of color in non-metro areas are far worse than they are for Whites living in such areas. This factor, along with income inequality for people of different races/ethnicities in such areas, contributes to a digital divide between people of different races and ethnicities living in non-metro areas.

[27] Our analysis of the July 2015 CPS data indicates that the average household family income in non-metropolitan areas is approximately $32,254, compared to $38,840 in metropolitan areas. Yet these are merely the average values based on self-reporting into one of 16 income bins, which yields a value that is below the actual average because the highest bin is "$150,000 or more." Recent Census data on income and poverty indicates that in 2015 the median household income for persons in metropolitan statistical areas was $59,258, but just $44,657 for persons outside of these areas. Median incomes in metro areas increased 1.75 percent from 2014 to 2015, and declined by 2 percent in non-metro areas. *See* United States Census Bureau, "Income and Poverty in the United States: 2014" (Sept. 2015).

[28] According to the July 2015 CPS data, 58 percent of households in metro areas subscribe to wired home internet, compared to 44 percent in non-metro areas (with 95 percent confidence intervals of 57 percent to 58 percent for wired adoption in metro areas, and 43 percent to 46 percent for wired adoption in non-metro areas). This 14 percentage point gap for wired adoption between metro and non-metro areas is larger than the 10 percentage point gap for overall home-internet adoption.

Home-internet adoption increases with household size, but then declines in very large households. This is consistent with the expected impact of household size on income. Single-person households must commit a larger portion of earnings to internet access, while larger households typically can spread this cost-burden across multiple incomes.[29] This data also possibly reflects the fact that age and household size are negatively correlated, and older people are less likely to have home internet.[30] In total, 82 percent of households with three or more members have home internet access, versus 68 percent of households with one or two members (*see* Figure 12).

Figure 12:
Home-Internet Adoption by Household Size (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Home-internet adoption levels for households with one or two persons is statistically significantly different from all other household sizes at p<0.05, except for the difference between single-person households and households with 9 or more persons. Households with 3, 4 and 5 to 8 members do not have statistically significantly different home-internet adoption levels from each other at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

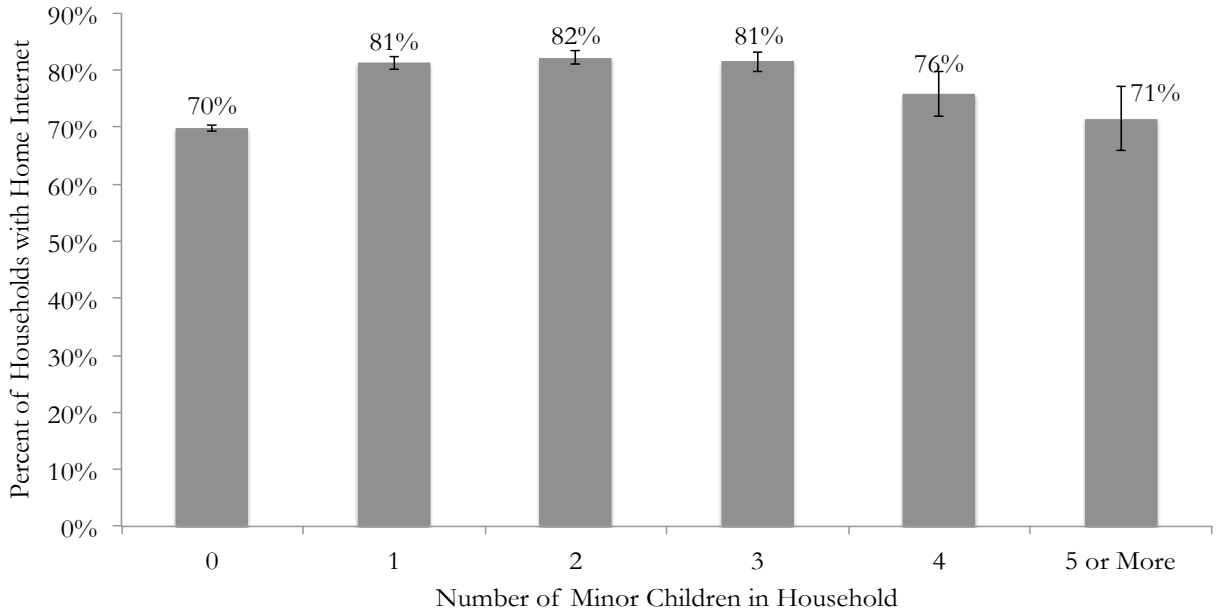
Households with minor children are more likely to have home internet than those without (*see* Figure 13). While 82 percent of households with minors have home internet, only 70 percent without minors do. This is likely due in part to the relationship between income and children in the home, as well as the relationship between age and children in the home. According to the July 2015 CPS, the median family income range for homes without children is $40,000 to $49,999. With children, it's $50,000 to $59,999. And the median age of persons in homes with children is 20, but 54 without children present. (The average age of adults in households where a minor is present is 39, but 54 in households where no children reside). The observation that households with 5 or more children have lower home-internet adoption levels than households with 1 to 3 children also likely stems in part from income differences.[31]

[29] The median reported income range for single-person households was $30,000 to $34,999. It was $50,000 to $59,999 for households with 2 to 3 members; $60,000 to $74,999 for households with 4 to 5 members; $50,000 to $59,999 for households with 6 to 9 members, and $40,000 to $49,999 for households with 10 or more members.

[30] The median age of persons in single-person households is 59, compared to 57 for persons in two-person households, 33 for persons in three-member households, and 22 for persons in households with 4 or more members.

[31] The median reported income range for households with 5 or more children in the household was $35,000 to $39,999, compared to a range of $50,000 to $59,999 for households with 1 to 3 children present.

Figure 13:
Home-Internet Adoption by Presence of Minor Children (2015)

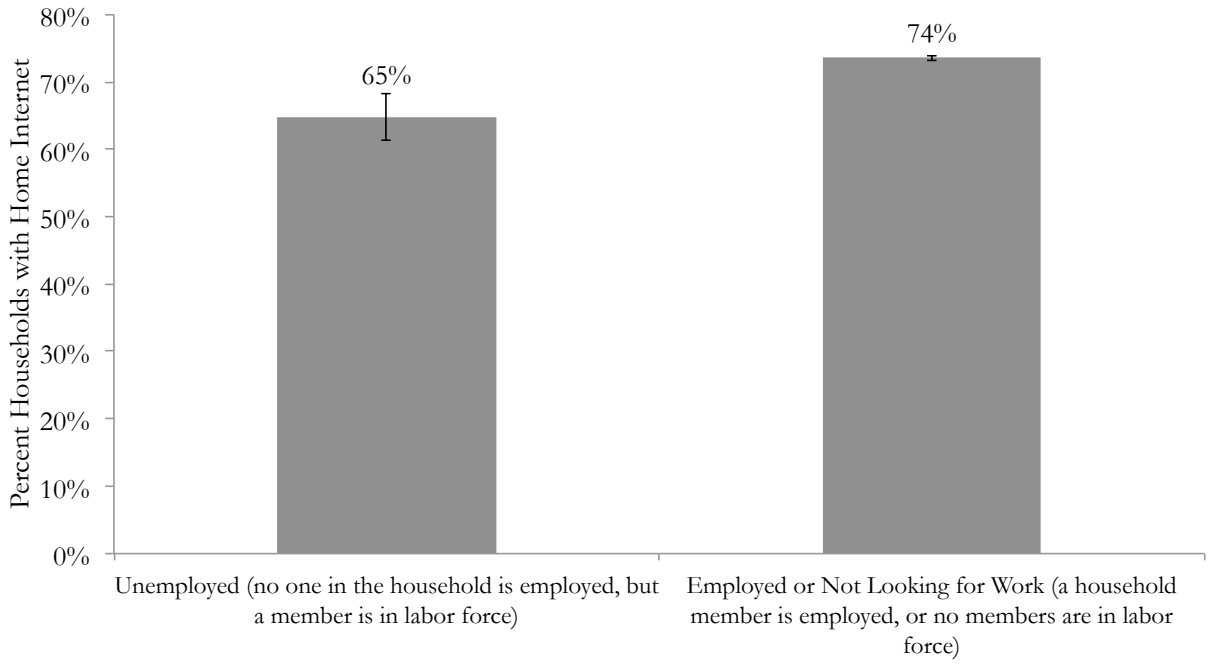


Source: Free Press analysis of July 2015 CPS Supplement. Average home-internet adoption levels for households with no minor children is statistically significantly different from all other categories of households with minor children at p<0.05, except for households with 5 or more minor children. Households with 1, 2, and 3 minor children do not have statistically significantly different average home-internet adoption levels from each other at p<0.05, but are significantly different from households with 4 or more minor children. Households with 4 minor children have an average home-internet adoption level that is statistically significantly different from all other categories of households with and without minor children, except for those with 5 or more minor children. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Households with members in the labor force who are currently employed (or with no members in the labor force) are more likely to have home internet (74 percent) than are unemployed households with one or more members seeking work (65 percent). (*See* Figure 14). The relatively small size of this gap, and the reality that two-thirds of unemployed households still subscribe to home internet, is a testament to the importance of online access. Yet by comparison, there is no real gap in cellphone adoption between unemployed and employed/not-looking households (80 percent and 81 percent, respectively); and there is a smaller gap for mobile data adoption by unemployed and employed/not-looking households (59 percent and 64 percent, respectively) than there is for home internet overall. (*See* Appendix Figure A25).

The data also indicates unemployed households disproportionately rely on mobile as their sole means of access. For those with home internet, 29 percent of unemployed households connect via mobile only, compared to 20 percent of employed/not in labor force households (*see* Appendix Figure A25).

Figure 14:
Home-Internet Adoption by Household Employment (2015)



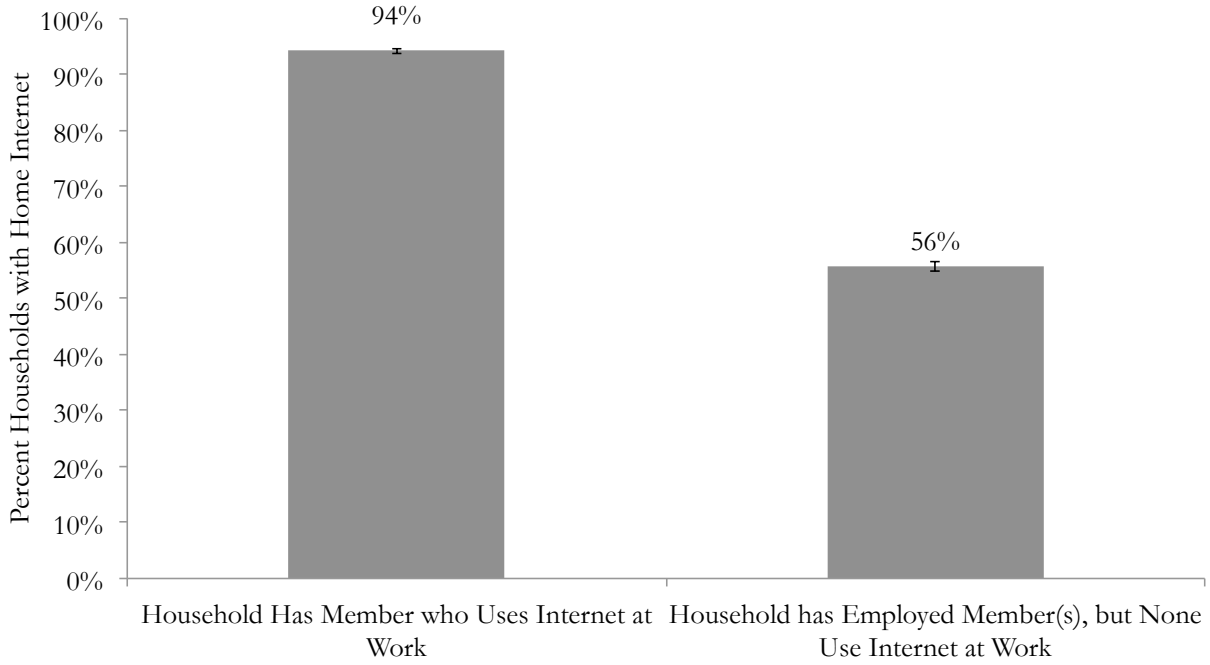
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Home-internet adoption levels for unemployed households is statistically significantly different from households with an employed household member or no members in labor force at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Despite this relatively small difference in home-internet adoption between unemployed and employed/not-looking households, there is a much larger gap in home-internet adoption depending on the functions of an employed person's job. Nearly all households with one or more members who use the internet at work have home internet (94 percent), compared to just 56 percent of households with none of their employed members using the internet at work (*see* Figure 15).[32]

[32] The level of home internet use among <u>all</u> households with no member using the internet at work is 55.2 percent: 37.14 million of 67.24 million households with no member who uses the internet at work have home internet. (That total includes households with no employed members and no members in labor force). The level of home internet use among <u>employed</u> households (with one or more member employed) but no member using the internet at work is 55.7 percent (*i.e.*, 18.26 million of the 32.76 million employed households). 58.5 million (or 47 percent) of the total 125.7 million U.S. households have one or more members who use the internet at work. That equates to 64 percent of the 91.2 million employed U.S. households with one or more members who use the internet at work.

This makes work internet use one of the most important factors associated with home adoption.[33] Use at work is certainly interrelated to income and education.[34] But as we will discuss below, internet use at work remains an important factor associated with home-internet adoption even when controlling for income, education level, and other factors. Furthermore, there are substantial differences in work internet use depending on a person's race/ethnicity and income, with this combination of factors contributing to the digital divide in ways beyond the impacts caused by income differences alone.

Figure 15:
Home-Internet Adoption by Internet Use at Work (2015)



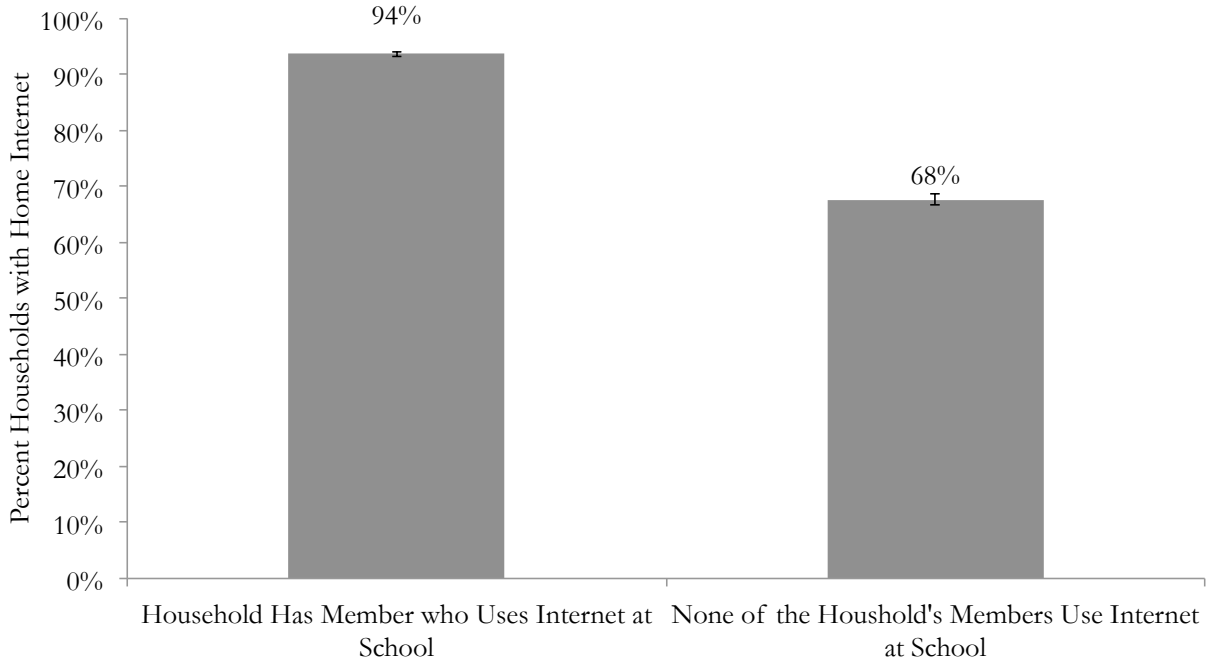
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Difference is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

[33] We recognize that use of internet at home can impact a person's use at work, just as exposure to the internet at work can influence the decision to subscribe to home internet. However, we use exposure to the internet via methods other than a home subscription as an indicator for experience. In other words, persons who are exposed to the internet at work or at school can be characterized as having experience with the use of the technology, which can influence home adoption. We estimate our econometric models for home-internet adoption with and without indicator variables for work and/or school use. The models with these indicator variables capture the impact of the other independent variables while controlling for household experience. Thus, we are estimating the relationship between factors like income and home-internet adoption, while accounting for differences in exposure to and familiarity with the use of the internet outside of a home wired or wireless subscription. *See* Appendix Figure A51.

[34] The median reported income range for households with members who use the internet at work was $60,000 to $74,999, compared to a range of $35,000 to $39,999 for employed households with no members who use the internet at work. The median reported maximum educational attainment in households using the internet at work was a bachelor's degree, compared to some college but no degree for employed households with no members using the internet at work.

Use at work is one access mode that does not rely on a home subscription but that appears to have a substantial relationship to home adoption.[35] Use at school is another. If a household has a student who goes online at school, that household is highly likely to have home access.[36] Nearly 94 percent households with students who go online at their school have home internet, compared to just 68 percent home-internet adoption for all households without a member who goes online at school (*see* Figure 16).

Figure 16:
Home-Internet Adoption by Internet Use at School (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Difference is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

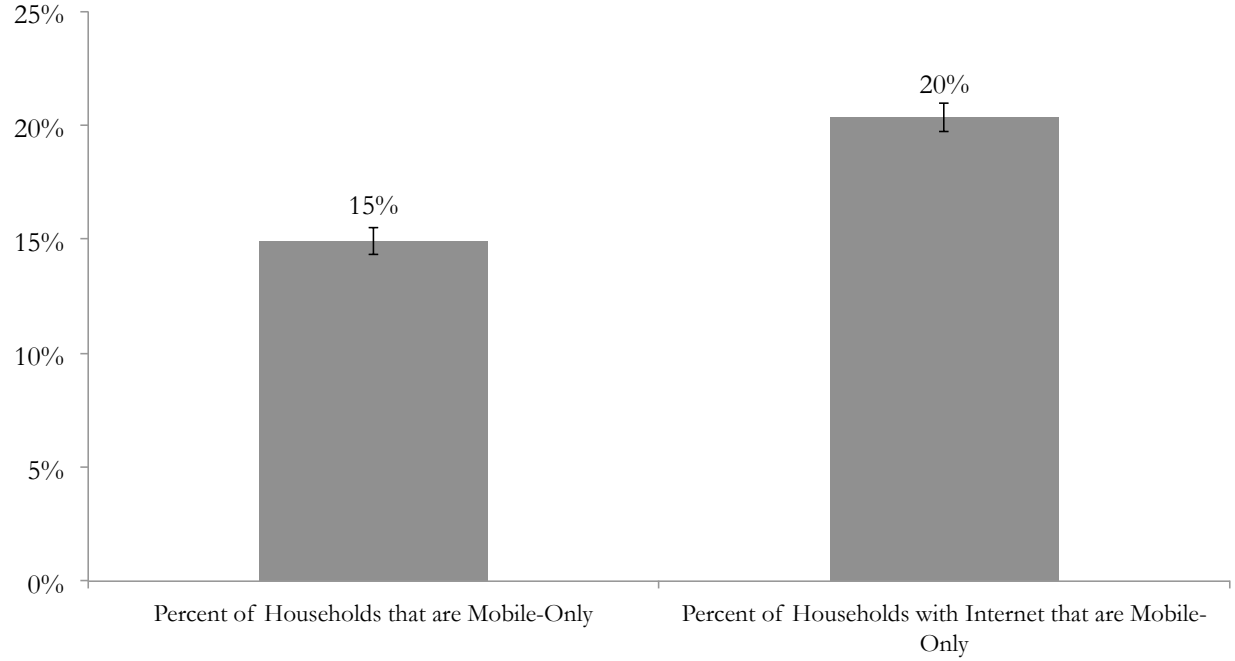
[35] Questions about causality are always central in policy research, and the direction of a factor's impact is often impossible to know with certainty (*see* footnote 34). However, internet use at school is in most cases not a specific choice made by students, but an activity central to their participation in that academic program (particularly for minors). In the case of work use, there is of course reason to believe that long-term exposure to internet in the home will have some impact on a person's ability to obtain a job that requires internet use; and in the case of school use, long-term home use could impact a person's admission into a college program that requires internet use. But the more likely direction of these factors is that household income, educational attainment, and social condition impact the decision to purchase home internet, as does familiarity with the internet due to household members' exposure to it at work or school.

[36] According to the CPS, there were 46.9 million persons in 27.6 million households who reported going online at school. We have not presented the home-internet adoption level for households with students who do not go online at school, because the CPS data does not make it possible to calculate the universe of households with members enrolled in school. The CPS asks persons age 16 to 54 if they were enrolled in a high school, college or university during the prior week. There are however 11.7 million persons age 16 to 54 who report going online at school who did not report being enrolled in school during the prior week. There are also 1.2 million persons over the age of 54 who report going online at school. But the total population of persons who did not report being enrolled in school the prior week who should be classified as students is unknown. For the purposes of the econometric analysis we discuss herein, this discrepancy does not matter, since our independent variable is whether or not a household has a person who reports accessing the internet at school. This discrepancy however will impact the calculation of the percentage of households with students who do not go online at school that nonetheless have home internet, since the full universe of households with students is unknown. We do however present herein person-level home-internet adoption data for school-age persons (age 3 to 15) and those age 16 to 54 who report being enrolled in school, as this is a known and defined population. *See* Part VIII.

A Significant Proportion of Households Report Using Mobile Internet as Their Sole Method Of Access. Among Households with Some Form of Home Internet, Low-Income Households and People of Color Are More Likely to Use Mobile Access Only.

Recent data from both the July 2015 CPS and Pew indicates that a large and growing share of the population relies solely on mobile technology for home internet access. We've previously addressed discrepancies between the July 2015 CPS and Pew numbers, and why the size of this mobile-only population may actually be lower than the survey results indicate (see page 21). But there is certainly ample reason to believe that the mobile-only population is growing, and that certain demographic groups with home internet are more likely to be mobile-only. There are several factors driving this trend. First, while mobile internet access services remain largely capped and subject to monthly data limits, 4G LTE speeds are sufficient enough to support most types of online activities. Second, most carriers now promote mobile data as their central service, with cellular telephony as a "free" add-on. Thus if a person is a cellphone adopter, they are likely to be a mobile data adopter.[37] Because of these factors, a certain proportion of households will decide that the additional expense of a wired home internet connection is not worth the cost – and a proportion of those households will be simply unable to afford both mobile and wired access.

Figure 17:
Households That Access the Internet Only via Mobile Wireless (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all persons (age 3+) or households. The universe for the second column is households that have a home internet connection.

When discussing this trend, it's important to distinguish between *all* households and *internet-adopting* households. For example, as we show in Figure 18, there is no significant relationship between income and the percentage of all households that only connect to the internet at home via mobile wireless. There is however a significant relationship between income and the percentage of households with home internet whose sole connection at home is a mobile wireless service. That is, if the universe is internet homes and not all homes, we see that low-income households are more likely to be mobile-only.

[37] For example, 86 percent of persons age 18 to 54 who personally use a cellphone live in a household that subscribes to mobile data services (with or without wired home-internet service; we present household-level mobile data adoption here as CPS does not ask about personal use of mobile data).

This means the mobile-only rate is uniform across the universe of households of all incomes, if we look both at households that have home internet and those that don't. But the mobile-only rate differs across incomes for internet-adopting households, once we drop out households that have no home internet access of any kind. This reflects an income effect that occurs in a two-stage purchasing decision. A household's income first influences its demand for internet access; then, if it does adopt, income influences the choice of access technology. This is similar to many two-stage purchasing decisions that households make, where those with higher incomes purchase a higher-quality (and more expensive) type of good in the second stage. For example, television ownership is nearly universal in America. There is little difference in TV ownership rates across income strata.[38] However, those with higher incomes are more likely to subscribe to cable or satellite multichannel video, and those with lower incomes are less likely to do so, because of affordability concerns.[39]

Cellphone adoption in low-income homes is substantially higher than internet adoption.[40] Because these households have smaller budgets, we would expect that those already subscribing to cellphone service are more likely to add mobile data services than subscribe to a wired internet service. And if they do add mobile data, they would be less likely to also subscribe to wired internet.[41] Many low-income householders might decide some home access is better than none, even if mobile internet is inferior to wired access. And as we see in Figure 17, this is indeed the case. While there is no significant difference in the percentage of all households that are mobile-only across income strata, there is a significant negative relationship between increasing income and the percentage of internet-connected households that only connect via mobile.

As shown below, 29 percent of low-income internet households (defined as annual family incomes below $20,000) are mobile-only, compared to 15 percent of internet households with incomes above $100,000.[42] This reflects the expected income effect on this two-stage purchasing decision: low-income households are less likely to subscribe to home internet; and when they do, they are more likely to purchase the less expensive mobile service, which is often an add-on service for the already highly valued cellular telephone service they likely have. By contrast, high-income households are more likely to adopt home internet; and then more likely to adopt a more expensive wired service. These differences essentially balance out for the overall population. Higher-income households are more likely to have internet access in the first place, so a relatively large proportion of all high-income households still will tend to be mobile-only because the starting universe of high-income home internet users is large.

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[38] *See, e.g.*, Julie Siebens, United States Census Bureau, "Extended Measures of Well-Being: Living Conditions in the United States: 2011" (Sept. 2013) (showing TV-ownership rates from the bottom to top income quintiles of 96.4 percent, 98.2 percent, 98.6 percent, 99.0 percent, and 99.2 percent, respectively).

[39] *See, e.g.*, Keith Nissen, "Survey finds video cord cutting in US grew an estimated 5% during 2015," *SNL Kagan,* (May 5, 2016) (showing that 28 percent of internet households with less than $25,000 in annual income have dropped multichannel service, compared to just one percent of internet households with incomes above $150,000); *see also* Leichtman Research Group, "86% of TV Households Subscribe to a Multi-Channel Video Service" (Aug. 8, 2013) (showing that 80 percent of TV households with annual incomes below $50,000 are multichannel subscribers, compared to 91 percent of those with incomes above $50,000).

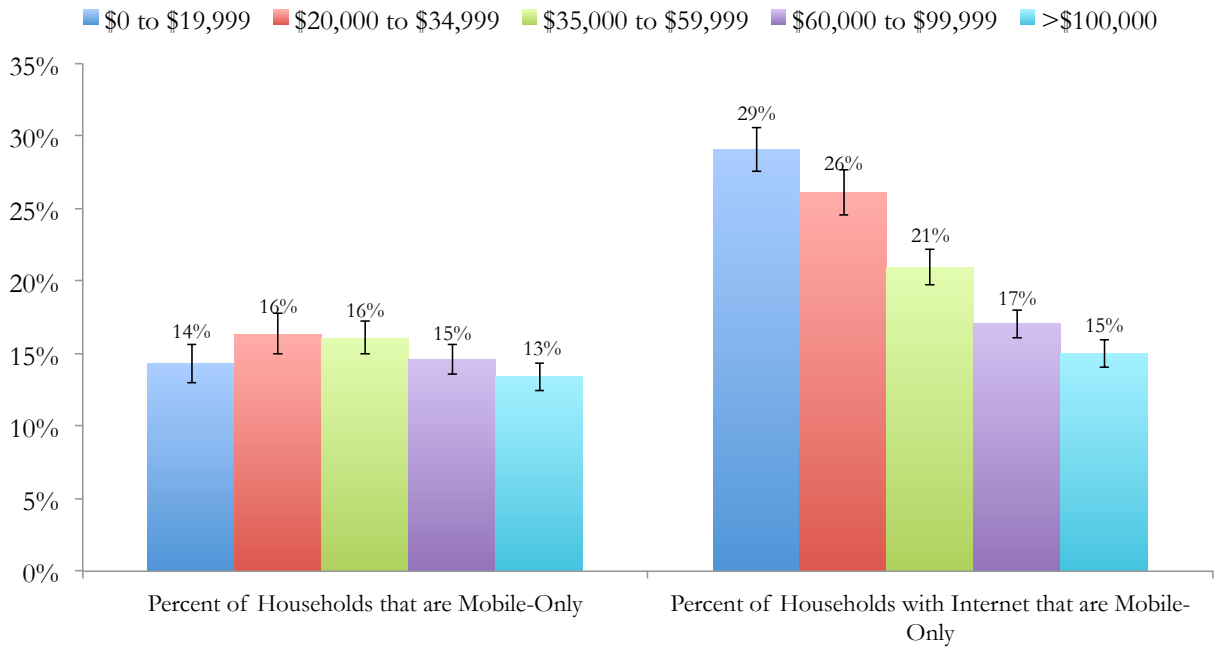
[40] See Part VI below summarizing home internet, cellphone and mobile data use amongst low-income households. Approximately 69 percent of households with annual family incomes below $20,000 subscribe to cellular service, while only 49 percent in that income bracket subscribe to home-internet service (using any technology). Only 33 percent of these low-income households subscribe to wired internet service.

[41] Among households with less than $20,000 in annual family income who subscribe to cellphone service, 58 percent subscribe to mobile wireless data services, but only 42 percent subscribe to wired home-internet services.

[42] We again emphasize our expectation that the absolute sizes of these mobile-only percentages are somewhat inflated, as explained in the methodology section above; but there's clearly a relationship between income and mobile-only use among internet-adopting homes.

Because of this relationship between income the likelihood that an internet-adopting home is mobile-only, we would expect to see a higher level of mobile-only adoption for Hispanic and Black home internet-adopting households than for White households, simply due to income inequality.[43] And this is indeed the case. While 18 percent of White internet households are mobile-only, 28 percent of Hispanic internet households and 28 percent of Black internet households use mobile data as their sole connection (*see* Figure 19). Yet this gap persists even among the poorest households, when we account to some degree for income. One quarter (25 percent) of low-income White households that have home internet connect using only mobile services, versus 36 percent and 37 percent of low-income Hispanic and Black internet households. This difference in mobile reliance between White households and non-White households, even among the poor members of all three racial/ethnic groups, suggests that factors other than income contribute to this aspect of the digital divide.

Figure 18:
Households That Access the Internet Only via Mobile, by Family Income (2015)

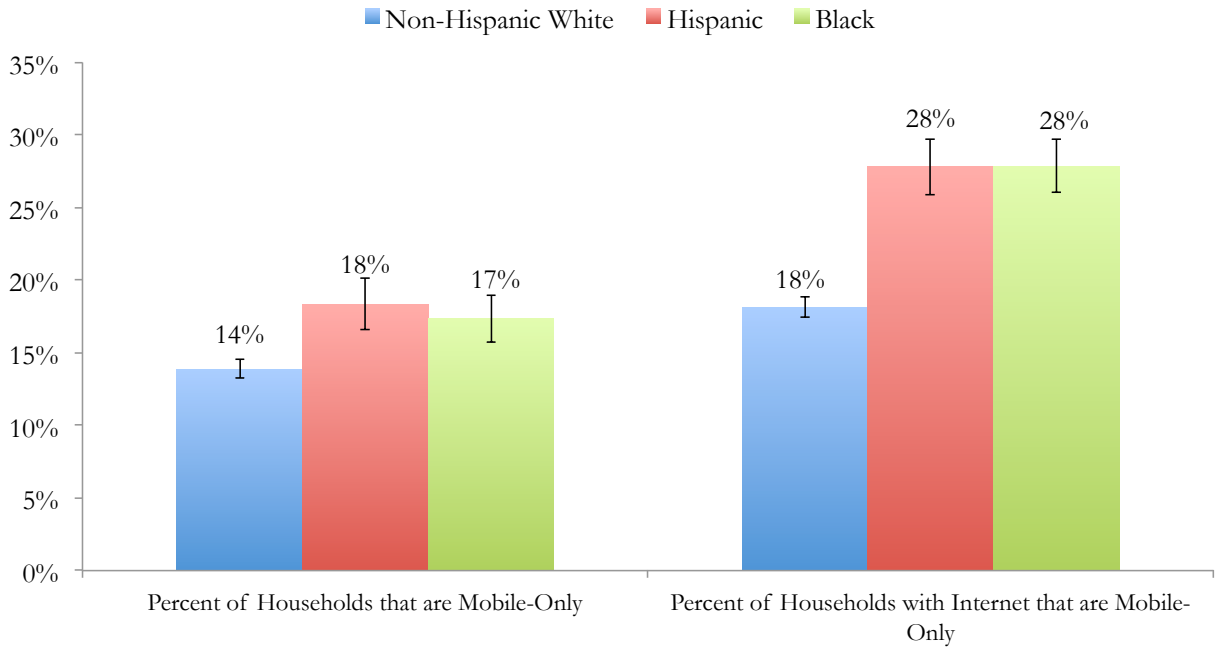


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement (error bars represent 95 percent confidence interval calculated using successive difference replication standard error values). The universe for the first column is all households. The universe for the second column are households that have a home internet connection.

The over-reliance by Hispanic and Black internet households on mobile service is partially driven by affordability. As discussed below, members of these demographic groups more frequently cite concerns about the affordability of internet access in response to Census surveys. The higher level of competition between mobile providers, and the widespread availability of prepaid mobile services, contribute to the availability of more low-priced offerings. Because such wireless services are more affordable, even if they are inferior to wired access in terms of speed and monthly capacity, the lower price contributes to low-income populations and people of color over-indexing on mobile.

[43] *See* Part II for fuller discussion of differences in income between individuals and households of different races/ethnicities.

Figure 19:
Households That Access the Internet Only via Mobile, by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between non-Hispanic White households and Hispanic households is statistically significant at p<0.05 for all categories. The differences between non-Hispanic White households and Black households is statistically significant at p<0.05 for all categories. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

There are also other factors associated with being an internet household that is mobile-only (*see* Statistical Appendix I). Younger persons who have some form of home internet, and internet households with younger average adult ages, are more likely to be mobile-only when compared to older persons or households who subscribe to home-internet services too. People and households with less educational attainment that subscribe to internet access are more likely to be mobile-only than those with higher educational attainment. People and households located in non-metropolitan areas who subscribe to internet service are more likely to be mobile-only, when compared to those in metropolitan areas. Renters who subscribe to internet service are more likely to be mobile-only than home owners who subscribe to home internet. Internet households with minor children in them are more likely to be mobile-only than are internet households without minor children. And internet-adopting households that are unemployed are more likely to be mobile-only than those internet adopting households with one or more employed members (or with no members in labor force).

These factors are all intertwined with each other, and all interrelate with income differences. To analyze them more effectively therefore, in Part III, we present econometric data that isolates the impact of each of these factors as well as the impact of racial and ethnic group membership on wired internet home adoption. Most factors remain statistically significant even when all others are held constant, with Hispanic and Black households less likely to have wired internet access than White households are, even after we control for income and other demographic differences.

PART II

UNDERSTANDING THE RACIAL/ETHNIC DIGITAL DIVIDE

America Is a Nation of Increasing Diversity, but Substantial Inequities Between People of Different Races and Ethnicities Persist. These Inequities Directly and Indirectly Contribute to the Digital Divide.

This report focuses on the persistent racial and ethnic dimensions of the digital divide, the cause of such disparities, and policies that can close the home-internet adoption gap. Our analysis is based in comparative statistical analysis and econometrics: first, we look for differences in adoption between people in different racial or ethnic groups, then examine differences in adoption across specific sub-populations within those groups (*e.g.*, low-income households identifying as members of different racial or ethnic groups). We then model the impact of race, ethnicity, and other explanatory factors on home-internet adoption using various multivariate econometric techniques. Finally, we consider the results of all these analyses in context with other facts about the home internet market and similar product markets, as well as information on the impact that structural discrimination has on other aspects of society. From this, we make several conclusions about the causes of the racial/ethnic digital divide, suggesting actions that could narrow or close these gaps.

To begin this work, we must understand the basics of race in America. As discussed above, there are internet adoption gaps across many demographic factors. These include income, age, education, residence in a metropolitan area, household size, household composition (*i.e.*, presence of minors), home ownership, employment, and exposure to the internet outside of the home (*i.e.*, at work or school). There are differences in each of these factors for people identifying in different racial and ethnic groups, which we discuss below.

Before we begin, we note some important limitations in the data that impact our analytical approach. First, our analysis is based primarily on Census survey data. This survey allows householders to identify themselves and their household members as belonging to one of five races (White, Black, American Indian/Alaska Native, Asian, and Hawaiian/Pacific Islander), or a combination of two or more of these races. The Census then asks if a person is Hispanic. That identifies seven large and non-mutually exclusive racial/ethnic demographic groups (in descending order of population): Non-Hispanic White, Hispanic (of any race), Black, Asian, multiracial, American Indian/Alaska Native, and Hawaiian/Pacific Islander.

As shown below in Figure 20, non-Hispanic Whites (hereinafter, "Whites," unless specified otherwise) make up nearly 62 percent of the U.S. population as of July 2015, followed by Hispanics (18 percent), Blacks (13 percent), Asians (6 percent), persons of two or more races (2 percent), and American Indian/Alaska Natives (1 percent).[44] The overall sample size of the CPS is very large (comprising more than 149,000 persons in nearly 53,000 households), but some demographic groups have small representation in the survey.[45] These overall small sample sizes for certain groups means that we are unable to present statistically meaningful comparisons for all races/ethnicities in all of our cross-tabulation comparisons.[46]

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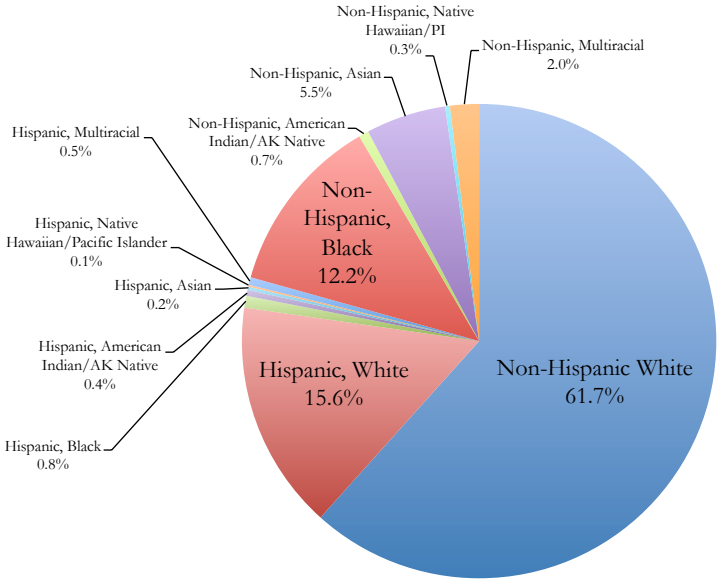
[44] As Figure 20 shows, the previous numbers exceed 100 percent because approximately 2 percent of the U.S. population identifies as of July 2015 as "Hispanic" and as members of one or more races other than White.

[45] The CPS sample sizes by race/ethnicity for persons is as follows: Non-Hispanic White (85,748); Hispanic (18,490); Black (14,319); Asian (6,419); multiracial (2,834); American Indian/Alaska Native (1,764); and Hawaiian/Pacific Islander (697). The household sample sizes are 2-3 times smaller.

[46] For example, persons and households with family incomes below $20,000 are a key demographic group of interest in our research. But the sample sizes for some races/ethnicities in this low-income group are too low to allow for statistically meaningful comparisons. The July 2015 CPS surveyed more than 10,000 non-Hispanic Whites and approximately 4,000 Hispanics and 4,000 Blacks with family incomes below $20,000. But the sample sizes of low-income persons in the other four primary race/ethnicity categories are very small (approximately 600 for Asians, 550 for American Indian/Alaska Natives, 500 for persons of two or more races, and 100 for Hawaiian/Pacific Islanders).

Thus, because of this sample size limitation, in many places in this report we focus on and show comparisons between persons or households that identify as White, Hispanic, or Black.

Figure 20:
Racial and Ethnic Composition of U.S. Population (2015)



Race/Ethnicity	Population (2015)	Percent of Population
Non-Hispanic White	194,834,770	62%
Hispanic, Any Race	55,882,475	18%
Black	41,217,074	13%
American Indian, Alaskan Native	3,408,440	1%
Asian	17,945,640	6%
Hawaiian/Pacific Islander	1,422,678	0%
Two or More Races	7,865,516	2%

sums to more than 100 percent, due to non-white Hispanics

Source: July 2015 Current Population Survey.

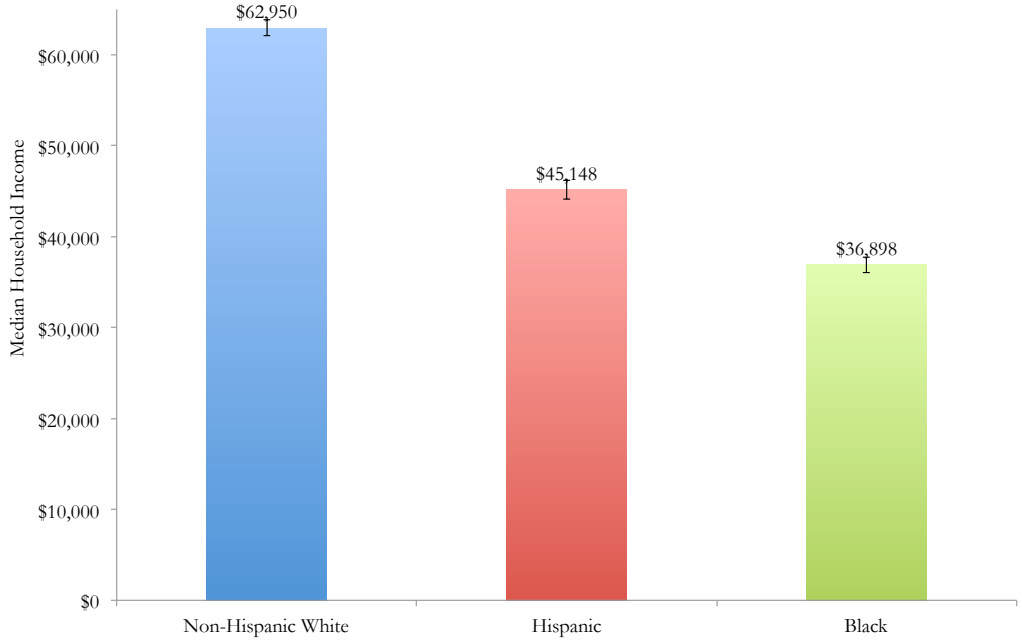
One of the key determinants of home internet access is a person's or household's income. And as is painfully obvious and well known, income inequality is rampant between people of different races and ethnicities. According to the 2015 Census report on the state of income inequality and poverty in this country, the median household income for Whites is above $60,000 – some 39 percent higher than the median for Hispanics, and 71 percent higher than for Black people (*see* Figure 21). This disparity stems from a host of factors including differences in earnings,[47] employment,[48] and labor force participation.[49]

[47] The Bureau of Labor Statistics ("BLS") tracks median weekly earnings by calendar quarter. According to the most recent release (data from the second quarter of 2016), "median weekly earnings for Black men working at full-time jobs were $704, or 74.8 percent of the median for White men ($941). The difference was less among women, as Black women's median earnings ($646) were 85.1 percent of those for White women ($759). Overall, median earnings of Hispanics who worked full time ($618) were lower than those of Blacks ($677), Whites ($854), and Asians ($1,021)." *See* U.S. Bureau of Labor Statistics, "Usual Weekly Earnings of Wage and Salary Workers: Second Quarter 2016," USDL-16-1492 (July 19, 2016).

[48] According to recent data from the BLS, for persons in the labor force, 5.3 percent of Whites were unemployed, compared to 7.4 percent of Hispanics, 11.3 percent of Blacks, 5 percent of Asians, 10.2 percent of persons of two or more races, 11.3 percent of American Indian/Alaska Natives, and 6.1 percent of Hawaiian/Pacific Islanders. *See* BLS 2014 Labor Force Characteristics, *supra* note 21.

[49] There are small differences in labor force participation between people of different races and ethnicities, which can impact overall household incomes. The following are the labor force participation rates according to the BLS: White (63 percent); Hispanic (66 percent); Black (61 percent); Asian (64 percent); persons of two or more races (64 percent); American Indian/Alaska Native (61 percent); Hawaiian/Pacific Islander (68 percent). *See id.*

Figure 21:
Median Household Income by Race/Ethnicity (2015)



Source: United States Census Bureau, "Income and Poverty in the United States: 2015" (Sept. 2016). Values differ from each other at p<0.1. (Error bars represent 90% confidence interval calculated by the Census Bureau using replicate weights.)

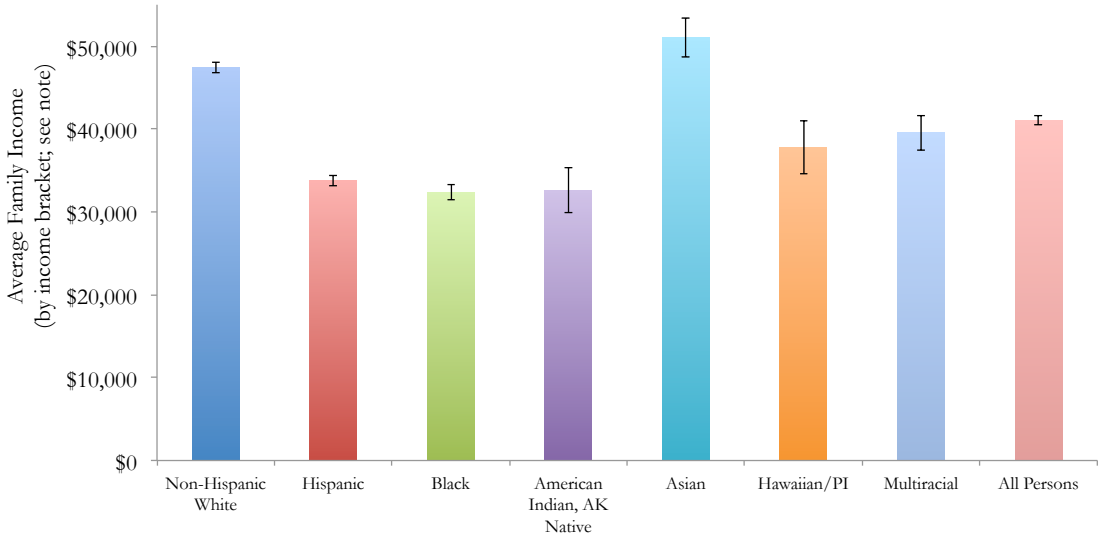
The CPS asks householders to self-report the combined income of all family members during the prior 12 months. However, the CPS does not ask for a specific value, it asks for reporting in one of 16 income ranges. The lowest range is less than $5,000 and the highest is $150,000 or more. Below in Figure 22 we show for each racial and ethnic group the dollar-converted figures of the averages of these income bin values. This data reflects the findings of other surveys showing that Whites and Asians have higher incomes than members of other racial/ethnic groups.[50] We note two caveats on this data. First, since this data reflects self-reporting, there is ample room for error – particularly considering that this variable has a 20 percent allocation rate.[51] Second, because the highest bin is open-ended, an average (or median value) of this CPS variable produces a value that is upper-limited, and lower than the true average or median value (*e.g.,* a billionaire's household will be reported simply as having an income of $150,000 or more).

These caveats aside, the CPS income variable is incredibly useful for our analysis. It reflects known income differences across races/ethnicities, educational attainment levels, age, and a host of other demographic factors that impact home-internet adoption. Income inequality between people of different races or ethnicities is obviously one of the most important demographic differences greatly impacting the digital divide. Exclusive of the additional impacts of other factors, including systemic discrimination, income inequality exacerbates the digital divide simply because of concerns about the affordability of home internet. And as the CPS data shows, Hispanics (22 percent) and Blacks (27 percent) are much more likely than Whites (11 percent) to live in poverty (*i.e.*, have annual family incomes below $20,000; *see* Figure 23).

[50] The referenced figure herein shows the dollar-converted averages of the July 2015 CPS income variable ("hefaminc"), which is a variable that captures a householder's/person's annual family income as a value in one of 16 income bins. The median values also reflect the differences shown in Figure 22: Whites ($60,000 to $74,999); Hispanics ($35,000 to $39,999); Blacks ($35,000 to $39,999); Asians ($60,000 to $74,999); persons of two or more races ($50,000 to $59,999); American Indian/Alaska Natives ($35,000 to $39,999); Hawaiian/Pacific Islanders ($50,000 to $59,999).

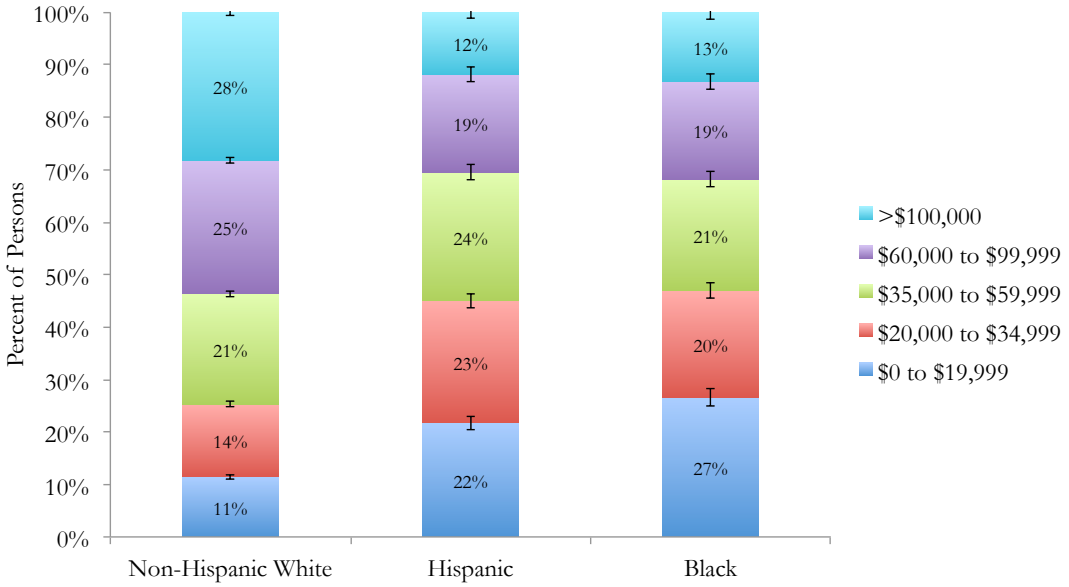
[51] *See* July 2015 CPS Technical Documentation, *supra* note 1, at p. 6-4.

Figure 22:
Average Family Income (upper-value limited)* by Race/Ethnicity (2015)



*Source: July 2015 Current Population Survey. Values for non-Hispanic Whites and Asians are statistically significantly different from all other races/ethnicities at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) *Results are based on self-reporting for 16 different income bins (i.e., not the actual value), with the top bin representing householders reporting annual family incomes of $150,000 or above. The average values shown above are below what the actual average annual family incomes are, due to the limited upper value.*

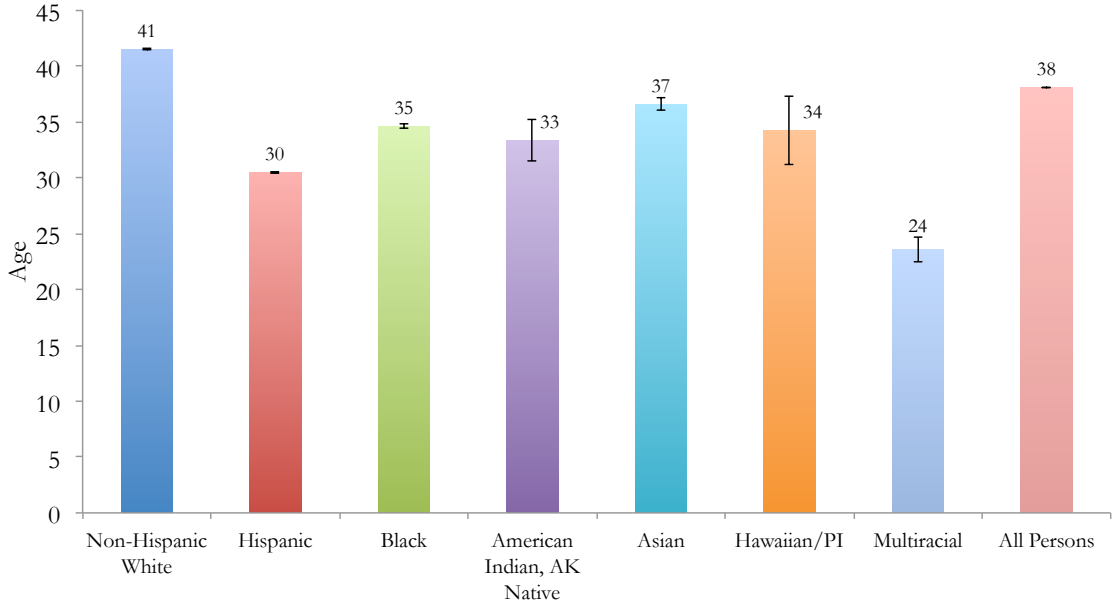
Figure 23:
Distribution of Family Income by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The Census Bureau urges caution when using answers for family income, due to approximately 20 percent allocation rate due to non-responses.

We've shown above that people over the age of 50 are less likely than younger people to have internet at home. Thus it's important to understand the differences in average ages between races/ethnicities. The average age of Whites (41) is substantially higher than the average age for Hispanics (30) or Blacks (35). (*See* Figure 24).[52]

Figure 24:
Average Age (upper-value limited)* by Race/Ethnicity (2015)



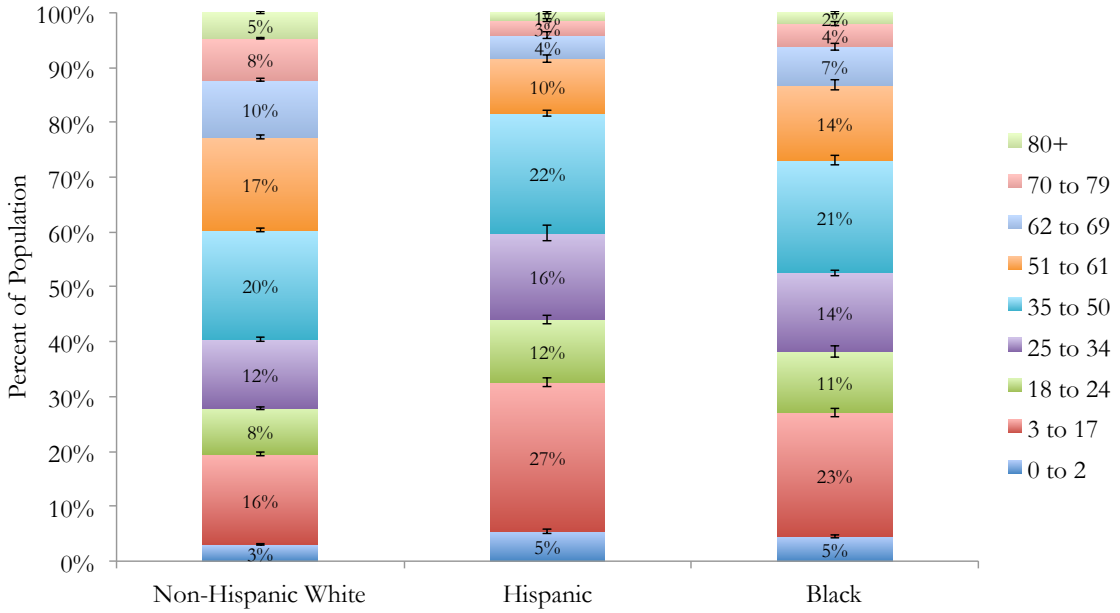
*Source: July 2015 Current Population Survey. Value for non-Hispanic Whites, Hispanics, and Multiracial persons are statistically significantly different from all other races/ethnicities at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) * Respondents report their specific age, up to 79. Persons age 80 to 84, and 85 and above are reported as single responses. This upper limit means that the values reported above are below the true averages.*

Average values are of course impacted by outliers. In this case, the relative age of Whites pushes their median age value higher than the average, and the relative youth of other races/ethnicities pushes their median age values below their averages.[53] As we see in Figure 25, Blacks and especially Hispanics skew very young relative to Whites. While 19 percent of Whites are under the age of 18, 28 percent of the Black population and nearly one-third of the Hispanic population are under the age of 18. By contrast, the White population is heavily skewed towards the older demographic that is less likely to have home internet. Only 18 percent of Hispanics and 28 percent of Blacks are above the age of 50, compared to 40 percent of Whites. These differences in age distribution could mitigate the impact of income on the racial/ethnic home-internet adoption gap; but other factors may swamp the impact of age, and household average ages are more relevant to household adoption. And as we discuss further below, there is a large home-internet adoption gap between Whites and non-Whites, even among the older age cohort (*see* Figure 36).

[52] It's important to note that these average age values are below the true averages, because the CPS variable for age is upper limited. Individuals under the age of 80 can report their actual age. Individuals ages 80 to 84 are coded as one group, as are persons age 85 and higher. The data indicates that 3.5 percent of the population were age 80 or older in July 2015, with 1.8 percent age 85 and older. Thus the impact of this upper-limiting on the average (and median) values is small.

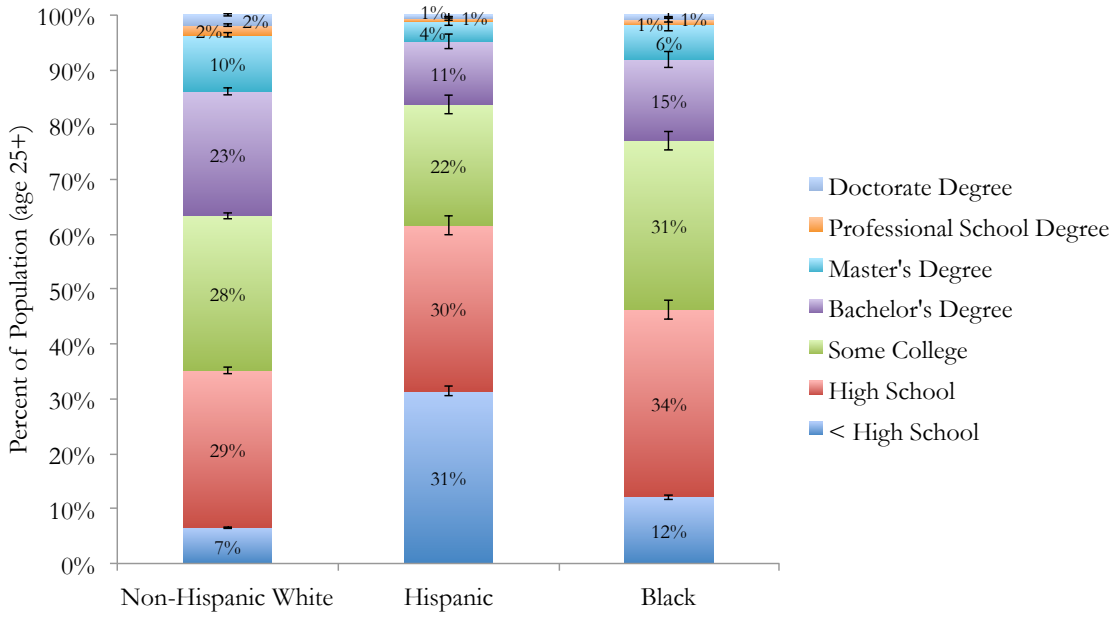
[53] The July 2015 CPS indicates the following median ages for each race/ethnicity: non-Hispanic White (43); Hispanic (28); Black (33); American Indian/Alaska Native (32); Asian (35); Hawaiian/Pacific Islander (33); and persons of two or more races (18).

Figure 25:
Distribution of Population by Age and Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure 26:
Distribution of Population by Education Level and Race/Ethnicity, for Persons Age 25 and Above (2015)

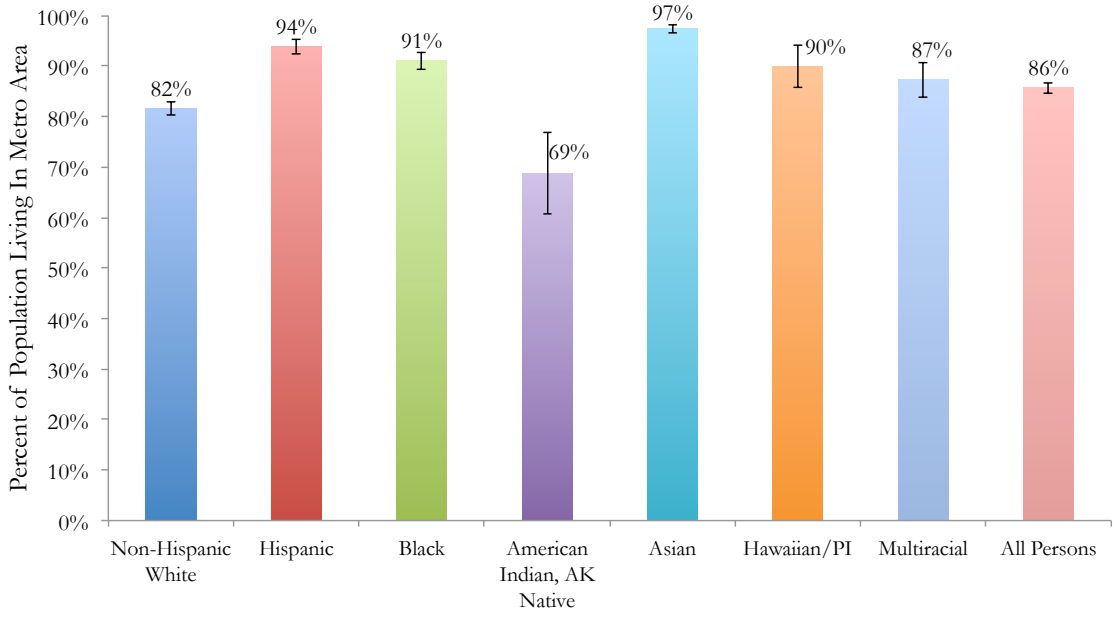


Source: Free Press analysis of July 2015 Current Population Survey. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

As also discussed above, educational attainment is closely related to home-internet adoption. This impact is most acute for persons with only high school or lower levels of education. And Hispanics and Blacks are disproportionately more likely than Whites to have lower levels of educational attainment, as shown in Figure 26.[54] Approximately 36 percent of Whites age 25 and older have a high-school or less level of education, compared to 61 percent of Hispanics and 46 percent of Blacks age 25 and above at those levels. We expect these differences in educational attainment between people of different races/ethnicities to be important in explaining the digital divide, both because of the impact that education has on earnings, and because of the differences in the types of jobs that persons with lower educational attainment typically have.

Approximately 81 percent of the U.S. population reside in urban areas, with 86 percent living in Census-designated metropolitan areas. As discussed previously, there is a small but significant difference in home-internet adoption between metro and non-metro areas, for a variety of potential reasons. And thus it's important to note that the non-White population is far more likely to be located in metro areas, with the exception of American Indian/Alaska Natives (*see* Figure 27). This could in theory mitigate the impact of race and ethnicity on the digital divide, though as we show below it actually does not.

Figure 27:
Proportion of Population Living in Metropolitan Areas by Race/Ethnicity (2015)

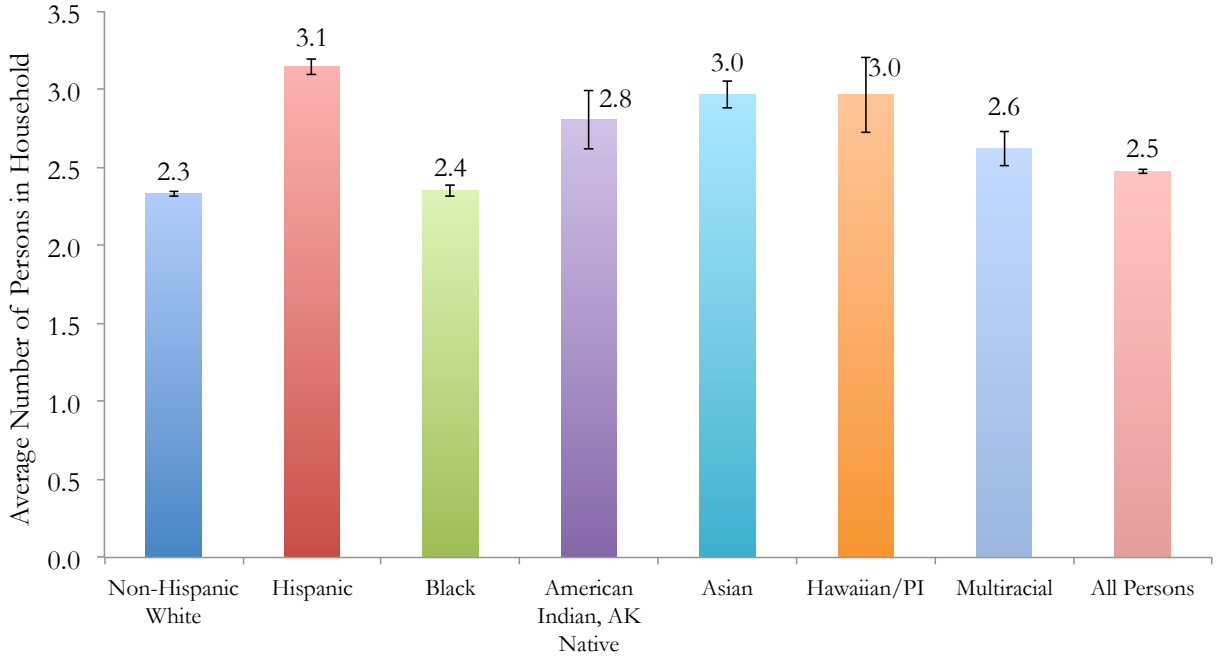


Source: Free Press analysis of July 2015 Current Population Survey. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

[54] The CPS allows respondents age 15 and older to report their educational attainment in one of 16 possible categories. To facilitate meaningful statistical comparisons, we combined these 16 categories into the 7 categories shown in Figure 26. We combined the first 8 of these into a category for less than a high-school diploma or equivalent level of education. And we combined the three categories representing associate degrees or some college into the "some college" category. Also, we've presented data for persons age 25 and above in order to reduce the impact of the relative youth of the Hispanic and Black populations on educational attainment levels. Our econometric analyses are primarily performed at the household-level, and there we use a variable representing the highest level of educational attainment within a household.

Households with only one or two members are less likely than those with three or more to have home internet; and very large households are less likely to have home internet than medium sized households. (*See* Figure 12 above). There are small but statistically significant differences in household size between members of different racial/ethnic groups (*see* Figure 28). White households have the fewest members on average (2.3), with Hispanic households having the highest average (3.1 members). There's no difference between White and Black households, and with all other factors like income held constant, we'd expect these differences in household size to have a very small impact on home-internet adoption (in isolation, or through their impact via race/ethnicity).

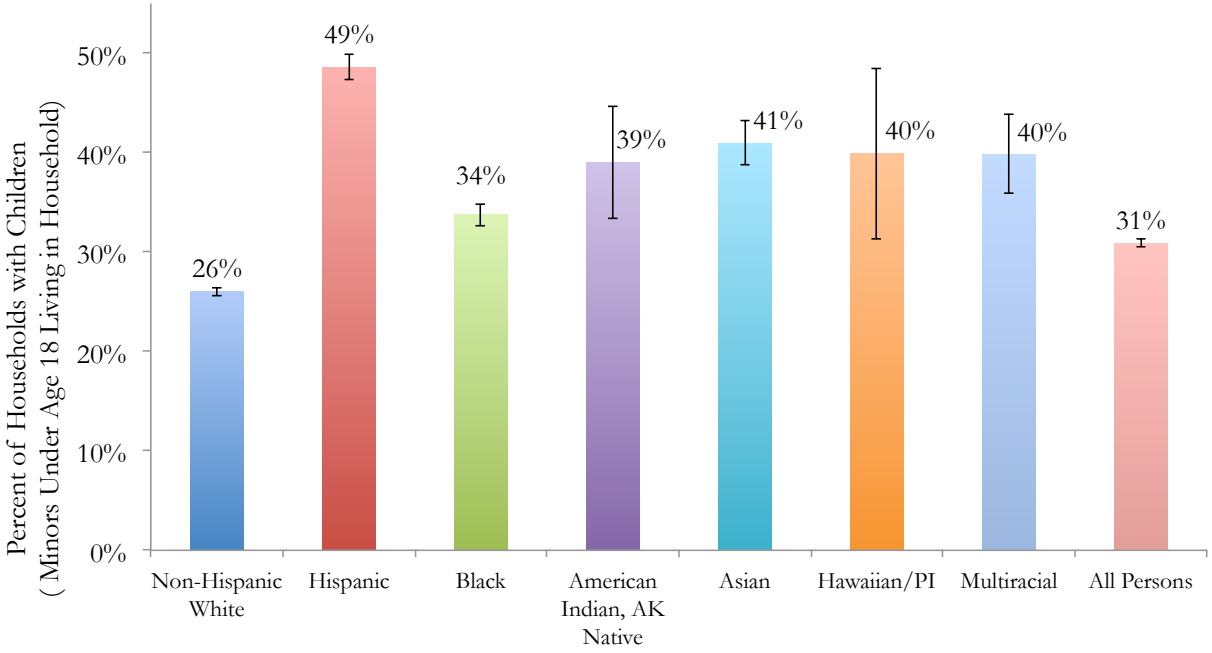
Figure 28:
Average Household Size by Race/Ethnicity of Householder (2015)



Source: July 2015 Current Population Survey. The average number of persons living in a non-Hispanic White householder's home and a Black householder's home are statistically significantly smaller than the average household size of all other race/ethnicities. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

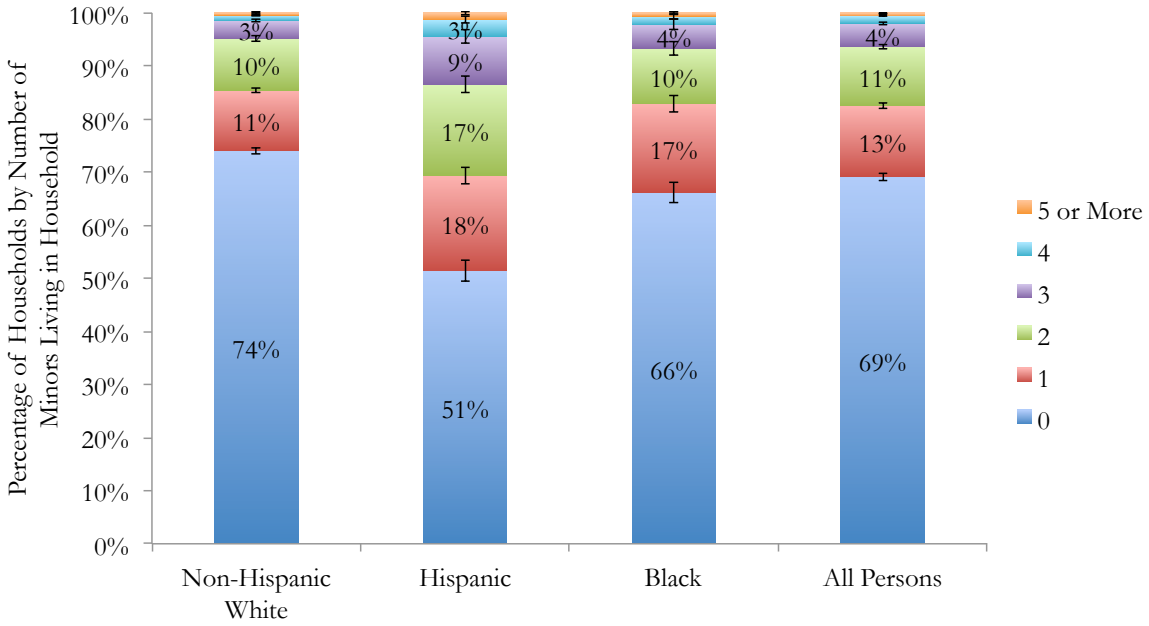
Households with children are more likely than those without children to have home internet (*see* Figure 13 above). As we first discussed above, this observation is potentially due in part to differences in the average ages and median incomes of households with children when compared to those without children. (The households with children have higher median incomes, but older ages on average for their adult members). Presence of a minor appears to be an important factor impacting home adoption. However, White households are far less likely to have minors living in them when compared to households headed by people of other races/ethnicities (*see* Figure 29). And when there are children present, households composed of people of color are also more likely than White households to have two or more children (*see* Figure 30).

Figure 29:
Presence of Minors Under Age 18 in Household, by Race/Ethnicity of Householder (2015)



Source: July 2015 Current Population Survey. The difference between the percentage of non-Hispanic White households with minors and all other races/ethnicities is statistically significant at p<0.05, except for Hawaiian/Pacific Islander households, which is statistically significant at p<0.1. The difference between the percentage of Hispanic households with minors and all other races/ethnicities is statistically significant at p<0.05, except for American Indian/Alaska Native households, which is statistically significant at p<0.1, and Hawaiian/Pacific Islander households, which is not significantly different. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

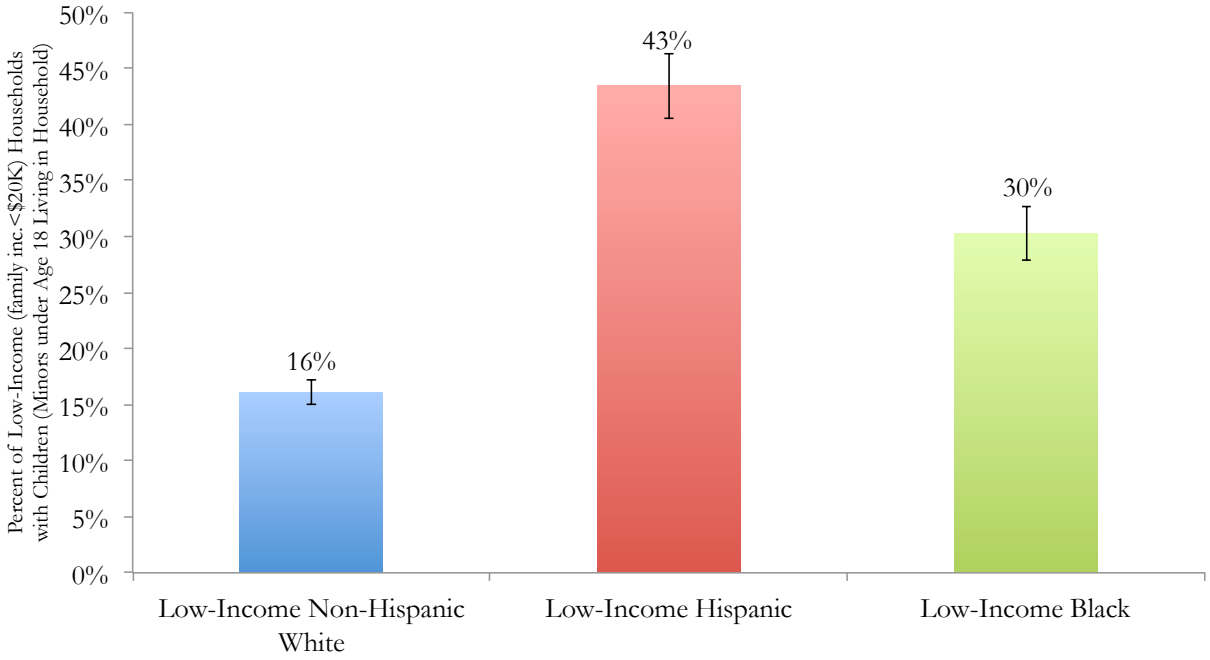
Figure 30:
Distribution of Households by Number of Minors in Household and Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

The percentage of Black and Hispanic households with children in them is higher than the percentage of White households with children. And typically we see a higher level of home-internet adoption in households with children, relative to adoption by households without children. But despite their increased likelihood of having children in the home, Black and Hispanic households are less likely to have home internet. This indicates that factors like income have a larger impact on home adoption than the presence of children does. And the data bares this out. Not surprisingly, just as people of color in general are, children of color are more likely to live in poverty. The most recent CPS data indicates that 9 percent of White children (defined as under 18 years of age) have family incomes below $20,000, compared to 24 percent of Hispanic children and 30 percent of Black children. Low-income householders of color are also more likely to have children in their homes. For example, 16 percent of low-income households (meaning annual family incomes below $20,000) headed by a White person have one or more minors present, compared to 43 percent of low-income Hispanic households and 30 percent of low-income Black households (*see* Figure 31).[55]

Figure 31:
Presence of Minors Under Age 18 in Households with Annual Family Incomes Below $20,000, by Race/Ethnicity of Householder (2015)



Source: July 2015 Current Population Survey. All differences are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

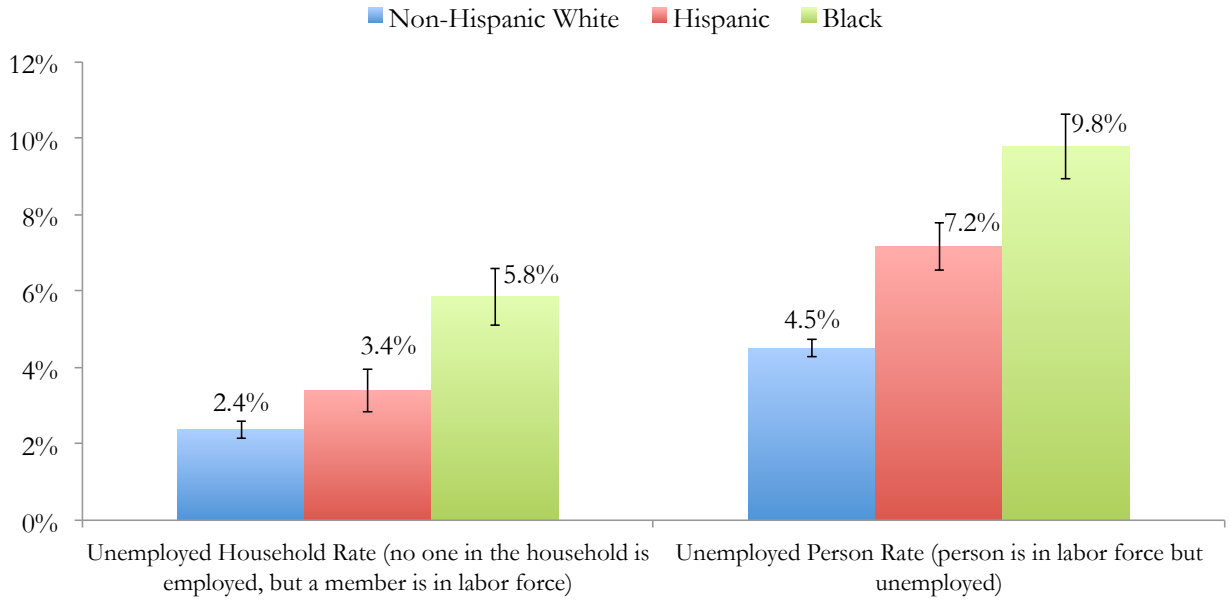
Children living in poverty creates a host of immediate social concerns, such as access to adequate nutrition, health care, education, housing, and other basic needs. But because poverty is often an inescapable situation, these children in low-income households are more likely to grow into adults on the wrong side of many divides, including the digital divide. As we discuss herein, exposure to internet use in schools is positively associated with internet use and adoption at home. Thus, equitable technology access and training in schools (and in these students' homes) is a critical component of closing the digital divide in future years.

[55] There are also differences in the number of children in low-income households of different races/ethnicities. Low-income non-Hispanic White households have on average 0.29 children present (95 percent confidence interval of 0.27 to 0.31), compared to an average of 0.95 children in low-income Hispanic households (95 percent confidence interval of 0.88 to 1.02), and an average of 0.57 children in low-income Black households (95 percent confidence interval of 0.52 to 0.62) (as calculated from July 2015 CPS, using successive difference replication standard error values).

There are important differences between people of different races and ethnicities when it comes to employment and labor force participation. Whites (4.5 percent) in the labor force have a lower level of unemployment than Hispanics (7.2 percent) and Blacks (9.8 percent) in the labor force.[56] There are similar differences in labor force participation.[57]

An individual's employment status impacts home-internet adoption (via the impact on their household's total income, as well as the impact on their household's overall demand). But because of the generally high demand for internet access, a household's overall employment status is a more important factor for adoption than an individual's employment status.[58] And just as for individual-level employment, there are significant differences in household employment level between households of different races or ethnicities. As of mid-2015, 5.8 percent of Black households were in the labor force but had no employed member, compared to 3.4 percent of Hispanic and 2.4 percent of White households in the labor force (*see* Figure 32).

Figure 32:
Household and Individual Unemployment Rates by Race/Ethnicity (2015)



Source: July 2015 Current Population Survey. The unemployed household rate represents the ratio of the number of households that have one or more members in the labor force but have no one currently employed, to the number of households that have one or more members in the labor force (i.e., the denominator is smaller than the total number of households for each race/ethnicity because some households have no members in the labor force, either employed or unemployed). The unemployed person rate represents the ratio of the number of unemployed persons in the labor force to the number of persons in the labor force. The difference between the household unemployment person rates is statistically significant at $p<0.05$ for all races/ethnicities shown. The difference between unemployed person rates is statistically significant at $p<0.05$ for all races/ethnicities shown. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

[56] These values from July 2015 differ slightly from those reported by the BLS for 2014 (which are 2014 averages of the CPS). *See* BLS 2014 Labor Force Characteristics, *supra* note 21, showing for 2014 that Whites (5.3 percent) and Asians (5 percent) in the labor force have lower levels of unemployment than members of other races/ethnicities who are in the labor force (7.4 percent of Hispanics; 11.3 percent of Blacks; 10.2 percent of multiracial persons; 11.3 percent of American Indian/Alaska Natives; and 6.1 percent of Hawaiian/Pacific Islanders).

[57] *See id.*

[58] Among households in the labor force, 65 percent of those with no employed members have home internet. Among persons in the labor force, 75 percent of those who are unemployed have home internet access.

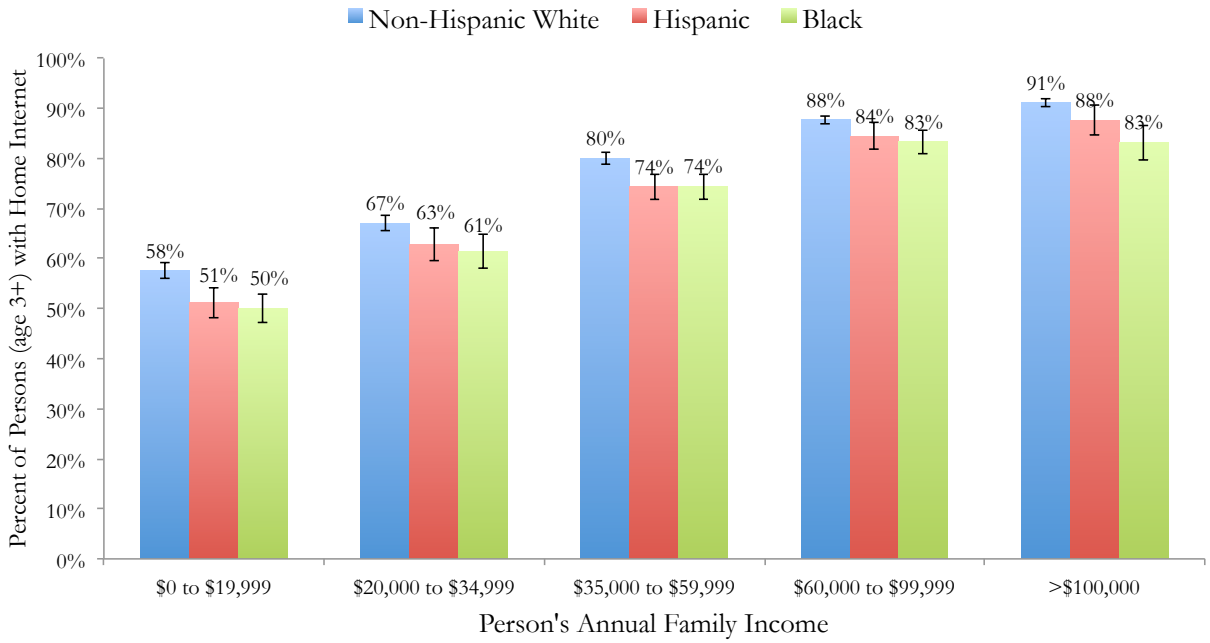
Gaps in Home-Internet Adoption Remain Between Whites and Non-Whites, Even Within Specific Sub-Populations.

We've established the basic contours of the digital divide. Whites and Asians have higher levels of home-internet adoption than members of other races/ethnicities. Income, educational attainment, and residing in a metropolitan area are each positively associated with home-internet adoption. People above 50 years of age are less likely than younger people to have internet access at their home. Households with kids are more likely to have internet than those without kids. Single-person households are less likely to subscribe, as are households that are in the labor force but have no employed members. And exposure to the internet at work or school is positively associated with home adoption.

We next examine how home-internet adoption varies between people of different races and ethnicities even when we account for these other metrics. The primary purpose is to look for persistent gaps in home adoption between people of different races or ethnicities, identifying divides not fully explained by income differences (or differences in these other metrics) alone. We ultimately provide econometric analysis that attempts to isolate the impact of each factor; but whether or not we can completely isolate the effects in each instance, these cross-tabulations at the very least help improve understanding of the nature of the digital divide and its impact within specific populations.

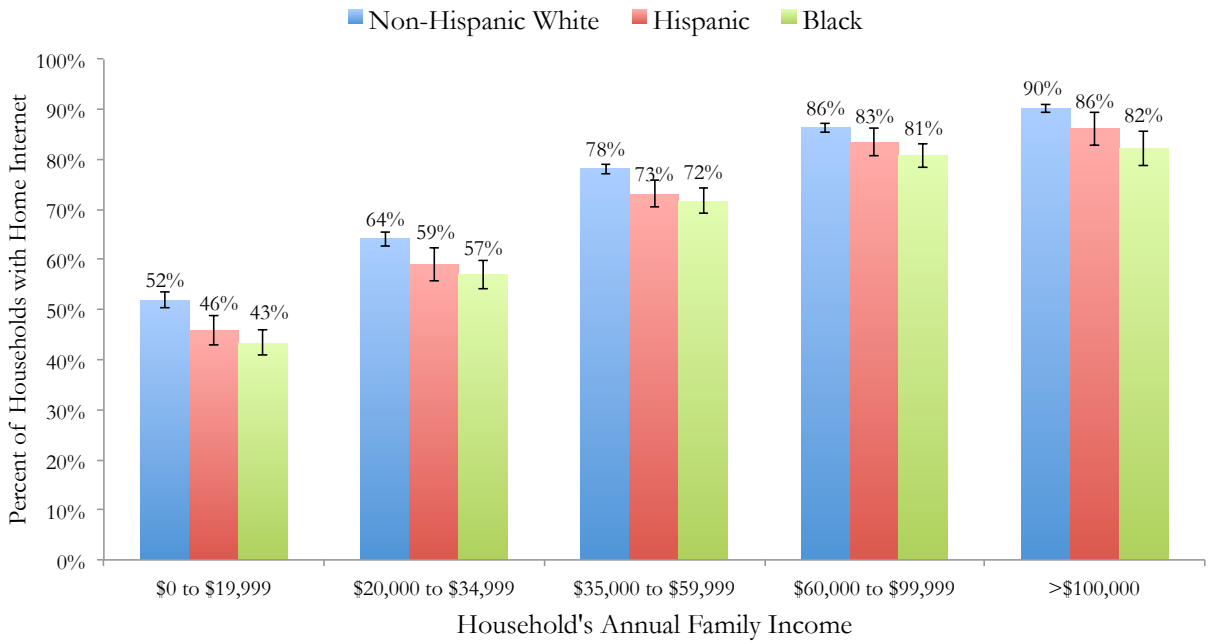
To begin, we note that the gaps in home-internet adoption between Whites, Hispanics, and Blacks are largest among persons with incomes below $20,000 (*see* Figure 33). This is also the case for household-level adoption (*see* Figure 34). And for persons and households with family incomes above $60,000, there is no statistically significant difference in home-internet adoption between Whites and Hispanics. The gap in home adoption between White and Black persons and/or households is statistically significant across all income strata, but generally narrows as incomes increase.

Figure 33:
Home-Internet Adoption by Race/Ethnicity and Family Income (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and Hispanics are statistically significant at p<0.05 for persons with family incomes below $20,000, and for persons with family incomes between $35,000 and $59,999. Differences between values for non-Hispanic Whites and Blacks are statistically significant at p<0.05 for all income strata. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure 34:
Household-Level Home-Internet Adoption by Race/Ethnicity and Family Income (2015)

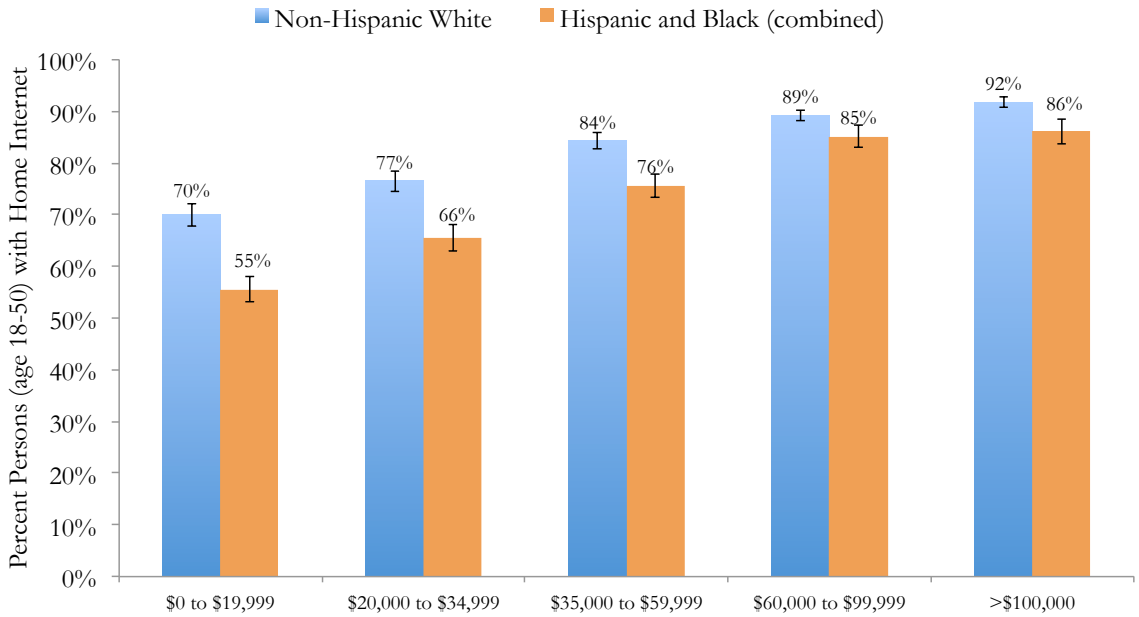


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic White households and Hispanic households are statistically significant at p<0.05 for households with family incomes below $60,000. Differences between values for non-Hispanic Whites and Blacks are statistically significant at p<0.05 for all income strata. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

As discussed above, the age of 50 is a key demarcation point for home-internet adoption. We also noted that the White population skews older, while the Hispanic and Black populations skew younger. To better capture the differences in home adoption between people of different races or ethnicities across different income strata, and in light of these differing population distributions by age, we reproduce the income-race home internet cross-tabulations separately for the respective sub-populations above age 50 and below age 50. However, the sample sizes of Hispanic or Black persons/households in some of these income strata are small, leading to large margins of error relative to the differences in the observed adoption levels between these groups and White persons/households. If we further segment these populations by age, these error ranges will increase. Therefore, to overcome this problem while maintaining an instructive comparison, we combine the Hispanic and Black populations.

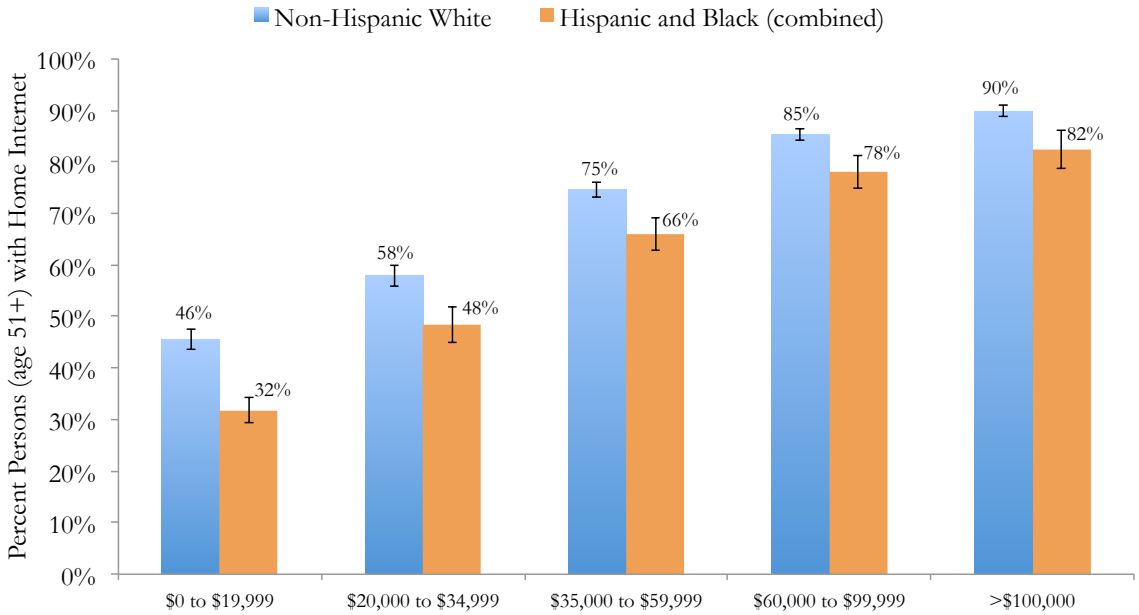
The result of this analysis is present below in Figure 35. There are significant gaps in home-internet adoption between Whites who are age 50 or younger and Hispanics or Blacks in this same age cohort across all income strata. But the magnitude of this gap is substantially larger for persons with low-incomes. This result also holds for people of different races/ethnicities across all income strata among persons age 51 and older. We note too that the race/ethnicity-based adoption gaps for people in high-income brackets are even larger for this older cohort than are the adoption gaps for people age 50 and under in these high-income brackets. (At age 50 and under, for persons reporting incomes of more than $100,000 per year, Whites outpace non-Whites in home-internet adoption by 6 percentage points. At age 51 and older, in that same income category, Whites outpace non-Whites by 8 percentage points.

Figure 35:
Non-Hispanic White vs. Hispanic and Black Home-Internet Adoption, by Family Income, for Persons Age 3 to 50 (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and the values for Hispanics and Blacks (combined) are statistically significant at p<0.05 for all income strata (error bars represent 95 percent confidence interval calculated using successive difference replication standard error values).

Figure 36:
Non-Hispanic White vs. Hispanic and Black Home-Internet Adoption, by Family Income, for Persons Age 51 and Above (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and the values for Hispanics and Blacks (combined) are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

This large gap between Whites and non-Whites in home-internet adoption, evident even among people with very limited incomes, is a consistent observation across other demographic factors. This is an indication of a problem in the broadband market. It could indicate a difference in demand between low-income Whites and low-income non-Whites, and such differences could be attributable to the impact of systemic discrimination in other sectors. (*E.g.*, populations with less exposure to the internet at work may have reduced demand for home internet.) However, if demand in low-income communities of color is equal to demand by low-income Whites (and survey data discussed below suggests demand in poor households headed by people of color is indeed very high), then this gap in adoption is a likely sign of one or two problems: that the broadband market is not meeting the demands of communities of color; and/or that people of color are prevented by non-market factors from exercising their demand for home internet.

Both things can be true simultaneously (*i.e.*, systemic discrimination can impact both ability to meet demand and the ability for people of color to exercise it). However, our analysis strongly suggests that demand for internet access is extremely high in low-income communities of color, and that market failures are responsible for the large adoption gaps between low-income people of different races and ethnicities.[59]

Low-income households and households headed by people of color both are less likely to have home internet connections. But if they do connect at home, they are more likely to rely solely on mobile wireless. While it's encouraging that members of typically marginalized communities are connecting by any means, mobile-only households do not have access to the full participatory benefits of fixed broadband connections, which typically offer far greater speeds and higher data caps (or no caps). Furthermore, unlike with a fixed connection, a mobile-only household's connection may not always be available to everyone in the household. The primary account holder is likely to take the mobile device with them when they leave the home.

As shown above, 18 percent of White households with home internet connect solely via mobile, while 28 percent of Hispanic and Black internet homes are mobile-only. This racial/ethnic gap persists among the poorest households, even when we control for income. One quarter (25 percent) of low-income White households that have home internet connect using only mobile cellular data services, while 36 percent and 37 percent of low-income Hispanic and Black internet households do (*see* Figure 37).

This is the inverse of the data for wired home-internet adoption. 36 percent of low-income White households have cable, DSL, or fiber connections, but only 26 percent of low-income Hispanic or Black households do (*see* Figure 38). This gap narrows in the highest income brackets, but does not disappear. Again, if demand for wired broadband is similar for people across all races and ethnicities, this disparity in wired adoption suggests the possibility that there is something in particular about the wired home internet market that is responsible for this gap.

The over-reliance by Hispanic and Black internet households on mobile service is partially driven by the affordability concerns voiced by many members of these communities. But as we explain below, the higher level of competition in mobile and the widespread availability of prepaid mobile services contribute to making such services more affordable, and thus contribute to low-income populations and people of color over-indexing on mobile.

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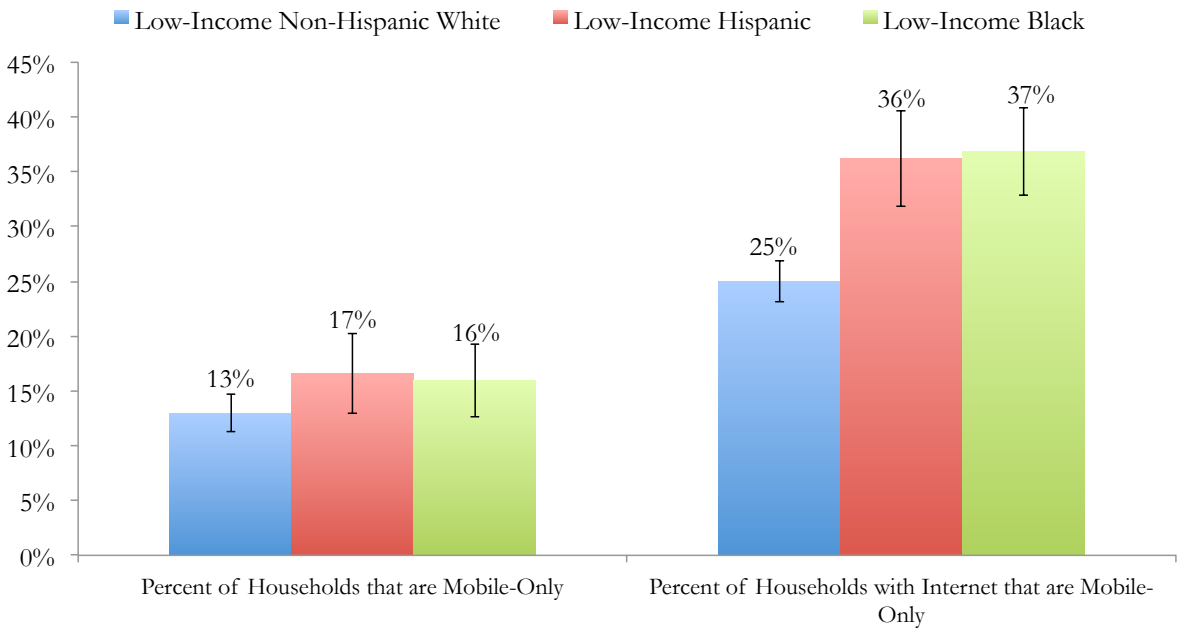
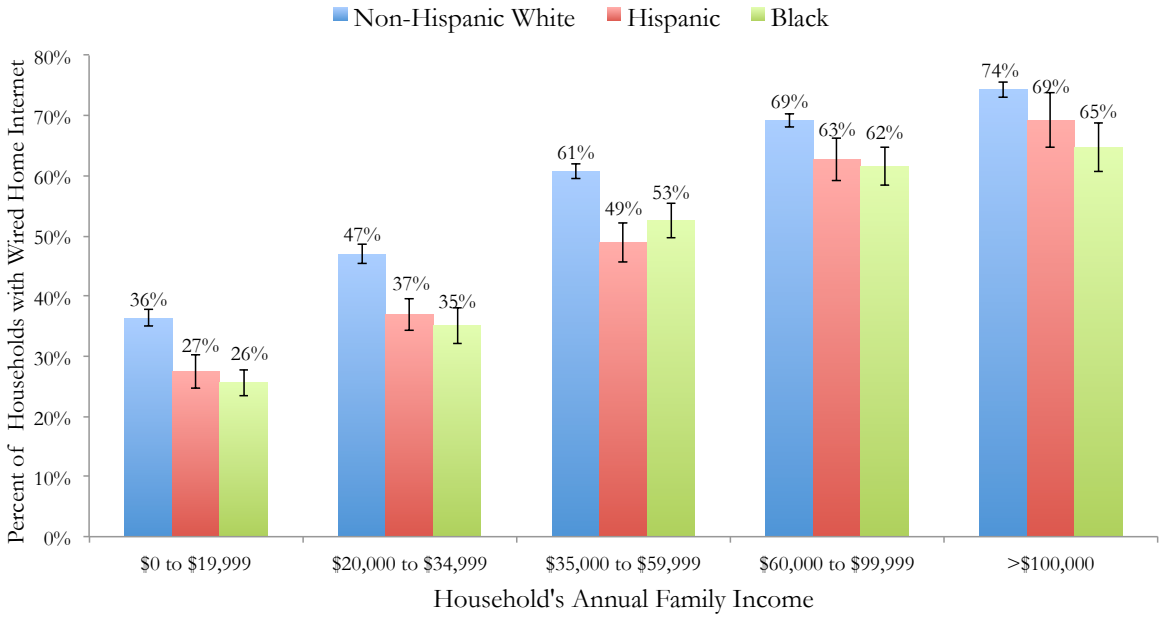
[59] We note that there are gaps between Whites and Blacks at higher incomes, though these gaps are substantially smaller than they are at lower incomes. As we discuss herein, there are aspects of the home internet market that disproportionately impact low-income consumers of color, such as credit check requirements. This would presumably be a much smaller adoption barrier for households with higher incomes. But other factors such as differences in deployment (and marketing of services) to communities of color, can also lead to gaps in adoption between households with higher incomes of different races or ethnicities. Furthermore, as we address in Part VIII, it's possible that network effects explain a small portion of these adoption gaps. That is, even if a high-income household can afford broadband, it may choose not to adopt if a substantial portion of its social circle is not online – a situation that is exacerbated by systemic discrimination and broadband market failures.

Figure 37:
Low-Income Households That Access the Internet Only via Mobile, by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between non-Hispanic White households with home internet that are mobile-only and Hispanic households with home internet that are mobile-only are statistically significant at p<0.05. The differences between non-Hispanic White households with home internet that are mobile-only and Black households with home internet that are mobile-only are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values). The universe for the first column is all households. The universe for the second column is households that have a home internet connection.)

Figure 38:
Households That Access the Internet via Wired Technology, by Race/Ethnicity (2015)

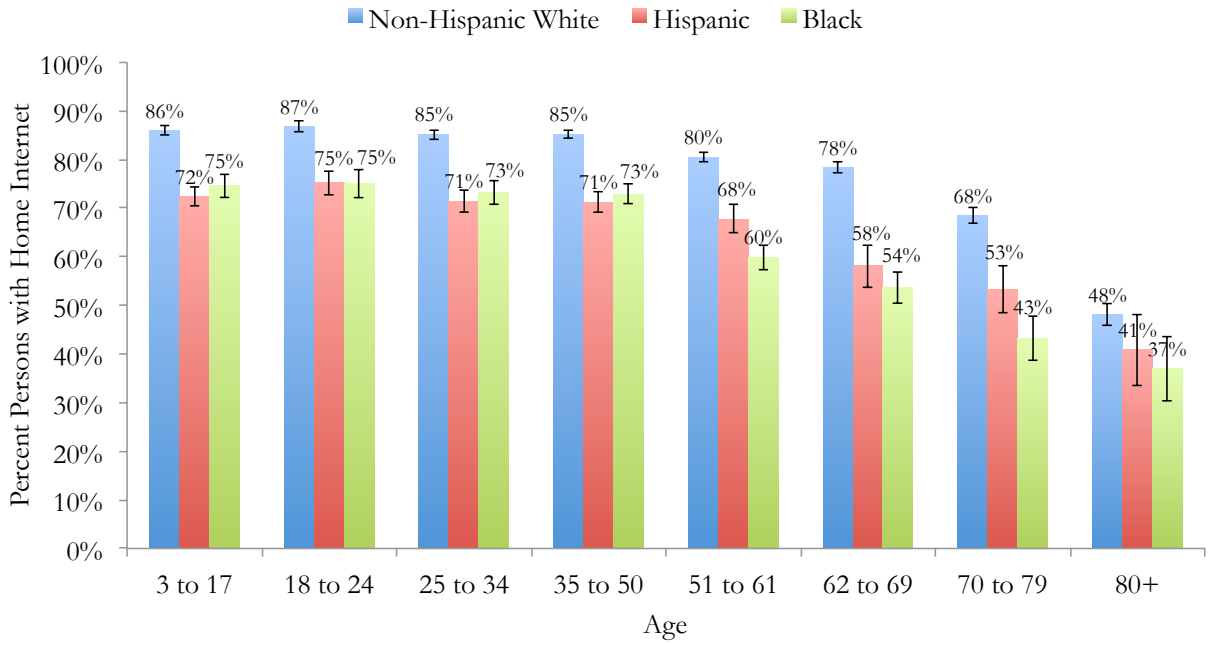


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between non-Hispanic White households and Hispanic households are statistically significant at p<0.05 for all income categories except households with family incomes above $100,000. The differences between non-Hispanic White households and Black households are statistically significant at p<0.05 for all income strata. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

People in typically marginalized and under-served racial and ethnic communities lag behind Whites in home-internet adoption in every age group (*see* Figure 39). For example, for people under age 50, 86 percent of Whites have home internet, versus 72 percent of Hispanics and 74 percent of Blacks. This sizable gap is seen in middle-aged groups as well. Home-internet adoption is 80 percent for Whites between ages 50 and 70, versus just 66 percent for Hispanics and 59 percent for Black people in this age group.

The overall relationship between consistent and high levels of home-internet adoption among persons age 50 and younger, and the rapidly declining adoption levels for persons above age 50, is observed across the three largest racial/ethnic groups. However, there are important differences. While the home-internet adoption gap between White households and Hispanic or Black households is large for persons age 50 and under, it's approximately of the same magnitude as the overall race/ethnicity home-adoption gap. But the adoption gap between White households and Hispanic or Black households widens substantially for persons above the age of 50. The gulf between White and Black households is particularly large for persons older than 50: nearly 20 percentage points. And as is the case for other demographic factors, the racial/ethnic differences in home adoption between people in different age categories persists even among the poorest households.[60]

Figure 39:
Home Internet by Race/Ethnicity and Age (2015)



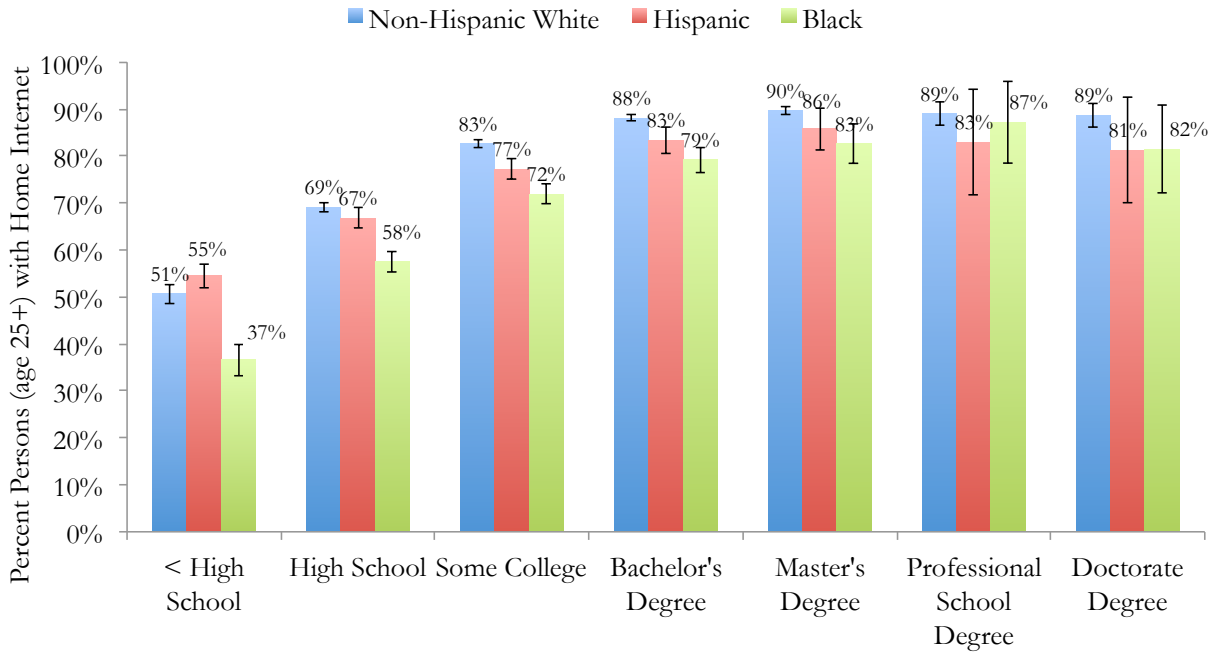
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and Hispanics, and for non-Hispanic Whites and Blacks, are statistically significant at p<0.05, except those for persons age 80 and above. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

[60] Among the poorest people in America, there is a gap in home-internet adoption between races/ethnicities, across all age groups. For example, home-internet adoption is 74 percent for Whites under age 25 with annual family incomes below $20,000, versus 57 percent for Hispanics and 63 percent for Blacks in this age and income group. This adoption gap among poorer populations, even for young demographics with higher demand for internet access, again suggests structural factors contributing to the racial/ethnic digital divide.

As we've noted, there is a clear line of demarcation in home-internet adoption between people with bachelor's degrees or higher, and people with lower levels of educational attainment. There are pronounced disparities in educational attainment between people of different races and ethnicities (*e.g.*, 36 percent of Whites age 25 and above have just a high-school or lower level of education, compared to 61 percent of Hispanics age 25 and above, and 46 percent of Blacks age 25 and above at those levels). We expect that these educational level differences impact the digital divide. However, there are also large differences in home-internet adoption – even among these sub-populations of persons with relatively low levels of educational attainment – between similarly educated people of different races or ethnicities (*see* Figure 40). Specifically, among those age 25 and above with a high school or lower level of educational attainment, Black people have substantially lower levels of home-internet adoption than both Hispanics and Whites.

As indicated in Figure 40, the sample sizes in the July 2015 CPS for Hispanic and Black persons with advanced degrees are too low to make meaningful comparisons. However, if we examine persons age 25 and above with Bachelor's-level or higher degrees, we see a small but statistically significant difference in home-internet adoption between Whites and Hispanics (89 percent vs. 84 percent), and between Whites and Blacks (89 percent vs. 81 percent).[61] The data shows a particularly acute adoption gap for Black people with lower education levels, narrowing somewhat for those with higher educational attainment.

Figure 40:
Home-Internet Adoption by Race/Ethnicity and Educational Attainment, for Persons Age 25 and Above (2015)

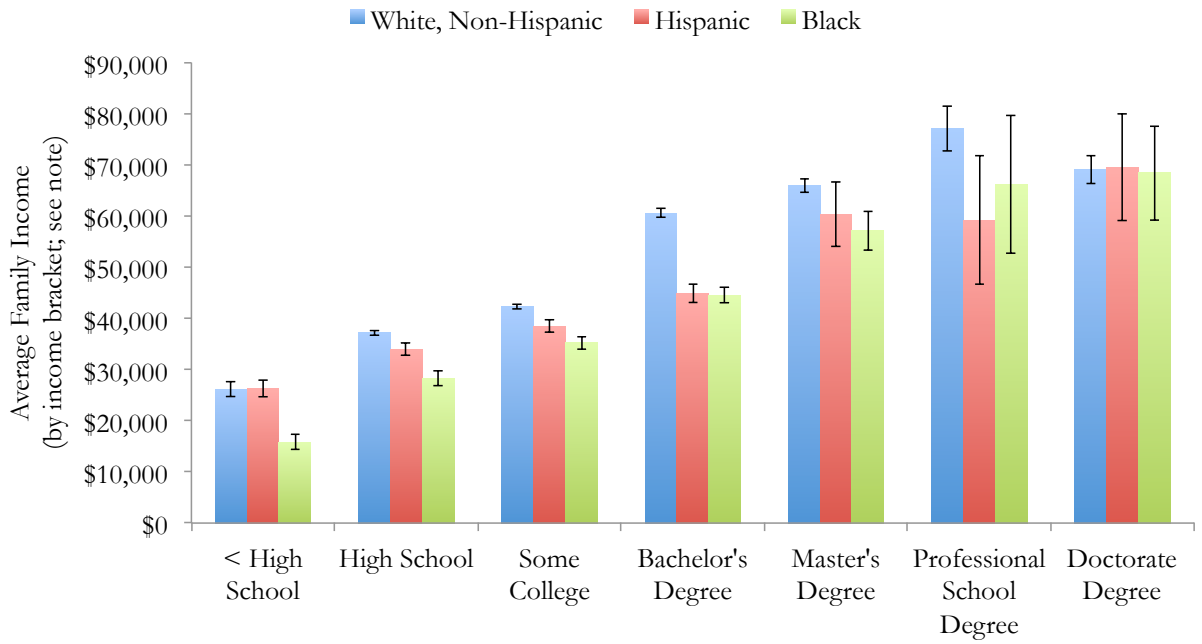


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and Hispanics are statistically significant at p<0.05 for persons age 25 and above with some college or a bachelor's degree. Differences between values for non-Hispanic Whites and Blacks are statistically significant at p<0.05 for persons age 25 and above Bachelor's degree or lower levels of educational attainment. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

[61] The value for home-internet adoption among Whites who are age 25 and above, and who have a Bachelor's-level or higher degree, is 88.6 percent, with a 95 percent confidence interval of 88.0 percent to 89.2 percent. The value for home-internet adoption among Hispanics age 25 and above with Bachelor's-level or higher degree is 83.9 percent, with a 95 percent confidence interval of 81.4 percent to 86.4 percent. The value for home-internet adoption among Blacks who are age 25 and above with Bachelor's-level or higher degree is 80.6 percent, with a 95 percent confidence interval of 78.3 percent to 82.9 percent.

Because of the strong relationship between educational attainment and income, we suspect that the overall low level of internet adoption among persons with only a high school degree or less[62] may be largely driven by affordability concerns.[63] But what can explain the data showing disproportionately low home-internet adoption levels for Black people with low educational attainment, as compared to Hispanics and Whites with similar education levels? It appears that the answer lies in the differences in incomes between people of different races or ethnicities across these various levels of educational attainment. As we see in Figure 41, there is no difference in average incomes between people who identify as Hispanics or Whites, and who in each case do not have a high school degree; but members of both of these groups without high school or equivalent degrees have substantially higher incomes than Blacks in this same education cohort.[64]

Figure 41:
Average Family Income (upper-value limited)*
by Race/Ethnicity and Educational Attainment for Persons Age 25 and Above (2015)



*Source: July 2015 Current Population Survey. Differences between values for Blacks and non-Hispanic Whites are statistically significant at p<0.05 for all educational attainment levels except for professional school and doctorate degrees. Differences between Hispanics and non-Hispanic Whites are statistically significant at p<0.05 for educational attainment levels of high school, some college, bachelor's and professional school degrees. Differences between values for Blacks and Hispanics are statistically significant at p<0.05 for educational attainment levels of less than high school, high school and some college. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) *Results are based on self-reporting for 16 different income bins (i.e., not the actual value), with the top bin representing those persons reporting annual family incomes of $150,000 or above. Therefore the average values shown here are below the actual average annual family incomes, due to the limited upper value. Also, the Census Bureau urges caution when using answers for family income, due to an approximately 20 percent allocation rate due to non-responses.*

[62] Approximately 63 percent of persons age 25 and older with a high school degree or no degree have home internet. Approximately 84 percent of persons age 25 and older with education above this level have home internet.

[63] It's of course also likely that differences in exposure to technology between persons with high and low educational attainment contributes a portion of the education-related home-internet adoption gap.

[64] The median family income range for Whites age 25 and above and for Hispanics age 25 and above, each with less than a high-school education, is $25,000 to $29,999. It's just $15,000 to $19,999 for Blacks in this age/education cohort. For persons age 25 and above with high school degrees, the median family income range is $40,000 to $49,999 for Whites; $35,000 to $39,999 for Hispanics; and $30,000 to $34,999 for Blacks.

The differences in family incomes between people of color and Whites, even among those with the same level of education, is a possible outcome of structural discrimination. This is not necessarily the case, of course, since this is a family-level variable. That means, in theory, that other differences in the household compositions of people of different races or ethnicities could possibly account for these observed differences too. But the results of multivariate regression analysis suggest that such other factors do not account for this racially driven income disparity.[65] That is, even after controlling for a variety of household characteristics including educational attainment, age, employment, geographic location, and other factors, we still observe that non-Whites have lower family incomes than Whites.

These income differences between people of different races and ethnicities, even after accounting for other demographic factors, are very important to the discussion of digital divide. All things being equal, if a person of color has the same educational level and same household composition that are generally associated with high demand for home internet, but that person of color has less available income, they will be less likely to subscribe. This is an example of how structural discrimination can indirectly impact the digital divide through its demonstrated impact on income inequality. This also demonstrates the absolute need for any policy solutions, or other efforts that are designed to close the adoption gap, to focus on increasing the affordability of home internet access.

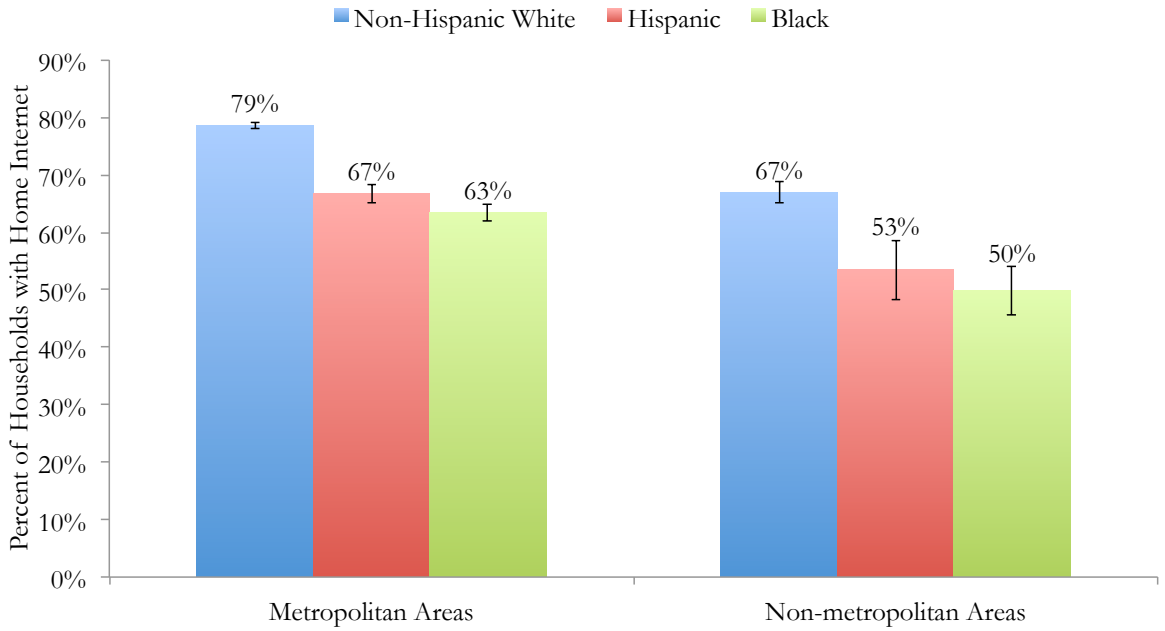
As noted previously, home-internet adoption is higher in metropolitan areas than in non-metro areas. And yet, as is the case for most other such determinants, there is still a gap in home-internet adoption (both in metro areas and non-metro areas) between White households, on one hand; and Hispanic and Black households, on the other hand. (*See* Figure 42).

The White low-income population is disproportionately located in non-metro areas, compared to the Hispanic and Black low-income populations.[66] Because this might impact the overall metro versus non-metro race and ethnicity comparison, we also examined the home-internet adoption rates for people of different races/ethnicities in metro and non-metro areas, specifically focusing on such adoption rates for the poorest households in each such demographic group (*see* Figure 43). This data indicates that White low-income households have significantly higher home-internet adoption rates than Hispanic or Black low-income households, both in metro and non-metro areas.

[65] *See* Appendix Figure A61, presenting an ordered logit model of the household-level CPS family income categorical variable as a function of a householder's race/ethnicity, a household's average adult age, a household's maximum educational attainment, whether the householder is female, the presence of minors in the household, the number of persons in the household, whether or not all of the household's labor force members are unemployed, the household's metropolitan area population size category, and state indicator variables. The results of this model indicate that even in the presence of these controls, Hispanic, Black, American Indian/Alaska Native, Asian, Native Hawaiian/Pacific Islander, and multiracial households have significantly lower family incomes than White households have. All controls in the model are statistically significant, and act in their expected direction (average adult age, educational attainment, household size, and metropolitan area size all positively impact household family income; having a female householder, minors in the household, and no member of the household's labor force employed all negatively impact household family income).

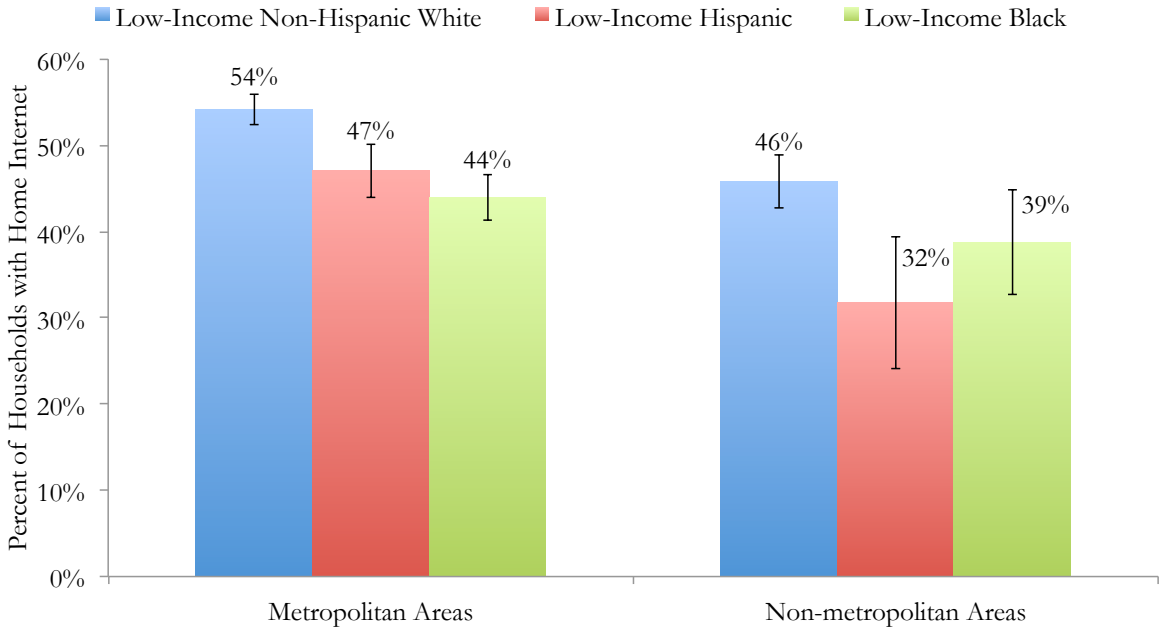
[66] Approximately 71 percent of the White population with family incomes below $20,000 lives in metro areas, versus 92 percent of the Hispanic population and 87 percent of the Black population with family incomes below that $20,000 level.

Figure 42:
Home-Internet Adoption by Race/Ethnicity and Metropolitan Location (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption values for non-Hispanic White households and Hispanic households, and between non-Hispanic White households and Black households in both metropolitan and non-metropolitan areas are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

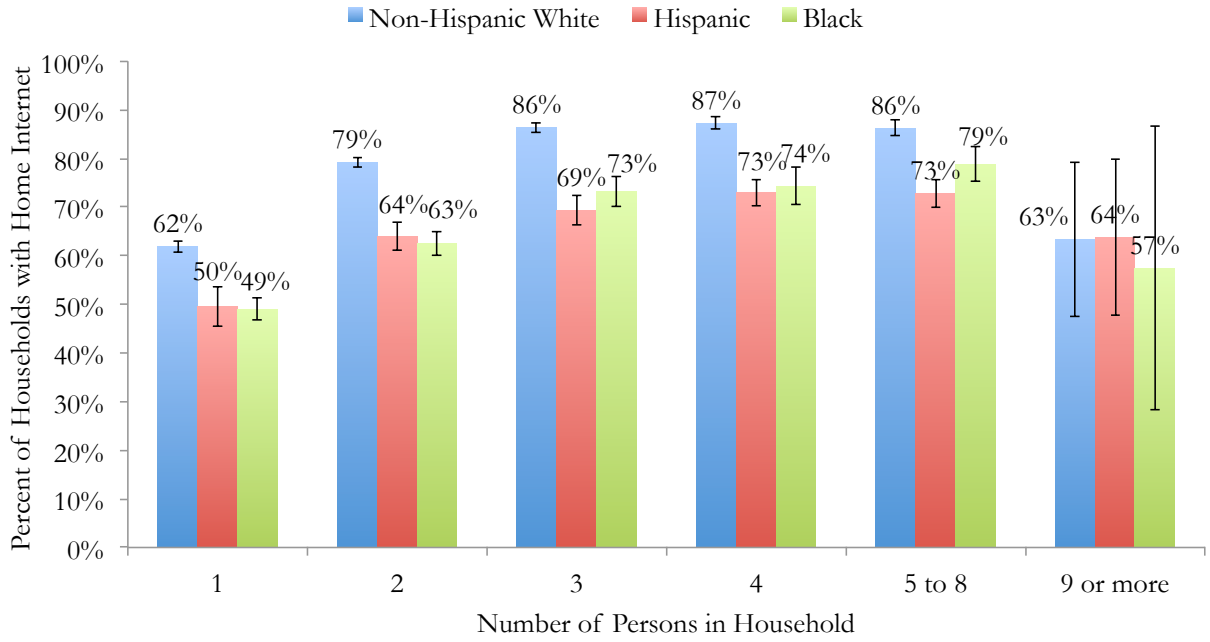
Figure 43:
Home-Internet Adoption by Race/Ethnicity and Metropolitan Location, for Persons with Annual Family Incomes Below $20,000 (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption values for non-Hispanic Whites and Hispanics, and between non-Hispanic Whites and Blacks in metropolitan areas are statistically significant at p<0.05. The difference between home-internet adoption values for non-Hispanic Whites and Hispanics in non-metropolitan areas is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

According to Census data, Whites skew to smaller household sizes (45 percent are in one- or two-person households), while Hispanics skew to larger household sizes (only 21 percent reside in one- or two-person households). Yet despite the overall trend showing that home-internet adoption increases with household size, an overall racial/ethnic home-internet adoption gap remains, and it exists across all household sizes. For example, while 71 percent of White one- or two-person households have home internet, only 58 percent of Hispanic and 55 percent of Black households of this same smaller size do (*see* Figure 44).

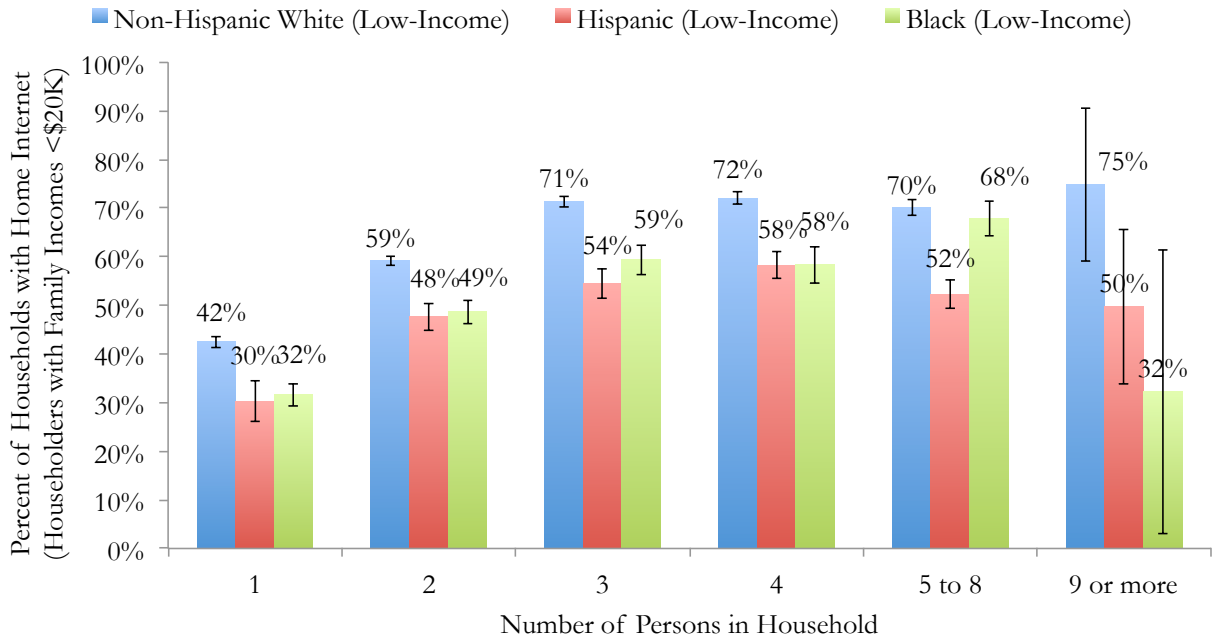
Figure 44:
Home-Internet Adoption by Race/Ethnicity and Household Size (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption for non-Hispanic White householders and Hispanic householders, and between non-Hispanic White householders and Black householders are statistically significant at p<0.05 for all household sizes, except those with 9 or more persons. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

And as in all other instances we examined, this racial and ethnic adoption gap persists among the poorest households. For example, 48 percent of low-income White households made up of only one or two persons have home internet; but only that figure for home internet access is just 38 percent of low-income Hispanic and 37 percent of low-income Black households of this same size. This disparity yet again suggests, along with other evidence, the impact of structural racial discrimination or other structural factors beyond simple income differences.

Figure 45:
Home-Internet Adoption by Race/Ethnicity and Household Size,
for Householders with Annual Family Incomes Below $20,000 (2015)



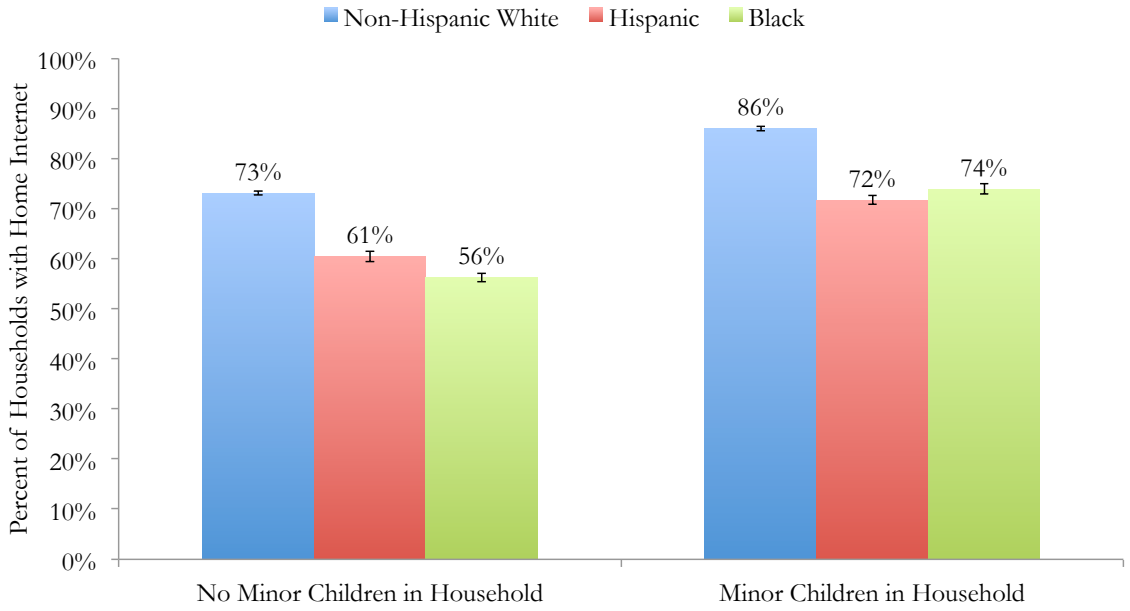
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption for low-income non-Hispanic White households and low-income Hispanic households are statistically significant at $p<0.05$ for all household sizes shown above except for low-income households with 9 or more persons. Differences between home-internet adoption for low-income non-Hispanic White householders and low-income Black householders are statistically significant at $p<0.05$ for all household sizes, except those with 5 ore more persons. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Households with minor children are more likely to have home internet than households without them (82 percent versus 70 percent). Yet once more, there is a large gap in home-internet adoption by people of different races and ethnicities, both for homes with children and homes without them.

Home internet is present in 86 percent of White households with minor children, but just 72 percent of Hispanic and 74 percent of Black households with minor children (*see* Figure 46). This gap is particularly concerning given the fact that a higher proportion of Hispanic (49 percent) and Black households (34 percent) have minor children, compared to White households (26 percent).

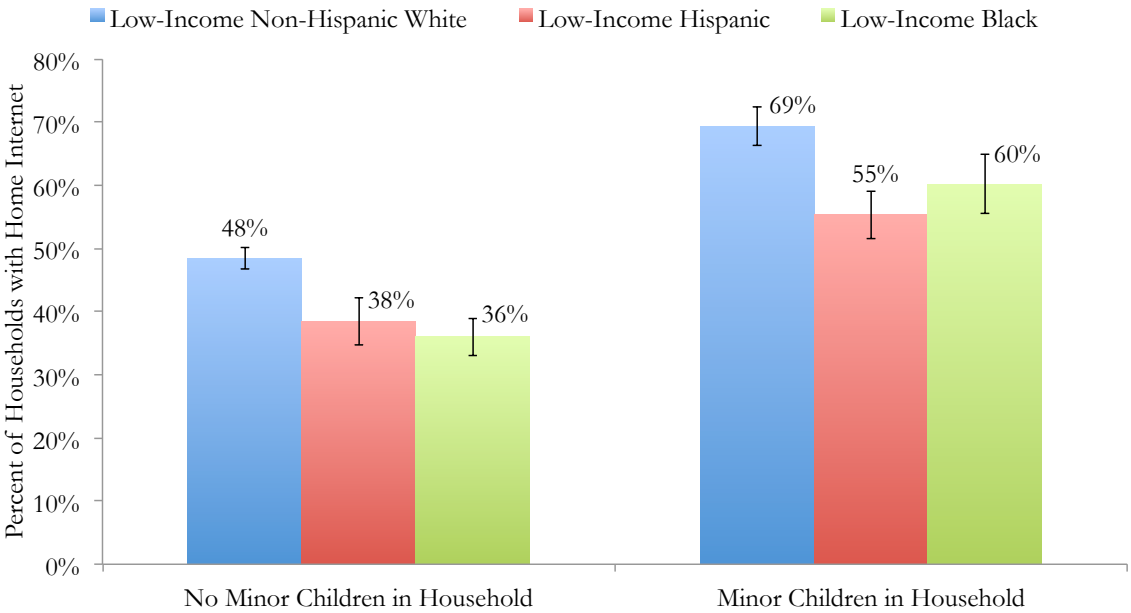
There is also a large gap in home-internet adoption by low-income households composed of different races or ethnicities, whether they have children in them or not. Home internet is present in 69 percent of low-income White households with minor children, but in just 55 percent of Hispanic and 60 percent of Black low-income households with minor children (*see* Figure 47).

Figure 46:
Home-Internet Adoption by Race/Ethnicity and Presence of Minor Children (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption for non-Hispanic White householders and Hispanic householders, and non-Hispanic White householders and Black householders, are statistically significant at p<0.05 for both households with and without minor children. The difference in home-internet adoption for Hispanic householders with no minor children in the household and Black householders with no minor children in the household is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

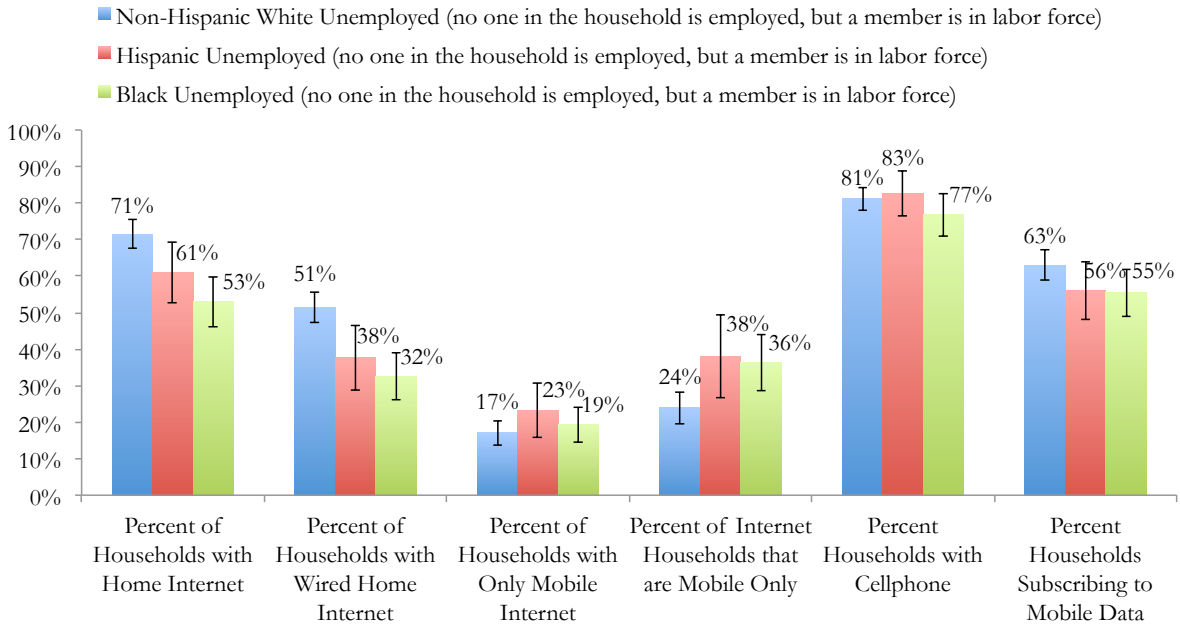
Figure 47:
Home-Internet Adoption by Race/Ethnicity and Presence of Minor Children, for Householders with Annual Family Incomes Below $20,000 (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption for low-income non-Hispanic White householders and low-income Hispanic householders, and low-income non-Hispanic White householders and low-income Black householders, are statistically significant at p<0.05 for both households with and without minor children. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Households with members in the labor force who are currently employed (or with no members in the labor force) are more likely to have home internet (74 percent) than are unemployed households (65 percent, in households with no employed members but one or more members seeking work). But home-internet adoption is higher in unemployed White households (71 percent) than in unemployed Hispanic households (61 percent) and unemployed Black households (53 percent). (*See* Figure 48). This size of this gap between unemployed White households and unemployed Hispanic and Black households is slightly larger for wired internet home adoption. There are however no statistically significant differences in adoption of cellphone or mobile data services between unemployed White, Hispanic, or Black households.

Figure 48:
Household-Level Telecom-Service Adoption by Race/Ethnicity and Employment (2015)

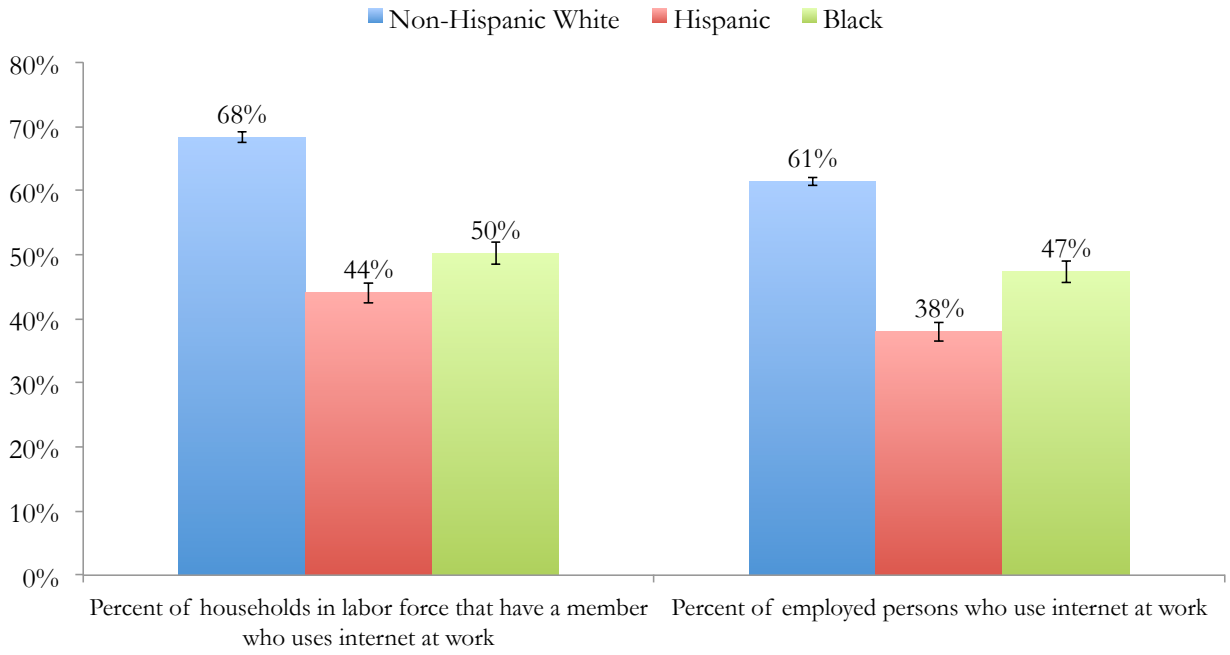


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The only differences that are statistically significant at p<0.05 are the differences between the percent of home-internet adoption for unemployed non-Hispanic White households and unemployed Black households; the percent of wired home-internet adoption for unemployed non-Hispanic White households and unemployed Hispanic households; and the percent of wired home-internet adoption for unemployed non-Hispanic White households and unemployed Black households. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) While these differences may be real, the sample sizes of households with a member in the labor force but unemployed are simply too small for meaningful comparisons (n= 623 for unemployed non-Hispanic White households, 166 for unemployed Hispanic households, and 278 for unemployed Black households).

As we discuss in several other places in this report, internet use at work is an important factor associated with home-internet adoption. Home-internet adoption in households with one or more members who use the internet at work is nearly universal (94 percent), but the home adoption level is much lower in households where no employed member goes online at work (56 percent). Nearly 95 percent of employed persons who go online at work have home internet, compared to just 66 percent of employed persons who do not use the internet at their jobs.

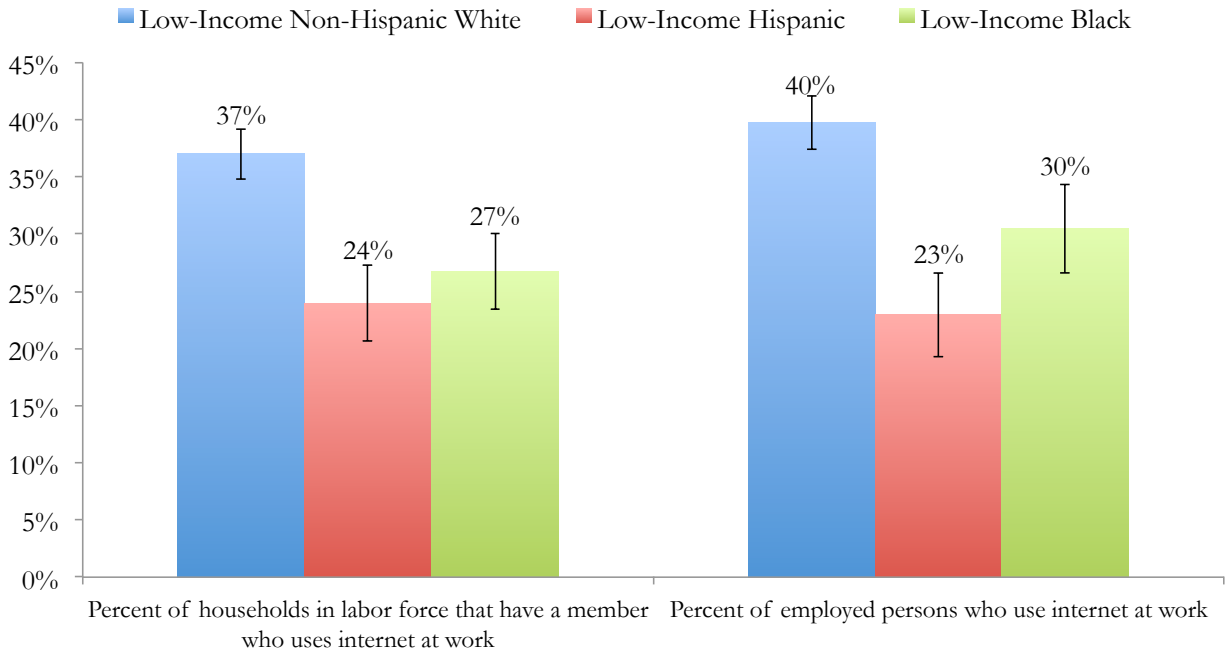
But yet again, exposure to the internet at work varies greatly by race/ethnicity (*see* Figure 49). For example, among all employed persons, 61 percent of Whites go online at work, versus just 38 percent of Hispanics and 47 percent of Blacks. This gap is seen at the household-level as well. While 68 percent of employed White households have a member who uses the internet at work, only 44 percent and 50 percent of Hispanic and Black employed households do. These differences are not driven just by the overall income differences we observe between people of different races or ethnicities. Even among low-income employed persons, 40 percent of Whites go online at work, versus just 23 percent of Hispanics and 30 percent of Blacks (*see* Figure 50).

Figure 49:
Internet Use at Work by Race/Ethnicity, Household and Person-Level (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure 50:
Internet Use at Work by Race/Ethnicity, Household and Person-Level, for Householders or Persons with Annual Family Incomes Below $20,000 (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Value for non-Hispanic White households in labor force is statistically significantly different from values for Hispanic and Black households in labor force at p<0.05. Value for employed non-Hispanic Whites is statistically significantly different from values for employed Hispanic and Black persons at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

It's also important to note any racial or ethnic disparities in home ownership, and the relationship of home ownership to home-internet adoption. As we discuss elsewhere in this report, a household's credit status can affect its ability to subscribe to certain types of home internet. There are numerous prepaid mobile carriers that offer data subscriptions without requiring a deposit or credit check. Yet most incumbent telecom and cable ISPs providing wired internet do require deposits and credit checks, and do not tend to offer prepaid options. Credit worthiness also can impact other aspects of a family's participation in the broadband market, such as whether providers select the family for promotional offers. Numerous factors impact credit scores, including income, education, and credit history. And people of color can have disproportionately lower credit scores as a result of the effects of discriminatory practices both in lending and scoring.[67]

One of the best ways to build a positive credit history is by making timely monthly mortgage payments. But it's a catch-22: Getting a mortgage on reasonable terms is difficult for people with low credit scores.[68] Given these factors, it should come as no surprise that there are very significant gaps in home-ownership rates between Whites, Hispanics and Blacks.[69]Nearly three out of every four White householders

[67] *See, e.g.*, Lisa Rice and Deidre Swesnik, National Fair Housing Alliance, "Discriminatory Effects of Credit Scoring on Communities of Color" (June 2012).

[68] *See, e.g.*, Freddie Mac, "Your Credit, Your Home, and Your Future" (June 2007).

[69] We note these differences in home ownership rates between people of different races and ethnicities because home ownership may be another important factor that impacts internet adoption. Home ownership is a sign of wealth beyond annual income, a proxy for perceived credit worthiness, and for ISPs may even serve as a way to judge whether subscribers are able to enter into long-term service contracts). Our econometric models discussed in the next section help to bear out this last supposition, indicating that home owners are more likely than renters to subscribe to home internet and then to use wired technologies when they do so, even with other factors such as income held constant.

(72 percent) own their home, compared to less than half of Hispanic (46 percent) and Black (43 percent) householders (*see* Appendix Figure A8).[70] The often-cited reasons for this gap mirror many of the reasons that contribute to the digital divide. Research studies cite differences in income, age, wealth, educational attainment, as well as marital status and savings behavior as explaining most of the racial/ethnic home ownership gap. But research also suggests that credit score biases, differences in access to information about the home buying process, and direct discrimination during the home buying process also contribute to the ownership gap.[71] The data on home ownership among the poorest households reflects these findings.

Consistent with the expected income effect, home-internet adoption is higher in households that own their home (77 percent) than in those that rent (67 percent). And as expected based on this data and the statistics we reported above, home-internet adoption in Hispanic and Black households lags adoption in White households, both in rented- and owned-homes (*see* Appendix Figure A10). However, the gap in wired adoption between White renters and Black renters (16 percentage points) is almost 50 percent larger than the gap in overall home-internet adoption between White and Black home owners (11 percentage points). (*See* Appendix Figure A11). This larger gap may be due in part to the impact of credit discrimination coupled with wired home internet providers' continued reliance on credit scoring as a customer screen.

Finally, we note that there are significant differences in home-internet adoption and wired home-internet adoption depending upon both a person's immigration tenure and a household's primary language. As we see in Figure 51, among persons born outside of the U.S., home internet and wired home-internet adoption are slightly higher for more recent immigrants than they are for immigrants who entered the U.S. more than 30 years ago. This difference is largely a function of age. However, home adoption and wired home adoption are significantly lower for Hispanics born outside the U.S than they are for non-Hispanic immigrants. For example, among persons who entered the U.S. in the past decade, 65 percent of non-Hispanic immigrants have wired home internet versus 40 percent of Hispanics. These differences, while stark, largely result from income differences. For example, the median family income range for such recent non-Hispanic immigrants is $50,000 to $59,999, compared to $30,000 to $34,999 for recent Hispanic immigrants.

Language barriers could help explain a portion of these observed differences. Unfortunately, the only question in the CPS concerning language is this: "is Spanish the only language spoken by all members of this household who are 15 years of age or older?" Thus, while we cannot investigate the impact language may have on the differences in internet adoption between Hispanic and non-Hispanic immigrants, we can look for differences in adoption between primary Spanish-speaking households and Hispanic households where Spanish is not the only language spoken by the adults. As Figure 52 shows, telecom and internet service adoption levels are significantly lower for Hispanic households in which all adults speak only Spanish than they are for Hispanic households in which that is not the case.

This difference is not driven by immigration tenure. There are approximately 2.4 million such Spanish-only households, and only 426,000 of these are headed by a householder who immigrated in the past decade. The difference appears to be primarily related to income. The family median income range for Hispanic households in which all adults speak only Spanish is $20,000 to $24,999, compared to a range of $35,000 to $39,999 for Hispanic households in which all adults do not speak only Spanish.[72]

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[70] The data in this figure derives from the July 2015 CPS. More recent information from the Census Bureau for the second quarter of 2016 indicates a stable home ownership rate for Whites and Hispanics, with a slight decline for Black households. *See* Robert R. Callis and Melissa Kresin, U.S. Department of Commerce, Social, Economic and Housing Statistics Division, "Residential Vacancies and Homeownership in the Second Quarter 2016," CB16-122 (July 28, 2016).

[71] *See, e.g.*, Dr. Kim Skobba, "Understanding Homeownership Disparities Among Racial and Ethnic Groups," Minnesota Home Ownership Center (Nov. 2013).

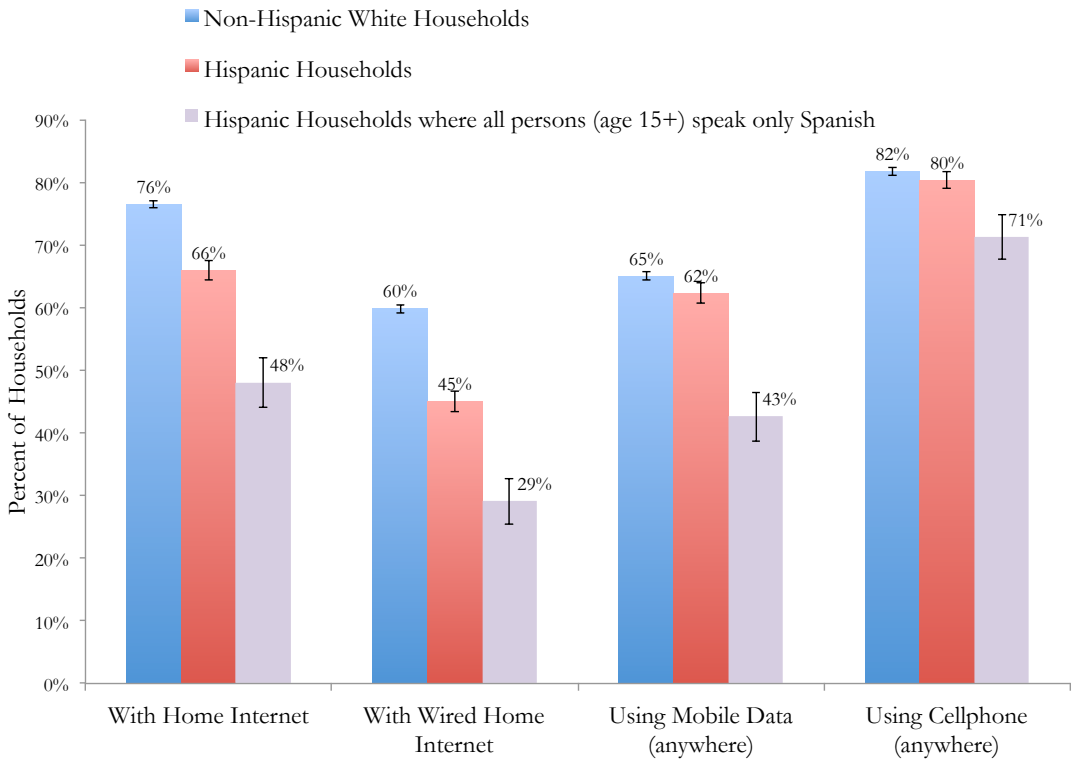
[72] In our exploratory econometric models, Spanish-only households were not significantly associated with home-internet adoption in the presence of controls for income and other factors. The lack of significance and high correlation with the Hispanic ethnicity indicator variable led us not to include a Spanish-only variable in our final model.

Figure 51:
Home-Internet Use and Immigration, Hispanics vs. Non-Hispanics (2015)

Year of Entry into U.S.	All Persons			Hispanic Persons			Non-Hispanic Persons		
	Average Age	Percent of Persons (age 3+) with Home Internet	Percent of Persons (age 3+) with Wired Home Internet	Average Age	Percent of Persons (age 3+) with Home Internet	Percent of Persons (age 3+) with Wired Home Internet	Average Age	Percent of Persons (age 3+) with Home Internet	Percent of Persons (age 3+) with Wired Home Internet
U.S. born	32	78.1%	59.9%	30	73.3%	51.9%	40	78.7%	61.0%
Before 1986	60	68.1%	52.6%	59	59.4%	43.0%	61	74.1%	59.3%
1986-1999	45	75.2%	55.2%	43	68.2%	44.9%	46	83.2%	67.0%
2000-2005	37	74.2%	52.1%	35	66.7%	42.6%	39	84.2%	64.6%
2006-2015	32	77.0%	55.6%	32	66.6%	39.8%	31	83.0%	64.7%

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure 52:
Home Internet, Wired-Home Internet, Mobile Data and Cellular Adoption for Spanish Language-Only Households (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

PART III

THE IMPACT OF RACE AND ETHNICITY ON HOME-INTERNET ADOPTION EXCLUSIVE OF INCOME AND OTHER FACTORS

There Is a Large Divide in Home-Internet Adoption and Wired-Broadband Use Between People of Different Races and Ethnicities, Even After Accounting for Income, Education, Age and Other Demographic Factors. This Suggests the Possibility That Structural Barriers, and Market Failures Exacerbated by Structural Factors, Depress Internet Adoption in Communities of Color.

To examine the impact of race and ethnicity on home-internet adoption exclusive of other determining factors, we examined the July 2015 CPS Supplement data utilizing multivariate probability regression analysis. We expect that income is an important determinant of home-internet adoption, and that it could explain a substantial portion of the adoption gap between people identifying in different racial/ethnic categories. As indicated in Figure 21 above and the accompanying text, it's painfully clear that this income gap is a huge problem in its own right. Intractable income disparities between people of different races and ethnicities have immense economic and social impacts, for a whole host of issues including broadband affordability and availability.

Yet we are interested in isolating any impact that race and ethnicity may have on home-internet adoption even after accounting for income disparities. To determine what people of each race's or ethnicity's adoption levels would be based on income alone, we first model the probability that a household would subscribe to home internet controlling only for family income. The results of this model are shown below in Figure 53. (*See* Appendix Figure A50 for full model results.)

The results indicate that home-internet adoption levels for Hispanic, Black, American Indian/Alaska Native, and Hawaiian/Pacific Islander households are well below those predicted based on income alone. Based on income alone, we should expect 69 percent of Hispanic households and 68 percent of Black households to have home internet (of any technology type). Their actual levels of adoption are 66 and 62 percent, respectively. By contrast, White households have a home-internet adoption level slightly above the expected value based on income (76 percent actual versus 75 percent expected).

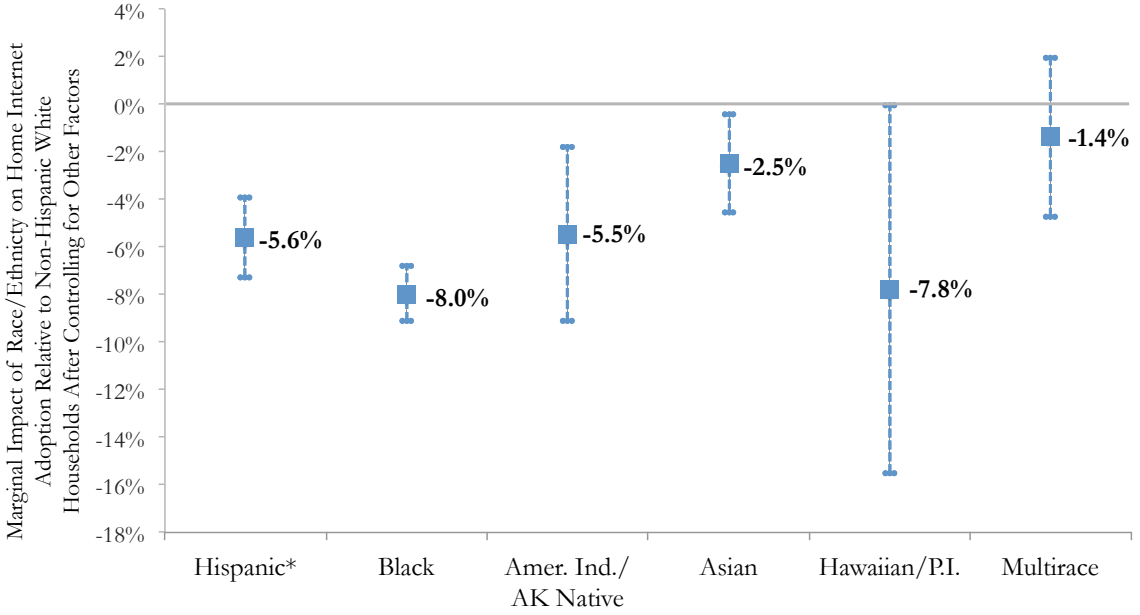
Figure 53:
Actual vs. Income-Based Expected Level of Home-Internet Adoption (household-level), by Race/Ethnicity (2015)

Race/Ethnicity	Percent of Households with Home Internet	Predicted based on income alone
Non-Hispanic White	76%	75%
Hispanic	66%	69%
Black	62%	68%
American Indian/Alaska Native	64%	68%
Asian	81%	77%
Hawaiian/Pacific Islander	67%	70%
Multirace	77%	72%

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. See Statistical Appendix for full results of probability regression models.

We then add race and ethnicity and other determining factors to the model as controls (*e.g.*, average age of adults in household; maximum educational attainment of persons in household; location in a metropolitan area and the area's population size; home ownership; number of persons in household; presence of a household member who uses internet at work; presence of a household member who uses internet at school; and state-level indicator variables).[73] The results of this model indicate that home-internet adoption levels for Hispanic, Black, American Indian/Alaska Native, Asian, and Hawaiian/Pacific Islander households are below the adoption level for White households, even after accounting for the impact of these additional control variables (*see* Appendix Figure A51 for full model results).[74] For example, after controlling for income and other factors, the marginal impact of race/ethnicity on household internet adoption relative to White adoption levels is -5.6 percentage points for Hispanics, -8 percentage points for Blacks, and -5.5 percentage points for American Indian/Alaska Natives. (See Figure 54 showing these marginal impacts on home-internet adoption for each race/ethnicity, along with 95 percent confidence intervals.)

Figure 54:
The Marginal Impact of Race/Ethnicity on Home-Internet Adoption
After Controlling for Income, Demographic, Geographic and Other Factors (2015)



*Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. See Statistical Appendix for full results of probability regression models. All marginal impacts except for that of multirace households are statistically significant from non-Hispanic white households at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values). * Non-white Hispanics were categorized by their race for this regression.*

[73] We opted to use the variables for presence in the household of a member who uses the internet at work or school, in place of household presence variables for employed or minor-age persons. We did so because the work and school internet use variables have substantially higher explanatory value than these other simple presence variables.

[74] In the full model, all racial/ethnic classifications are statistically significantly ($p<0.05$) negatively associated with home-internet adoption (relative to White households), except for the non-Hispanic multiracial classification. The following factors are statistically significantly ($p<0.05$) positively associated with home-internet adoption: income, education, location in a metropolitan area and that area's population size, home ownership, and presence of a household member using internet at work or at school. The following factors are statistically significantly ($p<0.05$) negatively associated with home-internet adoption: average age of adults in household and household size.

Other factors with a large impact on home-internet adoption are presence of a household member who uses the internet at work or school (marginal impacts of +25.6 and +19.3 percentage points, respectively), education (approximately +12 percentage points for households with advanced degrees relative to households with a high school degree), and income.[75]

Next, we examine the impact of income alone on wired internet adoption, followed by the impact of all control factors on wired internet adoption.[76] The results of these models are consistent with the observations above: First, wired adoption levels for Hispanic, Black and American Indian/Alaska Native households are well below what income alone would predict for members of these demographic groups (*see* Figure 55). For example, based on income alone, we should expect 51 percent of Hispanic and 50 percent of Black households to have wired home internet, but the actual values are only 45 percent and 43 percent respectively. White households slightly outperform their income-expected value for wired home-internet adoption. The expected value for such adoption, based on income alone, would be 58 percent of White households. Their actual adoption rate for wired home internet is 60 percent.

[75] *See* Appendix Figures A51–A53 for full results. Because our variables for income, education, metro area population, and state-level controls are all categorical variables, they are included in the model as factor-level controls (*e.g.*, the income variable is included as a series of 16 dummy variables, with the variable for incomes below $5,000 set as the base level). To simplify our reporting, we did not display the full results for these multilevel factor variables, but note they each have main effects that are significant. For example, income is positively associated with home-internet adoption. The marginal impact of a discrete change from the base level increases in size slightly, at first, as family income increases. There is a +10.6 percentage point impact relative to base level for households with family incomes between $60,000 and $74,999. After that, the size of the marginal impact decreases slightly for the remaining three high-income categories (+9.6 percentage points for incomes of $75,000 to $99,999; +9.1 percentage points for incomes of $100,000 to $149,999; and +7.7 percentage points for incomes of $150,000 or more). Increased household maximum educational attainment is also positively associated with higher levels of home-internet adoption, with the marginal impact (relative to the base level of a high school degree or GED) increasing at each level up to master's degrees (+12.9 percentage points), then declining slightly for professional degrees (+12.4 percentage points) and doctoral degrees (+11.6 percentage points). Adoption increases with increased metropolitan area population size (relative to non-metro areas), peaking at a marginal impact of +4.4 percentage points for metro areas with populations of 2.5 to 5 million, then declining to +4.1 percentage points for metro areas with 5 million or more people.

[76] A model that directly estimates the probability that a household subscribes to wired service may suffer from selection bias. This is because the decision about what type of technology to adopt is made subsequent to the decision to subscribe to home internet in the first place. This means that the population of wired adopters is a subpopulation of all home internet adopters. To address this possibility we compared a probability model for wired adoption with a two-stage selection regression probability model, with race/ethnicity, income, education and other controls included in each model. In the two-stage selection model, we estimate the probability that a household selects to adopt home internet in the first stage, and in the second stage we estimate the probability that the household adopts a wired technology access method. We present the results of all models in Appendix Figures A55 and A56. There are no meaningful differences between the direct and two-stage approaches (meaning, for example, no difference in the significance of the independent variables). However, because of the potential for sample selection bias, and because the two-stage model offers insight into the factors that most influence the choice of wired technology in internet-adopting homes, we consider it our preferred model for wired adoption.

Figure 55:
Actual vs. Income-Based Expected Level of Wired Home-Internet Adoption (household-level) by Race/Ethnicity (2015)

Race/Ethnicity	Percent of Households with Wired Internet Service	Predicted based on income alone
Non-Hispanic White	60%	58%
Hispanic	45%	51%
Black	43%	50%
American Indian/Alaska Native	46%	50%
Asian	65%	60%
Hawaiian/Pacific Islander	52%	52%
Multirace	60%	55%

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement. See Statistical Appendix for full results of probability regression models.

This result holds when the other controls are added to the model (*see* Appendix Figure A55 for full model results).[77] When all of these determining factors are accounted for, we see that White households are significantly more likely than Hispanic and Black households to have wired technology at home. In other words, the data indicate that race and ethnicity impact home-internet adoption and wired internet adoption, even after accounting for differences in income, education, age and other demographic factors among people in all of these racial and ethnic demographic groups, as well as their internet use at work or school. For example, after controlling for income and other factors, the marginal impact on household wired internet adoption is -7 percentage points for Hispanics and -9.7 percentage points for Blacks, relative to Whites.[78]

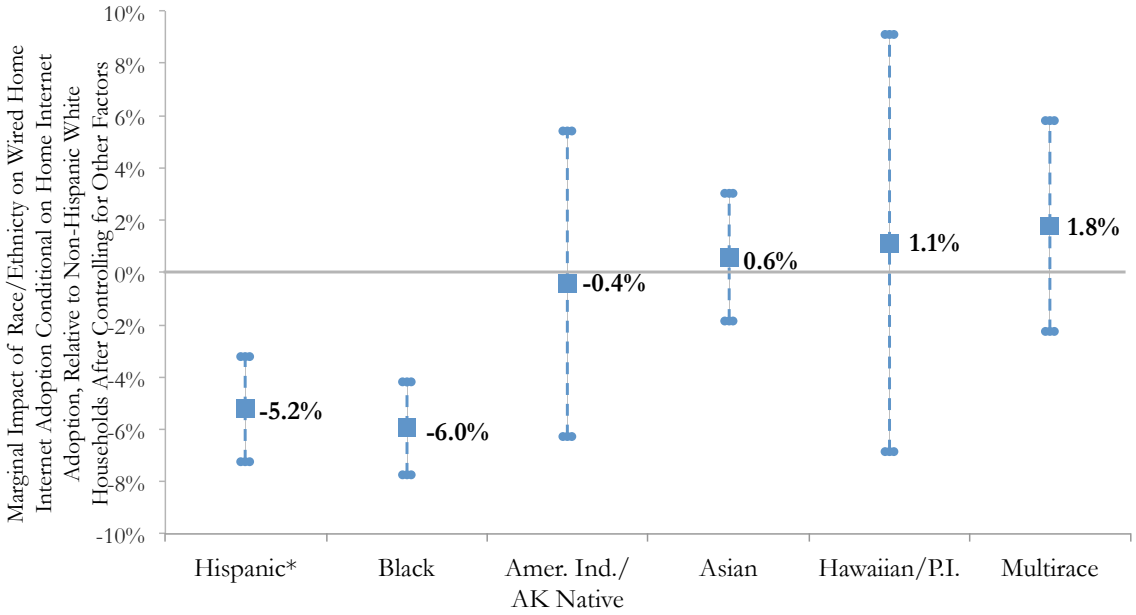
The above results are for wired adoption overall. But for various reasons (both methodological and interpretational), we also modeled the impact of race, ethnicity, and other factors on the adoption of wired technologies by households that choose first to adopt internet of any technology. Our analysis shows a similar result when examining the factors that impact wired adoption by the universe of households that first adopt home internet. (In other words, we see in the conditional model the same kinds of factors that impact home adoption in the first place also impacting the type of technology a household chooses – and whether a

[77] In our full, direct probability model (*i.e.*, not the two-stage selection model discussed in the preceding footnote), identification as a Hispanic or Black household is statistically significantly ($p<0.05$) negatively associated with wired adoption relative to White households, as is identification as an American Indian/Alaska Native household (but at $p<0.1$) relative to White households. The following factors are statistically significantly ($p<0.05$) positively associated with wired adoption: income, education, location in a metropolitan area and the metro area's population size, home ownership, presence of a household member using the internet at work, and presence of a household member using internet at school). The following factors are statistically significantly ($p<0.05$) negatively associated with wired adoption: average age of adults in household and household size.

[78] In the direct, single-stage probability model for wired adoption, the marginal impact of various racial/ethnic categories is -7 percent for Hispanic households, -9.7 percent for Black households (both significant at $p<0.05$) and -4 percent for American Indian/Alaska Native households (significant at $p<0.1$), relative in all cases to White households. We stress, however, that these marginal effects are not the same as the effects on wired adoption conditioned on home-internet adoption in the first place. These conditional effects are presented in Figure 56.

household that does adopt at home uses wired or is mobile-only).[79] For example, the marginal impact of race/ethnicity on wired adoption among internet-adopting households after controlling for other factors is -5.2 percentage points for Hispanics and -6 percentage points for Blacks, relative to Whites (*see* Figure 56).

Figure 56:
The Marginal Impact of Race/Ethnicity on Wired-Internet Adoption Conditional on Home-Internet Adoption, After Controlling for Income, Demographic, Geographic and Other Factors (2015)



*Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. See Statistical Appendix for full results of probability regression models. All marginal impacts except that for multirace households statistically significant from non-Hispanic White households at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values). * Non-white Hispanics were categorized by their race for this regression.*

This two-stage selection model indicates that having a household member who uses the internet at work or school positively impacts adoption of wired technology in internet-adopting homes (conditional marginal impacts of +4.5 and +5.5 percentage points, respectively). Home adopters in metropolitan areas are more likely to have wired access (conditional marginal impact of 9.1 percentage points). But unlike its effect on home adoption in general, higher average adult age positively impacts wired access for households that do first adopt home internet (conditional marginal impact of +0.1 percentage point for each additional year).[80]

[79] The results of the first stage in the model for households selecting to adopt home internet are essentially identical to our main probability model for home-internet adoption discussed above. In the second stage, we find Hispanic and Black households are less likely ($p<0.05$) than White households to adopt wired technology (with income, average adult age education, metro location, and presence of a person using internet at work and/or school positively associated with wired home-internet adoption at $p<0.05$; and a household's size negatively associated with wired adoption, at $p<0.05$). Two-stage models require that the selection equation have at least one independent variable not included in the outcome equation. Thus our selection equation is identical to our main full model for home-internet adoption, while our outcome equation replaces the categorical variable for metropolitan area size with an indicator variable for a metropolitan area.

[80] These are the marginal effects of race/ethnicity and the other controls, based on the predicted probability (conditioned on first selecting to adopt home internet) of having wired service. (Pr(wired=1|home internet=1) = Pr(wired=1, home internet=1)/Pr(home internet=1)). Therefore, the margins reported in Appendix Figure A55 (for the direct probit model for wired home internet) are not directly comparable to these results: they are comparable to the bivariate predicted probabilities and slightly larger than the conditional margins for the two-stage selection model.

These models capture the factors that have a significant impact on home-internet adoption. They indicate that there is a difference in home-internet adoption between Whites and people identifying as members of other races and ethnicities – even after accounting for the effects of several factors other than race or ethnicity that each independently impact home-internet adoption. This leads to the question of why such gaps exist? There are a host of non-mutually exclusive possibilities. As we discuss in this report, however, the answer is not that Hispanics and Blacks simply have a lower overall demand for internet access. Indeed, the data we present herein indicates that members of these communities (which are perpetually on the wrong side of the digital divide) have a high demand for internet access, but largely do not subscribe due to concerns about the cost of internet access.

One of our aims with this research is to uncover what possible systemic biases impact this racial and ethnic digital divide, outside of the already important impact of income inequality between people of different races and ethnicities. As we discuss below, it appears that systemic discrimination in credit scoring negatively impacts home-internet adoption in the communities that are on the receiving end of this harmful practice. The data also indicates that systemic biases in educational and job opportunities contribute to the digital divide by creating inequities in exposure to the internet at work. There are a myriad of other possibilities, some of which we address (*e.g.*, we observe differences in deployment to areas in which people of color live, which could be an effect of housing discrimination and could, in turn, impact adoption). But there are many possibilities that we cannot adequately address within the scope of this report. (*e.g.*, discrimination and so-called "White flight" may create false perceptions about the demand or ability to pay for quality home-internet services within a given neighborhood, which could in turn impact the offers and promotions mailed out to residents in that area).[81]

Ultimately, we cannot lose sight of the impact that income inequality has on home-internet adoption. Income inequality exacerbates the digital divide, both in isolation and in conjunction with the other impacts of structural discrimination. It's a simple reality: How much money a household has to spend greatly impacts whether they adopt home internet, and, if so, what quality of technology they select. Systemic discrimination creates income inequality, which in turn leads to a divide in home-internet adoption.

Solving the problems of income inequality and structural racism must be a top priority for America. Doing so would erase the digital divide. But there are important steps that we can take short of those crucial long-term goals. Because of the current high demand for internet access across all demographic groups, and because of the importance of income in determining adoption, all efforts that reduce the price of home internet access and increase its affordability will help overcome the impacts of income inequality and systemic discrimination in other areas of American society.

It's vital to recognize that income alone doesn't account for the size of the digital divide. As shown above, there are persistent and pernicious adoption gaps that cannot be explained solely by income differences between people of different races and ethnicities. It's equally important to note how crucial income is, because artificially high broadband prices are keeping millions of families offline.

[81] *See, e.g.*, John Eligon and Robert Gebeloff, "Affluent and Black, and Still Trapped by Segregation: Why well-off Black families end up living in poorer areas than White families with similar or even lower incomes," *New York Times*, (Aug. 20, 2016).

PART IV

LESSONS FROM ADOPTION IN THE CELLULAR AND MOBILE-DATA MARKETS

There Is No Racial/Ethnic Digital Divide for Cellphones or Smartphones Comparable to the Home Wired-Internet Divide, in Part Because the Cellular Market Is More Competitive Than the Home Broadband Market, With Many Carriers and Resellers Offering Lower-Priced Prepaid and Credit Check-Free Services.

We now turn to an examination of adoption trends in the cellular telephony and mobile data markets. These markets offer an instructive comparison to the wired home internet market. All three services have generally high adoption levels. All three services are two-way communications services, and mobile internet and home-internet services both serve as two-way communications and one-way content delivery services. Each service has been commercially available for many years, with adoption rates accelerating substantially in the past decade. Each service is available (in at least some form) to nearly the entire U.S. population, even in rural areas. And in the case of some of the largest carriers in the U.S. in terms od number of subscribers, a single carrier can offer all three services on one bill.

But there are major differences between these mobile service markets and the wired home internet market. The most important is the number of providers. Commercial cellular telephony and/or mobile internet purchasers have four national facilities-based carriers to choose from, along with these national carrier's prepaid subsidiaries (such as AT&T's Cricket, T-Mobile's MetroPCS, or Sprint's Virgin Mobile), as well as regional carriers (*e.g.*, U.S. Cellular, C-Spire), and numerous resellers (*e.g.*, Tracfone/StraightTalk).

This list of types of carriers highlights the second and third major differences between cellular/mobile and wired home internet: prepaid and resold options. While the cellular and mobile markets have numerous facilities-based carriers offering prepaid services and services that do not require a credit check, this is simply not the case in the wired home internet market. Where any such wired option does exist, it's not widely available or not heavily promoted, and it's priced in a manner that makes it substantially more expensive than regular post-paid service.[82] And customers for cellular/mobile data also can choose from a host of non-facilities based resellers, many of which offer service packages at lower prices that may be affordable for low-income households. Even though it's not positive that such lower-quality wireless services are all that many people can afford, they provide at least some option for people to connect. But resale is virtually non-existent in the wired home internet market, and (like any prepaid wired options out there) even where it has popped up it seemingly offers no savings over more typical wired options.[83]

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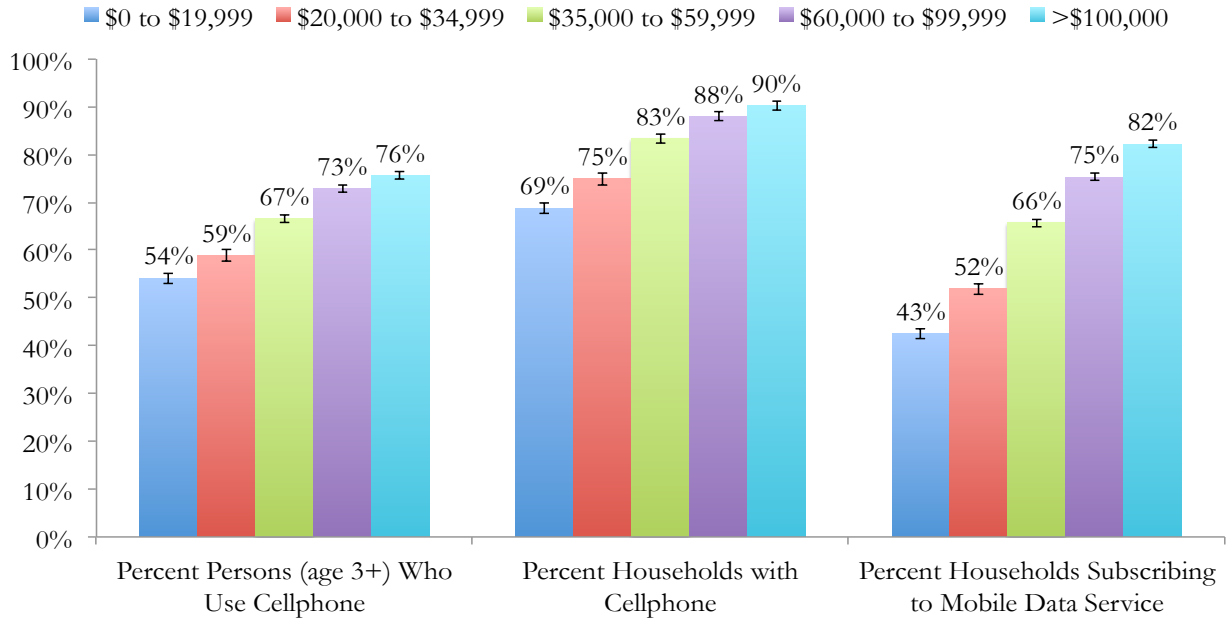
[82] Comcast recently announced a trial of prepaid services in select markets. These services do not require a credit check. However, they are notably more expensive than Comcast's existing post-paid home-internet services. For example, the service requires an initial $80 activation/equipment fee, then $45 per month for downstream speeds "up to 10 Mbps." By contrast, Comcast's post-paid services have no initial fee, offer promotional rates as low at $19.99 per month for the first year, and have standalone non-promotional prices starting at $39.95 per month depending on the local market. *See* "Multichannel High-Speed Data Pricing Report, Mid-2016," *SNL Kagan* (Sept. 15, 2016); "Comcast Announces Plans to Roll out Xfinity Prepaid Services," *PR Newswire* (July 21, 2016).

[83] Take the case of a recently launched reseller named Fido Cable. Its prices appear to offer no savings over the facilities-based ISPs' own offerings. *See, e.g.*, Phillip Dampier, "Fido Cable Leases Access from Current Cable Providers, Charges More Than They Do," *Stop the Cap* (Sept. 12, 2016) ("[Fido's] quoted rates were consistently higher than their cable company hosts charge their own customers. No wonder cable operators allowing Fido to compete using their systems are not breaking any sweat over the 'competition.' [. . .] Fido Cable charges $65 a month for 15/1Mbps service. Time Warner Cable's equivalent plan costs $59.99 a month for the service and modem rental (deduct $10 a month from TWC's price if you buy your own modem). A 50Mbps plan from Fido costs $120 a month, but it's $119 a month from Time Warner Cable (again, deduct $10 if you supply your own modem). For Charter customers, a 60/4Mbps plan is priced $59.99 direct from Charter, but if you choose Fido Cable you will pay $5 more a month: $65. A 100/7Mbps plan from Charter is priced at $99.99, or you can pay Fido $105.").

The data suggests that these differences in market structure positively impact cellular and mobile data adoption, particularly by low-income people of color. The data also indicates that low-income people of color disproportionately rely on mobile as their only home internet connection, in part because of these barriers to obtaining similarly low-priced or credit check-free options for wired internet access.

Income is still a primary factor influencing adoption, and it's strongly related to cellphone and smartphone use. Some 69 percent of households with family incomes in the bottom quintile use a cellphone. That climbs to 90 percent in the top income quintile (*see* Figure 57). This 21 percentage-point difference is substantially smaller than the 40 percentage point gaps between the bottom and top quintiles for home internet and wired adoption. (Bottom quintile households have a 49 percent home internet and 33 percent wired internet adoption rate; top quintile households stand at 89 percent and 73 percent.) The gap for household-level mobile internet use (either through a home subscription or through some other channel such as work or school) is almost 40 percentage points too: 43 percent vs. 82 percent.[84]

Figure 57:
Cellular Telephone and Mobile-Data Adoption by Family Income (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values represent those persons or households that report using mobile data either thanks to a home subscription or availability of mobile data options outside of the home.

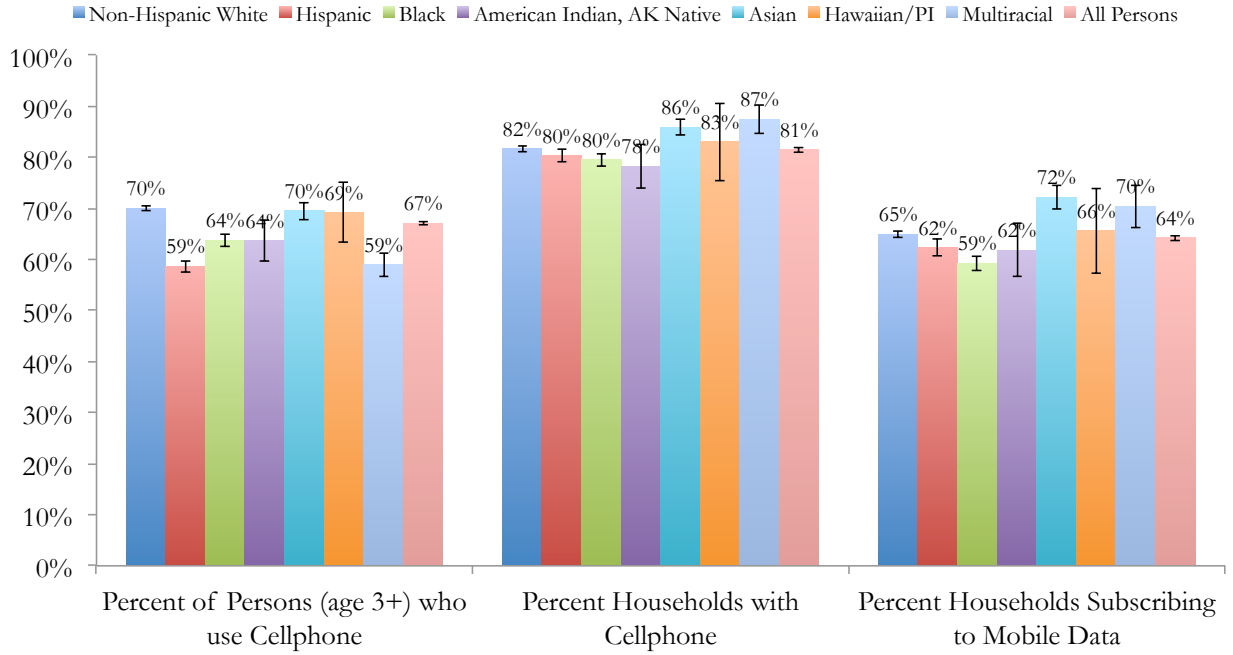
However, despite the adoption gaps in cellular telephony and mobile data across income strata, we do not see similar gaps across races/ethnicities. Some 82 percent of White households use cellular service in or out of the home, compared to 80 percent of Hispanic and Black households (*see* Figure 58).[85] There is a

[84] Values for mobile internet use include responses from householders indicating either in-home or out-of-home use. Approximately 10 percent of mobile internet-using households report only using their service in the home, while 30 percent say they only use it out of the home.

[85] The larger gaps shown in Figure 57 in person-level cellular adoption between Whites, Hispanics and Blacks are mostly due to the larger proportion of young people in Hispanic and Black households. That gap narrows for persons age 15 and above, with 77 percent of Whites, 71 percent of Hispanics, and 73 percent of Blacks reporting that they personally use a cellphone. (We do not present personal use for mobile internet because, unlike for cellular telephony, the Census did not ask about it.) Income also plays a likely role in the personal use gap, as low-income households have less money to purchase multiple lines.

slightly larger racial/ethnic adoption gap for mobile internet, with 65 percent of White households using mobile Internet (either in our outside the home), versus 62 percent of Hispanic households and 59 percent of Black households (*see* Figure 58).[86]

Figure 58:
Cellular Telephone and Mobile-Data Adoption by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences in values for percent of non-Hispanic White persons and all other races/ethnicities for persons (age 3+) who use cellphone are statistically significant at p<0.05 except for Asians and Hawaiian/Pacific Islanders. Differences in values for percent of non-Hispanic White households and all other races/ethnicities with cellphone are statistically significant at p<0.05 except for Hispanics, American Indian/Alaska Natives and Hawaiian/Pacific Islanders. Differences in values for percent of non-Hispanic White households and all other races/ethnicities subscribing to mobile data are statistically significant at p<0.05 except for American Indian/Alaska Natives and Hawaiian/Pacific Islanders. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

While cellular phone and mobile internet use rates are slightly higher for White households, this difference is entirely explained by income differences (and we discuss below our econometric analysis of cellular and mobile data adoption). Indeed, when we look at low-income populations, use rates are actually higher for low-income Hispanics and Blacks than they are for low-income Whites (*see* Figure 59). Low-income Hispanic (70 percent) and Black households (72 percent) have higher cellular adoption levels than low-income White households do (67 percent). Low-income Hispanic (46 percent) and Black households (44 percent each) also have higher mobile-internet adoption levels than low-income White households do (41 percent).[87]

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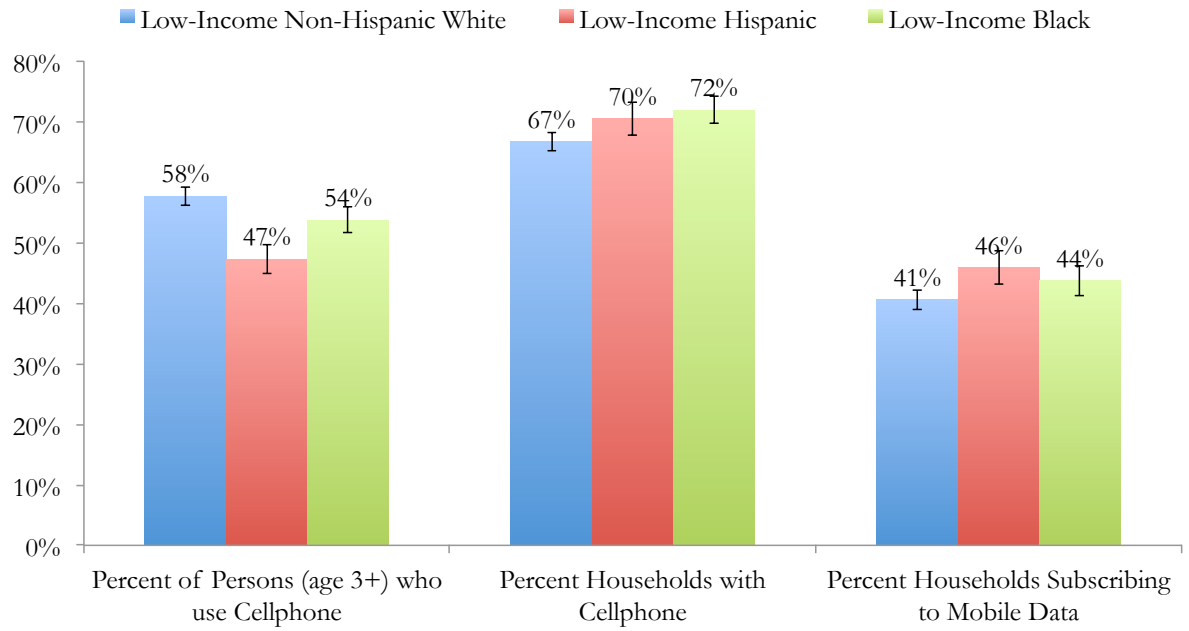
[86] The CPS findings mirror those of Pew Research from the same time period. According to Pew, as of mid-2015, "there are no differences in smartphone ownership among different racial and ethnic groups," citing their survey data showing a 66 percent smartphone ownership rate for White adults, compared to 68 percent for Black adults and 64 percent for Hispanic adults. The same survey reported a 91 percent cellphone ownership rate for White adults, compared to 94 percent for Black adults and 92 percent for Hispanic adults. *See* Monica Anderson, Pew Research Center, "Technology Device Ownership: 2015" (Oct. 29, 2015).

[87] Thus the small overall gap between Hispanic/Black households and White households in cellular/mobile data adoption across all income strata actually stems from lower levels of adoption among higher income Hispanic and Black households (*see* Appendix Figures A5 and A6).

Figure 59:
Cellular Telephone and Mobile-Data Adoption by Race/Ethnicity
for Persons with Annual Family Incomes Below $20,000 (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between races/ethnicities for persons (age 3+) using cellphone are statistically significant at p<0.05. The difference in values for percent of low-income non-Hispanic White households and low-income Black households with a cellphone is statistically significant at p<0.05. The difference in household mobile data adoption between low-income non-Hispanic White households and low-income Hispanic households is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values represent persons or households reporting use of mobile data either thanks to home subscription or availability of mobile data options outside of a home, wired broadband or wireless subscription.

Hispanic and Black household-level cellular and mobile internet adoption rates are at the levels one should expect based on income alone.

To analyze the impact of race and ethnicity on household-level cellular and mobile data adoption, we examine the July 2015 CPS Supplement data utilizing multivariate probability regression analysis. We expect that income is an important determinant of cellular and mobile data adoption (though we expect it to be less of a determinant than in the case of home internet, due to the lower prices and lower barriers to adoption discussed at the outset if this Part IV).

To determine what people of each race's and/or ethnicity's adoption levels would be based on income alone, we model the probability that a household subscribes to cellular or mobile data controlling only for family income. We then use the results of this model in conjunction with the average family income value for households of each race and/or ethnicity, in order to produce predicted adoption levels based on income alone. The results of this model are shown below in Figure 60. They indicate that household-level cellular telephone adoption levels for people of each race and/or ethnicity are close to those predicted by income alone. This is also the case for household-level mobile internet service adoption. Average income differences between households identifying as members of races and ethnicities account for observed differences in adoption (*see* Figure 61).

Figure 60:
Actual vs. Income-Based Expected Level of Home Cellular-Telephone Adoption (household-level) by Race/Ethnicity (2015)

Race/Ethnicity	Percent of Households With Cellular Phone	Predicted based on income alone
Non-Hispanic White	82%	82%
Hispanic	80%	79%
Black	80%	78%
American Indian/Alaska Native	78%	79%
Asian	86%	84%
Hawaiian/Pacific Islander	83%	80%
Multirace	87%	81%

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Cellular use includes use data either thanks to home subscription or availability cellular options outside the home. See Statistical Appendix for full results of probability regression models.

Figure 61:
Actual vs. Expected Level of Mobile-Data Adoption (household-level) by Race/Ethnicity (2015)

Race/Ethnicity	Percent of Households Using Mobile Data	Predicted based on income alone
Non-Hispanic White	65%	66%
Hispanic	62%	60%
Black	59%	59%
American Indian/Alaska Native	62%	59%
Asian	72%	59%
Hawaiian/Pacific Islander	66%	61%
Multirace	70%	63%

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement. Mobile data use includes use data either thanks to home subscription or availability of mobile data options outside the home. See Statistical Appendix for full results of probability regression models.

However, cellular and mobile data use are also highly correlated with other factors that tend to differ between populations of different races and ethnicities, including age and educational attainment. To account for this, we add race/ethnicity and other determining factors to the model as controls. First, we model household cellular telephone adoption as a function of the householder's race/ethnicity, family income, the average age of adults in the household, the maximum educational attainment in the household, whether or not the household is located in a metropolitan area and that area's population, home ownership, number of persons in the household, the presence of a minor in the household, and state-level indicators.

The results indicate a small gap in cellular use at the household level for Hispanic and Black households, both relative to White households. After controlling for income and other factors, the marginal impact of ethnicity on household cellular telephone adoption is -2 percentage points for Hispanic households,

relative to White households. The marginal impact of race for Black households, relative to White households, is -1.8 percentage points (*see* Appendix Figure 58 for full model results).[88]

Household mobile data adoption levels for people of all races/ethnicities are at or very close to the values expected based on each group's average income alone. However, the results of the model that includes all controls[89] indicate a small gap in household mobile data adoption between White households and Hispanic, Black, and Asian households.[90] After controlling for income and other factors, the marginal impact of race or ethnicity on household mobile internet adoption is -1.7 percentage points for Hispanic households, -2.7 percentage points for Black households, and -3.6 percentage points for Asian households, each relative to White households (*see* Appendix Figure 60 for full model results).

Overall, these models indicate that race and ethnicity do indeed impact household-level cellular telephone and mobile data adoption. They have impacts beyond those that stem from differences between households of different races and ethnicities in terms of demographic factors such as average income, education, and age. But the impact of race/ethnicity is much less than it is for overall home-internet adoption.

The small magnitude of the observed divide for adoption of cellular telephone and mobile internet services, and the lack of any real divide between low-income households of different races or ethnicities, is likely due to the existence of a more competitive and better functioning market. As noted above, these mobile markets in the U.S. include many resellers that specifically endeavor to serve low-income customers and do not subject them to credit checks. The lack of significant mobile services market divides also reflects the reality that many low-income households – having been priced out of the wired internet market, or kept out of it by credit check requirements – turn to mobile to meet their home internet needs.

This finding does <u>not</u> suggest that wired high-speed home-internet service and mobile internet service are perfect substitutes for one another at this time. It also does not suggest (let alone prove) that there is no divide between persons who choose to adopt wired internet service, on one side, and those who choose to or are able to adopt mobile internet service only. But when we analyze the cellular telephone and mobile internet markets in their own right, there is no persistent racial and ethnic digital divide comparable to the divide observed for high-speed, wired home-internet adoption.

AT&T and Verizon dominate the cellular market, and for years they ignored the low-income market segment. Yet despite AT&T and Verizon's seemingly insurmountable lead in market shares and revenues, the

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[88] In the full model for cellular telephone adoption, Hispanic and Black households are the only races/ethnicities that are statistically significantly ($p<0.05$) negatively associated with cellular adoption (relative to White households). In this model, income, education, metropolitan location and population size, home ownership, and the presence of a minor are statistically significantly ($p<0.05$) positively associated with cellular adoption. The model also indicates older average adult age households are more likely to have cellular service.

[89] We model household mobile internet adoption as a function of the householder's race/ethnicity, family income, the average age of adults in the household, the maximum educational attainment in the household, whether or not the household is located in a metropolitan area and that area's population, the householder's home ownership, number of persons in the household, the presence of a household member who uses the internet at work, and the presence of a household member who uses the internet at school.

[90] In the full model for mobile data adoption, Hispanic, Black, and Asian household identifications are the only ones that are statistically significantly ($p<0.05$) negatively associated with mobile data adoption (relative to White households). In this model, we see that income, education, metropolitan location and the metro area's population size, and the presence of persons using the internet at work and/or school are statistically significantly ($p<0.05$) positively associated with mobile data adoption; while older average adult age households are less likely to have mobile data service ($p<0.05$).

mobile market – with four national carriers, a handful of regional carriers, and a number of resellers – is still far more competitive than the wired home internet market is.

One positive outcome from this higher level of competition is the existence of a vibrant resale market. Facilities-based wireless carriers have sold bulk capacity to resellers (such as Tracfone), which in turn offer lower-priced prepaid services that do not require customers to undergo a credit check or put up a deposit. The higher level of competition has also produced (in recent years) a vibrant prepaid market for licensed carriers themselves too (*e.g.*, Sprint's "Boost" and "Virgin" brands). That means we see not just resellers, but even these facilities-based carriers, offering services directly to market segments that some other carriers might eschew.

By contrast, there is no functioning resale or prepaid market for wired home-internet service. This market failure directly contributes to the digital divide. It denies potentially more affordable services to people with less income. It also likely exacerbates, and replicates in the internet access market, any structural racism and discrimination already at play in the credit system. Incumbent providers of wired home internet access services typically impose credit checks on customers, and require cash deposits before these customers can obtain service.

Because of systemic racial biases in credit scoring practices, the typical ISP requirement that wired home internet customers first pass a credit check or make a cash deposit disproportionately harms broadband adoption in communities of color. This credit check practice is likely a key reason that we see lower wired home-internet adoption rates for low-income Hispanic and Black people, compared to the adoption rates for low-income Whites. But we do not observe such a substantial difference in cellular telephone or smartphone adoption between people of different races and ethnicities – not even between low-income people in these different racial and ethnic demographic groups.

PART V

PEOPLE OF COLOR WITHOUT HOME-INTERNET ACCESS ARE MORE LIKELY TO USE PUBLIC-INTERNET ACCESS AT LOCATIONS OUTSIDE THE HOME, AND TO SAY THAT THEY ARE READY TO SUBSCRIBE AT A LOWER PRICE

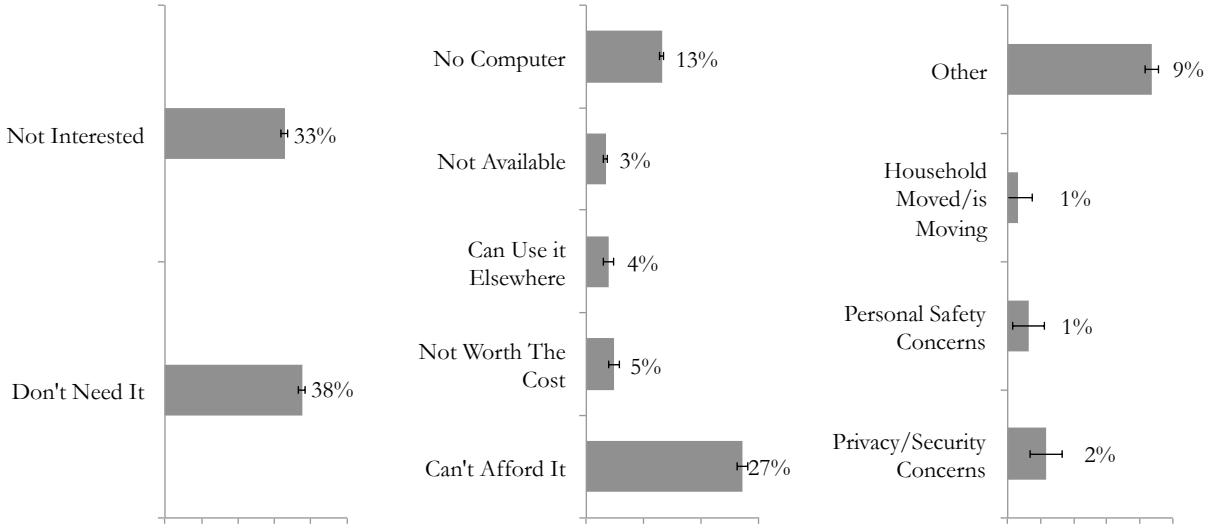
While the majority of home internet non-adopters cite "not interested" or "don't need it" when the Census Bureau asks about the reasons they do not subscribe, a large number of non-users cite cost and other reasons related to affordability and value (*see* Figure 62).

However, it should come as no surprise that among all non-adopters, very few of them with higher incomes cite affordability concerns, in contrast to those with lower incomes who do. That's why it's most instructive, for the purposes of formulating public policy, to put these answers in context by accounting for the incomes and demographics of those answering.

Figure 62: Reasons for Not Subscribing to Home Internet (2015)

Q: What are the reasons why your household does not use the internet at home?

(can provide multiple reasons; universe = households who do not have home internet)



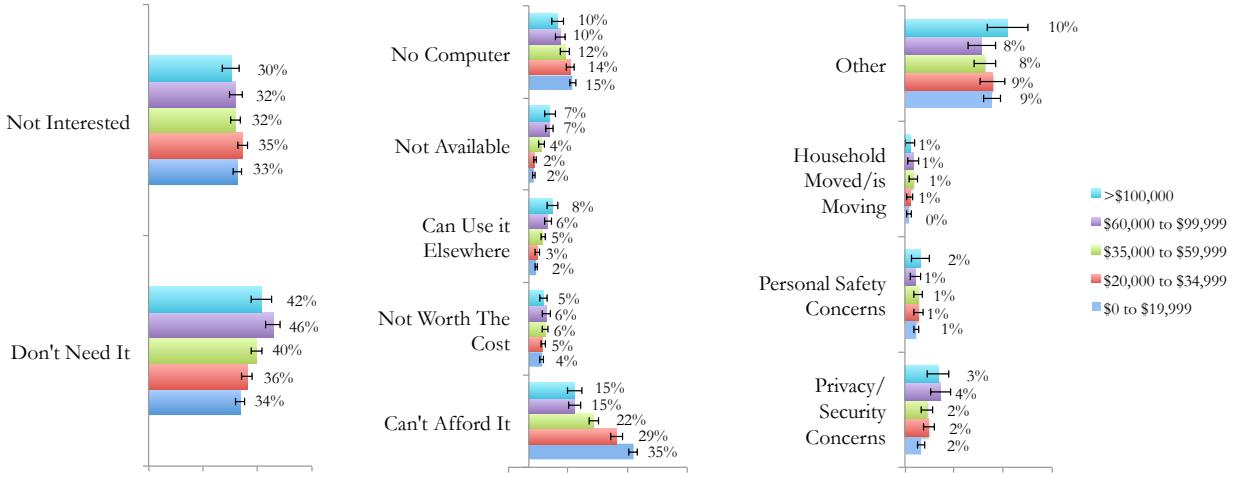
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

These answer distributions are different for households with different income levels. As we might expect, the lower the family income of a household that has not adopted home internet, the more likely that household is to cite broadband affordability and lack of computer ownership as reasons for not subscribing (*see* Figure 63). So it's important yet unsurprising to note that affordability actually is the most-cited reason for not adopting among households with family incomes below $20,000, while "don't need it" is the most-cited reason for households above this income level.

Figure 63: Reasons for Not Subscribing to Home Internet by Family Income (2015)

Q: What are the reasons why your household does not use the internet at home?

(can provide multiple reasons; universe = households who do not have home internet)



The lower their income, the more likely a person is to cite affordability as a reason for not adopting home internet

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Non-Adopting People of Color Are More Likely to Care About the Cost of Home-Internet Service.

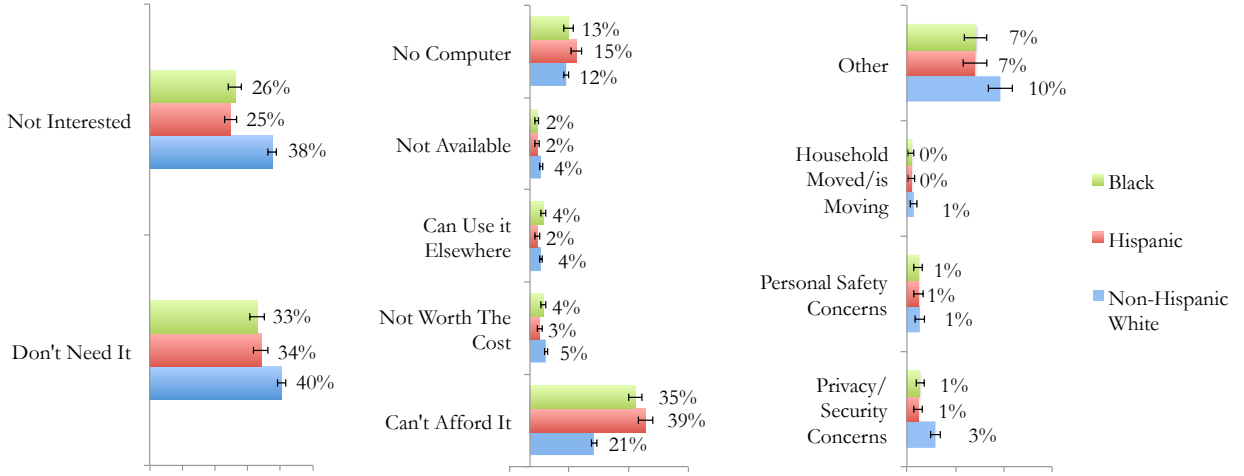
Black and Hispanic households without home internet are far more likely to cite affordability, and far less likely to cite don't want/don't need, than are White households without home internet (*see* Figure 64). For example, 39 percent of non-internet Hispanic households and 35 percent of non-internet Black households cite "can't afford it" as a reason for not subscribing, compared to just 21 percent of White households without home internet.

This racial/ethnic gap in reported affordability concerns also appears among low income populations in different racial/ethnic demographics (*see* Figure 65). While 44 percent of low-income Hispanic households without home internet and 41 percent of low-income Black households without home internet cite "can't afford it" as a reason for not subscribing, only 29 percent of low-income White households without home internet cite that reason for not adopting it.

Figure 64: Reasons for Not Subscribing to Home Internet by Race/Ethnicity (2015)

Q: What are the reasons why your household does not use the internet at home?

(can provide multiple reasons; universe = households who do not have home internet)



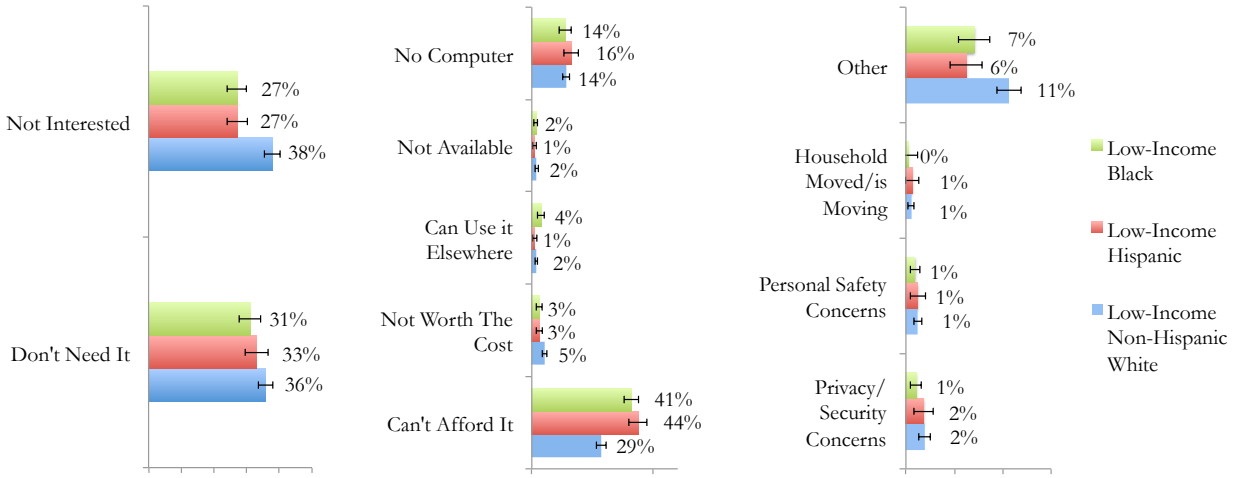
Non-Hispanic White households without home internet are more likely to cite non-interest and less likely to cite affordability as reasons for non-adoption compared to Hispanic and Black non-adopting households

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure 65: Reasons for Not Subscribing to Home Internet by Race/Ethnicity for Persons with Annual Family Incomes Below $20,000 (2015)

Q: What are the reasons why your household does not use the internet at home?

(can provide multiple reasons; universe = households with annual family incomes <$20,000,who do not have home internet)



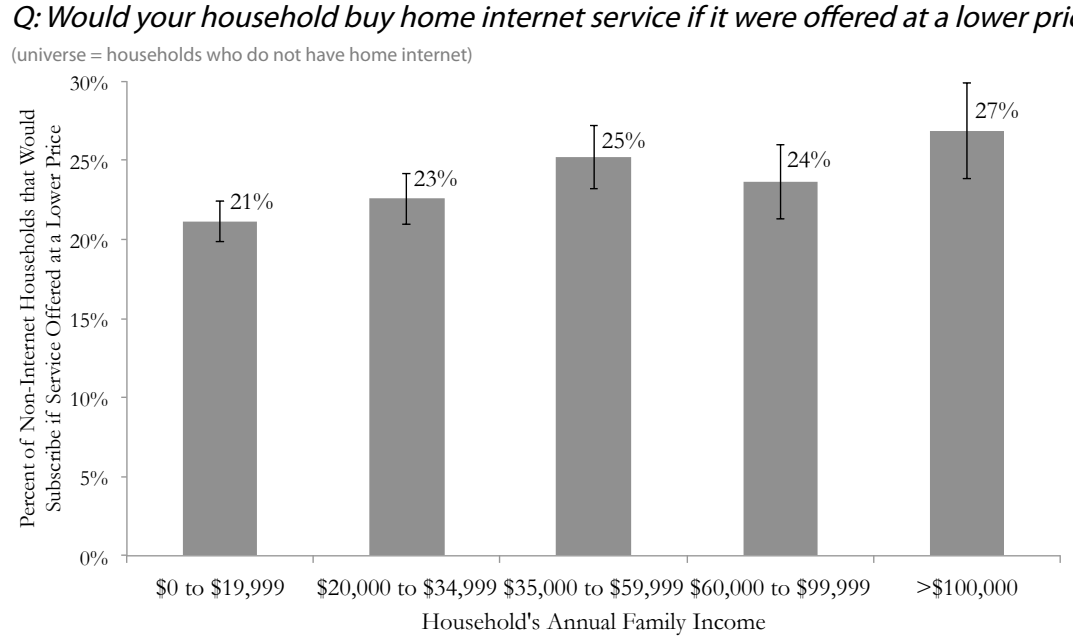
Low-income Hispanics and Blacks are more likely than low-income non-Hispanic whites to cite affordability as a reason for not adopting home internet

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Non-Adopting People of Color Are More Likely to Say They Would Subscribe at a Lower Price.

The Census Bureau asked householders without home internet if they would buy service offered at a lower price. Nearly one-quarter (23 percent) of all non-adopting households said they would subscribe at a lower price. That result that did not vary significantly between high- and low-income non-adopters (*see* Figure 66 below). This similarity is not surprising, because non-adopters with higher incomes are less likely to cite affordability as a reason for not subscribing, so a lower price may not entice many of them to sign up; whereas low-income non-adopters are simply less likely to have the ability to pay for internet service (or purchase a computer) even if it were offered at a lower price.

Figure 66:
Non-Home Internet Adopters – Willingness to Subscribe at a Lower Price (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

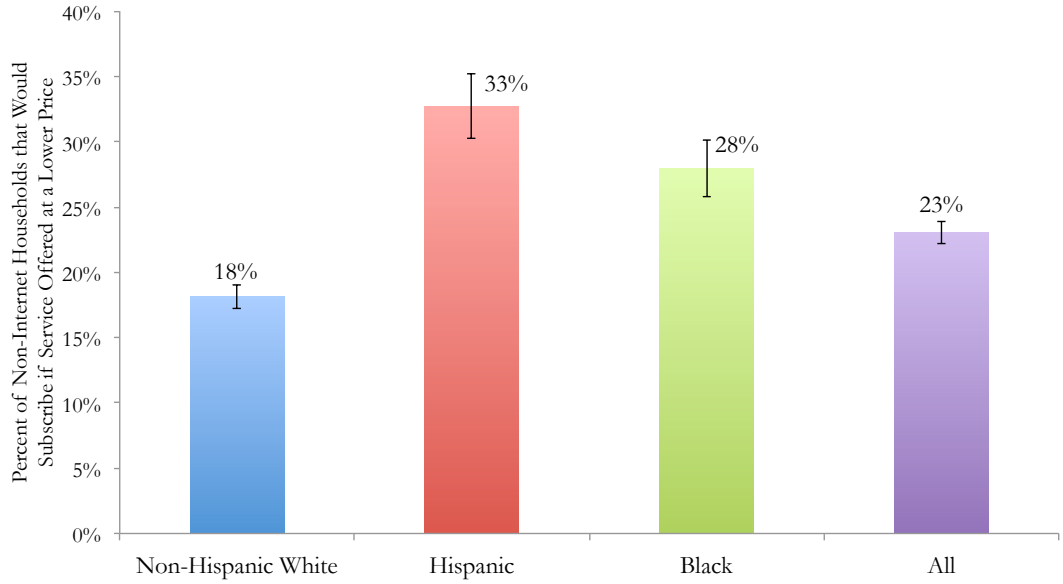
Despite this similar willingness across income strata to subscribe at lower prices, there is a large difference in the answers to this question for people of different races or ethnicities. While only 18 percent of non-adopting White households say they'd subscribe at a lower price, 33 percent of non-adopting Hispanic households and 28 percent of non-adopting Black households say they would (*see* Figure 67). Put in terms of population, of the 28 million Black and Hispanic persons (age 3+) without home internet, 15 million reside in households that cite cost and affordability-related reasons for non-adoption, and 10 million of these 28 million say they'd subscribe at a lower price.

This difference in their willingness to adopt home internet at a lower price, as expressed generally by respondents of different races or ethnicities, is also evident in the answers from subpopulations in these demographics that are made up of the poorest people in America. Only 16 percent of low-income non-adopting White households say they'd subscribe to home internet at a lower price; but 27 percent of low-income Black non-adopting households would, as would 26 percent of low-income Hispanic non-adopting households (*see* Figure 68).

Figure 67:
Home-Internet Non-Adopters – Willingness to Subscribe at a Lower Price by Race/Ethnicity (2015)

Q: Would your household buy home internet service if it were offered at a lower price?

(universe = households who do not have home internet)

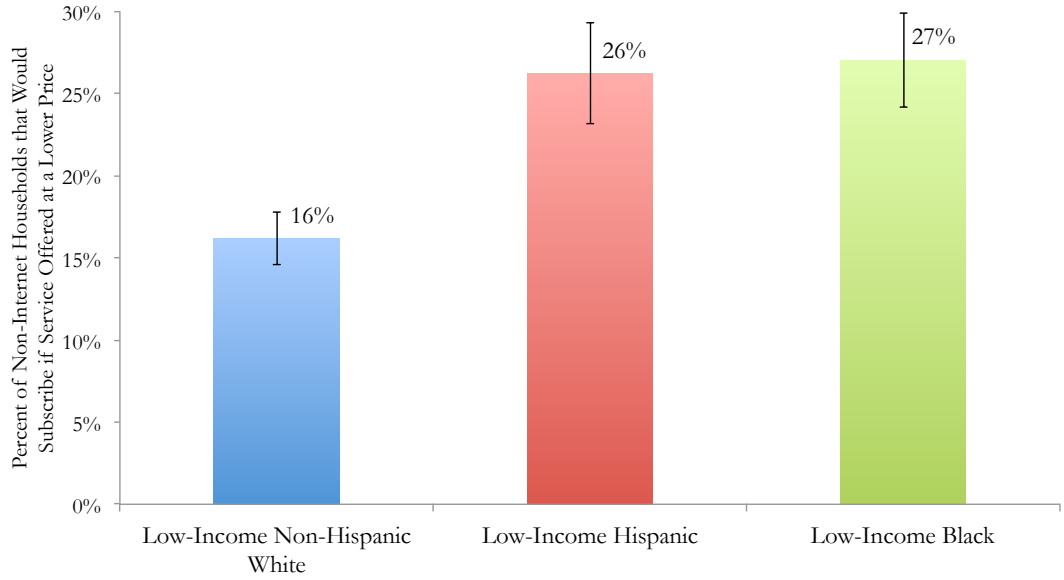


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between non-Hispanic White non-adopters and Hispanic non-adopters, and between non-Hispanic White non-adopters and Black non-adopters, is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure 68:
Home-Internet Non-Adopters – Willingness to Subscribe at a Lower Price by Race/Ethnicity for Persons with Annual Family Incomes Below $20,000 (2015)

Q: Would your household buy home internet service if it were offered at a lower price?

(universe = households with annual family incomes <$20,000,who do not have home internet)



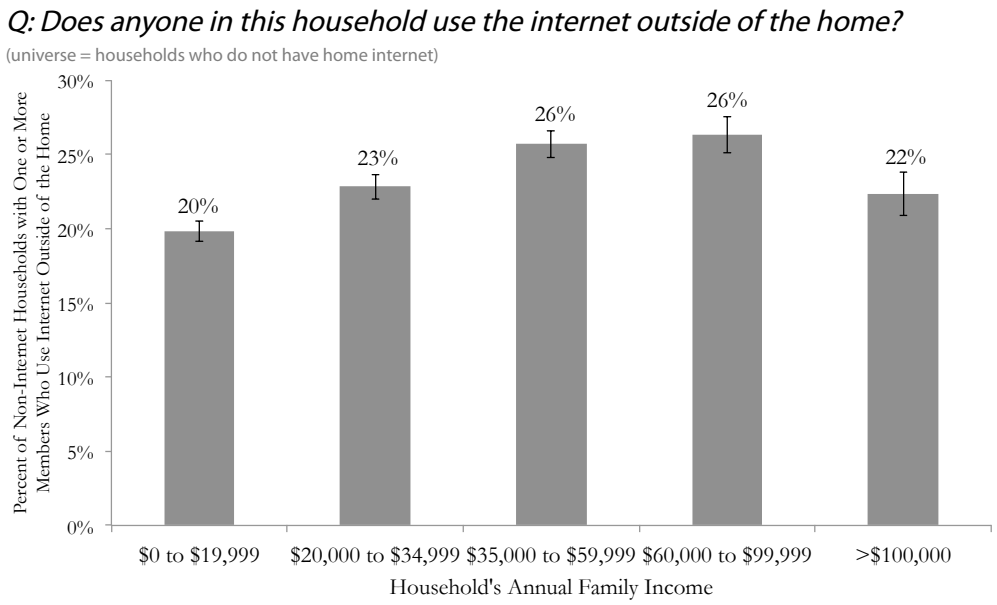
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between non-Hispanic White non-adopters and Hispanic non-adopters, and between non-Hispanic White non-adopters and Black non-adopters, is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Non-Adopting People of Color Are More Likely to Compensate for the Lack of a Home-Internet Subscription by Going Online Using Some Other Access Method Outside of the Home.

To understand the digital divide better, it's important to examine whether and how home internet non-users go online anyway without a home subscription. People with budget constraints may forgo home internet subscriptions, doing without either a wired or mobile plan, but still connect to the internet via other routes. Many such people presumably are familiar with the internet, and ready to use it, but don't subscribe due to the high price exceeding their ability to pay or exceeding their perceived value from subscribing. Where and how they connect is also important. An office worker without children may fulfill most of their internet usage needs at work, but a kid without home internet can't use the library as a full replacement.

There are only small differences in such use across income strata for home internet non-adopters (*see* Figure 69). For example, 20 percent of households in the bottom income quintile without any internet access at home (neither wired nor mobile subscriptions) still have one or more members using internet access at other locations. That figure is 22 percent of non-adopters in the top income quintile. These low percentages are not surprising. If a person uses the internet at any location, their demand for home internet will be high, and home adoption is thus more likely. It's also not very surprising that there's no relationship between income and use by people who don't (or can't) subscribe at home. This is because there are different options for where users can access the internet even when they don't do so through a home subscription. These different methods might be more attractive or more available to people at different income levels. As we discuss below, high-income home internet non-adopters are more likely than low-income non-adopters to use the internet at work, but less likely to go online at a library or community center.

Figure 69:
Home-Internet Non-Adopters – Use of Internet Access at Other Locations (2015)

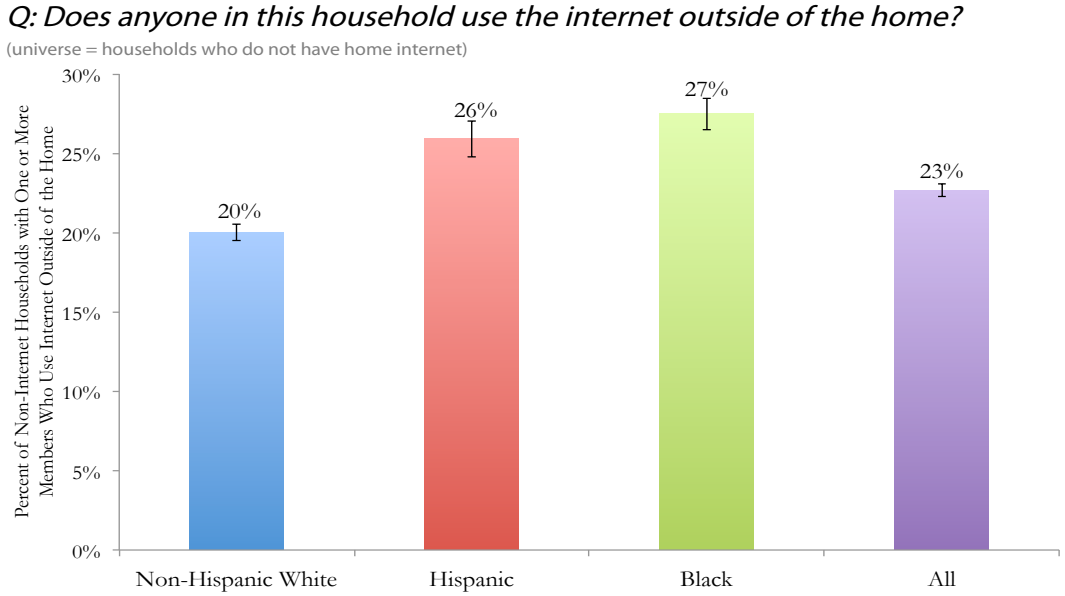


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Yet Black and Hispanic households without home internet are more likely to have a member using internet access available from some other source (*see* Figure 70). While only 20 percent of White households without internet at home have a household member or members who use the internet elsewhere, this value is 26 percent for non-adopting Hispanic and 27 percent for non-adopting Black households. This difference holds for home internet non-subscribers with family incomes below $20,000. 16 percent of such non-

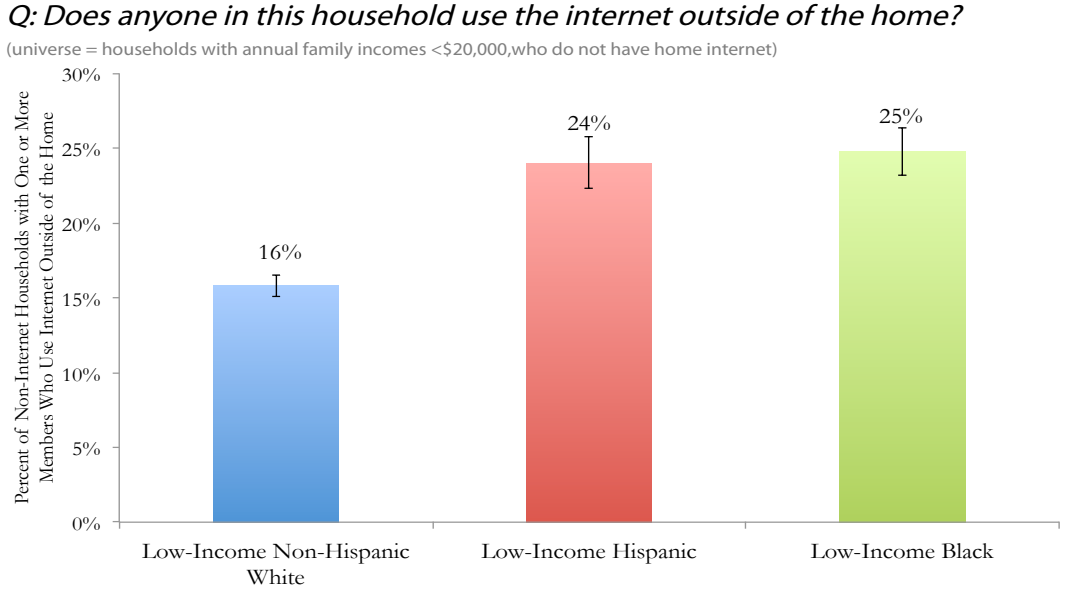
adopting White households have a member who uses the internet elsewhere – far below the level for Hispanic (24 percent) or Black households (25 percent) in that income category (*see* Figure 71).

Figure 70:
Non-Home Internet Adopters – Use of Internet Access at Other Locations by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between non-Hispanic White non-adopters and Hispanic non-adopters, and between non-Hispanic White non-adopters and Black non-adopters, is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

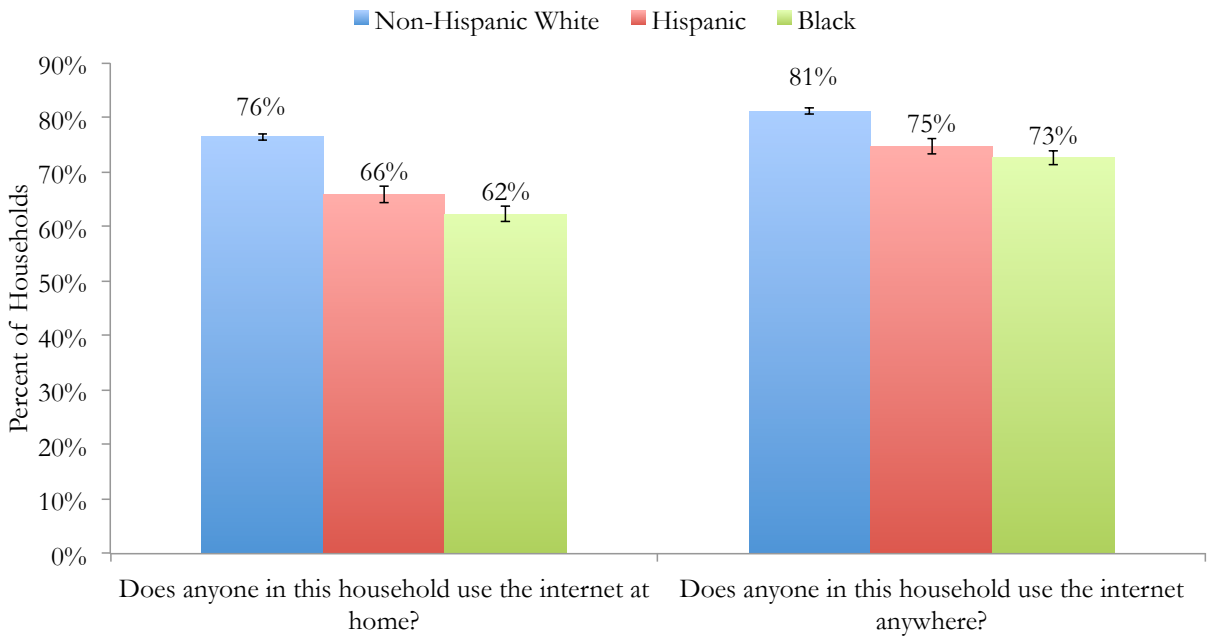
Figure 71:
Home-Internet Non-Adopters – Use of Internet Access at Other Locations by Race/Ethnicity for Persons with Annual Family Incomes Below $20,000 (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between non-Hispanic White non-adopters and Hispanic non-adopters, and between non-Hispanic White non-adopters and Black non-adopters, is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Because Hispanic and Black home internet non-subscribers are more likely to go online at other locations, the size of the racial/ethnic digital divide closes slightly if we count such usage (*see* Figure 72. There is a gap of 10 or 14 percentage points between White households and Hispanic or Black households, respectively, if we only count usage of the internet through the household's own wired or mobile wireless subscriptions. That gap shrinks to 6 or 8 percentage points, respectively, if we include persons using the internet anywhere via any source.

Figure 72:
Household-Level Internet Adoption by Family Income by Race/Ethnicity, Home-Subscription Use vs. Use Anywhere (2015)



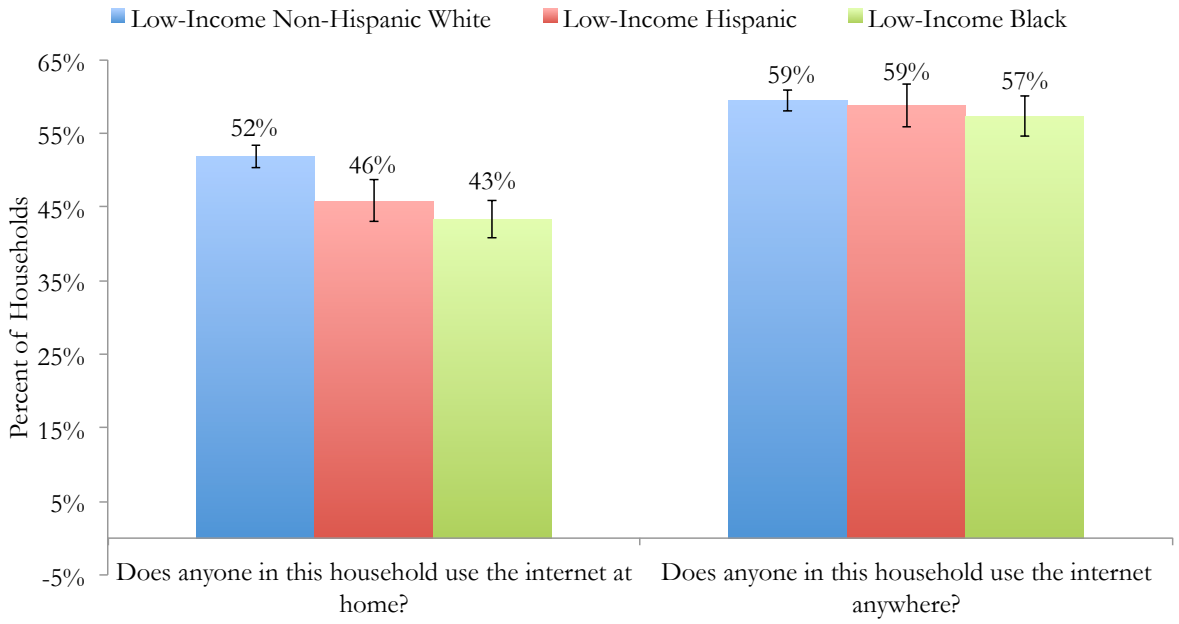
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between internet use for non-Hispanic White households and Hispanic households, and for non-Hispanic White households and Black households, are statistically significant at p<0.05 for both categories of internet use. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Furthermore, counting such usage from other locations also nearly eradicates the gap in internet usage between people in low-income White households versus those in low-income Hispanic or low-income Black households (*see* Figure 73).[91] This indicates that usage through access methods other than a household's own wired or mobile subscription is an incredibly important method for getting online by those who are priced out of the home internet market, particularly people from Hispanic or Black families.

This also indicates that these home internet non-subscribers are "internet-ready." The racial and ethic demographic gaps in home adoption overall, and especially in affordable access to wired home internet options, remain as tremendous barriers to building a more equitable society and economy. Lawmakers must address these digital divides using the policy prescriptions in this report. Yet if we view connecting at work, school, or public access points as a temporary bridge to close the digital divide, and as a way to alleviate in part the problems that a complete lack of access creates, then it's important to understand the differences in how certain populations access the internet when they don't have any subscription at home.

[91] These results are presented at the household level. However, we also see the same kind of narrowing of the usage divide between members of different racial and ethnic groups – and elimination of these internet usage gaps between low-income individuals of different races or ethnicities – if we examine usage without a home wired or mobile subscription at the individual person-level. *See* Appendix Figures A72 and A73.

Figure 73:
Household-Level Internet Adoption by Family Income by Race/Ethnicity
for Householders with Annual Family Incomes Below $20,000, Home Use vs. Use Anywhere (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between home internet use for low-income non-Hispanic White households and low-income Hispanic households, and low-income non-Hispanic White households and low-income Black households, are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Income, along with race and ethnicity, all play a role in where home internet non-adopters go online. Non-adopting households with higher incomes are more likely than lower-income households are to have a member who goes online at work. Only 13 percent of low-income homes without an internet subscription have a household member who goes online at work, compared to 23 percent of non-adopting homes with incomes between $35,000 and $100,000 (*see* Appendix Figure A30).

Racial and ethnic identifications once again factor in, along with income. Non-adopting and low-income White households are twice as likely as non-adopting, low-income Hispanic households to have a member who goes online at work (22 percent vs. 11 percent). (*See* Appendix Figure A33).[92] This is also true at the individual level: 19 percent of low-income Whites without home internet go online at work, but just 9 percent of low-income Hispanic home internet non-adopters do (*see* Appendix Figure A32). These racial/ethnic disparities for online use at work are for the (relatively) small subpopulation of workers without home access. But they mirror the results among all workers who go online at work (whether they have home internet or not). In each case, people of color are less likely to use the internet at work – particularly those with low-incomes.[93]

[92] These figures exclude households in which none of the members are in the labor force (*i.e.*, none of the household's members are employed, or unemployed but seeking work).

[93] Among all employed persons, 61 percent of Whites report going online at work, compared to just 38 percent of Hispanic workers and 47 percent of Black workers. (All values are statistically significantly different from each other at p<0.05; *see* Figure 49). Among all employed persons with annual family incomes below $20,000, 40 percent of Whites report going online at work, versus just 23 percent of Hispanic and 30 percent of Black workers. (Differences between the values for low-income White workers and low-income Hispanic workers, and between low-income White workers and Black workers, are statistically significant at p<0.05; *see* Appendix Figure A34).

This is why schools and libraries are an important connection point for low-income populations. Home internet non-adopters in the lowest income strata are far less likely (44 percent) to go online at their jobs than are highest-income home internet non-adopters (72 percent).[94] (*See* Appendix Figure A31). At other locations though, the numbers reverse: the lower the family income, the more likely a person is to go online at a public institution such as a library.[95] Among all persons without home internet who do go online elsewhere, 45 percent in the bottom income quintile do so at a public institution, versus just 26 percent in the top income quintile (*see* Appendix Figure A40). 21 percent of people in school (school-aged or adults in college/university) in the bottom income quintile and lack home internet do use it at school; just 5 percent of such students in the top quintile do (*see* Appendix Figure A36).[96]

Schools and libraries also are important connection points for people in communities of color who lack home internet access, precisely because they are less likely to go online at work.[97] For example, while 70 percent of employed Whites without home internet do access the internet at work, only 45 percent of similarly situated Hispanics and 56 percent of similarly situated Blacks do (*see* Appendix Figure A35). This is flipped for schools and libraries. Hispanic and Black students without home internet access are nearly twice as likely as White students without home access to go online at school.[98] And just 29 percent of Whites without home internet go online at a public institution, but 36 percent of such Hispanics and 46 percent of such Blacks do (*see* Appendix Figure A43).[99]

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[94] *See* Appendix Figure A29. Among all employed persons, only 33 percent in the bottom income quintile go online at work, versus 70 percent in the top quintile. Among employed persons without home internet, 12 percent in the bottom income quintile go online at work, versus 17 percent of those with higher incomes.

[95] See Appendix Figure A38 showing that households in the bottom income quintile and without home internet access are nearly twice as likely to report going online in a public place as are those without home internet but in the top income quintile. Yet if we look at the full universe of households, including those with and those without home internet, this relationship between income and accessing the internet in libraries or other public places is reversed. In general, people in higher income brackets are more likely to use internet access made available in a public place.

[96] Including those with and those without home access, low-income students are slightly less likely than high-income students to go online at school. 45 percent with family incomes below $20,000 do, versus 51 percent with family incomes above $100,000 (a difference that is statistically significant at $p<0.05$). *See* Appendix Figure A36.

[97] For employed persons without home internet, 19 percent of Whites go online at work, versus 13 percent of all other employed persons without home internet (statistically significant at $p<0.05$). This means 9 percent of such Hispanics and 16 percent of such Blacks go online at work. Among home internet non-adopting households with one or more employed members, 22 percent of White households have a member who uses internet at work, versus 11 percent of Hispanic households and 19 percent of Black households. The differences between White persons/households and Black persons/households is not statistically significant at $p<0.05$. *See* Appendix Figure A33.

[98] Among all school-age minors (age 3 to 15) and adults enrolled in school (age 16 to 54 who report enrollment in high school, college or university), Whites report higher levels of accessing internet at school (50 percent) than Hispanic or Black students (44 percent and 46 percent), with the differences between White students and Hispanic and Black students statistically significant at $p<0.05$. However, if the population is further restricted to students without internet at home, Hispanic and Black students report a higher level of use at school than White students do (19 percent, 19 percent and 11 percent, respectively), with differences between Whites, Hispanics, and Blacks statistically significant at $p<0.05$.

[99] *See* Appendix Figure A42. Among households without home internet, 6 percent headed by a White person report someone in the household accessing the internet from a library, community center, park or other public place, compared to 11 percent of such Hispanic households and 14 percent of such Black households (differences between White and other households statistically significant at $p<0.05$). Among all households (with or without home internet access) 26 percent of Hispanic and 28 percent of Black households, but just 21 percent of White households report a member going online at a public place (differences between White and other households statistically significant at $p<0.05$). These differences remain when asking a person (age 3 and above) if they themselves go online in a public place (5 percent of Whites, 6 percent of Hispanics and 10 percent of Blacks without home internet; 16 percent of Whites, 17 percent of Hispanics and 21 percent of Blacks with or without home internet) – with the difference between Whites and Blacks statistically significant at $p<0.05$.

These differences, in how home internet non-adopters in different racial or ethnic groups typically get online at other locations, also manifest among the poorest people in America – but with some minor differences. Just 6 percent of low-income Hispanic employed persons without home internet report using it at work, which is much lower than the 15 percent of low-income employed Whites without home internet who report using it at work. But among all low-income internet users without home internet, Blacks (15 percent) are far more likely to use the internet at public institutions than are Whites (7 percent).

Compared to libraries and community centers, coffee shops and other retail locations that offer internet access are less often utilized by home internet non-adopters of any income or any race/ethnicity.[100] That such retail locations with access are so sparingly utilized by people who lack home access, even among low-income home internet non-adopters, is likely the result of the need to bring your own computing device (which is likely provided by libraries) and of the restrictions on use (*e.g.*, the amount of time a patron is allowed to remain on the premises, and the likely need to purchase the retailer's services prior to using their internet access).

In sum, the data suggests that Blacks and Hispanics are particularly concerned about the price of internet access, and that concern is especially acute for those with lower incomes. Black and Hispanic community members partially compensate for the lack of home internet access by using the internet at public locations, more so than Whites do; and that means public institutions such as schools and libraries are an especially important access method for these communities. From this information it's clear that reducing the cost of home internet access service – and increasing people's ability to participate equitably in the market for it – would especially benefit home-internet adoption by people in communities of color.

People in communities of color are less likely to adopt at home. But they are more likely to use the internet in other locations outside of the home (besides work, as discussed above and in further detail again below). And they are more ready to subscribe at home at a lower price. This means that increasing competition among service providers, spurring lower prices, and reducing participation barriers (like credit checks and the lack of prepaid or resold options) should be top priorities for those who want to address the digital divide. Accomplishing these goals would the best way for communications law and policymakers to address persistent home-internet adoption gaps that are based solely on race and ethnicity, even once we control for income, employment status, educational attainment, household composition, and other variables that impact adoption.

[100] Only 4 percent of households without home internet report having a member who uses the internet "while at a coffee shop or other business that offers internet access," compared to 10 percent of such households that report having a member who goes online at a library/public access point. Among households without home internet access, there is no significant difference across income strata in the level of this reported "café" access. It's 4 percent for each of the five income quintiles. Hispanic households and Black households without home internet are slightly more likely than White households without home internet to report having a member who goes online at a retail location (6 percent, 5 percent, and 3 percent respectively; differences between White households and other households is statistically significant at $p<0.05$). *See* Appendix Figure A46.

PART VI

PEOPLE OF COLOR WHO USE THE INTERNET ARE PARTICULARLY CONCERNED ABOUT ITS AFFORDABILITY

A complete understanding of how people use the internet can aid efforts to close the digital divide – and do so without exacerbating newly emerging divides between people who can only afford to subscribe to cheaper, low-capacity mobile internet options and those who can afford higher speed wired connections.

Yet affordability is not just a measure of price: while it's directly related to individuals' ability to pay, the perception of affordability also stems from their willingness to pay based on the value they perceive from making that investment. So, if people of color over-index for certain online activities, or value some attributes of internet access over others, this knowledge can inform efforts to increase affordability and adoption.

The Factors That Home-Internet Users View as Most Important.

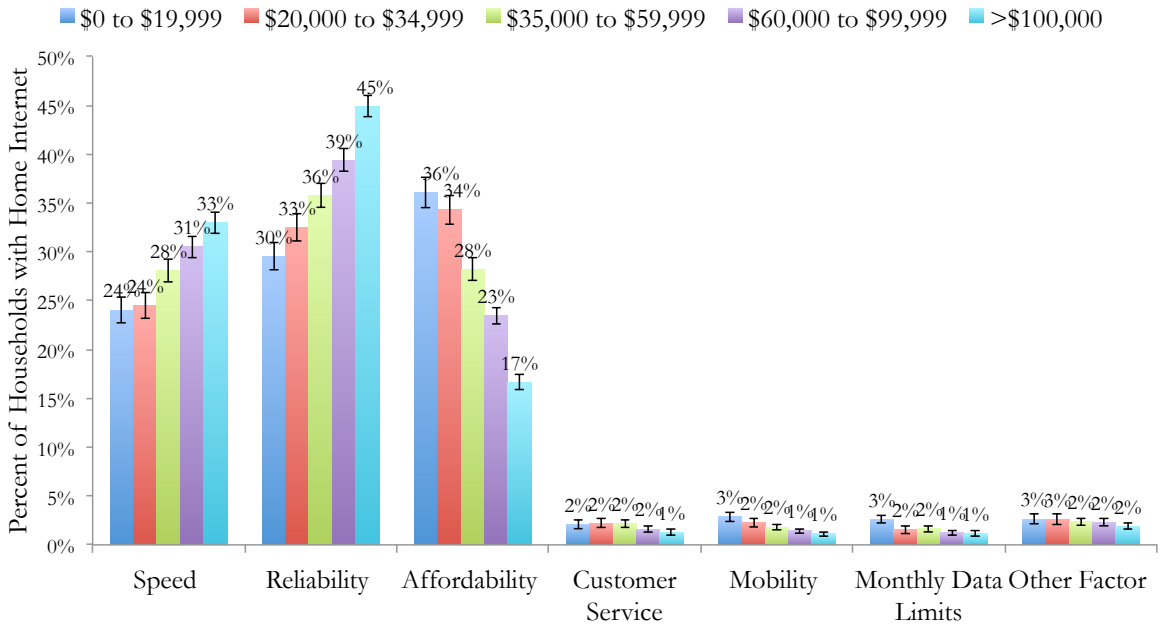
Reliability, speed, and affordability are by far the most important factors considered by internet-adopting households when they purchase their service (listed by 38 percent, 29 percent, and 26 percent of Census respondents, respectively). But various demographic groups weigh these factors differently.

Compared to high-income home internet users, lower income users place more emphasis on affordability, mobility, and data caps; they place less on reliability and speed. For example, 36 percent of households in the bottom income quintile with home internet listed affordability as their top concern. Only 17 percent of households in the top income quintile with home internet did (*see* Figure 74).

Figure 74:
Most Important Factors Considered When Purchasing Home-Internet Service by Family Income (2015)

Q: Which of the following is the most important factor regarding your internet service at home?

(can provide only one factor; universe = households with home internet)



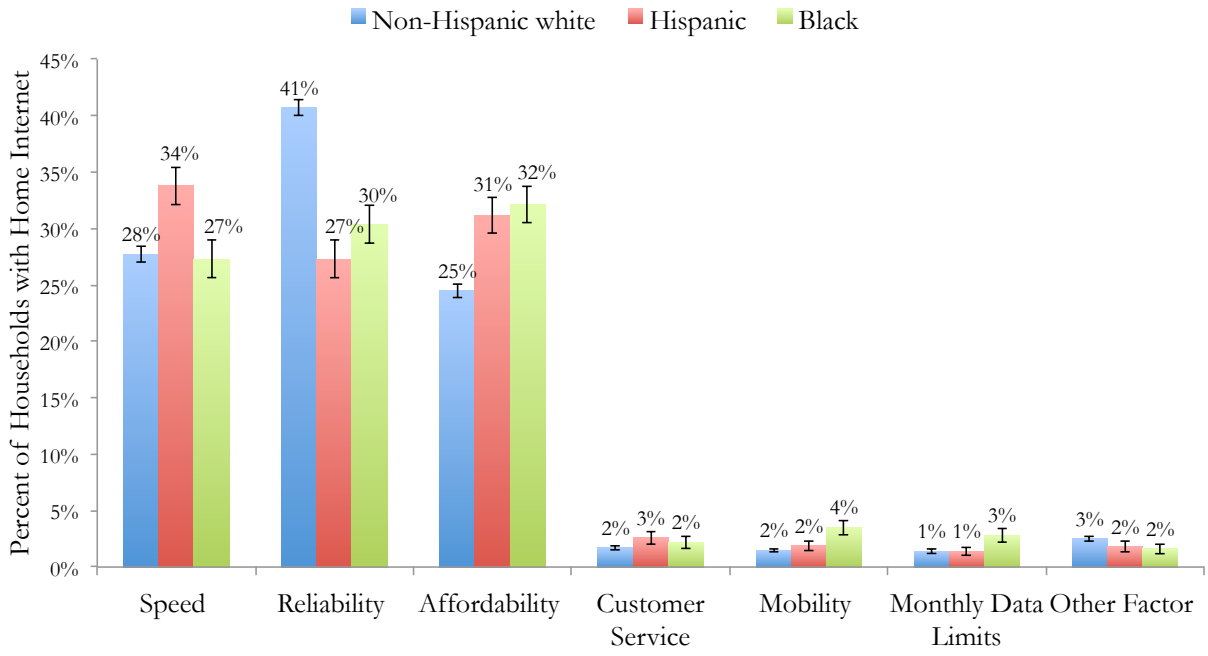
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Among those with home internet, Hispanic households (31 percent) and Black households (32 percent) rank affordability as a top concern more often than White households do (25 percent). (*See* Figure 75).

Figure 75:
Most Important Factors Considered When Purchasing Home-Internet Service by Race/Ethnicity (2015)

Q: Which of the following is the most important factor regarding your internet service at home?

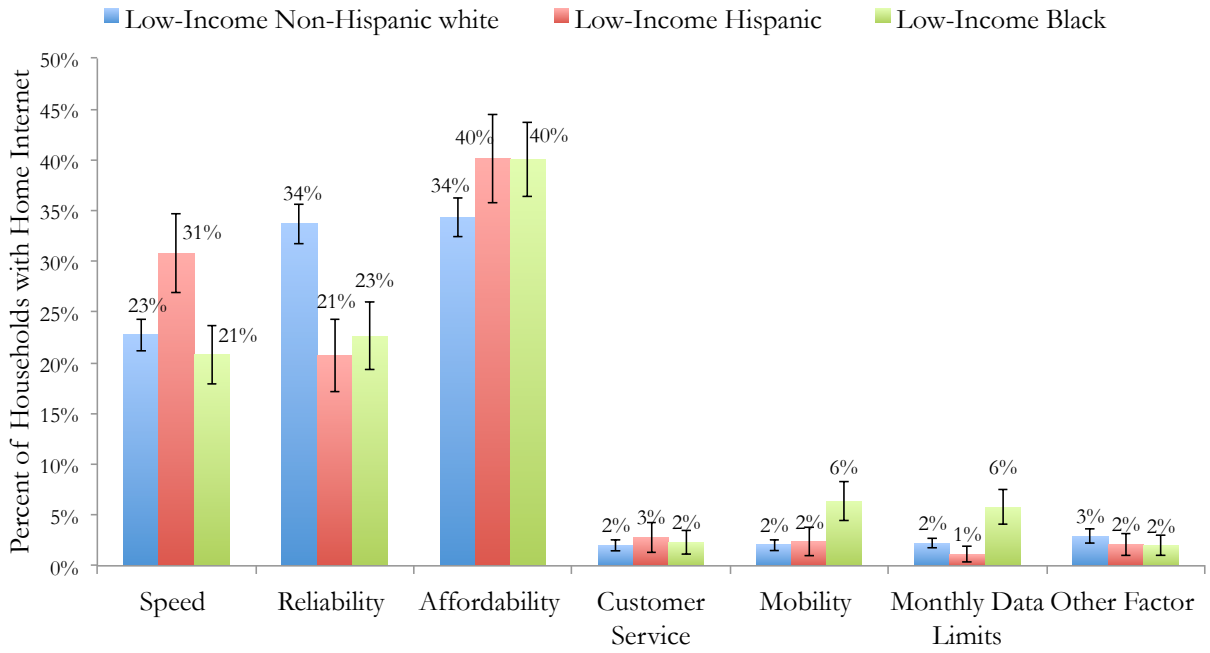
(can provide only one factor; universe = households with home internet)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Low-income Hispanic and Black home internet households are more concerned with their service's affordability than low-income White households, though affordability was the top factor cited by all low-income home internet-adopting households. For example, 40 percent of low-income Hispanic and Black home internet-adopting households cited affordability as the most important factor regarding their service, compared to 34 percent of low-income home internet-adopting White households (*see* Figure 76). Also, while the overall frequency of the answer was low, the survey indicates that low-income Black householders with home internet place a far higher emphasis on data caps and mobility than do low-income Hispanics and Whites.

Figure 76:
Most Important Factors Considered When Purchasing Home-Internet Service, by Race/Ethnicity for Households with Annual Family Incomes below $20,000 (2015)



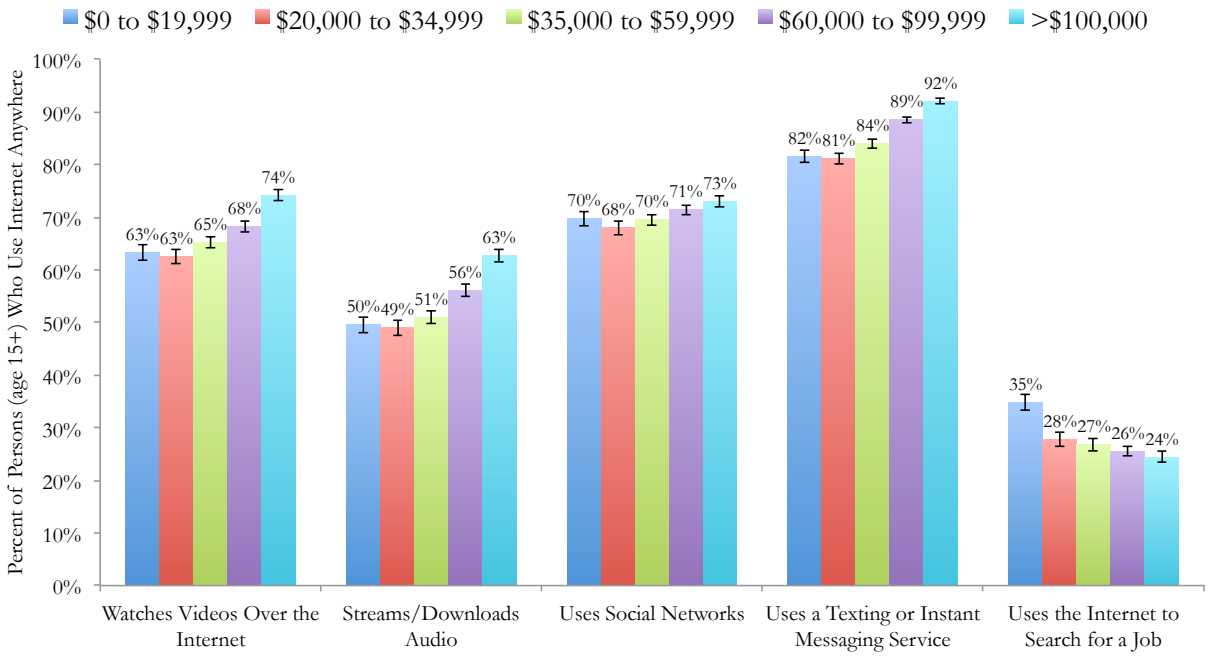
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

The Economic and Social Benefits of Closing the Digital Divide Will Be Significant: People of Color Are More Likely to Use the Internet to Watch Video, Stream Music and Search for Jobs Online.

Over two-thirds of internet users (age 15 and above, including those who have home internet or go online via some other method) watch online video. However, low-income internet users are less likely than high-income users to do so: 63 percent of those in the bottom income quintile versus 74 percent in the top quintile. (*See* Figure 77). Low-income internet users are also less likely to stream or download audio, and to use a texting/instant messaging service. But low-income internet users (35 percent) are more likely to use the internet to search for a job than internet users in the highest income bracket (24 percent).

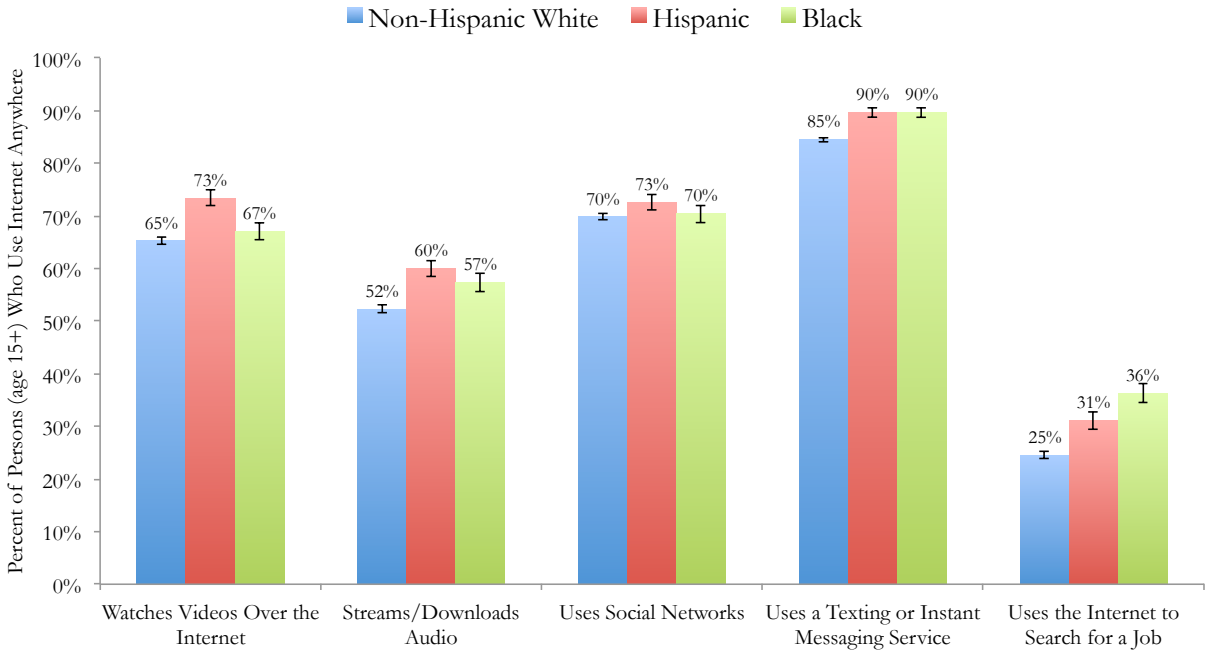
Despite these income-related internet application use gaps, for most applications we observe higher use rates for Hispanic and Black internet users compared to White internet users (again focusing on individuals age 15 and above). For example, Hispanic and Black internet users are more likely than White internet users to watch online video (73 percent of Hispanic users, 67 percent of Black users, and 65 percent of White users; *see* Figure 78). Hispanic and Black internet users are more likely than White users to stream or download audio (60 percent of Hispanic users, 57 percent of Black users, and 52 percent of White users). Hispanic and Black internet users are more likely than White users to use a texting/instant messaging service (90 percent of Hispanic users, 90 percent of Black users, and 85 percent of White users). And Hispanic and Black internet users are more likely than White users to search online for a job (31 percent of Hispanic users, 36 percent of Black users, and 25 percent of White users).

Figure 77:
Online Activities of Internet Users (age 15+) by Family Income (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

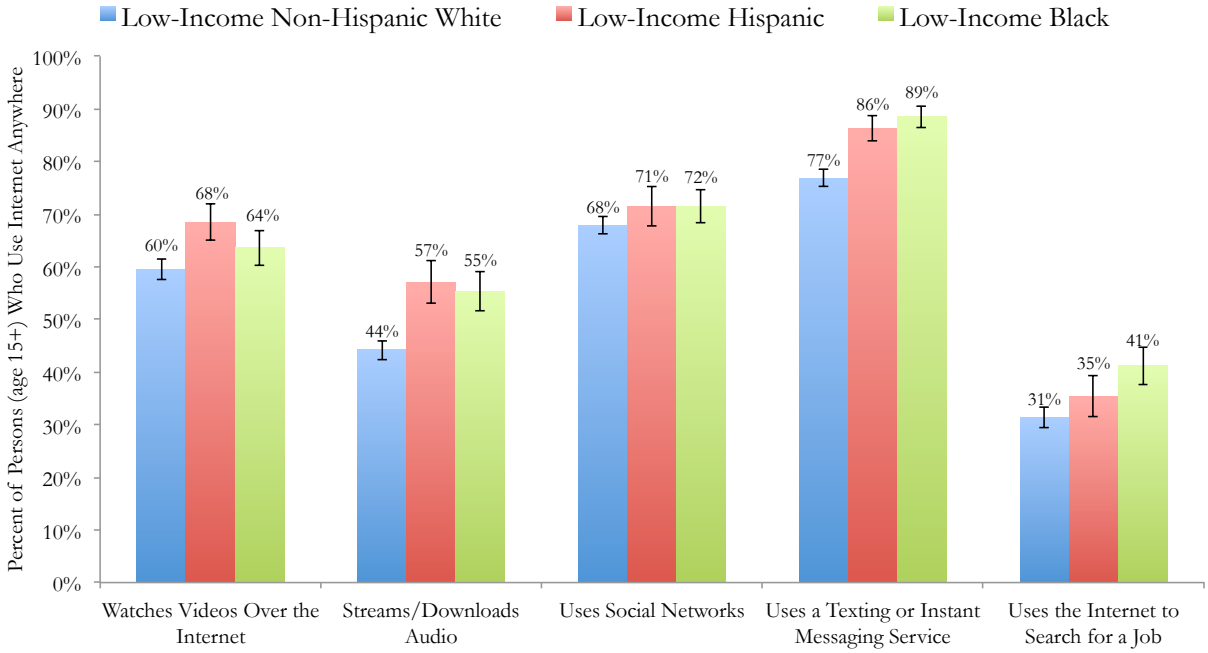
Figure 78:
Online Activities of Internet Users (age 15+) by Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic White internet users and Hispanic internet users are statistically significant at $p<0.05$ for all use cases shown. Differences between values for non-Hispanic White internet users and Black internet users are statistically significant at $p<0.05$ for streaming audio, texting/IM, and job searching. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

There are also notable application usage differences between low-income internet users who identify as members of different races and ethnicities. (*See* Figure 79). For internet users age 15 and above, Low-income Black (64 percent) and Hispanic (68 percent) individuals are more likely to watch online video than are low-income White individuals (60 percent). Low-income Black (55 percent) and Hispanic (57 percent) internet users are more likely to stream/download audio than are low-income White internet users (44 percent). Low-income Hispanic (86 percent) and Black (89 percent) internet users are more likely than low-income White internet users (77 percent) to use a texting/instant messaging service. And low-income Black internet users (41 percent) are more likely than low-income White internet users (31 percent) to use the internet to search for jobs.

Figure 79:
Online Activities of Internet Users (age 15+) by Race/Ethnicity
for Persons with Annual Family Incomes Below $20,000 (2015)

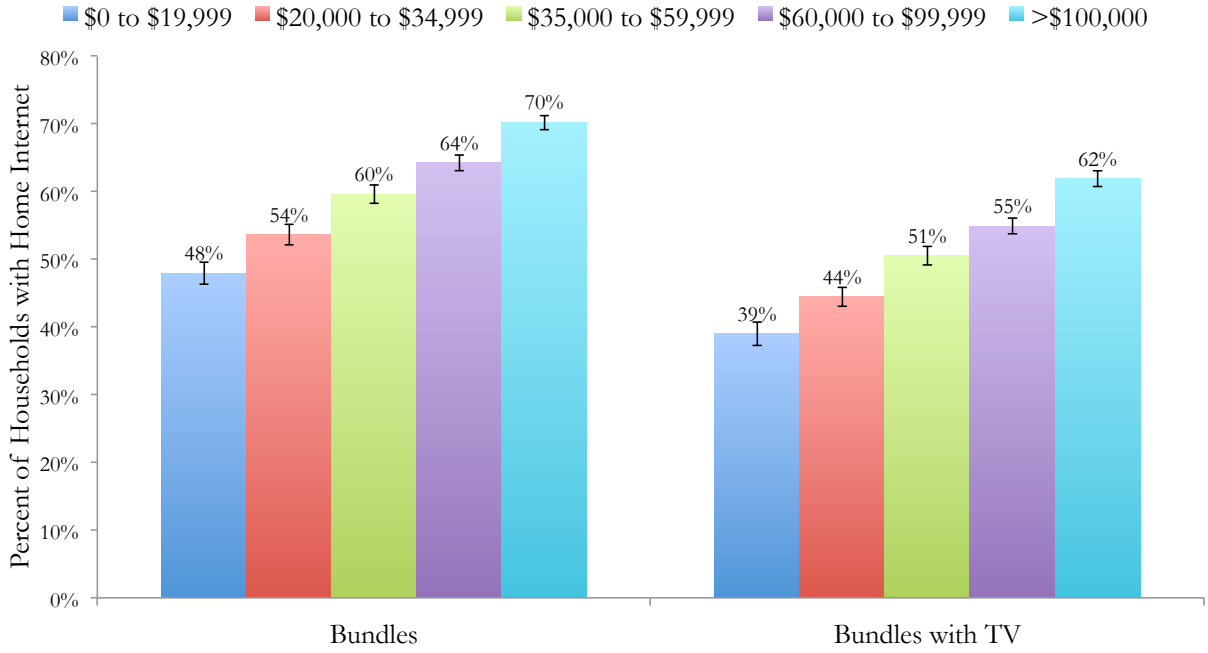


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for low-income non-Hispanic White internet users and low-income Hispanic internet users are statistically significant at p<0.05 for video, streaming audio, and texting/IM. Differences between values for low-income non-Hispanic White internet users and low-income Black internet users are statistically significant at p<0.05 for streaming audio, texting/IM, and job searching. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Hispanic and Black Home-Internet Users Are Less Likely to Purchase Internet Services in a Bundle with TV, y et Blacks Over-Index on TV Bundling Above What Would Be Expected Based on Income and Other Demographic Factors.

Even though there may be overall savings associated with purchasing communications services in a bundle, the monthly price for such a package is almost always higher than the price for any single service would be. It's unsurprising, then, that income is positively associated with purchasing home-internet service as part of a bundle with other communication services such as pay-TV, home phone, wireless, or others (*see* Figure 80). Overall, 61 percent of households with home internet purchase it in a bundle with one or more other services; but only 48 percent of households in the bottom income quintile with home internet do so, versus 70 percent of home internet households in the top income quintile. We see a similar relationship for bundling pay-TV services with home internet. While only 39 percent of low-income home internet households bundle it with pay-TV, almost two-thirds (62 percent) of top income quintile home internet households do.

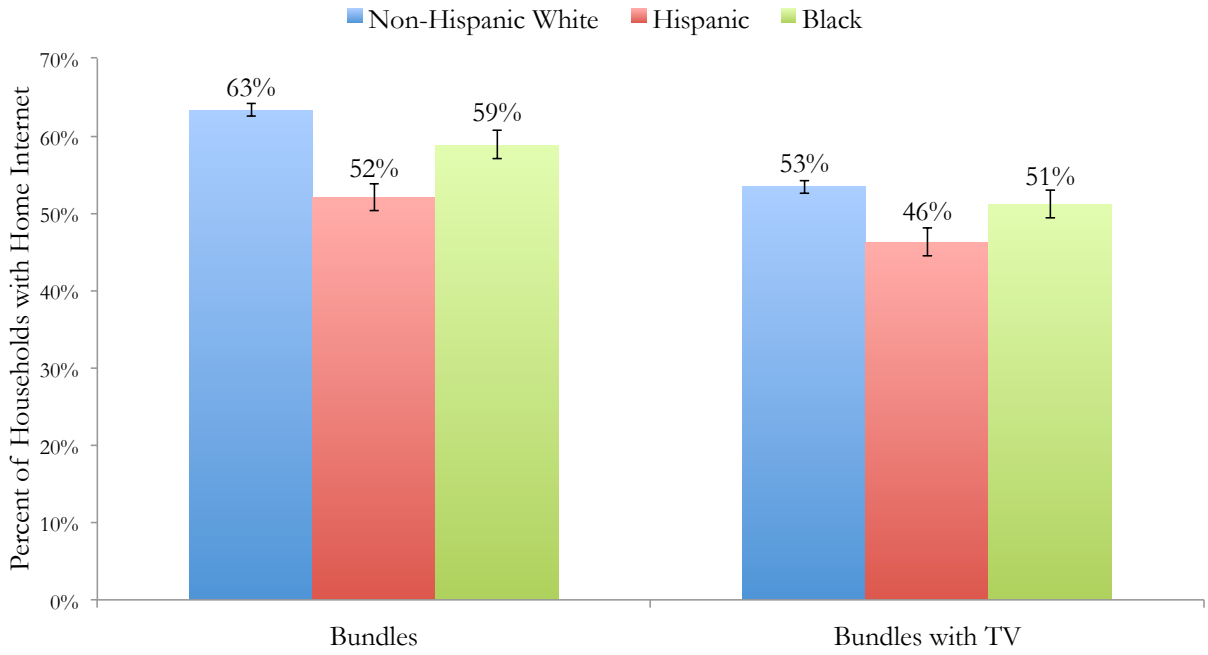
Figure 80:
Households with Internet That Bundle by Family Income – All Bundling vs. TV Bundling (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between incomes are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Black and Hispanic households that purchase home internet are less likely than White households are to purchase it in a bundle. While 63 percent of White home internet households bundle, only 52 percent of Hispanic and 59 percent of Black home internet-adopting households do. Hispanic households with home-internet service are less likely to purchase it in a bundle with television than are White households or Black households with home internet. Only 46 percent of Hispanic home internet households purchase it in a bundle with pay-TV service, compared to 53 percent of White home internet households and 51 percent of Black home internet households (*see* Figure 81).

Figure 81:
Households Purchasing Home Internet in Bundle by Race/Ethnicity – All Bundling vs. TV Bundling (2015)

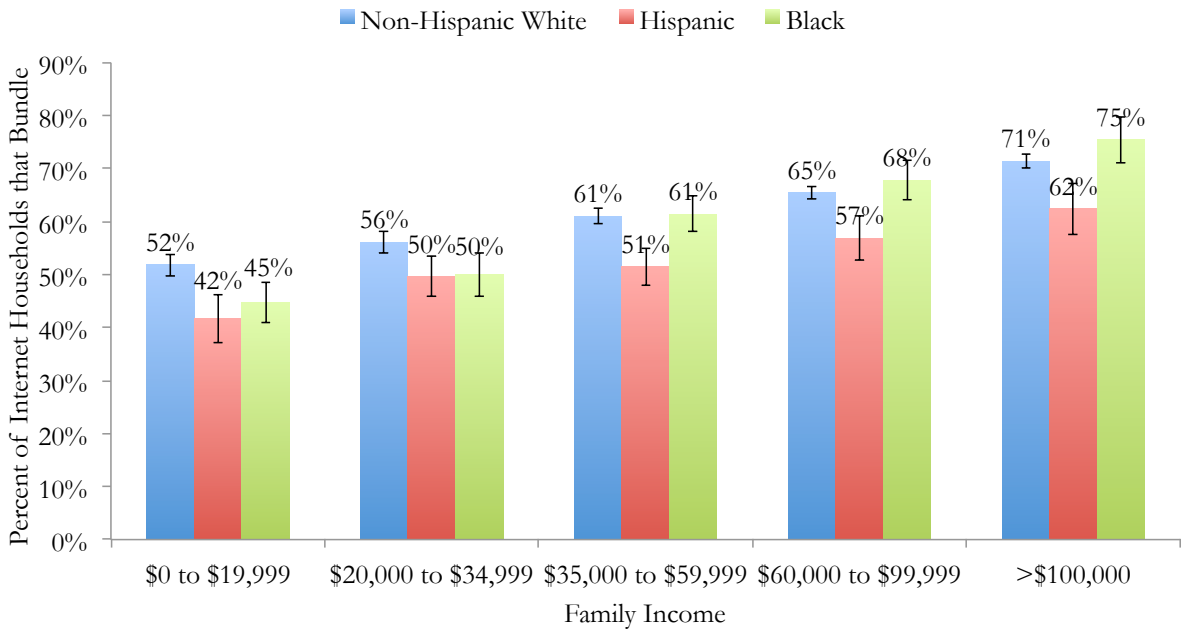


Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between races/ethnicities statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Low-income Black and Hispanic households that purchase home internet are less likely than White home internet households to purchase it in a bundle (*see* Figure 82). More than half (52 percent) of low-income White households with home internet buy such bundles, compared to just 42 percent of low-income Hispanic home internet households and 45 percent of low-income Black home internet households. As incomes increase, we see that White home internet households and Black home internet households are equally likely to bundle. But Hispanic home internet households lag behind both in bundling.

Low-income Hispanic (37 percent) and Black (35 percent) home internet subscribers have lower percentages of bundling with television than low-income White home internet households do (42 percent), though these differences are not statistically significant. As incomes increase, we see that Black home internet households are more likely than Hispanic or White home internet households to bundle with television (*see* Figure 83).

Figure 82:
Households with Internet That Bundle, by Race/Ethnicity and Family Income – All Bundling (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between non-Hispanic White internet households and Hispanic internet households are statistically significant at p<0.05. Differences between non-Hispanic White internet households and Black internet households are statistically significant at p<0.05 for incomes below $35,000. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

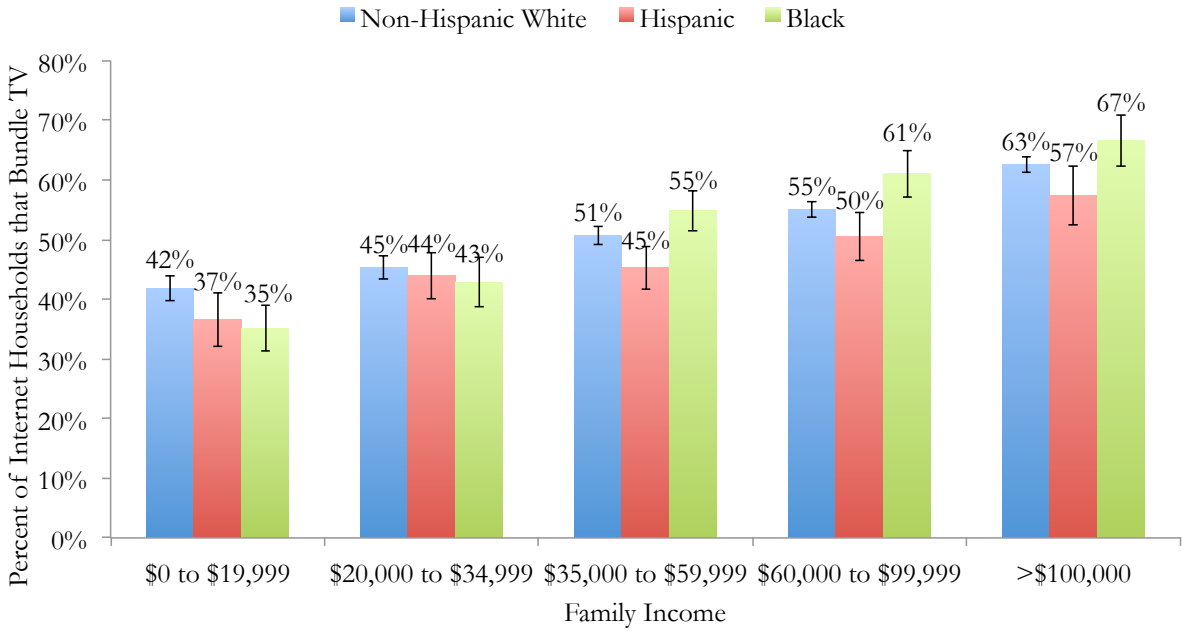
Overall, after controlling for income and other factors,[101] Black home internet users are as likely as White home internet users to bundle; but Hispanic home internet users are less likely to bundle.[102] For example, after controlling for income and other factors, the marginal impact of race or ethnicity on bundling

[101] See Appendix Figure A62 for full model results. We use a two-stage Heckman selection probability model to investigate the relationship between bundling and other factors. In the first stage, we model the probability that a household selects to subscribe to home internet as a function of the householder's race/ethnicity; the household's family income; the average age of adults in household; the maximum educational attainment of persons in household; its location in a metropolitan area or not, and that area's population size; home ownership; number of persons in household; presence of a household member who uses internet at work; presence of a household member who uses internet at school; and state-level indicators. Based on these results, in the second stage we model the probability that a household then chooses to bundle, as a function of the householder's race/ethnicity; the household's family income; the average age of adults in household; the maximum educational attainment of persons in household; its location in a metropolitan area or not, and that area's population size; home ownership; number of persons in household; and presence of a minor in the household.

[102] The results of the first stage of the full model are consistent with our main probit model for home-internet adoption discussed elsewhere. In the second stage of the full model, we find that only Hispanic, American Indian/Alaska Native and Asian households are less likely ($p<0.05$) than White households to bundle (with income, average adult age, education, metro location and size, home ownership, and number of persons in the household positively associated with bundling at $p<0.05$). Presence of a minor is negatively associated (at $p<0.05$). Educational attainment is not statistically significant.

is -5.4 percentage points for Hispanic internet households, relative to White internet households, while there's no difference between White and Black internet households.[103]

Figure 83:
Households with Internet That Bundle, by Race/Ethnicity and Family Income – TV Bundling (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The difference in TV bundling between non-Hispanic White internet households and Hispanic internet households is statistically significant at p<0.05 for incomes between $35,000 and $59,999. The difference in TV bundling between non-Hispanic White internet households and Black internet households is statistically significant at p<0.05 for incomes between $60,000 and $99,999. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

The results are similar for pay-TV bundling. After controlling for income and other factors,[104] Black home internet users are as likely as White home internet users to bundle internet with pay-television service; but Hispanic home internet users are less likely than White home internet users to bundle with television.[105] For example, after controlling for income and other factors, the marginal impact of race or ethnicity on bundling with television is -3.7 percentage points for Hispanic internet households, relative to White internet households, while there's no difference between Black and White internet households.[106]

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[103] The marginal impact of race/ethnicity on household bundling (conditional on subscribing to internet) is -5.4 percentage points for Hispanic households, -7 percentage points for American Indian/Alaska Native households, and -9.2 percentage points for Asian households relative to White households.

[104] We used the same approach (outlined *supra* note 101) of a two-stage Heckman selection probability model to investigate the relationship between bundling television and other demographic factors. *See* Appendix Figure A63 for full model results.

[105] The results of the first stage of the full model (modeling household home-internet adoption) are the same as they were in the selection model for all household bundling. In the second stage of the full model, we find that only Hispanic, American Indian/Alaska Native and Asian households are less likely (p<0.05) than non-Hispanic White households to bundle internet with television (with income, average adult age, metro location and population size, number of persons in the household, and presence of a minor positively associated with pay-TV bundling, at p<0.05).

[106] The marginal impact of race/ethnicity on household television bundling (conditional on subscribing to internet) is -3.7 percentage points for Hispanic households, -8.4 percentage points for American Indian/Alaska Native households, and -7.3 percentage points for Asian households, each relative to White households.

These results and other data indicate that Black families place a high valuation on, and have a high demand for, television service. This high demand contributes to Black people over-indexing on bundling relative to what would be expected when we control for income and other factors. However, a bundling gap is still seen across people of different races or ethnicities among the lowest income tiers (both for bundling overall and for bundling with television service), suggesting persistent structural issues that may depress adoption even once we account for income.

The data also points to another major problem for home-internet adoption. Broadband ISPs have incentives to use their market power in the home internet market in order to benefit their pay-television businesses. Lower-income internet households are far more likely to purchase internet as a standalone service. But many ISPs refuse to offer standalone broadband, or they price it in such a way that a family who might otherwise look to buy internet and TV service from two different providers will nevertheless buy the ISP's pay-TV service – even if it doesn't fully suit their needs.

Some people with severe budget constraints may see a maze of expensive, bundled wired internet and pay-TV offerings, and simply choose to stick with their mobile data connection. Others may go for a promotional bundle deal, only to drop the service after the bill shock hits when the discount expires. Also, as we show above, television appears to be a particularly important service to Black households. Some of these households may buy the ISP's TV/internet bundle in lieu of purchasing a separate TV service that they might prefer, simply because the ISP is their only option for broadband. That is especially likely when the high price of that ISP's standalone broadband offer makes creating a "synthetic" bundle (by combining internet and TV services from two different providers) simply too expensive for families who might choose that route if they could afford to do so.

The lesson is clear: Limited competition to provide high-speed wired internet access service may contribute greatly to the digital divide. It will do so any time there are just one or two ISPs, and they are vertically integrated providers of pay-TV services, who have the incentive and the ability to sustain their pay-TV business by resort to any number of tactics. Incumbent providers that sell both cable TV and broadband can cross-subsidize their pay-TV business, in the relatively competitive and relatively low-margin multichannel video business, with revenues from the less competitive wired home internet market. They can use pricing mechanisms that artificially inflate the cost of standalone internet service, as well as other promotions and methods for encouraging people to purchase more than one expensive communications service from the ISP. This all works to keep the price of obtaining home internet, either in a bundle or on its own, higher than it could otherwise be.

PART VII

THERE ARE SMALL BUT STATISTICALLY SIGNIFICANT DIFFERENCES IN BROADBAND DEPLOYMENT THAT PERPETUATE DIGITAL DIVIDES BASED SOLELY ON RACE AND ETHNICITY

It's clear that differences in income have a strong impact on the digital divide. Income is the number one factor influencing broadband affordability and adoption. Thus, any effort to close the adoption gap must focus on increasing internet affordability. But the data also indicates that Hispanic and Black home-internet adoption – and particularly wired home-internet adoption – lags well behind the expected value, even after accounting for demographic differences in income, age, education, household size and composition, and other factors. We must ask why that is. What other factors may contribute to this persistent digital divide, faced by people of different races and ethnicities, beyond their income and these other demographic differences?

Our analysis suggests that other structural factors likely account for some of this divide in home-internet adoption by people of different races and ethnicities, which cannot be explained by income differences alone. For example, as we discuss below, Hispanic and Black individuals' lower levels of internet use at work, relative to Whites, impacts their demand for home internet access. And this difference in use at work is at least partly due to structural discrimination in education, job training, and hiring. Or consider the likely impact of discrimination in credit and credit scoring practices, which can result in people of color being shut out from purchasing home-internet services that they clearly demand, and for which they are willing and able to pay. Structural discrimination evidenced by these and other practices likely impact how people of color participate in the market, meaning these practices have what is termed a demand-side impact; but they also affect how providers of internet access serve these communities, making for supply-side impacts too.

The task then, for policymakers who wish to eradicate these digital divides, is to stop shrugging their shoulders at the impact of income inequality on broadband adoption. They must recognize that the price is too high, and that this is the case because of market failure. Policymakers must also work to identify internet service adoption differences that are exacerbated by structural racial and ethic discrimination in our broader economy and society. This process begins by looking for both ways – on the demand side and the supply side too – that structural discrimination impacts people of color's participation in the internet access marketplace.

Analysis of the digital divide too often ignores that there are very real differences in how a given group of potential consumers is able to participate in the market. Observers tend to focus on income, but either do not know or choose to ignore that different people with the same incomes may have very different allocations and demands placed on that income. This may contribute to a persistent and pernicious digital divide based solely on race and ethnicity even once we control for income, educational attainment, and other differences. Structural factors well beyond the internet access market play a strong role in creating and sustaining those differences.

Observers also tend to overlook the fact that not everyone is able to participate equally and equitably in the marketplace. In other words, people of color too often face barriers that they must overcome in order just to spend their money – even on essential things like home-internet service – and even when they have the same income as White peers.

Yet the data shows that this racial/ethnic digital divide is not simply due to lack of demand. People of color have a high demand for internet access, but are particularly concerned with price. And the data suggests no difference in the level of demand beyond what we'd expect based on the income inequality faced by people of color. Other factors are in play, and contributing to adoption gaps between people of different races and ethnicities that are not explained by income disparities and other demographic differences.

Members of communities of communities utilize internet access available from sources other than a home (wired or wireless) subscription to partially overcome the digital divide. But it's not enough to close these gaps entirely. Indeed, the data presented above shows a persistent digital divide based on race and ethnicity, even between low-income persons of color and low-income Whites – along with higher price sensitivity and higher use of non-home internet options by low-income persons of color. All of this points strongly to structural problems beyond income and ability to pay.

In short, the data suggests possible supply-side problems that disproportionately impact communities of color. The first and most obvious question then is, are there differences in broadband deployment that contribute to this digital divide? To answer this question, we examined FCC broadband deployment data in conjunction with U.S. Census demographic data. This gives us a rich data set on broadband deployment and demographics, down to the granular level of census blocks, enabling an analysis of broadband deployment and potential competition. This leads in turn to a comparison of deployment patterns, as well as the number and quality of competitive options, in communities inhabited by people of different races and ethnicities.

People of Color Have Fewer Choices on Average for Broadband Providers at Every Speed; They Are More Likely to Live in an Unserved Area; They Are More Likely to Live in a Monopoly Area; and They Are Less Likely to Have Access to the Latest-Generation Broadband Technologies.

We begin this analysis of supply-side issues by examining the basics of broadband deployment in America. The numbers reflect what most families know all too well: the home broadband market is at best a duopoly, dominated by incumbent cable companies. A person in the U.S. has on average a choice of 2.05 wired internet service providers, though this number is partially inflated due to over-reporting issues in the FCC's data (*see* Figure 84).

Setting the minimum downstream speed threshold to 3 Mbps greatly reduces that over-reporting issue. At 3 Mbps downstream, a person in the U.S. has on average a choice of 1.9 wired ISPs. The average number of wired ISPs declines to 1.7 at 10 Mbps, and drops further to 1.2 providers offering speed at 25 Mbps.[107]

[107] In this section of the report, we focus for several reasons on service offered at the 3 Mbps, 10 Mbps, and 25 Mbps downstream thresholds. First, 3 Mbps is slow by today's standards, but still adequate to support streaming audio, video, video calls, and other common uses of the Internet. Second, the FCC's Form 477 data includes a large number of non-facilities-based carriers that report offering ADSL at speeds below this threshold. These do not appear to be actual in-market competitors. (See discussion above, in the section entitled "Important Notes on Data Sources and Methodology," of over-reporting issues in the FCC's data). Third, we report data for the 25 Mbps threshold because this is the level chosen at this time by the FCC to represent "advanced telecommunications capability." *See, e.g.*, *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act*, GN Docket No. 15-191, 2016 Broadband Progress Report, 31 FCC Rcd 699, ¶ 3 (2016). Fourth, we include the 10 Mbps threshold because it's a speed tier that can support high-definition video streaming, and because it captures legacy telephone company ADSL2+ and VDSL services that are sold in double or triple-play bundles (with pay-TV and/or voice) in direct competition with bundled cable modem services. While these cable modem services may offer speeds above the 25 Mbps threshold, this all means that the FCC's 25 Mbps threshold will exclude certain telco triple play services (1) that offer speeds at 10 Mbps and above, but below 25 Mbps; and (2) that consumers may find to be substitutes for cable modem wired internet services, despite these differences in promised or delivered speeds on these types of networks.

Figure 84:
Average Number of Available Wired ISPs by Downstream Speed (Year-End 2014)

Downstream Speed	Average Number of Wired ISPs Available
Any	2.05
≥ 3 Mbps	1.87
≥ 10 Mbps	1.70
≥ 25 Mbps	1.21
≥ 50 Mbps	1.09
≥ 100 Mbps	0.89

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. FCC Form 477 broadband deployment data is collected at census-block level. Values above represent the average number of ISPs available in populated census blocks, weighted by block population.

Less than 4 percent of the U.S. population has no wired ISP available to them at any speed, and 14 percent of the population lives in an area with either no wired providers or just one wired provider.

This problem of facing a monopoly at best, however – or even a "no-opoly," with no providers of wired internet service at a particular speed tier and above – gets significantly worse at higher speeds. More than 21 percent of the U.S. population has on average one or fewer wired ISPs offering downstream speeds at 3 Mbps or above. At a threshold of 10 Mbps, the number jumps to nearly one-third of Americans with one wired choice or none at all. And at the 25 Mbps downstream threshold, more than 70 percent of the population lives with either no wired options at all or with just one wired provider offering those speeds. (*See* Figure 85).

Figure 85:
Percent of Population by Number of Available Wired ISPs and Downstream Speed (Year-End 2014)

Number of Wired ISPs	Percent of Population (Any Speed)	Percent of Population (≥3Mbps)	Percent of Population (≥10Mbps)	Percent of Population (≥25Mbps)	Percent of Population (≥50Mbps)	Percent of Population (≥100Mbps)
0	3.5%	5.4%	7.1%	11.1%	15.4%	29.2%
1	10.4%	16.0%	24.8%	59.0%	61.5%	53.5%
2	66.2%	66.5%	59.8%	27.7%	21.7%	16.3%
3	17.4%	10.9%	7.6%	2.0%	1.3%	1.0%
4 or More	2.5%	1.3%	0.1%	0.1%	0.0%	0.0%

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data.

There are small but statistically significant differences in the average number of wired service providers available to people of different races and ethnicities residing in either urban or rural areas.

Hispanics, Blacks, American Indians, and Native Hawaiian/Pacific Islanders residing in urban areas have fewer available choices for wired service at every speed than Whites and Asians have (*see* Figure 86).[108] For example, Whites living in urban census blocks have an average of 2.03 wired ISPs offering service at downstream speeds of 3 Mbps and higher, compared to 1.97 such ISPs for urban Hispanics, 1.98 for urban Blacks, and 1.85 for urban American Indian/Alaska Natives. At 25 Mbps and higher, urban Whites have an average of 1.36 wired ISPs, compared to 1.26 for urban Hispanics, 1.23 for urban Blacks, and 1.2 for urban American Indian/Alaska Natives.

The same type of gap persists in rural areas (*see* Figure 87). For example, Whites living in a rural census block have on average 1.29 wired ISPs offering service at downstream speeds of 3 Mbps and higher, compared to 1.04 such ISPs for rural Hispanics, 1.22 for rural Blacks, and 0.78 for rural American Indian/Alaska Natives. At 25 Mbps and higher, rural Whites have an average of 0.71 wired ISPs, compared to 0.57 such ISPs for rural Hispanics, 0.66 for rural Blacks, and just 0.38 for rural American Indian/Alaska Natives.

Figure 86:
Average Number of Available Wired ISPs to Urban Population by Race/Ethnicity and Downstream Speed (Year-End 2014)

Downstream Speed	Average Number of Wired ISPs Available (Urban blocks)						
	to Non-Hispanic White Population	to Hispanic Population	to Black Population	to American Indian/AK Native Population	to Asian Population	to Hawaiian/ Pacific Islander Population	to Multirace Population
Any	2.19	2.16	2.15	2.08	2.22	2.09	2.17
≥ 3 Mbps	2.03	1.97	1.98	1.85	2.09	1.98	2.01
≥ 10 Mbps	1.86	1.82	1.83	1.67	1.96	1.83	1.86
≥ 25 Mbps	1.36	1.26	1.29	1.19	1.40	1.29	1.33
≥ 50 Mbps	1.24	1.11	1.21	1.07	1.32	1.16	1.22
≥ 100 Mbps	1.01	1.00	1.00	0.90	1.17	0.82	1.02

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. FCC Form 477 broadband deployment data is collected at census-block level. Values above represent the average number of ISPs available in populated census blocks, weighted by block population. Differences between values for non-Hispanic Whites and all other races/ethnicities are statistically significant at $p<0.05$, except for multiracial population at greater than 10 Mbps, and Black population at greater than 100 Mbps.

[108] We must present the racial/ethnic deployment comparisons separately for urban and rural census blocks because of the large differences in how White and non-White populations are distributed in these areas. While 19 percent of the total U.S. population resides in rural areas, only 8 percent of the non-White population is rural, compared to 26 percent of the White population. Whites comprise 85 percent of the rural population, but make up just 63 percent of the total population. Thus, if we were to present the deployment data by race/ethnicity for urban and rural areas combined, the results for the White rural population (which is present in rural areas with uniformly lower levels of deployment than observed in urban areas) and for the White population overall (which is numerically large, both in urban areas and rural areas) would mask the differences in deployment to people of color that we observe in rural and urban areas separately.

Figure 87:
Average Number of Available Wired ISPs to Rural Population
by Race/Ethnicity and Downstream Speed (Year-End 2014)

Downstream Speed	Average Number of Wired ISPs Available Rural blocks)						
	to Non-Hispanic White Population	to Hispanic Population	to Black Population	to American Indian/AK Native Population	to Asian Population	to Hawaiian/ Pacific Islander Population	to Multirace Population
Any	1.55	1.31	1.38	1.08	1.66	1.34	1.45
≥ 3 Mbps	1.29	1.04	1.22	0.78	1.45	1.19	1.22
≥ 10 Mbps	1.08	0.89	1.05	0.65	1.26	1.01	1.03
≥ 25 Mbps	0.71	0.57	0.66	0.38	0.89	0.68	0.67
≥ 50 Mbps	0.58	0.42	0.51	0.28	0.77	0.54	0.54
≥ 100 Mbps	0.40	0.31	0.34	0.15	0.58	0.26	0.37

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. FCC Form 477 broadband deployment data is collected at census-block level. Values above represent the average number of ISPs available in populated census blocks, weighted by block population. Differences between values for non-Hispanic Whites and all other races/ethnicities are statistically significant at p<0.05.

These same, often marginalized racial and ethnic groups are more likely than Whites are to have either just one wired ISP or no wired options available to them. This gap is particularly large in rural areas.

Hispanics, Blacks and Native Americans/Alaska Natives are more likely than members of other racial/ethnic groups to have no wired provider available to them. For example, while just 1.4 percent of Whites in urban areas have no available wired ISP at downstream speeds of 3 Mbps and higher, the number with no wired provider at that speed is 2.4 percent of urban Hispanics, 1.9 percent of urban Blacks, and 5.6 percent of urban American Indian/Alaska Natives (*see* Figure 88). At the 25 Mbps downstream threshold, 3.7 percent of urban Whites have no wired ISP offering that speed, compared to 4.7 percent of urban Hispanics, 4.3 percent of urban Blacks, and 10.3 percent of American Indian/Alaska Natives residing in urban areas (*see* Figure 90).

The unserved problem is particularly acute for members of these same racial and ethnic groups living in rural areas. While 19.7 percent of the rural White population has no available wired provider at downstream speeds of just 3 Mbps or higher, 32.3 percent of rural Hispanics, 21.8 percent of rural Blacks and 43.2 percent of rural American Indian/Alaska Natives are completely unserved by any wired ISP even at that relatively low speed (*see* Figure 88).

At downstream speeds of 25 Mbps and higher, 40.3 percent of the rural White population is unserved by a wired provider, compared to 52.1 percent of the rural Hispanic population, 44.6 percent of the rural Black population, and 67.1 percent of the rural American Indian/Alaska Native population (*see* Figure 90).

Hispanics, Blacks and Native Americans/Alaska Natives are also more likely than Whites to live in a wired monopoly area. For example, while 87.9 percent of Whites in urban areas have available to them two or more wired ISPs offering 3 Mbps and higher downstream speeds, only 85.6 percent of urban Hispanics, 86.3 percent of urban Blacks, and 78.5 percent of urban American Indian/Alaska Natives are served by two or more such providers (*see* Figure 88). At the 25 Mbps downstream threshold, 36.5 percent of urban Whites have two or more wired ISPs, compared to 28.8 percent of urban Hispanics, 31.7 percent of urban Blacks, and 28.1 percent of American Indian/Alaska Natives residing in urban areas (*see* Figure 90).

The monopoly problem is once again disproportionately larger for members of these same racial and ethnic groups who live in rural areas. While 43.3 percent of the rural White population has two or more wired providers at downstream speeds of 3 Mbps and higher, only 32.9 percent of rural Hispanics, 40 percent of rural Blacks and an exceedingly low 18.5 percent of rural American Indian/Alaska Natives have two or more such providers (*see* Figure 88). At downstream speeds of 25 Mbps and higher, 10.8 percent of the rural White population has two or more wired ISPs, compared to 8.4 percent of the rural Hispanic population, 9.9 percent of the rural Black population, and 5.3 percent of the rural American Indian/Alaska Native population (see Figure 90).

Figure 88:
Percent of Each Race's/Ethnicity's Population by Number of Available Wired ISPs ≥3 Mbps (Year-End 2014)

URBAN BLOCKS - Percent of Each Group's Population

Number of Wired ISPs (≥3Mbps)	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
0	1.4%	2.4%	1.9%	5.6%	1.1%	1.4%	1.6%
1	10.7%	12.0%	11.8%	15.9%	8.0%	11.2%	10.4%
2	73.3%	73.6%	74.0%	67.7%	73.9%	76.7%	74.6%
3	12.9%	10.8%	11.5%	9.7%	14.6%	9.0%	11.8%
4 or More	1.7%	1.2%	0.8%	1.1%	2.4%	1.7%	1.6%

RURAL BLOCKS - Percent of Each Group's Population

Number of Wired ISPs (≥3Mbps)	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
0	19.7%	32.3%	21.8%	43.2%	16.5%	25.4%	23.3%
1	37.0%	34.9%	38.4%	38.3%	28.8%	34.5%	36.5%
2	38.2%	29.4%	36.6%	16.4%	48.5%	36.4%	36.0%
3	4.7%	3.2%	3.2%	2.0%	5.6%	3.4%	3.9%
4 or More	0.4%	0.3%	0.2%	0.1%	0.6%	0.3%	0.3%

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data.

Figure 89:
Percent of Each Race's/Ethnicity's Population by Number of Available Wired ISPs ≥10 Mbps (Year-End 2014)

URBAN BLOCKS - Percent of Each Group's Population

Number of Wired ISPs (≥10Mbps)	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
0	1.8%	2.8%	2.4%	7.3%	1.4%	1.8%	2.0%
1	21.6%	20.3%	21.1%	25.3%	15.6%	22.1%	20.0%
2	66.3%	69.9%	67.7%	60.7%	70.1%	68.7%	68.8%
3	9.5%	6.4%	8.5%	6.2%	11.6%	6.4%	8.4%
4 or More	0.8%	0.6%	0.4%	0.5%	1.4%	1.0%	0.8%

RURAL BLOCKS - Percent of Each Group's Population

Number of Wired ISPs (≥10Mbps)	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
0	27.0%	38.7%	28.7%	50.8%	21.3%	30.6%	30.2%
1	41.5%	35.8%	40.1%	35.2%	35.8%	40.5%	39.7%
2	28.7%	23.3%	28.9%	12.8%	38.7%	26.9%	27.5%
3	2.7%	2.1%	2.2%	1.2%	3.9%	2.0%	2.5%
4 or More	0.2%	0.1%	0.1%	0.1%	0.3%	0.1%	0.1%

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data.

Figure 90:
Percent of Each Race's/Ethnicity's Population by Number of Available Wired ISPs ≥25 Mbps (Year-End 2014)

URBAN BLOCKS - Percent of Each Group's Population

Number of Wired ISPs (≥25Mbps)	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
0	3.7%	4.7%	4.3%	10.3%	2.2%	2.9%	3.5%
1	59.7%	66.4%	64.0%	61.6%	58.9%	67.2%	62.2%
2	33.8%	27.0%	29.7%	26.6%	35.5%	28.3%	32.0%
3	2.6%	1.7%	1.9%	1.4%	3.3%	1.4%	2.1%
4 or More	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%

RURAL BLOCKS - Percent of Each Group's Population

Number of Wired ISPs (≥25Mbps)	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
0	40.3%	52.1%	44.6%	67.1%	29.8%	39.4%	43.9%
1	48.8%	39.5%	45.5%	27.7%	52.5%	53.8%	46.3%
2	10.2%	7.8%	9.5%	5.1%	16.5%	6.5%	9.2%
3	0.6%	0.6%	0.4%	0.2%	1.2%	0.4%	0.6%
4 or More	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data.

Another way of capturing the disparities in deployment to communities of color is to compare a particular racial or ethnic group's proportion of the total population to that same group's proportion of the unserved population. While people of color make up just 42 percent of the total urban population, they account for 53 percent of the urban population that has no wired ISP available at 3 Mbps or above (*see* Figure 91). People of color make up 15 percent of the total rural population, but account for 21 percent of the rural population that has no wired ISP offering 3 Mbps or higher (*see* Figure 91).

Figure 91:
Percent of Unserved Population Comprised of Each Race/Ethnicity (Year-End 2014)

Urban Census Blocks	Percent of Population Comprised by Each Race/Ethnicity	Percent of Population without ≥ 3 Mbps Wired ISP	Percent of Population without ≥ 10 Mbps Wired ISP	Percent of Population without ≥ 25 Mbps Wired ISP
Black	14%	17%	17%	16%
Hispanic	20%	30%	27%	24%
Non-Hispanic White	58%	47%	49%	54%
All Non-White	42%	53%	51%	46%

Rural Census Blocks	Percent of Population Comprised by Each Race/Ethnicity	Percent of Population without ≥ 3 Mbps Wired ISP	Percent of Population without ≥ 10 Mbps Wired ISP	Percent of Population without ≥ 25 Mbps Wired ISP
Black	6%	6%	6%	6%
Hispanic	6%	9%	8%	7%
Non-Hispanic White	85%	79%	81%	82%
All Non-White	15%	21%	19%	18%

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data.

Phone and cable companies largely have deployed some type of wired broadband throughout the entirety of their services areas, but they have more narrowly targeted their deployments of "next-gen" broadband technologies such as DOCSIS3.0 by legacy cable companies, and fiber-to-the-home ("FTTH") or advanced forms of DSL by legacy phone companies (including ADSL2, ADSL2+, or VDSL; "ADSL" stands for Asymmetric Digital Subscriber Line, or Asymmetric DSL, a more advanced form of DSL that has higher downstream than upstream rates; "VDSL" stands for Very high bit-rate DSL, which typically offers even faster speeds than ADSL). The data indicates that on the whole, a larger percentage of Whites have benefited from next-gen deployments than have members of chronically underserved racial and ethnic groups.

In urban areas, 97.1 percent of Whites have access to an ISP offering next-gen service, compared to 95 percent of Hispanics, 97 percent of Blacks, and 92 percent of American Indian/Alaska Natives (*see* Figure 92). In rural areas, 67.3 percent of Whites have access to an ISP offering next-gen service, compared to 56.5 percent of Hispanics, 65.8 percent of Blacks, and 43.2 percent of American Indian/Alaska Natives (*see* Figure 92).

Whites also have on average a slightly higher number of ISPs offering next-gen broadband technologies. In urban areas, the average number of next-gen ISPs available to Whites is 1.65, compared to 1.59 for Hispanics, 1.63 for Blacks, and 1.56 for American Indian/Alaska Natives (*see* Figure 93). In rural areas, Whites and Blacks have an average of 0.9 next-gen ISPs, compared to 0.76 for Hispanics, and 0.56 for American Indian/Alaska Natives (*see* Figure 94).

Figure 92:
Percent of Each Race's/Ethnicity's Population Served by Available Technology Type (Year-End 2014)

URBAN BLOCKS - Percent of Each Group's Population

Technology Type	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
FTTH	22.6%	25.0%	23.7%	16.1%	29.4%	17.3%	23.7%
DOCSIS3	93.8%	85.9%	93.6%	85.0%	96.6%	94.8%	93.3%
VDSL	48.4%	58.7%	48.0%	51.9%	53.0%	63.4%	53.6%
ADSL2/2+	21.6%	18.3%	18.4%	23.6%	14.6%	39.4%	21.3%
FTTH/D3/VDSL	95.6%	92.2%	95.5%	88.2%	97.9%	96.5%	95.7%
Any of Above	97.1%	95.0%	97.0%	92.0%	98.3%	97.6%	97.2%

RURAL BLOCKS - Percent of Each Group's Population

Technology Type	Non-Hispanic White	Hispanic	Black	American Indian/AK Native	Asian	Hawaiian/ Pacific Islander	Multirace
FTTH	11.1%	11.1%	6.5%	10.1%	15.2%	7.8%	10.0%
DOCSIS3	51.0%	36.4%	47.3%	23.5%	64.1%	49.8%	47.8%
VDSL	19.8%	25.2%	20.9%	13.5%	25.7%	21.5%	22.4%
ADSL2/2+	31.3%	24.3%	34.9%	23.7%	27.7%	32.7%	29.5%
FTTH/D3/VDSL	57.6%	47.2%	51.4%	30.3%	69.8%	55.0%	55.2%
Any of Above	67.3%	56.5%	65.8%	43.2%	75.3%	61.7%	64.4%

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data.

Figure 93:
Average Number of Available ISPs to Urban Population by Race/Ethnicity and Technology Type (Year-End 2014)

Technology Type	Average Number of Wired ISPs Available (Urban blocks)						
	to Non-Hispanic White Population	to Hispanic Population	to Black Population	to American Indian/AK Native Population	to Asian Population	to Hawaiian/ Pacific Islander Population	to Multirace Population
VDSL, FTTH or DOCSIS3	1.48	1.43	1.47	1.36	1.56	1.44	1.48
ADSL2,ADSL2+, VDSL, FTTH or DOCSIS3	1.65	1.59	1.63	1.56	1.64	1.60	1.63

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. FCC Form 477 broadband deployment data is collected at census-block level. Values above represent the average number of ISPs available in populated census blocks, weighted by block population. Differences between values for non-Hispanic Whites and all other races/ethnicities are statistically significant at $p<0.05$, except for multirace population for VDSL/FTTH/DOCSIS3.

Figure 94:
Average Number of Available ISPs to Rural Population
by Race/Ethnicity and Technology Type (Year-End 2014)

Technology Type	Average Number of Wired ISPs Available (Rural blocks)						
	to Non-Hispanic White Population	to Hispanic Population	to Black Population	to American Indian/AK Native Population	to Asian Population	to Hawaiian/ Pacific Islander Population	to Multirace Population
VDSL, FTTH or DOCSIS3	0.70	0.58	0.62	0.37	0.89	0.64	0.68
ADSL2,ADSL2+, VDSL, FTTH or DOCSIS3	0.90	0.76	0.90	0.56	1.05	0.80	0.87

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. FCC Form 477 broadband deployment data is collected at census-block level. Values above represent the average number of ISPs available in populated census blocks, weighted by block population. Differences between values for non-Hispanic Whites and all other races/ethnicities are statistically significant at $p<0.05$, except for Black population for ADSL2/2+/VDSL/FTTH/DOCSIS3.

Deployment and Competition Are Worse in Lower-Income and Non-White Neighborhoods.

Because ISPs are in the business of profit maximization, and because of the industry's natural monopoly attributes (*e.g.*, high fixed costs and scale economies), we should expect broadband deployment patterns to be closely related to local incomes. That is, we should expect to see more providers deploying and building better quality infrastructure in neighborhoods with higher incomes. We also should still expect that decades of universal service funding and local franchising agreements will have resulted in basic levels of infrastructure availability, in high- and low-income areas alike. But there are likely to be fewer competitors and slower speeds available in the areas with lower average incomes.

This is indeed the case. Nearly all populated areas in the U.S. are served by some kind of wired or mobile internet access provider, at some bare minimum speed; but the richer the neighborhood is, the more providers there are for its residents to choose from, in both urban and rural areas. (*See* Figure 95 below; we show tract-level population-weighted averages here, as this is the most granular geographic level in the Census for which income data is available).

For example, urban census tracts with average incomes in the bottom quintile have an average of 1.9 wired providers offering speeds of 3 Mbps or higher, compared to 2.1 such providers in urban tracts with incomes in the top quintile. At 25 Mbps and higher, this difference is 1.2 such ISPs for urban tracts in the bottom income quintile, and 1.5 such ISPs for urban tracts in the top income quintile.

These gaps are even larger in rural areas. Rural census tracts with average incomes in the bottom quintile have an average of 1.1 wired providers at 3 Mbps or higher, compared to 1.4 for rural tracts with incomes in the top quintile. At 25 Mbps and higher, this difference is 0.5 such ISPs for the bottom income quintile, and 0.8 for the top.

Figure 95:
Average Number of Available Wired ISPs in Urban and Rural Census Tracts by Income Quintile and Downstream Speed (Year-End 2014)

Income Quintile	Urban Tracts			Rural Tracts		
	Population-Weighted Average Number of Wired ISP ≥3 Mbps	Population-Weighted Average Number of Wired ISP ≥10 Mbps	Population-Weighted Average Number of Wired ISPs ≥25 Mbps	Population-Weighted Average Number of Wired ISP ≥3 Mbps	Population-Weighted Average Number of Wired ISP ≥10 Mbps	Population-Weighted Average Number of Wired ISPs ≥25 Mbps
Bottom	1.92	1.73	1.17	1.09	0.88	0.50
2nd	1.92	1.74	1.21	1.1	0.9	0.53
3rd	1.93	1.76	1.25	1.11	0.9	0.55
4th	1.98	1.82	1.33	1.23	1.03	0.65
Top	2.05	1.92	1.47	1.44	1.22	0.84

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and U.S. Census Bureau American Community Survey Five-Year Estimates 2010–2014. Values derived from block-level data by first calculating the population-weighted average values for number of ISPs by speed tier for each tract, then calculating the population-weighted averages for all tracts by income quintile. Income quintiles are derived from tract-level values for median household income. Tract-level median household income values are missing for approximately 5 percent of tracts encompassing approximately 4.5 percent of the total U.S. population; these tracts are excluded from the calculations in the above figure.

In Part II above, we noted that White households on average have higher incomes than households of other races and ethnicities (except Asians). These income differences impact not only demand, as one might expect, because families with lower incomes are less able to afford broadband. They also impact supply, because carriers are less likely to deploy to areas with lower average incomes. Carriers even may be less willing to offer promotions in these areas. The demand-side and supply-side effects combine to depress adoption by people of color, as a consequence of our country's longstanding racial income gaps and as a result of our segregated housing patterns too.

Though the United States is an increasingly diverse country, our neighborhoods remain very segregated. For example, nine out of every ten White individuals live in a census block in which Whites make a majority of the block's population. The non-White population is similarly clustered, though to a lesser degree: 71 percent of the non-White population lives in census blocks where the majority of people are not White.[109]

This segregation by race thus impacts the digital divide. Differences in average incomes between people of different races and ethnicities, combined with segregated housing patterns, result in a situation in which neighborhoods with higher proportions of non-White population have lower average incomes. For example, as Figure 96 shows, the average for median household incomes in urban census tracts in which Whites make up more than 90 percent of the population is above $65,000. That's over 80 percent higher than the average for median incomes in urban tracts where non-Whites are more than 90 percent of the population.

[109] Values based on 2010 Census data, which indicates that non-Hispanic Whites are the least likely to live in blocks with high concentrations of people of other races/ethnicities, and that non-Whites are more likely to reside in areas with non-Whites of other races. For example, 90 percent of non-Hispanic Whites live in blocks where non-Hispanic Whites comprise a majority of the block's population (with 45 percent of Whites living in blocks where Whites are more than 90 percent of the population). By contrast, 54 percent of Hispanics live in majority-Hispanic census blocks, 52 percent of Blacks live in majority-Black census blocks, and 24 percent of American Indians live in majority-American Indian census blocks. Nearly 75 percent of the Hispanic population, 77 percent of the Black population, and 57 percent of the American Indian population resides in census blocks where non-Whites make up a majority of the population.

Figure 96:
Median Household Incomes in Census Tracts by Percent Non-White Population
Urban and Rural Blocks, population-weighted block averages (2010)

Percent of Minority Population in Census Tract	Urban Tract - Median Household Income (population-weighted tract averages)	Rural Tracts - Median Household Income (population-weighted tract averages)
0 to 10 percent	$65,114	$50,683
10 to 20 percent	$71,127	$51,035
20 to 30 percent	$67,871	$46,571
30 to 40 percent	$64,513	$43,025
40 to 50 percent	$59,553	$41,082
50 to 60 percent	$56,138	$39,514
60 to 70 percent	$52,575	$37,620
70 to 80 percent	$50,195	$34,516
80 to 90 percent	$46,044	$31,160
90 to 100 percent	$35,444	$28,885

Source: Free Press analysis of U.S. Census Bureau American Community Survey Five-Year Estimates 2010–2014.

Based on these income differences alone, we would expect to find that deployment and competition are worse in neighborhoods with higher concentrations of non-White population. And this is indeed the case, as shown below in Figures 97–98. For example, Figure 97 shows that as a block's proportion of non-White population increases, we see a decrease in the average number of wired ISPs offering service at 3, 10, and 25 Mbps – for both urban and rural neighborhoods.[110]

Similarly, Figure 98 shows that as a Block's proportion of non-White population increases, we see an increase in the percentage of the population that is completely unserved (by wired ISPs offering service at 3, 10 and 25 Mbps speed tiers), both in rural and urban areas.[111]

Though the overall population in rural areas is relatively small for these chronically underserved and unserved racial and ethic groups, the deployment gap between areas they inhabit and areas that have higher proportions of Whites is much larger than the gap in urban areas. For example, 63 percent of the people living in rural Blocks in which people of color make up 90 percent or more of the total population have no wired provider offering 25 Mbps (or higher) downstream speeds. But only 39 percent have no provider at this speed threshold in rural Blocks where the population is more than 90 percent White. That is a 24 percentage point gap, versus a gap of less than one percentage point in urban areas. (Some 4.6 percent of people living in urban Blocks in which people of color make up 90 percent or more of the total population have no wired provider offering at least 25 Mbps downstream, versus 3.8 percent of people lacking such offerings in urban Blocks where the population is more than 90 percent White).

[110] Figure [INSERT#] shows the population-weighted average number of ISPs available at each speed tier, by percentage of non-White population in a block, increasing from zero to 100 percent in groupings of 10 percentage points. In Appendix Figure A64, we present the fitted values (and 95 percent confidence interval) from a linear regression of the number of wired ISPs in a block, based on that block's percentage of non-White population, weighted by the block population.

[111] Figure [INSERT#] presents the percentage of population that is unserved, by percentage of non-White population in a block, increasing from zero to 100 percent in groupings of 10 percentage points. In Appendix Figure A65, we present the fitted values (and 95 percent confidence interval) from a binomial probability regression for the presence of a wired ISP in a block, based on the block's percentage of non-White population, weighted by the block population. This corresponds to the population-weighted probability that a block is unserved.

Figure 97:
Average Number of Available ISPs in Urban and Rural Census Blocks by Percent Non-White Population and Downstream Speed (Year-End 2014)

Percent of Minority Population in Census Block	Urban Block - Average Number of ≥ 3 Mbps Wired ISPs (population-weighted)	Rural Block - Average Number of ≥ 3 Mbps Wired ISPs (population-weighted)	Urban Block - Average Number of ≥ 10 Mbps Wired ISPs (population-weighted)	Rural Block - Average Number of ≥ 10 Mbps Wired ISPs (population-weighted)	Urban Block - Average Number of ≥ 25 Mbps Wired ISPs (population-weighted)	Rural Block - Average Number of ≥ 25 Mbps Wired ISPs (population-weighted)
0 to 10 percent	2.021	1.291	1.821	1.065	1.342	0.708
10 to 20 percent	2.064	1.398	1.894	1.203	1.398	0.798
20 to 30 percent	2.043	1.286	1.889	1.106	1.382	0.723
30 to 40 percent	2.027	1.226	1.881	1.056	1.362	0.691
40 to 50 percent	2.012	1.168	1.873	1.004	1.346	0.644
50 to 60 percent	2.001	1.053	1.861	0.888	1.325	0.566
60 to 70 percent	1.995	1.009	1.854	0.856	1.304	0.536
70 to 80 percent	2.002	1.001	1.864	0.854	1.307	0.540
80 to 90 percent	1.995	0.993	1.859	0.849	1.303	0.520
90 to 100 percent	1.935	0.813	1.787	0.695	1.220	0.400

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. Averages are population-weighted. Percent non-White population represents the percent of a census block's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure 98:
Percent of Population in Urban and Rural Census Blocks with No Available Wired ISP by Percent Non-White Population and Downstream Speed (Year-End 2014)

Percent of Minority Population in Census Block	Urban Block - Percent of Population in Census Blocks with No ≥ 3 Mbps Wired ISPs	Rural Block - Percent of Population in Census Blocks with No ≥ 3 Mbps Wired ISPs	Urban Block - Percent of Population in Census Blocks with No ≥ 10 Mbps Wired ISPs	Rural Block - Percent of Population in Census Blocks with No ≥ 10 Mbps Wired ISPs	Urban Block - Percent of Population in Census Blocks with No ≥ 25 Mbps Wired ISPs	Rural Block - Percent of Population in Census Blocks with No ≥ 25 Mbps Wired ISPs
0 to 10 percent	1.2%	18.7%	1.7%	25.7%	3.8%	38.7%
10 to 20 percent	0.8%	14.9%	1.1%	20.5%	2.4%	32.7%
20 to 30 percent	1.2%	19.0%	1.6%	25.4%	3.0%	38.7%
30 to 40 percent	1.6%	21.2%	2.0%	27.6%	3.5%	41.7%
40 to 50 percent	2.0%	23.2%	2.4%	29.6%	4.0%	44.4%
50 to 60 percent	2.0%	28.6%	2.5%	36.0%	4.1%	50.8%
60 to 70 percent	2.3%	31.1%	2.7%	37.7%	4.5%	52.9%
70 to 80 percent	2.5%	30.1%	2.9%	37.3%	4.3%	53.1%
80 to 90 percent	1.7%	30.7%	2.1%	38.2%	3.6%	54.5%
90 to 100 percent	2.5%	41.3%	2.9%	48.2%	4.6%	63.4%

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. Percent non-White population represents the percent of a census block's population made up of persons of races/ethnicities other than non-Hispanic White.

Higher-Income Areas Have More and Better Broadband Options, But the Income Gap Does Not Fully Explain the Observed Racial/Ethnic Broadband-Deployment Gap in Rural Areas.

The differences in broadband deployment for areas inhabited by people of color are primarily (but not totally) driven by income differences. When we examine the impact of a block's racial/ethnic composition but control for income, it's only in rural census tracts that blocks with a higher proportion of White population have more ISPs on average (*see, e.g.*, Appendix Figure A67).[112] For example, at average

[112] After controlling for income, the impact that a census' proportion of non-White population has on the variables for average number of ISPs (at 3, 10 and 25 Mbps) remains statistically significant but small. This impact is positive in urban tracts and negative in rural tracts. In other words, in urban areas, tracts with a higher proportion of non-Whites have more ISPs (controlling for income and tract population). Yet these simple models have little explanatory power,

values for income and tract population, a rural block with no people of color would be expected to have 1.18 wired ISPs at 3 Mbps or above, while a rural block made up completely of people of color would be expected to have 0.67 such ISPs.

These results are instructive, but aggregating block-level deployment data to tract-level population figures – necessary because tracts are the most granular geography level at which the Census Bureau collects income data – greatly diminishes the explanatory power of the deployment data.[113] This is especially the case in urban areas, where tracts can include individual blocks with vastly different demographics.

For policymakers, whether an area's racial/ethnic composition impacts broadband deployment significantly beyond the impact of income alone matters little. Efforts to close the digital divide will be most effective the more directly they target the core problem: affordability. There's no doubt that structural discrimination plays a role in the deployment differences noted here, but income inequality is the primary mechanism that makes these impacts felt. So, for example, when housing discrimination creates clusters of low-income populations, this means that ISPs are less likely to serve these areas.

The differences in deployment to communities of color in urban areas are significant, but small. This illustrates the importance of anti-redlining policies that resulted in widespread core infrastructure availability in poor urban areas. The question for policymakers is what to do now to completely close the gap in urban areas, particularly as incumbents move from first and second generation networks to fiber-based infrastructure.

Encouraging additional facilities-based deployment in urban areas could lead to more affordable services and products targeted at traditionally marginalized communities. However, there is a reason new entry is very rare, even in urban areas. A new entrant must recover its initial capital outlay in a reasonable time frame. But in areas that are already served, a new provider must capture market share from incumbent carriers, who likely long ago recovered their initial cost of capital. This is why the U.S. wired home internet market is dominated by incumbent phone and cable companies that came into existence as monopolists in their original product markets (voice and pay-television).

The market's inherent natural monopoly economics are responsible for the lack of any meaningful new entry, and the resulting lack of competition is the reason that incumbents can initially target their incremental upgrades at higher-income areas.[114] They go first to places where they are likely to get the greatest return on their investment, which means higher income areas where people have more to spend on higher-speed internet access. Thus, unless policymakers directly subsidize deployment of affordable broadband in low-income urban areas, the benefit of efforts to lower entry barriers and spur facilities-based deployment and upgrades will largely accrue to residents in higher-income communities. Overcoming this market-driven

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and likely suffer from omitted variable bias, which will inflate the observed impact of the explanatory variables. Other factors such as block density, average age, average education, distance from central office, or presence of universities likely impact deployment. Their inclusion could further reduce or eliminate the already small deployment impact beyond income alone of a block's racial/ethnic composition. We expect the bulk of the observed difference in deployment and competition in urban areas, between communities of color and White communities, is driven by income differences; while rural areas may see differing levels of deployment due to structural impacts beyond income inequity.

[113] The average census-block population is 69 in urban areas and 23 in rural areas. The average census tract population is 4,362 in urban areas and 3,399 in rural areas. Thus, the aggregation of block-level deployment data to tract-level population averages, in order to combine it with tract-level income data, reduces the explanatory power of the data by combining low-income blocks with higher-income blocks in the same tract.

[114] *See, e.g.*, Bob Fernandez, "Years After Verizon's Deal to Bring Fiber Optic Service to New Jersey, Many Towns Remain Unwired," *Philadelphia Inquirer* (June 1, 2015); Karl Bode, "AT&T Has Fooled the Press and Public Into Believing It's Building a Massive Fiber Network That Barely Exists," *Techdirt* (Dec. 10, 2015).

impact on deployment differences in communities of color therefore depends on adopting policies to increase competition over existing facilities, and on reducing the functional gap between wireless and wireline services.

Rural areas present a different challenge. People of color in rural areas are more often unserved and vastly underserved compared to Whites. And though the sheer number of people impacted in rural areas is smaller than in urban areas, the disparity is more acute. Only 2.2 million of the 106 million people of color in urban areas are unserved (2 percent), compared to 2.5 million of the 9.2 million people of color in rural areas (27 percent).[115] Moreover, unlike in urban areas, there are a number of state and federal universal service programs that directly subsidize the construction of broadband facilities in rural areas. Policymakers administering these programs must address this deployment gap to rural communities of color, and must ensure that new networks are not simply constructed in higher income areas.

In sum, there are statically significant differences in broadband deployment to communities of color. These are small but significant in urban areas, and large and significant in rural areas. Chronically underserved racial and ethnic communities – particularly in rural areas – have inferior internet access options compared to those that Whites have. Hispanics, Blacks, American Indian/Alaska Natives, and Native Hawaiians are more likely than Whites and Asians are to live in unserved areas. And Hispanics, Blacks, American Indian/Alaska Natives, and Native Hawaiians are more likely to have fewer choices of provider. Whites are more likely to live in an area served by one or more ISPs offering higher-speed, "next-gen" services, and they have a greater number of choices at this quality level. And as the percentage of an area's White population decreases, the number of available providers decreases, and the unserved population increases. These observations hold in rural areas even when we account for income differences. In other words, income inequality results in disproportionately low broadband deployment and competition in communities of color; and in rural areas, there is even more at play than income disparity, with a consistent digital divide for deployment that is apparently based on race and ethnicity alone.

All of this once again suggests that structural factors may be at play. First and foremost, it's certain that economic inequality impacts ISPs' deployment decisions. Higher-income areas are more profitable to serve. But the same structural factors that impact adoption by people of different races and ethnicities could also impact deployment. For example, housing discrimination could create clusters of populations that are more likely to be unserved or underserved – suggesting not just that internet access providers choose to serve more lucrative areas, but explaining <u>why</u> some areas are less lucrative.

Though most of these differences in deployment that are based on the racial and ethnic makeup of an area are small, they are large enough to have an impact on the digital divide. If people of color have fewer ISPs available to them on average, and if they are more likely to live in a monopoly area, this lower level of service quality and competition could lead to higher initial prices and higher non-promotional prices. Higher prices depress adoption in these areas, and so ultimately contribute to gaps in broadband adoption.

[115] Values represent areas with no available wired ISP at 3 Mbps or above. Approximately 2 million people out of the 146 million people in the urban White population have no such available provider (1.4 percent), while 10 million people (or 20 percent) are unserved out of a total population of 50 million rural Whites. At 10 Mbps, 2.7 million of the 106 million urban non-White population are unserved (2.5 percent) compared to 2.7 million of the 146 million urban Whites (1.8 percent). In rural areas, 3.2 million people of color have no 10 Mbps provider (35 percent of the total rural population for people of color) compared to 13.6 million unserved rural Whites (27 percent of total rural population for Whites). At 25 Mbps, 4.5 million of the 106 million urban population for people of color are unserved (4.2 percent) compared to 5.4 million of the 146 million urban Whites (3.7 percent). In rural areas, 4.5 million people of color have no 25 Mbps provider (49 percent of the rural population of color), compared to 20.3 million unserved rural Whites (40 percent of their total rural population).

PART VIII

HOW EMPLOYMENT DISPARITIES CONTRIBUTE TO NETWORK EFFECTS AND WIDEN THE DIGITAL DIVIDE

We've shown that there is a gap in home-internet adoption between White households on one side of this divide and Hispanic or Black households on the other, even after accounting for differences between these groups in terms of average income, education, age and other demographic factors. We've also shown that there are small but meaningful differences in deployment to communities of color, meaning that homes in these neighborhoods have fewer, slower, and potentially less affordable options available to them than White households do. And we've also shown that there is little to no gap in cellular and mobile data adoption between White households and Hispanic or Black households. Households of color in general adopt these mobile services at the same levels that their incomes alone predict, with low-income Hispanic and Black households in particular actually adopting mobile at levels above what their incomes alone predict.

We surmise that the higher level of competition in the cellular market produces more affordable services, as well as services that are more easily obtained by traditionally ignored and marginalized communities. For example, in contrast to the wired home internet market, cellular voice and data services are available from a number of carriers that do not require the subscriber to first pass a credit check. The practice of requiring a credit check reinforces a structural barrier to adoption, because credit scoring practices have historically discriminated against persons of color. This is just one of many structural racial barriers that could impact how people of color participate in the broadband market, with range of factors potentially creating such barriers to their participation while simultaneously decreasing their after-tax income available to allocate to home-internet services.[116]

We know that households of color report particular concern for affordability, more so than White households even within the same income strata. This concern, and the absence of a significant divide in mobile adoption, suggests that the low level of competition in the wired home internet market is a major factor in the digital divide. We also suggest that structural discrimination can exacerbate the impacts of this suboptimal competition. Spurring competition in the home internet market – in ways that increase not just the number of competitors offering affordable service, but also the number that offer services without credit checks and other such barriers to participation – is necessary to close the digital divide in any meaningful way.

But our research also reveals that exposure to the internet at work or school is strongly associated with household internet adoption, even after accounting for race/ethnicity, income, education, and other factors. This suggests that families of color who might be less able or less likely to subscribe, based on income or educational disparities they face, are more likely to overcome such obstacles and subscribe to home internet if they can use the technology at work or school. Eradicating inequities in exposure to the internet in workplaces and schools would have a substantial impact the digital divide.

As we discussed in Part II, among all employed persons, 61 percent of Whites report going online at work compared to just 38 percent of Hispanics and 47 percent of Blacks. These differences in work internet

[116] For example, Blacks have a disproportionately high number of interactions with the police, a higher likelihood of being issued a ticket and/or arrested during a traffic stop, and a higher likelihood of being searched during a traffic stop. These interactions are not cost-free, and the costs fall disproportionately upon people of color. Meanwhile, White drivers are far more likely than Hispanic or Black drives to receive only a written or verbal warning during a traffic stop. *See, e.g.*, U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics, "Contacts between Police and the Public, 2008," (Oct. 2011); *see also* German Lopez, "The Tyranny of a Traffic Ticket: How Small Crimes Turn Fatal for Poor, Minority Americans," *Vox* (Aug. 10, 2016).

use are possibly due to inequities in education[117] and discrimination in hiring practices.[118] These disparities can lead to persons of different races/ethnicities having different types of jobs, which in turn give people of color disproportionately less exposure to the internet at work.[119] But it's also possible that racial/ethnic biases (both implicit and explicit) impact what job responsibilities are given to persons of color, even once they are hired into the same types of jobs as White workers – meaning that people of color may still get disproportionately less exposure to the internet at work even when they do overcome hiring barriers.

Indeed, as we show in Figure 99, Hispanics and Blacks in many occupation categories are statistically significantly less likely to use the internet at work than Whites in those same occupation categories (with overall differences across all categories, but small sample sizes limiting the ability to say that all of these differences are statistically significant). Further research is required to determine the role that racial/ethnic discrimination and biases play in creating these differences in work exposure. But whatever the cause or causes, the strong relationship between work use and home-internet adoption is clear. Home internet is present in nearly every household that has one or more members who use the internet at work, with home adoption in 94 percent of such households. That compares to just over half (55 percent) of the households adopting home internet when no member of that household uses the internet at work. Work use is by far the single most important determinant of home-internet adoption, having a marginal impact of 26 percentage points even after controlling for race/ethnicity, income, education, geography, and other factors. That's why, no matter the root causes of such racial disparities in internet use at work, policymakers and businesses need to focus on increasing racial equity in exposure to the internet in the workplace.

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[117] *See, e.g.*, U.S. Dep't of Educ., Office for Civil Rights, "2013–2014 Civil Rights Data Collection: A First Look" (rel. June 7, 2016; updated Aug. 10, 2016) (showing, *e.g.*, that students of color are more likely to be suspended and taught by low-paid, inexperienced teachers; but less likely to have access to high quality math and science instruction).

[118] *See, e.g.*, Devah Pager *et al.*, "Discrimination in a Low-Wage Labor Market: A Field Experiment," 74 *Am. Soc. Rev.* 777 (Oct. 2009) ("Black applicants were half as likely as equally qualified Whites to receive a callback or job offer…. Black and Latino applicants with clean backgrounds fared no better than White applicants just released from prison…. These results point to the subtle yet systematic forms of discrimination that continue to shape employment opportunities for low-wage workers."); *see also* Bertrand & Mullainathan, "Are Emily and Greg More Employable than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination," National Bureau of Economic Research, Working Paper 9873 (July 2003) (finding "significant discrimination against African-American names: White names receive 50 percent more callbacks for interviews [and] race affects the benefits of a better resume. For White names, a higher quality resume elicits 30 percent more callbacks whereas for African Americans, it elicits a far smaller increase. Applicants living in better neighborhoods receive more callbacks.").

[119] According to 2014 data from the Bureau of Labor Statistics, 21 percent of employed Hispanics and 30 percent of employed Blacks work in "management, professional and related" occupations, compared to 39 percent of employed Whites and 51 percent of employed Asians. BLS also noted that "Hispanics accounted for 16 percent of total employment but were overrepresented by a substantial amount in several detailed occupational categories, including miscellaneous agricultural workers (49 percent), maids and housekeeping cleaners (44 percent), and grounds maintenance workers (44 percent). Blacks made up 11 percent of all employed workers, but accounted for one-quarter or more of those in several specific occupations, including nursing, psychiatric, and home health aides (36 percent); security guards and gaming surveillance officers (30 percent), and bus drivers (26 percent)." *See* BLS 2014 Labor Force Characteristics, *supra* note 21.

Figure 99:
Percent of Employed Persons Who Use Internet at Work by Race/Ethnicity and Occupation Type (2015)

Occupation Type	Percent of Employed Persons Who Use Internet at Work, by Race/Ethnicity and Occupation Type			
	Non-Hispanic White	Hispanic	Black	Statistical Significance Notes
Management occupations	74%	60%	65%	*,^
Business and financial operations occupations	82%	69%	71%	*,^
Computer and mathematical science occupations	84%	71%	77%	*
Architecture and engineering occupations	81%	68%	68%	
Life, physical, and social science occupations	87%	75%	78%	
Community and social service occupations	79%	72%	70%	
Legal occupations	84%	75%	77%	
Education, training, and library occupations	77%	66%	72%	*
Arts, design, entertainment, sports, and media	71%	62%	55%	^
Healthcare practitioner and technical occupations	71%	62%	62%	*,^
Healthcare support occupations	51%	36%	40%	*,^
Protective service occupations	61%	58%	42%	
Food preparation and serving related occupations	30%	21%	24%	*
Building and grounds cleaning and maintenance	28%	17%	28%	*
Personal care and service occupations	44%	32%	36%	*
Sales and related occupations	62%	43%	38%	*,^
Office and administrative support occupations	68%	55%	56%	*,^
Farming, fishing, and forestry occupations	29%	15%	24%	
Construction and extraction occupations	35%	22%	31%	*
Installation, maintenance, and repair occupations	56%	33%	48%	*
Production occupations	41%	21%	36%	*
Transportation and material moving occupations	35%	27%	33%	*

*Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. * = Values for Hispanics are different from values for non-Hispanic Whites at p<0.05; ^ = Values for Blacks are different from values for non-Hispanic Whites at p<0.05. (Confidence intervals calculated using successive difference replication standard error values.)*

Evidence of Network Effects on Internet Use and Adoption.

There are of course myriad additional factors beyond income inequality and suboptimal competition that could impact the digital divide (directly or indirectly). The lack of competitive offerings intersects with persistent income inequality between people of different races in particularly harmful ways, in our society in which structural discrimination persists, by reducing people of color's ability to pay for home-internet services. Another related factor possibly reducing their willingness to pay (by decreasing their perception of the value of internet access) is the presence of so-called "network effects," an economic term referring to the condition in which a network good's value to a user is directly related to the number of other people using the good.[120]

So if you do not know anyone that uses telephone service, the value of that service to you is lower than it would be to someone whose entire social circle is reachable via telephone. It's certainly plausible that the digital divide has this same ratcheting effect: the smaller the proportion of people online in a person of color's social circle, the lower that person's willingness may be to pay for home internet access. It seems unlikely that these network effects play an especially large role in the digital divide, given that all populations of interest (*e.g.*, low-income people in general, low-income Hispanic or Black people, etc.) have home-internet

[120] *See, e.g.*, Oz Shy, *The Economics of Network Industries* (2001).

adoption levels above 50 percent, and given that use at other locations by people without home subscriptions greatly narrows the overall gap in internet use between people of different race or ethnicities. And though internet access does fundamentally remain a network technology, it also used to consume content, which again may reduce the magnitude of network effects on an individual's demand for home access.

However, there is indeed some evidence of network effects impacting the digital divide. The CPS data indicates that there is a gap in individual-level home internet use between Whites and non-Whites in households that do subscribe to home internet. For example, 10 percent of Whites age 3 and above have internet at home but do not use it themselves. This is below the level of non-use by Hispanics and Blacks who live in a household that subscribes to internet but do not go online themselves at home (18 percent and 15 percent respectively; *see* Figure 100). This gap equates to a lower number of home internet users of color beyond what the overall household-level adoption gap between races/ethnicities would suggest;[121] and this in turn could exacerbate the overall home adoption digital divide via the impact of network effects. This impact would be distinct from that created by suboptimal competition, since it in part arises from homes that have already subscribed to internet services.

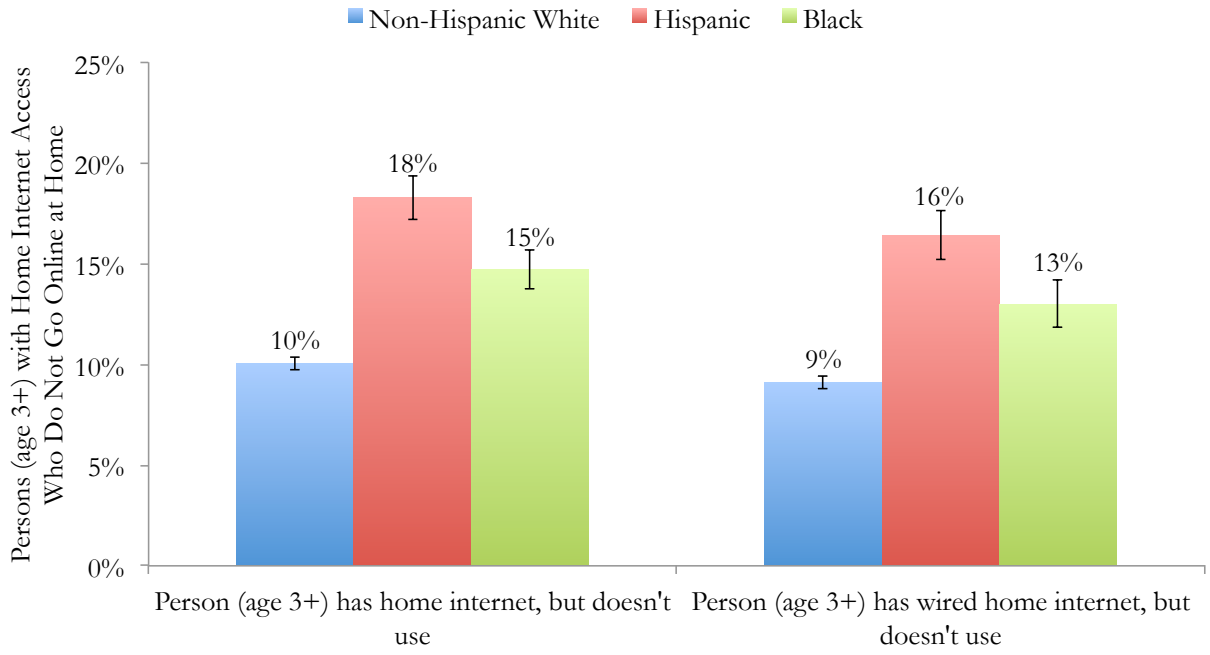
This internet usage gap at the person-level in the Census data, even within households that already do subscribe to home-internet service, might be explained by the disproportionately high level of mobile-only internet homes in communities of color. A household with a single smartphone user is counted as an internet home, even if the owner of the smartphone is the only person in the household that uses it to go online at home. The gap might also be due in part to differences in household age composition for different races/ethnicities (*see* Figure 25 above). Inequities in educational attainment also may play a role (if disparities in educational levels reduce individual-level demand for internet access, even in households with at least one member subscribing to and using home-internet service). And exposure to internet outside of the home (*i.e.*, at work or at school) may increase the likelihood that a person would go online at home.

We investigated all of these possibilities, looking at use by individuals of different races/ethnicities in these subpopulations, and examining as well the impact of these and other factors in probability regression models. We find that size of the gap in individuals' home use, in internet-adopting homes of different races or ethnicities, is in fact smaller for households with wired access than it is for the overall population of home internet households. But the gap for wired homes only narrows by approximately one percentage point. While 9 percent of Whites do not go online at home despite having access to wired internet, this is still less than the 16 percent of Hispanics and 13 percent of Blacks with wired access who do not go online at home (*see* Figure 100).

We also see that the racial/ethnic usage gap by individuals in internet-adopting homes is smaller if we look only at persons between the ages of 18 to 50 (*i.e.*, looking at the age range with near-uniform home adoption levels and accounting for the fact that the White population skews older than the Hispanic and Black populations). Among this age cohort, 4 percent of Whites do not go online at home, compared to 10 percent of Hispanics and 7 percent of Blacks. These values change little if the group is further restricted to those in this age range with wired home internet access (*see* Figure 101).

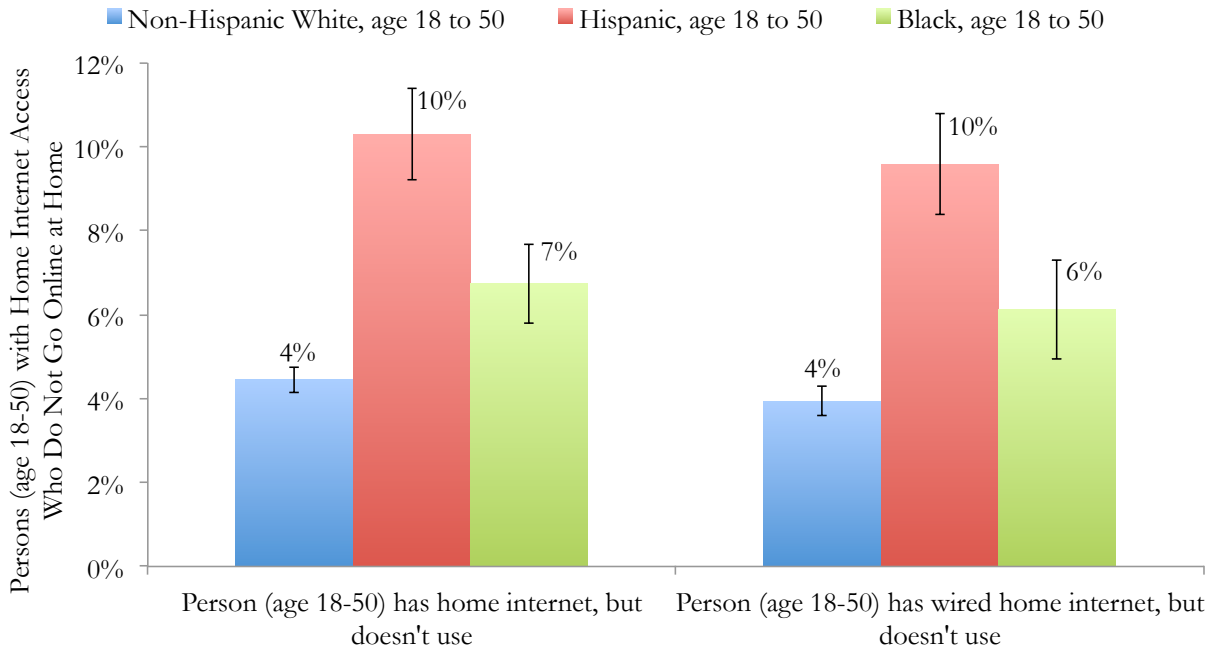
[121] As shown in Appendix Figure A1, internet access is available in 76 percent of non-Hispanic White homes, 66 percent of Hispanic homes, and 62 percent of Black homes. However, while 73 percent of non-Hispanic Whites (age 3 and above) report going online at home themselves, only 57 percent of Hispanic individuals and 58 percent of Black individuals age 3 and above say they go online at home.

Figure 100:
Persons (age 3+) With Home-Internet Access Who Do Not Go Online at Home, by Race/Ethnicity – All Connections vs. Wired Connections (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between races/ethnicities are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

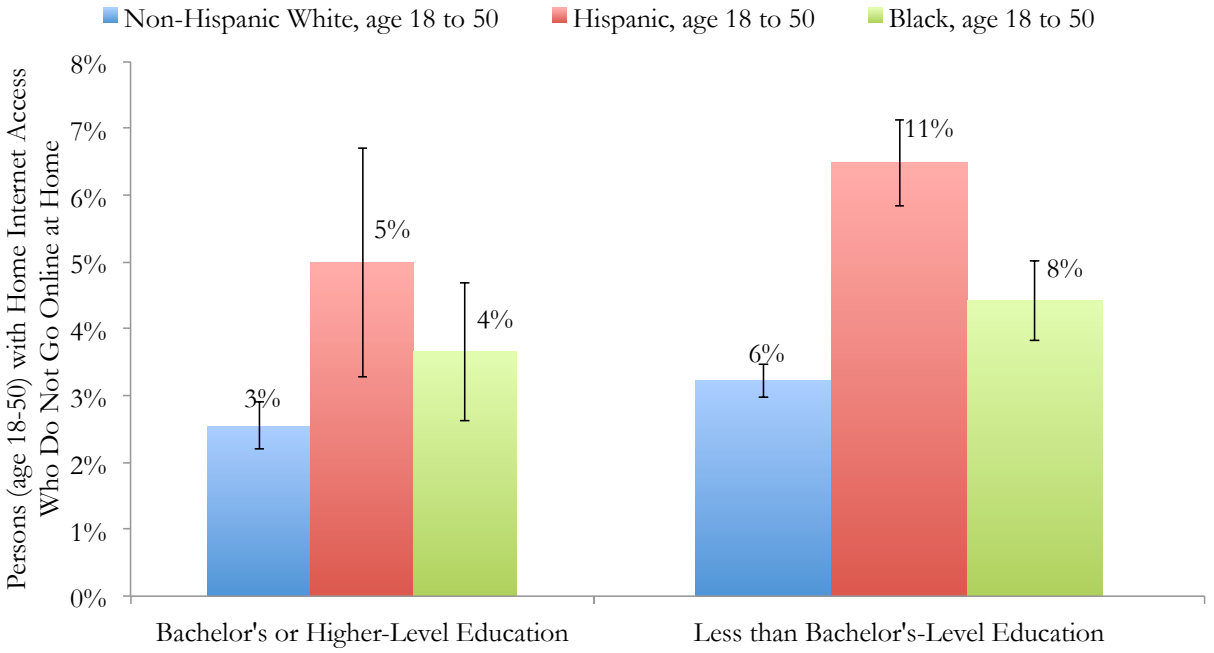
Figure 101:
Persons (age 18-50) With Home-Internet Access Who Do Not Go Online at Home, by Race/Ethnicity – All Connections vs. Wired Connections (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between races/ethnicities are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Differences in an individual's educational attainment appear to play a large role, influencing the choice some people make not to go online at home despite having home internet access. If we look at persons between the ages of 18 and 50 who have home internet access and a bachelor's-level or higher education, there is only a small gap in individual home internet use between White individuals and Hispanic individuals, and no such gap between Whites and Blacks. The gap does not narrow in this same fashion for individuals with educational attainment below this threshold, suggesting perhaps that differences in how people are exposed to technology outside the home (*e.g.*, at work or school) could impact their use at home.

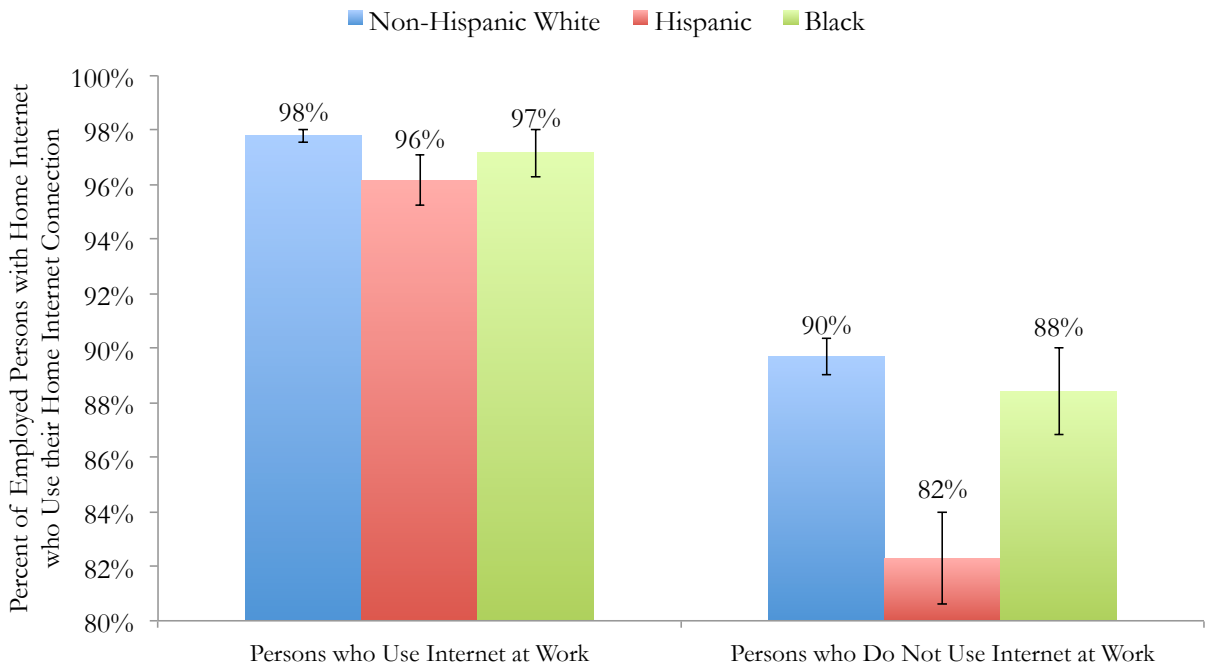
Figure 102:
Persons (age 18-50) With Home-Internet Access Who Do Not Go Online at Home, by Race/Ethnicity and Educational Attainment (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The difference between the value for non-Hispanic Whites and Hispanics for those persons with a bachelor's-level or higher education is statistically significant at p<0.05. All differences between races/ethnicities are statistically significant at p<0.05 for persons with less than a bachelor's-level education. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

And the comparative data strongly supports this hypothesis. Person-level home internet use, in households with home internet connections, is nearly universal among employed persons who use the internet at work – and there's little difference between races/ethnicities (*see* Figure 103). But if the person does not use the internet at work, they are much less likely to use even an internet connection available in their home (with Hispanic employed persons who do not go online at work significantly less likely to use their home internet connection).

Figure 103:
Person-Level Home-Internet Use by Employed Persons with Home Internet, by Race/Ethnicity and Use of Internet at Work (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The difference between the values for non-Hispanic Whites and Hispanics is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Differences in Workplace Access Impact the Racial/Ethnic Digital Divide.

Indeed, we can examine in isolation the impact of all these factors on individuals' home internet use, in households that do subscribe to home internet. Isolating these factors by using a two-stage multivariate probability regression analysis,[122] we see that internet use at work[123] or school[124] is a critical factor associated with whether or not a person uses the internet connection inside of their home, even when income, age, wired internet adoption,[125] and other factors are held constant.[126] These uses at internet access points other

[122] *See* Appendix Figures A72–A73. Because the population of non-users in internet-adopting homes is not a randomly selected sample, we employ a two-stage probability selection model (first, the household selects to adopt; second, the person selects whether to use) to mitigate the effects of selection bias.

[123] The results of this model indicate that the marginal effect of use at school on home internet use, among students living in a household with home internet, is 11 percentage points.

[124] The results of this model indicate that the marginal effect of use at work on home internet use, among persons living in a household with home internet, is 14.4 percentage points.

[125] The results of this model indicate that the marginal effect of having a wired connection on home internet use, among persons living in a household with home internet, is just 3.4 percentage points.

[126] In the selection model, Hispanic, Black, American Indian/Alaska Native and Hawaiian/Pacific Islanders (age 3+) are less likely than Whites to reside in a home that subscribes to internet (with household income, the household's maximum educational attainment level, location in a metro area and the area's population size, home ownership, presence of a person who uses the internet at work, and presence of a person who uses the internet at school, all positively associated with subscription; and the household's average adult age and size negatively associated). In the second stage, Hispanics, Blacks and Asians are less likely than Whites to go online themselves at home (with household income, their age, their use at work, their use at school, and a wired connection in their home positively associated with

than home also explain a sizable portion of the home use gap between White individuals and Hispanic or Black individuals.[127]

And though we do not attempt here to quantify it, the disproportionate impact of factors like work use on individual internet use in adopting households can translate into an impact on the overall digital divide through the mechanism of such network effects (*i.e.*, a household's initial decision to subscribe to home internet may be negatively impacted if a smaller number of individuals in their social network are online, even when that network includes individuals who live in homes with internet access but do not make use of it themselves).

This report's primary focus is on how policymakers closest to the broadband markets can address the digital divide with the most immediate impact. It's clear that increasing competition among providers, increasing the number of competitors offering service to traditionally marginalized communities, and increasing the ability of people in these communities to effectively participate in the market will have a large positive effect. Whatever the size of any possible network effects indirectly created by systemic discrimination and their contribution to the digital divide, they will be lessened by efforts that increase competition and affordability even without addressing these larger societal problems, as getting more people online will lessen such negative network effects and thereby increase the value of access to current non-adopters and non-users.

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their personal use of home internet; and their household's size and home ownership status negatively associated). We did not examine the impact of a person's educational attainment in the second stage of this model, because this information is only collected for persons age 15 and older. *See* Appendix Figure A72. We do provide an alternative model of person-level home internet use for persons age 15 and above that includes educational attainment. The results are similar to the model for personal use by persons age 3 and above. Higher levels of educational attainment are associated with higher rates of individual home internet use. *See* Appendix Figure A73.

[127] The results of the model indicate that the marginal impact of race/ethnicity on home internet use, for persons in a household that has home internet access, is -3 percentage points for Hispanics and -2.2 percentage points for Blacks, relative to Whites. Among persons who have home internet and who use internet at work, the marginal impact of race/ethnicity on home use is -0.9 percentage points for Hispanics and -0.6 percentage points for Blacks, relative to Whites. Among persons who have home internet and who use internet at school, the marginal impact of race/ethnicity on home internet use is -2.1 percentage points for Hispanics and -1.5 percentage points for Blacks, relative to Whites.

PART IX

POLICIES THAT INCREASE COMPETITION AND IMPROVE THE OVERALL FUNCTION OF THE HOME-INTERNET MARKET CAN REDUCE THE IMPACT OF LARGER STRUCTURAL FACTORS THAT CONTRIBUTE TO THE DIGITAL DIVIDE

Despite years of discussion of this topic, and some changes or attempts to change public policy, the digital divide persists. And it does so at a time when internet access is a necessity for full participation in America's society. All evidence suggests that the high price of internet access (particularly, wired internet access) is the primary reason for the digital divide. Because of rampant income inequality, this cost-factor disproportionately impacts communities of color.

But the data also shows internet adoption gaps for people of different races and ethnicities, even after accounting for persistent income differences between different racial/ethnic groups. Low-income Whites have a significantly higher rate of home-internet adoption than do non-Whites with similarly low incomes. By contrast, adoption rates for cellular phones and mobile internet access by people of color are largely the same as adoption rates for these mobile services by Whites. The cellular and mobile internet adoption rates for people in the bottom income quintile are actually higher for Hispanics and Blacks than they are for Whites. Overall, Hispanics and Blacks have cellular and smartphone adoption levels slightly above what one would predict based on income alone.

The data, and specifically these contrasts in adoption outcomes between wired and mobile services, suggest that structural factors beyond simple income inequality contribute to the digital divide. These other factors exacerbate market failures, adding additional barriers to broadband adoption in communities of color.

These other structural barriers to full participation are myriad, with some factors closer to the internet access market than others. For example, consider two populations of equal income in two different neighborhoods, one primarily White and one primarily Black. Discrimination in policing could result in residents of the Black neighborhood having more interactions with law enforcement than residents of the White neighborhood have – and with more expenses based on such interactions – leaving residents of the Black neighborhood with less available post-tax income to spend on internet access.[128] Or consider the impact of discriminatory credit scoring and lending practices, which can result in credit scores for low-income persons of color that overstate their true risk when compared to the scores for Whites with the same income. When this structural difference in credit scoring combines with the widespread practice by wired ISPs of requiring credit checks for potential subscribers, it can lower adoption levels in communities of color.

The issue of how structural discrimination impacts the efficiency of consumer markets is so complex that it can be paralyzing for policymakers. The FCC is not equipped to tackle the larger problems of income inequality, biased policing, credit discrimination, or employment disparities, even if each of these issues impact the agency's ultimate mission to make communications connections available to everyone at reasonable charges. But the FCC can reduce the impact of structural discrimination on the digital divide by examining *how* these structural problems distort the internet access market, and then acting to prevent those distortions. In sum, the agency can work to remedy internet access market failures when demand and supply do not meet in an efficient manner, no matter what the cause is for these market failures.

[128] *See supra* note 116.

*Increasing Effective Competition in the Broadband Market Will Mitigate the Impact of Structural Factors That Contribute to the Digital Divide***.**

There's no doubt that structural barriers, contemporary racism and the legacy of racism, and ongoing bias against people of certain races and ethnicities, all have a direct impact on the digital divide. Structural discrimination in numerous areas – such as inequities in primary education, housing discrimination, biased policing, predatory lending, algorithm-based biases in credit scoring, and others – all contribute to income inequality. That income inequality turn widens the adoption gap for many goods and services, including necessities such as internet access.

But these structural problems also have an indirect impact too, as we see in the sections above, with data showing a home-internet adoption gap between Whites and people of color even for similarly low-income subgroups of these racial/ethnic groups. The wired home internet divide based on race and ethnicity persists, even when we control for income, and it's wider than the overall home-internet adoption gap. Conversely, there is no significant gap for cellular phone and mobile internet adoption, in part because the credit-check barrier can more readily be avoided by mobile internet subscribers who choose a prepaid option.

Dealing directly with all such consequences of structural racism must be a top priority for America and its elected representatives. Regulatory agencies such as the FCC need to better examine how they can act to correct market failures that exacerbate these direct and indirect impacts of structural racism. In the case of telecommunications services, inadequate competition leads to entire market segments and demographic groups going underserved or entirely unserved at any reasonable price.

Interventions both large and small can add up to help eradicate the digital divide.

Our analysis indicates the following top goals for the FCC and other policymakers:

- Correct the wired home-internet market failure: Foster the creation of resold and prepaid wired home-internet services and stop abuses of market power.
    - The U.S. high-speed wired broadband market is, at best, a weak duopoly. At higher speeds, it's instead a cable company-dominated monopoly for a substantial majority of the people in America. One hundred years of experience suggests that new facilities-based entry will not be widespread, and that natural monopoly economics will always dominate. The FCC must acknowledge the lack of wired home-internet competition and the existence of ISP market power, and make protecting against monopoly abuses a top priority.
    - This monopoly impacts not only the wired home internet market, but the home communications market more generally – especially for multichannel and online video. Because of video's importance in people's overall communications purchases, the FCC must stop vertically integrated ISPs from using their market power in broadband to impact the video market. This action could take many forms. For example, while some home internet providers offer broadband on a standalone basis, others will not sell it unless the customer purchases other services. And while most cable ISPs sell standalone broadband, they often price it in a manner that incentivizes customers to bundle it with the ISP's video services. This only happens because cable ISPs have market power in the home internet market, and are able to cross-subsidize their video businesses with the inflated profits earned from their monopoly broadband services. This cross-subsidization harms both internet adoption and video market competition, and the FCC must use its authority under the Communications Act to ensure that standalone broadband is available to all at a fair price.

- Public policy efforts to encourage facilities-based wired home internet entry and competition are welcome and should continue, but the FCC and other policymakers must accept the reality that the vast majority of Americans will continue to face a monopoly or duopoly for wired broadband. Therefore, the FCC must take steps to encourage the development of a robust resale market for wired home-internet services. Resale developed in the cellular market absent regulatory intervention, in part because of the higher number of facilities-based carriers who had incentives to sell wholesale capacity instead of letting it lie fallow. The existence of a facilities-based wired internet market that is at best a duopoly does not create the same incentives to resell, even as the market matures and DSL carriers lose customer share to cable ISPs. Thus, while the FCC should examine all methods for encouraging the development of robust resale of home internet access, it will likely need a regulatory solution to this most basic of market failures.

- The FCC should take action to encourage the development of a robust prepaid wired home-internet service market. One of the primary benefits of creating a robust resale market will be the likely development of a prepaid market. While ISPs may want to hedge against the costs resulting from customer non-payment by imposing credit checks and cash deposits, the reality is that many customers who are not a material risk are denied services because of their inability to pass a credit check or offer a cash deposit. Resellers in the wireless market have been more than willing to shoulder this risk, and it has resulted in higher earnings for the facilities-based providers as well as more equitable adoption opportunities for those who might otherwise be shut out entirely due to poor credit. As it takes steps to correct the wired home internet resale market failure, the FCC must also act to ensure that facilities-based wired ISPs offer prepaid services on just and reasonable terms.

- The FCC must ensure that ISPs are not using credit scores to discriminate unreasonably on terms and services they offer; the FCC must also ensure that ISPs are not using credit checks to generate revenue. While the practice does not appear to be widespread, one cable company (Cable One) recently indicated that it might offer customers with lower credit scores a lower quality of customer care. The Washington State attorney general recently sued another cable company (Comcast) for many customer-service failings, including obtaining deposits from customers with high credit scores, improperly running credit checks on customers who paid a deposit to avoid a credit check, and improperly collecting deposits from customers who were not required to pay a deposit. The Communications Act has specific requirements that telecommunications services such as broadband internet access be offered on a reasonable and non-discriminatory basis, and the FCC must be vigilant in its efforts to enforce these requirements.

- Correct the wired home-internet market failure: Where possible, encourage new fiber-optic services and overbuilding while ensuring the benefits of new deployment are available to more than people living in wealthy areas.

  - The vast majority of the United States may never see fiber or cable overbuilding, no matter what basket of incentives local, state, and federal lawmakers offer (or the supposed "red tape" regulators manage to cut). See, for example, recent news regarding Google Fiber's pause in deployment.[129] However, any such efforts to promote overbuilding can bring new competition to select areas. Policymakers must ensure that overbuilding does not benefit only the privileged and wealthy.

    - Though there is a small but statistically significant gap in broadband deployment to communities of color, local franchising rules against redlining have ensured that a basic level of service is available to almost the entirety of the urban population. Local and state regulatory agencies must continue to prohibit redlining and encourage widespread and equitable deployment.

[129] *See, e.g.*, Jon Brodkin, "Google Fiber division cuts staff by 9%, 'pauses' fiber plans in 11 cities," *Ars Technica* (Oct. 25, 2016) (reporting that "Google Fiber apparently has not hit its subscriber goals," and that even for a company with Google's financial heft, "fiber construction is a costly endeavor").

- Because the racial/ethnic broadband deployment gap is largest in rural areas, the FCC and other agencies that oversee universal service funds must ensure that these funds are not used merely to bring broadband to the richest rural areas or solely to predominantly White rural areas.

- State and federal legislators should encourage equitable overbuilding through tax incentives and other incentives that encourage new entrants to deploy services across diverse neighborhoods.

- Close the Functionality Gap Between Wired and Wireless Home-Internet Services by Promoting Greater Competition as the Wireless Market Evolves to Higher-Capacity Fifth-Generation Technologies.

  - Low-income communities and communities of color are disproportionately more reliant on mobile internet services. This has led to a third distinct phase in the evolving digital divide: users in these communities typically have basic access, but it's inferior to the options in other communities. This is similar to the second phase divide between dial-up and broadband access. In this manner, the digital divide may shift over time without ever closing.

  - The impacts of this divide are myriad, given the limitations of mobile internet – particularly when it comes to use by children for schoolwork. There is ample reason to expect that the home internet market will always be dominated by wired providers, simply because coaxial and fiber optic cables will offer a far-higher quality of service and far-greater capacity than wireless technologies for the foreseeable future. However, fifth generation wireless technologies ("5G") hold the promise to close some of this functionality gap, particularly in urban areas where network densities are higher. Thus, the FCC's efforts to promote 5G development should ensure that ample spectrum is not only allocated, but allocated equitably among carriers, and between licensed and unlicensed use. Robust 5G wireless competition and greater opportunity for nonprofit ISPs are critical components to closing the digital divide in the face of a monopoly wired ISP market.

  - The FCC must protect the resale market in the face of potential wireless-industry consolidation. In recent years the wireless market has undergone consolidation, with national facilities-based providers purchasing resellers and smaller prepaid carriers (*e.g.*, Sprint's acquisition of Virgin Mobile; AT&T's purchase of Cricket Mobile; and T-Mobile's purchase of MetroPCS). Further consolidation – particularly involving any of the four national facilities-based carriers – would likely result in disproportionate harm to prepaid wireless users. The FCC should therefore be vigilant in its efforts to promote wireless competition and maintain a strong stance against any further national consolidation.

- Collect Better Data and Increase Access to this Information.

  - Our analysis suffers from one important missing variable: price. Despite the recommendations in the National Broadband Plan that it do, and despite tentatively concluding to do so years ago, the FCC has yet to adopt rules requiring ISPs to report their prices (offered and received) in the same systemic manner as they are required to report deployment and subscriber count data. Some prior research suggests that, as expected, greater levels of ISP competition lead to more affordable prices.

  - We assume that the relatively lower level of competition available to people in communities of color similarly impacts prices. We also surmise that there could be differences in promotional offers and general pricing to households of color. But without systematic pricing data, we cannot say for sure. Thus, the FCC should adopt its own tentative conclusion to include pricing information in its Form 477 reporting requirements.

  - This report and the analysis herein were possible only because the underlying CPS and Form 477 deployment data is freely available for public use. The FCC has a wealth of additional information, however, that it chooses not to publicize, citing ISP-confidentiality concerns. Setting aside the merit of these concerns, the Commission can facilitate better public-policy analysis by establishing a process for outside researchers to access this data while maintaining ISP confidentiality.

CONCLUSION

In this report we used comparative and econometric statistical analyses to demonstrate how communities of color find themselves on the wrong side of the digital divide for home-internet access – both in terms of adoption and deployment – in a manner that income differences alone fail to explain. There is a notable gap in wired home-internet adoption that is not solely due to observed racial/ethnic disparities in terms of income, age, education, location, exposure to internet via methods other than a home subscription or other factors. There also are significant differences in deployment to communities of color, where fewer wired ISPs compete, and where people are more likely to be completely unserved. We also observe that demand for home internet is high in communities of color, and that affordability is the key barrier to adoption.

There's no doubt that structural barriers, structural discrimination, and bias against people of certain races and ethnicities all have a direct impact on the digital divide. For example, structural discrimination in the banking and credit industry contribute to income inequality. That inequality widens the adoption gap for many goods and services, including necessities such as internet access.

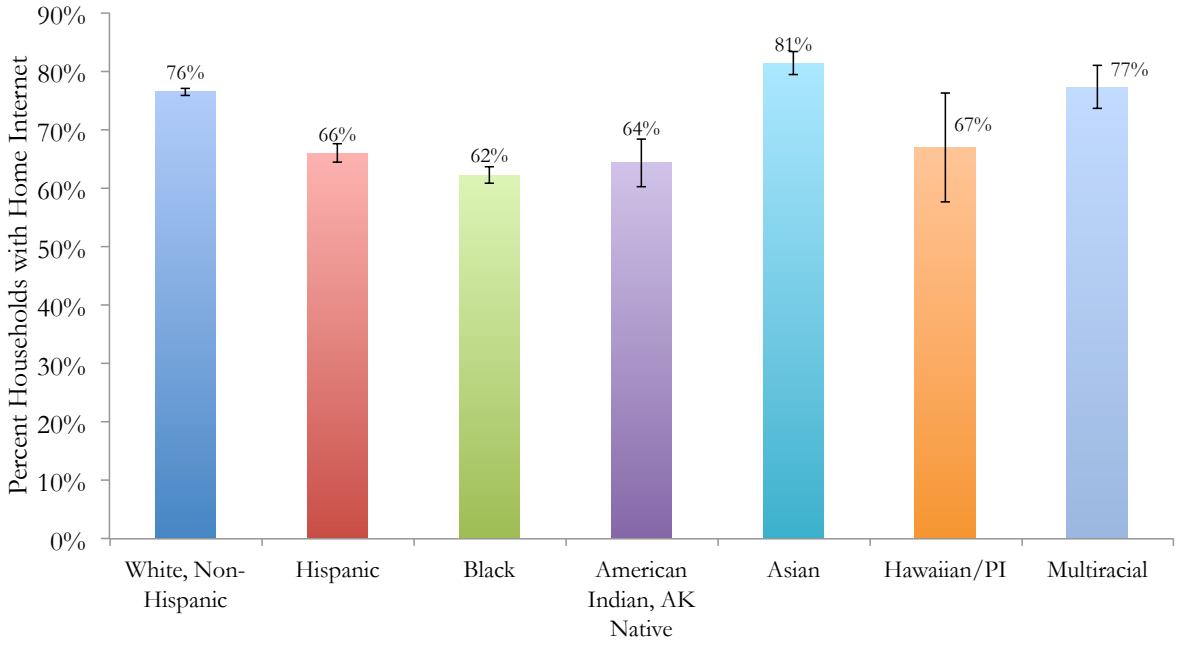
Structural discrimination and persistent racial bias also have indirect impacts, as we can see in the data showing a home-internet adoption gap between low-income households of different races/ethnicities. This analysis shows a home internet divide based on race and ethnicity even when we control for income and other demographic factors. A similar gap is not observed for cellular phone and mobile-internet adoption, however, in part because mobile-internet users who choose a prepaid option can avoid the barrier of a (discriminatory) credit-check that wired ISPs almost always require.

These findings together strongly suggest that the wired home-internet market is not serving the needs and demands of communities of color. And while income differences partly drive this failure, the gaps in adoption by and deployment to low-income White communities are not as severe as are the gaps for low-income communities of color. The total absence of an adoption gap for cellular/mobile services between low-income people of different races and ethnicities stems, in part, from the lower prices for mobile services. These in turn are attributable to increased facilities-based competition, and also mobile prepaid carriers' and resellers' willingness (in this relatively competitive market) to offer affordable services directly to typically marginalized communities. This all stands in stark contrast to high-speed wired-internet access, a market that is a duopoly at best. Wired providers have failed to offer resold or prepaid services, and they require potential customers to undergo credit checks or make cash deposits – practices that contribute to the digital divide by exacerbating structural discrimination in credit scoring and other sectors.

Thus, we conclude that public policies that correct the failures of the wired home-internet market will increase the ability of people in marginalized communities to access advanced telecommunications services and purchase those services in an equitable manner.

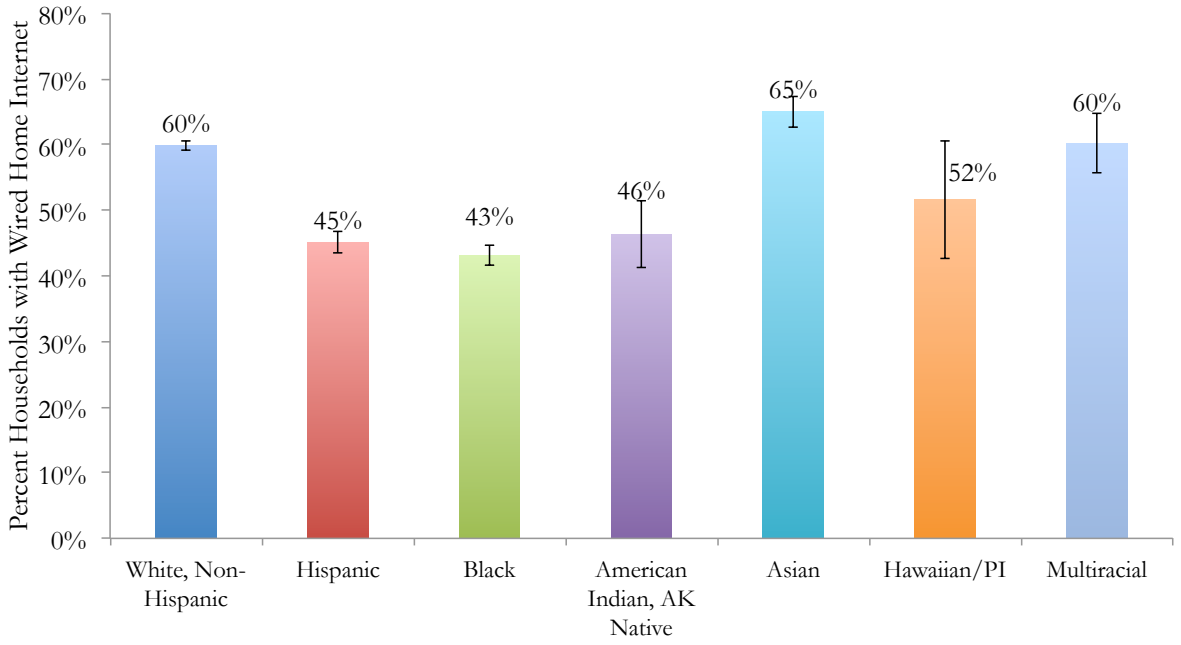
STATISTICAL APPENDIX I: ADDITIONAL FIGURES

Figure A1:
Household-Level Home-Internet Adoption by Race/Ethnicity (2015)



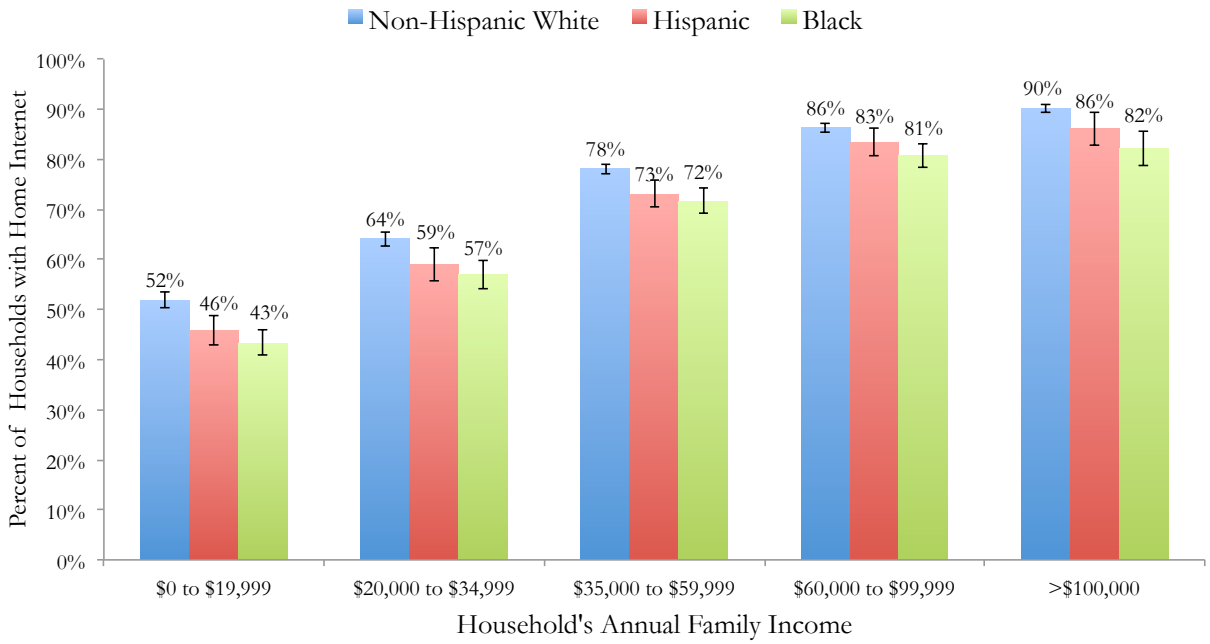
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences in values for non-Hispanic White households and all other values (except for Hawaiian/Pacific Islander and Multiracial households) are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A2:
Household-Level Wired Home-Internet Adoption by Race/Ethnicity (2015)



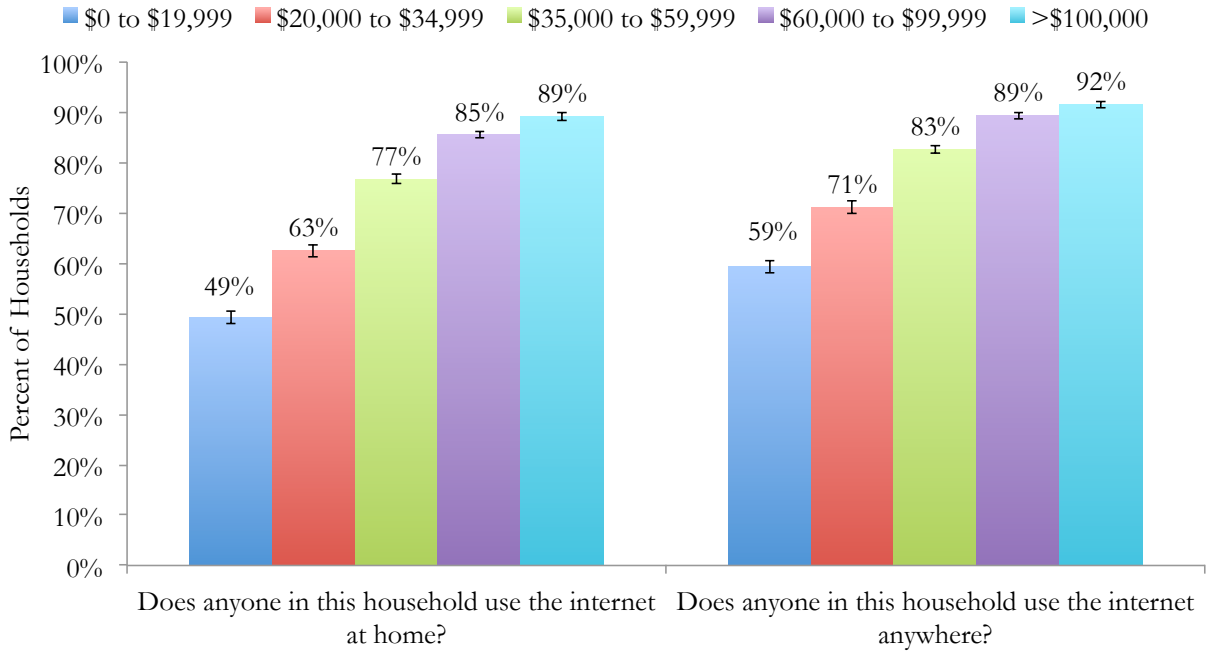
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences in values for non-Hispanic White households and all other values (except for Hawaiian/Pacific Islander and Multiracial households) are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A3:
Household-Level Home-Internet Adoption by Race/Ethnicity and Family Income (2015)



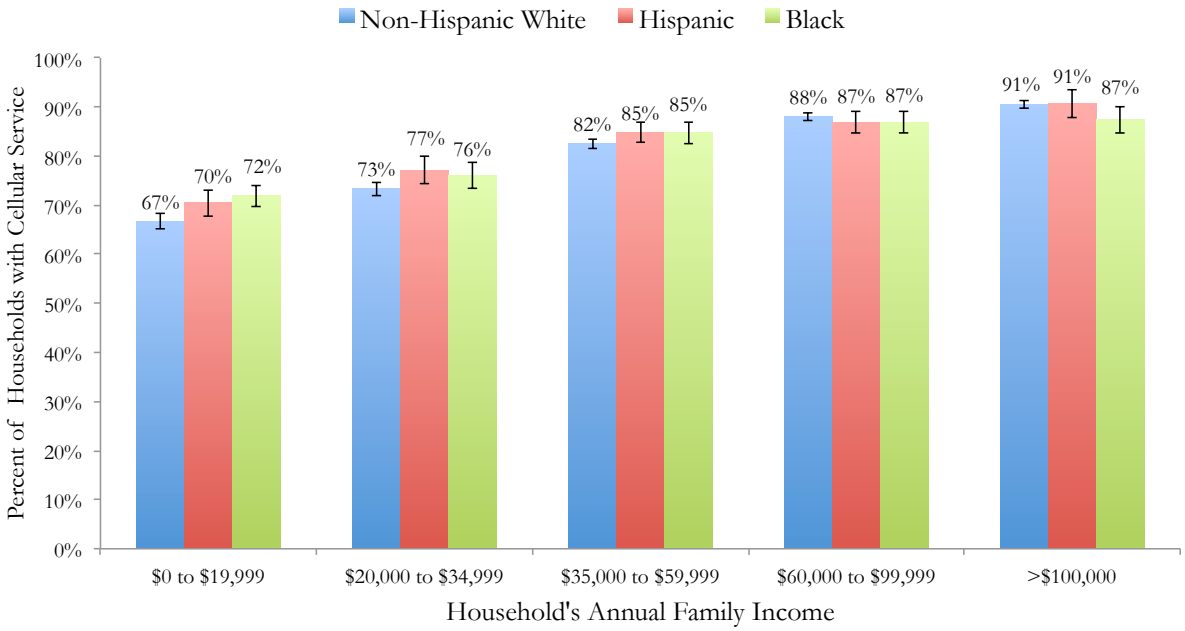
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic White households and Hispanic households are statistically significant at p<0.05 for person's with family incomes below $60,000. Differences between values for non-Hispanic Whites and Blacks are statistically significant at p<0.05 for all income strata. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A4:
Household-Level Internet Adoption by Family Income, Home Use vs. Use Anywhere (2015)



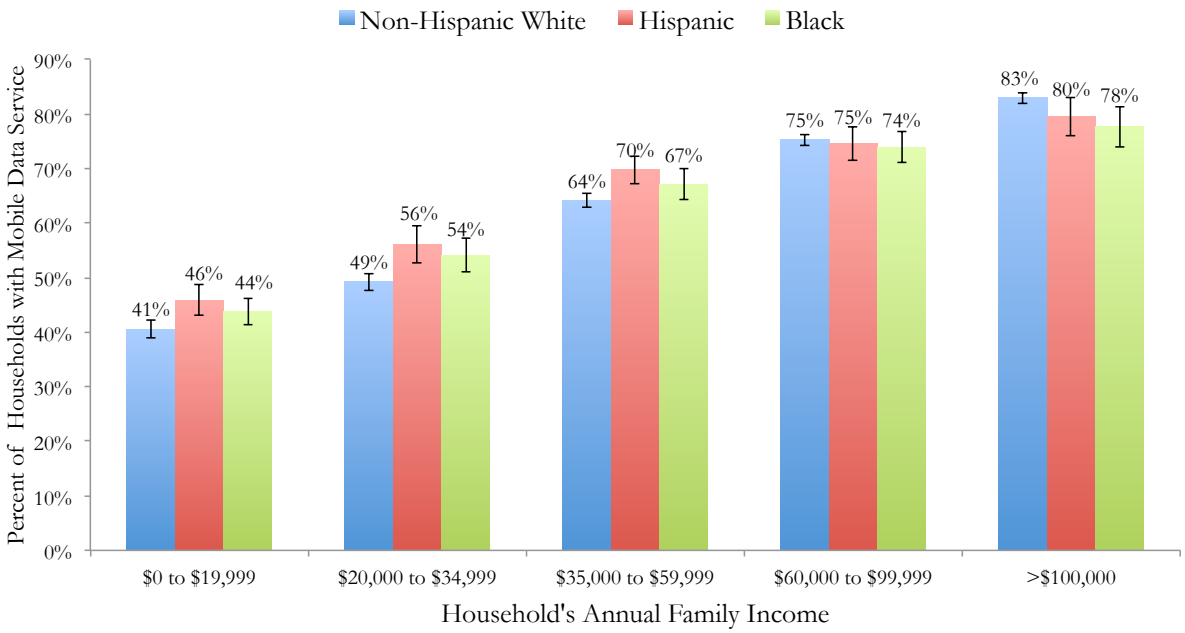
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A5:
Household-Level Cellular Adoption by Race/Ethnicity and Family Income (2015)



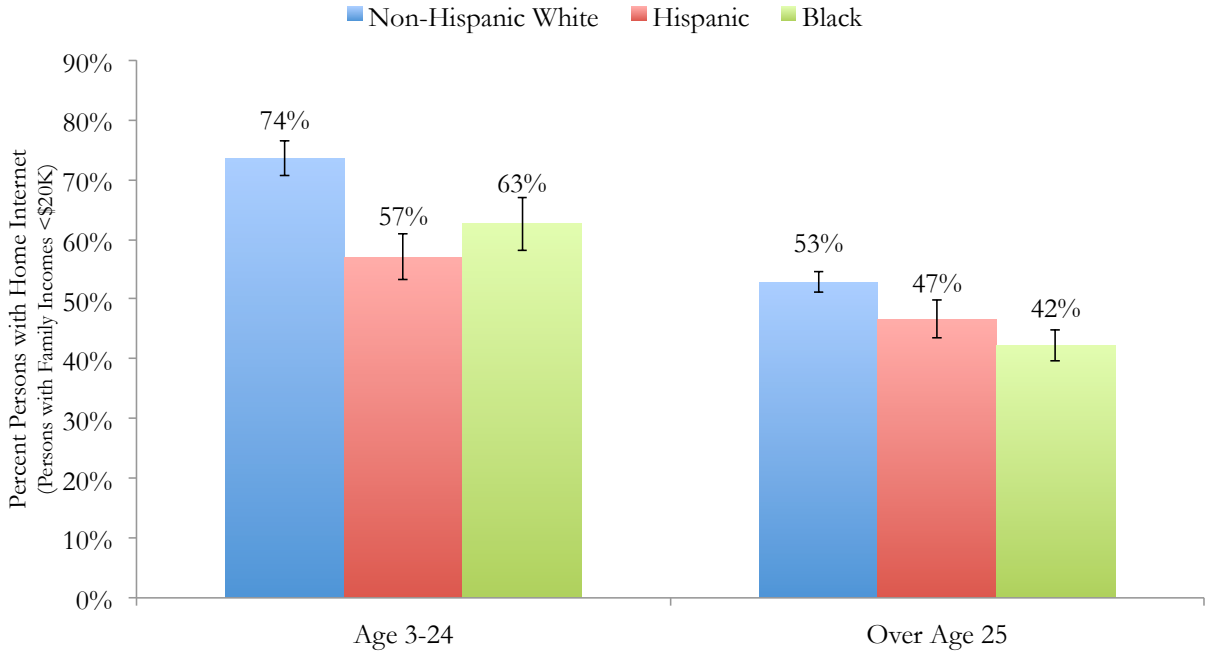
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic White households and Hispanic households are statistically significant at p<0.05 for person's with family incomes between $20,000 and $34,999. Differences between values for non-Hispanic White households and Black households are statistically significant at p<0.05 for households with family incomes below $20,000. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A6:
Household-Level Mobile-Data Adoption by Race/Ethnicity and Family Income (2015)



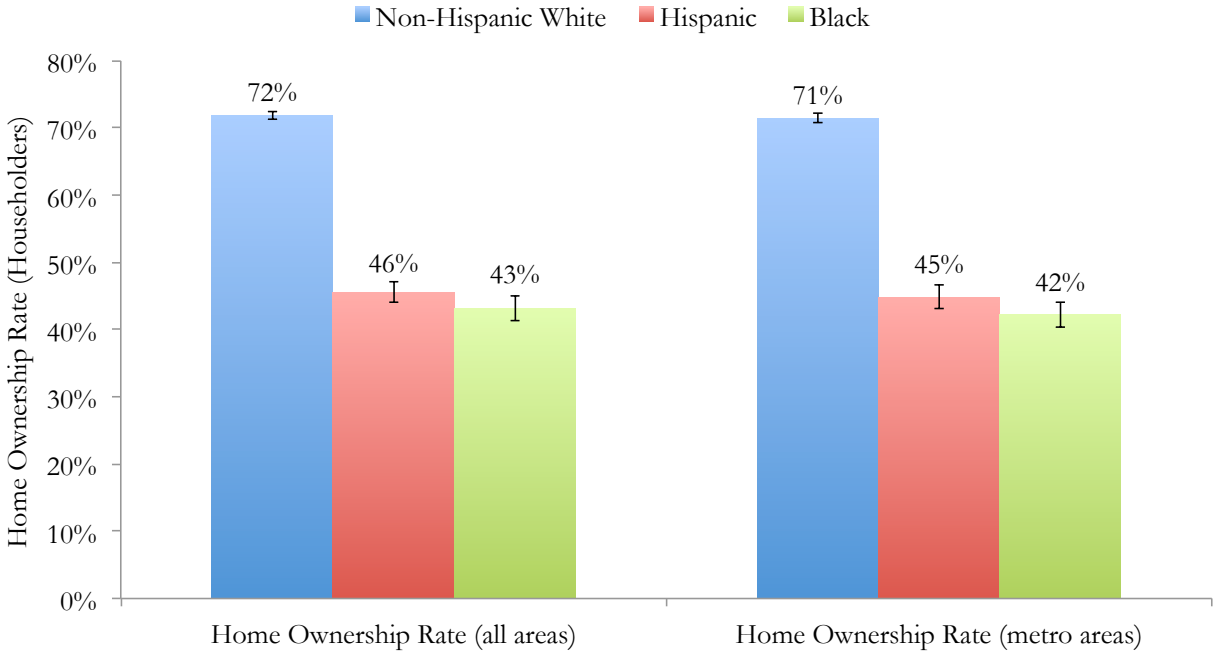
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic White households and Hispanic households are statistically significant at p<0.05 for person's with family incomes below $60,000. Differences between values for non-Hispanic White households and Black households are statistically significant at p<0.05 for households with family incomes above $100,000. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A7:
Home-Internet Adoption by Race/Ethnicity and Age
for Persons with Annual Family Incomes Below $20,000 (2015)



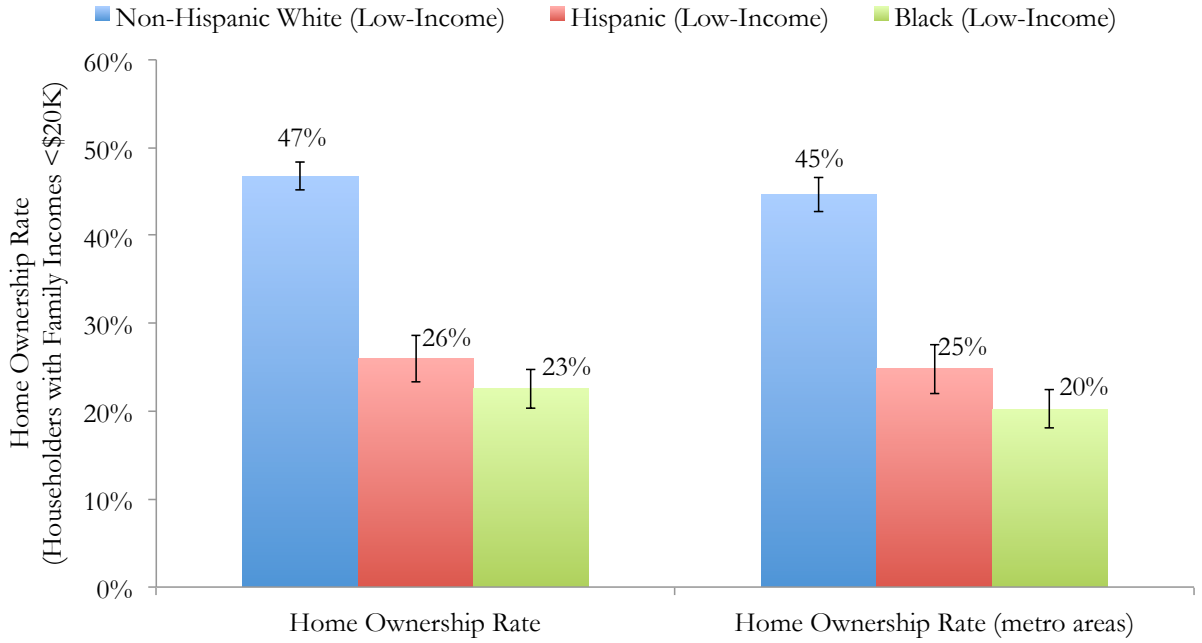
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic Whites and Hispanics, and between non-Hispanic Whites and Blacks, are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A8:
Home Ownership by Race/Ethnicity and Metropolitan Location (2015)



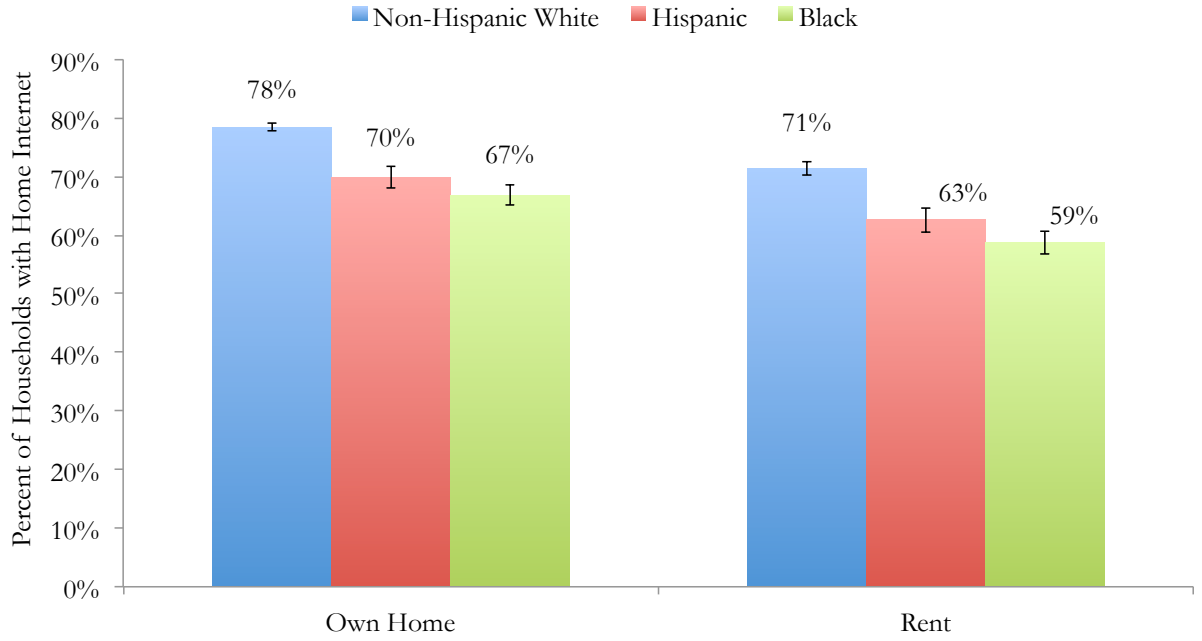
Source: July 2015 Current Population Survey. Differences between home ownership percentages for non-Hispanic White householders and Hispanic householders, and non-Hispanic White householders and Black householders in all areas are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A9:
Home Ownership by Race/Ethnicity and Metropolitan Location,
for Householders with Annual Family Incomes Below $20,000 (2015)



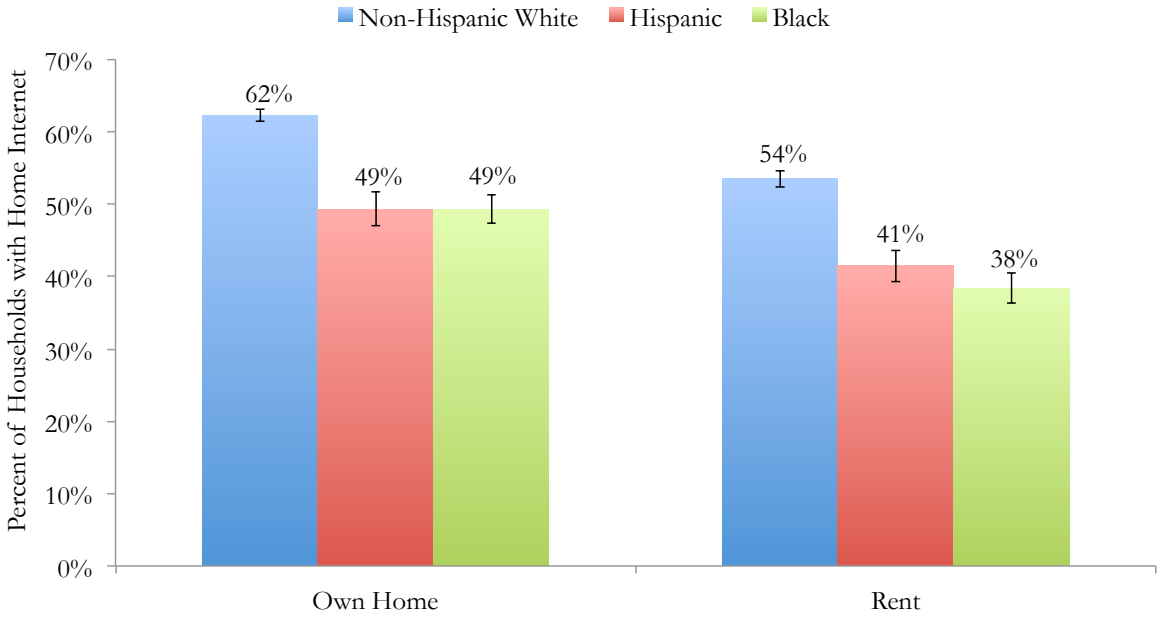
Source: July 2015 Current Population Survey. Differences between home ownership percentages for non-Hispanic White householders and Hispanic householders, and non-Hispanic White householders and Black householders in all areas are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A10:
Home-Internet Adoption by Race/Ethnicity and Home-Ownership Status (2015)



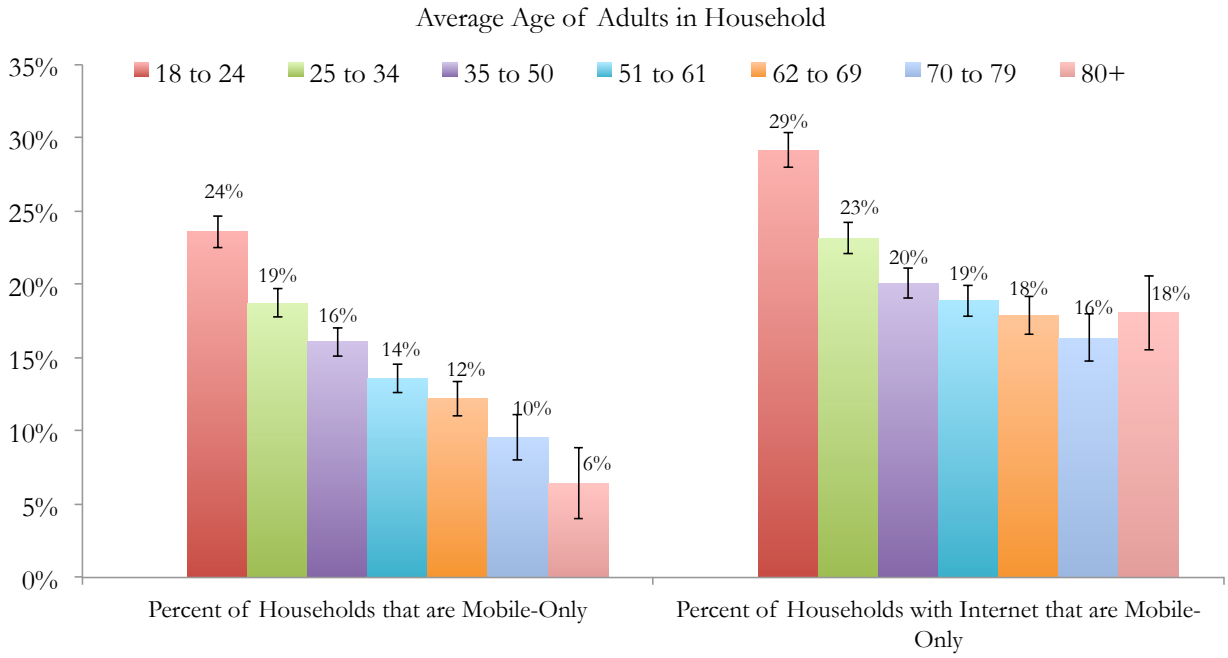
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption for non-Hispanic White householders and Hispanic householders, and between non-Hispanic White householders and Black householders for householders living in an owned-home or rented home are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A11:
Wired Home-Internet Adoption by Race/Ethnicity and Home-Ownership Status (2015)



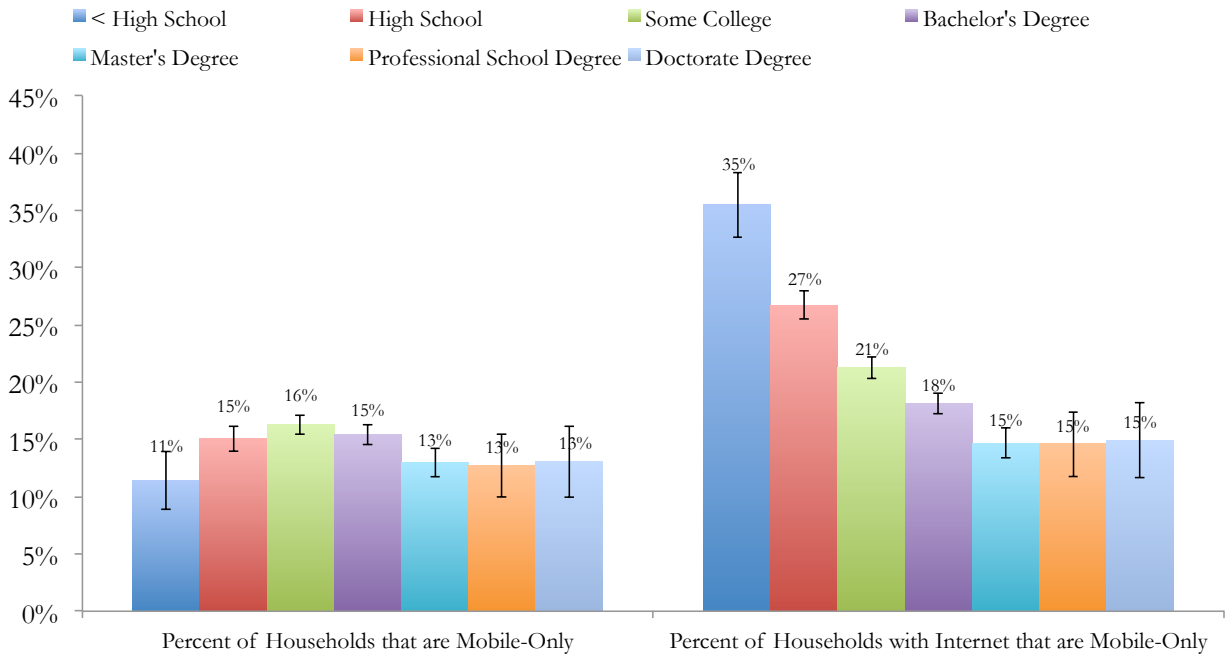
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between home-internet adoption for non-Hispanic White householders and Hispanic householders, and non-Hispanic White householders and Black householders for householders living in an owned-home or rented home are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A12:
Households That Access the Internet Only via Mobile by Age (2015)



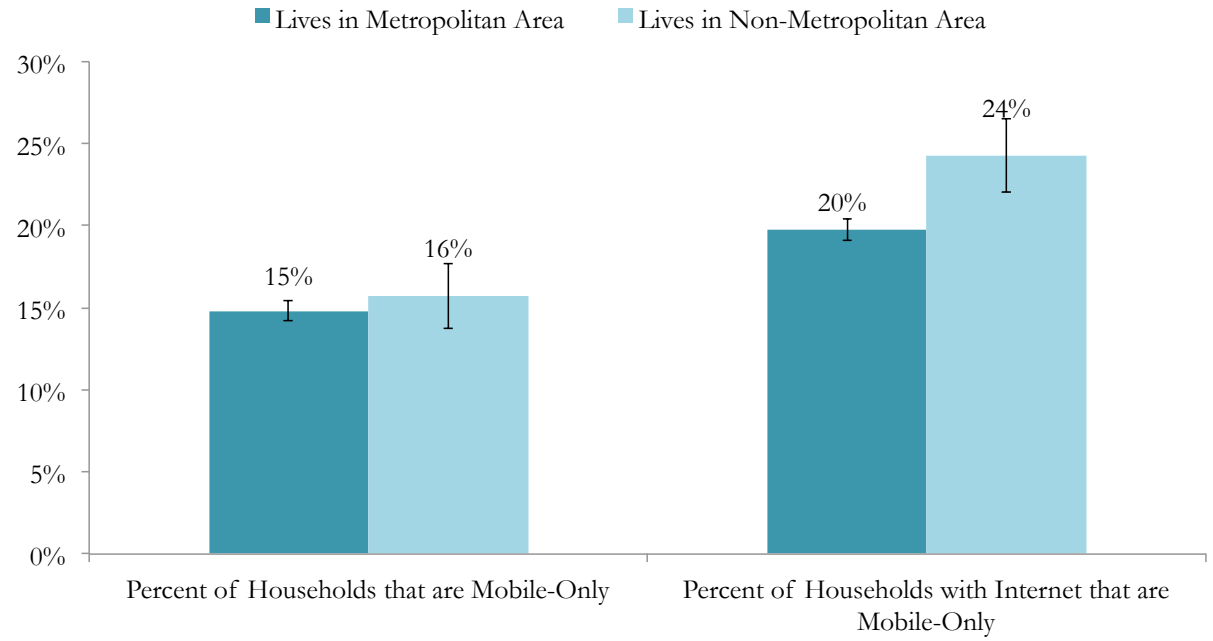
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all households. The universe for the second column is households that have a home internet connection.

Figure A13:
Households That Access the Internet Only via Mobile by Educational Attainment (2015)



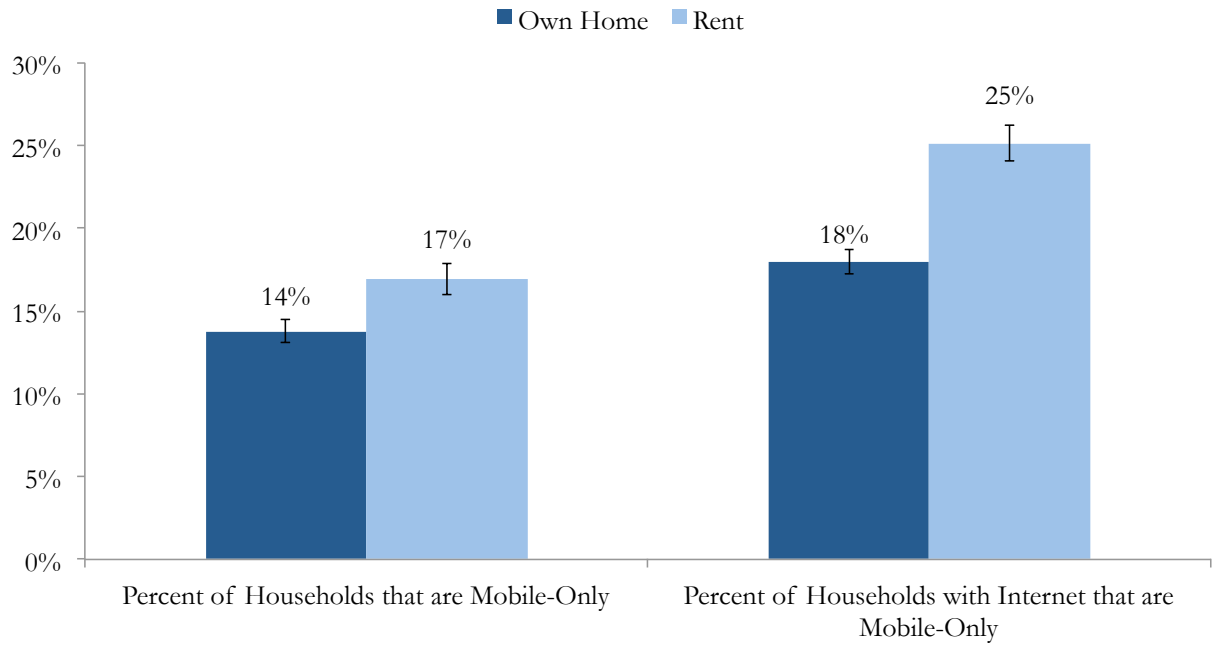
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all households. The universe for the second column is households that have a home internet connection. Educational attainment levels for household values represent the highest attainment level of a person in the household, not necessarily the householder's educational attainment.

Figure A14:
Households That Access the Internet Only via Mobile by Metropolitan Location (2015)



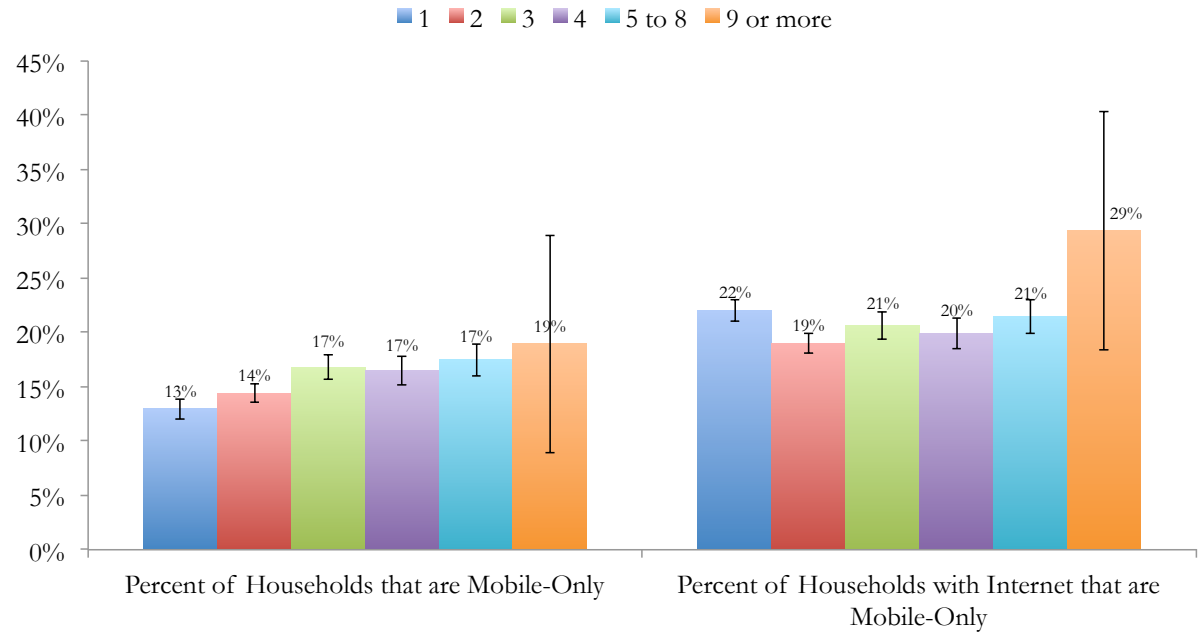
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between metropolitan area and non-metropolitan area for households with internet who are mobile-only is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all households. The universe for the second column is households that have a home internet connection.

Figure A15:
Households That Access the Internet Only via Mobile by Home Ownership (2015)



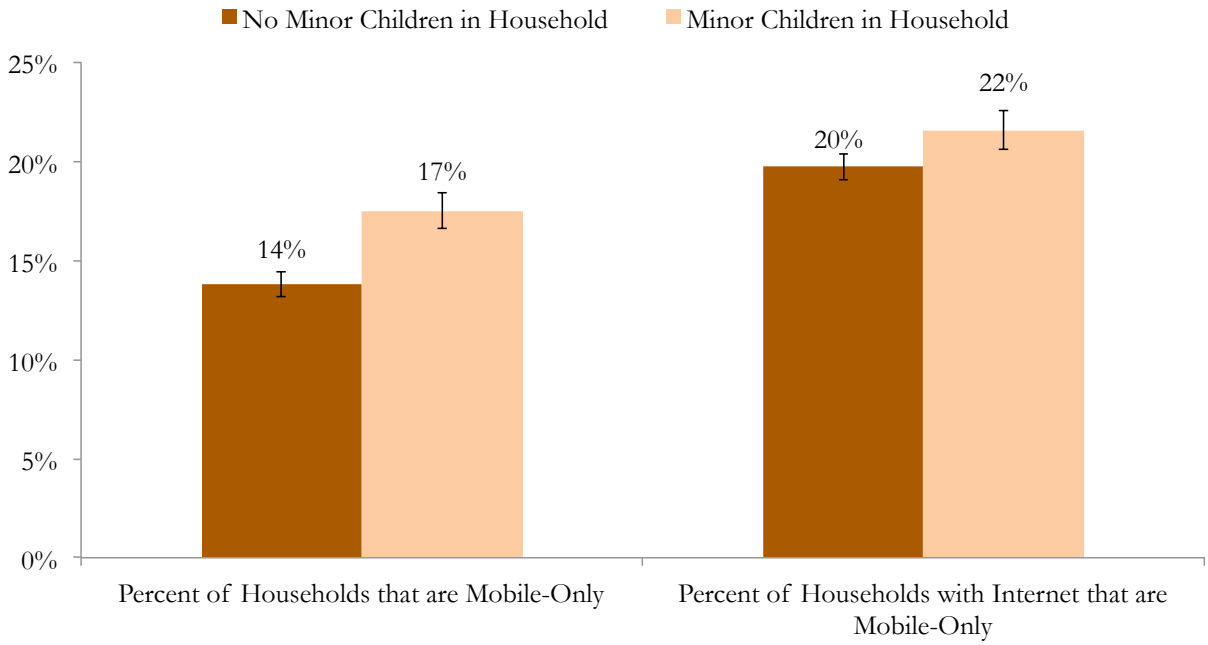
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between those living in an owned-home and rented-home are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all households. The universe for the second column is households that have a home internet connection.

Figure A16:
Households That Access the Internet Only via Mobile by Household Size (2015)



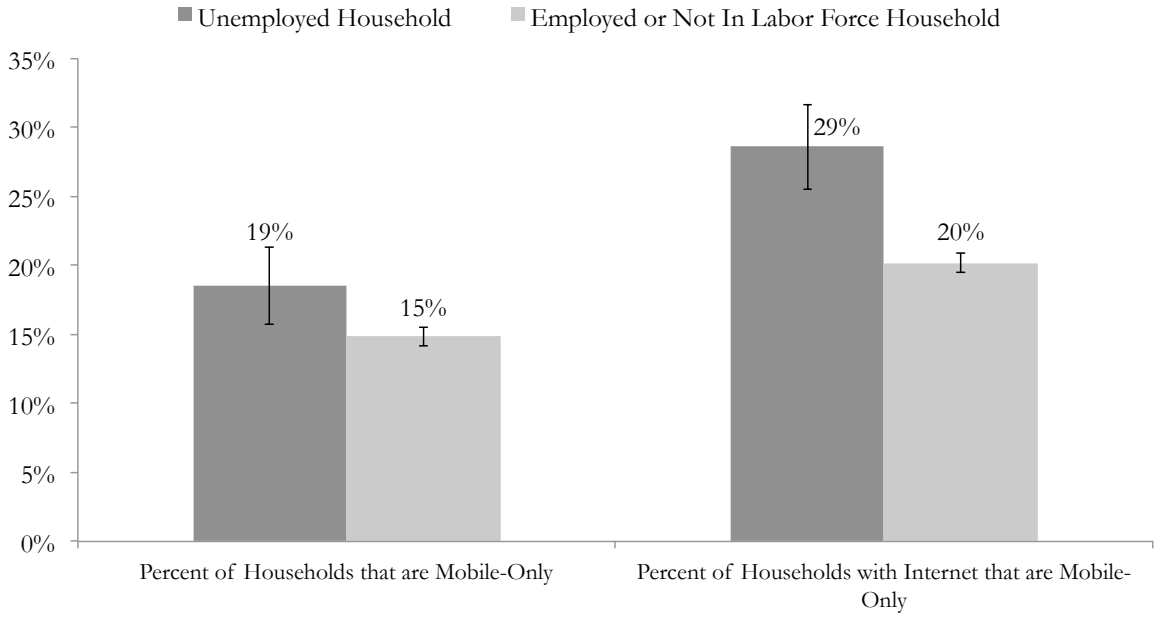
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all households. The universe for the second column is households that have a home internet connection.

Figure A17:
Households and Persons Who Access the Internet Only via Mobile by Presence of Minor Children (2015)



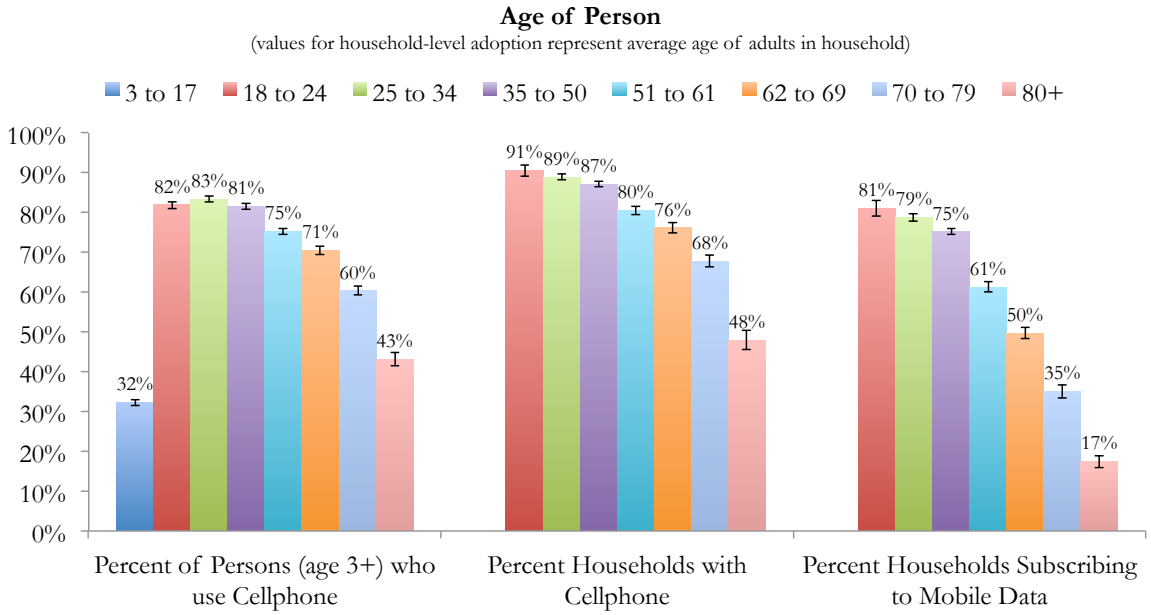
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between households with a minor child and households without a minor child are statistically significant at $p<0.05$. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all households. The universe for the second column is households that have a home internet connection.

Figure A18:
Households and Persons Who Access the Internet Only via Mobile by Employment (2015)



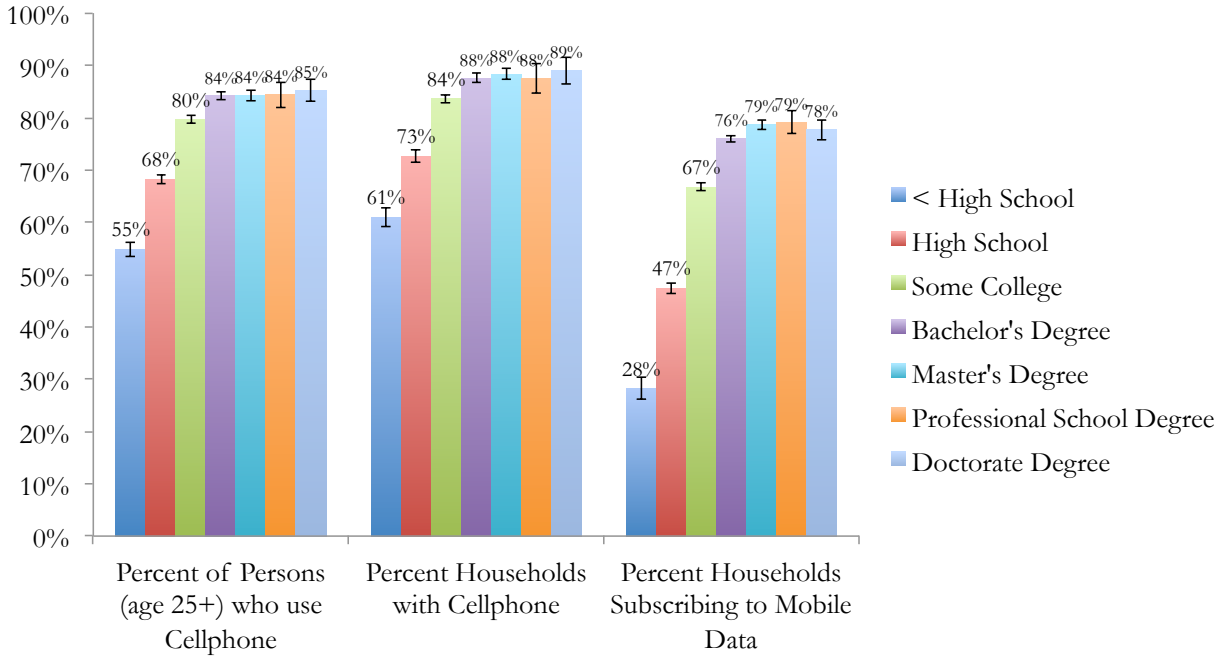
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The difference in the percent of households with internet that are mobile-only between unemployed households and employed households is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) The universe for the first column is all households. The universe for the second column is households that have a home internet connection.

Figure A19:
Cellular and Mobile-Data Adoption by Age (2015)



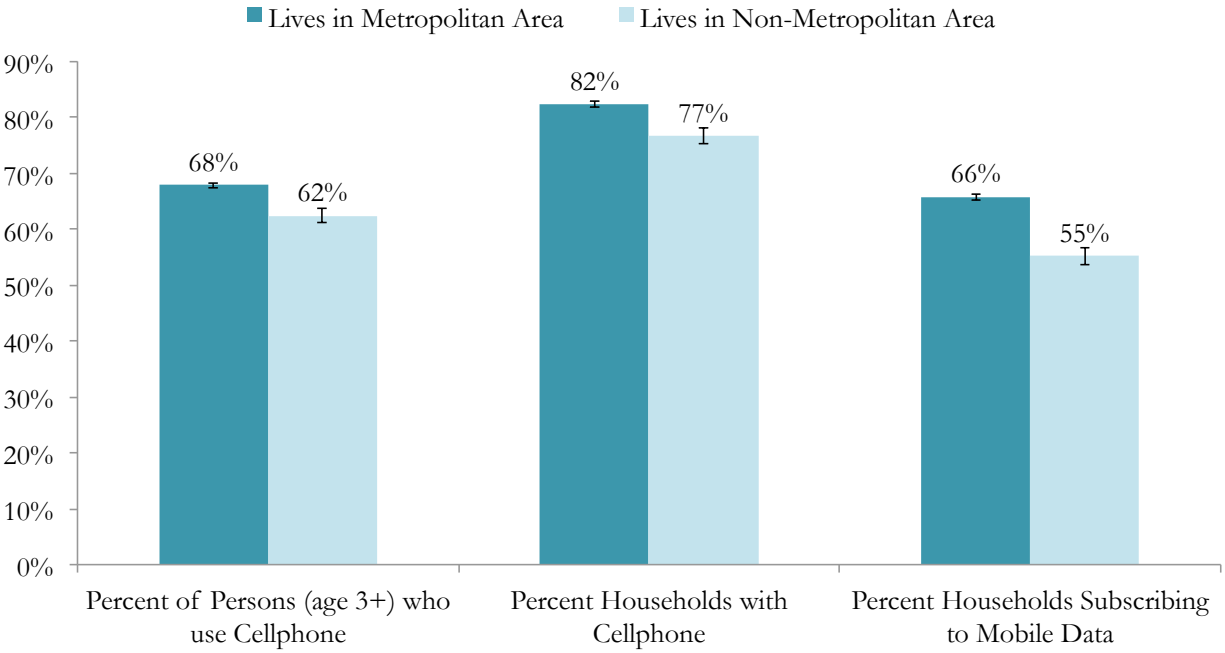
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values represent those persons or households that report using mobile data either via a home subscription or via some access method other than a home subscription (such as a device provided by an employer, etc.).

Figure A20:
Cellular and Mobile-Data Adoption by Educational Attainment (2015)



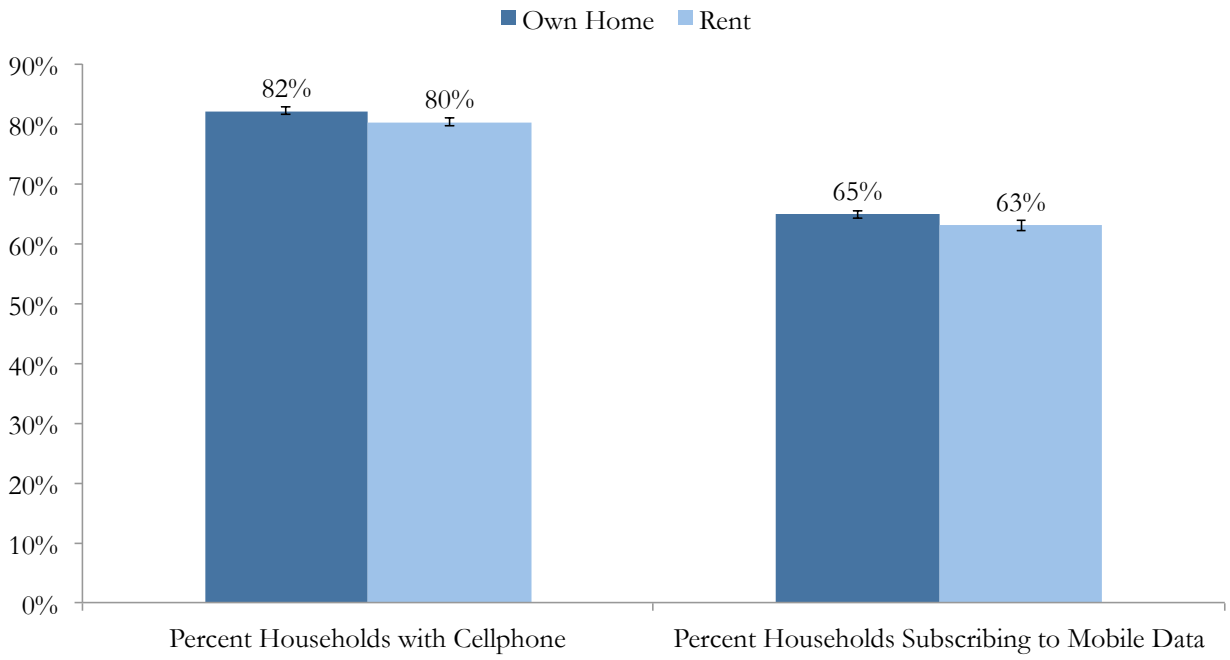
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Educational attainment levels for household values represent the highest attainment level of a person in the household, not necessarily the householder's educational attainment. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values represent those persons or households that report using mobile data either via a home subscription or via some access method other than a home subscription.

Figure A21:
Person and Household-Level Cellular-Telephone Adoption by Metropolitan Location (2015)



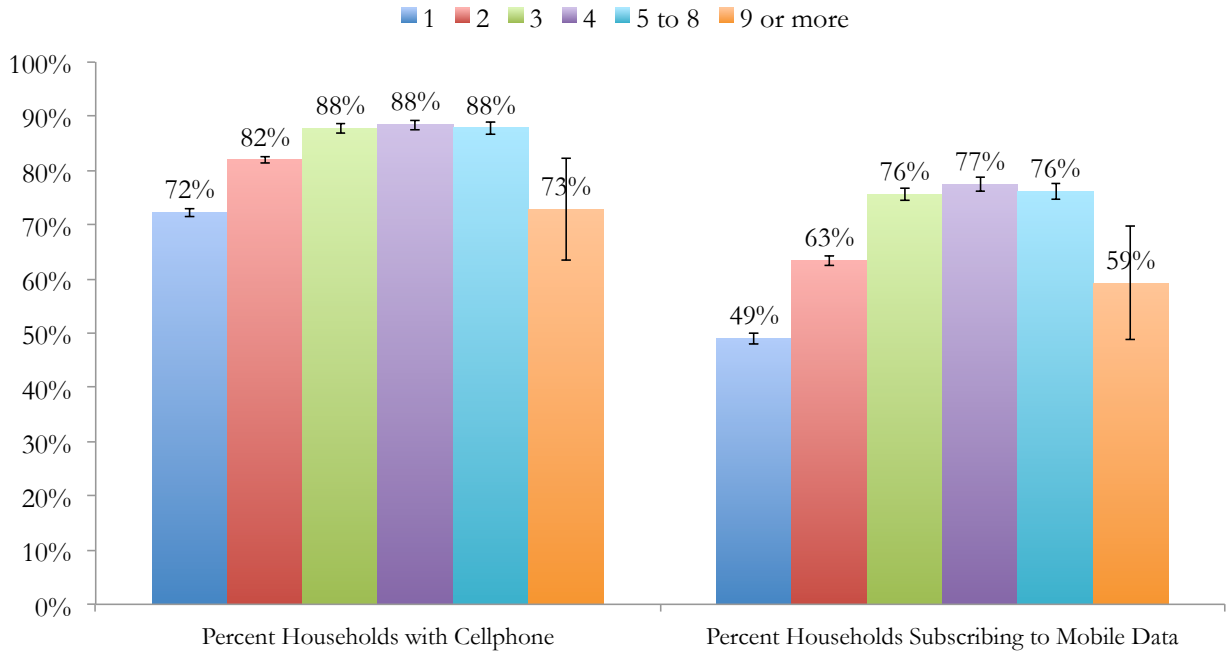
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between metropolitan and non-metropolitan areas are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A22:
Household Cellular and Mobile-Data Adoption by Home-Ownership Status (2015)



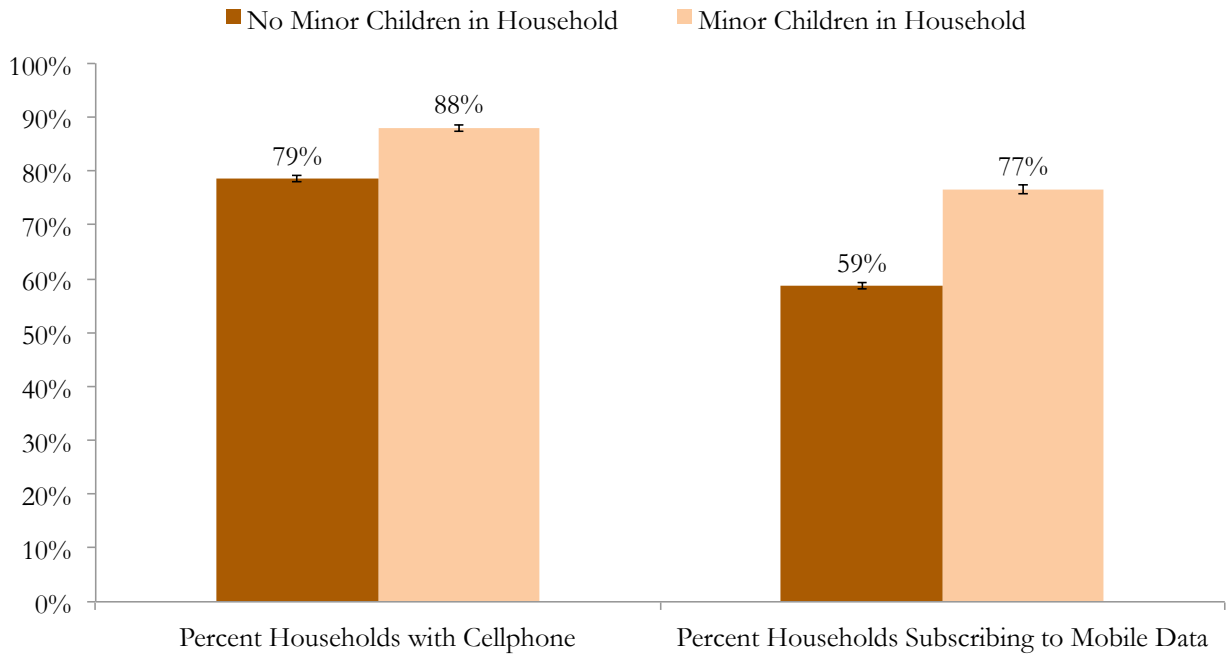
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values for households subscribing to mobile data represent those that report using mobile data either via a home subscription or some access method other than a home subscription.

Figure A23:
Household Cellular and Mobile-Data Adoption by Household Size (2015)



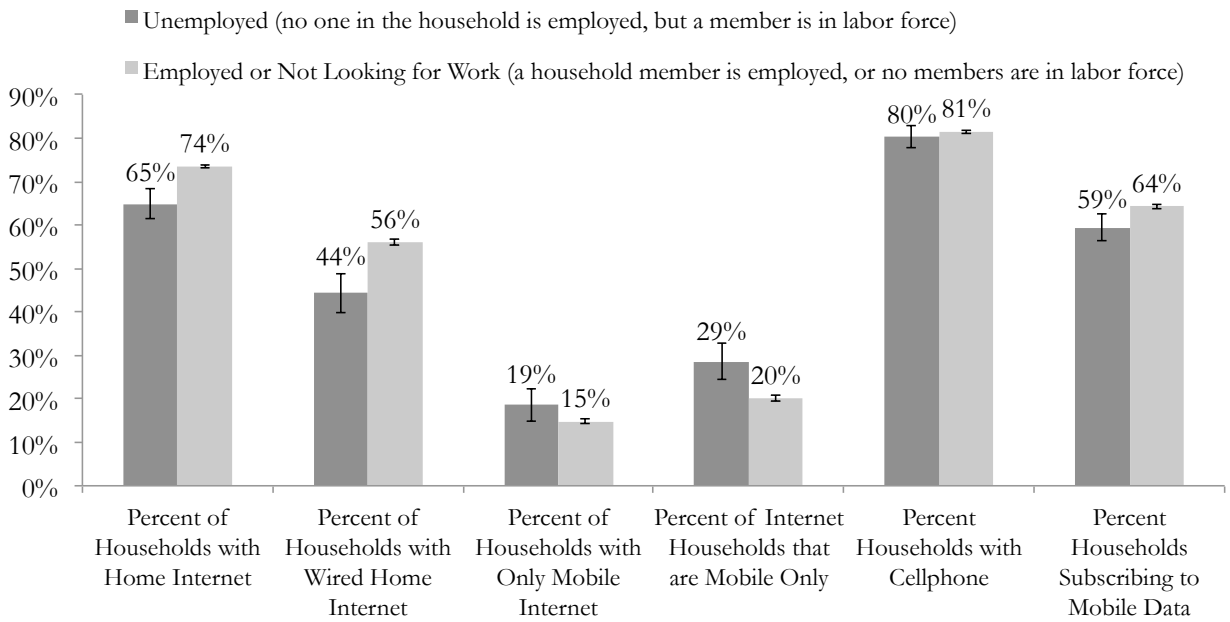
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between values for 1- and 2-person households and all other household sizes (except for those with 9 or more persons) are statistically significant at p<0.05 for both cellphone and mobile adoption. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values for households subscribing to mobile data represent those that report using mobile data either via a home subscription or some access method other than a home subscription.

Figure A24:
Household Cellular and Mobile-Data Adoption by Presence of Minor Children (2015)



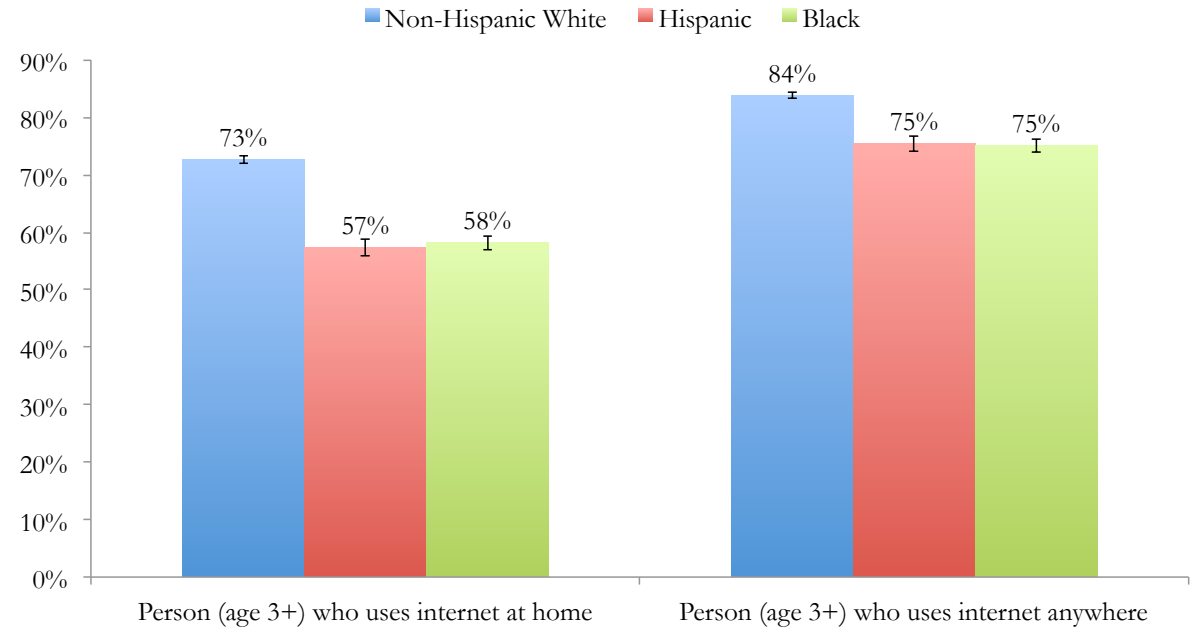
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values for households subscribing to mobile data represent those households that report using mobile data either via a home subscription or some other access method.

Figure A25:
Household-Telecom Adoption by Employment (2015)



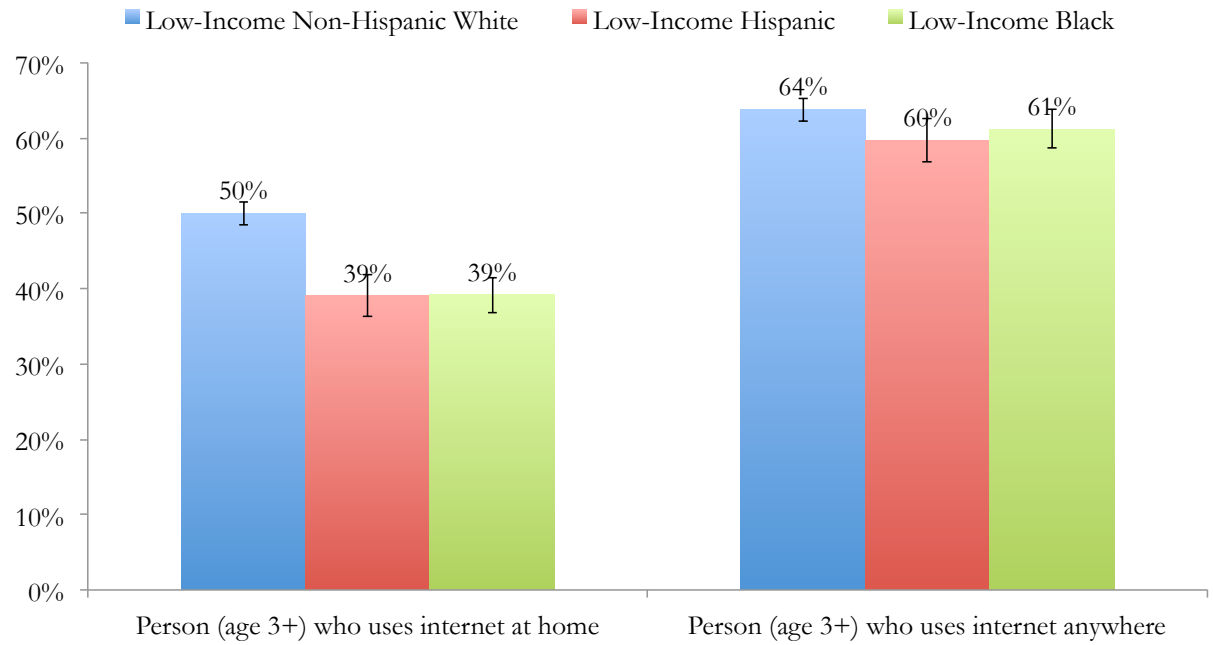
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences between unemployed households and employed/not in labor force households are statistically significant at p<0.05, except for the categories households with only mobile internet and households with cellphone. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) Values for mobile internet/data represent persons or households that report using it either via a home subscription or some other access method.

Figure A26:
Persons' (age 3+) Internet Use by Race/Ethnicity, Home Use vs. Internet Use Anywhere (2015)



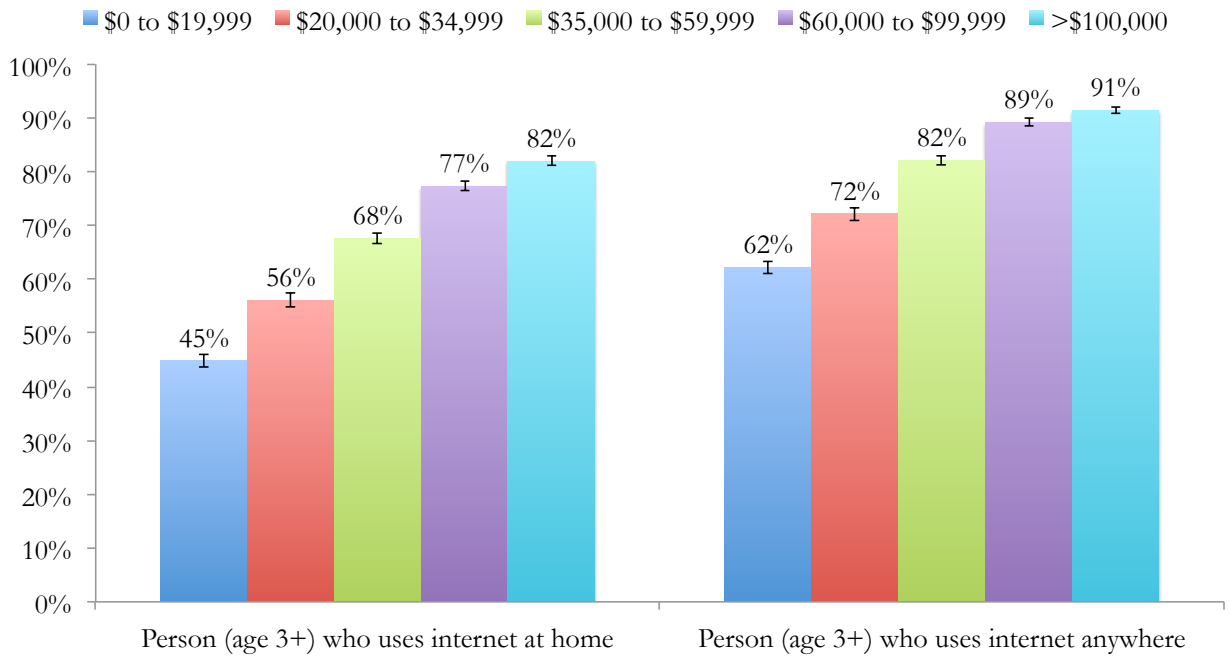
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between internet use for non-Hispanic Whites and Hispanics, and non-Hispanic Whites and Blacks are statistically significant at p<0.05 for both categories of internet use. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A27:
Persons' (age 3+) Internet Use at Home vs. Internet Use Anywhere
by Race/Ethnicity for Householders with Annual Family Incomes Below $20,000 (2015)



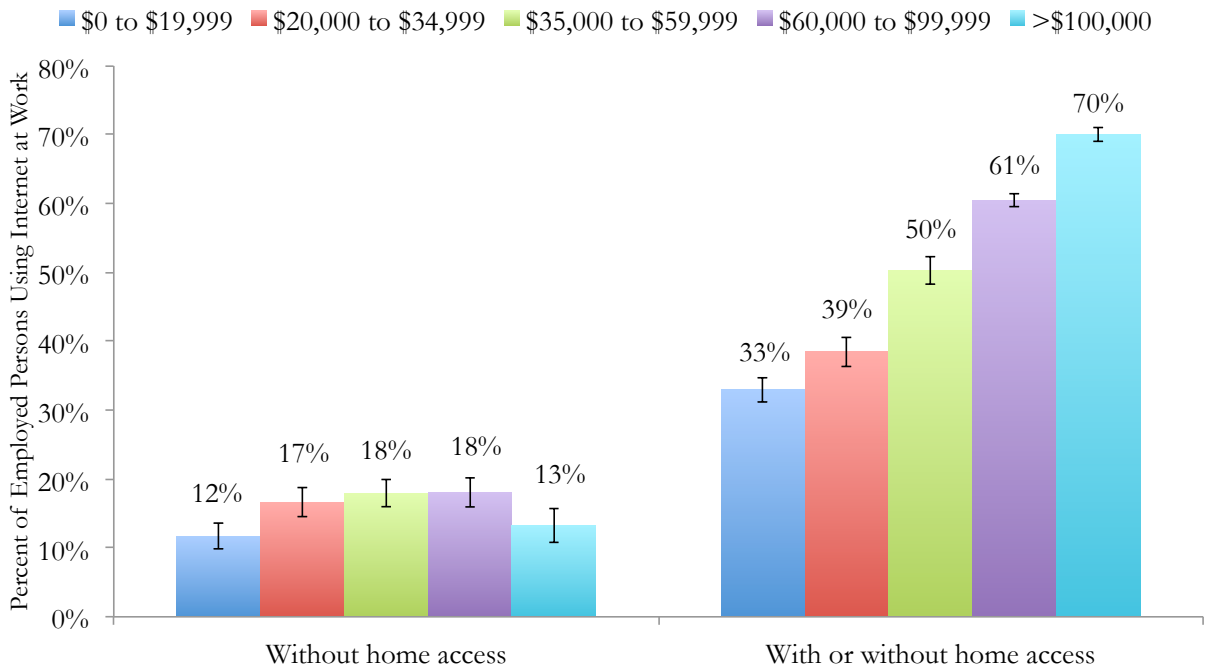
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. The differences between home internet use for low-income non-Hispanic Whites and low-income Hispanics, and low-income non-Hispanic Whites and low-income Blacks are statistically significant at p<0.05 only for persons who use internet at home. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A28:
Persons' (age 3+) Internet Use at Home vs. Internet Use Anywhere by Annual Family Income (2015)



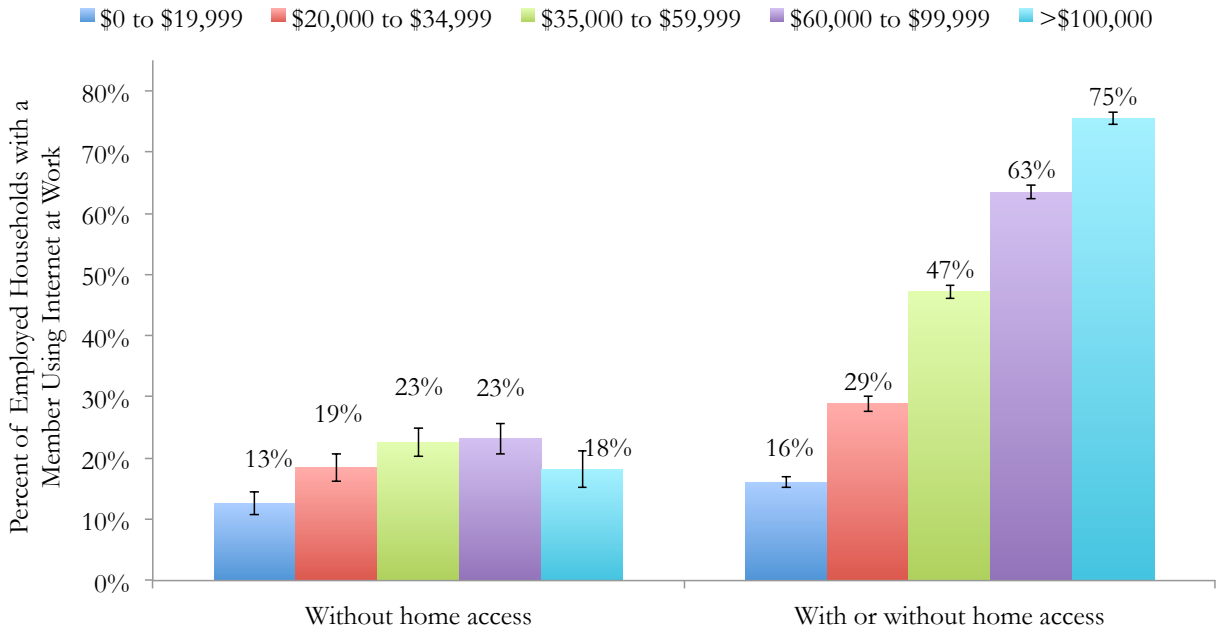
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. All differences are statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A29:
Employee Internet Use at Work by Family Income and Home-Internet Access (2015)



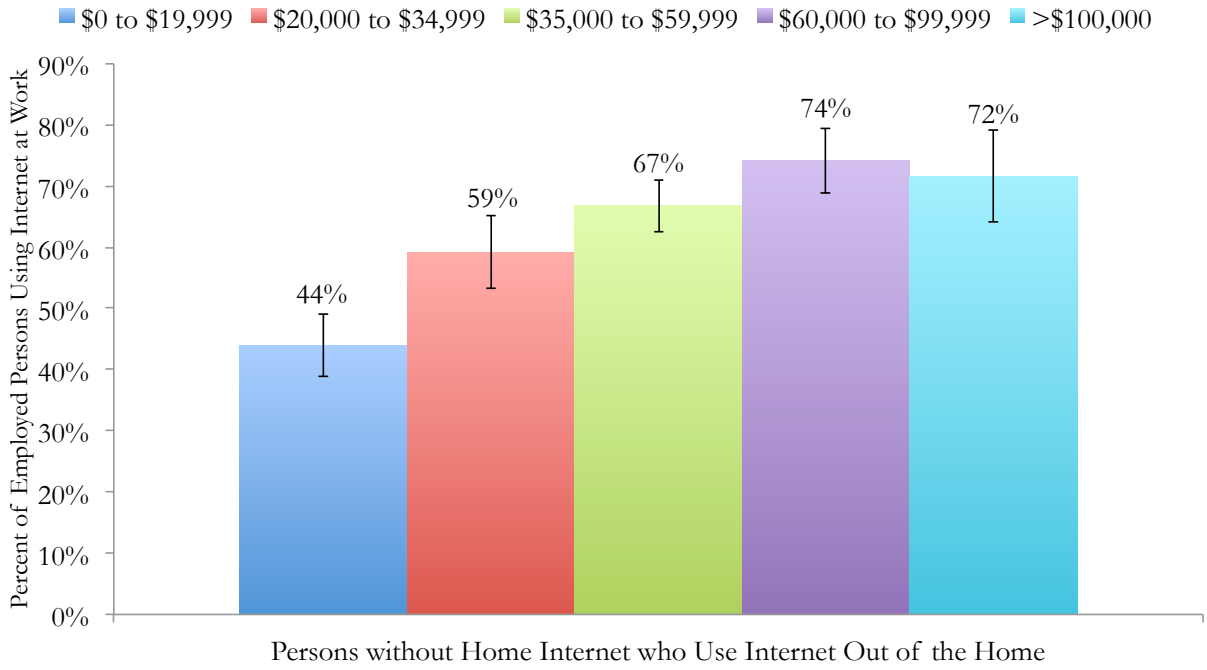
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A30:
Household Internet Use at Work by Family Income and Home-Internet Access (2015)



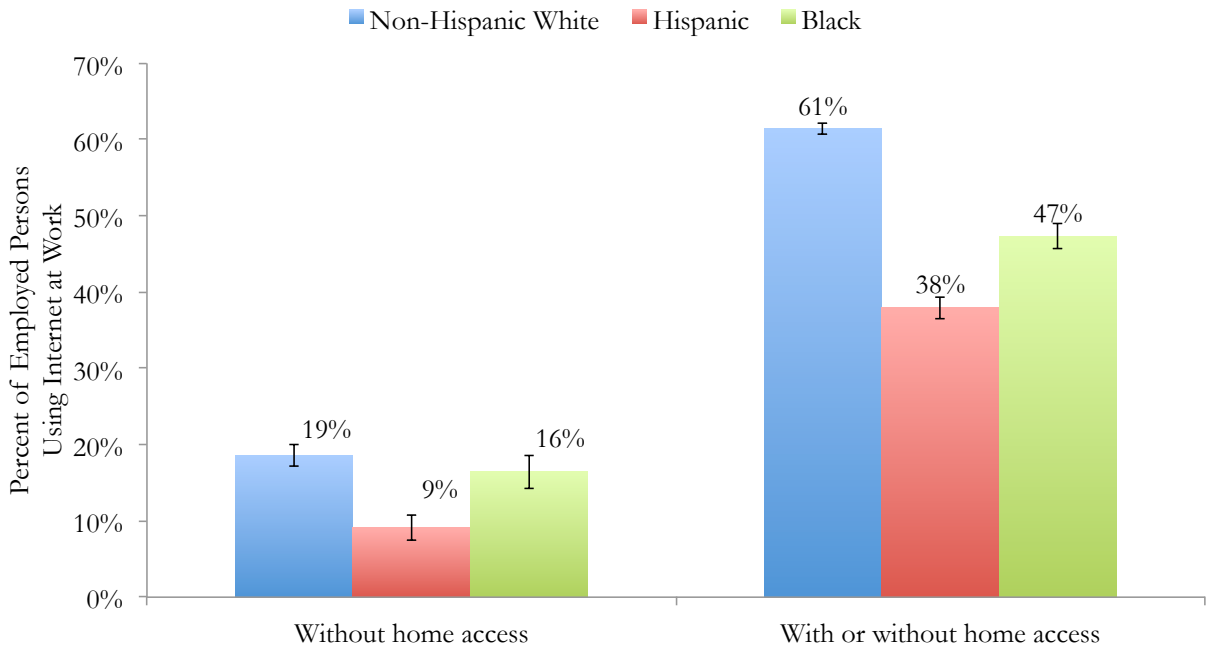
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A31:
Employee Internet Use at Work by Family Income, for Persons Without Home-Internet Access Who Use the Internet Elsewhere (2015)



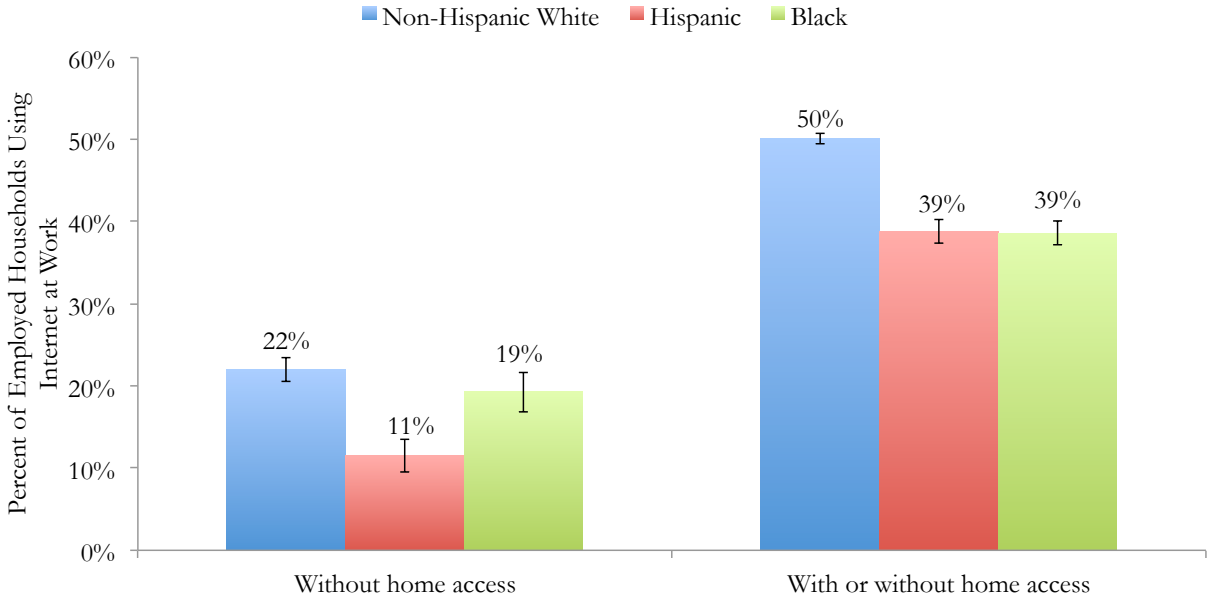
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A32:
Employee Internet Use at Work by Race/Ethnicity and Home-Internet Access (2015)



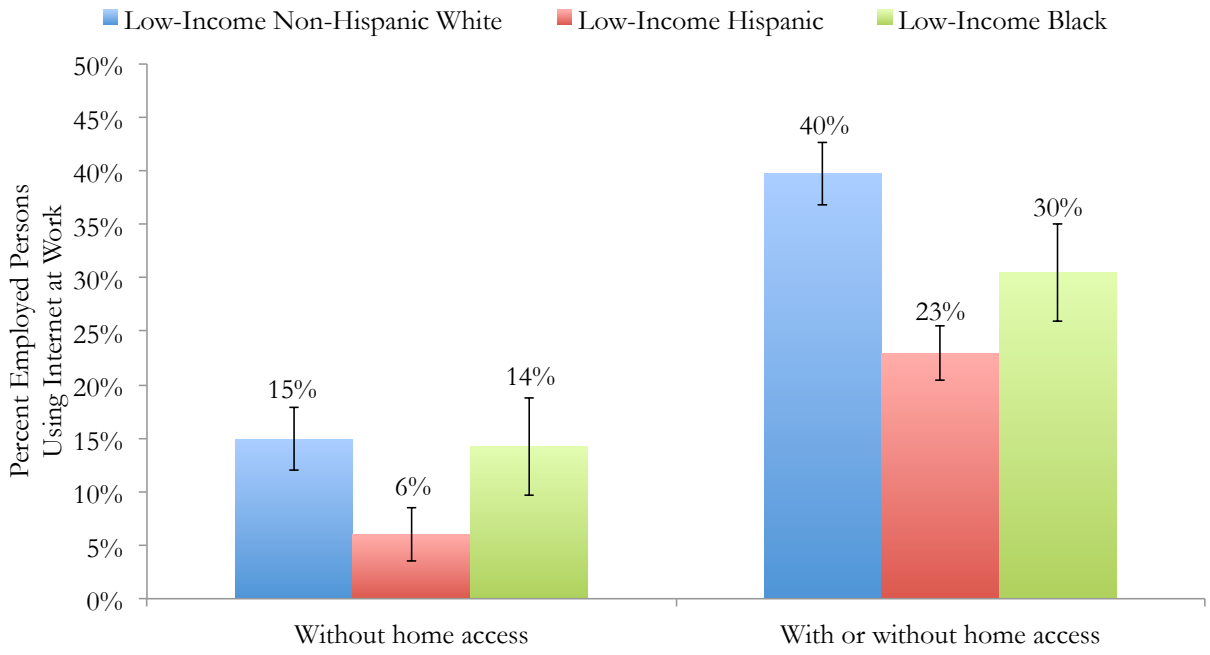
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A33:
Household Member's Internet Use at Work by Race/Ethnicity and Home-Internet Access (2015)



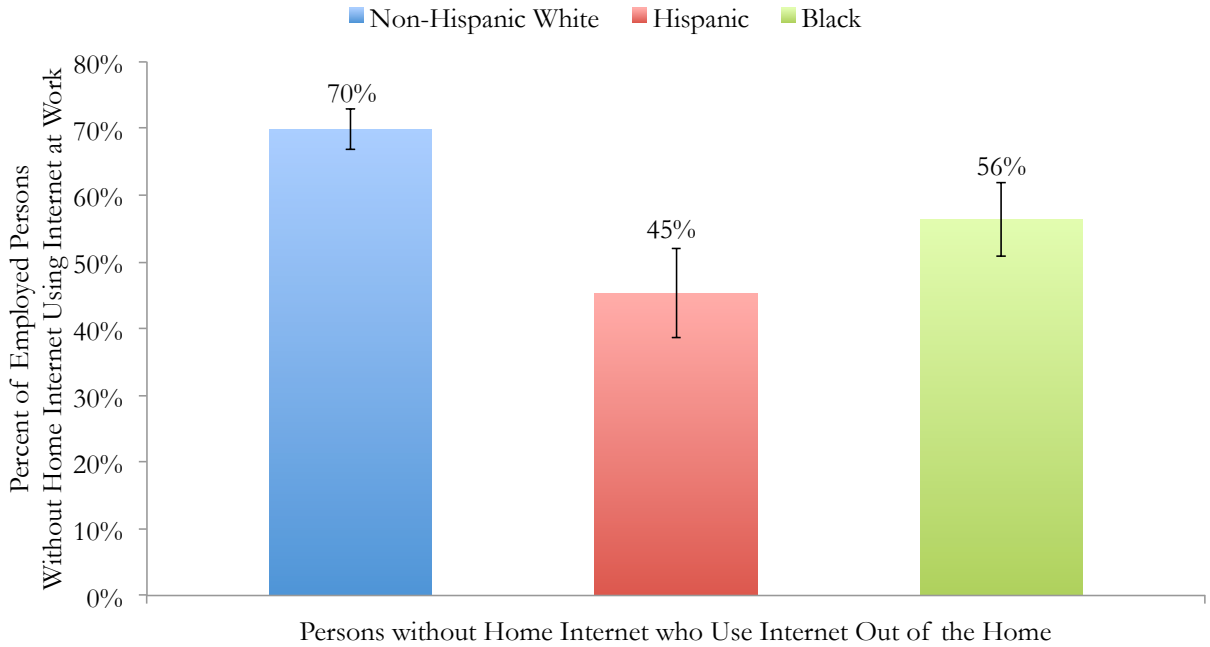
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A34:
Employee Internet Use at Work by Race/Ethnicity and Home-Internet Access for Persons with Annual Family Incomes Below $20,000 (2015)



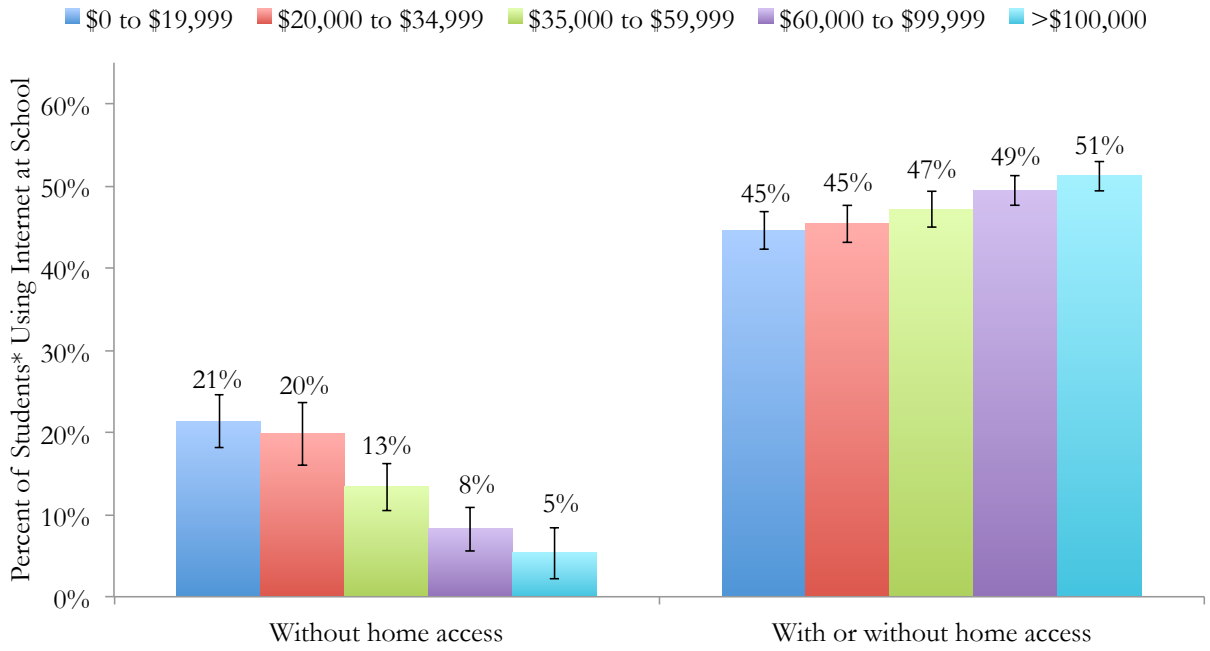
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A35:
Employee Internet Use at Work by Race/Ethnicity, for Persons Without Home-Internet Access Who Use the Internet Elsewhere (2015)



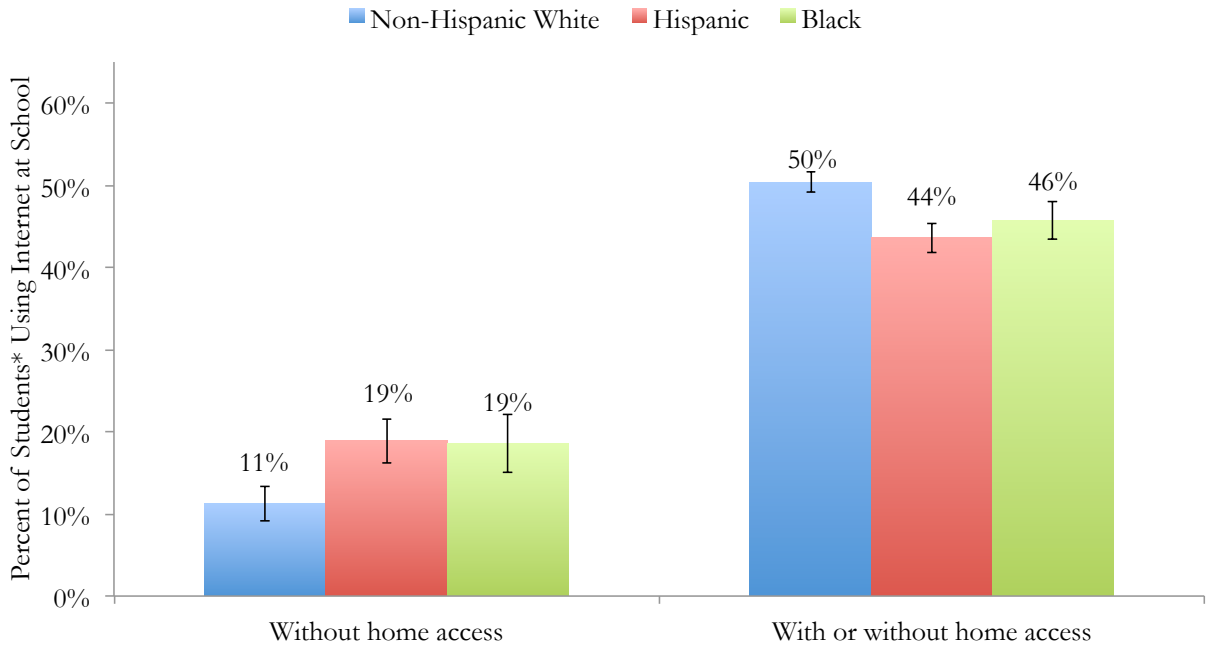
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A36:
Student* Internet Use at School by Family Income and Home-Internet Access (2015)



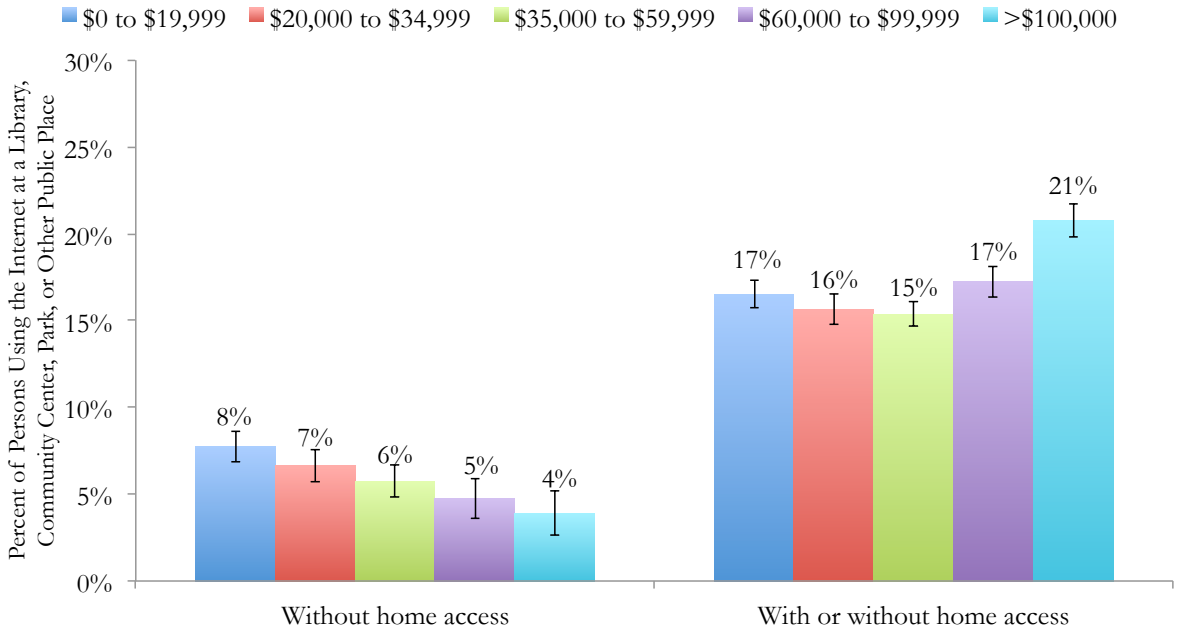
*Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) *The universe of students is defined as persons age 3 to 15, or those age 16 to 54 who reported being enrolled in high school, college or university during the prior week.*

Figure A37:
Student* Internet Use at School by Race/Ethnicity and Home-Internet Access (2015)



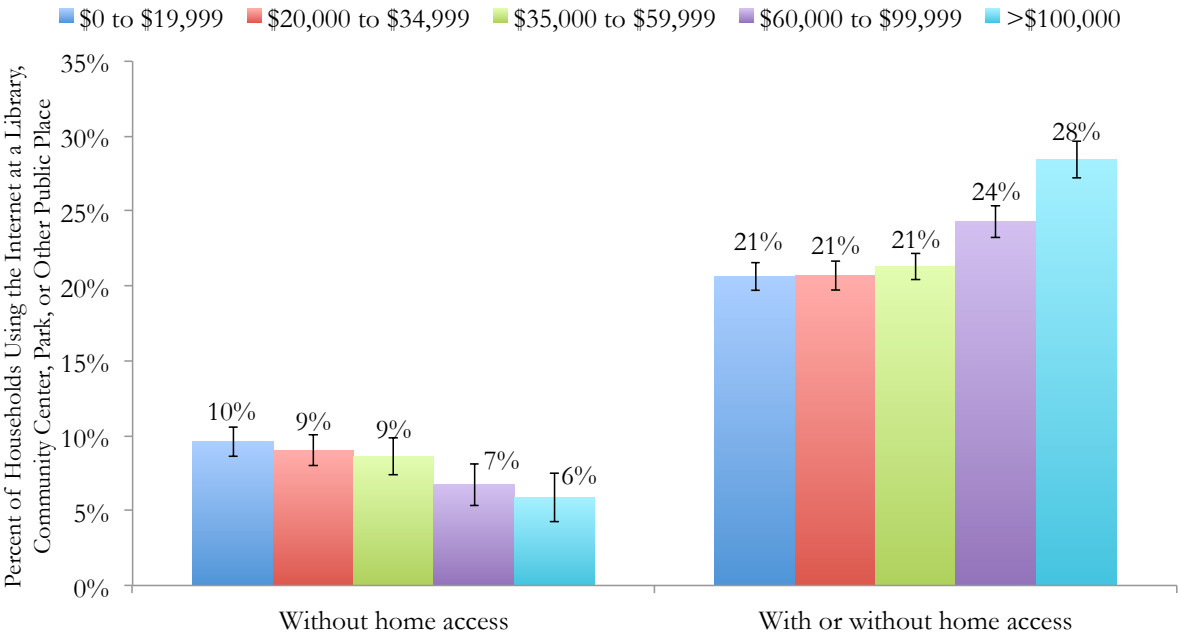
*Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.) *The universe of students is defined as persons age 3 to 15, or those age 16 to 54 who reported being enrolled in high school, college or university during the prior week.*

Figure A38:
Persons' (age 3+) Internet Use at Libraries/Public Places
by Family Income and Home-Internet Access (2015)



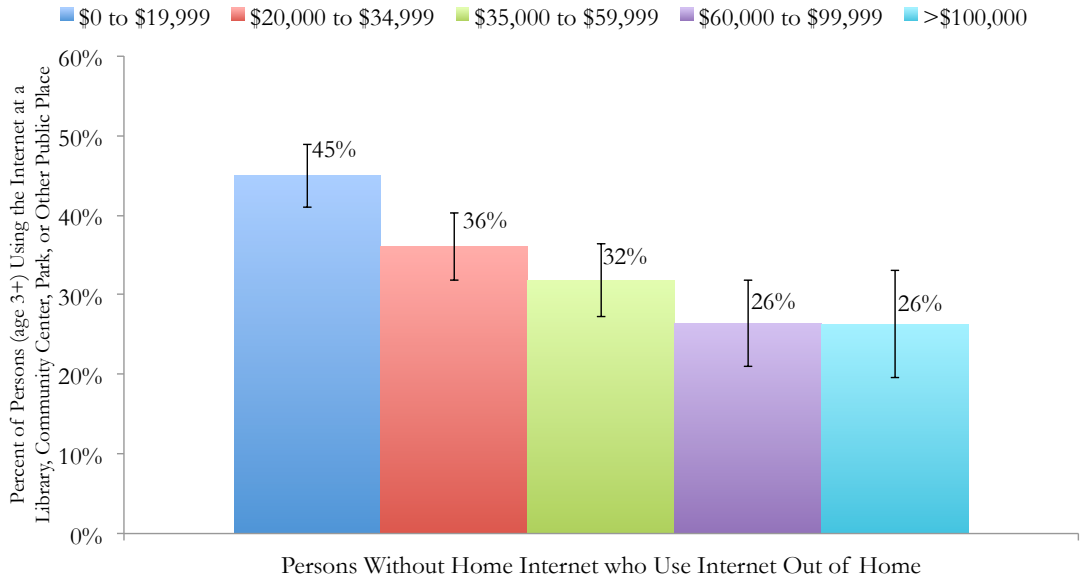
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the Internet at a library, community center, park, or other public place?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A39:
Household-Internet Use at Libraries/Public Places
by Family Income and Home-Internet Access (2015)



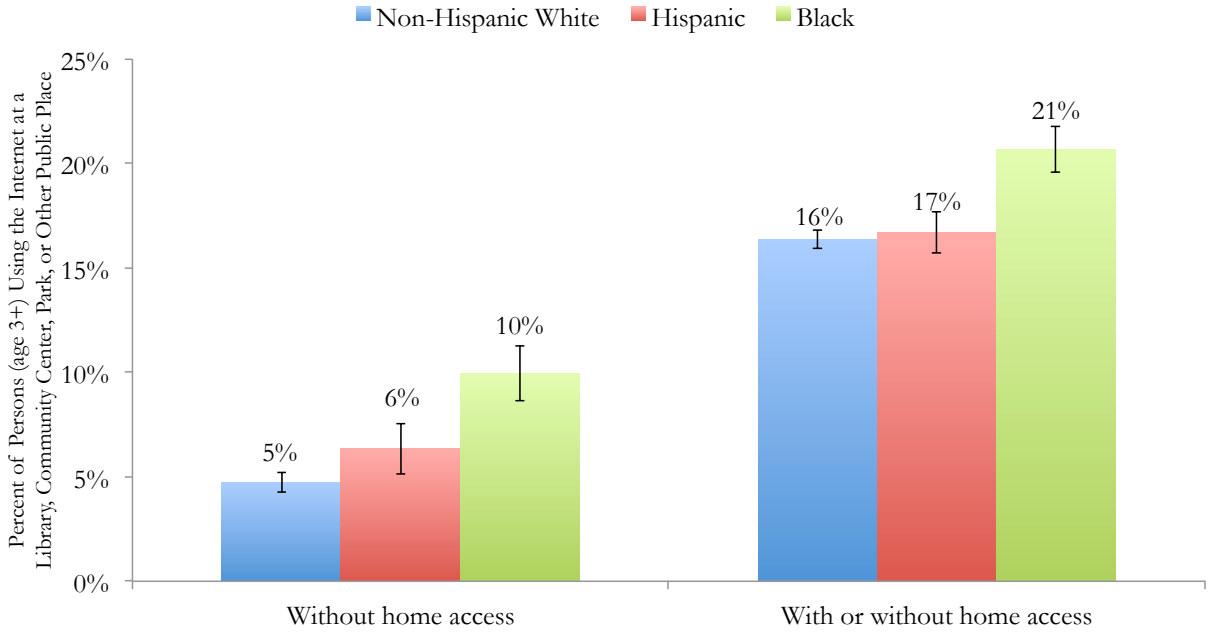
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the Internet at a library, community center, park, or other public place?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A40:
Internet Use at Libraries/Public Places by Family Income,
Persons Without Home Internet Who Go Online Elsewhere (2015)



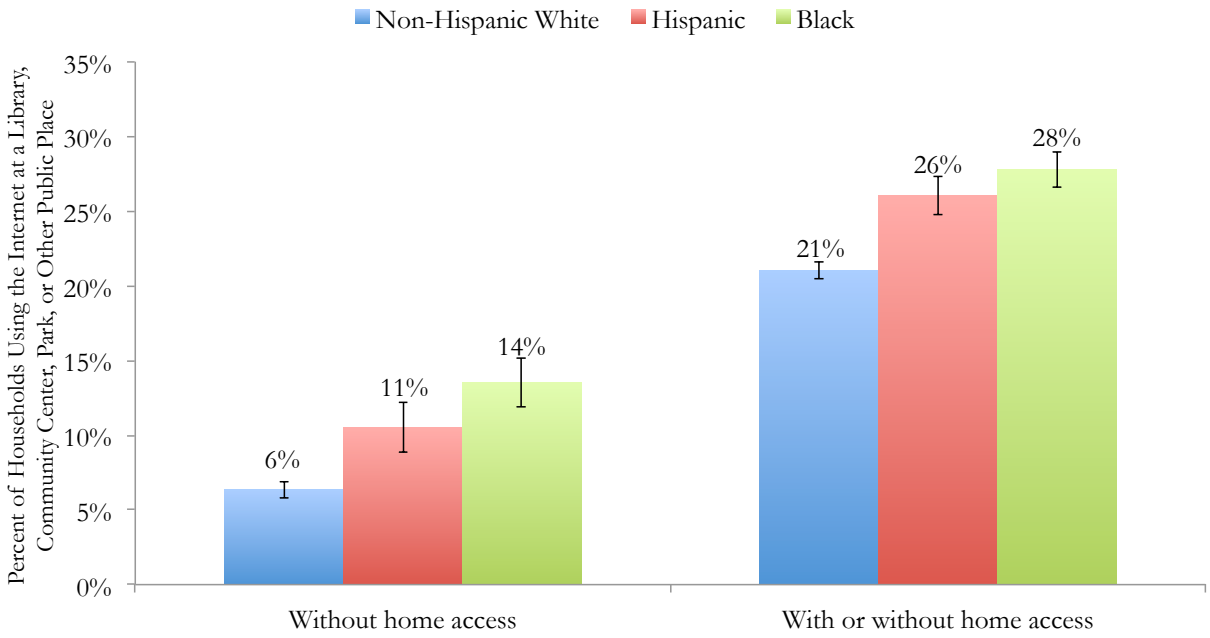
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the Internet at a library, community center, park, or other public place?" The difference between the value for the bottom income quintile and the top income quintile is statistically significant at p<0.05. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A41:
Persons' (age 3+) Internet Use at Libraries/Public Places by Race/Ethnicity,
and Home-Internet Use (2015)



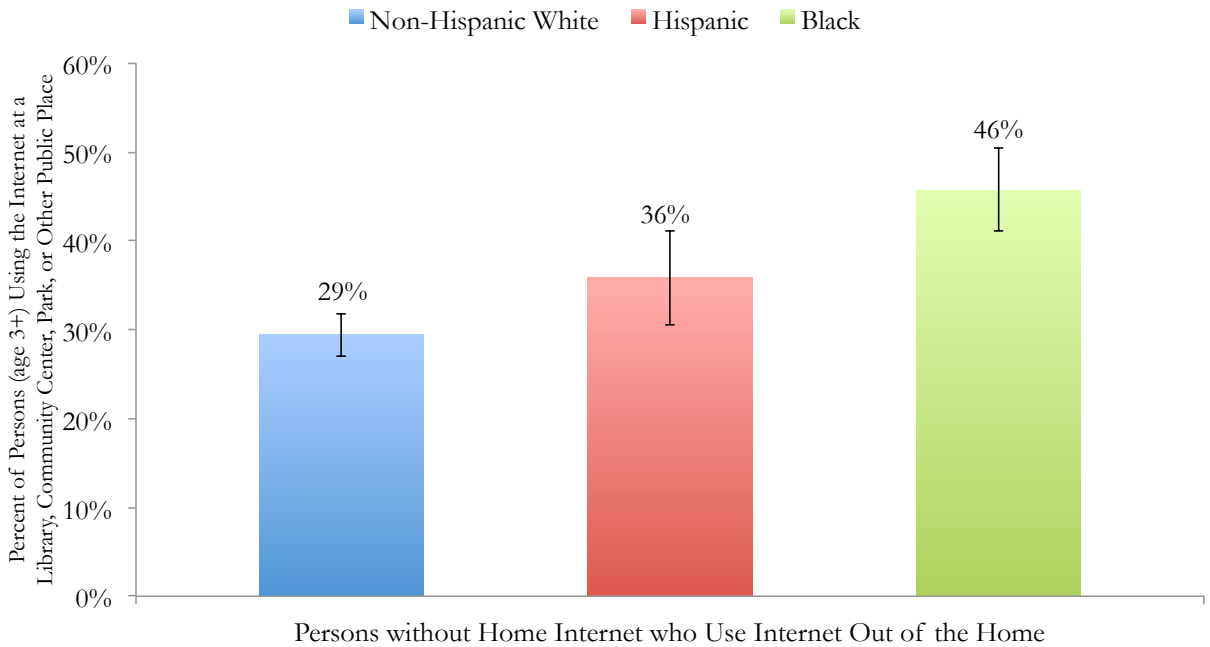
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Question asked householders, "Does anyone in this household use the Internet at a library, community center, park, or other public place?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values).

Figure A42:
Household-Internet Use at Libraries/Public Places by Race/Ethnicity, and Home-Internet Use (2015)



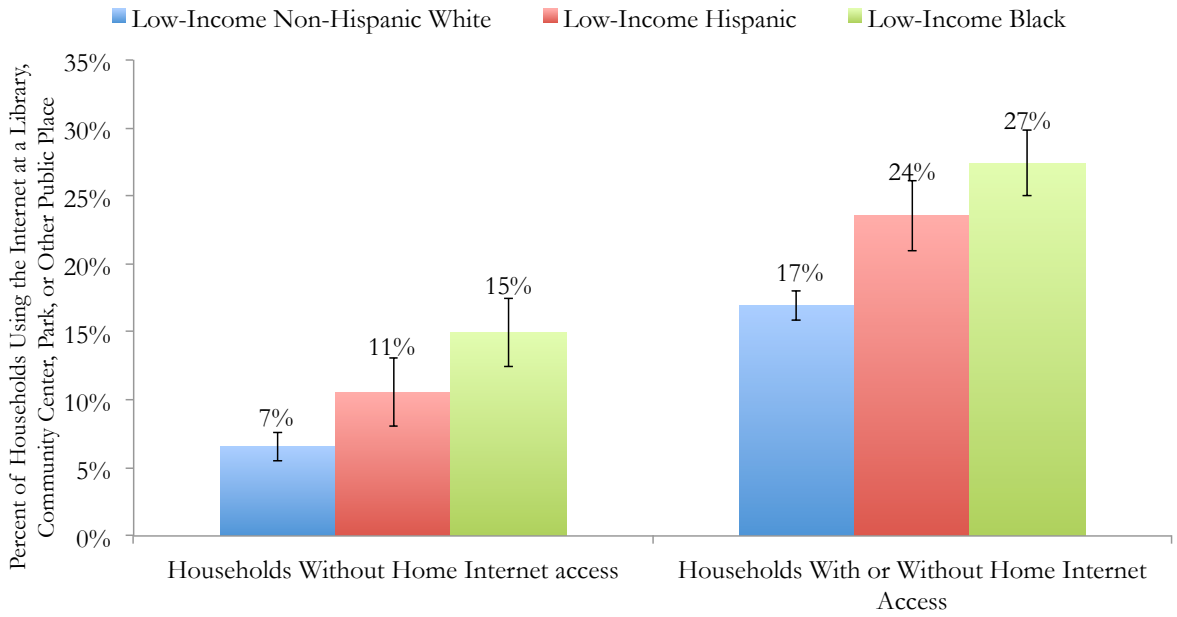
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the Internet at a library, community center, park, or other public place?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A43:
Persons' (age 3+) Internet Use at Libraries/Public Places by Race/Ethnicity for Persons Without Home-Internet Access Who Use the Internet Elsewhere (2015)



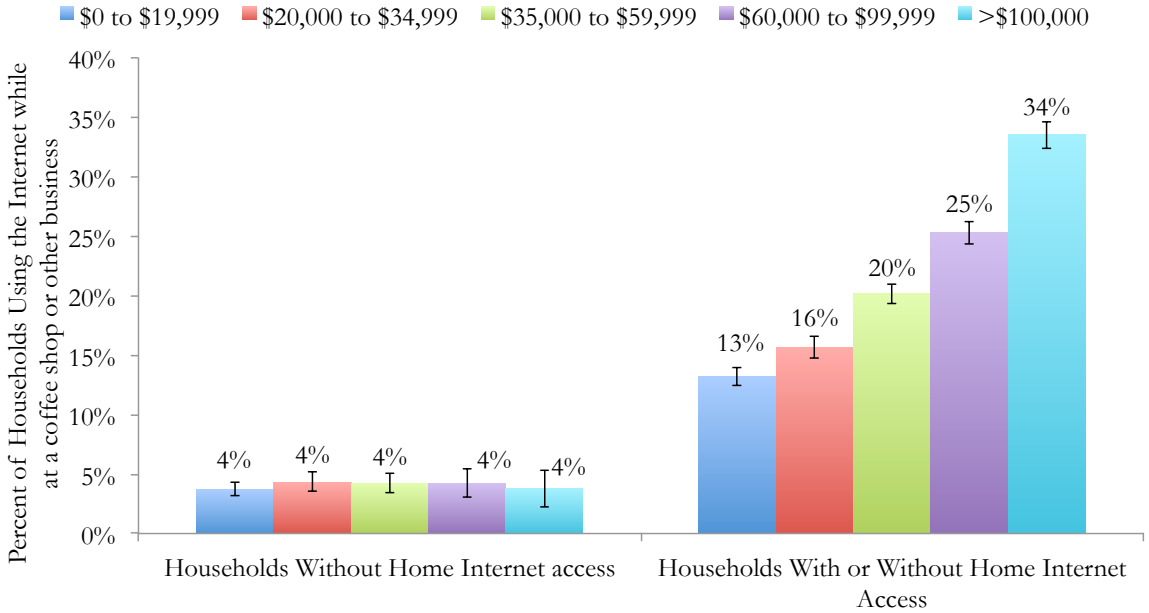
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A44:
Household-Internet Use at Libraries/Public Places by Race/Ethnicity and Home-Internet Access for Households with Annual Family Incomes Below $20,000 (2015)



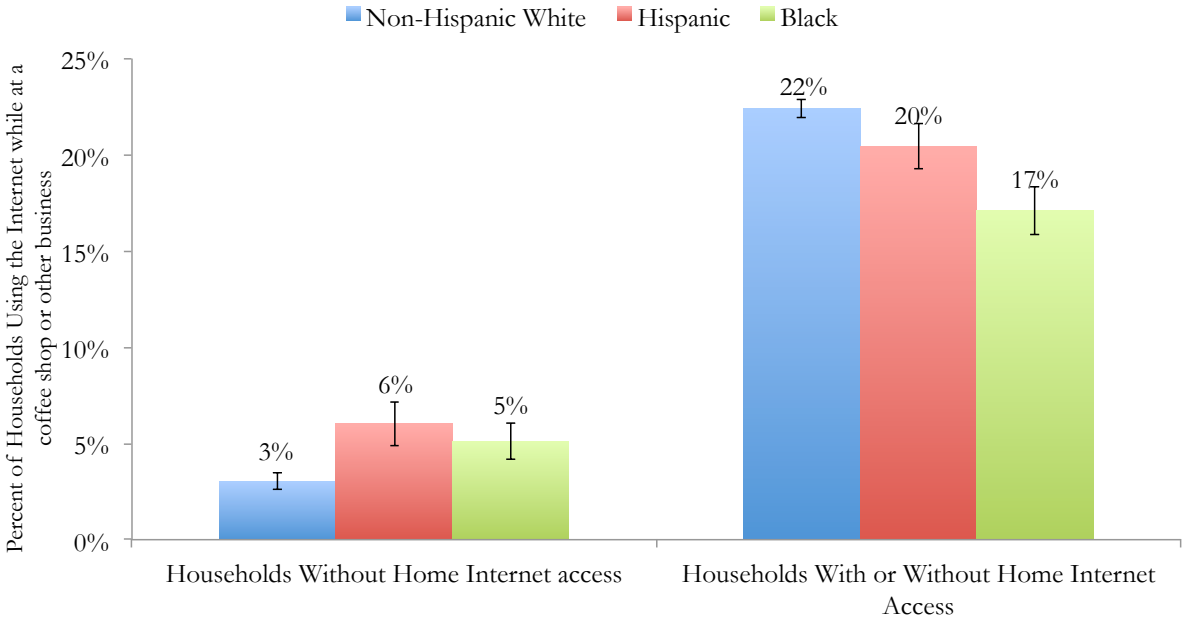
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the Internet at a library, community center, park, or other public place?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A45:
Internet Use at Retail Locations by Family Income, Non-Internet Households vs. All Households (2015)



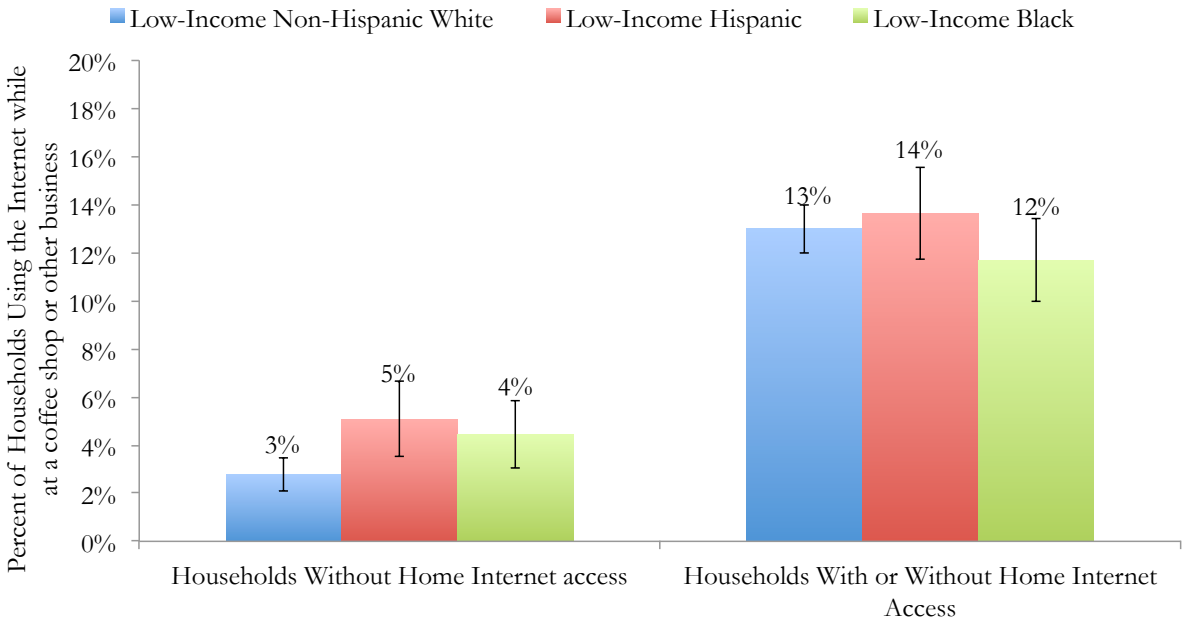
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the Internet while at a coffee shop or other business that offers Internet access?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A46:
Internet Use at Retail Locations by Race/Ethnicity,
Non-Internet Households vs. All Households (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the while at a coffee shop or other business that offers Internet access?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

Figure A47:
Internet Use at Retail Locations by Race/Ethnicity
for Households with Annual Family Incomes Below $20,000,
Non-Internet Households vs. All Households (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Question asked householders, "Does anyone in this household use the Internet while at a coffee shop or other business that offers Internet access?" (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

STATISTICAL APPENDIX II – ECONOMETRIC MODELS

Our analytical approach in this report begins with comparative statistics. We investigate which factors are associated with home-internet adoption, and how those factors intersect with race and ethnicity. For example, income is positively associated with home-internet adoption; yet, when analyzing adoption by population groups with similar incomes, there remain adoption gaps between people of different races and ethnicities. The question of course is why there are such differences. In order to answer this question, and to get a better understanding of how each factor impacts adoption in isolation, we use econometric modeling.

Based on our analysis of the descriptive survey data in the CPS, we model household-level home-internet adoption as a function of the following factors: householder race and ethnicity, family income, average age of the adults in a household, maximum educational attainment of persons in the household, location in non-metropolitan areas or in metropolitan areas (of various population sizes), home ownership, number of persons in the household, presence of a household member who uses the internet at work, presence of a household member who uses the internet at school, and state-level controls.

Our primary outcome variable of interest is whether a household subscribes to internet service. Because our outcome variable is not continuous (as, for example, income measured in dollars would be), we cannot model home-internet adoption as a linear function of our independent variables. We must use a non-linear model. There are several model specifications suited for dichotomous dependent variables. Our analysis uses models with probit functional forms.[130]

Our general approach to our econometric analysis involves first modeling home-internet adoption (or other technology adoption) as a function of just family income, then using the results of that analysis to produce the income-predicted level of adoption for each race/ethnicity as a class. We then model adoption as a function of income and other factors. Based on the results of these "full" models, we produce data that shows the marginal impact of race/ethnicity on adoption. In other words, holding income, education, age, and the other determining factors constant, what is the remaining gap in adoption (if any) between households of different races and ethnicities – particularly, between Census delineated non-Hispanic White households (hereinafter denoted as "White" in this Appendix II, as in the main report, unless context requires otherwise) and households identifying as other races or ethnicities?

For certain other outcome variables, we utilize different econometric techniques. For example, sample selection issues necessitate our utilization of a two-stage selection model when analyzing the factors that impact a household's decision to purchase additional services in a bundle with that household's home-internet services. In the case of our analysis of broadband deployment, we utilize an Ordinary Least Squares ("OLS") model because the outcome variable (number of available competitors) is continuous.

Since our primary data source is the CPS, we employ successive difference replication ("SDR") to calculate the standard error of our model coefficients and marginal impact values.[131]

Finally, the models discussed in this statistical appendix do not include interaction terms. Statistical Appendix III presents alternative forms of our model for home-internet adoption that include interaction effects.

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[130] *See, e.g.*, G.S. Maddala, "Limited-Dependent and Qualitative Variables in Econometrics" (1983); W.H. Greene, "Econometric Analysis" (3rd ed. 1997).

[131] *See, e.g.*, Stephen Ash, "Using Successive Difference Replication for Estimating Variances," 40 *Survey Methodology* 47 (June 2014); UCLA Statistical Consulting Group, "Sample setups for commonly used survey data sets" (last visited Nov. 7, 2016).

Modeling Household-Internet Adoption

We begin by fitting a model for household internet adoption as a function of that household's family income. There are of course more factors than just income that impact a household's decision to subscribe to home internet. Our purpose here is to generate the expected level of home-internet adoption for each race/ethnicity as a class, based on those racial or ethnic groups' respective average incomes. In other words, we hope to understand the following: once we account for income differences, what (if any) adoption gap remains between people in different racial and ethnic groups?

Figure A50 below provides the results of this income-only model. It indicates that income is positively correlated with household internet adoption. We have set the base factor variable level at $40,000 to $49,999 (the 11th category of the 16-category family income variable in the Census, which is the average value for U.S. households in the July 2015 CPS). For example, based on income alone, the probability that a household with a family income above $150,000 will adopt home internet is 13 percentage points higher than the probability that a household with average income will do so.

Based on income alone, we would expect to see 75 percent of White households adopt home internet, which is close to the actual observed level of 76 percent for this demographic group. Similarly, based on income alone we would expect to see 69 percent of Hispanic households and 68 percent of Black households adopt home internet, which is higher than the actual observed levels of 66 percent for Hispanic households and 62 percent for Black households (*see* Figure 53 in main text for comparisons for all race/ethnicities).

We next add additional explanatory variables to the model. Figure A51 shows the average marginal impacts for each variable. We present these results for five separate models. The first is the income-only model; the second adds race/ethnicity categorical variables; the third adds educational attainment categorical variables, metropolitan area population size categorical variables, average adult age, and home ownership; the fourth model adds work and school use indicators; and the fifth model includes state-level dummy variables.

As we show in Figure A51, all independent variables are statistically significant in all models, with a few exceptions. We observe a significant difference in adoption by Hispanic, Black and American Indian/Alaska Native households (relative to White households). The adoption gap for these groups is of similar magnitude across all models. The direction of the effect for Asian households is model dependent, moving from positive to negative in models that include factors other than race/ethnicity and income. The statistical significance for the difference in adoption between White households and Hawaiian/Pacific Islander households is model-dependent, though this is a consequence of the small sample size for the latter population. (The effect is significant in Model Four at $p = 0.06$.) Households headed by a person who identifies as belonging to two or more races show no significant difference in adoption from White households in all models.

The other controls are consistent and significant across all models, with one exception. The effect for the number of persons in a household decreases in magnitude and reverses direction in Models Four and Five. This is a reflection of the attenuation of this effect in very large households, which are a small proportion of the overall sample. (Transformation of this variable into quadratic form did not improve the model's performance, so we retain it as is.)

Model Five, which includes all previously-mentioned controls and state-level factor variables, is our preferred model. Figure A53 presents this model's full results, with the marginal impacts for multi-level factor variables shown in Figure A52.

Modeling Adoption of Wired Home-Internet Service

We proceed in a similar fashion to model the impact of these various factors on adoption of services other than home internet of any type, and begin by modeling adoption of wired home-internet service. The results from the income-only model indicate an adoption gap for Hispanic, Black and American Indian/Alaska Native households beyond what income alone would suggest, on the order of 4 to 7 percentage points. In the model that includes all controls, we observe even larger gaps in wired home-internet adoption by Hispanic and Black households relative to White households, of approximately 7 and 10 percentage points respectively.

However, a direct model of wired adoption may not be appropriate. This is because the population of wired home internet adopters is by definition a sub-sample of home internet adopters utilizing any technology. To account for this, and to get a better sense of the factors that impact the decision to subscribe to wired services, we utilize a two-stage selection model. In the first stage, we model household adoption of any home-internet service. The second stage then models adoption of wired services conditional on adoption of home internet in the first stage. Figure A56 presents the results of this two-stage model, including the marginal impact on wired adoption conditional on adoption of home internet in the first stage. This indicates that Hispanic and Black home internet households are less likely than White home internet households to adopt wired technology, by a magnitude of 5 and 6 percentage points respectively. The results also indicate that wired adoption among home-internet households is significantly higher in metropolitan areas than it is outside of them, and that it's slightly higher in households that have one or more members using the internet at work or at school.

Modeling Adoption of Cellular and Mobile-Data Services

We next turn to cellular telephone and mobile data adoption. The results of the income-only models indicate that cellular telephone and mobile data adoption is at or above the expected level based on family income alone for people of all races/ethnicities. These results also indicate a small gap in household cellular use by Hispanic and Black households, relative to White households. After controlling for income and other factors, the marginal impact of race/ethnicity on household cellular telephone adoption is -2 percentage points for Hispanic households and -1.8 percentage points for Black households, relative in each case to White households. (See Figure A58 for full model results).

Household mobile data adoption levels for all racial/ethnic groups are at or very close to the values expected based on each group's income alone. However, the results of the model that includes all controls indicate a small gap in household mobile data use between White households on the one hand and Hispanic, Black, or Asian households on the other. After controlling for income and other factors, the marginal impact of race/ethnicity on household wired internet adoption is -1.7 percentage points for Hispanic households, -2.7 percentage points for black households, and -3.6 percentage points for Asian households relative to White households (see Figure A60 for full model results).

Overall, these models indicate that race/ethnicity impacts household-level cellular telephone and mobile data adoption, beyond the impact created by differences in each racial/ethnic group's income, education, age and other demographic factors. But the impact of race and ethnicity is much less than it was for home-internet adoption.

Modeling Bundling of TV and Other Services with Home-Internet Service

We next turn to the factors that impact bundling. As was the case with wired adoption, the population that bundles is by definition a subset of the population that adopts home internet. Thus to account for the sampling bias and interpretational issues, we utilize a two-stage approach that models bundling as a second-stage decision subsequent to the decision to adopt home internet.

Overall, controlling for income and other factors, Black home internet users are just as likely as White home internet users to bundle home-internet service with any other communications service; but Hispanic, American Indian/Alaska Native, and Asian home internet households are less likely to purchase such bundles than are White home internet households. For example, after controlling for income and other factors, the marginal impact of race/ethnicity on bundling is -5.4 percentage points for Hispanic internet households, relative to White households.

The results are similar when we examine pay-TV bundling with home internet. After controlling for income and other factors, Black home internet users are just as likely as White home internet users to bundle internet with television service; but Hispanic, American Indian/Alaska Native, and Asian home internet households are less likely than White home internet households to bundle with television. For example, after controlling for income and other factors, the marginal impact of race/ethnicity on bundling home internet with television is -3.7 percentage points for Hispanic home internet households, relative to White home internet households.

Modeling Deployment

We modeled the number of wired ISPs in a census tract as a function of the tract's proportion of population made up of people other than non-Hispanic Whites and the tract's median household income. We present the results below in Figures A66–A71. These results indicate a negative association in rural tracts with greater proportions of people other than non-Hispanic Whites, but a positive association for such populations in urban tracts. We caution however that the variation in deployment patterns in urban areas is very small when observed at the tract level in comparison to the block level. Likewise, the need to compare block-level deployment data with aggregated median incomes at the tract level (which is the most granular level in the Census for which income data is available) likely reduces our ability to observe a meaningful variation in urban areas. The impact on deployment for small pockets of populations that differ significantly in demographic composition from the population in the tract as a whole is likely too difficult to parse out at the tract level.

Modeling Person-Level Use of Home Internet

The CPS includes a question posed to home internet adopting householders: who in their household uses that connection? To explore the factors associated with person-level home internet use, we utilized a two-stage selection model, in which the person's household adopts home internet in the first stage, and that person decides whether or not to use the connection in the second. The results of two slightly differing models are presented in Figures A72–A73. (The first is for all persons age 3 and above; the second includes educational attainment, which is measured only for persons age 15 and above). These results indicate a small gap in personal use of home internet connections for Hispanics, Blacks and Asians, on the order of 2 to 3 percentage points relative to White individuals (see main report for discussion of these results).

Econometric Tables

Figure A48:
Descriptive Statistics (non-categorical independent variables)

Independent Variables (non-categorical)	Average Value (Households)	SDR Standard Error	Average Value (Internet Households)	SDR Standard Error	Average Value (Non-Internet Households)	SDR Standard Error
Average Adult Age in Household	49.13	0.04	46.92	0.07	55.22	0.17
Household Size	2.48	0.01	2.61	0.01	2.09	0.01

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Standard error values calculated using successive difference replication.

Figure A49:
Descriptive Statistics (categorical independent variables)

Independent Variables (Categorical)	Sample Size (N)	Percent of All U.S. Households	Home Internet Adoption (%)	SDR 95% Confidence Interval (+/-)
Race/Ethnicity Category Factor Variables				
Non-Hispanic White	37,639	67.1%	76.5%	0.6%
Hispanic	5,592	11.9%	65.9%	1.5%
Black	6,172	13.3%	62.2%	1.4%
American Indian/AK Native	590	0.9%	64.3%	4.1%
Asian	2,161	4.9%	81.4%	2.0%
Hawaiian/Pacific Islander	216	0.4%	67.0%	9.4%
Multirace	758	1.5%	77.3%	3.7%
Family Income Category Factor Variables				
Less than $5,000	1,674	3.3%	51.5%	2.9%
$5,000 to $7,499	893	1.7%	49.4%	3.7%
$7,500 to $9,999	1,370	2.5%	43.4%	3.0%
$10,000 to $12,499	1,858	3.5%	46.4%	2.7%
$12,500 to $14,999	1,647	3.1%	48.8%	2.6%
$15,000 to $19,999	2,580	4.8%	52.9%	2.2%
$20,000 to $24,999	3,151	5.8%	58.2%	2.0%
$25,000 to $29,999	3,134	6.0%	62.7%	2.0%
$30,000 to $34,999	3,240	6.0%	66.5%	1.8%
$35,000 to $39,999	2,762	5.2%	70.7%	1.9%
$40,000 to $49,999	4,501	8.6%	76.9%	1.6%
$50,000 to $59,999	4,427	8.2%	80.4%	1.4%
$60,000 to $74,999	5,307	10.0%	84.6%	1.0%
$75,000 to $99,999	5,921	11.4%	86.2%	1.0%
$100,000 to $149,999	5,836	11.0%	88.8%	1.0%
$150,000 or More	4,373	8.8%	89.6%	1.1%
Household Maximum Education Category Factor Variables				
Less than 1st Grage	45	0.1%	18.3%	12.6%
1st, 2nd , 3rd or 4th Grade	139	0.3%	18.7%	7.9%
5th or 6th Grade	265	0.6%	23.5%	5.2%
7th or 8th Grade	495	0.9%	19.0%	4.0%
9th Grade	462	0.9%	29.9%	4.7%
10th Grade	585	1.1%	32.3%	4.8%
11th Grade	747	1.4%	40.5%	3.9%
12th Grade No Diploma	430	0.9%	46.5%	5.0%
High School Grad-Diploma or GED	12,393	22.9%	56.4%	1.1%
Some College But No Degree	9,665	18.4%	75.0%	0.9%
Associate Degree-Occupational	2,680	4.8%	77.7%	2.2%
Associate Degree-Academic Program	3,545	6.7%	80.8%	1.5%
Bachelor's Degree	12,261	23.7%	85.2%	0.7%
Master's Degree	6,388	12.5%	88.2%	0.9%
Professional School Degree	1,187	2.3%	87.2%	2.2%
Doctorate Degree	1,387	2.7%	87.6%	2.1%
Metropolitan Area Population Size Category Factor Variables				
Non-Metropolitan	14,495	18.6%	66.5%	1.4%
100,000 to 249,999 persons	4,228	6.6%	72.7%	2.1%
250,000 to 499,999 persons	4,170	8.2%	73.3%	2.0%
500,000 to 999,999 persons	6,596	11.7%	73.4%	1.4%
1,000,000 to 2,499,999 persons	7,763	16.6%	75.3%	1.1%
2,500,000 to 4,999,999 persons	5,731	14.3%	76.7%	1.3%
5,000,000-plus persons	9,691	24.1%	75.5%	1.0%
Home Ownership Category Factor Variable				
Rent	18,049	36.3%	67.4%	0.8%
Own	34,625	63.7%	76.7%	0.6%
Household Member Work Use				
Doesn't Use at Work	28,263	53.5%	55.2%	0.8%
Does Use at Work	24,411	46.5%	94.2%	0.3%
Household Member School Use				
Doesn't Use at School	41,403	78.0%	67.6%	0.6%
Does Use at School	11,271	22.0%	93.6%	0.5%

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. 95% +/- confidence interval values calculated using successive difference replication standard errors.

Figure A50:
Probability-Regression Model for Actual vs. Expected Level of Home-Internet Adoption
(household-level, based solely on family-income category)

Survey: Probit regression, household-level, dependent variable = household has internet (based solely on family income category)
Number of observations = 149,416
Population size = 311,270,387
Subpopulation observations = 52,674
Subpop. size = 125,693,492
Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Family Income Category Factor Variables						
Less than $5,000	-0.6957419	0.0458327	-15.18	0.000	-0.7855724	-0.6059114
$5,000 to $7,499	-0.7504202	0.054981	-13.65	0.000	-0.858181	-0.6426594
$7,500 to $9,999	-0.8997664	0.0483233	-18.62	0.000	-0.9944782	-0.8050545
$10,000 to $12,499	-0.8248104	0.0427626	-19.29	0.000	-0.9086235	-0.7409974
$12,500 to $14,999	-0.7635777	0.0412842	-18.5	0.000	-0.8444932	-0.6826623
$15,000 to $19,999	-0.661865	0.0393	-16.84	0.000	-0.7388916	-0.5848385
$20,000 to $24,999	-0.5276747	0.0365285	-14.45	0.000	-0.5992692	-0.4560801
$25,000 to $29,999	-0.409046	0.0408806	-10.01	0.000	-0.4891705	-0.3289216
$30,000 to $34,999	-0.3077915	0.0342298	-8.99	0.000	-0.3748806	-0.2407024
$35,000 to $39,999	-0.1900511	0.0399508	-4.76	0.000	-0.2683532	-0.111749
$40,000 to $49,999 (base level)						
$50,000 to $59,999	0.1215116	0.0358524	3.39	0.001	0.0512423	0.1917809
$60,000 to $74,999	0.2867891	0.0317678	9.03	0.000	0.2245253	0.3490529
$75,000 to $99,999	0.3571632	0.0354738	10.07	0.000	0.2876358	0.4266906
$100,000 to $149,999	0.4797138	0.0374624	12.81	0.000	0.4062888	0.5531389
$150,000 or More	0.5244918	0.0417616	12.56	0.000	0.4426406	0.6063429
_cons	0.7342	0.0272591	26.93	0.000	0.6807731	0.7876268

Predicted values of home internet adoption levels for each race/ethnicity, based on family income

Race/Ethnicity	Predicted Home Internet Adoption Rate	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White	75.08%	0.0024378	307.99	0.000	74.60%	75.56%
Hispanic	68.91%	0.0036078	190.99	0.000	68.20%	69.61%
Black	67.62%	0.0038957	173.59	0.000	66.86%	68.39%
American Indian/AK Native	68.00%	0.008577	79.28	0.000	66.32%	69.68%
Asian	77.39%	0.0044617	173.45	0.000	76.51%	78.26%
Hawaiian/Pacific Islander	69.95%	0.0137133	51.01	0.000	67.26%	72.64%
Multirace	72.43%	0.0064559	112.19	0.000	71.16%	73.69%

Marginal Impacts of Select Independent Variables on Home Internet Adoption

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Family Income Category Factor Variables						
Less than $5,000	-0.2532478	0.0168932	-14.99	0.000	-0.2863578	-0.2201378
$5,000 to $7,499	-0.2750572	0.0207444	-13.26	0.000	-0.3157155	-0.2343989
$7,500 to $9,999	-0.3343375	0.0177061	-18.88	0.000	-0.3690408	-0.2996341
$10,000 to $12,499	-0.3046855	0.0156684	-19.45	0.000	-0.3353951	-0.2739759
$12,500 to $14,999	-0.2803049	0.0150703	-18.6	0.000	-0.3098422	-0.2507676
$15,000 to $19,999	-0.2397543	0.0139601	-17.17	0.000	-0.2671155	-0.212393
$20,000 to $24,999	-0.1867769	0.0127641	-14.63	0.000	-0.2117941	-0.1617596
$25,000 to $29,999	-0.1411189	0.0139876	-10.09	0.000	-0.168534	-0.1137037
$30,000 to $34,999	-0.1034917	0.0113995	-9.08	0.000	-0.1258342	-0.0811491
$35,000 to $39,999	-0.0617561	0.0130011	-4.75	0.000	-0.0872378	-0.0362744
$40,000 to $49,999 (base level)						
$50,000 to $59,999	0.0353348	0.0104625	3.38	0.001	0.0148286	0.0558409
$60,000 to $74,999	0.0777836	0.0089513	8.69	0.000	0.0602393	0.0953279
$75,000 to $99,999	0.0938569	0.0096981	9.68	0.000	0.0748489	0.1128648
$100,000 to $149,999	0.1190231	0.0096319	12.36	0.000	0.1001449	0.1379014
$150,000 or More	0.1273426	0.0101731	12.52	0.000	0.1074037	0.1472814

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A51:
Marginal Impacts of Independent Variables on Home-Internet Adoption, Determined by Probit-Regression Models (household-level)

Independent Variable		Model 1 dydx (SDR Standard Error)	Model 2 dydx (SDR Standard Error)	Model 3 dydx (SDR Standard Error)	Model 4 dydx (SDR Standard Error)	Model 5 dydx (SDR Standard Error)
Race/Ethnicity	Non-Hispanic White			(base level)		
	Hispanic^		-0.0505	-0.0737	-0.0611	-0.0560
			(0.0078)*	(0.0085)*	(0.0082)*	(0.0086)*
	Black		-0.0673	-0.0948	-0.0823	-0.0797
			(0.0066)*	(0.0062)*	(0.0057)*	(0.0059)*
	Amer. Ind.		-0.0535	-0.0659	-0.0572	-0.0547
			(0.0201)*	(0.0200)*	(0.0181)*	(0.0186)*
	Asian		0.0268	-0.0260	-0.0222	-0.0248
			(0.0106)*	(0.0113)*	(0.0104)*	(0.0106)*
	Hawaiian/PI		-0.0439	-0.0891	-0.0740	-0.0778
			(0.0419)	(0.0411)*	(0.0391)	(0.0394)*
	Multirace		0.0305	-0.0164	-0.0145	-0.0138
			(0.0178)	(0.0181)	(0.0172)	(0.0171)
Family Income Category	[16-category factor variable; P>chi2 value for test of joint significance shown]	[0.000]*	[0.000]*	[0.000]*	[0.000]*	[0.000]*
Household Maximum Education Attainment	[16-category factor variable; P>chi2 value for test of joint significance shown]			[0.000]*	[0.000]*	[0.000]*
Household Metropolitan Location/Population Category	[7-category factor variable; P>chi2 value for test of joint significance shown]			[0.000]*	[0.000]*	[0.000]*
Number of Persons in Household				0.0100	-0.0036	-0.0037
				(0.0018)*	(0.0017)*	(0.0017)*
Average Age of Adults in Household				-0.0043	-0.0014	-0.0015
				(0.0001)*	(0.0001)*	(0.0001)*
Home Ownership	Rent				(base level)	
	Own			0.0323	0.0299	0.0325
				(0.0050)*	(0.0044)*	(0.0045)*
Household Member Work Use	Doesn't Use at Work				(base level)	
	Does Use at Work				0.2577	0.2565
					(0.0048)*	(0.0048)*
Household Member School Use	Doesn't Use at School				(base level)	
	Does Use at School				0.1936	0.1929
					(0.0047)*	(0.0047)*
State Categorical Factor Variables	[51-category factor variable; P>chi2 value for test of joint significance shown]					[0.000]*

^ non-white Hispanic persons categorized by race, not ethnicty for these regressions. * p<0.05.

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A52:
Marginal Impacts of Select Multi-Level Independent-Factor Variables on Home-Internet Adoption, from Probit Model #5 (household-level)

Marginal Impacts of Select Independent Variables on Home Internet Adoption

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Family Income Category Factor Variables						
Less than $5,000	-0.0821	0.0119	-6.89	0.0000	-0.1055	-0.0588
$5,000 to $7,499	-0.0880	0.0153	-5.74	0.0000	-0.1181	-0.0580
$7,500 to $9,999	-0.0881	0.0134	-6.59	0.0000	-0.1143	-0.0619
$10,000 to $12,499	-0.0864	0.0112	-7.71	0.0000	-0.1083	-0.0644
$12,500 to $14,999	-0.0824	0.0116	-7.08	0.0000	-0.1052	-0.0596
$15,000 to $19,999	-0.0619	0.0103	-6	0.0000	-0.0821	-0.0416
$20,000 to $24,999	-0.0497	0.0101	-4.92	0.0000	-0.0695	-0.0299
$25,000 to $29,999	-0.0429	0.0103	-4.19	0.0000	-0.0630	-0.0228
$30,000 to $34,999	-0.0270	0.0091	-2.97	0.0030	-0.0448	-0.0092
$35,000 to $39,999	-0.0172	0.0108	-1.59	0.1110	-0.0383	0.0040
$40,000 to $49,999			(base level)			
$50,000 to $59,999	0.0128	0.0093	1.37	0.1700	-0.0055	0.0310
$60,000 to $74,999	0.0234	0.0085	2.77	0.0060	0.0069	0.0400
$75,000 to $99,999	0.0135	0.0097	1.39	0.1640	-0.0055	0.0326
$100,000 to $149,999	0.0093	0.0100	0.94	0.3480	-0.0102	0.0288
$150,000 or More	-0.0052	0.0106	-0.49	0.6250	-0.0260	0.0156
Household Maximum Education Attainment Factor Variables						
Less than 1st Grage	-0.2212	0.0719	-3.08	0.0020	-0.3620	-0.0804
1st, 2nd , 3rd or 4th Grade	-0.2607	0.0467	-5.58	0.0000	-0.3523	-0.1692
5th or 6th Grade	-0.2547	0.0320	-7.95	0.0000	-0.3175	-0.1919
7th or 8th Grade	-0.2760	0.0238	-11.61	0.0000	-0.3227	-0.2294
9th Grade	-0.1989	0.0226	-8.81	0.0000	-0.2431	-0.1546
10th Grade	-0.1804	0.0227	-7.96	0.0000	-0.2248	-0.1360
11th Grade	-0.1428	0.0184	-7.76	0.0000	-0.1789	-0.1068
12th Grade No Diploma	-0.1265	0.0206	-6.13	0.0000	-0.1670	-0.0861
High School Grad-Diploma or GED	-0.0825	0.0109	-7.56	0.0000	-0.1038	-0.0611
Some College But No Degree	-0.0064	0.0106	-0.6	0.5490	-0.0272	0.0144
Associate Degree-Occupational			(base level)			
Associate Degree-Academic Program	0.0069	0.0117	0.59	0.5580	-0.0161	0.0298
Bachelor's Degree	0.0240	0.0109	2.19	0.0290	0.0025	0.0454
Master's Degree	0.0463	0.0114	4.07	0.0000	0.0240	0.0686
Professional School Degree	0.0416	0.0161	2.59	0.0100	0.0101	0.0731
Doctorate Degree	0.0331	0.0175	1.89	0.0590	-0.0013	0.0674
Metropolitan Area Population Size Category						
Non-Metropolitan			(base level)			
100,000 to 249,999 persons	0.0291	0.0098	2.97	0.0030	0.0099	0.0483
250,000 to 499,999 persons	0.0329	0.0101	3.24	0.0010	0.0130	0.0528
500,000 to 999,999 persons	0.0398	0.0079	5.07	0.0000	0.0244	0.0552
1,000,000 to 2,499,999 persons	0.0410	0.0080	5.13	0.0000	0.0253	0.0567
2,500,000 to 4,999,999 persons	0.0438	0.0082	5.35	0.0000	0.0278	0.0599
5,000,000-plus persons	0.0409	0.0094	4.33	0.0000	0.0224	0.0594

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A53:
Probability-Regression Model for Home-Internet Adoption (household-level)

Survey: Probit regression, household-level, dependent variable = household has internet

Number of observations = 149,412

Population size = 311,264,742

Subpopulation observations = 52,670

Subpop. size = 125,687,847

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.2344434	0.0350601	-6.69	0.000	-0.3031599	-0.1657268
Black	-0.328222	0.0240095	-13.67	0.000	-0.3752797	-0.2811642
American Indian/AK Native	-0.2292481	0.0746817	-3.07	0.002	-0.3756216	-0.0828746
Asian	-0.1061309	0.0447962	-2.37	0.018	-0.1939299	-0.0183319
Hawaiian/Pacific Islander	-0.3209068	0.1547178	-2.07	0.038	-0.6241481	-0.0176655
Multirace	-0.0598461	0.0731368	-0.82	0.413	-0.2031916	0.0834994
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Population Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.0062417	0.000625	-9.99	0.000	-0.0074667	-0.0050166
Householder owns home	0.1375669	0.0190882	7.21	0.000	0.1001548	0.1749791
Household Size	-0.0157498	0.0073372	-2.15	0.032	-0.0301304	-0.0013693
Household has member using internet at work	1.04804	0.0204257	51.31	0.000	1.008006	1.088073
Household has member using internet at school	0.9434505	0.0293643	32.13	0.000	0.8858975	1.001003
_cons	-0.6003568	0.2551418	-2.35	0.019	-1.100425	-0.1002881

Marginal Impacts of Select Independent Variables on Home Internet Adoption

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0560178	0.0085562	-6.55	0.000	-0.0727876	-0.039248
Black	-0.0796752	0.0059456	-13.4	0.000	-0.0913284	-0.0680219
American Indian/AK Native	-0.0547262	0.0186369	-2.94	0.003	-0.0912538	-0.0181986
Asian	-0.0247585	0.010612	-2.33	0.020	-0.0455576	-0.0039593
Hawaiian/Pacific Islander	-0.0778074	0.0394275	-1.97	0.048	-0.155084	-0.0005308
Multirace	-0.0138317	0.0170693	-0.81	0.418	-0.0472869	0.0196235
Average Adult Age in Household	-0.0014596	0.0001442	-10.12	0.000	-0.0017423	-0.001177
Householder owns home	0.0325323	0.0045324	7.18	0.000	0.023649	0.0414156
Household Size	-0.0036832	0.0017139	-2.15	0.032	-0.0070424	-0.0003239
Household has member using internet at work	0.2564892	0.0047758	53.71	0.000	0.2471287	0.2658497
Household has member using internet at school	0.1928623	0.0046621	41.37	0.000	0.1837248	0.2019998

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A54:
Probability-Regression Model for Actual vs. Expected Level of Wired-Internet Adoption
(household-level, based solely on family-income category)

Survey: Probit regression, household-level, dependent variable = household has wired internet (based solely on family income category)
Number of observations = 149,416
Population size = 311,270,387
Subpopulation observations = 52,674
Subpop. size = 125,693,492
Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Family Income Category Factor Variables						
Less than $5,000 (base level)						
$5,000 to $7,499	-0.0905517	0.0600987	-1.51	0.132	-0.2083429	0.0272395
$7,500 to $9,999	-0.075507	0.0596221	-1.27	0.205	-0.1923642	0.0413501
$10,000 to $12,499	-0.0500743	0.0549529	-0.91	0.362	-0.15778	0.0576314
$12,500 to $14,999	-0.0274675	0.0489926	-0.56	0.575	-0.1234912	0.0685562
$15,000 to $19,999	0.1001876	0.0477387	2.1	0.036	0.0066215	0.1937537
$20,000 to $24,999	0.2010478	0.0422586	4.76	0.000	0.1182225	0.2838732
$25,000 to $29,999	0.2831066	0.0467199	6.06	0.000	0.1915373	0.3746759
$30,000 to $34,999	0.3641678	0.047331	7.69	0.000	0.2714009	0.4569348
$35,000 to $39,999	0.4657393	0.0459435	10.14	0.000	0.3756918	0.5557868
$40,000 to $49,999	0.6623065	0.0429531	15.42	0.000	0.5781199	0.7464931
$50,000 to $59,999	0.7465735	0.0462405	16.15	0.000	0.6559437	0.8372034
$60,000 to $74,999	0.8708467	0.0419117	20.78	0.000	0.7887012	0.9529922
$75,000 to $99,999	0.9397411	0.0438996	21.41	0.000	0.8536996	1.025783
$100,000 to $149,999	1.035285	0.0437408	23.67	0.000	0.9495541	1.121015
$150,000 or More	1.10648	0.0465289	23.78	0.000	1.015285	1.197675
_cons	-0.4439134	0.0386599	-11.48	0.000	-0.5196855	-0.3681414

Predicted values of wired home internet adoption levels for each race/ethnicity, based on family income

Race/Ethnicity	Predicted Wired Adoption Rate	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White	57.60%	0.0028989	198.7	0.000	57.03%	58.17%
Hispanic	51.15%	0.0036845	138.82	0.000	50.42%	51.87%
Black	49.99%	0.0039791	125.63	0.000	49.21%	50.77%
American Indian/AK Native	50.42%	0.0085368	59.07	0.000	48.75%	52.10%
Asian	60.09%	0.0047028	127.77	0.000	59.17%	61.01%
Hawaiian/Pacific Islander	52.60%	0.0132984	39.55	0.000	49.99%	55.21%
Multirace	54.90%	0.0064064	85.69	0.000	53.64%	56.15%

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A55:
Probability-Regression Model for Wired Home-Internet Adoption (household-level)

Survey: Probit regression, household-level, dependent variable = household has wired internet

Number of observations = 149,412

Population size = 311,264,742

Subpopulation observations = 52,670

Subpop. size = 125,687,847

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.2102442	0.0261949	-8.03	0.000	-0.2615853	-0.1589032
Black	-0.289977	0.0207686	-13.96	0.000	-0.3306827	-0.2492713
American Indian/AK Native	-0.1202256	0.0711859	-1.69	0.091	-0.2597474	0.0192962
Asian	-0.0421335	0.0366459	-1.15	0.250	-0.1139582	0.0296912
Hawaiian/Pacific Islander	-0.1269935	0.1181198	-1.08	0.282	-0.358504	0.104517
Multirace	0.0167086	0.0620909	0.27	0.788	-0.1049874	0.1384047
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Population Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.0016102	0.0005056	-3.18	0.001	-0.0026011	-0.0006193
Householder owns home	0.0947551	0.0176841	5.36	0.000	0.060095	0.1294153
Household Size	-0.018	0.0055841	-3.22	0.001	-0.0289447	-0.0070553
Household has member using internet at work	0.5818423	0.0162741	35.75	0.000	0.5499457	0.6137388
Household has member using internet at school	0.459346	0.0207182	22.17	0.000	0.418739	0.4999531
_cons	-1.353542	0.2948706	-4.59	0.000	-1.931478	-0.7756065

Marginal Impacts of Select Independent Variables on Wired Internet Adoption

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0703286	0.0088021	-7.99	0.000	-0.0875803	-0.0530768
Black	-0.097228	0.0070057	-13.88	0.000	-0.1109589	-0.0834971
American Indian/AK Native	-0.0400383	0.0238475	-1.68	0.093	-0.0867785	0.0067019
Asian	-0.0139563	0.0121577	-1.15	0.251	-0.0377848	0.0098723
Hawaiian/Pacific Islander	-0.0423091	0.039553	-1.07	0.285	-0.1198315	0.0352133
Multirace	0.005507	0.020427	0.27	0.787	-0.0345291	0.0455431
Average Adult Age in Household	-0.0005302	0.0001665	-3.18	0.001	-0.0008566	-0.0002039
Householder owns home	0.0313958	0.0058992	5.32	0.000	0.0198335	0.0429581
Household Size	-0.0059275	0.00184	-3.22	0.001	-0.0095338	-0.0023211
Household has member using internet at work	0.2054011	0.005828	35.24	0.000	0.1939784	0.2168239
Household has member using internet at school	0.1503354	0.00658	22.85	0.000	0.1374388	0.163232

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A56:
Heckman Probability-Selection Model for Household Using Wired-Home Internet
(universe = households, selection model = household adopts internet)

Survey: Heckman selection probability regression, household-level, dependent variable = household subscribes to wired after selecting to subscribe to home internet

Number of observations =149,412

Population size = 311,264,742

Subpopulation observations = 52,670

Subpop. size = 125,687,847

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.1796566	0.0326126	-5.51	0.000	-0.2435762	-0.1157371
Black	-0.2085785	0.0304578	-6.85	0.000	-0.2682746	-0.1488824
American Indian/AK Native	-0.0302846	0.0969356	-0.31	0.755	-0.2202749	0.1597058
Asian	0.0117949	0.0417491	0.28	0.778	-0.0700318	0.0936217
Hawaiian/Pacific Islander	0.0139473	0.1405844	0.1	0.921	-0.2615931	0.2894877
Multirace	0.0561012	0.0711805	0.79	0.431	-0.08341	0.1956125
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area (indicator variable)	0.2759281	0.0377523	7.31	0	0.2019349	0.3499213
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	0.0032486	0.0007211	4.51	0.000	0.0018353	0.0046619
Householder owns home	0.0403504	0.0231663	1.74	0.082	-0.0050547	0.0857555
Household Size	-0.016073	0.006184	-2.6	0.009	-0.0281934	-0.0039526
Household has member using internet at work	0.176013	0.0493311	3.57	0.000	0.0793259	0.2727001
Household has member using internet at school	0.1965751	0.034675	5.67	0.000	0.1286133	0.264537
_cons	-0.3128745	0.5405055	-0.58	0.563	-1.372246	0.7464968
Selection variable = homeinternet						
Non-Hispanic White (base level)						
Hispanic*	-0.232639	0.0350777	-6.63	0.000	-0.3013901	-0.1638879
Black	-0.3262041	0.024025	-13.58	0.000	-0.3732923	-0.2791158
American Indian/AK Native	-0.2278022	0.074963	-3.04	0.002	-0.3747271	-0.0808774
Asian	-0.1094705	0.0448874	-2.44	0.015	-0.1974481	-0.0214929
Hawaiian/Pacific Islander	-0.3195877	0.1554314	-2.06	0.040	-0.6242276	-0.0149479
Multirace	-0.0580416	0.0732908	-0.79	0.428	-0.2016889	0.0856056
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.00628	0.0006277	-10	0.000	-0.0075103	-0.0050496
Householder owns home	0.1369826	0.0190768	7.18	0.000	0.0995926	0.1743725
Household Size	-0.0155286	0.0073365	-2.12	0.034	-0.0299078	-0.0011493
Household has member using internet at work	1.048258	0.0204412	51.28	0.000	1.008194	1.088322
Household has member using internet at school	0.9408682	0.0295893	31.8	0.000	0.8828743	0.9988621
_cons	-0.6015622	0.2552634	-2.36	0.018	-1.101869	-0.1012551
/athrho	0.1587057	0.1125871	1.41	0.159	-0.061961	0.3793723
rho	0.1573865	0.1097983			-0.0618818	0.3621622

Marginal Impacts of Select Independent Variables on Wired Adoption, Conditional on Adoption of Home internet

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0522531	0.0102644	-5.09	0.000	-0.072371	-0.0321351
Black	-0.059652	0.0090573	-6.59	0.000	-0.0774039	-0.0419001
American Indian/AK Native	-0.0043655	0.0297847	-0.15	0.883	-0.0627425	0.0540115
Asian	0.005814	0.012497	0.47	0.642	-0.0186797	0.0303076
Hawaiian/Pacific Islander	0.011091	0.040665	0.27	0.785	-0.068611	0.090793
Multirace	0.0178545	0.0206365	0.87	0.387	-0.0225923	0.0583014
Metropolitan Area (indicator variable)	0.0907469	0.0132666	6.84	0.000	0.0647448	0.116749
Average Adult Age in Household	0.0011437	0.0001987	5.76	0.000	0.0007542	0.0015331
Householder owns home	0.009607	0.0070839	1.36	0.175	-0.0042772	0.0234912
Household Size	-0.0046582	0.0019438	-2.4	0.017	-0.0084681	-0.0008484
Household has member using internet at work	0.033372	0.0060512	5.51	0.000	0.0215118	0.0452321
Household has member using internet at school	0.0427682	0.0076487	5.59	0.000	0.0277769	0.0577594

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A57:
Probability-Regression Model for Actual vs. Expected Level of Home-Cellular Adoption
(household-level, based solely on family-income category)

Survey: Probit regression, household-level, dependent variable = household uses cellular (based solely on family income category)
Number of observations = 149,416
Population size = 311,270,387
Subpopulation observations = 52,674
Subpop. size = 125,693,492
Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Family Income Category Factor Variables						
Less than $5,000 (base level)						
$5,000 to $7,499	0.025657	0.0576572	0.44	0.656	-0.087349	0.138663
$7,500 to $9,999	-0.1463389	0.0520422	-2.81	0.005	-0.2483398	-0.0443381
$10,000 to $12,499	-0.1025547	0.0467923	-2.19	0.028	-0.194266	-0.0108434
$12,500 to $14,999	-0.0903919	0.0520361	-1.74	0.082	-0.1923808	0.011597
$15,000 to $19,999	-0.0107503	0.0478859	-0.22	0.822	-0.1046049	0.0831043
$20,000 to $24,999	0.0510213	0.0497117	1.03	0.305	-0.0464117	0.1484544
$25,000 to $29,999	0.1496573	0.0423065	3.54	0.000	0.066738	0.2325765
$30,000 to $34,999	0.1811275	0.0462973	3.91	0.000	0.0903864	0.2718685
$35,000 to $39,999	0.3162383	0.045178	7	0.000	0.2276911	0.4047856
$40,000 to $49,999	0.4335993	0.0438221	9.89	0.000	0.3477096	0.5194889
$50,000 to $59,999	0.4877464	0.0432485	11.28	0.000	0.4029808	0.572512
$60,000 to $74,999	0.5995919	0.0435351	13.77	0.000	0.5142647	0.6849191
$75,000 to $99,999	0.6583096	0.0461321	14.27	0.000	0.5678924	0.7487268
$100,000 to $149,999	0.7482115	0.0446746	16.75	0.000	0.6606508	0.8357721
$150,000 or More	0.7505318	0.0473417	15.85	0.000	0.6577438	0.8433199
_cons	0.5445961	0.0357424	15.24	0.000	0.4745422	0.6146499

Predicted values of household cellular adoption levels for each race/ethnicity, based on family income

Race/Ethnicity	Predicted Home Internet Adoption Rate	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White	82.39%	0.002366	348.23	0.000	81.93%	82.85%
Hispanic	79.05%	0.0026427	299.11	0.000	78.53%	79.56%
Black	78.42%	0.0030467	257.39	0.000	77.82%	79.01%
American Indian/AK Native	78.60%	0.0048847	160.91	0.000	77.64%	79.56%
Asian	83.69%	0.0029977	279.18	0.000	83.10%	84.28%
Hawaiian/Pacific Islander	79.66%	0.0081369	97.9	0.000	78.06%	81.25%
Multirace	81.01%	0.0041332	196	0.000	80.20%	81.82%

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A58:
Probability-Regression Model for Home-Cellular Adoption (household-level)

Survey: Probit regression, household-level, dependent variable = household uses cellular
Number of observations = 149,412
Population size = 311,264,742
Subpopulation observations = 52,670
Subpop. size = 125,687,847
Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0843821	0.0353968	-2.38	0.017	-0.1537585	-0.0150057
Black	-0.0730699	0.0278923	-2.62	0.009	-0.1277379	-0.0184019
American Indian/AK Native	-0.1062783	0.0787153	-1.35	0.177	-0.2605575	0.0480008
Asian	-0.033106	0.0436021	-0.76	0.448	-0.1185645	0.0523525
Hawaiian/Pacific Islander	-0.0394886	0.1538858	-0.26	0.797	-0.3410992	0.262122
Multirace	0.1116298	0.0723166	1.54	0.123	-0.030108	0.2533677
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Population Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.0179479	0.0006003	-29.9	0.000	-0.0191244	-0.0167714
Householder owns home	0.05336	0.0189905	2.81	0.005	0.0161393	0.0905807
Household Size	-0.0026571	0.0091712	-0.29	0.772	-0.0206322	0.0153181
Household has minor	0.0570787	0.0285892	2	0.046	0.0010448	0.1131125
_cons	1.256599	0.0667914	18.81	0.000	1.12569	1.387507

Marginal Impacts of Select Independent Variables on Home Internet Adoption

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0204617	0.0087592	-2.34	0.019	-0.0376295	-0.003294
Black	-0.0176393	0.0068325	-2.58	0.010	-0.0310308	-0.0042478
American Indian/AK Native	-0.0259942	0.0200459	-1.3	0.195	-0.0652835	0.013295
Asian	-0.0078644	0.010461	-0.75	0.452	-0.0283676	0.0126387
Hawaiian/Pacific Islander	-0.009405	0.0366131	-0.26	0.797	-0.0811653	0.0623554
Multirace	0.0249501	0.0154372	1.62	0.106	-0.0053062	0.0552064
Average Adult Age in Household	-0.004279	0.0001368	-31.29	0.000	-0.004547	-0.0040109
Householder owns home	0.0128001	0.0045826	2.79	0.005	0.0038184	0.0217818
Household Size	-0.0006335	0.0021837	-0.29	0.772	-0.0049134	0.0036464
Household has minor	0.0135031	0.0066963	2.02	0.044	0.0003786	0.0266277

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A59:
Probability-Regression Model for Actual vs. Expected Level of Home Mobile-Data Adoption
(household-level, based solely on family-income category)

Survey: Probit regression, household-level, dependent variable = household uses mobile data (anywhere; based solely on family income category)

Number of observations = 149,416

Population size = 311,270,387

Subpopulation observations = 52,674

Subpop. size = 125,693,492

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Family Income Category Factor Variables						
Less than $5,000 (base level)						
$5,000 to $7,499	-0.0581354	0.0583542	-1	0.319	-0.1725074	0.0562367
$7,500 to $9,999	-0.328711	0.0522495	-6.29	0.000	-0.4311182	-0.2263039
$10,000 to $12,499	-0.2726063	0.0500551	-5.45	0.000	-0.3707125	-0.1745001
$12,500 to $14,999	-0.1501097	0.0518941	-2.89	0.004	-0.2518203	-0.0483991
$15,000 to $19,999	-0.1025612	0.0476819	-2.15	0.031	-0.1960159	-0.0091064
$20,000 to $24,999	-0.0195173	0.045515	-0.43	0.668	-0.1087251	0.0696906
$25,000 to $29,999	0.1063947	0.0465794	2.28	0.022	0.0151007	0.1976887
$30,000 to $34,999	0.1707176	0.0464638	3.67	0.000	0.0796502	0.261785
$35,000 to $39,999	0.2747639	0.0425957	6.45	0.000	0.1912777	0.35825
$40,000 to $49,999	0.4594086	0.0435709	10.54	0.000	0.3740111	0.5448061
$50,000 to $59,999	0.5420496	0.0418401	12.96	0.000	0.4600445	0.6240546
$60,000 to $74,999	0.6878568	0.0414532	16.59	0.000	0.6066099	0.7691037
$75,000 to $99,999	0.7556008	0.0416809	18.13	0.000	0.6739078	0.8372938
$100,000 to $149,999	0.9237864	0.0411632	22.44	0.000	0.843108	1.004465
$150,000 or More	1.011106	0.0469394	21.54	0.000	0.9191062	1.103105
_cons	-0.0395229	0.036837	-1.07	0.283	-0.1117221	0.0326763

Predicted values of household mobile data adoption levels for each race/ethnicity, based on family income

Race/Ethnicity	Predicted Home Internet Adoption Rate	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White	65.90%	0.0028233	233.41	0.000	65.35%	66.45%
Hispanic	59.62%	0.0037572	158.69	0.000	58.89%	60.36%
Black	58.69%	0.0037119	158.12	0.000	57.96%	59.42%
American Indian/AK Native	58.90%	0.0082438	71.45	0.000	57.29%	60.52%
Asian	68.60%	0.0047074	145.73	0.000	67.68%	69.52%
Hawaiian/Pacific Islander	60.90%	0.0134374	45.32	0.000	58.26%	63.53%
Multirace	63.36%	0.0067018	94.55	0.000	62.05%	64.68%

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A60:
Probability-Regression Model for Home Mobile-Data Adoption (household-level)

Survey: Probit regression, household-level, dependent variable = household uses mobile data anywhere

Number of observations = 149,412

Population size = 311,264,742

Subpopulation observations = 52,670

Subpop. size = 125,687,847

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0659283	0.0307819	-2.14	0.032	-0.1262598	-0.0055968
Black	-0.1024071	0.0256189	-4	0.000	-0.1526192	-0.052195
American Indian/AK Native	0.0090181	0.0814965	0.11	0.912	-0.1507122	0.1687483
Asian	-0.1337712	0.0422221	-3.17	0.002	-0.216525	-0.0510174
Hawaiian/Pacific Islander	-0.0535722	0.1179988	-0.45	0.650	-0.2848456	0.1777011
Multirace	-0.0164166	0.0726933	-0.23	0.821	-0.1588929	0.1260596
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Population Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.0170492	0.0005928	-28.76	0.000	-0.018211	-0.0158873
Householder owns home	0.0008565	0.0160671	0.05	0.957	-0.0306343	0.0323474
Household Size	-0.0413642	0.0065443	-6.32	0.000	-0.0541908	-0.0285377
Household has member using internet at work	1.026446	0.0180873	56.75	0.000	0.9909952	1.061896
Household has member using internet at school	0.7185859	0.024752	29.03	0.000	0.6700728	0.767099
_cons	0.4294978	0.0813856	5.28	0.000	0.2699851	0.5890106

Marginal Impacts of Select Independent Variables on Household Mobile Data Useage

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0174611	0.0081681	-2.14	0.033	-0.0334703	-0.0014519
Black	-0.0272223	0.006852	-3.97	0.000	-0.040652	-0.0137927
American Indian/AK Native	0.002369	0.0213805	0.11	0.912	-0.0395361	0.0442741
Asian	-0.0356667	0.01134	-3.15	0.002	-0.0578927	-0.0134408
Hawaiian/Pacific Islander	-0.0141703	0.0313423	-0.45	0.651	-0.0756001	0.0472595
Multirace	-0.004325	0.0191391	-0.23	0.821	-0.0418369	0.0331869
Average Adult Age in Household	-0.0045127	0.0001507	-29.94	0.000	-0.0048081	-0.0042173
Householder owns home	0.0002267	0.0042505	0.05	0.957	-0.0081041	0.0085575
Household Size	-0.0109486	0.0017269	-6.34	0.000	-0.0143332	-0.007564
Household has member using internet at work	0.3097039	0.005497	56.34	0.000	0.29893	0.3204778
Household has member using internet at school	0.18574	0.0058935	31.52	0.000	0.1741889	0.197291

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A61:
Ordered-Logit Model for Household's Family-Income Category

Survey, Ordered Logit model, household-level, dependent variable = CPS categorical variable for person's family income
Number of observations = 149,412
Population size = 311,264,742
Subpopulation number of observations = 52,670
Subpopulation size = 125,687,847
Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.7214678	0.0327933	-22	0.000	-0.7857414	-0.6571942
Black	-0.7774213	0.0301719	-25.77	0.000	-0.836557	-0.7182856
American Indian/AK Native	-0.6668063	0.1001707	-6.66	0.000	-0.8631373	-0.4704752
Asian	-0.4447613	0.0490319	-9.07	0.000	-0.5408621	-0.3486605
Hawaiian/Pacific Islander	-0.7783611	0.1701037	-4.58	0.000	-1.111758	-0.4449639
Multirace	-0.3834197	0.0723721	-5.3	0.000	-0.5252663	-0.241573
Household Average Adult Age	0.0000423	0.0005754	0.07	0.941	-0.0010855	0.0011701
Household Maximum Education Level ("peeduca")	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Female Householder	-0.3901345	0.0182046	-21.43	0.000	-0.4258149	-0.3544541
Household Has Minor	-0.2477061	0.0319683	-7.75	0.000	-0.3103629	-0.1850493
Numer of Persons in Household	0.3539719	0.0113259	31.25	0.000	0.3317736	0.3761702
None of household's labor force is employed	-1.420291	0.0682624	-20.81	0.000	-1.554082	-1.286499
Non-Metropolitan (base level)						
Metro area size = 100,000-249,000	0.1712862	0.0452657	3.78	0.000	0.0825672	0.2600053
Metro area size = 250,000-499,000	0.2692985	0.0453137	5.94	0.000	0.1804853	0.3581117
Metro area size = 500,000-999,000	0.2917018	0.0394476	7.39	0.000	0.2143859	0.3690176
Metro area size = 1,000,000-2,499,000	0.3904816	0.0346207	11.28	0.000	0.3226262	0.4583369
Metro area size = 2,500,000-4,999,000	0.5123046	0.0479745	10.68	0.000	0.4182762	0.606333
Metro area size = 5,000,000+	0.5685634	0.042582	13.35	0.000	0.4851042	0.6520226
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A62:
Heckman Probability-Selection Model for Household Bundling Internet with Other Service(s) (universe = households, selection model = household adopts internet)

Survey: Heckman selection probability regression, household-level, dependent variable = household bundles with another service after selecting to subscribe to home internet

Number of observations =149,412
Population size = 311,264,742
Subpopulation observations = 52,670
Subpop. size = 125,687,847
Replications = 160

Independent Variables	Coefficient	SDR Standard	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.1349698	0.0282736	-4.77	0.000	-0.1903851	-0.0795545
Black	-0.0174488	0.0267416	-0.65	0.514	-0.0698612	0.0349637
American Indian/AK Native	-0.1787712	0.0905143	-1.98	0.048	-0.3561759	-0.0013665
Asian	-0.2434801	0.039889	-6.1	0.000	-0.3216611	-0.1652992
Hawaiian/Pacific Islander	0.0092115	0.143423	0.06	0.949	-0.2718923	0.2903154
Multirace	0.0250325	0.0614294	0.41	0.684	-0.0953669	0.1454319
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is not jointly significant at P>chi2=.05]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	0.0098989	0.0006711	14.75	0.000	0.0085835	0.0112142
Householder owns home	0.1090283	0.0179346	6.08	0.000	0.0738772	0.1441794
Household Size	0.0380974	0.0075999	5.01	0.000	0.0232018	0.052993
Household has minor	-0.0649731	0.0220063	-2.95	0.003	-0.1081046	-0.0218415
_cons	-1.008143	0.5668971	-1.78	0.075	-2.119241	0.1029551
Selection variable = homeinternet						
Non-Hispanic White (base level)						
Hispanic*	-0.2355817	0.0350011	-6.73	0.000	-0.3041826	-0.1669807
Black	-0.3298969	0.0239922	-13.75	0.000	-0.3769208	-0.2828729
American Indian/AK Native	-0.2291951	0.0747184	-3.07	0.002	-0.3756405	-0.0827498
Asian	-0.1045144	0.045016	-2.32	0.020	-0.1927443	-0.0162846
Hawaiian/Pacific Islander	-0.3212024	0.1551484	-2.07	0.038	-0.6252877	-0.017117
Multirace	-0.0578898	0.0733021	-0.79	0.430	-0.2015592	0.0857796
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.0062751	0.0006228	-10.08	0.000	-0.0074957	-0.0050546
Householder owns home	0.1379252	0.0190996	7.22	0.000	0.1004907	0.1753596
Household Size	-0.0162038	0.0073217	-2.21	0.027	-0.0305541	-0.0018534
Household has member using internet at work	1.047014	0.0204637	51.16	0.000	1.006906	1.087122
Household has member using internet at school	0.9433348	0.0294155	32.07	0.000	0.8856815	1.000988
_cons	-0.5977391	0.2549706	-2.34	0.019	-1.097472	-0.0980058
/athrho	-0.1222387	0.0353952	-3.45	0.001	-0.191612	-0.0528653
rho	-0.1216335	0.0348716			-0.1893009	-0.0528161

Marginal Impacts of Select Independent Variables on Bundling, Conditional on Adoption of Home internet

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0537693	0.0104247	-5.16	0.000	-0.0742012	-0.0333373
Black	-0.0124237	0.0098389	-1.26	0.207	-0.0317076	0.0068601
American Indian/AK Native	-0.0699451	0.033994	-2.06	0.040	-0.136572	-0.0033181
Asian	-0.0917638	0.01485	-6.18	0.000	-0.1208691	-0.0626584
Hawaiian/Pacific Islander	-0.0025827	0.0513092	-0.05	0.960	-0.1031469	0.0979815
Multirace	0.0080186	0.0220134	0.36	0.716	-0.0351268	0.051164
Average Adult Age in Household	0.0034773	0.0002314	15.02	0.000	0.0030237	0.003931
Householder owns home	0.0423816	0.0064872	6.53	0.000	0.0296668	0.0550963
Household Size	0.0135236	0.0027538	4.91	0.000	0.0081263	0.0189209
Household has member using internet at work	0.0179119	0.0051059	3.51	0.000	0.0079044	0.0279193
Household has member using internet at school	0.0139296	0.0039872	3.49	0.000	0.0061149	0.0217443

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A63:
Heckman Probability-Selection Model for Household Bundling Internet with Television
(universe = households, selection model = household adopts internet)

Survey: Heckman selection probability regression, household-level, dependent variable = household bundles with television after selecting to subscribe to home internet

Number of observations =149,412

Population size = 311,264,742

Subpopulation observations = 52,670

Subpop. size = 125,687,847

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0882264	0.0284093	-3.11	0.002	-0.1439075	-0.0325452
Black	-0.0196919	0.025363	-0.78	0.438	-0.0694024	0.0300186
American Indian/AK Native	-0.2149984	0.0909847	-2.36	0.018	-0.3933252	-0.0366717
Asian	-0.1911829	0.0387537	-4.93	0.000	-0.2671388	-0.115227
Hawaiian/Pacific Islander	0.1700015	0.1384905	1.23	0.220	-0.1014348	0.4414378
Multirace	0.0310589	0.0657197	0.47	0.637	-0.0977494	0.1598672
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is not jointly significant at P>chi2=.05]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	0.006176	0.0006772	9.12	0.000	0.0048487	0.0075034
Householder owns home	0.0527972	0.019223	2.75	0.006	0.0151207	0.0904736
Household Size	0.0219023	0.0083741	2.62	0.009	0.0054894	0.0383152
Household has minor	-0.0487133	0.0225283	-2.16	0.031	-0.0928681	-0.0045586
_cons	-0.9863221	0.5586834	-1.77	0.077	-2.081321	0.1086772
Selection variable = homeinternet						
Non-Hispanic White (base level)						
Hispanic*	-0.2361764	0.0350392	-6.74	0.000	-0.304852	-0.1675009
Black	-0.3302458	0.023958	-13.78	0.000	-0.3772026	-0.2832889
American Indian/AK Native	-0.2292032	0.0747091	-3.07	0.002	-0.3756303	-0.082776
Asian	-0.1044725	0.04498	-2.32	0.020	-0.1926317	-0.0163133
Hawaiian/Pacific Islander	-0.3198476	0.1550633	-2.06	0.039	-0.6237661	-0.0159292
Multirace	-0.0592961	0.0731545	-0.81	0.418	-0.2026762	0.0840841
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.0062513	0.0006226	-10.04	0.000	-0.0074716	-0.005031
Householder owns home	0.1380555	0.0191044	7.23	0.000	0.1006116	0.1754993
Household Size	-0.0159092	0.0073268	-2.17	0.030	-0.0302695	-0.0015489
Household has member using internet at work	1.047152	0.0204459	51.22	0.000	1.007079	1.087225
Household has member using internet at school	0.9435265	0.0294109	32.08	0.000	0.8858822	1.001171
_cons	-0.6001846	0.2550952	-2.35	0.019	-1.100162	-0.1002073
/athrho	-0.119899	0.0344062	-3.48	0.000	-0.187334	-0.052464
rho	-0.1193277	0.0339163			-0.1851729	-0.0524159

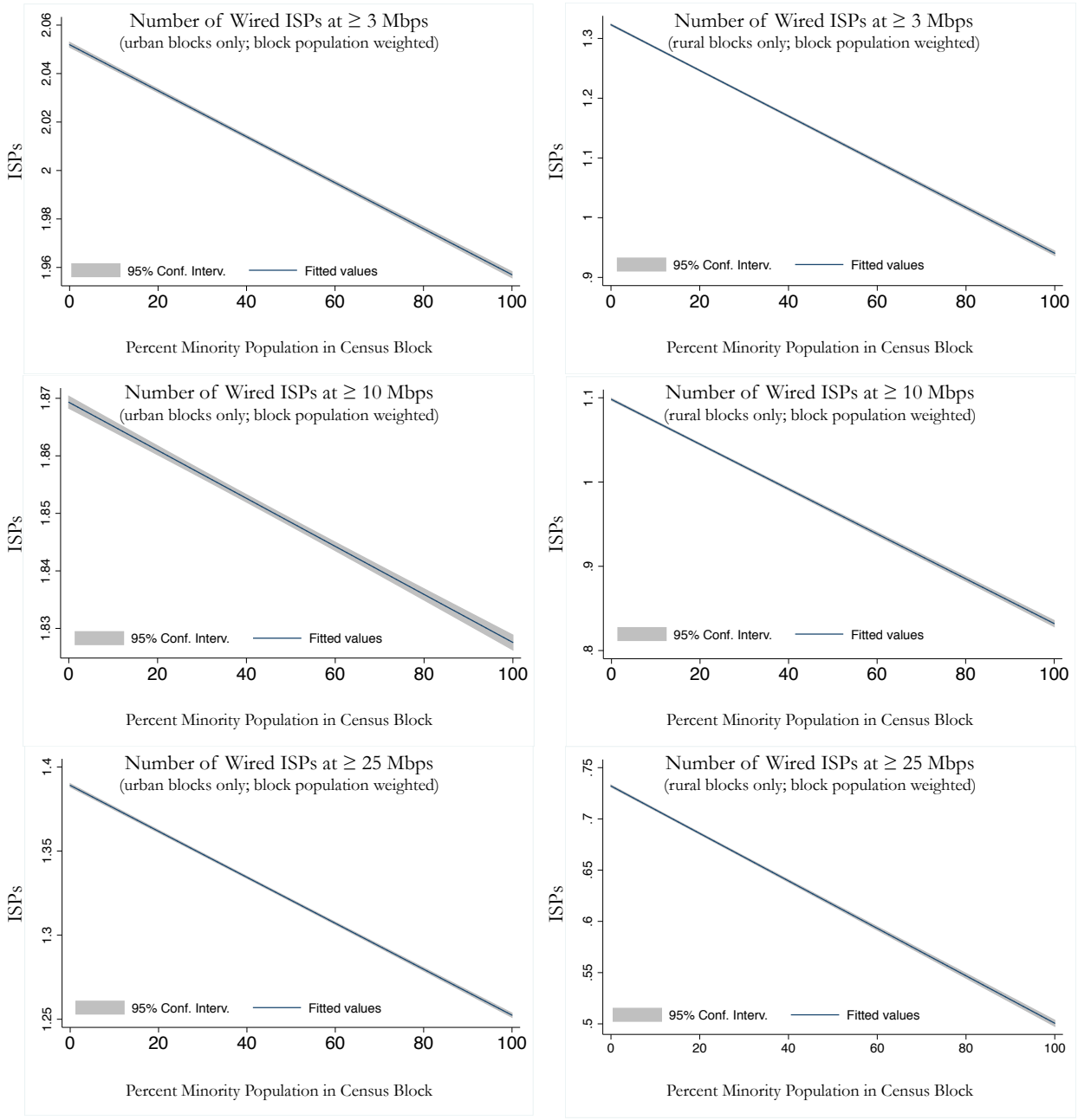
Marginal Impacts of Select Independent Variables on Bundling TV, Conditional on Adoption of Home internet

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0371845	0.0105484	-3.53	0.000	-0.057859	-0.0165101
Black	-0.0134843	0.0095357	-1.41	0.157	-0.0321739	0.0052054
American Indian/AK Native	-0.0839853	0.0337356	-2.49	0.013	-0.1501058	-0.0178648
Asian	-0.0729468	0.0143163	-5.1	0.000	-0.1010062	-0.0448874
Hawaiian/Pacific Islander	0.0571368	0.0504769	1.13	0.258	-0.041796	0.1560697
Multirace	0.0105586	0.0244557	0.43	0.666	-0.0373736	0.0584908
Average Adult Age in Household	0.0021903	0.0002406	9.1	0.000	0.0017187	0.002662
Householder owns home	0.0221909	0.0071776	3.09	0.002	0.0081231	0.0362587
Household Size	0.0078786	0.0031184	2.53	0.012	0.0017665	0.0139906
Household has member using internet at work	0.0180859	0.0051684	3.5	0.000	0.007956	0.0282158
Household has member using internet at school	0.0139838	0.0040102	3.49	0.000	0.0061239	0.0218436

* non-white Hispanic persons categorized by race, not ethnicity for this regression

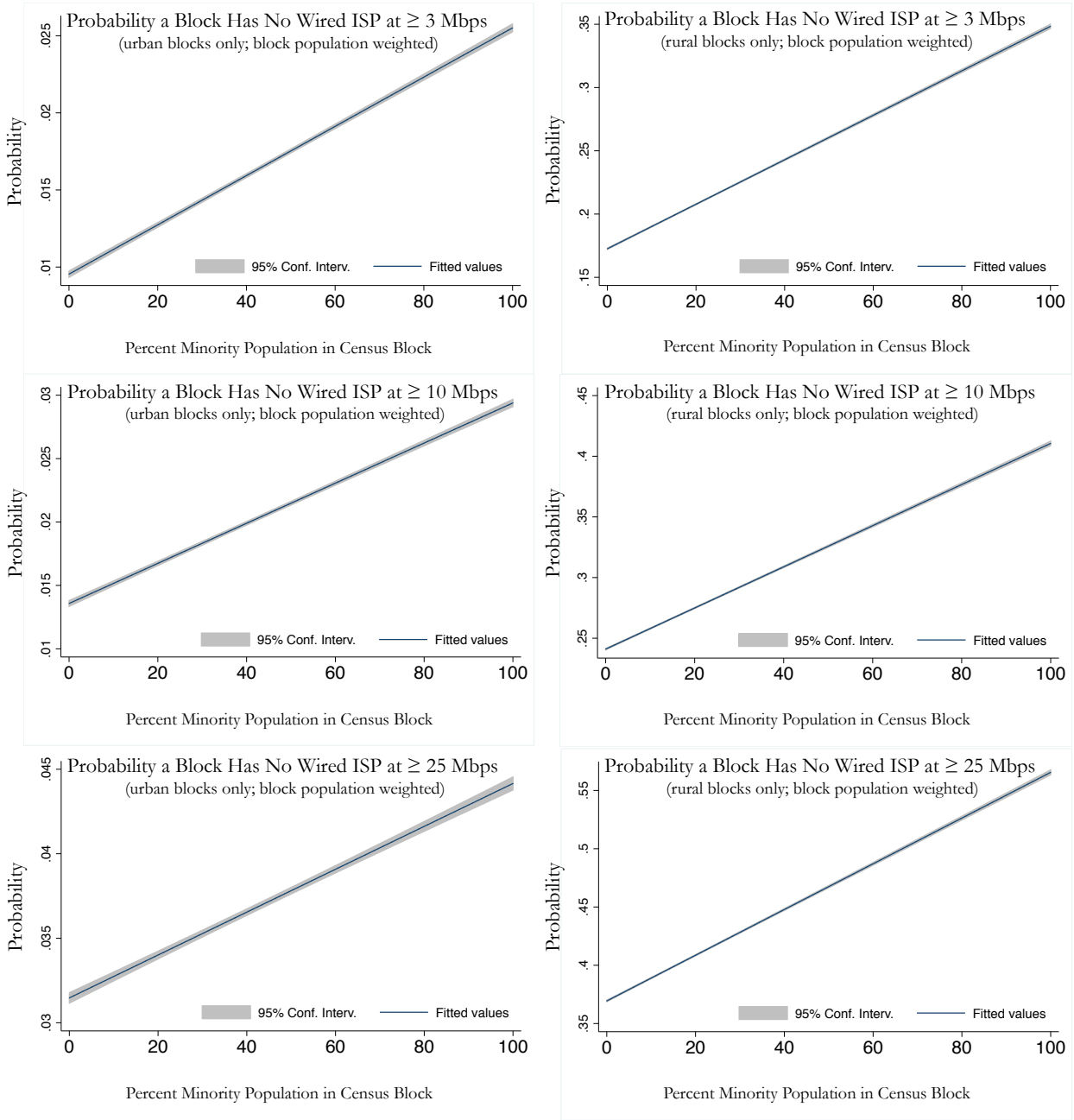
Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A64:
Predicted Number of Available ISPs in Urban and Rural Census Blocks by Percent Minority Population and Downstream Speed (Year-End 2014)



Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. Percent minority population represents the percent of a census block's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A65:
Probability an Urban or Rural Census Block Has No Available Wired ISP by Percent Minority Population and Downstream Speed (Year-End 2014)



Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and 2010 Census Data. Percent minority population represents the percent of a census block's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A66:
OLS-Regression Model for Number of Wired ISPs at ≥ 3 Mbps in Urban Tracts with Predicted Values Based on Tract's Proportion of Minority Population and Income

OLS regression, dependent variable = number of wired ISPs at ≥ 3 Mbps in Urban Census tracts
Number of observations = 63,151
R-squared = 0.0147

Independent Variables	Coefficient	Standard Error	t	P>|t|	95% Confidence Interval	
percent minority pop.	0.0010923	6.68E-05	16.35	0.000	0.0009614	0.0012232
median hh income	2.05E-06	6.97E-08	29.37	0.000	1.91E-06	2.18E-06
tract population	-0.0000101	9.87E-07	-10.24	0.000	-0.000012	-0.00000817
_cons	1.850779	0.0069258	267.23	0.000	1.837204	1.864353

Linear predicted values for number of wired ISPs at ≥ 3 Mbps in Urban Census tracts, by percent minority population at average values for median household income ($58,139.51) and tract population (4,370.795)

Tract's Percent Minority Population	Predicted Number of Wired ISPs at ≥ 3 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
0	1.925583	0.0032667	589.46	0.000	1.91918	1.931985
10	1.936506	0.0027536	703.27	0.000	1.931109	1.941903
20	1.947429	0.0023206	839.19	0.000	1.94288	1.951977
30	1.958352	0.00202	969.47	0.000	1.954393	1.962311
40	1.969275	0.0019153	1028.21	0.000	1.965521	1.973029
50	1.980198	0.0020367	972.26	0.000	1.976206	1.98419
60	1.991121	0.0023496	847.44	0.000	1.986516	1.995726
70	2.002044	0.0027902	717.54	0.000	1.996576	2.007513
80	2.012967	0.0033078	608.54	0.000	2.006484	2.019451
90	2.02389	0.0038718	522.72	0.000	2.016302	2.031479
100	2.034814	0.0044646	455.77	0.000	2.026063	2.043564

Linear predicted values for number of wired ISPs at ≥ 3 Mbps in Urban Census tract, by tract average median household income at average values for percent minority population (39.621 percent) and tract population (4,370.795)

Tract's Average Median Household Income	Predicted Number of Wired ISPs at ≥ 3 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
$20,000	1.890823	0.0032751	577.34	0.000	1.884403	1.897242
$40,000	1.931745	0.0022944	841.94	0.000	1.927248	1.936242
$60,000	1.972668	0.0019195	1027.72	0.000	1.968906	1.97643
$80,000	2.01359	0.0024467	822.97	0.000	2.008795	2.018386
$100,000	2.054513	0.0034886	588.92	0.000	2.047675	2.061351
$120,000	2.095436	0.0047156	444.37	0.000	2.086193	2.104678
$140,000	2.136358	0.0060154	355.15	0.000	2.124568	2.148148
$160,000	2.177281	0.0073495	296.25	0.000	2.162876	2.191686
$180,000	2.218203	0.0087021	254.9	0.000	2.201147	2.235259
$200,000	2.259126	0.0100658	224.44	0	2.239397	2.278855

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and US Census Bureau American Community Survey Five-Year Estimates 2010–2014. Percent minority population represents the percent of a census tract's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A67:
OLS-Regression Model for Number of Wired ISPs at ≥ 3 Mbps in Rural Tract with Predicted Values Based on Tract's Proportion of Minority Population and Income

OLS regression, dependent variable = number of wired ISPs at ≥ 3 Mbps in Rural Census tracts
Number of observations = 6,525
R-squared = 0.0587

Independent Variables	Coefficient	Standard Error	t	P>|t|	95% Confidence Interval	
percent minority pop.	-0.0051038	0.0003655	-13.96	0.000	-0.0058204	-0.0043873
median hh income	3.07E-06	4.75E-07	6.47	0.000	2.14E-06	4.00E-06
tract population	0.0000419	0.00000435	9.63	0.000	0.0000334	0.0000505
_cons	0.8827702	0.0295218	29.9	0.000	0.8248978	0.9406426

Linear predicted values for number of wired ISPs at ≥ 3 Mbps in rural Census tracts, by percent minority population at average values for median household income ($48,636.68) and tract population (3,447.741)

Tract's Percent Minority Population	Predicted Number of Wired ISPs at ≥ 3 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
0	1.176645	0.0082472	142.67	0.000	1.160477	1.192812
10	1.125606	0.0066305	169.76	0.000	1.112609	1.138604
20	1.074568	0.0068288	157.36	0.000	1.061182	1.087955
30	1.02353	0.0087192	117.39	0.000	1.006438	1.040623
40	0.9724923	0.0114951	84.6	0.000	0.949958	0.995027
50	0.9214543	0.0146620	62.85	0.000	0.892712	0.950197
60	0.8704162	0.0180147	48.32	0.000	0.835102	0.905731
70	0.8193782	0.0214665	38.17	0.000	0.777297	0.861460
80	0.7683401	0.0249762	30.76	0.000	0.719379	0.817302
90	0.7173021	0.0285225	25.15	0.000	0.661389	0.773216
100	0.666264	0.0320933	20.76	0.000	0.603351	0.729177

Linear predicted values for number of wired ISPs at ≥ 3 Mbps in rural Census tracts, by tract average median household income at average values for percent minority population (14 percent) and block population (3,447.741)

Tract's Average Median Household Income	Predicted Number of Wired ISPs at ≥ 3 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
$20,000	1.017247	0.0150538	67.57	0.000	0.987737	1.046758
$40,000	1.078664	0.0076572	140.87	0.000	1.063653	1.093675
$60,000	1.140081	0.0084215	135.38	0.000	1.123572	1.15659
$80,000	1.201497	0.0162321	74.02	0.000	1.169677	1.233318
$100,000	1.262914	0.0252253	50.07	0.000	1.213464	1.312364
$120,000	1.324331	0.034488	38.4	0.000	1.256723	1.391938
$140,000	1.385747	0.0438497	31.6	0.000	1.299787	1.471707
$160,000	1.447164	0.0532583	27.17	0.000	1.34276	1.551568
$180,000	1.50858	0.0626926	24.06	0.000	1.385682	1.631479
$200,000	1.569997	0.0721426	21.76	0.000	1.428574	1.71142

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and US Census Bureau American Community Survey Five-Year Estimates 2010–2014. Percent minority population represents the percent of a census tract's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A68:
OLS-Regression Model for Number of Wired ISPs at ≥ 10 Mbps in Urban Tracts with Predicted Values Based on Tract's Proportion of Minority Population and Income

OLS regression, dependent variable = number of wired ISPs at ≥ 10 Mbps in Urban Census tracts
Number of observations = 63,151
R-squared = 0.0352

Independent Variables	Coefficient	Standard Error	t	P>|t|	95% Confidence Interval	
percent minority pop.	0.002237	6.92E-05	32.33	0.000	0.0021014	0.0023727
median hh income	3.24E-06	7.22E-08	44.87	0.000	3.10E-06	3.38E-06
tract population	-0.00000659	1.02E-06	-6.45	0.000	-0.0000086	-0.00000459
_cons	1.549005	0.0071754	215.88	0.000	1.534941	1.563069

Linear predicted values for number of wired ISPs at ≥ 10 Mbps in Urban Census tracts, by percent minority population at average values for median household income ($58,139.51) and tract population (4,370.795)

Tract's Percent Minority Population	Predicted Number of Wired ISPs at ≥ 10 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
0	1.708469	0.0033845	504.8	0.000	1.701835	1.715102
10	1.730839	0.0028528	606.71	0.000	1.725248	1.736431
20	1.75321	0.0024042	729.21	0.000	1.748497	1.757922
30	1.77558	0.0020928	848.4	0.000	1.771478	1.779682
40	1.79795	0.0019843	906.09	0.000	1.794061	1.80184
50	1.820321	0.0021101	862.66	0.000	1.816185	1.824457
60	1.842691	0.0024343	756.98	0.000	1.83792	1.847462
70	1.865062	0.0028907	645.19	0.000	1.859396	1.870727
80	1.887432	0.0034271	550.74	0.000	1.880715	1.894149
90	1.909802	0.0040114	476.09	0.000	1.90194	1.917665
100	1.932173	0.0046255	417.72	0.000	1.923107	1.941239

Linear predicted values for number of wired ISPs at ≥ 10 Mbps in Urban Census tract, by tract average median household income at average values for percent minority population (39.621 percent) and tract population (4,370.795)

Tract's Average Median Household Income	Predicted Number of Wired ISPs at ≥ 10 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
$20,000	1.673593	0.0033931	493.23	0.000	1.666943	1.680244
$40,000	1.73836	0.0023771	731.3	0.000	1.733701	1.74302
$60,000	1.803127	0.0019887	906.71	0.000	1.79923	1.807025
$80,000	1.867894	0.0025349	736.87	0.000	1.862926	1.872863
$100,000	1.932661	0.0036144	534.71	0.000	1.925577	1.939746
$120,000	1.997428	0.0048855	408.84	0.000	1.987853	2.007004
$140,000	2.062195	0.0062322	330.89	0.000	2.04998	2.07441
$160,000	2.126962	0.0076144	279.34	0.000	2.112038	2.141887
$180,000	2.191729	0.0090158	243.1	0.000	2.174058	2.2094
$200,000	2.256496	0.0104286	216.38	0.000	2.236056	2.276936

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and US Census Bureau American Community Survey Five-Year Estimates 2010–2014. Percent minority population represents the percent of a census tract's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A69:
OLS-Regression Model for Number of Wired ISPs at ≥ 10 Mbps in Rural Tract with Predicted Values Based on Tract's Proportion of Minority Population and Income

OLS regression, dependent variable = number of wired ISPs at ≥ 10 Mbps in Rural Census tracts
Number of observations = 6,525
R-squared = 0.0429

Independent Variables	Coefficient	Standard Error	t	P>|t|	95% Confidence Interval	
percent minority pop.	-0.0036589	0.0003633	-10.07	0.000	-0.0043711	-0.0029467
median hh income	3.48E-06	4.72E-07	7.38	0.000	2.56E-06	4.41E-06
tract population	0.0000378	0.00000433	8.74	0.000	0.0000293	0.0000463
_cons	0.6546358	0.0293413	22.31	0.000	0.5971173	0.7121543

Linear predicted values for number of wired ISPs at ≥ 10 Mbps in rural Census tracts, by percent minority population at average values for median household income ($48,636.68) and tract population (3,447.741)

Tract's Percent Minority Population	Predicted Number of Wired ISPs at ≥ 10 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
0	0.9544418	0.0081967	116.44	0.000	0.938374	0.970510
10	0.9178529	0.0065899	139.28	0.000	0.904934	0.930771
20	0.8812639	0.0067871	129.84	0.000	0.867959	0.894569
30	0.844675	0.0086659	97.47	0.000	0.827687	0.861663
40	0.808086	0.0114248	70.73	0.000	0.785690	0.830482
50	0.7714971	0.0145723	52.94	0.000	0.742931	0.800064
60	0.7349081	0.0179045	41.05	0.000	0.699809	0.770007
70	0.6983191	0.0213352	32.73	0.000	0.656495	0.740143
80	0.6617302	0.0248235	26.66	0.000	0.613068	0.710392
90	0.6251412	0.0283481	22.05	0.000	0.569570	0.680713
100	0.5885523	0.0318970	18.45	0.000	0.526024	0.651081

Linear predicted values for number of wired ISPs at ≥ 10 Mbps in rural Census tracts, by tract average median household income at average values for percent minority population (14 percent) and block population (3,447.741)

Tract's Average Median Household Income	Predicted Number of Wired ISPs at ≥ 10 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
$20,000	0.8034629	0.0149617	53.7	0.000	0.774133	0.8327928
$40,000	0.8731291	0.0076104	114.73	0.000	0.8582103	0.888048
$60,000	0.9427954	0.00837	112.64	0.000	0.9263874	0.9592033
$80,000	1.012462	0.0161329	62.76	0.000	0.9808359	1.044087
$100,000	1.082128	0.025071	43.16	0.000	1.03298	1.131275
$120,000	1.151794	0.034277	33.6	0.000	1.0846	1.218988
$140,000	1.22146	0.0435815	28.03	0.000	1.136026	1.306894
$160,000	1.291126	0.0529326	24.39	0.000	1.187361	1.394892
$180,000	1.360793	0.0623092	21.84	0.000	1.238646	1.482939
$200,000	1.430459	0.0717014	19.95	0.000	1.289901	1.571017

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and US Census Bureau American Community Survey Five-Year Estimates 2010–2014. Percent minority population represents the percent of a census tract's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A70:
OLS-Regression Model for Number of Wired ISPs at ≥ 25 Mbps in Urban Tracts with Predicted Values Based on Tract's Proportion of Minority Population and Income

OLS regression, dependent variable = number of wired ISPs at ≥ 25 Mbps in Urban Census tracts
Number of observations = 63,151
R-squared = 0.0531

Independent Variables	Coefficient	Standard Error	t	P>|t|	95% Confidence Interval	
percent minority pop.	0.0013797	6.90E-05	19.99	0.000	0.0012444	0.0015149
median hh income	4.28E-06	7.20E-08	59.46	0.000	4.14E-06	4.42E-06
tract population	-0.00000962	1.02E-06	-9.43	0.000	-0.0000116	-0.00000762
_cons	1.029469	0.0071561	143.86	0.000	1.015443	1.043495

Linear predicted values for number of wired ISPs at ≥ 25 Mbps in Urban Census tracts, by percent minority population at average values for median household income ($58,139.51) and tract population (4,370.795)

Tract's Percent Minority Population	Predicted Number of Wired ISPs at ≥ 25 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
0	1.236244	0.0033753	366.26	0.000	1.229628	1.242859
10	1.25004	0.0028451	439.36	0.000	1.244464	1.255617
20	1.263837	0.0023978	527.09	0.000	1.259137	1.268536
30	1.277634	0.0020872	612.12	0.000	1.273543	1.281724
40	1.29143	0.001979	652.58	0.000	1.287551	1.295309
50	1.305227	0.0021044	620.23	0.000	1.301102	1.309351
60	1.319023	0.0024277	543.32	0.000	1.314265	1.323782
70	1.33282	0.002883	462.31	0.000	1.327169	1.338471
80	1.346617	0.0034179	393.99	0.000	1.339918	1.353316
90	1.360413	0.0040006	340.05	0.000	1.352572	1.368255
100	1.37421	0.0046131	297.9	0.000	1.365168	1.383252

Linear predicted values for number of wired ISPs at ≥ 25 Mbps in Urban Census tract, by tract average median household income at average values for percent minority population (39.621 percent) and tract population (4,370.795)

Tract's Average Median Household Income	Predicted Number of Wired ISPs at ≥ 25 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
$20,000	1.127683	0.003384	333.24	0.000	1.12105	1.134316
$40,000	1.213276	0.0023707	511.78	0.000	1.20863	1.217923
$60,000	1.298869	0.0019833	654.9	0.000	1.294982	1.302757
$80,000	1.384463	0.0025281	547.63	0.000	1.379508	1.389418
$100,000	1.470056	0.0036047	407.82	0.000	1.462991	1.477121
$120,000	1.555649	0.0048724	319.28	0.000	1.546099	1.565199
$140,000	1.641242	0.0062154	264.06	0.000	1.62906	1.653425
$160,000	1.726835	0.0075939	227.4	0.000	1.711951	1.741719
$180,000	1.812429	0.0089915	201.57	0.000	1.794805	1.830052
$200,000	1.898022	0.0104006	182.49	0.000	1.877637	1.918407

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and US Census Bureau American Community Survey Five-Year Estimates 2010–2014. Percent minority population represents the percent of a census tract's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A71:
OLS-Regression Model for Number of Wired ISPs at ≥ 25 Mbps in Rural Tract with Predicted Values Based on Tract's Proportion of Minority Population and Income

OLS regression, dependent variable = number of wired ISPs at ≥ 25 Mbps in Rural Census tracts
Number of observations = 6,525
R-squared = 0.0436

Independent Variables	Coefficient	Standard Error	t	P>|t|	95% Confidence Interval	
percent minority pop.	-0.0028835	0.0003193	-9.03	0.000	-0.0035093	-0.0022576
median hh income	3.89E-06	4.15E-07	9.39	0.000	3.08E-06	4.70E-06
tract population	0.0000285	0.0000038	7.51	0.000	0.0000211	0.000036
_cons	0.2928935	0.0257855	11.36	0.000	0.2423455	0.3434416

Linear predicted values for number of wired ISPs at ≥ 25 Mbps in rural Census tracts, by percent minority population at average values for median household income ($48,636.68) and tract population (3,447.741)

Tract's Percent Minority Population	Predicted Number of Wired ISPs at ≥ 25 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
0	0.580594	0.0072034	80.6	0.000	0.566473	0.594715
10	0.5517592	0.0057913	95.27	0.000	0.540406	0.563112
20	0.5229244	0.0059646	87.67	0.000	0.511232	0.534617
30	0.4940897	0.0076157	64.88	0.000	0.479160	0.509019
40	0.4652549	0.0100403	46.34	0.000	0.445573	0.484937
50	0.4364201	0.0128063	34.08	0.000	0.411316	0.461525
60	0.4075853	0.0157348	25.9	0.000	0.376740	0.438431
70	0.3787505	0.0187497	20.2	0.000	0.341995	0.415506
80	0.3499157	0.0218152	16.04	0.000	0.307151	0.392681
90	0.321081	0.0249127	12.89	0.000	0.272244	0.369918
100	0.2922462	0.0280316	10.43	0.000	0.237295	0.347197

Linear predicted values for number of wired ISPs at ≥ 25 Mbps in rural Census tracts, by tract average median household income at average values for percent minority population (14 percent) and block population (3,447.741)

Tract's Average Median Household Income	Predicted Number of Wired ISPs at ≥ 25 Mbps	Standard Error	t	P>|t|	95% Confidence Interval	
$20,000	0.4287733	0.0131486	32.61	0.000	0.4029978	0.4545488
$40,000	0.5066098	0.0066881	75.75	0.000	0.4934989	0.5197207
$60,000	0.5844463	0.0073557	79.46	0.000	0.5700268	0.5988658
$80,000	0.6622827	0.0141778	46.71	0.000	0.6344896	0.6900759
$100,000	0.7401192	0.0220328	33.59	0.000	0.6969278	0.7833106
$120,000	0.8179557	0.0301231	27.15	0.000	0.7589045	0.8770069
$140,000	0.8957922	0.0383001	23.39	0.000	0.8207115	0.9708729
$160,000	0.9736287	0.0465179	20.93	0.000	0.8824383	1.064819
$180,000	1.051465	0.0547582	19.2	0.000	0.9441211	1.158809
$200,000	1.129302	0.0630122	17.92	0.000	1.005777	1.252826

Source: Free Press analysis of December 31, 2014 FCC Form 477 broadband deployment data and US Census Bureau American Community Survey Five-Year Estimates 2010–2014. Percent minority population represents the percent of a census tract's population made up of persons of races/ethnicities other than non-Hispanic White.

Figure A72:
Heckman Probability-Selection Model for Person Who Uses Home Internet
(universe = persons age 3+, selection model = person's household subscribes to home internet)

Survey: Heckman selection probability regression, person-level (age 3+), dependent variable = person uses internet at home, after person's household selects to subscribe to home internet

Number of observations =149,410

Population size = 315,996,905

Subpopulation observations = 124,363

Subpop. size = 304,127,021

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.1486172	0.0266171	-5.58	0.000	-0.2007858	-0.0964486
Black	-0.1086705	0.0257055	-4.23	0.000	-0.1590523	-0.0582887
American Indian/AK Native	0.0012761	0.08092	0.02	0.987	-0.1573242	0.1598764
Asian	-0.1112609	0.0321665	-3.46	0.001	-0.174306	-0.0482158
Hawaiian/Pacific Islander	-0.1708162	0.0975944	-1.75	0.080	-0.3620977	0.0204653
Multirace	-0.0646202	0.0566464	-1.14	0.254	-0.1756451	0.0464047
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is not jointly significant at P>chi2=.05]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Person's age	0.0056828	0.0004643	12.24	0.000	0.0047727	0.0065929
Lives in an Owned-Home	-0.0949755	0.018835	-5.04	0.000	-0.1318914	-0.0580596
Household Size	-0.1016451	0.0060067	-16.92	0.000	-0.1134179	-0.0898722
Person Uses Internet at Work	0.9682536	0.0239295	40.46	0.000	0.9213527	1.015155
Person Uses Internet at School	0.7033327	0.0224624	31.31	0.000	0.6593073	0.7473581
Person's Household has Wired Internet	0.1676511	0.0183864	9.12	0.000	0.1316145	0.2036877
_cons	0.8990609	0.0896739	10.03	0.000	0.7233033	1.074818
Selection variable = homeinternet						
Non-Hispanic White (base level)						
Hispanic*	-0.1918485	0.0355055	-5.4	0.000	-0.261438	-0.122259
Black	-0.303993	0.0264285	-11.5	0.000	-0.3557919	-0.2521941
American Indian/AK Native	-0.1407682	0.0755289	-1.86	0.062	-0.288802	0.0072657
Asian	-0.0594421	0.0456134	-1.3	0.193	-0.1488427	0.0299585
Hawaiian/Pacific Islander	-0.4258192	0.1596033	-2.67	0.008	-0.7386358	-0.1130025
Multirace	-0.0518667	0.0581395	-0.89	0.372	-0.165818	0.0620846
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.0042163	0.0006924	-6.09	0.000	-0.0055734	-0.0028592
Householder owns home	0.1050132	0.0236749	4.44	0.000	0.0586111	0.1514152
Household Size	-0.0425377	0.0084858	-5.01	0.000	-0.0591696	-0.0259058
Household has member using internet at work	1.106819	0.024047	46.03	0.000	1.059688	1.15395
Household has member using internet at school	1.024438	0.0301274	34	0.000	0.9653891	1.083486
_cons	-0.5790999	0.2508247	-2.31	0.021	-1.070707	-0.0874925
/athrho	0.0019195	0.0317661	0.06	0.952	-0.0603409	0.06418
rho	0.0019195	0.031766			-0.0602678	0.064092

Marginal Impacts of Select Independent Variables on Personal Use of Home Internet, Conditional on Household Adoption of Home internet

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0301421	0.0056156	-5.37	0.000	-0.0411484	-0.0191359
Black	-0.0216095	0.0053472	-4.04	0.000	-0.0320898	-0.0111292
American Indian/AK Native	0.000263	0.0153003	0.02	0.986	-0.029725	0.030251
Asian	-0.0221962	0.0067063	-3.31	0.001	-0.0353403	-0.0090521
Hawaiian/Pacific Islander	-0.0349534	0.0215596	-1.62	0.105	-0.0772094	0.0073026
Multirace	-0.0126099	0.0113662	-1.11	0.267	-0.0348873	0.0096674
Person's Age	0.001124	0.0000913	12.31	0.000	0.0009451	0.001303
Lives in an Owned-Home	-0.0185315	0.0036106	-5.13	0.000	-0.0256082	-0.0114549
Household Size	-0.0200977	0.0012161	-16.53	0.000	-0.0224812	-0.0177141
Person Uses Internet at Work	0.1444601	0.0027889	51.8	0.000	0.138994	0.1499262
Person Uses Internet at School	0.1102214	0.0027383	40.25	0.000	0.1048544	0.1155884
Person's Household has Wired Internet	0.0335101	0.0038029	8.81	0.000	0.0260566	0.0409635

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A73:
Heckman Probability-Selection Model for Person Who Uses Home Internet
(universe = persons age 15+, selection model = person's household subscribes to home internet)

Survey: Heckman selection probability regression, person-level (age 15+), dependent variable = person uses internet at home, after person's household selects to subscribe to home internet

Number of observations =149,410

Population size = 315,996,905

Subpopulation observations = 104,463

Subpop. size = 255,123,393

Replications = 160

Independent Variables	Coefficient	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.1689632	0.0359845	-4.7	0.000	-0.2394916	-0.0984348
Black	-0.2225262	0.0298314	-7.46	0.000	-0.2809947	-0.1640578
American Indian/AK Native	-0.0195205	0.1026063	-0.19	0.849	-0.2206252	0.1815842
Asian	-0.1959936	0.0397871	-4.93	0.000	-0.2739749	-0.1180124
Hawaiian/Pacific Islander	-0.1477964	0.0923455	-1.6	0.109	-0.3287903	0.0331974
Multirace	0.0520905	0.0758534	0.69	0.492	-0.0965794	0.2007604
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Person's Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is not jointly significant at P>chi2=.05]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Person's age	-0.0153821	0.0005781	-26.61	0.000	-0.0165152	-0.0142491
Lives in an Owned-Home	-0.0287478	0.0257415	-1.12	0.264	-0.0792003	0.0217046
Household Size	-0.0942439	0.0069229	-13.61	0.000	-0.1078125	-0.0806754
Person Uses Internet at Work	0.6243467	0.024474	25.51	0.000	0.5763787	0.6723148
Person Uses Internet at School	0.4067402	0.0334692	12.15	0.000	0.3411418	0.4723385
Person's Household has Wired Internet	0.1182722	0.0213091	5.55	0.000	0.0765072	0.1600373
_cons	1.202981	0.1496946	8.04	0.000	0.9095846	1.496377
Selection variable = homeinternet						
Non-Hispanic White (base level)						
Hispanic*	-0.2065563	0.0356961	-5.79	0.000	-0.2765195	-0.1365931
Black	-0.3290988	0.0265232	-12.41	0.000	-0.3810833	-0.2771143
American Indian/AK Native	-0.1542959	0.0727493	-2.12	0.034	-0.2968819	-0.0117099
Asian	-0.0737063	0.0458973	-1.61	0.108	-0.1636633	0.0162508
Hawaiian/Pacific Islander	-0.423789	0.1545017	-2.74	0.006	-0.7266067	-0.1209712
Multirace	-0.0778741	0.0637539	-1.22	0.222	-0.2028294	0.0470813
Family Income Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Maximum Education Level Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Metropolitan Area Size Category	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
State Factor Variables	[Factor level variables not shown; main effect is jointly significant at P>chi2=.0000]					
Average Adult Age in Household	-0.004233	0.0006525	-6.49	0.000	-0.0055119	-0.0029541
Householder owns home	0.1101722	0.0228449	4.82	0.000	0.0653971	0.1549473
Household Size	-0.0351971	0.0081164	-4.34	0.000	-0.0511048	-0.0192893
Household has member using internet at work	1.099834	0.0230226	47.77	0.000	1.05471	1.144957
Household has member using internet at school	1.003094	0.0307519	32.62	0.000	0.9428219	1.063367
_cons	-0.6764276	0.249789	-2.71	0.007	-1.166005	-0.1868501
/athrho	0.2309325	0.0348984	6.62	0.000	0.1625329	0.2993322
rho	0.2269131	0.0331015			0.1611166	0.2907013

Marginal Impacts of Select Independent Variables on Personal Use of Home Internet, Conditional on Household Adoption of Home internet

Independent Variables	dy/dx	SDR Standard Error	z	P>|z|	95% Confidence Interval	
Non-Hispanic White (base level)						
Hispanic*	-0.0228772	0.005784	-3.96	0.000	-0.0342135	-0.0115408
Black	-0.0296755	0.0049874	-5.95	0.000	-0.0394506	-0.0199003
American Indian/AK Native	-0.0003662	0.0146269	-0.03	0.980	-0.0290344	0.0283021
Asian	-0.0300931	0.0069318	-4.34	0.000	-0.0436792	-0.0165069
Hawaiian/Pacific Islander	-0.0150814	0.0147775	-1.02	0.307	-0.0440447	0.0138819
Multirace	0.0084134	0.0101227	0.83	0.406	-0.0114268	0.0282536
Person's Age	-0.0023583	0.0000906	-26.03	0.000	-0.0025359	-0.0021808
Lives in an Owned-Home	-0.0062434	0.0038503	-1.62	0.105	-0.0137899	0.0013031
Household Size	-0.0138543	0.0010758	-12.88	0.000	-0.0159629	-0.0117457
Person Uses Internet at Work	0.0800906	0.0027549	29.07	0.000	0.074691	0.0854901
Person Uses Internet at School	0.0515096	0.0034192	15.07	0.000	0.0448082	0.058211
Person's Household has Wired Internet	0.0182414	0.0033946	5.37	0.000	0.0115882	0.0248946

* non-white Hispanic persons categorized by race, not ethnicty for this regression

Source: Free Press Research; July 2015 Current Population Survey Computer and Internet Use Supplement.

STATISTICAL APPENDIX III:
EXAMINING INTERACTION EFFECTS IN HOUSEHOLD INTERNET-ADOPTION ECONOMETRIC MODELS

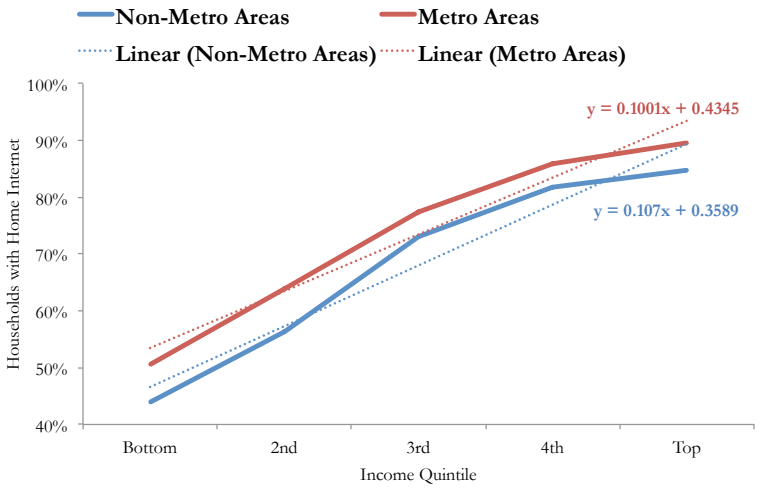
To determine the impact of race, ethnicity, and other factors on home-internet adoption, we constructed a binary probability econometric model ("probit" model). This model presents household-level home-internet adoption as a function of the following factors: householder race and ethnicity, family income, average age of the adults in a household, maximum educational attainment of persons in the household, location in non-metropolitan areas or in metropolitan areas (of various population sizes), home ownership, number of persons in the household, presence of a household member who uses the internet at work, presence of a household member who uses the internet at school, and state-level controls. All coefficients for the independent variables are statistically significant, and have the expected sign based on the results of the descriptive statistics. This model, and similar models for other outcomes of interest, are our preferred models. The results are presented above in Statistical Appendix II.

We chose the independent variables in our model based on our analysis of the descriptive statistics (*e.g.*, income is positively associated with home-internet adoption, as shown in Figure 3). The descriptive data suggests that each factor's impact on home-internet adoption is generally additive. For example, home internet is present in 44 percent of non-metropolitan households in the bottom income quintile, and in 85 percent of top income quintile non-metro households. In metro areas, home internet is present in 51 percent of bottom income quintile homes and 90 percent of top income quintile homes. In other words, there's about a 40 percentage point difference in home-internet adoption between the bottom and top income quintile households in both metro and non-metro areas; and there is also about a 7 percentage point difference in adoption between metro and non-metro areas, no matter the income quintile (*see* Figure A74). Put in mathematical terms, the slopes of these lines are very similar. Thus the impact of each factor on home-internet adoption is additive. This is in contrast to a non-additive relationship (*e.g.*, the impact of educational attainment on the belief in anthropogenic climate change depends upon a person's political ideology: education is positively associated with this belief for liberals, and negatively associated for conservatives).[132]

The observed additivity in our independent variables of interest – along with other reasons discussed below – led us to not include any interaction effects in our preferred econometric models. In this appendix we discuss our analytical approach that led us to this decision, and we present alternative models that do include interaction effects. We start by looking at what the changes in the outcome of our preferred model of home-internet adoption would be if we were to add specific race/ethnicity interaction effects in isolation (*i.e.*, we explore the changes to the model's predicted outcomes produced by adding a single interaction effect). We then present a similar analysis for a model that includes all possible interaction effects (*see* Figure A90 for the marginal impacts of each factor in the final model with all interaction effects). The results of this analysis indicate that there are small interaction effects in a few cases, but that the inclusion of these interaction terms would not add to the explanatory power of our model. The primary conclusions of our preferred model (*i.e.*, the size and statistical significance of each independent variable's impact on home-internet adoption) are consistent whether or not interaction effects are included.

[132] *See, e.g.*, Chelsea Harvey, "Science confirms it: Denial of climate change is all about the politics," *Washington Post* (Feb. 22, 2016).

Figure A74:
Home-Internet Adoption by Metro Area and Family-Income Quintile (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Race/Income Interaction Effects in Primary Econometric Model for Household-Level Home-Internet Adoption

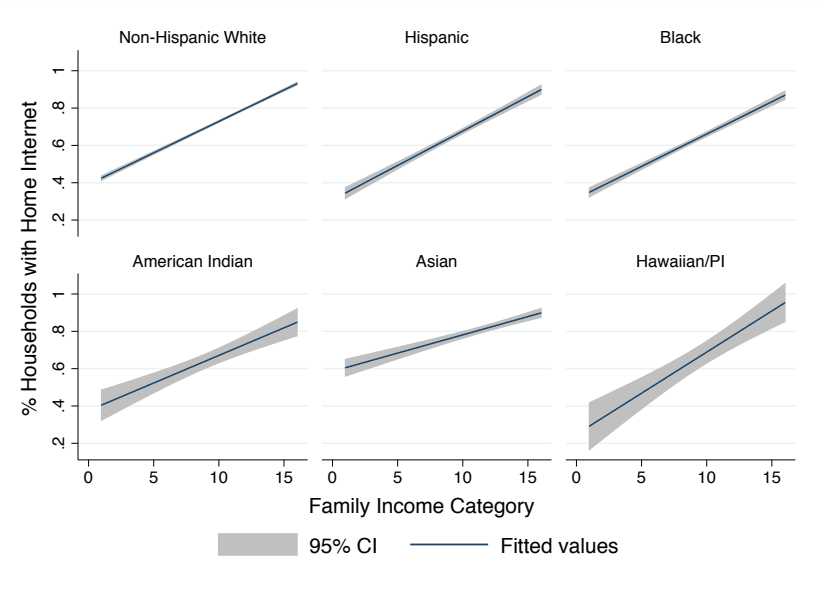
Our outcome variable of interest is binary: does a surveyed household subscribe to internet? Because our outcome is dichotomous, we cannot model this outcome as a linear function of our independent variables. We must use a non-linear model. However, the use of a non-linear model introduces substantial methodological issues when dealing with interaction effects.

Interpretation of interaction effects in non-linear models is substantially different than in linear models.[133] For example, the marginal effect of a change in two interacted variables does not equal the marginal effect of the change in the interaction term (as it does in linear models). Also, the sign of the interaction terms' coefficient can differ across observations. And the statistical significance of the interaction term cannot be determined from the z-statistic in the regression output. Thus, unless the descriptive data suggests a need to examine interaction effects, or there are theoretical reasons to do so, it may not be necessary or informative to add interaction effects to the model.

Our analysis of the descriptive data from the July 2015 CPS does not clearly suggest that combinations of predictor variables in our preferred model for home-internet adoption (*see* Figure A53) are associated with home-internet adoption in a non-additive manner. For example, below in Figure A75 we plot the fitted values of home-internet adoption versus income category (in 16 unequal-sized bins) for non-Hispanic Whites, Hispanics, Blacks, American Indians/Alaska Natives, Asians, and Hawaiian/Pacific Islanders. There are no notable differences in the slopes of these fitted lines, with the exception of the line for Asian households having a shallower slope. In other words, there does not appear to be a non-additive impact from income, even when examining data across different races/ethnicities: adoption increases with increasing income, with increases in adoption of approximately the same magnitude for each racial/ethnic group as a whole.

[133] *See, e.g.*, Chunrong Ai and Edward C. Norton, "Interaction Terms in Logit and Probit Models," 80 *Economics Letters* 123 (2003).

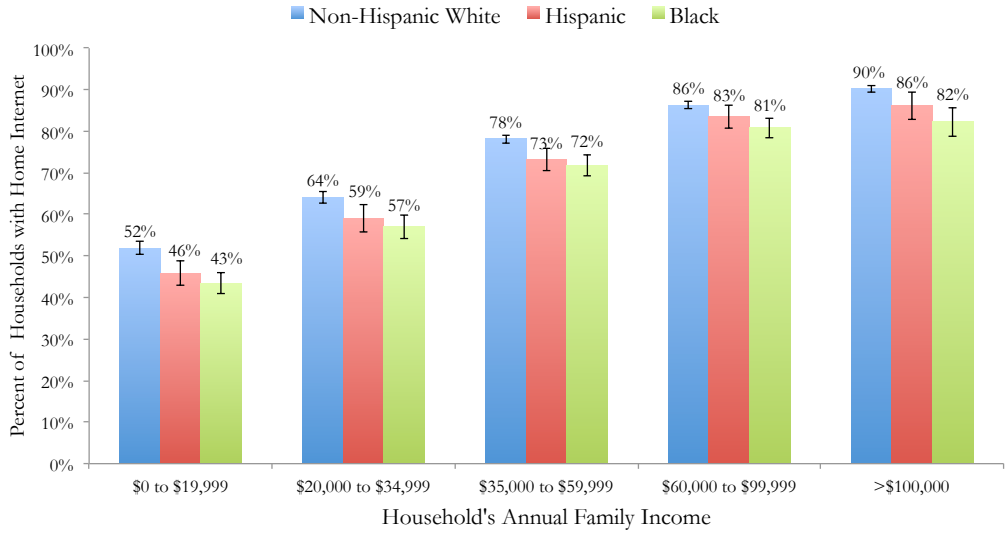
Figure A75:
Fitted Values of Home-Internet Adoption by Family-Income Category and Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

However, the slopes are not identical. The cross-tabulation of home-internet adoption by income quintile across race/ethnicities shown below does indicate a slight narrowing of the gap between White and Hispanic households, as well as between White and Black households, though the size of this narrowing is not statistically significant. However, given that the gap between Hispanic and White households narrows at higher incomes, as does the gap between White and Black households at higher incomes (or conversely, that these respective gaps widen at lower incomes), this could suggest the need to examine a race/income interaction effect in the full probit model. In other words, the impact of low income could be more acute for Hispanic and Black households than it is for White households, all other factors being equal.

Figure A76:
Household-Level Home-Internet Adoption by Race/Ethnicity and Family Income (2015)



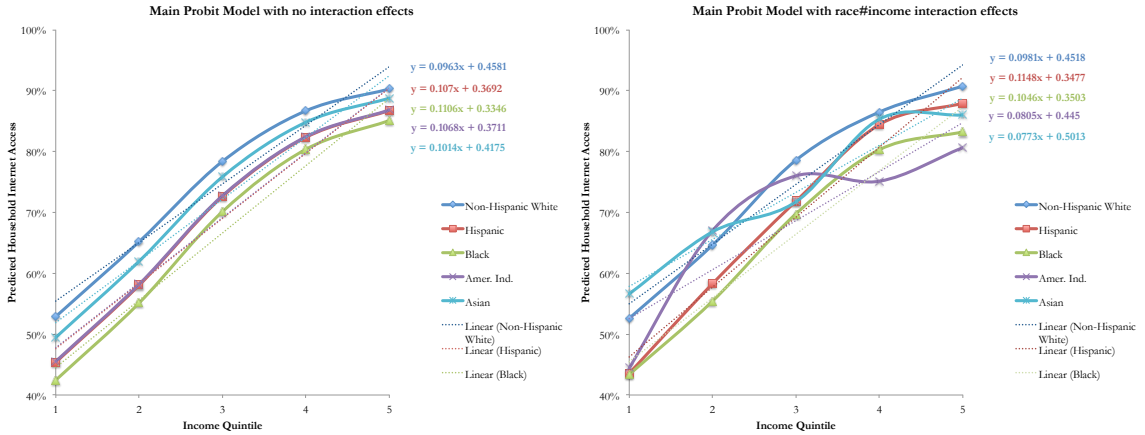
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Differences between values for non-Hispanic White households and Hispanic households are statistically significant at p<0.05 for person's with family incomes below $60,000. Differences between values for non-Hispanic White households and Black households are statistically significant at p<0.05 for all income strata. (Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values.)

We added a race/income interaction variable to our main probit model by interacting two categorical variables (race/ethnicity and the CPS's categorical family income variable) that are included in the probit model as factor variables. Adding these interactions did not increase the informational power of the model (as measured by Bayesian Information Criterion); it did not materially change the marginal impact of the predictor variables; and very few of the interaction terms were statistically significant. These results do not strongly indicate that this interaction belongs in the model; but because the model is not linear, we cannot conclude that there is no interaction effect simply by looking at the regression output. To investigate further, we graphically compare (i) the predicted probabilities of home-internet adoption as income increases for the most populous races/ethnicities in a model without the interaction variables, against (ii) the predicted values from a model with the interaction effect.[134]

From this comparison we observe several interesting results. In the model without interaction effects, the slopes of the predicted values are similar for the three most populous non-White races/ethnicities, but slightly shallower for White households. This is consistent with the descriptive data that suggests a small narrowing of the adoption gap between Whites (on the one hand) and Blacks and Hispanics (on the other) at higher incomes. However, in the model with the interaction effect we observe a small steepening of the slope for Hispanic households, and a small shallowing of the slope for Asian households, relative to the model without these interaction terms. These plots suggest that there may be a race/income interaction effect that acts to increase adoption in low-income Asian households above what would be predicted based on income alone. Put another way, this data may indicate that the negative impact of a low-income on home-internet adoption is less severe for Asian households than it is for households of other races/ethnicities.

[134] *See, e.g.*, William Greene, "Testing Hypotheses About Interaction Terms in Nonlinear Models," Working Paper, Department of Economics, Stern School of Business, New York University (2009).

Figure A77:
Probit Model-Predicted Home-Internet Adoption
by Race/Ethnicity and Family-Income Quintile,
No Interaction Effects vs. Race/Income Category Interaction Effect (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Inclusion of a race/income interaction term in the econometric model produces several changes in the marginal impact of race/ethnicity on home-internet adoption (*see* Figure A78). Adding the race/income interaction term to the main probit model reduces slightly the marginal impact on home-internet adoption of Hispanic ethnic identification, for all income quintiles; while it increases the marginal impact on home-internet adoption of Black racial identification for the top income quintile. However, these changes in marginal impact between models are not statistically significant. The impact of including the interaction term for other races/ethnicities is less consistent, with many of the interaction effect model's marginal impact values not statistically significant. (The lack of significance and large swings for some groups is likely a consequence of the very small sample sizes for many of these interaction factor variables.) Most notable is the change in marginal impact for low-income Asian households, which moves from negative to positive in the model with interaction effects. This is consistent with the descriptive data shown above, illustrating a smaller gap in home-internet adoption between low-income and high-income Asian households when compared to the income-based gap for other races/ethnicities. We also observe that the marginal impact for top income quintile Hispanic households is no longer significantly different relative to top income quintile White households ($p=0.058$), a result consistent with the bivariate cross-tabulations. (Those cross-tabulations showed no significant difference in adoption between Hispanic and White households in the top two income quintiles; *see* Figure A76).

Figure A78:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Family-Income Quintile, No Interaction Effects vs. Race/Income Quintile Effect (2015)

Race/Ethnicity	Income Quintile	Main Model with No Interaction Effect		Main Model with Race#Income Category Interaction Effect		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	Bottom	-7.5%	0.000	-6.7%	0.000	No
	Second	-7.2%	0.000	-6.0%	0.000	No
	Third	-5.8%	0.000	-5.6%	0.000	No
	Fourth	-4.4%	0.000	-3.5%	0.019	No
	Top	-3.5%	0.000	-3.5%	0.058	No
Black	Bottom	-10.5%	0.000	-10.6%	0.000	No
	Second	-10.1%	0.000	-9.3%	0.000	No
	Third	-8.3%	0.000	-8.7%	0.000	No
	Fourth	-6.3%	0.000	-5.8%	0.000	No
	Top	-5.2%	0.000	-7.2%	0.000	No
American Indian/ AK Native	Bottom	-7.4%	0.002	-10.5%	0.000	No
	Second	-7.0%	0.003	0.7%	0.840	Yes
	Third	-5.6%	0.004	-6.7%	0.097	No
	Fourth	-4.3%	0.005	-13.6%	0.002	Yes
	Top	-3.5%	0.006	-9.6%	0.100	No
Asian	Bottom	-3.4%	0.017	10.1%	0.000	Yes
	Second	-3.2%	0.019	6.8%	0.006	Yes
	Third	-2.5%	0.021	1.4%	0.532	No
	Fourth	-1.9%	0.022	1.1%	0.550	No
	Top	-1.5%	0.023	-2.1%	0.218	No
Hawaiian/ Pacific Islander	Bottom	-10.2%	0.033	-1.1%	0.855	No
	Second	-9.8%	0.041	-9.1%	0.167	No
	Third	-8.1%	0.052	-0.9%	0.879	No
	Fourth	-6.2%	0.063	-2.3%	0.709	No
	Top	-5.1%	0.071	-8.5%	0.289	No

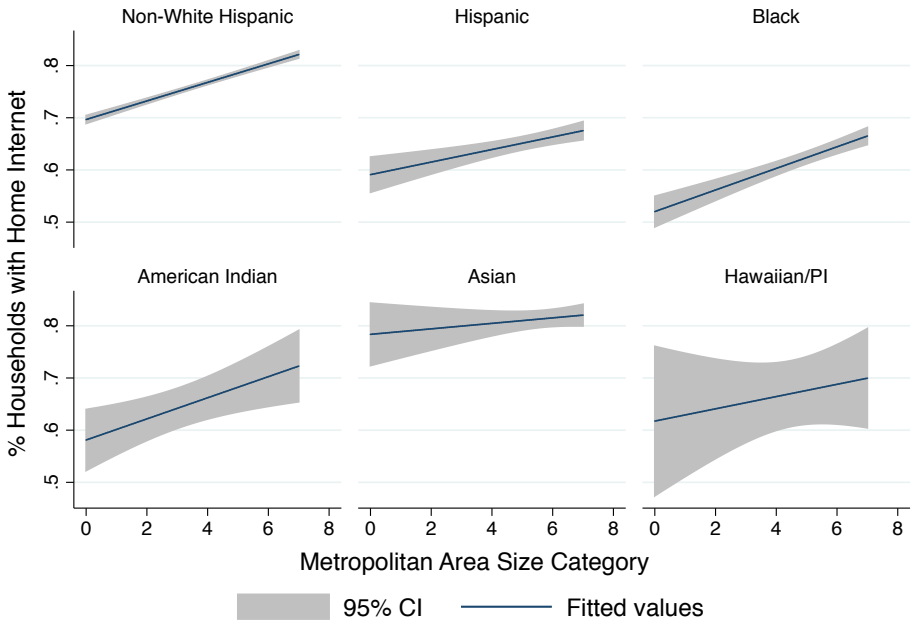
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

The lack of an increase in the primary model's explanatory power, the small potential effect of this interaction, the issues presented when using interactions with small sample sizes, and the underlying issues with the reliability of the CPS family income variable all lead us to exclude this interaction effect from our preferred model. However, in the interest of completeness, we present a model showing this and other interaction effects at the end of this Appendix III.

Race/Geography Interaction Effects in Primary Econometric Model for Household-Level Home-Internet Adoption

Another potential interaction effect of interest is race interacted with geography. However, the descriptive data does not provide a compelling reason to suspect such an effect. Below we plot the fitted values of home-internet adoption versus metropolitan area population size (from non-metro areas to those with populations of more than 5 million) for White, Hispanic, Black, American Indian/Alaska Native, Asian, and Hawaiian/Pacific Islander households. There are no substantial differences in the slopes of these fitted lines, with the exception of a notably shallower slope in the line for Asian households (*see* Figure A79).

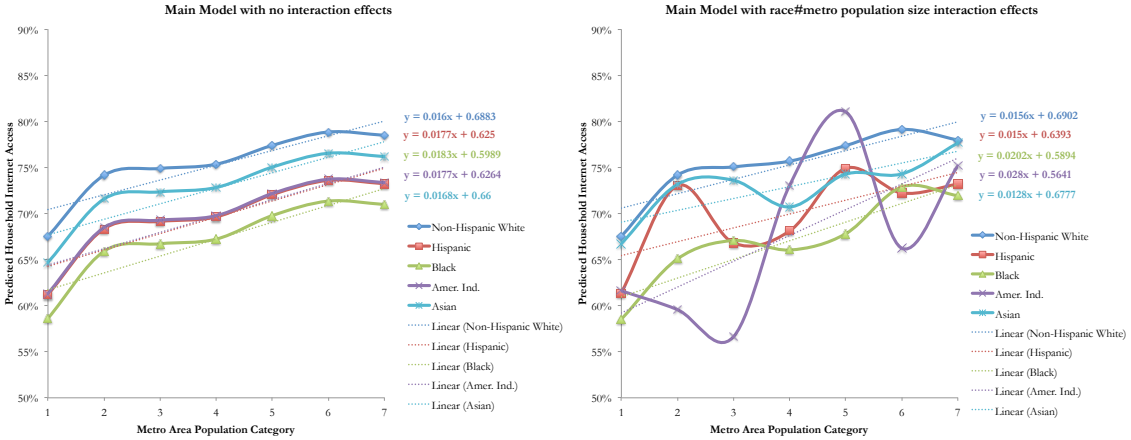
Figure A79:
Fitted Values of Home-Internet Adoption by Metropolitan-Area Population Category and Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Though there is little reason from this data to expect that the interaction of race and geography is non-additive, we explored this possibility further by adding a race/geography interaction variable to our main probit model. The results do not strongly indicate that this interaction belongs in the model. But because the model is not linear, we cannot conclude that there is no interaction effect. To investigate further, we graphically compare (i) the predicted probabilities of home-internet adoption as metropolitan population size increases for the five most populous races/ethnicities, in a model without the interaction variables, against (ii) the predicted values from a model with the interaction effect. The results shown below indicate no substantial movement in the slopes of the predicted lines between these two models, with and without this interaction effect, though there are large swings in the predicted values moving across metro area size categories. The largest difference in slope change is seen in the change of slope for the fitted line for American Indian/Alaska Native households, though this could be driven by the small sample sizes for the different metropolitan population size categories. For the three groups with large sample sizes (White, Hispanic, and Black households), there appears to be no differing impact of metropolitan population.

Figure A80:
Probit Model-Predicted Home-Internet Adoption
by Race/Ethnicity and Metropolitan-Area Population Category,
No Interaction Effects vs. Race/Geography Category Interaction Effect (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A81 below, which reports the marginal impact of race for each metro area population size category, illustrates the changes created by including a race/categorical population interaction term in the econometric model. Adding this interaction term to the main probit model alters slightly the marginal impact on home-internet adoption of Hispanic and Black identification, for all income quintiles, though there's no consistent impact. The impact of the interaction term on other races/ethnicities is much larger and more erratic, with many values not statistically significant – likely a consequence of the very small sample sizes for many of these interaction factor variables. Comparing the two model's marginal impacts, we see that only one of these changes in marginal impact is statistically significant.

Therefore, the lack of any increase in the primary model's explanatory power, the small potential effect of this interaction, and the issues presented when using interactions with small sample sizes all lead us to exclude this particular interaction effect from our preferred model. However, in the interest of completeness, we present a model showing this and other interaction effects at the end of this Appendix III.

Figure A81:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Family-Income Quintile, No Interaction Effects vs. Race/Income Category Interaction Effect (2015)

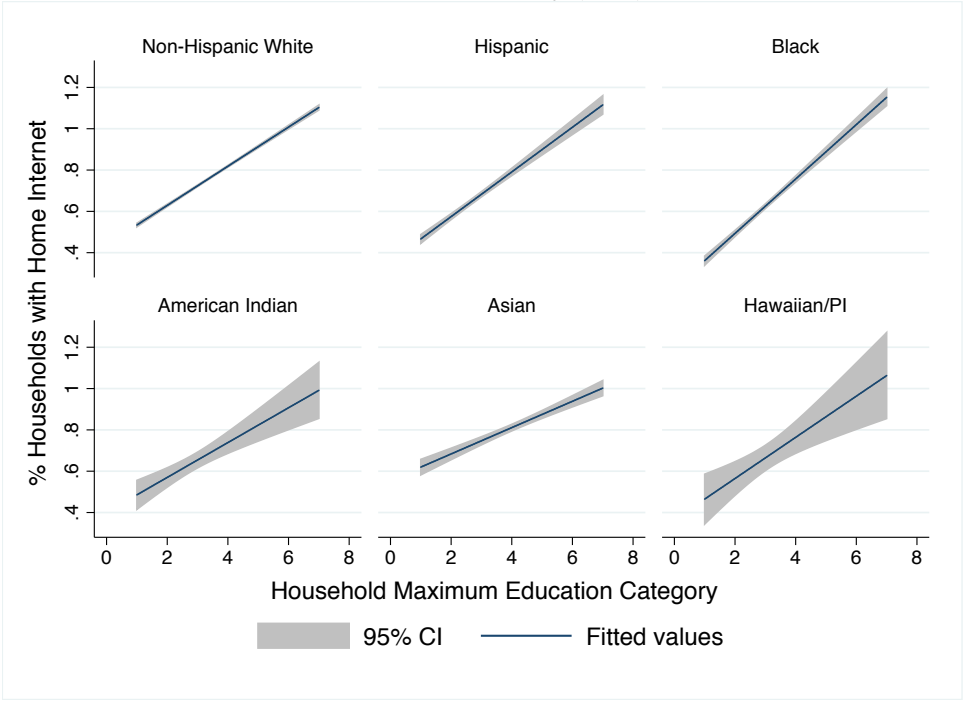
Race/Ethnicity	Metropolitan Area Population	Main Model with No Interaction Effect		Main Model with Race#Metro Area Size Category Interaction Effect		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	Non-Metro	-6.4%	0.000	-6.1%	0.003	No
	100K-250K	-5.8%	0.000	-1.1%	0.684	No
	250K-500K	-5.7%	0.000	-8.3%	0.001	No
	500K-1M	-5.7%	0.000	-7.6%	0.000	No
	1M-2.5M	-5.3%	0.000	-2.5%	0.148	No
	2.5M-5M	-5.2%	0.000	-6.9%	0.000	No
	5M+	-5.3%	0.000	-4.8%	0.000	No
Black	Non-Metro	-9.0%	0.000	-9.0%	0.000	No
	100K-250K	-8.2%	0.000	-9.1%	0.001	No
	250K-500K	-8.2%	0.000	-8.0%	0.000	No
	500K-1M	-8.1%	0.000	-9.6%	0.000	No
	1M-2.5M	-7.6%	0.000	-9.6%	0.000	No
	2.5M-5M	-7.5%	0.000	-6.2%	0.000	No
	5M+	-7.5%	0.000	-6.0%	0.000	No
American Indian	Non-Metro	-6.2%	0.003	-5.9%	0.037	No
	100K-250K	-5.7%	0.003	-14.6%	0.020	No
	250K-500K	-5.6%	0.003	-18.4%	0.212	No
	500K-1M	-5.6%	0.003	-2.6%	0.573	No
	1M-2.5M	-5.2%	0.003	3.7%	0.357	Yes
	2.5M-5M	-5.1%	0.004	-12.9%	0.132	No
	5M+	-5.1%	0.003	-2.8%	0.626	No
Asian	Non-Metro	-2.8%	0.019	-0.8%	0.858	No
	100K-250K	-2.6%	0.020	-1.0%	0.886	No
	250K-500K	-2.5%	0.020	-1.5%	0.771	No
	500K-1M	-2.5%	0.020	-5.0%	0.136	No
	1M-2.5M	-2.4%	0.020	-3.1%	0.203	No
	2.5M-5M	-2.3%	0.020	-4.8%	0.043	No
	5M+	-2.3%	0.020	-0.3%	0.828	No
Hawaiian/ PI	Non-Metro	-8.8%	0.042	-16.8%	0.008	No
	100K-250K	-8.0%	0.047	-18.5%	0.166	No
	250K-500K	-8.0%	0.048	(not estimable)		No
	500K-1M	-7.9%	0.049	3.5%	0.49	No
	1M-2.5M	-7.4%	0.05	-1.1%	0.846	No
	2.5M-5M	-7.3%	0.052	3.3%	0.731	No
	5M+	-7.3%	0.052	-23.7%	0.034	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Race/Education Interaction Effects in Primary Econometric Model for Household-Level Home-Internet Adoption

We also explored the possibility of an interaction effect for race and educational attainment. We cannot however use our main model's factor variable for household maximum educational attainment level, as there are too many empty cells or zero-variation cells when using the CPS's 16 education categories. Therefore we re-estimate our main model using a truncated 7-category attainment variable (which largely consolidates several sparsely populated categories below high school-level educational attainment), then interact this categorical education variable with the race categorical variable. The descriptive data provides little reason to suspect that this interaction is appreciably non-additive. Cross-tabulations of home-internet adoption and education across races/ethnicities show similar slopes, with the slope for Black households slightly steeper than the slope for other races/ethnicities, and the slope for Asian households slightly shallower. (*See* Figure A82).

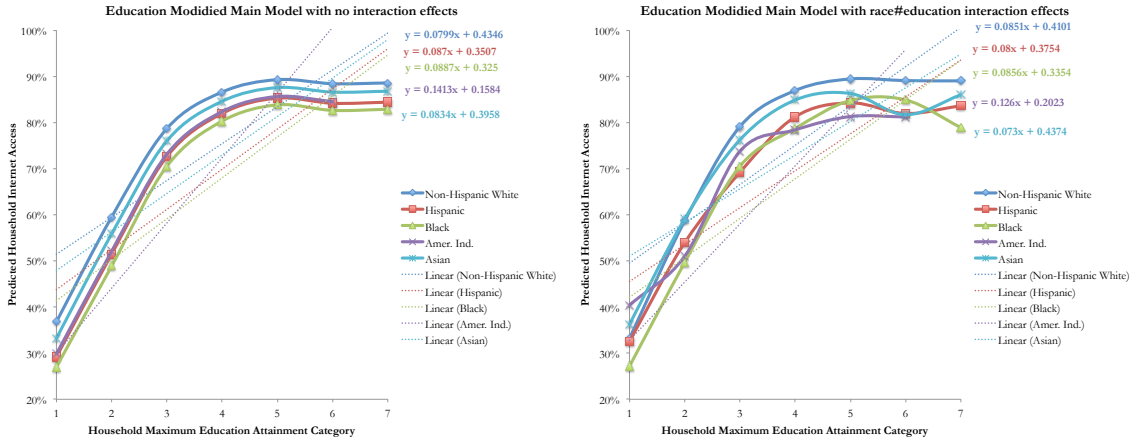
Figure A82:
Fitted Values of Home-Internet Adoption by Household Maximum-Education Category and Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

However, we proceed as above and analyze the predicted probabilities of home-internet adoption as household maximum educational attainment increases for the five most populous races/ethnicities, comparing a model without the interaction variables against the predicted values from a model with this interaction effect. The results shown below indicate no substantial movement in the slopes of the predicted lines between the models with and without this interaction effect. (The model with this interaction effect does not include a predicted value for American Indian households in the highest educational category due to insufficient data; therefore we show a similarly truncated slope for the model without interaction effects. The full slope in that model is similar to all the others.) The most notable result is that the addition of the interaction term narrows the gap between White households (on the one hand) and Hispanic and Black households (on the other) at the lowest educational attainment level.

Figure A83:
Probit Model-Predicted Home-Internet Adoption
by Race/Ethnicity and Household Maximum Educational Attainment,
No Interaction Effects vs. Race/Education Category Interaction Effect (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A84 below, which reports the marginal impact of race for each educational attainment category, illustrates the changes created by including a race/categorical education interaction term in the econometric model. Adding this interaction term to the main probit model alters slightly the marginal impact on home-internet adoption of Hispanic and Black identification, for all income quintiles, though there's no consistent impact. The effect of the interaction term on other races/ethnicities is somewhat erratic – particularly for those with small sample sizes – with many values not statistically significant. There are very few changes in marginal impact that are statistically significant, notably the decrease in the absolute size of the marginal impact for Hispanic households with the lowest education levels. Overall, the marginal impacts (where calculable) remain significant, but they also remain approximate in size to those in the main model without this interaction effect.

The lack of any increase in the primary model's explanatory power, the small potential effect of this interaction, and the issues presented when using interactions with small sample sizes all lead us to exclude this particular interaction effect from our preferred model. We do emphasize this point, however: the data does indicate that, to the extent there is a small race/education interaction effect, it acts to narrow the gap between Whites and non-Whites for households with less than a high school-level educational attainment; but this narrowing of the gap does not occur for Black households in this educational category. Put another way, the negative impact of low-education on internet adoption may be more pronounced for the least educated Black households than it is for similarly educated households of other races/ethnicities.

Figure A84:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Educational-Attainment Category, No Interaction Effects vs. Race/Education Category Interaction Effect (2015)

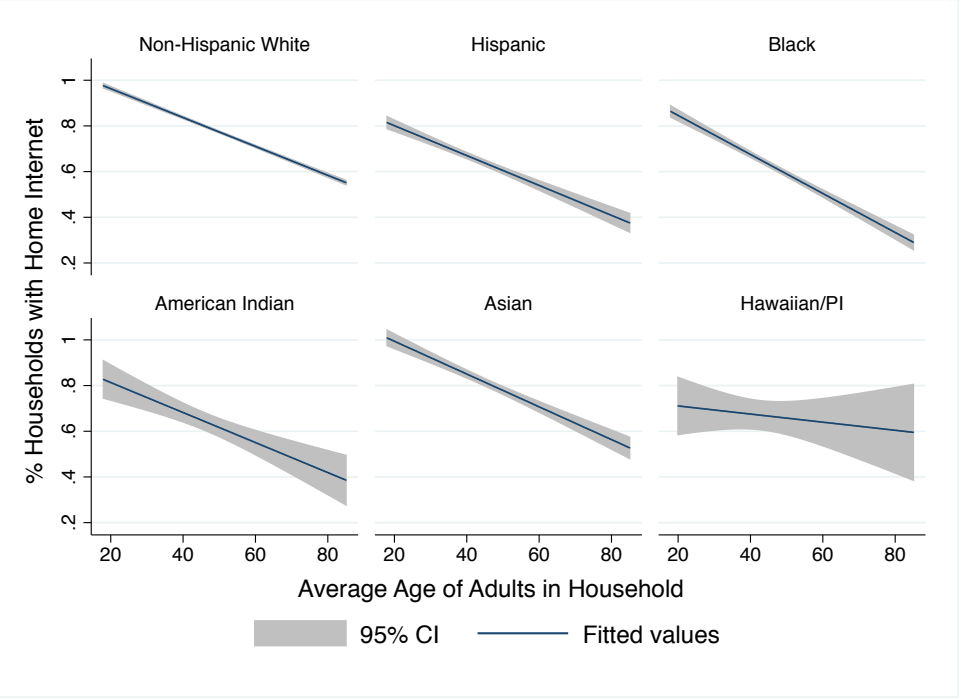
Race/Ethnicity	Household Maximum Education Attainment	Main Model with No Interaction Effect		Main Model with Race#Education Category Interaction Effect		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	< High School	-7.6%	0.000	-0.6%	0.749	Yes
	High School	-8.0%	0.000	-4.7%	0.001	Yes
	Some College	-6.1%	0.000	-9.9%	0.000	Yes
	B.S. Degree	-4.6%	0.000	-5.7%	0.000	No
	Master's Degree	-4.0%	0.000	-5.2%	0.025	No
	Professional Degree	-4.2%	0.000	-7.1%	0.153	No
	Doctorate Degree	-4.2%	0.000	-5.4%	0.299	No
Black	< High School	-9.8%	0.000	-6.1%	0.009	No
	High School	-10.6%	0.000	-9.0%	0.000	No
	Some College	-8.2%	0.000	-8.6%	0.000	No
	B.S. Degree	-6.3%	0.000	-8.2%	0.000	No
	Master's Degree	-5.5%	0.000	-4.7%	0.005	No
	Professional Degree	-5.8%	0.000	-4.2%	0.370	No
	Doctorate Degree	-5.7%	0.000	-10.1%	0.014	No
American Indian	< High School	-7.0%	0.001	7.2%	0.321	No
	High School	-7.4%	0.002	-7.7%	0.084	No
	Some College	-5.6%	0.004	-5.4%	0.146	No
	B.S. Degree	-4.2%	0.005	-8.5%	0.065	No
	Master's Degree	-3.7%	0.006	-8.1%	0.260	No
	Professional Degree	-3.9%	0.006	-7.9%	0.623	No
	Doctorate Degree	-3.8%	0.005	(not estimable)		No
Asian	< High School	-3.6%	0.010	3.0%	0.604	No
	High School	-3.7%	0.012	0.4%	0.893	No
	Some College	-2.7%	0.014	-2.9%	0.242	No
	B.S. Degree	-2.0%	0.015	-2.1%	0.152	No
	Master's Degree	-1.7%	0.016	-3.2%	0.068	No
	Professional Degree	-1.8%	0.016	-7.4%	0.019	No
	Doctorate Degree	-1.8%	0.015	-3.0%	0.287	No
Hawaiian/ PI	< High School	-10.1%	0.018	-13.3%	0.304	No
	High School	-10.9%	0.03	-21.8%	0.012	No
	Some College	-8.4%	0.044	7.1%	0.097	Yes
	B.S. Degree	-6.5%	0.054	-16.7%	0.002	No
	Master's Degree	-5.6%	0.058	-6.5%	0.427	No
	Professional Degree	-6.0%	0.056	(not estimable)		No
	Doctorate Degree	-5.9%	0.058	-35.1%	0.287	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Other Interaction Effects in Primary Econometric Model for Household-Level Home-Internet Adoption

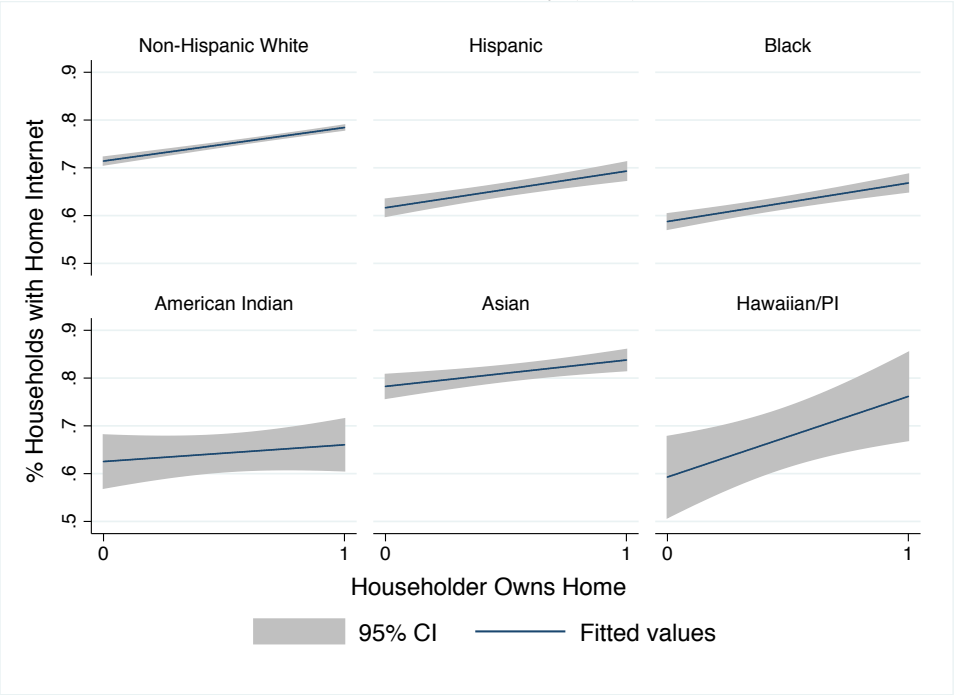
Our main model for home-internet adoption includes 9 independent variables and state-level dummy variable controls. We've explored in detail the interaction of the race/ethnicity independent variable with three of the other independent variables (family income, geography, and educational attainment). Below we present the two-way fitted values of home-internet adoption as a function of the remaining five independent variables, for each race/ethnicity. The slopes of these fitted lines are very similar for each race/ethnicity, suggesting that their effect on home-internet adoption is additive. We therefore do not explore the changes to the model's predicted values from the addition of these interactions in isolation. We do, however, present a model with all possible interaction effects in the final section of this Appendix III.

Figure A85:
Fitted Values of Home-Internet Adoption by Household Average Adult Age and Race/Ethnicity (2015)



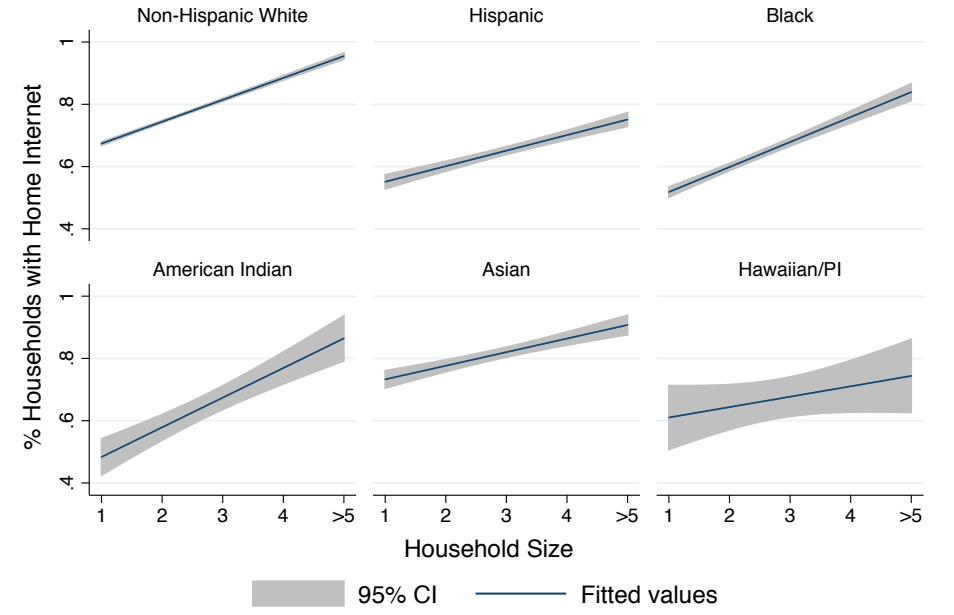
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A86:
Fitted Values of Home-Internet Adoption by Home Ownership and Race/Ethnicity (2015)



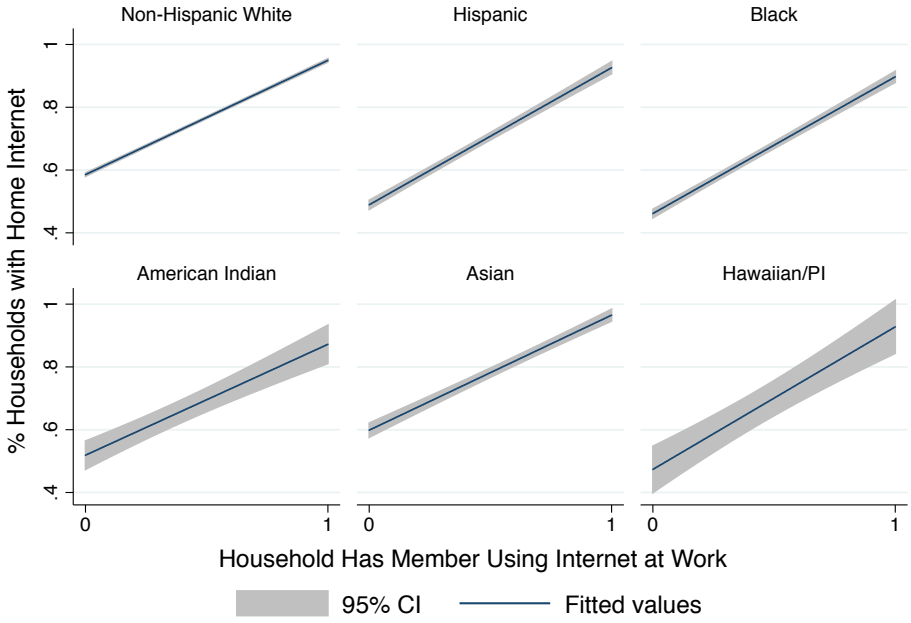
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A87:
Fitted Values of Home-Internet Adoption by Household Size and Race/Ethnicity (2015)



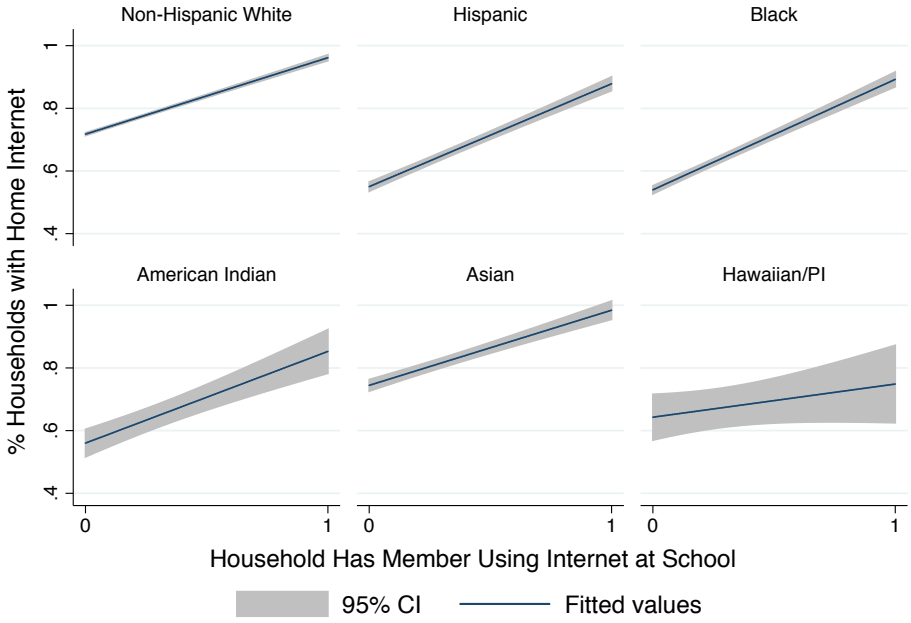
Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A88:
Fitted Values of Home-Internet Adoption by Internet Use at Work and Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A89:
Fitted Values of Home-Internet Adoption by Internet Use at School and Race/Ethnicity (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

A Model for Household-Level Home-Internet Adoption That Includes All Interaction Effects

Our analysis indicates that the independent variables used in our probability model for household home-internet adoption largely act in an additive manner. Thus our preferred model presented in the main section of this report does not include any interaction effects. However, in the interest of completeness, we present below a modified version of our main model that includes all possible interactions of the model's nine independent variables (but does not include interactions with the state categorical dummy variables), for a total of 36 interaction terms.

Because of the small sample sizes for some of these interactions (with numerous cases of perfect prediction or null cells), we must first truncate some of our categories in order to produce a model that can fit data for all races/ethnicities. These modifications are: consolidation of the 16-category family income variable into quintiles; consolidation of the 16-category household maximum educational attainment variable into 6 categories (less than high school; high school; some college; bachelor's degree; master's degree; and professional or doctorate degree); consolidation of the 7-category metropolitan area population size variable into a binary metropolitan indicator variable; and truncation of the household size categorical variable by setting the highest category as 5 or more members.

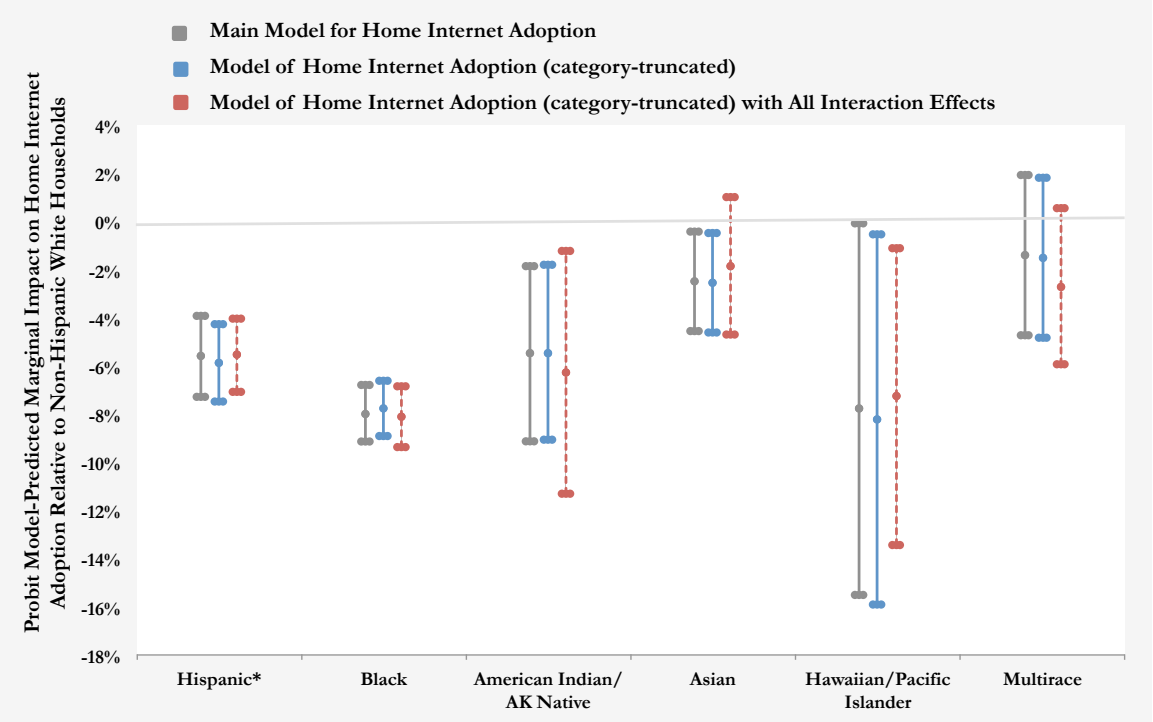
Below we present the results of this category-truncated full interaction model,[135] and compare the results of this model to those of the category-truncated model without interaction terms, as well as our preferred full model without interaction effects.

First, we compare the marginal impacts of race/ethnicity on household internet adoption for each model. As we show in Figure A90, there is little difference across the three models in terms of the magnitude of the marginal impact (*i.e.*, the percentage point difference in home-internet adoption, between White households and households of each other racial/ethnic group, is similar across the three probit models). The main difference is the size of the 95 percent confidence intervals in the model with all interaction effects, which are larger in some instances. This change results in no significant difference in adoption between Asian and White households. In other words, our primary findings – on the impact of race/ethnicity once we account for all other controls – are very similar in all three models.

Next we look at the model-predicted values of household home-internet adoption for each race/ethnicity, across the various levels of each independent variable, comparing the results from the category-truncated model with and without all interaction effects. We are looking specifically for how the slopes of the curves change (if at all) when we move from the model without interaction terms to the model with those terms. We do the same for the predicted marginal impacts of race/ethnicity.

[135] The model with all interaction effects measures the binary outcome of home internet adoption for householders as a function of race/ethnicity, family income quintile, household maximum educational attainment (6-category), metropolitan area status (binary), average age of adults in household, home ownership, household size (5-category), presence of a household member who uses internet at work, presence of a household member who uses internet at school, state-level dummy variables, and the 36 interaction terms (not including any interactions for the state categorical dummy variables).

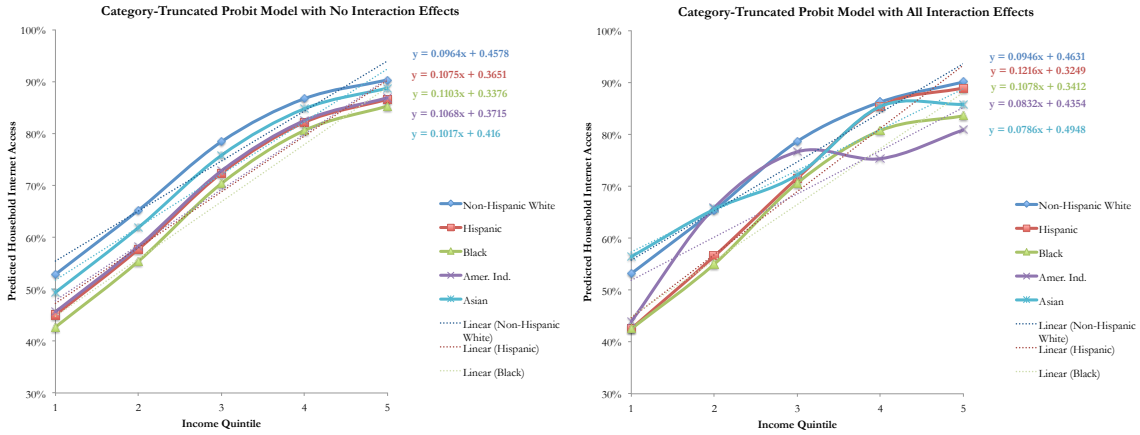
Figure A90:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption Comparison of Main Model, Category-Truncated Model with No Interaction Effects and Category-Truncated Model with All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement. Center points represent the marginal impact on home-internet adoption for each race/ethnicity relative to non-Hispanic White households, as determined by the probability models described herein. Error bars represent 95 percent confidence interval calculated using successive difference replication standard error values. Differences between values for non-Hispanic White households and households of other races/ethnicities are statistically significant at $p<0.05$ for all races/ethnicities in all models, except for multirace households (in all models) and Asian households (in the model with interaction effects).

Figure A91 compares the results for the truncated model with and without interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity by income quintile. Most notable from these results is that in the interaction effects model, the predicted values for home-internet adoption by Hispanic households at higher incomes are close to those for White households of comparably higher incomes. This also indicates that the negative impact of low income on home-internet adoption is less acute for White and Asian households; and the positive impact of high income is less acute for Black and American Indian/Alaska Native households.

Figure A91:
Category-Truncated Probit Model-Predicted Home-Internet Adoption by Race/Ethnicity and Family-Income Quintile, No Interaction Effects vs. All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A92 below illustrates the changes created by including the 36 interaction terms in the econometric model – showing changes to the marginal impact on home-internet adoption of race or ethnicity, for each income quintile. Adding the interaction terms to the category-truncated probit model increases the marginal impact of Hispanic ethnicity on home-internet adoption for the bottom three income quintiles (a result in the opposite direction of that observed for the model with just a race/income interaction effect), and decreases the marginal impact for the top two quintiles (which are no longer statistically significantly different from White households in the top two income quintiles). There is little change in the marginal impact values for Black households in each income quintile. The impact of the interaction terms on other races/ethnicities is less consistent. However, these changes in marginal impact between models are not statistically significant for most races/ethnicities and income quintiles.

From these data and the above exploration of a race/income interaction effect in isolation, we conclude that there may be a small race/income interaction effect that amplifies the impact of income for Hispanic households, erasing the adoption gap between Hispanics and Whites among higher income households. Put another way, the impact of high income may have a larger impact for Hispanic households than it does for Black households, all other things being equal. The data also suggests that home-internet adoption in Asian households is not impacted by income as acutely as adoption is impacted by income in other non-White households.

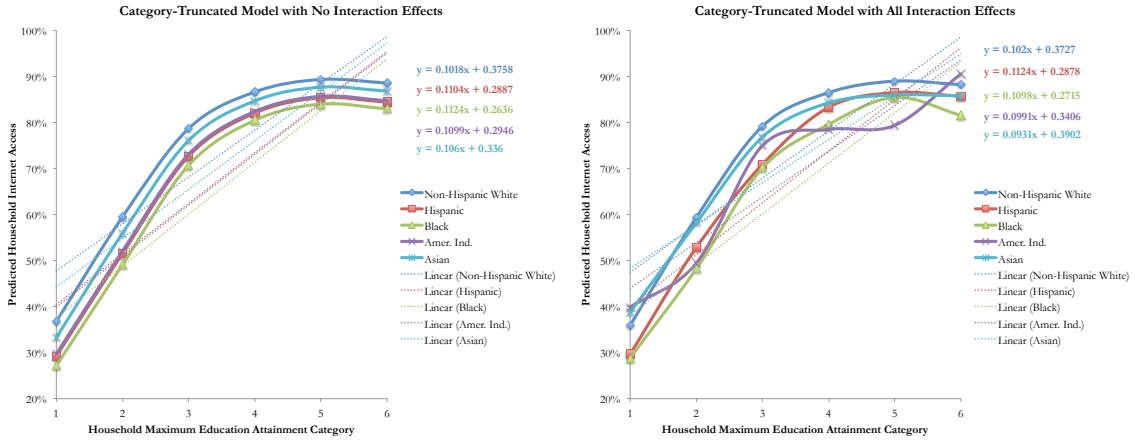
Figure A92:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Family-Income Quintile, No Interaction Effects vs. All Interaction Effects (2015)

Race/Ethnicity	Income Quintile	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	Bottom	-7.8%	0.000	-10.6%	0.000	No
	Second	-7.5%	0.000	-8.9%	0.000	No
	Third	-6.1%	0.000	-7.1%	0.000	No
	Fourth	-4.6%	0.000	-0.8%	0.502	No
	Top	-3.7%	0.000	-1.1%	0.345	No
Black	Bottom	-10.2%	0.000	-10.7%	0.000	No
	Second	-9.8%	0.000	-10.4%	0.000	No
	Third	-8.1%	0.000	-8.0%	0.000	No
	Fourth	-6.1%	0.000	-5.5%	0.000	No
	Top	-5.0%	0.000	-6.5%	0.000	No
American Indian/ AK Native	Bottom	-7.3%	0.005	-9.2%	0.027	No
	Second	-7.0%	0.007	0.5%	0.923	No
	Third	-5.6%	0.009	-2.0%	0.692	No
	Fourth	-4.2%	0.012	-10.9%	0.022	No
	Top	-3.4%	0.013	-9.2%	0.134	No
Asian	Bottom	-3.5%	0.011	3.2%	0.351	No
	Second	-3.3%	0.012	0.2%	0.959	No
	Third	-2.6%	0.013	-6.5%	0.014	No
	Fourth	-1.9%	0.014	-0.8%	0.639	No
	Top	-1.6%	0.015	-4.3%	0.005	No
Hawaiian/ Pacific Islander	Bottom	-10.7%	0.016	-10.9%	0.061	No
	Second	-10.4%	0.022	-12.5%	0.106	No
	Third	-8.6%	0.030	-7.2%	0.289	No
	Fourth	-6.5%	0.038	4.8%	0.209	Yes
	Top	-5.4%	0.043	-12.2%	0.104	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A93 compares the results for the truncated model with and without interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity by household maximum educational attainment category (a 6-category variable, with options for educational attainment of: less than high school-level; high school; some college; bachelor's degree; master's degree; and professional or doctorate degree). Though there are some change to the shapes of the predicted curves when we move from the model without interaction effects to the model with them (especially for American Indian/Alaska Native households), there is little change in the fitted linear slopes.

Figure A93:
Category-Truncated Probit Model-Predicted Home-Internet Adoption by Race/Ethnicity and Household Maximum Educational Attainment, No Interaction Effects vs. All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

There is little change in the marginal impact values for Hispanic and Black households, across each level of educational attainment, when we move to the model with all interaction effects. The impact of the interaction term on other races/ethnicities is less consistent, with many of the standard errors so large as to render the marginal impacts of the model switch not statistically significant.

From these data and the above exploration of a race/education interaction effect in isolation, it appears that there is no race/education interaction effect.

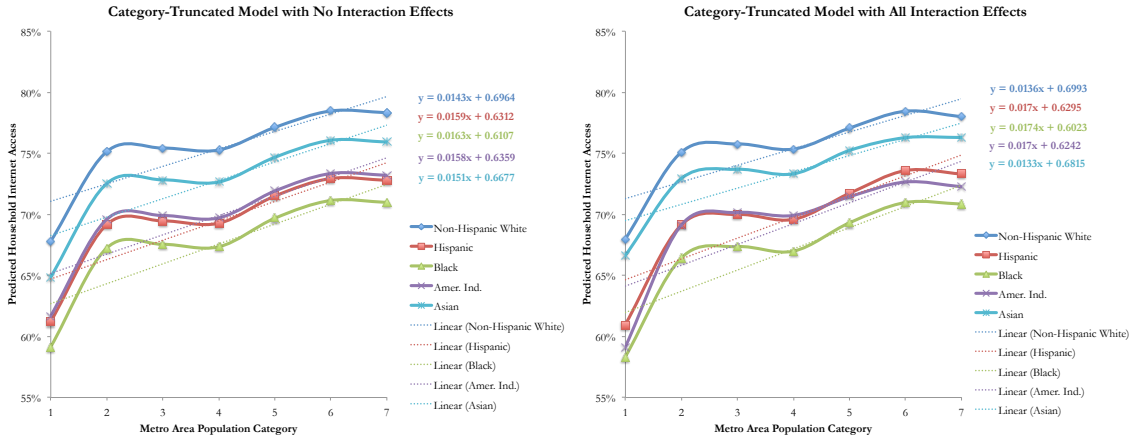
Figure A94:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Household Maximum Educational Attainment, No Interaction Effects vs. All Interaction Effects (2015)

Race/Ethnicity	Household Maximum Education Attainment	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	< High School	-7.5%	0.000	-6.3%	0.003	No
	High School	-8.0%	0.000	-6.5%	0.000	No
	Some College	-6.0%	0.000	-8.3%	0.000	No
	B.S. Degree	-4.6%	0.000	-3.2%	0.010	No
	Master's Degree	-4.0%	0.000	-2.5%	0.167	No
	Prof. or PhD Degree	-4.2%	0.000	-2.5%	0.412	No
Black	< High School	-9.6%	0.000	-7.1%	0.002	No
	High School	-10.4%	0.000	-11.1%	0.000	No
	Some College	-8.0%	0.000	-9.1%	0.000	No
	B.S. Degree	-6.2%	0.000	-6.9%	0.000	No
	Master's Degree	-5.3%	0.000	-3.5%	0.019	No
	Prof. or PhD Degree	-5.6%	0.000	-6.7%	0.022	No
American Indian	< High School	-7.0%	0.004	3.9%	0.513	No
	High School	-7.4%	0.006	-9.9%	0.045	No
	Some College	-5.6%	0.009	-4.2%	0.287	No
	B.S. Degree	-4.2%	0.011	-8.0%	0.120	No
	Master's Degree	-3.7%	0.012	-9.6%	0.150	No
	Prof. or PhD Degree	-3.9%	0.012	2.4%	0.802	No
Asian	< High School	-3.5%	0.009	2.8%	0.597	No
	High School	-3.6%	0.011	-1.2%	0.749	No
	Some College	-2.6%	0.013	-2.3%	0.356	No
	B.S. Degree	-2.0%	0.014	-2.2%	0.150	No
	Master's Degree	-1.7%	0.015	-3.0%	0.101	No
	Prof. or PhD Degree	-1.8%	0.014	-2.4%	0.276	No
Hawaiian/ PI	< High School	-10.1%	0.011	-15.2%	0.133	No
	High School	-11.0%	0.019	-16.0%	0.018	No
	Some College	-8.5%	0.029	4.5%	0.306	No
	B.S. Degree	-6.6%	0.037	-13.1%	0.016	No
	Master's Degree	-5.7%	0.041	-5.7%	0.345	No
	Prof. or PhD Degree	-6.0%	0.040	-4.3%	0.766	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A95 compares the results for the truncated model with and without interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity by metropolitan area size category (a 7-category variable, with options for: non-metro areas; metro areas with 100,000 to 250,000 persons; 250,000 to 500,000 persons; 500,000 to 1 million persons; 1 million to 2.5 million persons; 2.5 to 5 million persons; and more than 5 million persons). There is little change in the fitted linear slopes when we move from the model without interaction effects to the model with the 36 separate interaction effect variables.

Figure A95:
Category-Truncated Probit Model-Predicted Home-Internet Adoption by Race/Ethnicity and Metropolitan-Areas Population Category, No Interaction Effects vs. All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

The marginal impacts shown in both models reflect the lack of any apparent race/geography interaction effect (*see* Figure A96). The most notable difference is the loss of statistical significance for the difference between Asian and White households, though the magnitude of the marginal impact is similar in both models.

From these data and the above exploration of a race/geography interaction effect in isolation, we have little reason to suspect that there is a meaningful difference in the impact of geography for different racial/ethnic groups.

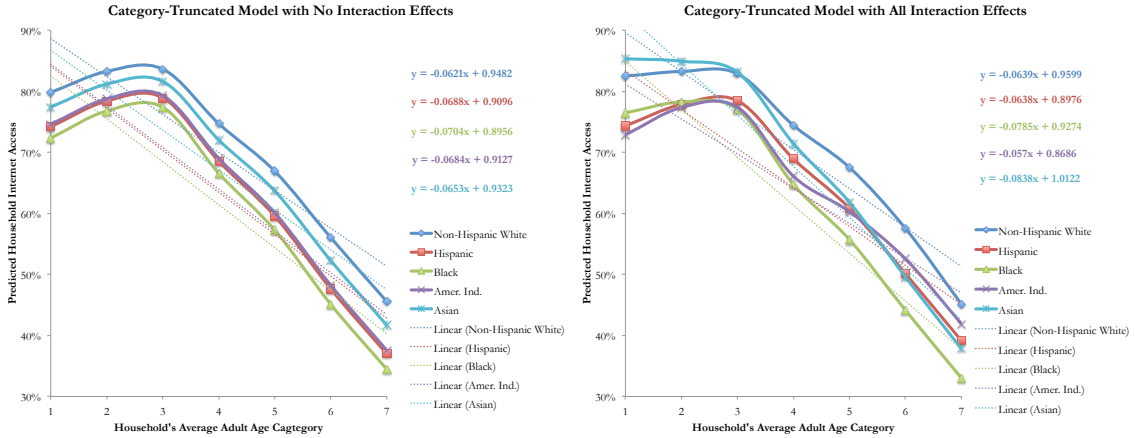
Figure A96:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Metropolitan-Areas Population Category, No Interaction Effects vs. All Interaction Effects (2015)

Race/Ethnicity	Metropolitan Area Population	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	Non-Metro	-6.6%	0.000	-7.0%	0.000	No
	100K-250K	-6.0%	0.000	-6.0%	0.000	No
	250K-500K	-6.0%	0.000	-5.8%	0.000	No
	500K-1M	-6.0%	0.000	-5.8%	0.000	No
	1M-2.5M	-5.6%	0.000	-5.3%	0.000	No
	2.5M-5M	-5.5%	0.000	-4.9%	0.000	No
	5M+	-5.5%	0.000	-4.7%	0.000	No
Black	Non-Metro	-8.7%	0.000	-9.6%	0.000	No
	100K-250K	-7.9%	0.000	-8.7%	0.000	No
	250K-500K	-7.9%	0.000	-8.4%	0.000	No
	500K-1M	-7.9%	0.000	-8.4%	0.000	No
	1M-2.5M	-7.4%	0.000	-7.8%	0.000	No
	2.5M-5M	-7.3%	0.000	-7.5%	0.000	No
	5M+	-7.3%	0.000	-7.2%	0.000	No
American Indian	Non-Metro	-6.1%	0.007	-8.8%	0.003	No
	100K-250K	-5.5%	0.008	-6.0%	0.046	No
	250K-500K	-5.5%	0.008	-5.6%	0.057	No
	500K-1M	-5.6%	0.008	-5.4%	0.067	No
	1M-2.5M	-5.2%	0.009	-5.6%	0.048	No
	2.5M-5M	-5.1%	0.009	-5.8%	0.049	No
	5M+	-5.1%	0.009	-5.7%	0.049	No
Asian	Non-Metro	-2.9%	0.012	-1.3%	0.784	No
	100K-250K	-2.6%	0.012	-2.1%	0.132	No
	250K-500K	-2.6%	0.012	-2.1%	0.128	No
	500K-1M	-2.6%	0.012	-2.0%	0.134	No
	1M-2.5M	-2.4%	0.013	-1.8%	0.141	No
	2.5M-5M	-2.4%	0.013	-2.2%	0.062	No
	5M+	-2.4%	0.013	-1.7%	0.124	No
Hawaiian/ PI	Non-Metro	-9.2%	0.023	-17.4%	0.001	No
	100K-250K	-8.4%	0.027	-3.6%	0.322	No
	250K-500K	-8.4%	0.027	-3.7%	0.301	No
	500K-1M	-8.4%	0.027	-4.3%	0.222	No
	1M-2.5M	-7.9%	0.028	-4.7%	0.146	No
	2.5M-5M	-7.8%	0.029	-4.6%	0.151	No
	5M+	-7.8%	0.029	-6.3%	0.049	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A97 compares the results for the truncated model, with and without all interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity based on the average age of a household's adults (7 categories, with options for: under 25; 25-34; 35 to 50; 51 to 61; 62 to 69; 70 to 79; and 80-plus). There is very little change in the slopes for these curve's fitted lines. The largest change is observed for American Indian/Alaska Native and Asian households. For the former, we see a smaller decline for older households when using the interaction effects model. For the latter, we see higher adoption levels for young households when using the interaction effects model. However, none of these changes in predicted values, when moving between models, is statistically significant.

Figure A97:
Category-Truncated Probit Model-Predicted Home-Internet Adoption by Race/Ethnicity and Household Average Adult Age, No Interaction Effects vs. All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

The change in marginal impacts when moving to the model with all interaction effects suggests a few interesting differences (*see* Figure A98). The interaction effect model shows a slightly larger gap between young Hispanic and young American Indian/Alaska Native households relative to young White households. We also see a slightly smaller gap between young Black and young White households in the interaction effects model. We also observe the loss of statistical significance in the marginal effect for Asian households under the average age of 62. However, as is the case elsewhere, the marginal impacts in both models are not statistically significantly different from each other.

Thus, to the extent that there is a meaningful interaction effect here, it would appear to be one that increases the positive impact of young average adult age for Asian households, and that reduces this positive impact for the youngest Hispanic and American Indian/Alaska Native households.

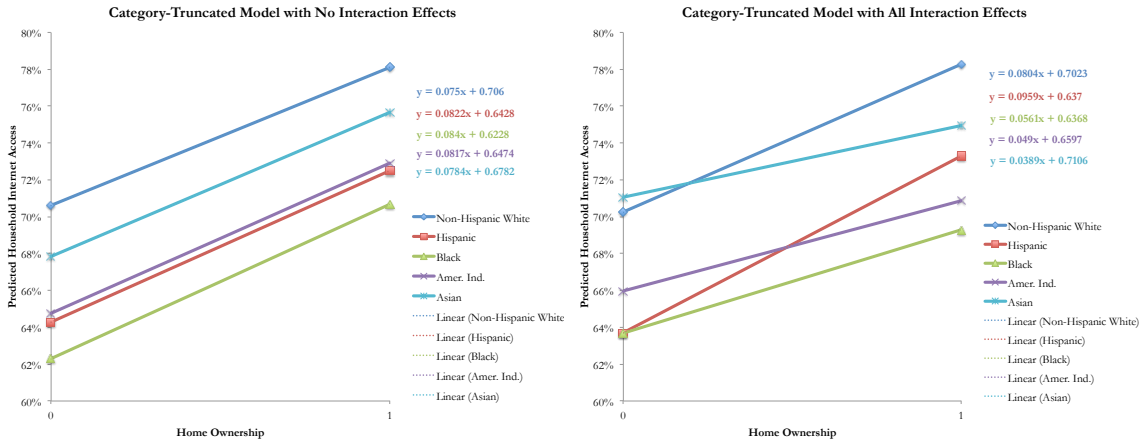
Figure A98:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Household Average Adult Age, No Interaction Effects vs. All Interaction Effects (2015)

Race/Ethnicity	Average Age of Adults in Household	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	Under 25	-5.6%	0.000	-8.1%	0.000	No
	25 to 34	-4.9%	0.000	-5.4%	0.000	No
	35 to 50	-4.7%	0.000	-4.4%	0.000	No
	51 to 61	-6.2%	0.000	-5.5%	0.000	No
	62 to 69	-7.3%	0.000	-6.7%	0.000	No
	70 to 79	-8.4%	0.000	-7.4%	0.000	No
	80+	-8.6%	0.000	-6.0%	0.011	No
Black	Under 25	-7.4%	0.000	-6.0%	0.000	No
	25 to 34	-6.5%	0.000	-5.0%	0.000	No
	35 to 50	-6.3%	0.000	-5.9%	0.000	No
	51 to 61	-8.1%	0.000	-9.7%	0.000	No
	62 to 69	-9.6%	0.000	-11.8%	0.000	No
	70 to 79	-10.9%	0.000	-13.4%	0.000	No
	80+	-11.1%	0.000	-12.1%	0.000	No
American Indian	Under 25	-5.2%	0.009	-9.6%	0.052	No
	25 to 34	-4.5%	0.010	-5.9%	0.063	No
	35 to 50	-4.3%	0.010	-5.5%	0.022	No
	51 to 61	-5.7%	0.008	-8.3%	0.009	No
	62 to 69	-6.8%	0.007	-7.2%	0.072	No
	70 to 79	-7.8%	0.006	-5.0%	0.336	No
	80+	-8.0%	0.005	-3.2%	0.621	No
Asian	Under 25	-2.4%	0.013	2.9%	0.172	No
	25 to 34	-2.1%	0.013	1.7%	0.252	No
	35 to 50	-2.0%	0.013	0.2%	0.840	No
	51 to 61	-2.7%	0.013	-3.0%	0.105	No
	62 to 69	-3.2%	0.012	-5.7%	0.019	No
	70 to 79	-3.8%	0.011	-8.0%	0.014	No
	80+	-3.9%	0.010	-7.3%	0.052	No
Hawaiian/ PI	Under 25	-7.9%	0.031	-15.0%	0.007	No
	25 to 34	-6.9%	0.034	-11.1%	0.001	No
	35 to 50	-6.7%	0.033	-9.7%	0.001	No
	51 to 61	-8.7%	0.027	-4.6%	0.220	No
	62 to 69	-10.2%	0.023	-2.1%	0.709	No
	70 to 79	-11.6%	0.018	-1.7%	0.831	No
	80+	-11.7%	0.014	-3.1%	0.732	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A99 compares the results for the truncated model, with and without all interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity by home ownership status. The slopes for Black, American Indian/Alaska Native, and Asian households are shallower in the model with all interaction effects. This could indicate that home ownership has less of an impact on internet adoption for Black, American Indian/Alaska Native, and Asian households. However, looking at the predicted values, it appears that these changes in slopes are created by changes in both populations: *i.e.,* slightly higher predicted values of adoption for renters in the interaction effects model, but slightly lower predicted values of adoption for home owners. None of these changes in predicted values when moving between models is statistically significant.

Figure A99:
Category-Truncated Probit Model-Predicted Home-Internet Adoption
by Race/Ethnicity and Home Ownership,
No Interaction Effects vs. All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

The change in marginal impacts when moving to the model with all interaction effects confirms these observations (*see* Figure A100). For Black, American Indian/Alaska Native, and Asian renters, the move to the model with interaction effects slightly decreases their adoption gap with White renters, with the gap no longer statistically significant for the latter two. The move to the interaction effects model increases the gap for these same three groups among the home-owning population, and all three figures are or are close to being statistically significant (though none of the overall changes in marginal impact between the two models are statistically significant).

This data suggests the possibility that the impact of home ownership on household internet adoption is less for members of these three races/ethnicities than it is others. But the magnitude of this effect is small, and the gap is no different from the model without interaction effects.

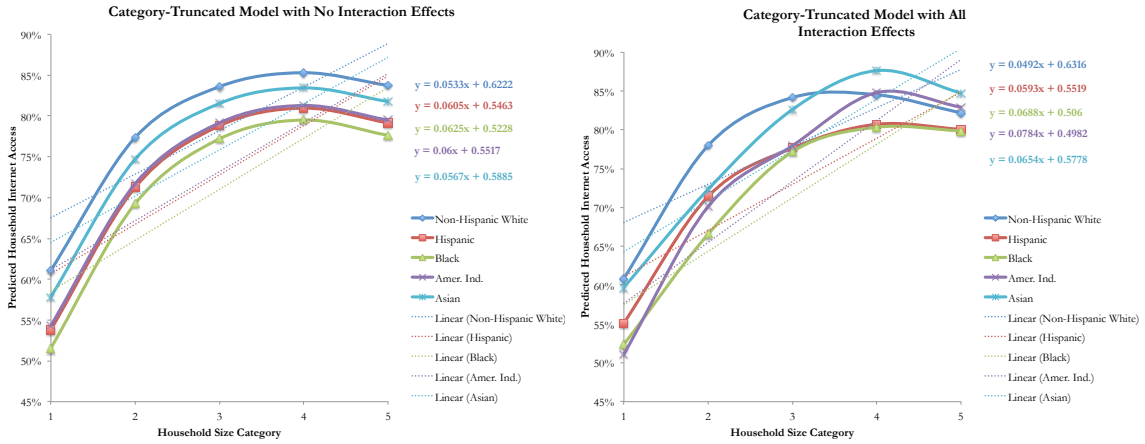
Figure A100:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption
by Race/Ethnicity and Home Ownership,
No Interaction Effects vs. All Interaction Effects (2015)

Race/Ethnicity	Household Ownership Status	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	Rent	-6.3%	0.000	-6.5%	0.000	No
	Own	-5.6%	0.000	-5.0%	0.000	No
Black	Rent	-8.3%	0.000	-6.6%	0.000	No
	Own	-7.4%	0.000	-9.0%	0.000	No
American Indian	Rent	-5.9%	0.008	-4.3%	0.199	No
	Own	-5.2%	0.009	-7.4%	0.020	No
Asian	Rent	-2.8%	0.012	0.8%	0.649	No
	Own	-2.4%	0.013	-3.3%	0.061	No
Hawaiian/ PI	Rent	-8.8%	0.024	-9.5%	0.010	No
	Own	-7.9%	0.029	-6.0%	0.157	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A101 compares the results for the truncated model, with and without all interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity by the number of persons in the household. The slopes for each race/ethnicity are similar in both models, with a slight steepening for American Indian/Alaska Native households. This reflects mostly an inflation of the predicted value for adoption in larger American Indian/Alaska Native households (though the change in values between models is not statistically significant).

Figure A101:
Category-Truncated Probit Model-Predicted Home-Internet Adoption by Race/Ethnicity and Household Size, No Interaction Effects vs. All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

The change in marginal impacts when moving to the model with all interaction effects suggests a few interesting differences (*see* Figure A102). The difference between White and Hispanic households with 5 or more members is no longer statistically significant. The benefit in adoption when moving from a single person household to a two person household is slightly lower for Black households relative to others. We see the erasure of the adoption gap between larger American Indian/Alaska Native households and larger White households. The impact of the interaction effects on other groups is less consistent, likely reflecting the small sample sizes for these populations.

These changes in predicted values largely involve households of larger sizes, and they are small relative to the overall positive impact on adoption shown for multiple person households as opposed to single person households. To the extent that there is an interaction effect here, it would appear to be one that lessens the positive impact of multi-person households for non-White racial/ethnic groups, and that mitigates the small negative impact of very large household size for these same groups.

Figure A102:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Household Size, No Interaction Effects vs. All Interaction Effects (2015)

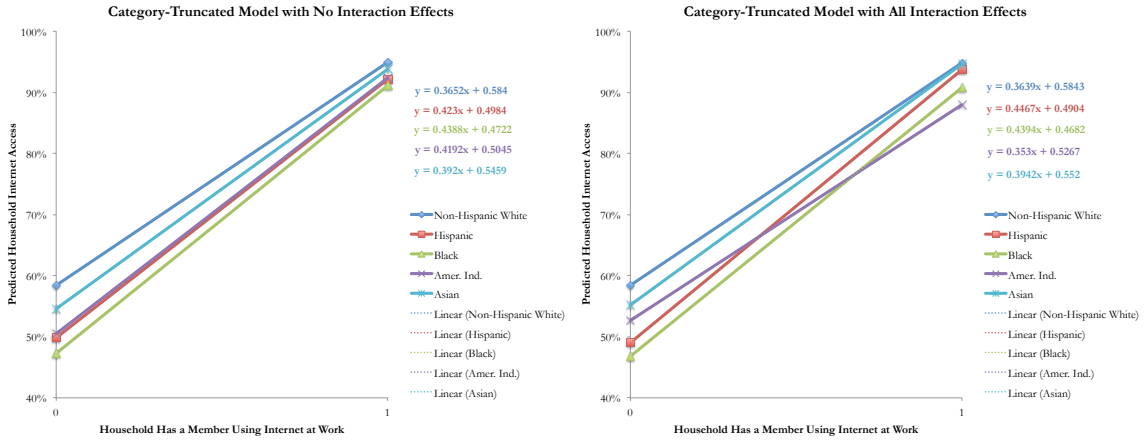
Race/Ethnicity	Number of Persons in Household	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	1	-7.3%	0.000	-5.8%	0.001	No
	2	-6.1%	0.000	-6.6%	0.000	No
	3	-4.8%	0.000	-6.5%	0.000	No
	4	-4.3%	0.000	-3.8%	0.001	No
	>5	-4.6%	0.000	-2.1%	0.111	No
Black	1	-9.5%	0.000	-8.5%	0.000	No
	2	-8.1%	0.000	-11.4%	0.000	Yes
	3	-6.4%	0.000	-7.0%	0.000	No
	4	-5.8%	0.000	-4.2%	0.003	No
	>5	-6.1%	0.000	-2.3%	0.197	No
American Indian	1	-6.8%	0.006	-9.8%	0.056	No
	2	-5.7%	0.009	-7.8%	0.054	No
	3	-4.4%	0.010	-6.2%	0.169	No
	4	-4.0%	0.010	0.3%	0.951	No
	>5	-4.2%	0.010	0.7%	0.842	No
Asian	1	-3.3%	0.011	-1.1%	0.694	No
	2	-2.7%	0.013	-5.6%	0.017	No
	3	-2.1%	0.013	-1.5%	0.447	No
	4	-1.9%	0.013	3.1%	0.052	No
	>5	-2.0%	0.013	2.6%	0.268	No
Hawaiian/ PI	1	-10.1%	0.020	-11.5%	0.042	No
	2	-8.6%	0.029	2.8%	0.645	No
	3	-6.8%	0.034	-16.4%	0.01	No
	4	-6.2%	0.034	-12.4%	0.075	No
	>5	-6.5%	0.033	-8.9%	0.053	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A103 compares the results for the truncated model, with and without all interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity by the presence of a household member using the internet at work. The slopes for each racial/ethnic group are similar in both models.

The change in marginal impacts is small, when moving to the model with all interaction effects (*see* Figure A104). The most notable change is a slight increase in the gap between American Indian/Alaska Native households with a member who uses the internet at work and White households with a member using the internet at work. We also observe a loss of statistical significance in some cases (due to an increase in standard error). Overall, there does not appear to be any appreciable interaction effect for work internet use, though as is the case with other factors, the negative impact on home adoption from a lack of use at work use appears to be slightly more acute for Black and Hispanic households.

Figure A103:
Category-Truncated Probit Model-Predicted Home-Internet Adoption by Race/Ethnicity and Presence of Household Member Using Internet at Work, No Interaction Effects vs. All Interaction Effects (2015)



Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A104:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Presence of Household Member Using Internet at Work, No Interaction Effects vs. All Interaction Effects (2015)

Race/Ethnicity	Household Uses Internet at Work?	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	No	-8.6%	0.000	-9.4%	0.000	No
	Yes	-2.8%	0.000	-1.1%	0.063	No
Black	No	-11.2%	0.000	-11.6%	0.000	No
	Yes	-3.8%	0.000	-4.1%	0.000	No
American Indian	No	-7.9%	0.006	-5.8%	0.115	No
	Yes	-2.6%	0.018	-6.8%	0.018	No
Asian	No	-3.8%	0.011	-3.2%	0.181	No
	Yes	-1.1%	0.017	-0.2%	0.824	No
Hawaiian/ PI	No	-11.8%	0.020	-10.9%	0.044	No
	Yes	-4.1%	0.058	-3.1%	0.299	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A105 compares the results for the truncated model, with and without all interaction effects, showing the predicted level of home-internet adoption for each race/ethnicity by the presence of a household member using the internet at school or university. The slopes for each race/ethnicity are similar in both models.

The change in marginal impacts, when moving to the model with all interaction effects, shows little difference in magnitude or statistical significance (*see* Figure A106). The most notable change from the move is for Asian households with a member who uses the internet at school, which goes from negative to positive relative to White households. Overall, there does not appear to be any appreciable interaction effect for school internet use, though the data suggests that the positive impact of a household having such a member who uses the internet at school is slightly higher for Asian households than it is for households of other races/ethnicities.

Figure A105:
Category-Truncated Probit Model-Predicted Home-Internet Adoption by Race/Ethnicity and Presence of Household Member Using Internet at School, No Interaction Effects vs. All Interaction Effects (2015)

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Figure A106:
Probit Model-Predicted Marginal Impacts of Race/Ethnicity on Home-Internet Adoption by Race/Ethnicity and Presence of Household Member Using Internet at School, No Interaction Effects vs. All Interaction Effects (2015)

Race/Ethnicity	Household Uses Internet at School/University?	Category-Truncated Model with No Interaction Effect		Category Truncated Model with All Race/Ethnicity and All Income Interaction Effects		Is the Difference in Marginal Impact Between Models Statistically Significant?
		Marginal Impact	p-value	Marginal Impact	p-value	
Hispanic	No	-6.8%	0.000	-6.3%	0.000	No
	Yes	-2.4%	0.000	-2.7%	0.000	No
Black	No	-9.0%	0.000	-9.6%	0.000	No
	Yes	-3.3%	0.000	-2.7%	0.000	No
American Indian	No	-6.3%	0.008	-6.6%	0.034	No
	Yes	-2.2%	0.015	-5.2%	0.051	No
Asian	No	-3.0%	0.012	-3.0%	0.095	No
	Yes	-1.0%	0.016	2.5%	0.003	Yes
Hawaiian/ PI	No	-9.6%	0.025	-4.7%	0.213	No
	Yes	-3.6%	0.051	-16.4%	0.002	No

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

Below in Figure A107 we present the marginal impact on household internet adoption of all independent variables in the model with the 36 interaction terms. The results of this analysis closely mirrors the result of our preferred model, which does not include interaction terms. All other factors being equal, we observe that:

- Whites are 6 to 8 percentage points more likely than households of other races/ethnicities (except for Asian and multirace households) to adopt home internet.

- Home-internet adoption increases as a household moves from the bottom income quintile to the middle income quintiles.

- Home-internet adoption increases with increasing education, but the effect levels off for college-educated households and those with even higher maximum educational attainment.

- Single occupant households are less likely to have home internet than households with multiple members.

- Households in non-metropolitan areas are less likely to have home internet than households in metro areas.

- Households who own their home are slightly more likely to subscribe to home internet than households who rent their home.

- Households that have one or more members using the internet at work are far more likely to adopt home internet than those without any such members. This marginal impact is 25 percentage points. That is larger even than the marginal impact of having an advanced degree versus having less than a high school education.

- Households that have one or more members using the internet at school or university are far more likely to adopt home internet than those without any such members. This marginal impact is 19 percentage points – three and a half times larger than the marginal impact of moving from the bottom to the top income quintile.

In sum, while there is some evidence of small interaction effects, the addition of these interaction terms to our preferred model did not significantly increase the model's explanatory power. And while none of our independent variables act in an opposed manner, the interaction effects model does reflect the small difference in magnitude that various independent variables have on home-internet adoption across races/ethnicities. The major conclusions drawn from our non-interaction effects model are robust to the inclusion of interaction terms. Namely, in both models we observe a significant home-internet adoption gap between White households and Hispanic and Black households, and we find that exposure to the internet outside of the home (at work and/or at school) is by far the most important factor associated with home-internet adoption other than family income.

Figure A107:
Probit Model-Predicted Marginal Impacts of Various Demographic Factors on Home-Internet Adoption, from Model Including All (non-state) Interaction Effects (2015)

Independent Variable		Marginal Impact (relative to base level)	p-value	95 Percent Confidence Interval	
Race/Ethnicity	Non-Hispanic White		(base level)		
	Hispanic	-5.5%	0.000	-7.1%	-4.0%
	Black	-8.1%	0.000	-9.4%	-6.8%
	Amer. Ind.	-6.3%	0.015	-11.3%	-1.2%
	Asian	-1.8%	0.214	-4.7%	1.0%
	Hawaiian/PI	-7.3%	0.021	-13.4%	-1.1%
	Multirace	-2.7%	0.104	-5.9%	0.6%
Income Quintile	Bottom		(base level)		
	Second	2.7%	0.000	1.2%	4.1%
	Third	7.0%	0.000	5.6%	8.3%
	Fourth	8.7%	0.000	7.2%	10.3%
	Top	5.3%	0.000	3.2%	7.4%
Household Maximum Education Attainment	< High School		(base level)		
	High School	6.8%	0.000	3.9%	9.6%
	Some College	14.7%	0.000	11.9%	17.5%
	B.S. Degree	17.3%	0.000	14.4%	20.2%
	Master's Degree	19.5%	0.000	16.3%	22.6%
	Prof. or PhD Degree	17.9%	0.000	14.0%	21.8%
Number of Persons in Household	1		(base level)		
	2	4.0%	0.000	2.9%	5.0%
	3	2.4%	0.003	0.8%	4.0%
	4	-0.1%	0.907	-2.5%	2.2%
	>5	-0.4%	0.781	-3.6%	2.7%
Household Location	Non-Metropolitan		(base level)		
	Metropolitan	4.3%	0.000	3.1%	5.4%
Home Ownership	Rent		(base level)		
	Own	3.1%	0.000	2.2%	4.0%
Household Member Work Use	Doesn't Use at Work		(base level)		
	Does Use at Work	24.8%	0.000	23.8%	25.9%
Household Member School Use	Doesn't Use at School		(base level)		
	Does Use at School	18.5%	0.000	16.9%	20.1%
Average Age of Adults in Household		-0.1%	0.000	-0.2%	-0.1%

Source: Free Press analysis of July 2015 Current Population Survey Computer and Internet Use Supplement.

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