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# Mobile Banking as a Mechanism to Increase Access to Financial Services

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# Mobile Banking as a Mechanism to Increase Access to Financial Services

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under the advising of

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## **Abstract**

We study the determinants of mobile banking adoption, with a special interest on how mobile banking can increase access to financial services among racial and ethnic minorities in the United States. In our analysis, we use survey data from two different sources: 1) Survey of Consumers' Use of Mobile Financial Services (SCUMFS) We conduct a regression analysis and Oaxaca Decomposition to determine the explanatory factors of racial and ethnic gaps in bank account ownership. We find that minorities are less likely to use mobile banking than Whites in the NSUUH, but more likely to adopt mobile banking according to SCUMFS, after controlling for individual characteristics. When we restrict our sample to only individuals with a bank account in the NSUUH, we no longer observe differences in mobile banking usage between Whites and Hispanics. We find that age is a major factor explaining the gap in mobile banking usage among Whites and Hispanics, and that education and income reduce this gap in both datasets.

**Working paper, please do not cite without permission**

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## **I. Introduction**

Participation in the formal financial sector, which is associated with economic inclusion, is an important policy issue. The usage of new technologies and innovation has been the main source of proposed solutions in addressing gaps in bank account ownership between demographic groups. Between 2013 and 2015 the number of unbanked American households fell by 0.7-percentage points, and fully banked American households rose by a full percentage point (Federal Deposit Insurance Corporation, 2016). According to the FDIC, “approximately half of the decline in the unbanked rate from 2013 to 2015 can be attributed to improvements in the socioeconomic circumstances in U.S. households” (Federal Deposit Insurance Corporation, 2016).

Unbanked and underbanked rates are higher among low-income, less-educated, younger, and black and Hispanic households (Federal Deposit Insurance Corporation, 2016). Heightened financial inclusion has bred not only economic growth and stability for target individuals and households but also for the market at large (Dabla-Norris, Ji, Townsend, & Unsal, 2015). Finding ways to mitigate these gaps, therefore, is paramount to improving both the economy and the standard of living for American households.

Mobile platforms for banking and financial transactions is one form of mitigating technology, allowing individuals to use a more robust set of financial tools and creating the possibility for greater penetration into markets. In fact, Hispanics, non-Hispanic Blacks, and younger Americans report using mobile banking and mobile payment services to a higher degree than the average consumer (Board of Governors of the Federal Reserve System, 2016); all three of these demographic groups are of interest when looking at the unbanked.

This paper seeks to fill a gap in understanding the factors that explain racial and ethnic disparities in bank account ownership and mobile banking usage. Our analysis aims at providing evidence on the role that mobile banking plays in improving usage of financial services among minorities. We focus our analysis on Hispanics and Blacks and use data from two surveys in our analysis: 1) Survey of Consumers' Use of Mobile Financial Services (SCUMFS), conducted by the Federal Reserve Board's Division of Consumer and Community Affairs (DCCA), and 2) National Survey of Unbanked and Underbanked Households (NSUUH), conducted by the Federal Deposit Insurance Corporation's (FDIC). We analyze how individual and household level socio-economic characteristics influence bank account ownership and mobile financial service (MFS) adoption among different racial and ethnic groups.

We use two different surveys in our analysis because data from the SCUMFS is likely to be representative of technologically savvy households, while NSUUH is likely to be representative of the entire population—based on their methodological designs. Across both datasets, we find that minorities are less likely than Whites to be banked after controlling for socioeconomic characteristics. Interestingly, minorities are less likely to adopt MFS technologies than Whites in the NSUUH, but more likely to adopt mobile banking according to SCUMFS, after controlling for individual characteristics. When we restrict our sample to individuals with a bank account, our regression no longer shows any difference in the adoption rates of mobile banking between Whites and Hispanics in the NSUUH data.

We also conduct a Oaxaca Decomposition to better understand how socioeconomic and demographic factors explain bank account ownership and mobile banking usage among different racial and ethnic groups. We find that age is a major factor explaining the gap in mobile banking

usage among Whites and Hispanics, and that education and income reduce this gap in both datasets.

Our paper is organized as follows. Because we aim with our analysis to provide an understanding of the role of mobile banking as a tool to increase participation in the formal financial sector, we present a literature review on the determinants of mobile banking in Section II. We discuss the data used in our analysis in Section III and provide a description of the methodology used in Sector IV. Section V presents the results, and Section VI concludes.

## **II. Mobile Banking: Determinants and Financial Inclusion**

As both smart mobile devices and internet services penetrate further into the American market, there is a corresponding rise in the usage of mobile financial services (MFS). We specifically note three such services: mobile banking, online banking, and mobile payment. Mobile banking is defined as accessing a bank or credit union account via mobile device, specifically mobile and smart phones (Luo, Li, Zhang, & Shim, 2010). This can be done via web browser, text message, or downloaded mobile phone applications (Board of Governors of the Federal Reserve, 2016). In contrast, online banking is defined more broadly as “consumers accessing and using existing bank accounts online” (Servon and Kaestner, 2008). Lastly, mobile payment is defined as any payment made using a mobile device. Such payments may be carried out via a mobile device’s web browser, text message, or downloaded application (Board of Governors of the Federal Reserve, 2016).

### ***Demographic factors as determinants of mobile financial services***

According to Pew Research Center’s Internet and American Life Tracking and Omnibus Survey in 2013, 51 percent of adults in the United States banked online and 32 percent banked

using mobile phones (Fox, 2013). Race, age, educational attainment, and household income all impacted the likelihood of individuals and households banking via a mobile platform (Fox, 2013). Non-White cellphone owners, including Hispanics, were nine percentage points more likely to use mobile banking when compared to Whites (Fox, 2013). Almost twice as many Americans who owned a cell phone aged 18 to 29, used mobile banking services, versus those ages 50 to 64—54 percent and 25 percent, respectively (Fox, 2013). Among American adults who owned a cell phone, 41 percent with some college, a college degree, or higher report using mobile banking, while only 27 percent who have attained a high school diploma or less report using mobile banking services (Fox, 2013). Additionally, nearly forty-five percent of American cell phone-owning adults in households with an income of \$50,000 or more used mobile banking (Fox, 2013). Thus, Fox (2013) found that younger, wealthier, better educated, and minority groups tended to have higher rates of mobile banking adoption than others.

As with banking practices, mobile finance service (MFS) adoption is heavily correlated with demographic markers. Electronic and online payment adoptions, for instance, vary across age and race (Mann, 2011). This is exemplified in the habits and traditions of older consumers, who are less likely to change their payment behavior, contrasted to younger consumers, who are more prone to change their manner of payment (Mann, 2011). There is also evidence of reluctance to adopt electronic payment types—in 2008, 25 percent of online retail was paid via mailed-in check (Mann, 2011). With respect to race, Mann (2011) found that Whites are less likely than Blacks (Hispanics were not included in the study) to change their usage across payment instruments.

More recently, Stavins (2016) found that there is a significant correlation between age, education, income, and racial demographics and the adoption of online banking bill pay (OBBP).

Using the Survey of Consumer Payment Choice, Stavins found that, even when controlling for individual and payment instrument characteristics, lowest-income, lowest-education, and minority consumers are “significantly less likely to adopt many payment instruments” (Stavins, 2016). With respect to sex, Stavins found that women, in comparison to men, were more likely to use electronic payment, credit cards, and debit cards, even after controlling for when bill-paying responsibility (Stavins, 2016).

Gross, Hogarth, & Schmeiser (2012) took a more descriptive approach and looked at the possible impact of MFS on unbanked Americans. Unbanked respondents, or those without a checking savings, or money market account, tended to be lower income, younger, minority, female, unmarried, and unemployed people, who made up around 11 percent of U.S. consumers (Gross, Hogarth, & Schmeiser, 2012). The study also found that 63.4 percent of unbanked respondents have a mobile phone, while 87.1 percent of the full sample owned a mobile phone (Gross, Hogarth, & Schmeiser, 2012). With regards to mobile banking behavior, the most common use for mobile banking was checking the balances of accounts—90 percent of the sample used by Gross, Hogarth, & Schmeiser (2012). The second highest use for mobile banking was downloading bank applications—48 percent of the sample. Less than a third of the sample used mobile banking for fraud alerts, and less than half used the services for transferring money between accounts (Gross, Hogarth, & Schmeiser, 2012).

### ***Consumer experience and adoption of mobile banking services***

When individuals and households decide whether to adopt new banking and financial platforms, their consumer experiences influence their decision. This was explained by Cheney (2008), who used the experience goods and learning-by-doing constructs to better understand trends in adopting mobile banking and mobile bill payment in the United States. To better

understand what factors influence the mobile financial services market, Cheney (2008) examined the “building blocks” of MFS—online banking and contactless payments—as well as financial inclusion opportunities, security concerns, and coordination problems. The advent of internet capable phones, SMS texting, and near field communication (NFC) technology all make the mobile platform more appealing because of ease of use (Cheney, 2008). The ability to access bank account information and transfer money while on the go, according to Cheney, is what makes mobile banking the preferable choice for many consumers.

Chemingui and Iallouna (2013) took a more quantitative approach when looking at consumer experience and behavior by testing the notion that an individual’s higher propensity to resist change led to lower adoption of mobile banking. They found that tradition (i.e. habit) is the only influential barrier for intention to use mobile platforms for banking services. Furthermore, a consumer’s intention to use mobile banking services is significantly correlated with the ability to try the service before committing to it, as well the service’s compatibility with the consumer’s lifestyle, preferences, and needs.

Yen and Wu (2016) also examined the perceived usefulness of MFS. Akin to Chemingui and Iallouna (2013), Yen and Wu find that personal habit, as well as perceived mobility, usefulness, and ease of use are major determinants. Some of these, they also noted, influence one another. For instance, perceived mobility will invariably have an impact on perceived usefulness and perceived ease of usefulness (Yen, & Wu, 2016). Most interestingly, however, is the results in regard to gender differences in determinants. While both groups’ intents are heavily influenced by personal habit and perceived usefulness of the platform, they bifurcate on the final major determinant: men prefer mobility as important while women prefer ease of use (Yen and Wu 2013).



Trust and risk also are integral in the adoption of a new technologies (Luo, Li, Zhang, & Shim, 2010). When the security of financial institutions is continually challenged, the emphasis on trust and risk is especially true of mobile technologies. Perception of the security of a platform dictates how quickly or widely a technology will be adopted (Luo, Li, Zhang, & Shim, 2010). Therefore, the security of wireless Internet, as well as device security, impacts the adoption of MFS technologies.

### ***Mobile Banking and Financial Inclusion***

MFS adoption presents a possible solution for financial and economic inclusion, as consumers will choose the most convenient option when selecting financial services (Rengert & Rhine, 2016). Adding features such as mobile remote deposit capture (mRDC), the ability to open accounts online, and even specialized accounts that limit some of the traditional features of bank accounts with the purpose to lower fees, make banking a more attractive choice than alternative financial services (AFS), such as payday loans (Rengert & Rhine, 2016). For example, the FDIC ran a pilot program that removed features such as personal checks and the ability to use branch locations, replacing them with incentives such as low initial and monthly balances, as well as prohibition of overdraft fees and nonsufficient fund fees (NSF). They found that specialized transaction and savings accounts led to incredibly high end-of-pilot retention rates—eighty-one percent for transaction accounts and ninety-five percent for savings accounts (Federal Deposit Insurance Corporation, 2012). While implementing these features led to increased convenience and allows for better market penetration in areas in which few branches are located, it did not necessarily affect channel usage for currently banked consumers (Burhouse, Navarro, & Osaki, 2016).

### **III. Data**

To study the determinants of usage of mobile financial services and how mobile banking might be used as a tool to increase participation in the formal financial sector among minorities we use two different surveys: 1) Survey of Consumers' Use of Mobile Financial Services (SCUMFS), and 2) National Survey of Unbanked and Underbanked Households (NSUUH). Using these two different surveys is a contribution of our study since these surveys cover different populations, thus enhancing our analysis.

The SCUMFS was conducted by the Federal Reserve Board's Division of Consumer and Community Affairs (DCCA) in annual basis during the period 2011-2015, and it was designed specifically to examine the trends in the adoption of mobile banking and use of mobile financial services. This survey was an internet panel, which contained a mix of previous respondents and new contacts. The survey was conducted in English and was longitudinal in nature since a respondent was assigned with a unique identifier that could be traced across years.

SCUMFS was designed and administered in consultation with GfK, a market research company. GfK applied their representative probability-based panel, KnowledgePanel, to collect information. KnowledgePanel used random-digit dial methods to recruit households from new addresses each year. It consists of around 55,000 adult members and includes people who do not have internet access. Respondents answer surveys by using their computers. In order to involve non-internet households, KnowledgePanel provided these households with a notebook computer and free internet service, allowing them to participate as online panel members. GfK adopted a unique methodology for sample selection that used customized strata based on studies to accurately represent the US population.

The FDIC's National Survey of Unbanked and Underbanked Households (NSUUH) is a biennial survey conducted in partnership with the U.S. Census Bureau. The NSUUH assesses the inclusiveness of the banking system. In this survey, the unbanked refers to households without a bank account, and the underbanked refers to households which have a bank account but have sought alternative financial services (AFS) and non-bank financial services within twelve months of the survey.

This survey is collected as a Supplement to the monthly Current Population Survey (CPS) every other June, except for the first supplement in 2009, which was conducted in January. We use data from a repeated cross section for our analysis for the following years: 2009, 2011, 2013, and 2015. Every household that participated in the June CPS survey is eligible to participate in the supplement. However, only households whose respondents had some level of participation in the household's finances and also answered "Yes" or "No" to household bank account ownership were considered respondents. Non-participants and those responding "Don't know" were considered non-respondents. It is important to note that the 2009 instrument underwent four rounds of cognitive field-testing, and has been revised every survey year since. This makes some direct comparisons between years impossible for some questions/variables.

Tables 1 and 2 present the summary statistics of the data used in this analysis from the two surveys discussed above, and Table A1 in the Appendix describes in detail how the variables used in the analysis were constructed.

## **IV. Methodology**

In our analysis, we estimate a simple model on the determinants of bank account ownership and usage of mobile banking services. We look at differences among racial and ethnic

groups, where we restrict our sample to: non-Hispanic Whites, non-Hispanic Blacks, and Hispanics. We restrict our analysis to Blacks and Hispanics because these minority groups show higher rates of being unbanked and underbanked than other minority groups and have the largest representation in our datasets.

We include in the right-hand side of our model demographic and socio-economic characteristics at the individual and household level, such as age, gender, household size/type, income, education, employment status, nativity, citizenship, Spanish language spoken primarily, access to internet, region/state of residency, and year of survey. Due to the different surveys used in our analysis, we use different models; while some variables are available in one dataset, others are not.

Because the SCUMFS provides us with a longitudinal panel, where individuals can be followed over time, we estimate our model using the Correlated Random Effects (CRE) model. The fixed effects model is not appropriate because we are interested in understanding the racial and ethnic differences in bank account ownership and usage of mobile banking services, and race and ethnicity is time invariant. The CRE model is an improvement over Random Effects (RE) since it allows us to specify a less restrictive within-individual error structure and to obtain estimates of time-invariant variables that are corrected for individual heterogeneity as measured by cross-individual differences in time-varying covariates. We include in the appendix the estimation of our model using RE just as a point of comparison, but focus our discussion on the CRE results. When using data from the NSUUH we are unable to follow individuals over time, and for that reason we use a Probit model.

We apply Oaxaca Decomposition (OD) in our analysis to evaluate how the variables in our model explain differences between racial and ethnic groups in relation to participation in the financial sector and usage of mobile banking services.

## **V. Results**

### *Survey of Consumers' Use of Mobile Financial Services (SCUMFS)*

Households who participate in the SCUMFS seem to be more technology savvy than the general population, given that data is collected through an online panel. Table 3 presents the percentage of those households who do not own a bank account or mobile phone by race and ethnicity. Table 3 also shows the percentage of those households who do not use mobile banking by race and ethnicity. In this table, we observe that minorities are more likely to be unbanked than Whites. During the period 2011-2015 the unbanked rates among Whites was in the range of 6-7 percent, while for Blacks and Hispanics it was in the range 15-30 and 15-23 percent, respectively. In 2015, there was a significant drop in the number of Blacks and Hispanics without a bank account (50 percent and 35 percent reduction in rates), which is likely the result of a change in the wording of the question in the survey (questions were modified to match the Survey of Household Economic Decision-making, SHED). The difference in the unbanked rates across racial/ethnic groups is statistically significant at the 1 percent level in all years.

We observe something different with regard to financial technology adoption than with bank account ownership when it comes to racial and ethnicity differences. Lack of ownership of a mobile phone among Whites has been stable around 11-12 percent, but for Hispanics the rate of ownership of a mobile phone has been increasing in most of the years during the period 2011-2015. For Blacks, ownership of a mobile phone increased in 2014 and 2015 compared to 2012

and 2013. When we conduct a test on whether there is a significant difference on ownership of a mobile phone among racial/ethnic groups, we find that the difference between groups is statistically significant for 2011-2013, but insignificant for 2014 and 2015 at the 5 percent level. In relation to usage of mobile banking financial services, we find that minorities are more likely to use mobile banking than Whites in all years of the survey. The difference in mobile banking usage across racial/ethnic groups is statistically significant at the 5 percent level in all years but 2012.

Table 4 shows the estimates of the determinants of bank account and mobile ownership, mobile banking services usage, and mobile payment using the CRE model (Table A3 in Appendix shows the full set of estimates for the CRE model). We focus our discussion on the estimates obtained using the CRE model, but we include in Table A4 in the Appendix the estimates using a RE model as reference. The coefficients from the CRE and RE model are virtually the same, which might be due to a small variation in the time variant variables we include in our model.

In relation to ownership of a bank account, after we control for demographic and socioeconomic characteristics in the CRE model, we observed that Blacks and Hispanics are less likely to own a bank account than Whites by 9 and 2 percentage points, respectively. When looking at the gap in bank account ownership among racial/ethnic groups in this survey, the gap seems much narrower after controlling for individual and household characteristics than by just looking at the percentages in Table 3, which was expected.

In relation to financial technology adoption, we observe in Table 4 that there are no racial/ethnic differences after controlling for socioeconomic and demographic characteristics in mobile phone ownership (column 2), but minorities are more likely to use mobile banking

services (column 3) and mobile payment (column 4). Blacks and Hispanics are more likely to use mobile banking financial services than Whites by 12 and 10 percent, respectively. We also observe also that minorities are more likely than Whites to do mobile payments by 10-11 percentage points, respectively.

Through the Oaxaca Decomposition (OD) we are able to determine how differences in demographic and socioeconomic factors explain the racial/ethnic gap in bank account ownership and MFS technology adoption. Table 5 presents the estimates of the Oaxaca Decomposition of the gaps between racial/ethnic groups, where we only include in our table decompositions for cases in which there is a significant difference between groups and in cases for which differences in demographic and socioeconomic factors explain the racial/ethnic gap significantly.<sup>1</sup>

In relation to bank account ownership, decomposition estimates are shown in Panel A of Table 5 for differences between Whites and Blacks, and Whites and Hispanics (we do not include the decomposition of the difference between Blacks and Hispanics in bank account ownership since our model shows that the gap cannot be accounted for by differences in demographic and socioeconomic factors). Whites are 14.91 percentage points more likely than Blacks to own a bank account, and our model shows that differences on the demographic and socioeconomic factors explain 36.82 percent of the gap. The factors that contribute the most to this gap are internet access, education, and income (71.59 percent of the gap is explained by these 3 factors together).<sup>2</sup> Age and employment status also seem to contribute to the gap, but to a

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1 Percentages for a category shown in the tables for the OD are calculated as the sum of the contributions to the explained gap from each demographic and socioeconomic variable in the category, multiplied by 100 and divided by explained gap. Significance stars are for the joint hypothesis that all the estimates of the explained portion of the gap for the group of demographic and socio-economic variables indicated are zero.

2 When referring to internet access, the SCUMFS asks whether the individual has access to internet either at home or outside her home (school, work, public library) that is not provided by GfK.

smaller magnitude (30.23 percent of the gap, together). Whites are more likely to own a bank account by 8.55 percentage points than Hispanics, and our model shows that differences in the factors considered are able to explain 71 percent of the gap. Education and age are the major factors explaining this gap, where they explain 40.20 and 31.47 percent of the gap, respectively. Differences in internet access, income and employment status contribute to the gap to a lesser degree (28.01 percent of the gap explained by differences in these factors together).

In Table 5, Panel B and Panel C show the OD for the gap in mobile banking usage and mobile payment between racial/ethnic groups. In Panel B of Table 5 we observe that Blacks and Hispanics are more likely to use mobile banking by 15.08 and 18.81 percent than Whites, respectively, where our model shows that differences in demographic and socioeconomic factors explain better the gap between Hispanics and Whites than between Blacks and Whites (45.45 percent of the gap explained between Hispanics and Whites versus 18.37 percent of the gap explained between Blacks and Whites). Difference in age is the factor contributing to the most of the gap in mobile banking usage between minorities and Whites (103.61 and 91.70 percent). Internet access, education, and income account for -108.3 percent of the gap between Blacks and Whites in mobile banking. The negative sign indicates that without these mitigating factors the gap would have been much greater, where the gap would have been even twice as large. For the gap between Hispanics and Whites in mobile banking usage, differences in these three factors also account for -32.75 percent of the gap. Thus, the mitigating effect of these factors is smaller for the gap between Hispanics and Whites.

As shown in Panel C of Table 5, The gap between groups in mobile payment seems to be also explained by differences in age to a large degree (67.54 and 90.00 percent). Differences in geographic location of residency (metropolitan status and region) are other important factors



contributing to the racial/ethnic gap in mobile payment usage, where they explain together 35.97 and 23.75 percent of the gap between Blacks and Whites and between Hispanics and Whites, respectively.

### **National Survey of Unbanked and Underbanked Households (NSUUH)**

Our analysis of the SCUMFS complements the analysis of the NSUUH since the NSUUH is more representative of the entire population and has a greater coverage on the unbanked and underbanked households, while the SCUMFS is likely to be more representative of technology savvy households. Table 6 shows the percentages of lack of bank account and mobile phone ownership by race and ethnicity. Table 6 also shows the percentages of those who do not use mobile banking usage among the full sample and among those who are banked by race and ethnic groups. We observe that, just as observed in the SCUMFS, minorities are less likely to own a bank account than Whites, but here the gap here is much larger than what it was observed in the SCUMFS. This is expected because of the nature of the NSUUH, which surveys in more detail the unbanked and underbanked. The difference in bank account ownership among racial/ethnic groups is statistically significant at the 1 percent level in all years.

Data on mobile ownership and mobile banking is only available for 2013 and 2015, where Table 6 shows that there is a reduction on those who do not own a mobile phone for all racial/ethnic groups, and the difference between groups is also statistically significant at the 1 percent level in both years. For Whites, Blacks and Hispanics the lack of mobile ownership decreased by 25, 24 and 30 percent, respectively. Usage of mobile banking financial services is lower among minorities when looking at the full sample, and the difference between racial/ethnic groups is statistically significant at the 1 percent level. On the other hand, when considering only those households who are banked, the usage of mobile banking is higher for minorities than for

Whites. Among those who are banked, the difference among racial/ethnic groups in usage of mobile banking is only significant in 2015.

Comparing percentages of the lack of mobile banking usage in the NSUUH versus the SCUMF, we observe a big difference among minorities, where minorities are more likely to use mobile banking in the SCUMF than in the NSUUH. Looking at 2015, which is the most recent year in both surveys, while 66-67 percent of minorities do not use mobile banking in the NSUUH, only 43-46 percent do not use mobile banking services in the SCUMF. Interestingly, usage of mobile financial services among Whites is more consistent across surveys, where 70 and 63 percent of Whites in 2015 did not use mobile banking services in the NSUUH and SCUMF, respectively. Differences in the proportions of banked and mobile banking users between surveys might be due the different compositions of the sample, where there might be a concern of over representation of minorities in the SCUMF, which is a smaller sample in comparison to the one sample used by the NSUUH.

We provide in Table 7 the marginal effects obtained by estimating a probit model on the determinants of bank account, mobile ownership, and usage of mobile banking both for the full model and for the subsample of those banked. Note that for our analysis using the SCUMF we did include estimates of our model restricting the sample to banked households since in that survey 93 percent are banked, which results on almost identical results than when estimating the model for the full sample. On the other hand, in the NSUUH only 63 percent of households are banked; thus, estimating our model using a subsample of banked households is useful. The regressors in this model are similar to the ones included in our estimations using the SCUMF. Some additional regressors that we were able to incorporate here given their availability of data

in the NSUOH are the following: homeownership, whether the household is primarily a Spanish speaking household, whether individual is foreign-born, and citizenship status.

We observe in Table 7 that Black and Hispanics are less likely to own a bank account than Whites by ten and four percentage points, respectively. A similar gap in bank account ownership was found when using the CRE model with data from the SCUMFS (nine and two percentage points below for Blacks and Hispanics, respectively). Thus, this reveals that once we control for demographic and socioeconomic characteristics, racial/ethnic gaps in bank account ownership are similar across these two different datasets.

In Table 7, column 2, we observe that minorities are two percentage points less likely to own a mobile phone than Whites, where in the SCUMFS there was no difference in mobile phone ownership among different racial/ethnic groups. In relation to mobile banking, column 3 of Table 7 shows the opposite of the SCUMFS (Table 4, column 3), where Blacks and Hispanics are less likely to use mobile banking by 3 and 1 percentage points than Whites. In the SCUMFS, minorities were in fact more likely to use mobile banking services than Whites. The difference in mobile banking usage findings across surveys can not only be explained by differences in the composition of their samples, but also by differences in the definition of mobile banking. While the SCUMFS asks whether the individual has used mobile banking in the past 12 months, the NSUOH asks whether the household has accessed a bank account via mobile banking methods in the past 12 months.

When we estimate our model on the determinants of mobile banking usage among those individuals that are already banked (Table 7, column 4), the difference among racial/ethnic groups is diminished. Among the banked, Hispanics are no longer different than Whites, and Blacks are one percentage point less likely than Whites to use mobile banking (the gap in mobile

banking usage between Whites and Blacks is reduced by 40 percent when considering only the banked households).

Estimates from the OD using the NSUOH on the racial/ethnic gaps in bank account and mobile phone ownership, and mobile banking usage are shown in Table 8. Panel A in Table 8 shows the OD for the racial/ethnic gaps in bank account ownership, where our model shows that differences in demographic and socioeconomic factors explain 37.96 percent of the gap between Whites and Blacks. Differences in income explain the largest portion of the gap in bank account ownership between Whites and Blacks, followed by differences in education. Our model also shows that differences in education and citizenship are the two major factors contributing to the gap in bank account ownership between Whites and Hispanics. Surprisingly, differences in citizenship and education are the two factors that most explain the gap in bank account ownership among Hispanics and Blacks.

In relation to mobile ownership racial/ethnic gaps we only present the OD results when comparing Whites and Blacks (Panel B, Table 8), since our model shows that differences in demographic and socioeconomic factors were not able to explain the gap in mobile ownership between Whites and Hispanics, and there was no significant gap in mobile ownership among Blacks and Hispanics. Difference in income is the major factor contributing the gap between Whites and Blacks in relation to mobile ownership (income explains 142.04 percent of the gap).

When estimating the OD for mobile banking usage for the full sample, we find that differences in the factors considered in our model are unable to explain the gap between Whites and minorities. Thus, we only include in Panel B of Table 8 the OD for the gap in mobile banking usage between Hispanics and Blacks. Difference in education is the major factor contributing to the gap (176.71 percent), where age plays a significant mitigating effect on the

gap (-206.85). When we look at the gap in mobile banking usage among banked households, there is no significant gap between Whites and Blacks, while Hispanics are more likely to use mobile banking. The OD for mobile banking usage among banked households is shown in Panel C of Table 8. Here we observe that difference in age is the major factor contributing to the gap in mobile banking usage among Hispanics and other racial/ethnic groups. When looking at the gap on mobile banking usage between banked Hispanics and Whites, income, education, Spanish speaking household, and citizenship are mitigating effects on the gap. When looking at the gap on mobile banking usage between banked Hispanics and Blacks, education, Spanish speaking household, and citizenship help to close the gap.

## **VI. Conclusion**

In our regression analysis of the SCUMFS and NSUOH we observe that minorities are less likely to be banked compared to Whites after controlling for individual characteristics. Differences in education and income explain more than one third of the gap in bank account ownership between Whites and Hispanics in both datasets. Mobile banking usage among is higher among minorities with respect to whites in the SCUMFS, but it is lower among minorities for the full sample in the NSUOH after controlling for individual characteristics. Once we restrict the sample to those banked in the NSUOH, there is no significant difference between Whites and Hispanics. Age is an important factor for explaining differences in mobile banking usage among Hispanics and Whites, where income and education mitigate this gap in both datasets.

We derive some policy implications from our analysis. First, federal institutions interested in mobile banking should explore the possibility of partnerships so that data is

consistent and comparable across different datasets. Second, we find that demographic factors are relevant for mobile technology adoption because younger people are more likely to use mobile banking. Thus, we might expect higher participation in the formal financial sector as we continue to see the youth and younger population engage with mobile banking. Mobile banking presents a great opportunity to improve not only access to financial services but also financial behavior among minority groups that are less likely to be unbanked and underbanked.

We were unable to discover any casual relationships and our results should be interpreted as associations of different factors related to bank account ownership and mobile banking usage. An experiment to explore how access to mobile technologies affects usage of financial services is warranted. For future research, we suggest exploring how different dimensions of mobile banking influence the likeliness of an individual to become banked through the use of mobile banking. It will be also interesting to explore to which degree spillovers in the household can lead to greater participation in the formal financial sector, where youth might influence their parents to make use of mobile financial technologies.

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**TABLE 1 – Summary Statistics – Data source: Survey of Consumers' Use of Mobile Financial Services (SCUMFS)**

	Percentage	Mean	Std. Dev.	Min.	Max.	Obs
Ownership of bank account (No=0, Yes=1)		0.926	0.261	0	1	14,979
Ownership of mobile phone (No=0, Yes=1)		0.887	0.317	0	1	15,049
Ownership of smartphone (No=0, Yes=1)		0.607	0.488	0	1	13,581
Mobile banking usage (No=0, Yes=1)		0.297	0.457	0	1	12,716
Mobile payment (No=0, Yes=1)		0.162	0.369	0	1	13,292
Race & ethnicity						
White, non-Hispanic (No=0, Yes=1)	78.13					11,048
Black, non-Hispanic (No=0, Yes=1)	10.64					1,505
Hispanic (No=0, Yes=1)	11.23					1,588
Gender (Female =0, Male = 1)		0.489	0.500	0	1	15,049
Education						
Less than high school (No=0, Yes=1)	7.56					1,138
High school & some coll. (No=0, Yes=1)	57.59					8,666
Bachelor or more (No=0, Yes=1)	34.85					5,245
Age		51.453	16.746	18	97	15,049
Number of people in the household		2.624	1.421	1	14	15,049
Employment status						
Not in labor force (No=0, Yes=1)	38.71					5,826
Unemployed (No=0, Yes=1)	6.27					943
Employed (No=0, Yes=1)	55.02					8,280
Region of residence						
Northeast (No=0, Yes=1)	17.82					2,681
Midwest (No=0, Yes=1)	24.99					3,760
South (No=0, Yes=1)	35.14					5,288
West (No=0, Yes=1)	22.06					3,320
Metropolitan area (No=0, Yes=1)		0.788	0.409	0	1	15,049
Internet access (No=0, Yes=1)		0.847	0.360	0	1	15,049
Income						
Group 1, <25,000	17.20					2,588
Group 2, 25,000 to 39,999	18.50					2,784
Group 3, 40,000 to 74,999	19.26					2,899
Group 4, 75,000 to 99,999	19.72					2,967
Group 5, >100,000	25.32					3,811

Data collected by the Federal Reserve Board's Division of Consumer and Community Affairs and available online for 2011, 2012, 2013, 2014, and 2015.

Data available at: [https://www.federalreserve.gov/consumerscommunities/mobile\\_finance\\_data.htm](https://www.federalreserve.gov/consumerscommunities/mobile_finance_data.htm)



**TABLE 2 – Summary Statistics – Data source: National Survey of Unbanked and Underbanked Households (NSUOH)**

	Percentage	Mean	Std. Dev.	Min.	Max.	Obs
Ownership of bank account (No=0, Yes=1)		0.632	0.482	0	1	287,314
Mobile banking usage (No=0, Yes=1)	0.126		0.332	0	1	141,946
Ownership of mobile phone (No=0, Yes=1)		0.882	0.323	0	1	72,989
Race & ethnicity						
White, non-Hispanic (No=0, Yes=1)	77.87					156,614
Black, non-Hispanic (No=0, Yes=1)	11.92					23,973
Hispanic (No=0, Yes=1)	10.21					20,538
Age		51.079	16.950	15	85	
Generation						
Earlier generation	14.85					42,979
Boomer	27.28					78,968
Generation X	21.76					62,976
Millennial	9.97					28,855
Post Millennial	26.14					75,662
Household type						
Other indicators	26.24					75,951
married	36.33					105,148
unmarried	12.23					35,386
individual	25.21					72,955
Education						
Less than high school	34.46					99,743
High school graduate and some college	42.48					122,942
Bachelor or above	23.06					66,755
Employment status						
Not in the labor force group	35.21					75,273
Unemployed	4.10					8,766
Employed	60.69					129,739
Income						
Group 1, <15,000	14.95					30,686
Group 2, 15,000 to 29,999	17.47					35,853
Group 3, 30,000 to 49,999	20.41					41,904
Group 4, 50,000 to 74,999	18.59					38,163
Group 5, >75,000	28.58					58,656
Home ownership (No=0, Yes=1)		0.525	0.499	0	1	289,440
Metro status (No=0, Yes=1)		0.717	0.451	0	1	235,630
Spanish-speaking household (No=0, Yes=1)		0.013	0.115	0	1	289,440
Foreign born (No=0, Yes=1)		0.118	0.323	0	1	213,778
Citizenship (No=0, Yes=1)		0.942	0.233	0	1	213,778

Data collected by the Federal Deposit Insurance Corporation through the Current Population Survey (CPS) Unbanked/Underbanked supplement and available online for 2009, 2011, 2013, and 2015. Mobile banking variable only available for years 2013 and 2015.

Data available at: <https://www.economicinclusion.gov/surveys/>

**TABLE 3 – Bank account and mobile ownership, and usage of mobile banking services by race and ethnicity, Percentages – Data source: SCUMFS**

	2011	2012	2013	2014	2015
<b><i>Bank account ownership (Do not have a bank account)</i></b>					
White (%)	6	6	7	7	7
Black (%)	27	24	28	30	15
Hispanic (%)	18	15	12	23	15
Observations	2,122	2,416	2,459	2,717	2,342
<b><i>Mobile phone ownership (Do not own a mobile phone)</i></b>					
White (%)	11	12	12	12	12
Black (%)	15	19	20	17	17
Hispanic (%)	19	17	11	15	10
Observations	2,133	2,433	2,478	2,721	2,350
<b><i>Mobile banking usage (Did not use mobile banking services in the past 12 months)</i></b>					
White (%)	82	74	70	65	63
Black (%)	70	68	57	55	46
Hispanic (%)	72	66	55	45	43
Observations	1,862	2,134	2,036	3,299	2,621

Percentages estimated using population weights provided by the survey.

**TABLE 4 – Correlated Random Effects Model - Data source: SCUMFS**

	(1) Bank Acct. Own.	(2) Mobile Own.	(3) Mob. Bank. Use	(4) Mob. Pmt.
Black	-0.0907*** (0.0082)	0.0097 (0.0098)	0.1215*** (0.0154)	0.1001*** (0.0127)
Hispanic	-0.0169** (0.0083)	0.0099 (0.0099)	0.0976*** (0.0152)	0.1062*** (0.0126)
Male	-0.0128** (0.0050)	-0.0321*** (0.0060)	-0.0085 (0.0091)	-0.0172** (0.0076)
Age	0.0023*** (0.0002)	-0.0011*** (0.0002)	-0.0093*** (0.0003)	-0.0045*** (0.0003)
High school completed	0.0076 (0.0245)	0.0536* (0.0323)	0.0295 (0.0511)	0.0437 (0.0485)
Bachelor or Above	0.0564* (0.0330)	0.0546 (0.0436)	0.1070 (0.0655)	0.0382 (0.0622)
Income, quartile 2	-0.0019 (0.0126)	-0.0265 (0.0166)	0.0223 (0.0241)	-0.0114 (0.0239)
Income, quartile 3	-0.0178 (0.0147)	-0.0225 (0.0194)	0.0221 (0.0280)	-0.0202 (0.0276)
Income, quartile 4	-0.0130 (0.0163)	-0.0250 (0.0215)	0.0292 (0.0306)	-0.0164 (0.0302)
Income, quartile 5	-0.0163 (0.0187)	-0.0254 (0.0247)	0.0046 (0.0344)	0.0116 (0.0341)
Household size	0.0036 (0.0050)	0.0126* (0.0066)	0.0029 (0.0102)	-0.0157 (0.0099)
Unemployed	0.0503** (0.0200)	0.0235 (0.0264)	-0.0422 (0.0396)	-0.0149 (0.0374)
Employed	0.0548*** (0.0180)	0.0280 (0.0238)	-0.0457 (0.0358)	0.0207 (0.0333)
Metro	-0.0244 (0.0270)	0.0151 (0.0356)	-0.0046 (0.0476)	0.0308 (0.0490)
Midwest	0.0016 (0.0484)	0.0555 (0.0640)	0.1602* (0.0841)	-0.0180 (0.0850)
South	-0.0706** (0.0345)	-0.0357 (0.0457)	0.1515** (0.0653)	-0.0701 (0.0655)
West	-0.0002 (0.0082)	0.0016 (0.0097)	0.0380** (0.0148)	0.0170 (0.0124)
Internet Access	-0.0044 (0.0142)	0.0423** (0.0187)	-0.0011 (0.0295)	-0.0106 (0.0285)
Observations	14,075	14,141	11,953	12,496
R-sqr, overall	0.158	0.0950	0.183	0.0762

Coefficients and standard errors in parenthesis. Significance denoted as \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Refer to Table A3 in the Appendix for the full set of estimates (year dummies and mean of time variant variables).

**TABLE 5 – Oaxaca Decomposition - Data source: SCUMFS**

<b>Panel A: Bank account ownership</b>		
	<b>White vs Black</b>	<b>White vs Hispanic</b>
Gap	14.91	8.55
Percentage of gap explained diff. in variables	36.82	70.99
Percentage of the quantity effect explained by...		
Gender	-0.73	0.16
Age	16.39 ***	31.47 ***
Household size	0.36	3.95 *
Metro status	-1.82	-1.81
Internet access	25.50 ***	10.38 ***
Education	20.04 ***	40.20 ***
Income	26.05 ***	7.58 ***
Employment status	13.84 ***	10.05 ***
Region	4.37 *	1.81
Year	-4.19 *	-3.62 **
<b>Panel B: Mobile banking usage</b>		
	<b>Black vs White</b>	<b>Hispanic vs White</b>
Gap	15.08	18.81
Percentage of gap explained by diff. in variables	18.37	45.45
Percentage of the quantity effect explained by...		
Gender	-0.72	0.12
Age	103.61 ***	91.70 ***
Household size	-0.72	-6.67 **
Metro status	32.85 ***	11.70 ***
Internet access	-54.51 ***	-7.13 ***
Education	-22.02 ***	-16.73 ***
Income	-31.77 ***	-8.89 ***
Employment status	-3.61	3.16
Region	38.27 ***	16.61 ***
Year	38.63 ***	16.26 ***
<b>Panel C: Mobile payment usage</b>		
	<b>Black vs White</b>	<b>Hispanic vs White</b>
Gap	13.52	15.15
Percentage of gap explained by diff. in variables	16.86	26.40
Percentage of the quantity effect explained by...		
Gender	0.88	0.00
Age	67.54 ***	90.00 ***
Household size	-0.44	-11.00 **
Metro status	19.74 ***	11.75 ***
Internet access	-15.35 **	-4.50 **
Education	-7.02	-9.75
Income	5.26	0.25
Employment status	-12.28 ***	-6.00 *
Region	16.23 *	12.00 **
Year	25.00 ***	17.25 ***

**TABLE 6 - Bank account and mobile ownership, and usage of mobile banking services by race and ethnicity, Percentages – Data source: NSUUH**

	2009	2011	2013	2015
<b><i>Bank account ownership (Do not have a bank account)</i></b>				
White (%)	3.3	4.0	3.7	3.2
Black (%)	21.4	21.7	21	18.5
Hispanic (%)	19.2	20.4	18.3	16.5
Observations	50,805	50,805	49,941	49,941
<b><i>Mobile phone ownership (Do not own a mobile phone)</i></b>				
White (%)			12.4	9.3
Black (%)			15.0	11.4
Hispanic (%)			15.5	10.9
Observations			47,476	47,476
<b><i>Mobile banking usage (Did not use mobile banking services in the 12 past months)</i></b>				
White (%)			78.2	69.8
Black (%)			82.3	73.3
Hispanic (%)			80.0	71.6
Observations			48,367	48,304
<b><i>Mobile banking usage among banked (Did not use mobile banking services in the past 12 months)</i></b>				
White (%)			77.3	68.8
Black (%)			77.3	66.8
Hispanic (%)			75.2	65.8
Observations			34,031	30,459

Percentages estimated using population weights provided by the survey.

**TABLE 7 – Probit Model - Marginal Effects - Data source: NSUHH**

	(1) Bank Acct. Own.	(2) Mobile Own.	(3) Mob. Bank. Use	(4) Mob. Bank. Use
Black	-0.0963*** (0.0036)	-0.0210*** (0.0044)	-0.0344*** (0.0039)	-0.0137** (0.0059)
Hispanic	-0.0378*** (0.0041)	-0.0200*** (0.0056)	-0.0137*** (0.0048)	-0.0093 (0.0068)
Age	0.0012*** (0.0001)	-0.0029*** (0.0001)	-0.0052*** (0.0001)	-0.0078*** (0.0001)
Married	0.0614* (0.0319)	0.0428 (0.0379)	-0.0207 (0.0335)	-0.0775 (0.0560)
Unmarried	0.0371 (0.0320)	0.0394 (0.0379)	-0.029 (0.0336)	-0.0761 (0.0561)
Individual	0.0766** (0.0319)	0.0066 (0.0378)	-0.0318 (0.0335)	-0.0989* (0.0560)
High school completed	0.0647*** (0.0038)	0.0558*** (0.0049)	0.0665*** (0.0044)	0.0733*** (0.0072)
Bachelor or above	0.1046*** (0.0043)	0.0823*** (0.0054)	0.1142*** (0.0050)	0.1204*** (0.0078)
Not in labor force	0.0088 (0.0056)	-0.0423*** (0.0071)	-0.0325*** (0.0073)	-0.0356*** (0.0104)
Employed	0.0416*** (0.0053)	0.0076 (0.0068)	0.0181** (0.0070)	0.0188* (0.0100)
Group 2, 15,000 to 29,999	0.0865*** (0.0039)	0.0285*** (0.0051)	0.0298*** (0.0042)	0.0209*** (0.0067)
Group 3, 30,000 to 49,999	0.1228*** (0.0040)	0.0631*** (0.0052)	0.0625*** (0.0042)	0.0565*** (0.0065)
Group 4, 50,000 to 74,999	0.1318*** (0.0043)	0.0828*** (0.0055)	0.0896*** (0.0045)	0.0917*** (0.0068)
Group 5, >75,000	0.1276*** (0.0045)	0.1049*** (0.0055)	0.1291*** (0.0047)	0.1494*** (0.0071)
Homeownership	0.0362*** (0.0026)	0.0082** (0.0032)	-0.0148*** (0.0033)	-0.0301*** (0.0046)
Metro status	-0.0058** (0.0030)	0.0253*** (0.0037)	0.0425*** (0.0036)	0.0648*** (0.0050)
Spanish-speaking household	-0.0618*** (0.0084)	-0.0256** (0.0105)	-0.0606*** (0.0100)	-0.0718*** (0.0160)
Foreign born	0.0083* (0.0048)	-0.0084 (0.0065)	-0.0054 (0.0061)	-0.0078 (0.0085)
Citizenship	0.0557*** (0.0068)	0.0149* (0.0086)	0.0344*** (0.0076)	0.0361*** (0.0113)
Observations	152,630	55,331	77,791	51,706
Log-likelihood	-73802	-16800	-30712	-24319

Coefficients and standard errors in parenthesis. Significance denoted as \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Estimates for year and state dummies are not included for purpose of space.

**TABLE 8 - Oaxaca Decomposition - Data source: NSUOH**

<b>Panel A: Bank account ownership</b>			
	<b>White vs Black</b>	<b>Whites vs Hispanics</b>	<b>Hispanic Vs Black</b>
Gap	16.73	14.16	2.57
Percentage of gap explained by diff. in variables	37.96	71.33	111.28
Percentage of the quantity effect explained by....			
Age	7.87 ***	9.41 ***	34.27 ***
Household type	6.93 ***	5.94 ***	-10.84 **
Education	15.43 ***	23.56 ***	59.79 ***
Employment status	2.52 ***	-1.58 ***	-17.48 ***
Income	34.02 ***	12.38 ***	-40.91 ***
Metro status	5.04 ***	3.07 ***	-0.35
Homeownership	13.86 ***	8.12 ***	-5.59 ***
Spanish-speaking household	0.31 **	11.39 ***	36.71 ***
Foreign born	0.31	0.00	-23.08 **
Citizenship	0.16	20.30 ***	68.53 ***
Region	3.46 ***	2.48 ***	3.50
Year	9.92 ***	5.15 ***	-4.20
<b>Panel B: Mobile ownership and mobile bank usage</b>			
	<b>Mobile ownership</b>	<b>Mobile bank Usage</b>	
	<b>White vs Black</b>	<b>Hispanic vs Black</b>	
Gap	2.62	2.25	
Percentage of gap explained by diff. in variables	59.92	32.44	
Percentage of the quantity effect explained by...			
Age	-84.71 ***	-206.85 ***	
Household type	10.19 *	-41.10 **	
Education	63.69 ***	176.71 ***	
Employment status	2.55	-50.68 ***	
Income	142.04 ***	-45.21 ***	
Metro status	-32.48 ***	-16.44 ***	
Homeownership	19.11 ***	4.11	
Spanish-speaking household	0.00	91.78 ***	
Foreign born	8.92 **	57.53	
Citizenship	-2.55	161.64 ***	
Region	-21.66 ***	-36.99	
Year	-3.82 ***	4.11	
<b>Panel C: Mobile bank usage if banked</b>			
	<b>Hispanic vs White</b>	<b>Hispanic vs Black</b>	
Gap	3.60	3.01	
Percentage of gap explained by diff. in variables	111.39	41.53	
Percentage of the quantity effect explained by...			
Age	158.35 ***	252.8 ***	
Household type	1.25	31.2 **	
Education	-40.90 ***	-124 ***	
Employment status	6.23 ***	22.4 ***	
Income	-44.89 ***	24.8 **	
Metro status	36.16 ***	17.6 ***	
Homeownership	20.95 ***	-7.2 **	
Spanish-speaking household	-22.94 ***	-62.4 ***	
Foreign born	-13.72	-36	
Citizenship	-30.92 ***	-84 ***	
Region	28.18 ***	74.4 ***	
Year	2.49 *	-8.8	

**Table A1 - Description of Variable Construction**

Variable name	Description
<i>Source: Survey of Consumers' Use of Mobile Financial Services (SCUMFS)</i>	
Ownership of bank account	Dummy variable equal to 1 if household currently have a checking, savings or money market account, 0 otherwise.
Usage of mobile banking services	Dummy variable equal to 1 if household has used mobile banking in the past 12 months, 0 otherwise.
Intensity of mobile banking services usage	We use index for mobile banking usage intensity, ranging from 0 to 6. The intensity is found by summing the following functions (1 if used, 0 if not), (1) check bank balance, (2) make bill payment, (3) receive alerts, (4) depositing a check electronically, (5) transfer money within or outside the U.S. and (6) locate the in-network ATM or branch.
Mobile payment	Dummy variable equal to 1 if household has made a mobile payment in the past 12 months, 0 otherwise.
Ownership of mobile phone	Dummy variable equal to 1 if household have regular access to a mobile phone, 0 otherwise.
Ownership of smartphone	Dummy variable equal to 1 if mobile phone is a smartphone, 0 otherwise.
Mobile payment	Dummy variable equal to 1 if household has made a mobile payment in the past 12 months, 0 otherwise.
Race/ethnicity	Individuals assigned to mutually exclusive racial groups: White, Black, and Hispanic.
Education	We create the following three groups for individual's level of education: no high school diploma, high school diploma or some college, and college degree.
Age	Age of the householder respondent in years.
Household size	Numbers of people in the household
Employment status	Individuals are assigned to employed, unemployed, or not in the labor force groups.
Gender	Dummy variable equal to 1 if respondent is male, 0 otherwise.
Income	We use indicators for less than \$25,000, \$25,000 to \$39,999, \$40,000 to \$74,999, \$75,000 to \$99,999 and greater than \$100,000 groups.
Metropolitan status	Dummy variable equal to 1 if household is in a metropolitan area, 0 otherwise.
Region of residence	Individuals are assigned to the Northeast, Midwest, South and West regions
Internet Access	Dummy variable equal to 1 if household has internet access either at home or outside her home (work, school, library, etc...), 0 otherwise.



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*Source: National Survey of Unbanked and Underbanked Households (NSUUH)*

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Ownership of bank account	Dummy variable equal to 1 if currently banked (includes underbanked), 0 otherwise.
Usage of mobile banking services	Dummy variable equal to 1 if household accessed bank account via mobile banking methods in past 12 months (these include text messaging, mobile application, or Internet browser or email on a mobile device), 0 otherwise.
Race/ethnicity	Individuals assigned to mutually exclusive racial groups: White, Black, and Hispanic.
Education	We create the following three groups for individual's level of education: no high school diploma, high school diploma or some college, and college degree
Age	Age of the householder respondent in years.
Household type	Households are assigned to married, unmarried, individual, and other groups.
Employment status	Individuals are assigned to employed, unemployed, or not in the labor force groups.
Metropolitan status	Dummy variable equal to 1 if household is in a metropolitan area, 0 otherwise.
Home ownership	Dummy variable equal to 1 if household owns the home in which it lives, 0 otherwise.
Spanish-speaking household	Dummy variable equal to 1 if the only language spoken by all members of a household who are 15 years or older is Spanish, 0 otherwise.
Foreign born	Dummy variable equal to 1 if foreign born, 0 otherwise.
Citizenship	Dummy variable equal to 1 if U.S. citizen, 0 otherwise.
Generation	Individuals are assigned to Silent or earlier generation, Baby Boomer generation, Generation X, or Millennial generation groups determined by year of birth.
State	State in which the individual resides at the time of the survey.
Region of residence	Region of the United States in which the individual resides. Northwest, Midwest, South, and West used as regions.

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**TABLE A3 – Correlated Random Effects Model - Data source: SCUMFS**

	(1) Bank Acct. Ownership	(2) Mobile Ownership	(3) Mob. Bank. Usage	(4) Mobile Payment
Black	-0.0907*** (0.0082)	0.0097 (0.0098)	0.1215*** (0.0154)	0.1001*** (0.0127)
Hispanic	-0.0169** (0.0083)	0.0099 (0.0099)	0.0976*** (0.0152)	0.1062*** (0.0126)
Male	-0.0128** (0.0050)	-0.0321*** (0.0060)	-0.0085 (0.0091)	-0.0172** (0.0076)
Age	0.0023*** (0.0002)	-0.0011*** (0.0002)	-0.0093*** (0.0003)	-0.0045*** (0.0003)
High school completed	0.0076 (0.0245)	0.0536* (0.0323)	0.0295 (0.0511)	0.0437 (0.0485)
Bachelor or Above	0.0564* (0.0330)	0.0546 (0.0436)	0.1070 (0.0655)	0.0382 (0.0622)
Income, quartile 2	-0.0019 (0.0126)	-0.0265 (0.0166)	0.0223 (0.0241)	-0.0114 (0.0239)
Income, quartile 3	-0.0178 (0.0147)	-0.0225 (0.0194)	0.0221 (0.0280)	-0.0202 (0.0276)
Income, quartile 4	-0.0130 (0.0163)	-0.0250 (0.0215)	0.0292 (0.0306)	-0.0164 (0.0302)
Income, quartile 5	-0.0163 (0.0187)	-0.0254 (0.0247)	0.0046 (0.0344)	0.0116 (0.0341)
Household size	0.0036 (0.0050)	0.0126* (0.0066)	0.0029 (0.0102)	-0.0157 (0.0099)
Unemployed	0.0503** (0.0200)	0.0235 (0.0264)	-0.0422 (0.0396)	-0.0149 (0.0374)
Employed	0.0548*** (0.0180)	0.0280 (0.0238)	-0.0457 (0.0358)	0.0207 (0.0333)
Metro	-0.0244 (0.0270)	0.0151 (0.0356)	-0.0046 (0.0476)	0.0308 (0.0490)
Midwest	0.0016 (0.0484)	0.0555 (0.0640)	0.1602* (0.0841)	-0.0180 (0.0850)
South	-0.0706** (0.0345)	-0.0357 (0.0457)	0.1515** (0.0653)	-0.0701 (0.0655)
West	-0.0002 (0.0082)	0.0016 (0.0097)	0.0380** (0.0148)	0.0170 (0.0124)
Internet Access	-0.0044 (0.0142)	0.0423** (0.0187)	-0.0011 (0.0295)	-0.0106 (0.0285)
2012	-0.0051 (0.0060)	-0.0108 (0.0079)	0.0516*** (0.0108)	0.0353*** (0.0111)
2013	-0.0152** (0.0066)	-0.0148* (0.0088)	0.0963*** (0.0121)	0.0489*** (0.0122)
2014	-0.0257*** (0.0074)	-0.0164* (0.0098)	0.1405*** (0.0136)	0.0692*** (0.0137)
2015	-0.0017 (0.0081)	-0.0115 (0.0107)	0.1788*** (0.0147)	0.0714*** (0.0148)

<i>Coefficients of mean for time variant variables</i>				
High School Completed	0.1148*** (0.0264)	0.0096 (0.0344)	0.0501 (0.0549)	-0.0245 (0.0510)
Bachelor or Above	0.0952*** (0.0347)	0.0245 (0.0455)	-0.0055 (0.0689)	-0.0083 (0.0645)
Income, quartile 2	0.0814*** (0.0154)	0.0790*** (0.0197)	-0.0321 (0.0294)	0.0106 (0.0276)
Income, quartile 3	0.1157*** (0.0172)	0.0797*** (0.0221)	-0.0258 (0.0327)	-0.0131 (0.0309)
Income, quartile 4	0.1040*** (0.0187)	0.1057*** (0.0241)	-0.0106 (0.0351)	-0.0065 (0.0333)
Income, quartile 5	0.0971*** (0.0209)	0.1152*** (0.0271)	0.0403 (0.0385)	-0.0178 (0.0370)
Household size	-0.0084 (0.0054)	-0.0102 (0.0071)	-0.0142 (0.0109)	0.0086 (0.0103)
Unemployed in labor force	0.0481** (0.0232)	-0.0371 (0.0299)	0.0556 (0.0457)	0.0470 (0.0416)
Employed	0.0718*** (0.0211)	0.0070 (0.0272)	0.1052** (0.0416)	0.0381 (0.0374)
Metro	0.0309 (0.0277)	0.0077 (0.0364)	0.0649 (0.0490)	-0.0013 (0.0500)
Midwest	0.0023 (0.0487)	-0.0508 (0.0644)	-0.1710** (0.0848)	0.0095 (0.0855)
South	0.0628* (0.0350)	0.0707 (0.0462)	-0.0925 (0.0663)	0.0942 (0.0662)
West	0.1207*** (0.0161)	0.1135*** (0.0208)	0.1237*** (0.0332)	0.0428 (0.0310)
Internet access	0.0233* (0.0139)	0.0145 (0.0171)	0.0260 (0.0243)	-0.0113 (0.0220)
2012	0.0003 (0.0135)	0.0126 (0.0165)	0.0428* (0.0243)	0.0108 (0.0215)
2013	0.0059 (0.0119)	0.0335** (0.0149)	0.0369* (0.0215)	0.0123 (0.0197)
2014	0.0104 (0.0125)	0.0360** (0.0156)	0.0370 (0.0225)	0.0263 (0.0207)
2015	0.4380*** (0.0205)	0.6442*** (0.0244)	0.3323*** (0.0393)	0.2218*** (0.0320)
Observations	14,075	14,141	11,953	12,496
R-sqr, overall	0.158	0.0950	0.183	0.0762

Coefficients and standard errors in parenthesis. Significance denoted as \*\*\* p<0.01, \*\* p<0.05, \* p<0.10

**TABLE A4 – Random Effects Model – Data source: SCUMFS**

	(1)	(2)	(4)	(6)
	Bank Acct. Own	Mobile Own.	Mob. Bank. Usa.	Mobile Payment
Black	-0.0948*** (0.0082)	0.0092 (0.0097)	0.1187*** (0.0152)	0.1029*** (0.0125)
Hispanic	-0.0191** (0.0082)	0.0113 (0.0098)	0.0955*** (0.0150)	0.1091*** (0.0125)
Male	-0.0125** (0.0051)	-0.0314*** (0.0060)	-0.0074 (0.0091)	-0.0171** (0.0076)
Age	0.0023*** (0.0002)	-0.0012*** (0.0002)	-0.0093*** (0.0003)	-0.0045*** (0.0003)
High school completed	0.1124*** (0.0092)	0.0667*** (0.0110)	0.0747*** (0.0186)	0.0210 (0.0149)
Bachelor or Above	0.1469*** (0.0102)	0.0853*** (0.0122)	0.1040*** (0.0201)	0.0302* (0.0163)
Income, quartile 2	0.0648*** (0.0071)	0.0366*** (0.0087)	0.0055 (0.0136)	-0.0042 (0.0118)
Income, quartile 3	0.0772*** (0.0075)	0.0490*** (0.0092)	0.0108 (0.0142)	-0.0285** (0.0123)
Income, quartile 4	0.0791*** (0.0078)	0.0672*** (0.0096)	0.0329** (0.0146)	-0.0219* (0.0126)
Income, quartile 5	0.0708*** (0.0082)	0.0775*** (0.0099)	0.0487*** (0.0152)	-0.0020 (0.0130)
Household size	-0.0030 (0.0019)	0.0039* (0.0022)	-0.0100*** (0.0034)	-0.0079*** (0.0029)
Unemployed	-0.0860*** (0.0102)	0.0050 (0.0124)	0.0032 (0.0196)	-0.0242 (0.0164)
Employed	0.0265*** (0.0056)	0.0441*** (0.0068)	0.0379*** (0.0103)	0.0274*** (0.0088)
Metro	0.0044 (0.0061)	0.0201*** (0.0073)	0.0563*** (0.0112)	0.0282*** (0.0095)
Midwest	0.0028 (0.0078)	0.0044 (0.0093)	-0.0076 (0.0141)	-0.0092 (0.0118)
South	-0.0108 (0.0073)	0.0320*** (0.0087)	0.0609*** (0.0132)	0.0221** (0.0110)
West	-0.0008 (0.0082)	0.0010 (0.0097)	0.0392*** (0.0148)	0.0162 (0.0124)
Internet access	0.0952*** (0.0066)	0.1392*** (0.0081)	0.0988*** (0.0134)	0.0249** (0.0112)
2012	0.0047 (0.0053)	-0.0007 (0.0069)	0.0605*** (0.0095)	0.0349*** (0.0094)
2013	-0.0105* (0.0056)	-0.0030 (0.0072)	0.1125*** (0.0102)	0.0557*** (0.0098)
2014	-0.0260*** (0.0057)	-0.0012 (0.0072)	0.1544*** (0.0103)	0.0778*** (0.0096)
2015	-0.0030 (0.0060)	0.0039 (0.0075)	0.1926*** (0.0108)	0.0867*** (0.0100)
Observations	14,075	14,141	11,953	12,496
R-sqr, overall	0.154	0.0915	0.181	0.0755

Coefficients and standard errors in parenthesis. Significance denoted as \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.