

How US Consumers without Bank Accounts Make Payments

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Summary:

Using data from the 2021 Survey and Diary of Consumer Payment Choice, this article investigates two questions: What payment instruments do consumers without bank accounts adopt? How do these consumers make payments?

Key findings:

1. Consumers without bank accounts rely heavily on cash for purchases, bill payments, and payments to other people.
2. Consumers without bank accounts are about half as likely to have set up nonbank payment accounts like PayPal, compared to consumers with bank accounts.
3. Compared to banked consumers, unbanked consumers adopt different types of special-purpose prepaid cards. They are more likely to have cards related to receipt of income, including payroll cards and cards for receiving government benefits.
4. Consumers without bank accounts report using bank account–linked instruments to make payments, perhaps due to payments access provided by friends and family.

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Introduction

Universal access to digital payments would benefit all US consumers. However, significant obstacles remain, especially for consumers who do not have a bank account. A recent survey by the Federal Deposit Insurance Corporation (FDIC 2022) estimates that 4.5 percent of US households were unbanked in 2021, or approximately 5.9 million households. (The survey defined a household as unbanked when no one in the household had a checking or a savings account at a bank or a credit union.)

Using a unique dataset, this article aims to analyze how unbanked consumers pay for the goods and services they buy and how they pay bills. Most unbanked consumers do not have access to debit and credit cards. Without such cards, consumers are shut out from the digital payment system and from making remote (online) payments.¹ In addition, mobile payment apps, such as Venmo, PayPal, and Cash, rely on funding via debit cards or bank accounts and hence often exclude unbanked consumers.

In an earlier article (Greene and Shy 2022), we tried to understand how consumers who do not have debit or credit cards make payments. In contrast, this article focuses specifically on unbanked consumers, allowing us to separate the consumers who simply do not want to use cards from consumers who do not have cards because they are unbanked. In addition, the article’s appendix provides various analyses of the demographics of unbanked consumers.

The policy issue

What innovations could enable all US consumers access to digital means of payment? The Federal Reserve Bank of Atlanta engages in research with the goal of improving payments inclusion—that is, ensuring that everyone has access to digital payments, whether banked or unbanked, and that cash users are able to fully participate in the economy (see, for example, atlantafed.org/payments-inclusion).²

Several countries have already taken measures to facilitate unbanked consumers’ access to digital payments. For example, the Eastern Caribbean Central Bank initiated a central bank digital currency (CBDC) pilot where, in addition to banks, the central bank allows any merchant (grocery store chain, pharmacy, etc.) to become an “agent” (eccb-centralbank.org/p/about-the-project). These agents are authorized to convert cash to CBDC (Dcash) and the other way around. In the Bahamas, Sand dollar was designed for a similar

¹ There are some exceptions involving nonbank account service providers that provide general purpose reloadable (GPR) prepaid cards that also serve as debit cards on prefunded accounts. For example, Walmart’s Bluebird card, NetSpend, and neobanks such as Chime, Dave, and Acorns. These providers still rely on commercial banks to store excess balances and to gain access to payment services provided by the Federal Reserve and The Clearing House.

² “Payments inclusion” is different from “financial inclusion.” Financial inclusion is a broader term that encompasses access to credit.

purpose (sanddollar.bs). Another example is Pix, which is an instant payment system (not a CBDC) developed by the central bank of Brazil ([en.wikipedia.org/wiki/Pix_\(payment_system\)](https://en.wikipedia.org/wiki/Pix_(payment_system))). Nonbank payment service providers perform a significant share of Pix’s transactions volume.

In the United States, most unbanked consumers are excluded from or find it hard to use digital payment services at a time when digital payments are rising overall. Data collected by the Census Bureau show a continuous rise in the share of e-commerce retail sales as a percentage of total sales (fred.stlouisfed.org/series/ECOMPCTSA). This share reached 16.4 percent in 2020 during the COVID pandemic and 14.8 percent at the end of 2022. Further, the share of cash payments fell from 26 percent in 2019 to 20 percent in 2021 (Cubides and O’Brien 2022).

Integrating unbanked end users into the digital payment system is called the “last mile” problem, because it involves finding ways to fund digital payments with some source of money, such as a bank account (Shy 2021). Before solutions can be designed and analyzed, however, we must first learn how US consumers without bank accounts pay, which is the goal of our article. Knowing how unbanked consumers pay should be helpful for finding solutions in sync with these consumers’ past and current behavior, constraints, knowledge, and preferences.

Data

The analysis of consumer payment choice involves a classification of payment methods into categories such as cash, paper checks, credit cards, debit cards, prepaid cards, and ACH payments from bank accounts. Data on how consumers pay are collected by consumer surveys in which consumers list all the payment instruments they own or have set up ready to use (called “adopting” a payment instrument) and how they use them.

In consumer diary surveys, consumers record—either in real time or at the end of each day—information about all their payment-related activities, including dollar amounts, transaction types, merchant types, and payment methods, as well as money transfers and ATM cash withdrawals.

In this article, we use data from the 2021 Survey and Diary of Consumer Payment Choice (SDCPC).³ The SDCPC surveys a representative sample of US adults 18 and older. Respondents rate payments on various characteristics, report the payment instruments they have adopted, and record all their transactions during three consecutive days. Transactions include purchases (in person or online), bill payments, person-to-person (p2p) payments, and ATM withdrawals and deposits. Respondents’ three-day diaries are evenly distributed throughout the month of October each year. Each October diary day has an equal number of overlapping respondents recording their first-, second-, and third-day payment information.

³ Data and summary reports are available for downloading from atlantafed.org/banking-and-payments/consumer-payments/survey-and-diary-of-consumer-payment-choice.

Banking status and payment choice

We investigate three questions:

1. How do consumers without bank accounts make payments?
2. How do unbanked consumers differ from consumers with a bank account in their use of payment methods for paying bills?
3. To what degree do unbanked consumers use nonbank payment services relative to consumers with a bank account?

We classify the consumer population into two mutually exclusive groups: consumers who have either a checking or a savings account (hereafter, “banked”) and consumers who have neither account (hereafter, “unbanked”). Banked consumers have their accounts at a bank, credit union, brokerage, or investment firm and are able to make payments from such accounts. Unbanked consumers have limited access to the payments system because, by definition, they do not have access to the payment instruments linked to a bank account, comprising debit cards, paper checks, and payment via the ACH system.⁴

For purposes of this article, we do not identify “underbanked” consumers, because prior research has shown that the payment choices of these underbanked consumers are similar to those of other banked consumers (Cole and Greene, 2017). Underbanked consumers are defined as consumers with a bank account who have used some alternative payment or credit system at least once in the past year.⁵

The share of US consumers who are unbanked has declined steadily since 2019, when 8 percent of US consumers reported that they had neither a checking nor a savings account. As table 1 shows, the share of unbanked consumers fell to 5 percent in 2021 (Foster et al. 2022). Similarly, the biannual FDIC survey of US households found that 4.5 percent of households were unbanked in 2021, down from 5.4 percent in 2019 (FDIC 2021). The share of banked households naturally exceeds the share of banked consumers because a household is considered banked if at least one member of the household has a bank account, and a consumer is considered banked only if that individual has a bank account. The FDIC report relates households’ changing economic circumstances to this decline.

⁴ In the SDCPC, respondents report two types of ACH payments: online banking bill pay (OBBP), that is, a payment made via the consumer’s online banking website or mobile banking app, and bank account number payment (BANP), that is, a payment made by providing a routing number and bank account number to the payee.

⁵ Underbanked consumers are consumers with a bank account who make use of any of five alternative financial services—money order, cashier’s checks, check cashing, remittances, and payday loans—from a nonbank and /or have used personal property to secure a loan at a pawn shop, used rent-to-own services, or taken out a tax refund anticipation loan within the preceding 12 months (FDIC 2022).

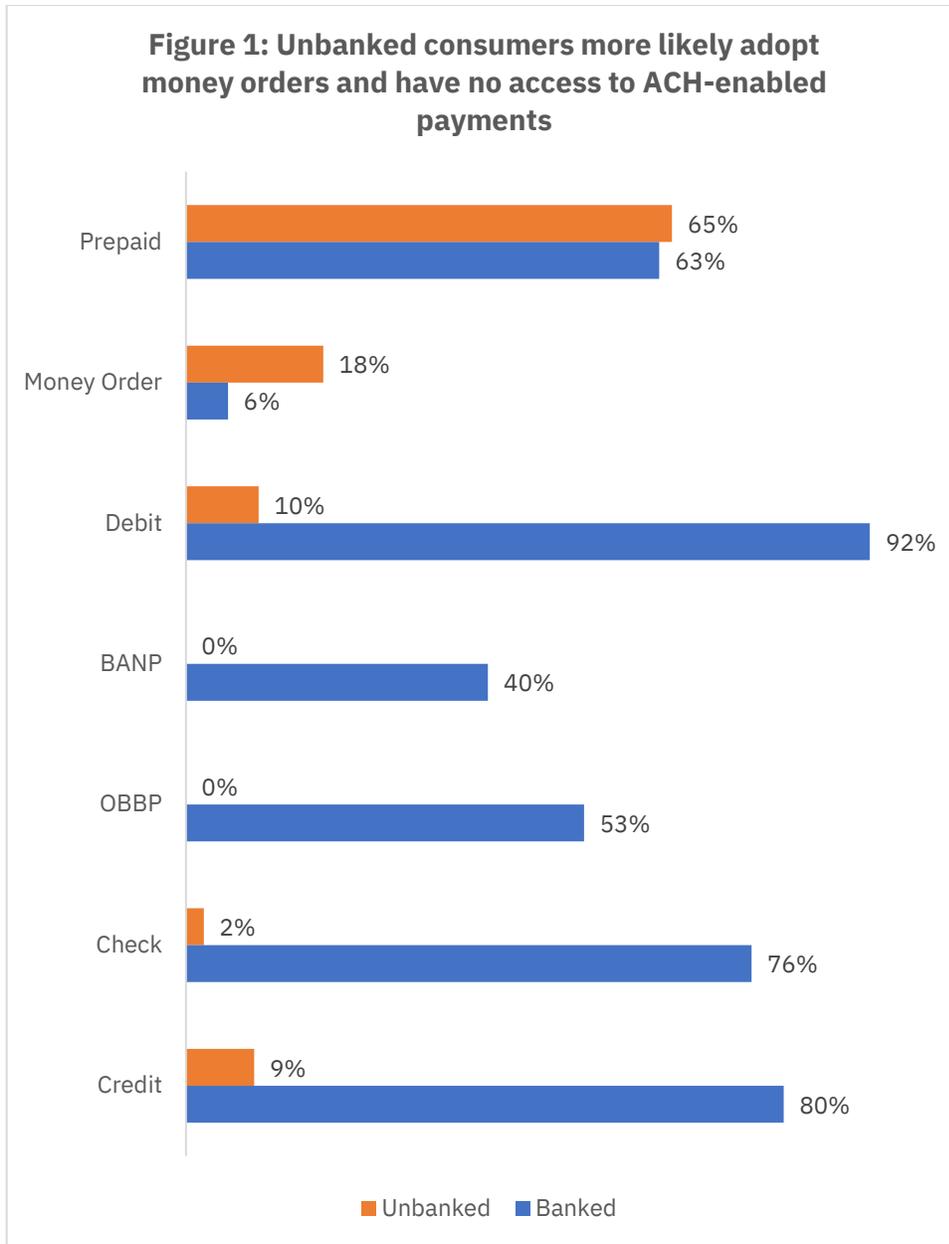
Table 1: 5% of U.S. consumers do not have a bank account

Shares of US consumers 18 and older	
Unbanked	5%
Banked	95%
Have checking account	93%
Have savings account	74%
Have both checking and savings	72%

Source: 2021 SDCPC

Access to the payments system

By default, adoption of payments instruments is vastly different between banked and unbanked consumers. Without bank accounts, unbanked consumers have no access to make ACH payments from bank accounts (bank account number payment, or BANP, and online banking bill payment, or OBBP), paper checks, or debit cards. In the SDCPC, no unbanked consumers reported access to ACH payment methods (see figure 1). A small share (2 percent) of unbanked consumers reported access to paper checks, which could be cashier’s or travelers’ checks, or access to checks via a banked household member. Some unbanked consumers (10 percent) reported access to debit cards, which could be erroneous reporting of adoption of “prepaid debit” cards or debit cards belonging to a household member. Greene and Shy (2021) noted that informal arrangements with family and friends could account for some of these results.



Note: Cash is excluded from this figure; cash use is included in the discussion below.

Source: 2021 SDCPC

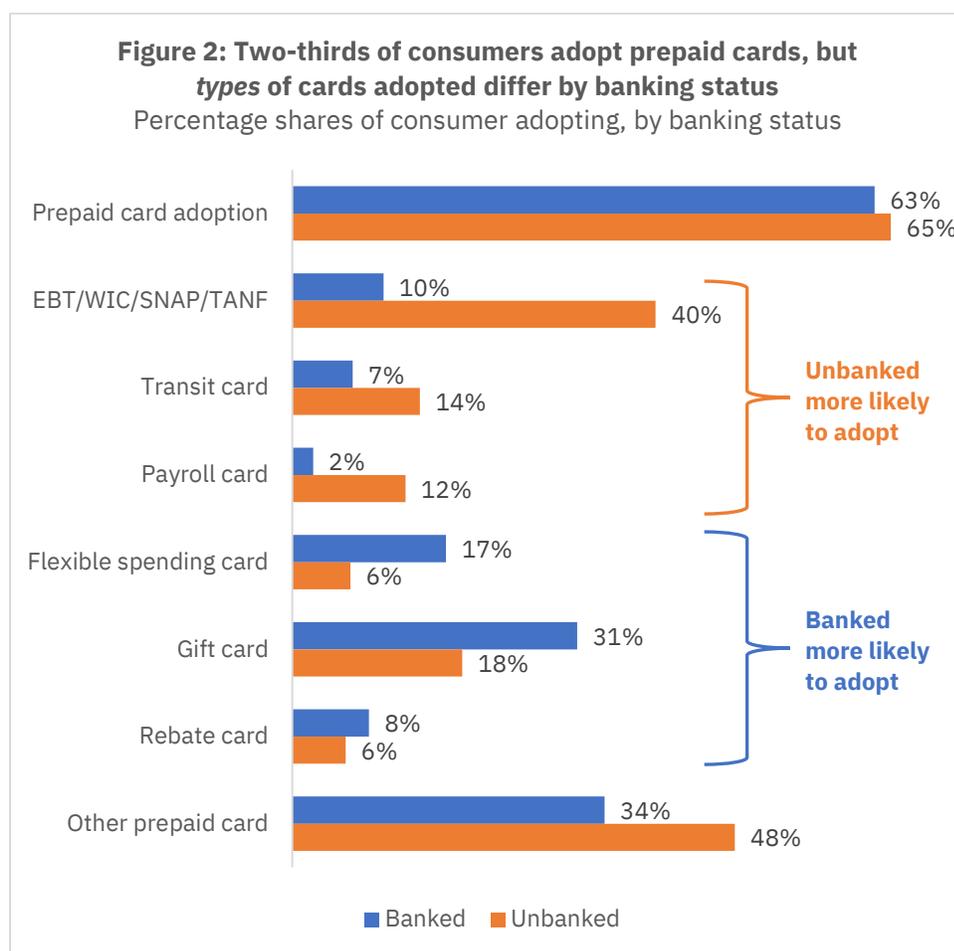
Access to the payment system via nonbank means

Prepaid cards and nonbank payment accounts can provide services that in past decades were only available via a bank checking account. These services include access to cash via ATMs, direct deposit of a paycheck, online account management, online bill payment, and general-purpose network payment cards (Greene and Shy 2015). Some consumers might choose these nonbank means in lieu of traditional bank accounts. In this section, we examine the adoption of these nonbank means by banked and unbanked consumers.

Prepaid cards

Two-thirds of US consumers own some type of prepaid card. Shares of ownership are about the same for consumers with (63 percent) and without (65 percent) bank accounts. What differs is the types of prepaid cards that banked and unbanked consumers adopt (see figure 2). Unbanked consumers are more likely to have cards related to receipt of income, including payroll cards and cards for receiving government benefits. An important function of a bank account is to receive income, and these higher adoption rates show that for some unbanked consumers, prepaid cards could be an acceptable way to take in funds and then manage payments out. For more on prepaid cards as substitutes for bank accounts, see Hayashi and Cuddy (2014), Greene and Shy (2015), and Toh (2021).

Compared to banked consumers, unbanked consumers are less likely to have flexible spending cards linked to employment, gift cards, and rebate cards.

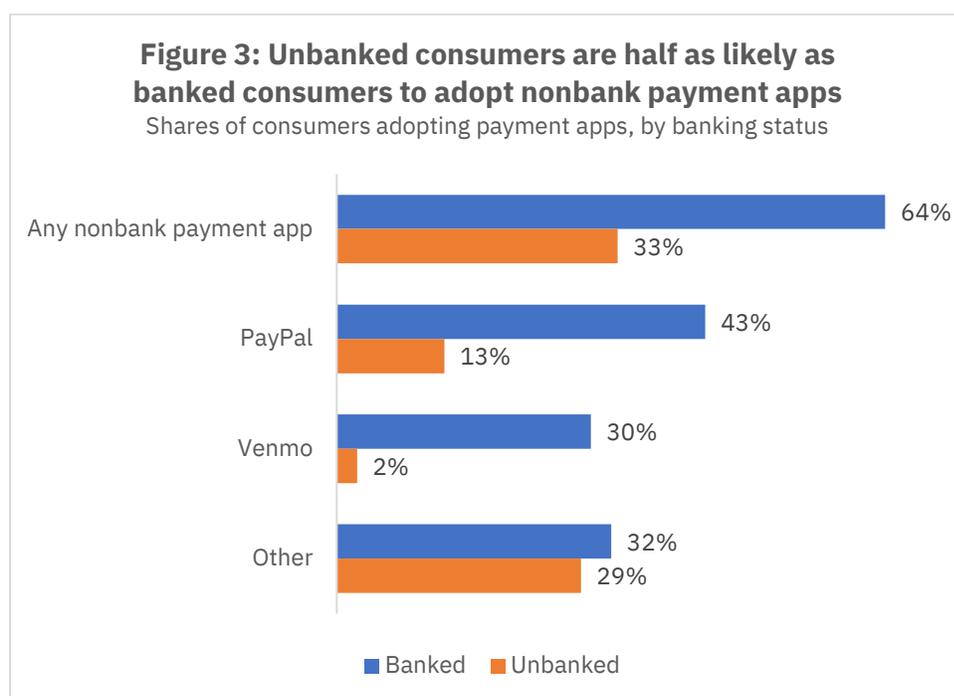


Source: 2021 SDCPC

Nonbank payment accounts

Some nonbank payment accounts (some of which are referred to as “neobanks”) also enable consumers to take in funds and then manage payments out. Therefore, it might seem

counterintuitive that unbanked consumers are less likely to adopt nonbank payment apps, with one-third of unbanked consumers adopting nonbank payment apps, compared to two-thirds of banked consumers (see figure 3).⁶ The lower adoption by unbanked consumers, also observed in the FDIC household survey, could be because unbanked consumers might lack access—or easy access—to methods for funding digital payment methods, typically cash, cards, and bank account transfers (Shy 2021). This problem of funding is not relevant for individuals who have a bank account. As noted in Bostic et al. (2020), if cash-in/cash-out networks were more ubiquitous (along the lines of ATM networks), funding of these accounts could be more accessible to unbanked consumers.



Source: 2021 SDCPC

Payment instrument use

Compared to banked consumers, unbanked consumers make fewer payments in all, fewer bill payments, and fewer p2p payments (see table 2). Banked consumers made more than twice as many payments in October 2021 as unbanked consumers.

Of all payments by unbanked consumers, 27 percent are for bills, relatively more than the share of bills paid in the month by banked consumers (23 percent). In addition, unbanked consumers make notably more payments to another person on a relative basis, 6 percent

⁶ FDIC (2021) reports that unbanked households are less than half as likely to use “nonbank online payment services,” (defined in the questionnaire as “with an account feature that allows you to receive and store money in the account).” Eighteen percent of unbanked households were using “nonbank online payment services,” compared to 48 percent of banked households.

compared to 4 percent for banked consumers. This larger share of p2p payments could be related to repaying friends or family providing access to payment instruments linked to bank accounts.

Table 2: Unbanked consumers relatively less likely to make remote payments

	Banked	Unbanked
Average number of payments for the month	40.8	17.1
Payments made remotely as a share of all	33%	17%
Average number of bill payments for the month	9.3	4.6
Bill payments as a share of all	23%	27%
Average number of p2p payments for the month	1.6	1.0
P2P payments as a share of all	4%	6%

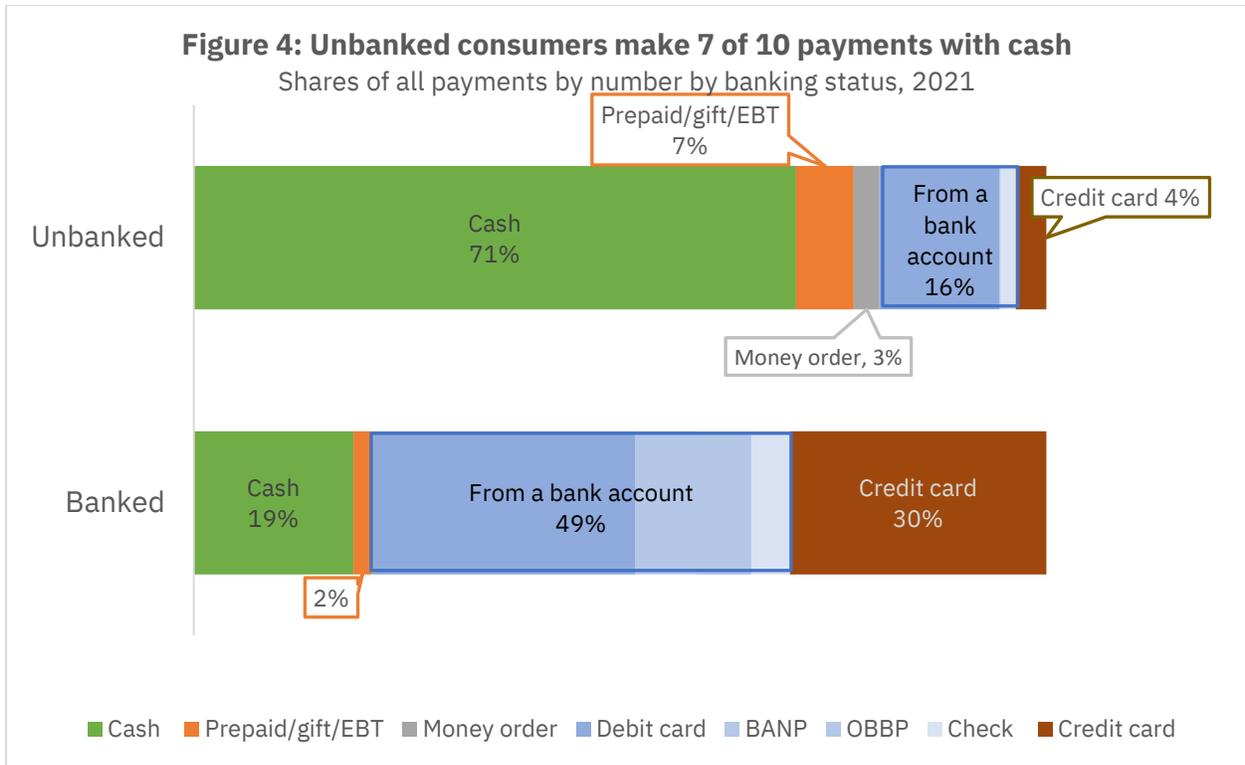
Note: Values are unweighted.

Source: 2021 SDCPC

Unbanked consumers make most payments with cash

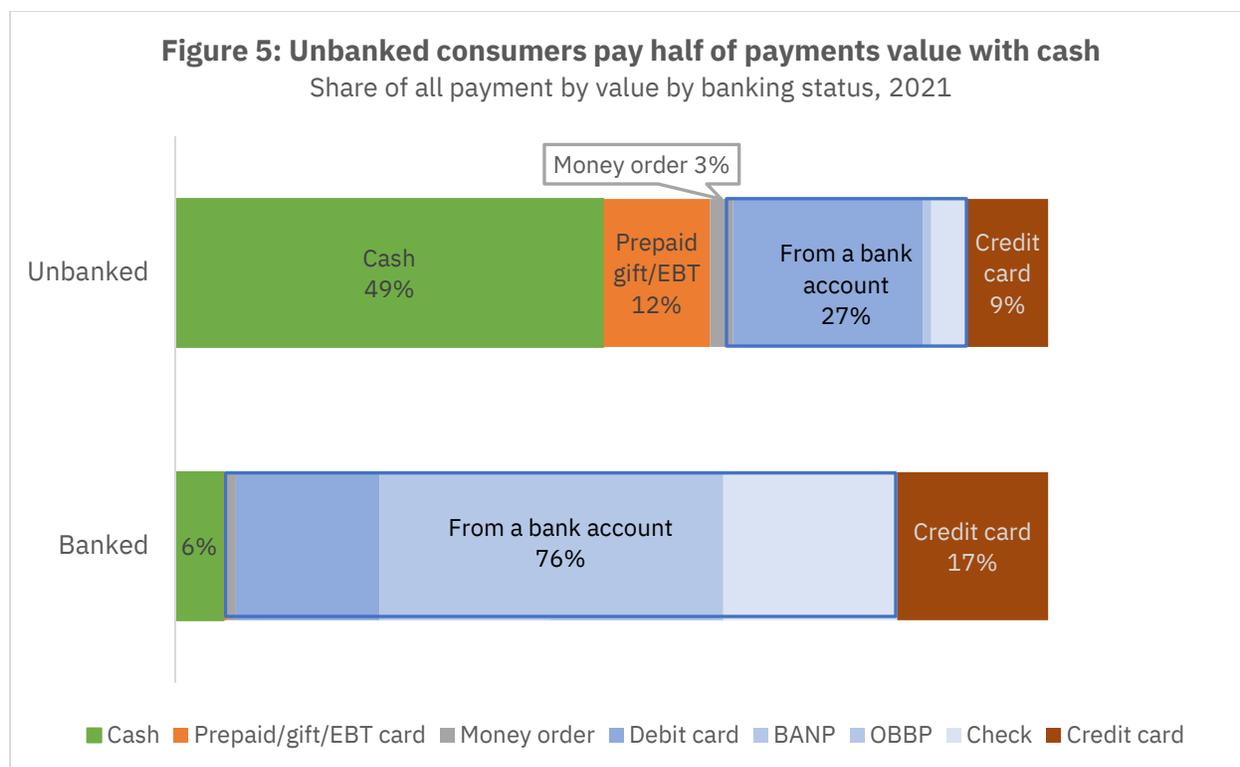
As noted above, nonbank payment methods, including prepaid cards, nonbank payment accounts, and money orders, are available to all consumers. Unbanked consumers have a greater propensity to use prepaid cards and money orders for payments, which total 10 percent of their payments by number, compared to 2 percent for banked consumers.

Despite the availability of other payment instruments, unbanked consumers make 71 percent of their payments (by number) with cash (see figure 4). In contrast, banked consumers make 19 percent of payments with cash. Perhaps most interesting, unbanked consumers report making payments from a bank account, 16 percent of their payments compared to 49 percent for banked consumers, perhaps because another member of their household has a bank account or because unbanked consumers rely on informal arrangements with friends and family (Greene and Shy 2022).



Source: 2021 SDCPC and authors' calculations

Unbanked consumers make about half of the value of their payments in cash (see figure 5). Cash, prepaid cards, and money orders make up two-thirds of the value of payments made by unbanked consumers, compared to just 7 percent of the value of payments by banked consumers. As noted above, unbanked consumers make fewer payments overall. Other research has shown that consumers generally move away from cash payments as the dollar value of the payment increases (Kim et al. 2020).



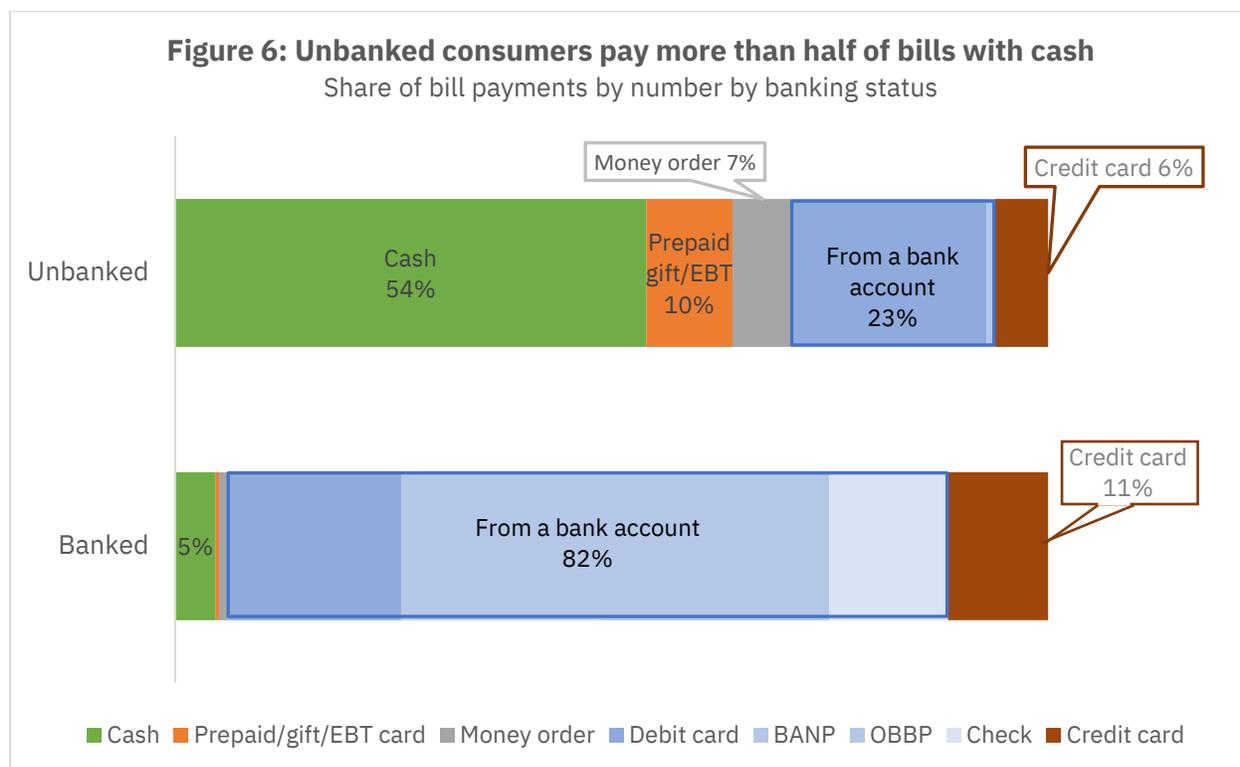
Source: 2021 SDCPC and authors' calculations

For bill pay, unbanked consumers also mostly use cash

Unbanked consumers pay most bills with cash, prepaid cards, or money orders: 71 percent of bills. Using data from 2017, Greene and Stavins (2021) find similar reliance on these three payment instruments. Banked consumers pay just 6 percent of bills with cash, prepaid cards, or money orders. Unbanked consumers use cash to pay 54 percent of their bills, compared to 5 percent for banked consumers.

While nonbank payment apps might eventually prove useful for those without bank accounts, we do not see such usage in these data for bill payments, perhaps because of the small sample size. And, as noted above, unbanked consumers are less likely to have adopted these apps than are banked consumers.

Banked consumers pay most bills—eight in 10 of them—from a bank account, using debit cards, ACH methods (BANP or OBBP), and check (see figure 6). Notably, unbanked consumers pay a quarter of bills from a bank account, perhaps that of a household member or via some informal arrangement.



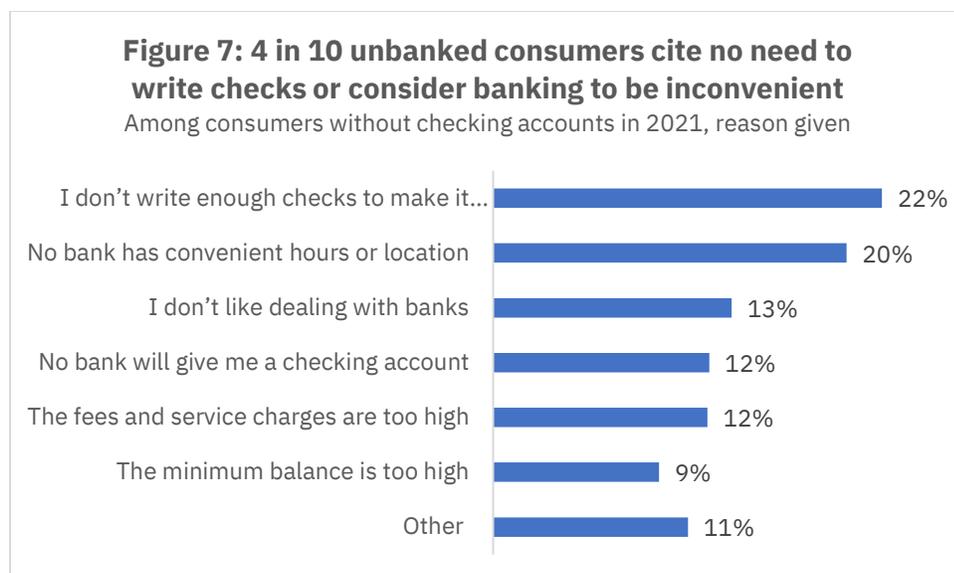
Source: 2021 SDCPC and authors' calculations

Attitudes and stated preferences

Looking at the challenges of assuring unbanked consumers full access to the payment system, subjective attitudes and preferences also could come into play. In this section, we look at two aspects of consumer attitudes:

1. Unbanked consumers' stated reason for being unbanked
2. Unbanked consumers' subjective assessments of payment instruments, based on characteristics such as cost, acceptance, and convenience

Why be unbanked? About 40 percent of unbanked consumers gave reasons related to cost: too few checks written to make it worthwhile, fees and service charges too high, and minimum balance requirements too high. As figure 7 shows, however, another 40 percent of consumers cited reasons relating to convenience: hours, location, and not writing checks. Respondents to the FDIC survey also did not coalesce around just a few reasons for not having a bank account (FDIC 2022, figure ES.3). The heterogeneous nature of consumers' reasons for being unbanked shows the need to dig deeper into underlying causes than can be understood via multiple-choice questions.



Source: 2021 SDCPC

Compared to banked consumers, unbanked consumers generally give lower ratings to all payment instruments (see table 3). Only money orders rate better on six of six characteristics (cost, convenience, security, set-up, acceptance, and record-keeping). Unbanked consumers say prepaid cards are better on four characteristics: security, set-up, acceptance, and record-keeping. And compared to bank consumers, unbanked consumers rate cash better for convenience, security, and record-keeping. A composite rating built from the six characteristics finds unbanked consumers give overall higher ratings to money orders, cash, and prepaid cards compared to banked consumers.

Like reasons for being unbanked, ratings of payment instruments could be related to underlying, unobserved factors, aside from consumers' demographics and income. Ratings could be the result of myriad factors, perhaps most important, more familiarity with payment instruments not associated with a bank account and constraints on the respondent's payment options. Our finding on ratings shows the limitations of quantitative survey research for understanding complex decisions and implies that more focused survey research, perhaps including face-to-face conversations, would be useful for product design and innovation to address the last mile problem. Projects like the US Financial Diaries (usfinancialdiaries.org/) and investigations centered around understanding the needs and preferences of consumers (buildcommonwealth.org/research/actionable-insights-for-inclusive-product-design/) are a step in this direction.

Table 3: Unbanked consumers rate prepaid cards and money orders relatively better

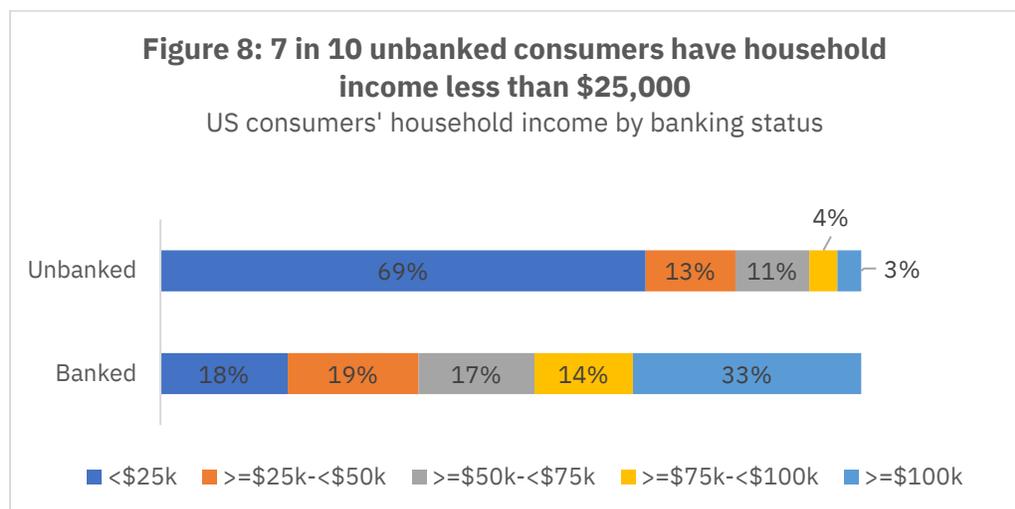
	Cost	Convenience	Security	Set-up	Acceptance	Record-Keeping
Cash		↑	↑			↑
Prepaid			↑	↑	↑	↑
Money order	↑	↑	↑	↑	↑	↑
Debit			↑			
OBBP						
BANP						
Check		↑				
Credit						

Note: Up arrows (↑) indicate that unbanked consumers rated the payment instrument more highly for the characteristic compared to ratings by banked consumers.

Source: 2021 SDCPC and authors' analysis

What consumers are most likely to be unbanked?

Lack of a bank account correlates with lower household income (see figure 8). Of unbanked consumers, 70 percent live in households with income less than \$25,000, compared to 18 percent of banked consumers. At the other end of the income spectrum, 3 percent of unbanked consumers have household income greater than \$100,000, compared to 33 percent of banked consumers.



Source: 2021 SDCPC and authors' calculations

Compared to banked consumers and as summarized in appendix table 3, unbanked consumers are:

- Younger: 44 percent of unbanked consumers are younger than 35, compared to 28 percent of banked consumers
- More likely to be female: 56 percent versus 52 percent
- More likely to be Black: 37 percent of unbanked consumers compared to 12 percent of banked consumers

- More likely to be Hispanic or Latino: 18 percent compared to 11 percent of banked consumers
- More likely to have a high school education or less: 82 percent of unbanked consumers compared to 36 percent of banked consumers
- Less likely to be married: 27 percent compared to 55 percent of banked consumers
- Less likely to be employed: 27 percent compared to 57 percent
- Less likely to own their home: 22 percent compared to 65 percent of banked consumers
- In lower income households, with median household income of \$9,360, compared to \$69,000 for banked households

Some differences (particularly household income, employment status, and age) hold true when we control for income and demographics. We estimate the probability of being unbanked as a function of age, gender, race, ethnicity, marital status, employment, household income, household size, and home ownership (see appendix table 4). All things equal, we find that age, household income, and being employed all are negatively associated with being unbanked. Regardless of other demographics, logistic regression results displayed in the column labeled model 3 in appendix table 4 show that every 10 years of age makes a consumer about 1.5 percentage points less likely to be unbanked. Being employed makes a consumer about 3 percentage points less likely to be unbanked. And every \$10,000 of income makes a consumer about 1 percentage point less likely to be unbanked; every \$50,000, 6 percentage points less likely.

Are digital solutions failing unbanked consumers?

Unbanked consumers are not enjoying the full benefits of innovations in digital payments. Unbanked consumers make seven in 10 payments in cash, but banked consumers make fewer than one in 10 payments with cash. Unbanked consumers pay more than half of bills with cash, whereas banked consumers pay a minuscule share of bills with cash. By definition, using a paper payment instrument (such as cash, money orders, or checks) precludes easy access to the digital economy. As a percentage share of all payments, unbanked consumers make half as many remote payments as banked consumers, perhaps indicating restricted digital access.

In addition, unbanked consumers are less likely than banked consumers to access digital payments via nonbank payment apps, which have sometimes been proposed as a solution to the last mile problem. Their reported use of debit cards and paper checks implies that unbanked consumers use informal relationships to access payments via bank accounts. Something about these informal relationships— anonymity? low cost? convenience?—could be making them more attractive than existing products and services that aim to close the digital divide in payments.

Appendix

Appendix Table 1

How Consumers Pay by Banking Status

Distributions of all payments by number and value

	Number shares		Value shares	
	Banked	Unbanked	Banked	Unbanked
Cash	18.7%	70.6%	5.6%	49.1%
Debit card	30.6%	14.0%	16.5%	21.8%
Prepaid/gift/EBT	2.1%	6.8%	0.4%	12.2%
Credit card	30.1%	3.6%	17.3%	9.3%
Money order	0.3%	3.0%	1.0%	2.6%
Check	4.6%	1.7%	20.0%	4.1%
BANP	7.2%	0.2%	19.6%	1.0%
OBBP	6.4%	0.0%	19.8%	0.0%

Note: Percentages are weighted.

Source: 2021 SDCPC

Appendix Table 2

How Consumers Pay Bills by Banking Status

Distributions of bill payments by number and value

	Number shares		Value shares	
	Banked	Unbanked	Banked	Unbanked
Cash	4.6%	54.0%	2.5%	46.6%
Debit card	19.8%	22.1%	13.6%	16.3%
Prepaid/gift/EBT card	0.4%	9.9%	0.1%	19.4%
Money order	1.1%	6.9%	1.2%	2.1%
Credit card	11.5%	6.1%	7.5%	13.8%
BANP	22.9%	0.9%	29.4%	1.8%
OBBP	26.1%	0.0%	32.4%	0.0%
Check	13.6%	0.0%	13.2%	0.0%

Note: Percentages are weighted.

Source: 2021 SDCPC

Appendix Table 3

Sample Distribution: Demographics and Income by Banking Status

	Banked consumers	Unbanked consumers
Percentage of all respondents	94.5	5.5
Age		
18-24	6.0	7.8
25-34	22.1	35.9
35-44	15.9	19.5
45-54	15.6	15.6
55-64	16.9	13.7
65 and older	23.5	7.6
Gender		
Female	51.6	55.5
Race		
Asian	5.7	2.0
Black	12.2	37.4
White	72.4	54.9
Other/combo	9.6	5.3
Ethnicity		
Hispanic/Latino	10.8	18.0
Education		
Less than high school	5.6	34.9
High school	30.7	47.0
Some college or associate's degree	27.1	13.7
College degree	20.0	3.2
Graduate degree	16.6	0.9
Marital status		
Married	54.6	27.4
Household income		
<25k	18.2	69.2
≥\$25k-<\$50k	18.7	12.8
≥\$50k-<\$75k	16.5	10.6
≥\$75k-<\$100k	14.0	4.0
≥\$100k	32.6	3.4
Employment status		
Employed	57.4	26.6
Home ownership		
Own home	65.0	21.5
Number of respondents	3,790	174

Note: Percentages are weighted.

Source: 2021 SDCPC

Regression results: Demographic attributes of unbanked consumers

Dependent variable: Consumer does not have a checking or savings account

Unbanked_i = 1 if consumer has no checking or savings account

Unbanked_i = 0 if consumer has either a checking or a savings account

Unbanked_i = $f\{\text{age, gender, race, ethnicity, marital status, employment, household income, household size, home ownership}\}$

All variables are categorical (factors) except for household income (measured in \$10,000 units), household size (number of people in the household), and age. The subscript “*i*” refers to a unique respondent in the SDCPC dataset. Note that education is excluded from the models because it correlates closely to income. Appendix table 4 exhibits the marginal effects associated with the estimated coefficients.

Appendix Table 4

Likelihood of Being Unbanked, Controlling for Demographics and Income

Average Marginal Effects

	Model 1	Model 2	Model 3
Age	-0.0006*	-0.0013***	-0.0014***
Gender: Female	-0.0055	0.0036	
Race: Asian	-0.0363***	-0.0263	-0.0280*
Race: Black	0.0163	0.0271**	0.0244*
Race: Other	-0.0149	-0.0206*	-0.0192*
Ethnicity: Hispanic	0.0181	0.0274	
Marital status: Married	-0.0143*	-0.0170**	-0.0167**
Household income/\$10k	-0.0094***	-0.0122***	-0.0123***
Employment: Employed	-0.0196**	-0.0274***	-0.0274***
Household size	0.0045***		
Home ownership:			
Homeowner	-0.0270***		
Number of observations	3335	3864	3864
Log Likelihood	-368.4791	-493.4579	-495.9488
Deviance	736.9582	986.9158	991.8977
AIC	760.9582	1006.9158	1007.8977
BIC	834.3049	1069.5104	1057.9733

***p < 0.001; **p < 0.01; *p < 0.05

Reference categories: Gender: Male, Race: White, Ethnicity: Other than Hispanic or Latino, Marital status: Not married, Employment: Not employed, Home ownership: Not a homeowner.

Models: Model 1 in appendix table 4 excludes education, which is heavily correlated with income and race. Model 2 excludes household size and home ownership, which increases the significance level of Race: Black. Model 3 excludes gender and ethnicity, which are not statistically significant.

Note: Three respondents reporting household income of \$1 million or more have been removed from the models.

Source: Source: 2021 SDCPC and authors' calculations

Additional demographic analysis: Random forest

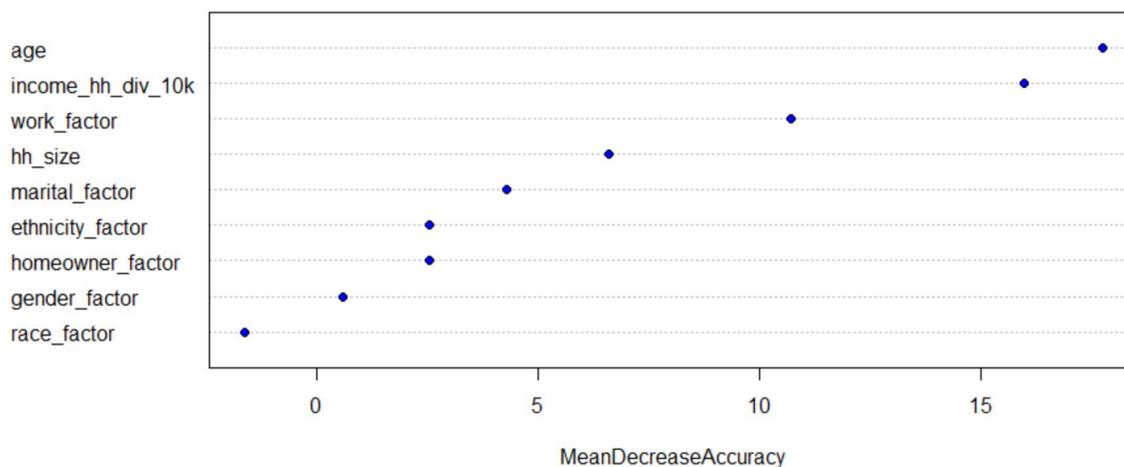
Above and in appendix table 4, we examined the demographics of unbanked consumers using standard logistic regressions. Here, we explore the regression model depicted in appendix table 4 using a machine learning technique called [random forest](#). Random forest excels in identifying and ranking variables according to their importance in predicting the probability that an individual with certain demographic characteristics is unbanked. This technique is accomplished by running hundreds of [classification trees](#) using only a subset of the variables on a subset of the observations and testing the prediction accuracy on out-of-sample testing data.

Using the regression model 1 in appendix table 4, the random forest technique yields the variable importance plot shown in appendix figure 1.

Appendix Figure 1

Random forest identifies age and household income as most important predictor of banking status

Variable importance plot



Source: Authors' calculations

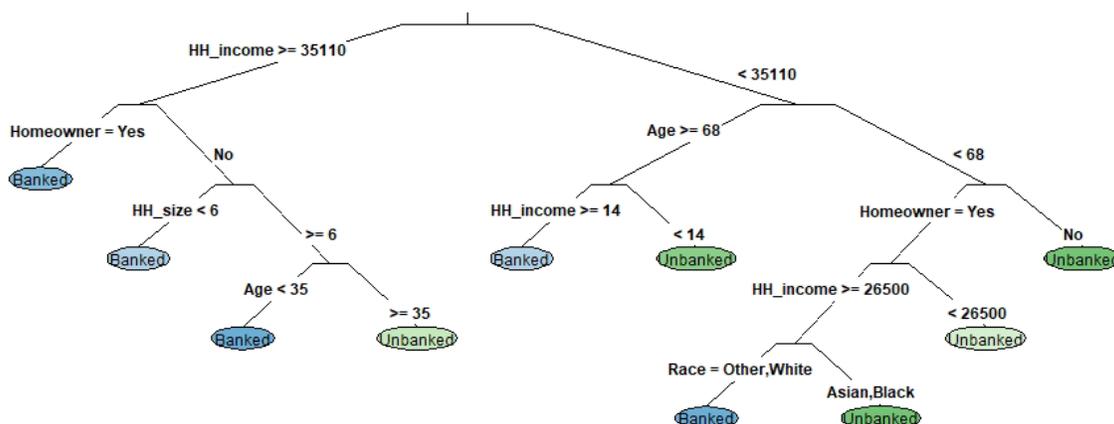
Appendix figure 1 shows that age and household income are the most important predictors of banking status. Clearly, low-income individuals make less use of formal banking. Appendix figure 1 shows that removing age from the model would decrease the classification accuracy

by 17.73 and removing household income by 15.96.⁷ In other words, removal of either variable would generate the largest increase in classification errors, both false positives and false negatives, for unbanked status.

The [classification tree](#) in appendix figure 2 shows that household income is the main predictor of banking status, with individuals with household income greater than \$35,110 most likely to be banked. This machine learning technique displays an optimized algorithm in the form of an upside-down classification tree. The tree illustrates how the software splits and classifies respondents by banking status, with the objective of minimizing the number of classification errors.⁸ The tree also shows that age and home ownership are important predictors for banking status.

As we move down the tree, lower branches display splits (between banked and unbanked) by less important predictors. Finally, the reader should be aware of the fact that the displayed tree is much shorter than the optimal tree that should be used to maximize prediction accuracy. We pruned the displayed tree only for the sake of illustration (the longer tree would not fit on a single page).

Appendix Figure 2: Classification tree—Predictors of banking status



⁷ Formally, the mean decrease in accuracy is computed as the mean change in accuracy scaled by its standard deviation when a variable is removed from the regression model.

⁸ After restricting the sample to respondents with an annual household income below \$1 million, the sample size slightly dropped to 164 unbanked and 3,715 banked. Given the low number of unbanked respondents in our data relative to the number of banked respondents, we use make use of the CARET package in R to “upsample” the unbanked respondents, which balances the unbanked and banked number of observations. This technique is widely used in machine learning—for example, to identify rare diseases with a relatively small number of observations. Therefore, the classification results displayed in appendix figure 2 are based on an artificially equal number of 3,715 unbanked and banked consumers.

References

- Bostic, Raphael, Shari Bower, Oz Shy, Larry Wall, and Jessica Washington. 2020. Digital payments and the path to financial inclusion. Federal Reserve Bank of Atlanta *Promoting Safer Payments Innovation* no. 2020-1.
- Cole, Allison, and Claire Greene. 2017. Financial inclusion and consumer payment choice. *Journal of Financial Transformation* 46: 219–35.
- Cubides, Emily, and Shaun O’Brien. 2022. 2022 Findings from the diary of consumer payment choice. Federal Reserve Bank of San Francisco *FedNotes*.
- Federal Deposit Insurance Corporation (FDIC). 2022. 2021 FDIC national survey of unbanked and underbanked households.
- Greene, Claire, and Joanna Stavins. 2021. Income and banking access in the USA: The effect on bill payment choice. *Journal of Payments Strategy & Systems* 15(3): 244–49.
- Greene, Claire, and Oz Shy. 2015. How are U.S. consumers using general purpose reloadable prepaid cards? Are they being used as substitutes for checking accounts? Federal Reserve Bank of Boston *Research Data Report* 15-3.
- . 2022. Payment card adoption and payment choice. Federal Reserve Bank of Atlanta *Policy Hub* no. 2022-10.
- Hayashi, Fumiko, and Emily Cuddy. 2014. General purpose reloadable prepaid cards: Penetration, use, fees, and fraud risks. Federal Reserve Bank of Kansas City working paper no. 14-01.
- Kim, Laura, Raynil Kumar, and Shaun O’Brien. 2020. 2020 Findings from the Diary of Consumer Payment Choice. Federal Reserve Bank of San Francisco *FedNotes*.
- Shy, Oz. 2021. Digital currency, digital payments, and the “last mile” to the unbanked. Federal Reserve Bank of Atlanta *Policy Hub* no. 2021-9.
- Toh, Ying Lei. 2021. Prepaid cards: An inadequate solution for digital payments inclusion. Federal Reserve Bank of Kansas City *Economic Review* 106(4).