

Banking on Distributed Ledger Technology: Can It Help Banks Address Financial Inclusion?

By Jesse Leigh Maniff and W. Blake Marsh

Access to financial services is an important policy goal. Households with access to financial services are able to withstand temporary financial hardship and build wealth, ultimately improving economic outcomes (Raskin; Brainard 2017). Banking services, in particular, facilitate inclusion in the financial mainstream by enabling households to deposit and save income, make payments, and obtain credit while offering substantial consumer protections (Gruenberg). Yet despite these benefits, 7 percent of U.S. households do not have a checking or savings account and are thus considered unbanked (FDIC 2016).

Policymakers and consumer advocates have suggested that financial technology (or “fintech”) may address the needs of these consumers (Carney; Curry). One particular innovation, distributed ledger technology (DLT), has been promoted as a solution given its potential to reduce costs and increase access points for consumers (Committee on Payments and Market Infrastructures; Higgins; Walport; Mills and others; World Economic Forum; He and others; Baruri). By removing the need for a central authority through decentralizing records

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into a shared digital ledger, DLT could potentially lead to cheaper, faster financial transfers (Wessel). To date, however, most analyses of DLT's ability to provide financial services to underserved communities have focused on broad international case studies or nonbank financial institutions (Baruri; Biggs; Georgetown University). Few researchers have connected the specific issues affecting unbanked consumers in the United States to the services DLT could provide.

In this article, we analyze whether DLT addresses unbanked consumers' primary concerns about having a checking or savings account. We argue that while DLT addresses each concern in at least a limited capacity, it is unlikely to significantly reduce the share of unbanked consumers in the United States. Historical examples show that banks are unlikely to pass DLT's cost savings through to consumers. Further, outcomes from previous cost-focused policy initiatives suggest demand for banking services among the unbanked is either low or relatively unresponsive to changes in the cost of banking services. DLT is also unlikely to make banks more trustworthy in the eyes of the unbanked or provide more privacy for consumers. Although DLT may address concerns about convenience and account offerings, only a small percentage of unbanked households report these concerns as the major factor in their banking status.

Section I examines data on unbanked consumers and the reasons they forego banking services. Section II provides a high-level summary of DLT's benefits. Section III explains why DLT's benefits are unlikely to address the obstacles unbanked consumers face.

I. The Unbanked: Demographics and Rationales

While financial inclusion can refer to the use of any consumer financial service, we focus on household use of bank accounts rather than alternative financial services (AFS) such as title and payday loans, check-cashing, and money order services. Although AFS providers may benefit some consumers, their temporary, one-time services do little to improve consumers' long-term financial status (Baker). Moreover, the high cost of basic financial services from AFS providers may undermine redistributive income policies aimed at helping the poor.¹

In contrast, bank accounts can carry substantial, long-term benefits. For example, bank accounts reduce the risk of loss or theft of

financial assets and enable households to accumulate wealth (Barr). This wealth can provide a buffer against transitory financial shocks, ultimately reducing insecurity and stress (Caskey 2002; Brainard 2017). Consistent with this hypothesis, Caskey (1994) finds that unbanked consumers are more likely to have credit problems. In addition, obtaining a bank account often precedes more complex financial investment (Beverly, Moore, and Schreiner; Caskey 2005).

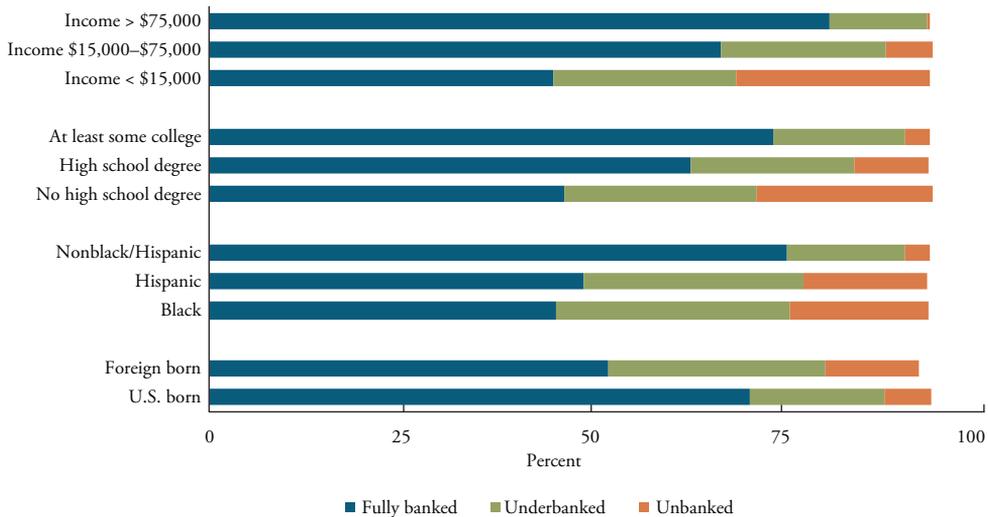
To identify financially underserved populations, we use the 2015 FDIC National Survey of Unbanked and Underbanked Households (FDIC 2016). The survey groups households into one of three banking status categories. “Banked” households are those that have a checking or savings account at a commercial bank or credit union and have not used AFS providers during the last 12 months. “Underbanked” households are those that have accounts with commercial banks and credit unions but have also used AFS providers in the last 12 months. And “unbanked” households are those that do not have accounts with commercial banks or credit unions. In addition to collecting demographic and banking status information, the FDIC survey also asks unbanked households why they do not have a bank account.

Demographics

To assess whether DLT promotes inclusion in the banking system, we first identify the characteristics of underserved populations. Nearly 20 percent of all U.S. households are underbanked, and 7 percent are unbanked (FDIC 2016). Chart 1 shows the banking status of households in key demographic groups. Overall, unbanked and underbanked households are more likely than banked households to have lower incomes, attain lower levels of education, and identify as black, Hispanic, or foreign-born.

Household banking status is most sharply divided by income. Only about 45 percent of households earning less than \$15,000 annually are fully banked, while more than 80 percent of households earning at least \$75,000 are fully banked. Low-income households are much more likely to report being unbanked. More than one-quarter of households earning less than \$15,000 state they are unbanked, while households earning at least \$75,000 rarely report being unbanked.

Chart 1
Demographic Profile of Unbanked Consumers



Note: Percentages do not sum to 100 percent due to some households having an unknown banking status.
Source: 2015 FDIC National Survey of Unbanked and Underbanked Households.

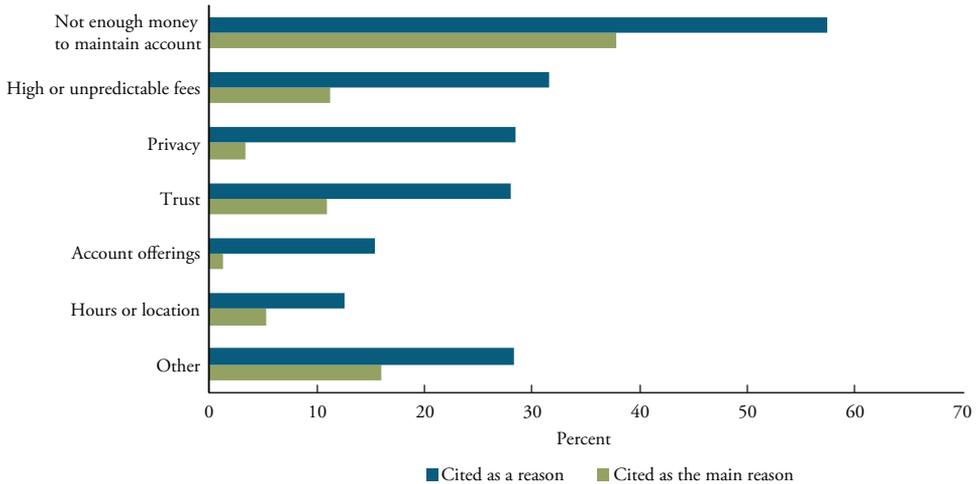
Education, race, and birthplace also appear to be highly correlated with household banking status. Fewer than half of all households with less than a high school education are fully banked, whereas nearly three-quarters of households with at least some college education are fully banked. More than three-quarters of nonblack, non-Hispanic households are fully banked, while less than half of black and Hispanic households are fully banked. Finally, U.S.-born households are more likely to be fully banked than foreign-born households.

Rationales

Identifying the reasons households choose not to participate in the banking system is another crucial step in determining whether DLT might promote financial inclusion. In the FDIC survey, unbanked households can select several reasons for their banking status while also identifying a single main reason. Chart 2 shows the shares of unbanked households from the 2015 survey that selected each reason for being unbanked. The chart also reports the shares of unbanked households that selected each main reason. The results are little changed from the 2013 survey (see Hayashi).

Chart 2

Reasons Households Do Not Have Bank Accounts



Source: 2015 FDIC National Survey of Unbanked and Underbanked Households.

Unbanked households most commonly cited cost-related concerns as the reason for their banking status. The two most common reasons given for lack of a bank account were not having enough money to maintain an account (57 percent of unbanked households) and high or unpredictable fees (32 percent of unbanked households). The main reasons these households selected for their banking status were also cost-related: 40 percent stated they had too little money to maintain an account, and more than 10 percent listed high and unpredictable fees. The high incidence of cost concerns is consistent with the fact that unbanked households are more likely to have low to moderate incomes.

Trust and privacy concerns were also commonly reported in the survey, but they appear to be less significant obstacles overall. Nearly 30 percent of unbanked households selected trust and privacy as reasons for their banking status. However, only about 14 percent of these households selected trust or privacy as the *main* reason they did not have an account. About 11 percent selected trust as the main reason, while less than 4 percent listed privacy as the main reason.

Finally, a moderate share of unbanked households listed account offerings or issues of convenience, such as hours and location, as a reason for not having an account. However, less than 7 percent of unbanked

households cited these as main reasons. This result is unsurprising, because banks are reasonably accessible to the majority of U.S. households.²

II. A New Technology: What Can DLT Do?

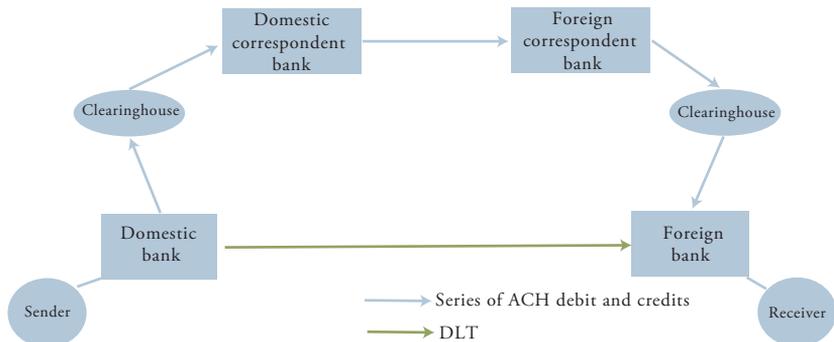
DLT's potential benefits have generated broad interest from the banking and payments industries. Perhaps due to the variety of these interested stakeholders, DLT has no universal, authoritative definition.³ For the purpose of this paper, we define DLT as a series of technological procedures that allow parties who may not trust one another to share an identical and agreed-upon record of information known as a ledger (see the Appendix for a more detailed overview of DLT and its benefits).⁴

The potential benefits of DLT arise from its decentralized nature and the fact that participants hold identical copies of a shared ledger that is updated algorithmically.⁵ A shared ledger reduces the need for third parties to reconcile individual ledgers, thereby reducing complexity and increasing the speed with which transactions can be processed. Moreover, a shared ledger improves network resiliency: when every participant has a copy of the ledger, there is no single point of attack. Finally, a shared ledger inherently increases transparency and accuracy, because unilateral changes to the ledger are usually prohibited and updates require agreement among several participants.

In banking, one of DLT's most promising potential benefits is streamlining cross-border payments. Under the existing correspondent banking system, cross-border payments can encounter multiple points of friction (Rosner and Kang). Figure 1 illustrates this process using an automated clearinghouse (ACH) transaction under both the current system and under bank implementation of DLT.⁶ First, the remittance sender's bank makes an ACH transfer to a domestic correspondent bank. Second, the correspondent bank provides foreign exchange for the transaction through a local account at a foreign correspondent bank ("nostro account"). Third, the foreign correspondent bank debits the domestic correspondent bank's nostro account and credits the receiving foreign bank through an ACH. Each step results in a time delay and a fee. Under a DLT system with a shared ledger, however, the banks transact directly. Intermediaries no longer handle settlement, minimizing dependence on correspondent banking aside from a

Figure 1

Example of Remittances in a Correspondent Banking System versus Bank Implementation of DLT



potential currency exchange. In this way, DLT may provide faster, cheaper remittances for consumers (Brainard 2016).

DLT's real-time value transfer ability could also improve check processing, drawing unbanked consumers to banks in the process. Although check processing speeds have increased, check clearing times are still an obstacle for some unbanked consumers who need quick access to funds to pay bills or purchase household goods. Currently, these consumers rely on check cashing services. DLT could streamline the check clearing process for banks by reducing the number of counter-parties involved in the transaction. Similar to cross-border payments, check clearing often relies on the correspondent banking system, with multiple banks debiting and crediting multiple parties. Under a shared ledger, however, third-party intermediaries are unnecessary, allowing check processing and settlement to be near-instantaneous.

III. Does DLT Provide Solutions to the Unbanked?

Although DLT has clear benefits for certain banking and payments processes, it is unclear whether it can directly address the needs of unbanked households. On the surface, DLT features align very well with the major obstacles facing unbanked consumers. But its success in overcoming these obstacles may depend heavily on its accessibility as well as its implementation.

Can unbanked households use DLT-based services?

For DLT to benefit the unbanked, consumers must be able to access the technology. Offering DLT solutions through mobile banking platforms could allow banks to reach a large proportion of unbanked households. Table 1 lists the shares of mobile phone ownership by household banking status and indicates that a supermajority of all household types own mobile phones, as reported in the 2015 FDIC National Survey of Unbanked and Underbanked Households. Interestingly, underbanked households are more likely to own mobile phones than fully banked households despite significant income differences between the groups. Independently administered surveys find similar rates of phone ownership by banking status (BOG 2016).

One explanation for the different ownership shares is that underbanked and unbanked households may use their mobile devices not only for telephone services but as an access point to other internet-based services such as mobile payment services. The Pew Research Center finds that smartphone dependency, a term applied to consumers who use smartphones as their primary means of internet access, is higher among low-income, minority, and less-educated populations—populations that are more likely to be underbanked or unbanked.

Unbanked households also report high rates of mobile phone ownership, though notably lower than the rates of underbanked and banked households. However, only about half of all unbanked households own smartphones (not shown), and households with lower incomes, lower educational attainment, and that comprise a single individual have even lower shares of smartphone ownership. Lack of a smartphone may not affect their ability to access mobile banking, however, as households can access text banking from phones without internet access.

Still, DLT may not offer these consumers a wholly new experience. Mobile banking already provides users many features that a DLT-based banking service would provide. Mobile banking allows consumers to initiate transactions remotely, alleviating many access barriers. It also allows consumers to access their bank accounts to verify pending and completed transactions and, in some cases, set up balance alerts to help avoid overdrafts and unwanted fees. A DLT-based banking solution would simply alter the transactions process used by depository institutions so that funds are moved more quickly. In other words, DLT

Table 1
Mobile Phone Ownership by Banking Status

Demographics	Unbanked (percent)	Underbanked (percent)	Banked (percent)
All households	78.2	93.2	90.5
Single household head	83.8	95.1	91.8
Individuals	71.5	89.4	85.8
Black	78.8	93.0	88.9
Hispanic	80.4	94.4	88.3
U.S. born	77.5	93.2	90.8
Foreign born	79.9	93.1	88.9
Income < \$15,000	76.3	87.3	76.0
Income \$15,000–\$75,000	80.4	93.7	88.8
No high school degree	72.7	86.2	74.0
High school degree	80.9	92.3	86.4

Note: Statistics are based on respondents with known mobile banking status.
 Source: 2015 FDIC National Survey of Unbanked and Underbanked Households.

will not require consumers to purchase a new application—instead, it will upgrade the underlying infrastructure of existing applications. To banked consumers, DLT implementation may simply appear as an improved mobile banking experience.

Does DLT solve high costs and account requirements?

Lower operational costs are a major driver of financial services providers' investment in DLT. Total cost reductions will likely result from DLT's ability to settle transactions in real time, reducing both liquidity needs and operational costs. In addition, the record-keeping features of DLT and the ease with which the ledger can be shared may reduce compliance and regulatory costs. DLT is also expected to reduce frictions within the payments system and improve security, thereby lowering costs.

For DLT to foster financial inclusion, however, the savings from banks' reduced liquidity needs and lower operational costs must be passed through to consumers. Reduced liquidity needs and significant cost reductions that are passed on to consumers could address the main obstacles unbanked consumers face: limited funds to maintain an account and high fees. Specifically, banks' reduced liquidity needs could facilitate lower minimum balance requirements, while lower operational,

maintenance, compliance, and security costs could reduce associated account fees.

To assess the likelihood of banks passing cost savings from DLT-based banking services on to their customers—and of unbanked households adopting these services—we first examine the effect of account fees on total revenues for an indication of banks' ability and willingness to adjust that income component. Then, we review prior research on events that affect bank revenues, the effects of those events on bank revenues, and banks' responses. Finally, we examine the efficacy of various policy initiatives that sought to encourage unbanked consumers to become banked.

Service fees charged on bank accounts represent a significant share of total bank income. Since 1985, account service fees have constituted 2 to 6 percent of gross bank income, with the share averaging more than 4.5 percent recently (Chart 3).⁷ These fees can provide an important counterbalance to offset lost revenue during recessions and other times of stress for banks. Indeed, evidence suggests that banks actively adjust account service fee schedules to offset lost income during these times: the share of banks offering free checking accounts declined following the 2007–09 financial crisis, while minimum balance requirements and monthly maintenance fees increased (Zywicki and others).

One case study in banks' ability and willingness to adjust fees to offset profitability shocks occurred in the mid-to late 1980s, when interest rate ceilings that limited interest payments on interest-bearing accounts were repealed. Before the repeal, banks could not attract depositors with competitive interest rates. Instead, they offered cheap and often free account services. As a result, account service fees were a relatively small source of total income (Chart 3). Washington argues that once interest rate caps were lifted, interest expenses increased as banks paid market deposit rates. To offset these higher interest expenses, banks increased account service fees for depositors. Indeed, Chart 3 shows that account service fees as a share of total income increased during this time.

The Dodd-Frank Act's Durbin Amendment, which limits debit-card interchange fees that banks with \$10 billion or more in total assets can collect from merchants, provides a more recent example of a profitability shock subsequently offset by a fee adjustment. The amendment is estimated to have reduced total revenue at affected

Chart 3

Account Service Fees as a Share of Total Income



Note: Total income includes interest and noninterest income. Service fees on deposit accounts include both consumer and commercial fees. Gray bars denote National Bureau of Economic Research (NBER)-defined recessions. Data are at a quarterly frequency and not seasonally adjusted.
Sources: NBER and Call Reports.

banks by approximately 5 percent. Kay, Manuszak, and Vojtech estimate that affected banks were able to offset about 30 percent of the revenue decline by increasing account service fees. Notably, the authors find little evidence that affected banks reduced operating costs or total expenses during this period. The results confirm reports that large banks increased account fees in response to the interchange fee rule (Zywicki and others).

Even when banks have reduced fees, those actions ultimately led to higher total fee income. In the early 2000s, banks sought to offset falling fee income from investment and money management activities by driving up the number of fee-paying depositors. To do so, banks offered checking accounts without monthly maintenance fees but increased both the number and size of fees tied to account activities. Thus, banks worked to increase the fee-paying base while expanding the scope of the fee payment schedule (Atlas).

One natural question is why banks wait until negative profitability shocks occur to raise fees. First, a small number of consumers incur the majority of consumer account fees. Because most consumers keep a sufficient balance to avoid incurring account service fees, the effect of an increase on revenue may be low. Second, banks often seek to maximize

income per customer rather than per account. For example, a bank may be willing to offer free checking accounts to customers who are more likely to borrow money for a car or a home in the future. Thus, checking accounts may be thought of as “loss leaders” that enable banks to generate future consumer revenue.

A second question is whether demand for bank accounts increases among unbanked consumers when costs decline. Starting in the late 1980s, policy programs implemented at both the state and federal levels, as well as by commercial banks, sought to offer low-cost accounts to the unbanked. Most of these programs, however, were unsuccessful in attracting unbanked consumers, raising questions about the nature of unbanked households’ demand for banking services.

The first attempts to offer low-cost accounts to the unbanked were so-called “state lifeline banking laws.” These laws required banks to offer low-cost accounts with basic functionality to low-income populations. Research on the efficacy of these state-level programs overwhelmingly finds that they were unsuccessful in drawing the unbanked into the financial system (Doyle, Lopez, and Saidenberg; Washington). In particular, Prescott and Tatar and Doyle, Lopez, and Saidenberg argue that low-income consumers are relatively insensitive to price changes, especially small price changes. Washington finds that caps on check-cashing fees are more effective at increasing the banked share of low-income consumers.

A second policy initiative, the 1999 Electronic Funds Transfer provisions to the Debt Collection Improvement Act of 1996, encouraged unbanked households to open bank accounts by initially requiring all nontax, government transfer checks to be electronically deposited. Stegman notes, however, that the initiative’s final implementation was substantially weakened by a provision that allowed the U.S. Treasury to grant an unlimited number of waivers to consumers. In addition, Good notes that the U.S. Treasury coordinated with AFS providers to facilitate electronic funds transfer rather than establishing exclusive relationships with banks to provide accounts to low-income households. While individual policy effects are difficult to identify during the period due to a number of simultaneous changes targeting low-income communities, Hogarth and others find that, all else equal, the probability of a household holding a bank account was statistically unchanged from 1998 to 2001.

A third policy initiative that focused on low-income populations was the individual development account (IDA). Rather than reducing consumers' costs, IDAs increased their returns on savings by matching funds when account holders withdrew savings for pre-determined purposes such as a home purchase or education expenses. Grinstein-Weiss and others (2012) find that after six years, IDA program participants were no more likely to have a retirement account or sufficient savings for retirement. Similarly, Grinstein-Weiss and others (2013) show that these programs had no long-term effect on homeownership, though they may have had some short-term benefits (Grinstein-Weiss and others 2008; Mills and others 2008).

Finally, at least one known private sector attempt to bank the unbanked was also unsuccessful.⁸ From January 2000 to May 2001, Shorebank, a commercial bank focused on low- and moderate-income communities, conducted a program offering low-income families free tax preparation and the opportunity to deposit their Earned Income Tax Credit in a low-cost account. As Beverly, Tescher, and Romich discuss, only about 20 percent of eligible consumers using the tax preparation services opened an account with the bank. Only 44 of the consumers participating in the study were unbanked before opening an account. Statistical analysis confirms that unbanked participants were no more likely to open an account than their banked peers.

Collectively, this evidence suggests that either demand for banking services among the unbanked is low or that this population is relatively unresponsive to changes in the cost of banking services. Notably, previous attempts to offer unbanked consumers low-cost accounts failed even when paired with additional benefits such as matched savings and additional financial services or requirements for the consumer to take action to forego banking services. Thus, DLT is unlikely to reduce the proportion of unbanked households even if banks pass cost savings on to consumers. Instead, income, as suggested by Hogarth and others, is likely the main determinant of whether a household is banked.

Nevertheless, DLT has the potential to reduce the unpredictability of account fees—a common concern among the unbanked.⁹ Consumers can sometimes be assessed overdraft fees believing there were adequate funds in their account.¹⁰ Currently, delays occur between initial payment and final funds disbursement, requiring banks to authorize

payment amounts that may differ from the settlement amount (Consumer Financial Protection Bureau 2013). Adding to the unpredictability, banks have some discretion over the order in which these “pending” transactions are ultimately settled. DLT may eliminate both the confusion over pending and settlement differences as well as bank discretion by enabling immediate settlement and clearing. If DLT could reduce instances of overdraft in this way, more consumers might stay included in mainstream financial services.

Does DLT address unbanked trust and privacy issues?

The rapid rise of virtual currencies outside the banking system has driven discussion about DLT’s potential to address consumer trust and privacy issues. Where virtual currencies are concerned, DLT may resolve trust issues around third-party actors by facilitating peer-to-peer currency trades in an anonymous system that does not require trust between parties. Unbanked consumers’ lack of trust in banking organizations, however, is more likely to revolve around concerns about unethical practices, misuse of funds, or data loss. Banks can potentially resolve these issues for the majority of unbanked households through face-to-face interactions with customers, open and transparent observations of bank activities, and increased expectations of privacy.

DLT is unlikely to assist banks in achieving these goals, as moving away from relationship-based affiliations to technology-based solutions may further alienate those who already do not trust banks. In an FDIC qualitative survey, counselors in underserved communities noted that unbanked consumers felt more comfortable with AFS providers than banks because of a perceived familiarity that traditional banking relationships lack (Rengert and Rhine). DLT further facilitates automated processes that closely resemble mobile banking and are inherently nonpersonal. Increased automation is unlikely to appeal to consumers wanting a more personal relationship with their financial services providers.

Although DLT’s open and transparent ledger capabilities may allow banks to address trust issues by providing greater transparency, this, too, is unlikely to encourage the unbanked to establish a banking relationship. Complete ledger transparency is not a feasible business practice. Full transparency requires disclosing lending relationships, pricing and investment strategies, and other competitive information that banks and their customers often wish to protect. Instead, banks are

likely to implement DLT in a way that restricts most users' access and is thus unlikely to provide sufficiently detailed information to overcome customer concerns.

Moreover, balancing trust with privacy may prove untenable for banks. Sixty percent of unbanked consumers who listed trust as their main reason for being unbanked were also concerned about privacy. While proponents of DLT tout trust and privacy as two major benefits, there are inherent trade-offs between the two in banking. Certain DLT features that address privacy concerns may not be applicable to bank customers. Early DLT systems used pseudonymous transactions, which traced transactions without identifying parties by name, to protect privacy; however, Know-Your-Customer and Anti-Money Laundering requirements are likely to prevent banks from implementing fully anonymous systems. A more transparent system without complete anonymity may actually reduce consumer privacy, and, if data are shared among many participants, raise concerns over disclosure of personal information.

Does DLT solve inconvenience and insufficient product offerings?

DLT may solve certain inconveniences that discourage potential customers from opening a bank account. As previous examples on check settlement and remittances illustrate, the ability to initiate a transfer anytime, anywhere, and instantaneously receive funds should alleviate timing concerns related to the availability of deposits to make time-sensitive payments.

While mobile banking has already significantly lowered access barriers through reduced reliance on branch hours and locations, DLT may offer additional improvements. Online or mobile banking platforms alone are often insufficient for consumers needing to supply documentation to open an account. Recent estimates suggest that only about one-quarter of new accounts are opened completely online or using mobile applications (Schwanhausser and others). Instead, the majority of new accounts are either fully or partially completed within physical branches. Banks could acquire and store documentation in DLT systems to facilitate new account openings for consumers hindered by inconvenient hours and locations.¹¹ And DLT's digital identity and electronic record-keeping potential could streamline this process, allowing consumers to conveniently provide necessary documentation.

Furthermore, DLT's immediate settlement capabilities may allow banks to compete with AFS providers for unbanked consumers. AFS providers argue they provide a service to consumers who need funds immediately. For example, funds from checks deposited at a bank may take several days to become available, whereas a nonbank check casher is more likely to provide immediate cash and payment services (Klein). DLT, however, may decrease this market advantage by significantly reducing settlement times. If funds availability is a major obstacle for unbanked households, these households may switch to checking accounts with immediate funds availability to avoid paying check-cashing service fees.

Finally, DLT may allow banks to improve remittance services for the unbanked. In 2014, U.S. consumers sent \$54.2 billion in personal remittances (U.S. Government Accountability Office). More than 10 percent of those households who have sent remittances in the past 12 months are unbanked (FDIC 2016). Banks have increasingly withdrawn from remittance businesses, leaving AFS providers to pick up the slack. If DLT can facilitate more cost-effective, cross-border transactions, increased competition may drive down the costs and improve the quality of remittance services across the industry—thereby drawing more consumers into banking services.

IV. Conclusion

Unbanked consumers could benefit significantly from banking relationships. DLT has been touted as one way to address the issues these consumers face in obtaining banking services. Upgrading existing banking infrastructure with DLT may, indeed, attract unbanked consumers who struggle with access issues and insufficient product offerings. However, we find that bank adoption of DLT is unlikely to address the needs of consumers who are wary of high account fees, have limited funds to maintain an account, or have concerns about trust and privacy with banks. As a result, bank adoption of DLT may ultimately have a limited effect on the number of unbanked consumers in the United States, as less than 10 percent of unbanked households cite access concerns and insufficient product offerings as their main reason for being unbanked. The majority of U.S. consumers who are currently unbanked are unlikely to enter the banking system due to bank adoption of DLT alone. Our

findings, however, do not preclude that this innovative technology could help foster financial inclusion. Indeed, private currencies and mobile apps have allowed consumers who were previously unable to participate in the global financial system to receive and transfer funds (Vigna and Casey 2015). Instead, we simply find that access to the financial system in the United States is not the main barrier to becoming banked.

Our findings have relevant implications for policymakers. While DLT will likely lower costs for banks, the savings may not be passed on to consumers. Even if banks do pass along these savings, improved technology and cost savings alone may not solve the problem of financial inclusion, because low-cost accounts are largely unsuccessful in attracting the unbanked. Some suggest that initial progress in financial inclusion requires providing unbanked consumers with the requisite skillset to make financial decisions, not just open accounts (Lyons and Scherpf). Thus, efforts focused on financial literacy may have greater success in addressing the problem of financial inclusion. Others have argued that financial programs targeting low-income communities should promote income and expense smoothing (Barr and Schaffa).

Our results and a review of previous programs suggest that a core group of unbanked consumers wishes to remain unbanked. If this is the case, product offerings from nonbank fintech firms may be more attractive to these consumers than bank products. Though these services are not as likely to support wealth accumulation as bank accounts, they may be less costly and more convenient than the products AFS providers currently offer. Consumers adopting these fintech products in place of checking or savings accounts, however, will not realize the full benefits of a banking relationship and will continue to be categorized as unbanked.

Appendix

DLT Basics

The key technological achievement of DLT is a ledger that is shared among parties that may not trust one another. Prior to Nakamoto, electronic transactions required centralized systems to ensure that all ledgers contained the same information—usually through reconciliation—and that double spending did not occur. Absent a centralized system, users could not ensure the information contained in the ledger was accurate. DLT combines technical protocols to validate transactions and ensure all ledgers are in agreement, thus confirming a single truth. In other words, DLT provides a decentralized way to reach consensus on the shared ledger's contents. Distributing ledger copies and validating changes through an independently verified consensus process are DLT's essential characteristics (McKinsey 2015).

DLT systems vary in how their protocols validate, come to agreement, and grant ledger access. While most protocols validate digital signatures using public key infrastructure, a type of cryptography that uses key pairs to encrypt and decrypt messages, encryption algorithms vary. Though ledger agreement was initially determined using proof-of-work models, these models have since been criticized as too resource intensive. Instead, newer consensus mechanisms focus on preventing collusion among untrusted participants rather than on totally decentralizing systems. Permissioned protocols have aided the movement away from complete decentralization: these protocols control ledger access by determining who can read, write, validate, and participate in the consensus process.

A single, distributed version of the truth removes frictions that exist in current systems, thereby reducing complexity, improving speed, and decreasing reconciliation needs. Third-party reconciliation and clearing is unnecessary if every party possesses the same ledger. Instead, new transactions are simply reflected in the next ledger update. Reducing the need for third parties may also reduce costs and fees associated with transactions. Distributed ledger technology streamlines transactions by removing third-party middlemen and reducing system confusion about who owns what and when.

The immutability and transparency of the ledger are vital to trust among parties. As most ledger protocols currently function, no single party can unilaterally override a transaction added to the ledger. Advanced cryptography ensures that altering the ledger comes with high computational costs. As a result, the ledger is largely tamper-proof and practically immutable. Moreover, by requiring consensus among participants who can view what the ledger currently recognizes as true, attempts to falsify a ledger should fail.

In an era filled with cyberattacks, DLT's network resiliency may be an improvement over centralized technology. If every participant has a copy of the ledger and one node goes down, participants can continue to function without confusion as to what the ledger contains. As a result, there is no single, vulnerable point for a cyberattack as there would be in a centralized system.

Despite its promise, there are a variety of risks associated with DLT. Though the ledger improves security by being tamper-resistant and resilient, some users may be concerned about endpoint access and privacy due to the ledger's transparency. In addition, consensus algorithms and cryptographic verification require bandwidth, raising questions about scalability and latency. Finally, interoperability may hinder early adoption prior to universal standards. The current legal regime is built around existing infrastructure involving third parties; absent a central counterparty, governance structures may become complicated.

Endnotes

¹Barr, for example, argues that a substantial amount of check-cashing fees earned by AFS providers during the 1990s and early 2000s were generated from government transfer checks. This source of fee revenue has likely diminished: since 2011, most nontax federal payments have been required to be paid electronically (U.S. Treasury). Other authors have found that payments received through the Earned Income Tax Credit are often used to pay down outstanding debt, some of which is likely debt issued by AFS providers (Beverly, Tescher, and Romich; Mendenhall and others; Baker).

²Despard and Friedline find that the ratio of bank and credit union branches to population is relatively uniform across the United States, while access to AFS providers varies only slightly across market area size, implying that most U.S. consumers enjoy easy access to financial institutions. They focus, however, on financial services within metropolitan statistical areas, which are by definition more densely populated and thus more likely to host financial service providers. Dahl and Franke find that of the 1,132 “banking deserts” in 2014, 734 (65 percent) were in rural areas. Nonetheless, the authors estimate that 3.74 million people, or just about 1 percent of the 2014 U.S. population, live in banking deserts. Friedline and Despard discuss access issues facing consumers in these areas.

³The industry has defined DLT in a variety of ways. For example, many use “distributed ledger technology” interchangeably with the term “blockchain” which refers to a specific type of distributed ledger.

⁴More specifically, DLT refers to a combination of technology and protocols—including peer-to-peer networking, cryptography and consensus algorithms—whose key aspect is a shared data repository that provides electronic storage, transfer, and recordkeeping of value. Thus, DLT requires both a means to validate transactions and a method for ensuring ledgers agree with one another (Ali and others).

⁵DLT may “(i) reduce complexity; (ii) improve end-to-end processing speed and thus availability of assets and funds; (iii) decrease the need for reconciliation across multiple record-keeping infrastructures; (iv) increase transparency and immutability in transaction record keeping; (v) improve network resilience through distributed data management; and (vi) reduce operational and financial risks” (Committee on Payments and Market Infrastructures, p. 1; see also Mills and others 2016). Examples of DLT’s benefits in the banking system can easily be seen through improvements in payments, clearing, and settlement (PCS) which allow for faster, cheaper, and push-only transactions. Push transactions involve sending money to a receiver rather than the receiver taking money from the sender’s account. DLT’s benefits are not limited to PCS, however.

⁶We do not examine peer-to-peer solutions, which are more likely to be developed by fintech companies than banks.

⁷Chart 3 shows service fees charged on all deposit accounts, both commercial and consumer. Service fees on deposit accounts charged to consumers are available on the Call Reports only since 2015:Q1. These data suggest that the majority of all service fees collected on accounts since that time were charged to consumers. Presumably, the share was higher prior to the 2010 implementation of the Federal Reserve's amendment to Regulation E requiring consumers to opt in to overdraft protection. The Consumer Financial Protection Bureau (2014) finds that overdraft and nonsufficient funds fees are the majority of fees charged on consumer checking accounts and that consumers that opt in to overdraft protection experience overdrafts seven times more often than consumers that do not opt in.

⁸In 2011, the FDIC launched the Model Safe Accounts Pilot, a one-year program targeting low-cost checking and savings accounts to low-income communities (FDIC 2012). Though promising, it is unclear whether the program was successful among the unbanked; the business models and marketing strategies differed among participating banks, making program evaluation difficult.

⁹According to the FDIC, 46 percent of households that are currently unbanked previously had a bank account. Of these, 40 percent reported high or unpredictable fees as a reason for being unbanked. As previously mentioned, overdraft and nonsufficient funds fees are the majority of fees charged on consumer checking accounts.

¹⁰A qualitative study using Consumer Financial Protection Bureau complaints finds that the top two overdraft complaints from consumers are confusion over available balance and the timing of posting debits and credits (Borné, Smith, and Anderson). In both circumstances, consumers often reported that they checked their balances, believed as a result of the inquiry that funds were available for transactions, and were ultimately charged a fee.

¹¹An immutable, tamper-resistant ledger improves document-intensive processes associated with identity management. As opposed to the current siloed system, a shared ledger would grant multiple parties access to a common set of identity information such as personal records and credit histories (World Economic Forum). For financial institutions, this may lead to improved products and services as a result of increased access to detailed and reliable user information and better operational efficiency. These benefits may include the ability to streamline customer-facing operations such as onboarding new customers. Banks are developing similar applications for mortgage loan applications (Hong Kong Monetary Authority).

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