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The impact of using financial technology on positive financial behaviors

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Abstract

This study uses 2013 Survey of Consumer Finances data to explore the impact of financial technologies on households' positive financial behaviors. After controlling for variables on general capitals, financial literacy capitals, and financial resources, we find that only planning technologies (e.g., direct deposit and computer software) are positively related to households' engagement in positive financial behaviors. In contrast, the impact of transaction technologies (e.g., using ATM card, credit card, phone banking, and computer banking) is negative. Policymakers and financial service providers should assist consumers with better financial tools and help them manage financial resources and behaviors.

Keywords: Financial technology; Financial software; Positive financial behaviors

1. Introduction

Technological innovation plays an important role in the development of the financial services industry. The way households manage finances now has changed rapidly over the past decade as a variety of technologies, such as electronic banking and automated advisers, have been designed to help households achieve better financial well-being. However, today's

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financial world is much more complicated because of the wide range of financial products and services (Parrish & Servon, 2006). Most of these products and services are associated with e-banking products and services provided by banks and financial institutions, such as automated teller machine (ATM), credit cards, direct deposit, preauthorized debit, phone banking, online banking, and so forth. A recent report on consumer mobile banking finds that over three-fourths of the U.S. population now has a smartphone (Pew Research Center, 2018), and about 50% of users have used mobile banking in the past 12 months (Merry, 2018). It is said that electronic banking technologies have improved the effectiveness of distribution channels by reducing the transaction costs and service time (Lee & Lee, 2001) and expanding credit access in consumer lending (Jagtiani & Lemieux, 2018). However, there is mixed evidence regarding whether e-banking technologies are helpful in managing household finance. Some research finds that electronic banking technologies help consumers save time in managing their finances through easier access to financial services (Anguelov, Hilgert, & Hogarth, 2004). Other studies find that consumers are concerned about security issues associated with online banking (Hamlet & Strube, 2000).

Although many researchers have investigated the determinants for consumers to adopt Internet banking (Kim, Widdows, & Yilmazer, 2005; Jun & Cai, 2001; Lee, Lee, & Eastwood, 2003; Lee & Lee, 2000), the literature on the impact of electronic technology is very limited. Son and Hanna (2011) find that the Internet affects how consumers use financial services and how consumers search and evaluate financial information before making financial decisions. Evidence shows that technological training and e-banking support financial literacy (Servon & Kaestner, 2008). While the question is: *are households who adopt these transaction-based technologies improving their financial well-being status?* In this article, we use the term "financial technology" to include both electronic technology and computer software technology, and examine the impact of using financial technology on households' positive financial behaviors.

We hypothesize that different types of financial technologies affect household financial behaviors differently. Specifically, we use a life cycle and human capital theoretical framework and differentiate two types of financial technologies: transaction-based financial technologies (i.e., ATM card, credit card, phone banking, and computer banking), and planning-based financial technologies (i.e., preauthorized debit, direct deposit, and computer software use). We hypothesize that transaction-based financial technologies should be negatively related to positive financial behaviors as they greatly increase the ease of accessing financial capital and the risks of overspending as well, especially for customers with self-control issues. In contrast, planning-based financial technologies should be positively associated with financial behaviors as households with clear planning goals are more likely to save for the future efficiently.

To test the hypotheses, we construct our sample using the data from the 2013 Survey of Consumer Finances (SCF). Following previous studies in Dew and Xiao (2011), Xiao et al. (2007), Worthy et al. (2010), and Hayhoe et al. (2000), we first measure positive financial behaviors based on 13 financial behaviors. We then create three proxies for positive financial behaviors using different methodologies including principal component analysis based on these thirteen financial behaviors. To test how different types of financial technologies affect household financial behaviors, we also use principal component analysis to construct a

measure of transaction-based technology usage and a measure of planning-based technology usage, respectively. Last, we include a vector of other variables to control for the impact of other factors that are likely to affect household financial behaviors.

Our univariate analysis suggests that 81.9% of respondents use an ATM card, 72.4% of respondents use a credit card, 21.2% of respondents use phone banking, 67.5% of respondents use computer banking, 57% of respondents used preauthorized debit, 86.4% of respondents use direct deposit, and 21% of respondents use computer software to manage their household finances. These findings are consistent with previous studies demonstrating that household adoption of electronic technologies has expanded substantially (Anguelov, Hilgert, & Hogarth, 2004; Servon & Kaestner, 2008). For the multivariate analysis, the results are consistent with our hypotheses that not all currently used financial technologies contribute to positive financial behaviors and personal financial well-being. Households that use planning purposed financial technologies are significantly related to higher positive financial behaviors while households using transactional purposed financial technologies are negatively related to positive financial behaviors. These results are robust after controlling for various household-level and economic factors, as well as to different measures of financial behaviors. Our findings suggest that planning-based financial technologies appear to create a more positive environment and enhance household financial well-being.

Previous research has shown that the very act of monitoring progress promotes better goal attainment and behavioral moderation (Harkin et al., 2016). The present study demonstrates that technological innovations like computer banking that assimilate planning-based financial technology have the potential to improve households' financial well-being and promote savings behavior and progress towards long-term goals (e.g., saving for retirement). U.S. households are facing an increasingly complex world that places more responsibility on their shoulders. Our findings in this study suggest that policy-makers, financial planning professionals, employers, and financial service providers should find means and methods to assist consumers with better financial tools and help households manage their financial resources and behaviors so that households can enjoy the peace of mind and security from financial well-being.

The rest of the article is organized as follows. Section 2 reviews related literature and develops our hypotheses. We show data and variable constructions in Section 3. Section 4 presents the results and discusses the findings. Finally, Section 5 provides the conclusions.

2. Literature review and hypothesis development

2.1. Positive financial behavior

Garman, Leech, and Grable (1996) define poor financial behaviors as personal and family money management practices that have consequential, detrimental, and negative impacts on one's life at home and/or work. Prior research finds that positive financial behaviors are associated with positive life outcomes (Shim et al., 2009) and negative financial behaviors tend to cede to more negative financial behaviors (Dean et al., 2013). Given the common

financial activities that households need to deal with, we consider positive financial behaviors in three categories: debt management, planning activities, and risk management.

2.1.1. Debt management

Consumer credit use plays an important role in how modern households handle their debt. Among all household debt management activities, the most obvious positive financial behavior is to pay bills on time. However, almost seven percentage of U.S. households reported having at least one payment in the past year that was at least 60 days late (Hogarth & Anguelov, 2004). Other than loans and mortgages, credit card use is another financial activity that will cause consumers into debt. In 2008, the total outstanding credit debt carried by Americans is about $976 billion (Federal Reserve, 2009). According to the Federal Reserve (2013), credit card transactions increased at a 7.6% annual rate, rising from $21 billion in 2009 to $26.2 billion in 2012. The average number of credit cards that U.S. credit users hold is more than five and the average balance for each card is at least $1,000 (Experian, 2009). Recently, a report by TransUnion (2019) shows that bank-issued (private) credit card balances increased to $5,668 ($2,022) on a personal level as of Q3 2019.[1]

Rutherford and DeVaney (2009) define two types of credit card users: convenience users and revolvers. Convenience users are those who pay the balance in full on a regular basis while revolvers are those who pay only a portion of the balance and let the remaining balance accrue interest. Other research suggests that high credit card balances are a result of behavior problems instead of liquidity problems (Gross & Souleles, 2001). Thus, carrying a balance in credit cards while having money in the checking account is not considered a positive financial behavior because one has to pay high interest on the credit card balance and the checking account provides no or little interest. Moreover, making late payments on credit cards will lead to late fees and a negative remark on the credit report. It is worth mentioning that consumers with a history of late payments are less likely to be convenience users (Rutherford & DeVaney, 2009), as they tend to pay off small debts first even when the larger debt have higher interest rates (Amar et al., 2011).

The high debt-payment-to-income ratio is another detriment to households' lives. According to the SCF, 11% of all families in the United States had debt-payment-to-income ratios greater than 40% in 2001. This number increased to 15% in 2007 and 18.5% in 2010. Bricker et al. (2017) examined changes in financial management of U.S. families and reported that over 20% of families felt constrained in credit though their access to consumer credit has been increased. Aizcorbe et al. (2003) point out that most of the debtors who had greater than 40% debt-payment-to-income ratios were from lower-income families. Severe consequences such as bankruptcy might happen to these families in the long-run if they are unable to make adjustments on their debt management. Late payments along with high debt-payment-to-income ratios will negatively affect credit scores and limit future possibilities (i.e., access to credit, housing, or employment) of exhibiting positive debt management behaviors.

2.1.2. Planning activities

According to life cycle theory, individuals are saving and borrowing to smooth out consumption over lifetime (Modigliani & Brumberg, 1954). The assumption of life cycle theory is that people are forward-looking and making plans for the future. Planning for the future is a positive financial behavior as it allows households to smooth out consumption to maximize lifetime utility. To effectively transfer financial resources from one period to another, individuals need to have an extensive planning process. Rutherford and DeVaney (2009) suggest that financial advisors and educators must encourage and assist households in preparing financial plans that extend beyond five years. They find that households who have financial planning horizons of at least five years are more likely to be convenience users of credit.

Stawski et al. (2007) find that goal clarity serves as an important psychological mechanism, which motivates individuals to plan for the future. For example, Neukam and Hershey (2003) demonstrate that financial goals have a significant impact on retirement savings contributions. Specifically, goals help individuals structure perceptions and form expectations about future resource needs so they help increase both actual savings levels and the intention to save (Stawski et al., 2007). Moreover, households who had not engaged in planning activities are significantly less likely to accumulate wealth (Ameriks et al., 2002; Lusardi, 2010).

Another class of financial planning activities involves information-seeking, especially when individuals are shopping for credit, savings, and investment products. Lee and Hogarth (1999) find that households who extensively search when shopping for credit are more likely to have lower APRs and more likely to solve their credit card debts. Consumers who take more effort to shop for credit are likely to find loans with good terms and conditions as well as being more likely to be convenience credit users (Rutherford & DeVaney, 2009). The more exploration a household does when making financial decisions on credit, savings, and investments, the more likely it is going to get a better deal.

2.1.3. Risk management

Households are vulnerable when facing a variety of unexpected events that could lead to serious financial difficulties. Insurance is a tool to protect against substantial financial losses when unplanned perils or health circumstances occur. Thus, insurance is an important aspect of personal financial management.

Lin and Grace (2007) find that financial vulnerability has a significant impact on the amount of term life or total life insurance purchased. They argue that the key determinant of the demand for life insurance is the impact of the insured's death on the future consumption of other household members. Households with dependent children are more financially vulnerable because children consume most resources but generally contribute little to the household income. Preparing for the potential loss of the breadwinner of the household is very beneficial especially for households with children under 18 present (Lewis, 1989). Evidence shows that around two-thirds of poverty among surviving women and more than one-third of poverty among surviving men result from failures to insure survivors against sudden loss of household head (Bernheim et al., 2001). Although other research finds that life insurance

is essentially uncorrelated with financial vulnerability at every stage of the life cycle (Bernheim et al., 2003), we consider protection for your dependents as a positive financial behavior because it protects the family from the financial shock of losing a breadwinner.

Households need to insure against the loss of health-related human capital of its earners to ensure viability. However, health insurance products are too complicated for most households. According to data from the 1977 National Medical Expenditure Survey, 4.3% of nonelderly families spent more than 20% of their income on health care (Feenber & Skinner, 1994). Health expenditure shocks can lead to households' bankruptcy (Livshits, Tertilt, & MacGee, 2007) yet only high-income households accumulate precautionary savings to shield themselves from catastrophic health expenditures (Jeske & Kitao, 2009).

Other than health-related human capital loss, households are facing temporary or permanent disability risks as well. In theory, disability insurance provides benefits to workers who are physically unable to find suitable work. Although programs like Social Security Disability Insurance (SSDI) and Supplemental Security Income (SSI) are designed to help workers with disabilities, these benefits are not enough to lift incomes above the poverty line (Stapleton et al., 2006). Between 1985 and 2004, the number of disabled individuals receiving disability insurance increased by over 100% (Chen & Van der Klaauw, 2008). However, SSDI only pays benefits to "insured" workers and certain members of their family. In other words, workers with a disability need to have worked and paid Social Security taxes for a long enough period to receive disability benefits from SSDI. A recent fact sheet from the Social Security website shows that about over one in four of today's 20 year-olds will become disabled before reaching age 67 (SSA, 2019) (https://www.ssa.gov/pubs/EN-05-10029.pdf). In addition, 68% of the private sector workforce has no long-term disability insurance (SSA, 2019). Because the purpose of disability insurance is to provide substitute income to workers with disabilities, individuals need to be covered with disability insurance if they are currently working and should not need coverage if they have retired.

In addition to protecting against health issues, disability, and potential loss of life—unexpected events could also place households into financial difficulties. Setting aside a bucket of money to prepare for rainy days is imperative so households do not have to sell off their cars, appliances, and other household durables (Huston & Chang, 1997). A three-month income reserve is used as an adequate holding of an emergency fund in household emergency fund research (Chang & Huston, 1995; Huston & Chang, 1997).

2.2. Financial technology

Electronic banking technologies include ATM, online banking, debit (or check) card, direct deposit, direct payment (also electronic bill payment), electronic bill presentment and payment (EBPP), electronic check conversion, electronic fund transfer (EFT), payroll card, preauthorized debit (or automatic bill payment), prepaid card, smart card, and stored-value card (Anguelov, Hilgert, & Hogarth, 2004). Because the diffusion of innovation has not been applied to financial innovations, the current understanding of electronic banking technology, such as ATM card, debit card, direct deposit, and direct payment is very limited (Lee & Lee, 2000).

Anguelov, Hilgert, and Hogarth (2004) use three specific technologies to represent different types of e-banking technologies at different stages in their development: debit cards, preauthorized debits, and electronic banking. Computer ownership and internet access are related to the adoption of electronic banking but many studies have been unable to control for those variables. Consumers' acceptance of technological innovations is influenced by socioeconomic characteristics, demographic characteristics, perceptions of specific technologies, and the characteristics of different products and services. Electronic banking technologies can be classified as either "passive" or "active" (Kolodinsky, Hogarth, & Hilgert, 2004). Passive technologies (i.e., direct deposit and preauthorized debit) do not require any behavioral changes or continuous effort by the consumer so it is easier to spread. In contrast, active technologies (i.e., electronic banking) require new behaviors or repeated effort so they are hard to spread (Kolodinsky et al., 2004; Servon & Kaestner, 2008).

Davis (1989) created the technology acceptance model (TAM) that shows that perceived usefulness and ease of use are factors associated with the adoption of a system. Interconnections between technologies exist because the diffusion of any technology is not independent of the diffusion of another technology (Stoneman & Kwon, 1994). Moreover, a consumer's prior pattern of adopting related technology will affect his or her willingness to adopt new technology (Bayus, 1987). Consumers with good knowledge of computers are generally more likely to engage in electronic banking usage. Demographic factors such as age, income, education, occupation are significant factors for Internet banking adoption as well (Kim et al., 2005).

When relating financial technology to financial behaviors, we can categorize financial technologies into two main functions—technologies that are fundamentally transactional and technologies that aid in planning. Transaction-based technologies include ATM cards, credit cards, phone, and electronic banking. Households use an ATM card to access their bank account at an electronic terminal without the limitations of finding the nearest branch of their local bank. This is especially useful for transactions when traveling. It is more common to see consumers use credit cards to complete transactions for online purchases now than 50 years ago. Credit cards make online transactions convenient and safe by allowing households to set up transaction alerts on their mobile device and monitor spending instantaneously. Households also use preauthorized debit to set up electronic auto-payments on loans. Phone banking and electronic banking provides 24/7 financial service with almost no cost. Using these e-banking technologies, households can access their account information with little or no cost and conduct financial transactions conveniently (Lee & Lee, 2001).

Another important reason for using financial technology is to plan for the future. Research finds that computer-based mediated interventions contribute to a variety of behavior changes. Behavioral modification strategies include self-monitoring, goal-setting, shaping, reinforcement, and stimulus control (Butryn, Webb, & Wadden, 2011). The very act of monitoring progress towards goals has demonstrated evidence of significant improvement towards behavioral changes and the actual outputs desired (Harkin et al., 2016). Household finance-related computer software can help households make better financial decisions by providing financial knowledge and information, enhancing numerical ability on calculations, and monitoring finance on a regular basis. Governments and organizations use direct deposit as the preferred way to make reimbursements and distributions on salaries. Households who

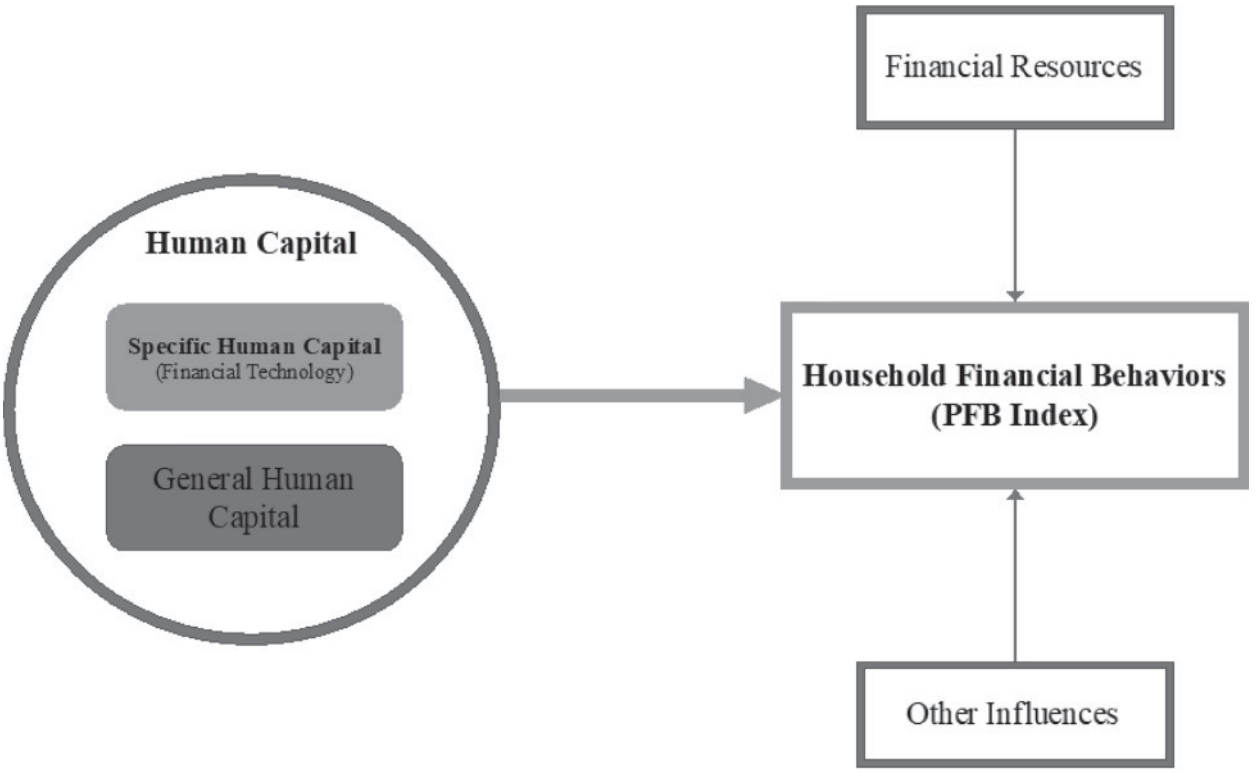

Fig. 1. Household financial behavior conceptual framework.

use preauthorized debit and direct deposit are trying to simplify their financial management, and automate their savings for the future.

The conceptual framework used for this study builds upon life cycle theory (Modigliani & Brumberg, 1954) and human capital theory (Becker & Tomes, 1994). According to the life cycle theory, an individuals' objective is to maximize lifetime utility. Individuals try to achieve higher lifetime utility through improved financial well-being. In our article, we measure household financial well-being through positive financial behaviors regarding debt management, planning activities, and risk management.

The positive financial behavior (PFB) index in Fig. 1 is a set of household financial behaviors that will lead to positive financial outcomes. Household financial behaviors are affected by household human capital, the endowed and acquired knowledge and skills a household has (Huston, 2010). Following previous studies, we consider two types of household human capital: specific human capital and general human capital (Becker & Tomes, 1994), as illustrated in Fig. 1 Specific human capital represents knowledge and skills that a household has towards specific areas such as financial technology and financial management. Specifically, financial technology indicates how well a household can understand and potentially use technology-related products and services to increase the probability of increased positive financial behaviors. Financial literacy indicates how well an individual can understand and potentially use personal finance-related information to increase expected lifetime utility from consumption (Huston, 2010). In contrast, general household capital represents the knowledge and skills that a household has and

could be used in many areas. For example, households who have more education are more likely to perform better in a wide variety of tasks. Last, household financial behaviors are also influenced by other factors such as behavioral biases, self-control, family, peer, cultural, environmental, and economic conditions (Huston, 2010). Financial resources also impact the household's financial well-being.

Households with more positive financial behaviors are more likely to have a higher level of financial well-being, after controlling for financial resources and other influences. Based on our theoretical framework in Fig. 1, positive financial behavior is a function of household capital, cultural/environmental influences, economic status:

$$\begin{aligned} &Positive\,Financial\,Behaviour(PFB) \\ &\quad = f\{Specific\,Household\,Capital,\ General\,Household\,Capital,\ Cultural/ \\ &\quad\ Environmental\,Influences,\ Economic\,Stat \end{aligned}$$

Using this conceptual framework, we test the impact of specific household capital (financial technology) on positive financial behaviors, controlling for all other factors, using the following empirical regression model.

$\text{PFB} = \beta_0 + \beta_1(\textit{Specific Household Capital}) + \beta_2(\textit{General Household Capital}) + \beta_{3\text{-}6}(\text{Financial sophistication level}) + \beta_7(\text{Homeownership}) + \beta_{8\text{-}10}(\text{Age groups}) + \beta_{10\text{-}12}(\text{Education level}) + \beta_{13}(\text{Married}) + \beta_{14\text{-}17}(\text{Income quintiles}) + \beta_{17\text{-}20}\ (\text{Net worth quintiles}) + \beta_{21\text{-}22}(\text{Household size}) + \beta_{23}(\text{Presence of children under 18}) + \beta_{24}(\text{Female}) + \beta_{25\text{-}26}(\text{Race groups}) + \beta_{27}(\text{Economic expectation}) + \beta_{28}(\text{Interest rate expectation}) + \beta_{29\text{-}30}(\text{Risk tolerance}) + \epsilon\ (2).$

3. Data and variables descriptions

This study uses data from the 2013 Survey of Consumer Finances (SCF).[2] The SCF is a triennial survey of U.S. households sponsored by the Federal Reserve, in cooperation with the Internal Revenue Service, Statistics of Income Division, and collected by NORC at the University of Chicago. The survey data includes information on families' balance sheets, pensions, income, and demographic characteristics. Information is also included from related surveys of pension providers and the earlier such surveys conducted by the Federal Reserve Board.[3]

In the 2013 SCF survey, 6,015 households were available in the public dataset. While our study focuses on the use of financial technology and requires households to have at least a checking or a savings account. As a result, we censored the data to include banked households only for the purpose of this study. After applying this filter, our final sample includes a total of 5,447 households.

3.1. Positive financial behaviors proxies: The dependent variable

Based on the theoretical framework, we identify thirteen financial behaviors from the SCF to construct our positive financial behavior proxies. These behaviors cover three

Table 1 Percentage of banked households engaging in positive financial behavior

Positive financial behavior	Measurement	Banked households (%)	Standardized scoring coefficients
Debt management			
No late payments	1 if all loan and mortgage payments made on time or ahead of time, 0 otherwise.	85.9	0.219
Good credit report	1 if not been turned down for credit or if turned down but received full amount when they reapplied or never apply within the past five years because of afraid of being turned down, 0 otherwise.	76.4	0.227
Credit card balance	1 if not carrying credit card balance when having money in bank accounts, 0 otherwise.	61.5	0.101
No bankruptcy	1 if never filed for bankruptcy, 0 otherwise.	86.5	0.144
Total debt payment ratio	1 if total debt payment ratio smaller than 36%, 0 otherwise.	89.6	0.111
Planning activities			
Planning horizon	1 if planning horizon is a few years or more, 0 otherwise.	58.5	0.227
Currently saving	1 if have at least one reason to save, spending is less than income, and actually have saved for that reason, 0 otherwise.	58.6	0.276
Level of shopping for credit	1 if when making major decisions about credit or borrowing, do a moderate to a great deal of shopping, 0 otherwise.	75.1	0.099
Level of shopping for savings and investments	1 if when making major decisions about saving or investing, do a moderate to a great deal of shopping, 0 otherwise.	69.8	0.145
Risk management			
Children under 18 covered by life insurance	1 if children under 18 covered by life insurance or no children under 18 present in the household, 0 otherwise.	89.0	0.184
Health insurance	1 if everyone in the household is covered under health insurance, 0 otherwise.	81.1	0.219
Disability income insurance	1 if head of household is working and covered by disability insurance or is retired and not covered by disability insurance, 0 otherwise.	25.4	0.126
Emergency fund	1 if having $3,000 emergency fund prepared or being confident about borrow $3,000 from friends or relatives, 0 otherwise.	86.6	0.207

decision-making domains in debt management, planning activities, and risk management, respectively.

Table 1 shows the descriptions and measures of these financial behaviors and the summary statistics. For debt management activities, our results show that more than 85% of respondents have no late payments, no bankruptcy, and a total debt payment ratio that is smaller than 36%. Further, 76.4% of respondents indicate having a good credit report; 61.5% of respondents do not carry credit card balances when they have money in their bank accounts. For financial planning activities, 58.5% of respondents indicate that they are planning a few years ahead and have saved for specific goals. 75.1% of respondents report that they do a lot of shopping when making decisions on credit, savings, and investments. Additionally, households get involved in risk management; 89% of respondents who have children under 18 are covered by some sort of life insurance, as compared with 81.1% of respondents reporting that everyone in the household is covered by health insurance. In addition, 86.6% of respondents have an emergency fund (or are confident that they can borrow in an urgent situation), but only 25.4% of respondents have appropriate disability insurance coverage.

Based on these variables, we construct three positive behavior proxies. The first proxy is the number of positive financial behaviors adopted, that is, a simple summation of these 13 behavior dummies. The second proxy is a positive behavior index created through principal component analysis. Finke and Huston (2013) use the principal component analysis and construct a measure of time preference through eight financial decisions that indicate individual time preference. Letkiewicz, Robinson, and Domian (2016) apply the same approach and create a measure of financial self-efficacy and a measure of financial stress based on individuals' financial circumstances. Following their studies, we construct component factors based on the thirteen positive financial behaviors and select the first factor as our proxy for the positive financial behavior. This factor has an eigenvalue of 2.27 and is the only factor with an eigenvalue larger than 1.50. The standardized scoring coefficient to each behavior dummy variable is provided in Table 1. The majority of the behavior dummy variables carry a scoring coefficient in a narrow range of 0.10 and 0.25, suggesting that most of the positive financial behaviors included in this study contribute to the measure of a single positive behavior proxy. Last, we also create a dummy variable to indicate above-average positive behavior if a respondent's positive behavior index score is greater than the median index score of the full weighted sample. To ease our interpretation, for all proxies, the higher the score, the more the adoption of financial behaviors, and the higher lifetime utility.

Table 2 presents summary statistics of our three positive financial behavior proxies for the full weighted sample. The range of the number of positive financial behaviors is from zero to 13. All households in the sample report engaging in at least two positive financial behaviors. The mean and median number of positive financial behaviors is nine and 10, respectively. The majority of households engage in eight to 12 positive financial behaviors but only 4.28% of them have engaged in all of them. The mean and median of the index are provided in Table 2.

Table 2 Descriptive statistics of dependent variables: Positive financial behavior proxies

Number of positive financial behaviors	Banked households %
Panel A: Number of positive financial behaviors	
Zero	0
One	0
Two	0.03
Three	0.33
Four	0.91
Five	2.05
Six	5.62
Seven	9.4
Eight	13.33
Nine	16.48
Ten	17.35
Eleven	17.36
Twelve	12.88
Thirteen	4.28
Mean	9.44
Median	10
Panel B: Principle Component Index	
Mean	−0.153
Median	−0.011
Panel C: Above-average positive behavior	
Mean	0.500
Median	0.000

3.2. Independent variables on personal finance-specific human capital

Personal finance-related human capital illustrates how well an individual understands and potentially uses personal finance-related information to increase expected lifetime utility from consumption (Huston, 2010). From this perspective, financial technology is part of the personal finance-related human capital, which indicates how well an individual can use technology to help manage household resources or finances. In this study, we use the following financial behaviors available from SCF and create seven dummy variables to measure personal finance-specific human capital.

3.2.1. Transaction-based financial technologies

ATM card: "An electronic terminal provided by financial institutions and other firms that permits consumers to withdraw cash from their bank accounts, make deposits, check balances, and transfer funds" (Anguelov, Hilgert, & Hogarth, 2004).

Credit card: Using credit cards allows households to borrow up to the credit limit, build good credit, reap rewards, and make payments for online merchandise easier. However, we consider borrowing too much without an appropriate repayment schedule as bad financial behavior because of the high interest and fees on the unpaid amount and the negative impact on their credit record.

Phone banking: Phone banking provides households an immediate solution to emergency issues such as reporting a stolen or lost card, applying for new credit cards, checking account balances, etc. Mobile banking has also been developed very fast recently. Phone banking makes it very convenient for households to solve banking related financial problems so they can better manage their money.

Computer banking: "Banking services that consumers can access, by using an internet connection to a bank's computer center, to perform banking tasks, receive and pay bills, and so forth (Anguelov, Hilgert, & Hogarth, 2004). Computer banking allows the households to manage their accounts wherever they are as long as they have computers and internet access. Computer banking allows households to check account balances, make electronic transfers, transfer money into designated saving accounts, keep themselves updated on new banking services or receive important warnings from financial institutions, and so on. It provides a convenient channel for households to manage their finance with almost no costs.

3.2.2. Planning-based financial technologies

Preauthorized debit: "A form of payment that allows a consumer to authorize automatic payment of regular, recurring bills from his or her account on a specific date, and usually for a specific amount" (Anguelov, Hilgert, & Hogarth, 2004). For example, households use pre-authorized debit to set up automatic car payments, housing payments, utility bills, and so on. This method makes it easier for the households to make their payments on time.

Direct deposit: "A form of payment by which an organization pays funds via an electronic transfer" (Anguelov, Hilgert, & Hogarth, 2004). Direct deposit makes it easier for households to save because it transfers directly into designated accounts before the consumer has a chance to spend the money elsewhere.

Computer software: Households who use computer software to manage their finance are more likely to make the right decisions for savings and investments. Computer software can help households calculate how much they need to save for each goal, such as retirement savings, college fund savings, and so on. It provides more accurate spending and saving information, which can assist households with better data to make proper financial decisions. Using computer software can increase the probability of households reaching financial goals by facilitating consumers to save amounts that are more appropriate and aiding consumers in considering multiple goals simultaneously.

The descriptive statistics of financial technology variables are presented in Panel A of Table 3. Direct deposit is the most commonly used technology, as 81.9% of banked households report that they use it. With the new technologies coming out, phone banking is not as popular as before. Our results suggest only 21.2% of banked households report using phone banking while 67.5% report using computer banking. Moreover, 21.2% of banked households report using computer software to help managing their finance.

Similar to how we construct the positive financial behavior index, we also adopt principal component analysis to form two composite technology usage measures: transactional tech usage index and planning tech usage index. The transactional tech usage index is a measure of transaction-based technology usage based on ATM card use, credit card use, phone banking use, and computer banking use. The planning tech usage index measures planning-based technology usage based on the last three technology-use behaviors. Both composite measures use the first component factor from principal component analysis as the proxy. The standardized scoring coefficients are provided in Table 3.

Table 3 Descriptive statistics of financial technology variables and other control variables

Panel A: Key independent variables on specific household capital

Variables	Measurement	Banked households (%)	Standardized scoring coefficients
Transaction technologies			
ATM card	1 if use ATM card as one of the main ways you do business with bank or if you have a card that allows you to deposit or withdraw money from your bank using an ATM, 0 otherwise	81.9	0.43
Credit card	1 if have any credit card or charge card, 0 otherwise	72.4	0.389
Phone banking	1 if use automated phone system as one of the main ways to do business with bank, 0 otherwise	21.2	0.222
Computer banking	1 if use computer as one of the main ways to do business with bank, 0 otherwise	67.5	0.571
Planning technologies			
Preauthorized debit	1 if have utility bills, mortgage or rent payments, or other payments automatically paid directly from bank accounts without having to write a check, 0 otherwise	57	0.608
Direct deposit	1 if have paychecks or Social Security benefits or other money automatically paid directly into accounts, 0 otherwise	86.4	0.426
Computer software	1 if use computer software to manage money, 0 otherwise	21	0.52

Panel B: Composite technology usage measures from principal component analysis

	Mean	Median
Transactional tech usage index	−0.095	0.286
Planning tech usage index	−0.058	0.385

Panel C: Other control variables on general household capital

Variables	Measurement	Banked households (%)
Financial sophistication		
0–20 percentile	1 if household financial sophistication level is in the 0% to 20% range, 0 otherwise	20
21–40 percentile	1 if household financial sophistication level is in the 20% to 40% range, 0 otherwise	20
41–60 percentile	1 if household financial sophistication level is in the 40% to 60% range, 0 otherwise	20
61–80 percentile	1 if household financial sophistication level is in the 60% to 80% range, 0 otherwise	20

(continued on next page)

Table 3 (Continued)

Panel C: Other control variables on general household capital

Variables	Measurement	Banked households (%)
81–100 percentile	1 if household financial sophistication level is in the 80% to 100% range, 0 otherwise	20
Homeownership	1 if household owns or partially owns a home, 0 otherwise	68.1
Age		
18–34	1 if the head of household is age 18-34, 0 otherwise	21.3
35–49	1 if the head of household is age 35-49, 0 otherwise	26.4
50–64	1 if the head of household is age 50-64, 0 otherwise	29
65 and over	1 if the head of household is age 65 and over, 0 otherwise	23.3
Education level		
Less than high school	1 if household highest level of school completed is <12, 0 otherwise	6
High school/GED	1 if household highest level of school completed is =12 or high school diploma/GED, 0 otherwise	24.8
Some college	1 if household highest level of school completed is >12 but never get a college degree, 0 otherwise	26.8
Bachelors or higher	1 if household highest level of school completed is bachelors or higher, 0 otherwise	42.4
Married	1 if head of household is currently married or living with a partner, 0 otherwise	59
Financial resources		
Income		
0–20 percentile	1 if household income is between $1 and $25,000, 0 otherwise (reference)	23.9
21–40 percentile	1 if household income is between $25,001 and $48,000, 0 otherwise	25.5
41–60 percentile	1 if household income is between $48,001 and $85,000, 0 otherwise	23.2
61–80 percentile	1 if household income is between $85,001 and $192,000, 0 otherwise	20.8
81–100 percentile	1 if household income is between $192,001 or more, 0 otherwise	6.7
Net worth		
0–20 percentile	1 if household net worth is less than $0 to $10,682, 0 otherwise (reference)	23
21–40 percentile	1 if household net worth is between $10,683 to $90,119, 0 otherwise	25
41–60 percentile	1 if household net worth is between $90,120 to $352,741, 0 otherwise	26.8
61–80 percentile	1 if household net worth is between $352,742 to $1,825,468, 0 otherwise	19.8
81–100 percentile	1 if household net worth is between $1,825,469 or more, 0 otherwise	5.5
Household size		
One person	1 if number of people in household = 1, 0 otherwise	25.3
Two person	1 if number of people in household = 2, 0 otherwise	34.2
Three or more	1 if number of people in household>=3, 0 otherwise	40.5
Presence of children under age 18	1 if children under age 18 are present in the household, 0 otherwise	34.4
Other influences		
Female	1 if head of household is female, 0 is male	51.9

(continued on next page)

Table 3 (Continued)

Panel C: Other control variables on general household capital

Variables	Measurement	Banked households (%)
Race and ethnicity		
White and "other"	1 if household describes itself as White, Asian, Pacific Islander, or Native American, 0 otherwise	77.7
Black	1 if household describes itself as Black, 0 otherwise	12.7
Hispanic	1 if household describes itself as Hispanic, 0 otherwise	9.6
Economic expectations	1 if expect the U.S. economy to perform better over the next 5 years, 0 otherwise	45.4
Interest rate expectations	1 if expect interest rates will be higher 5 years from now, 0 otherwise	77
Risk tolerance		
No risk	1 if not willing to take any financial risks, 0 otherwise	44.4
Moderate risk	1 if willing to take average or above average financial risks expecting to earn average or above average return, 0 otherwise	52.7
Substantial risk	1 if willing to take substantial financial risks expecting to earn average or above average return, 0 otherwise	2.9

Based on Shefrin and Thaler's (1981) "doer versus planner" model, consumers experience a costly intrapersonal conflict between a "Planner" and a "Doer" (Gul & Pesendorfer, 2001) where the planner is concerned with lifetime utility but the doer exists for only one time period and would consume most of their resources today. The authors suggest that to shift intertemporal choice (Benabou & Pycia, 2002) and prevent the doer from consuming total lifetime income in the first period, some psychic technology capable of affecting the doer's behavior is required.[4] Based on the theoretical model of Shefrin and Thaler (1981), planning purposed financial technologies have the potential to fulfill all three ways the authors identify for shifting the myopic doer to more of a "planner" mindset: (1) Modify the doers' preferences, (2) Force doer to input to a savings program or budget, "simply keeping track seems to act as a tax on any behavior the planner views as deviant," and (3) Alter incentives. We expect that using transaction-based financial technologies may not have a positive impact on households' engagement in positive financial behaviors because transaction-based technologies basically enhance consumer discretion and ability to myopically overextend themselves by consuming too much today. In contrast, we expect that the use of planning purposed financial technologies will have a positive impact on positive financial behaviors. In Panel B of Table 3, it shows that the mean (median) of the transitional technology usage index and planning technology usage index is −0.095 (0.286) and −0.058 (0.385), respectively.

3.3. Other control variables

To control for other factors that are likely to be related to households' positive financial behaviors, we include a range of other measures as shown in Panel B of Table 3.

Financial sophistication*:* A score from four questions in SCF that represents the financial literacy of a household (Huston et al., 2012). We expect that households with higher financial sophistication levels are more likely to engage in positive financial behaviors.

Homeownership*:* Households with homeownership have more personal finance experiences, such as payments of mortgage loans, and refinance options. We expect that such households are more likely to engage in positive financial behaviors.

3.3.1. General human capital

Age: As age goes up, years of experience become valuable human capital.

Education level: Generally speaking, more years of schooling will increase households' general productivities. We expect that older households and those with more education are more likely to engage in positive financial behaviors.

Marital Status: From the whole household level, married households have more general human capital because one partner can access the other's resources. We expect married households are more likely to engage in positive financial behaviors.

3.3.2. Financial resources

Income: The more income a household has, the more resources that could be managed to achieve higher lifetime utility.

Net Worth: If the households have higher net worth, they are more likely to be in good shape with their finances but it does not necessarily mean that they are better financial managers compared with the others.
Household composition: Having children under 18 influences household expenditure. We expect households without children under 18 are more likely to engage in positive financial behaviors.

3.3.3. Cultural/environmental influences

Gender: Gender differences have been explored, identified, and established for different financial behaviors from savings (Strömbäck et al., 2017; Fisher, 2010) to willingness to take risks (Fisher & Yao, 2017). For example, Hayhoe et al. (2000) found that gender was more influential in predicting financial management practices than was affective credit attitude, with female students employing a greater number of financial practices. Gender differences have also been demonstrated for objective financial knowledge and numeric ability, where males typically perform better than females (Chen & Volpe, 2002; Fonseca et al., 2012; Lusardi & Mitchell, 2008; Powell & Ansic, 1997). Lind et al. (2020) attempted to explore how gender impacted broader measures of financial behavior while controlling for differences in relevant cognitive abilities and demographic statistics—their research discovered that women reported a lower level of subjective financial wellbeing even though they reported a more prudent financial behavior than men when controlling for socio-demographics and cognitive abilities.
Race and ethnicity: Cultural biases and behaviors affect households' financial behaviors. For example, Asian households are more likely to save and more encouraged to attain higher education.
Economic expectations: Different economic expectations affect households' financial decisions such as saving and consumption.
Interest rate expectations: Different interest rate expectations affect households' financial decisions such as saving and consumption, and chosen loan products.
Risk tolerance: Willingness to take risk affects households' investment related financial decisions. We expect households who are willing to take on some risk are more likely to engage in positive financial behaviors.

4. Multivariate analysis, results, and discussions

To determine the impact of using financial technology on positive financial behavior, we use ordinary least square (OLS) by regressing the independent variables on the positive financial behavior indexes as specified in Equation (2). Results of the regression analysis are shown in Table 4.

Models (1), (2), and (3) show the regression results using three different measures of positive financial behaviors as mentioned previously. Our results suggest that transactional technology usage is significantly and negatively related to positive financial behaviors. For example, in Model (2), it indicates that a one unit increase in the transactional technology index will cause the composite positive financial behavior index to decrease significantly by −0.051 units. This result is consistent across all three models regardless of how we measure positive financial behaviors. The results indicate that transaction-based financial technologies like ATM card, credit card, phone banking, and computer banking negatively affect households' engagement in positive financial behaviors. For example, the convenience of using ATM cards to withdraw money at any location might increase the probability of households consuming now instead of saving for the future. Overuse of credit cards could lead to high-interest expenses or over-purchasing behaviors

Table 4 The impact of technology adoption on positive financial behaviors, estimated through multiple regression specifications

Variables	Number of positive financial behaviors (1)	Principle Component Index (2)	Above-average positive behavior (3)
Constant	8.139***	−0.804***	−1.712***
Specific household capital			
Financial technologies			
Transactional tech usage index	−0.169***	−0.051***	−0.102***
Planning tech usage index	0.079***	0.035***	0.082***
Financial sophistication (relative to 41–60%)			
1–20 percentile	−0.65***	−0.323***	−0.704***
21–40 percentile	−0.234***	−0.122***	−0.227***
61–80 percentile	0.48***	0.243***	0.776***
81–100 percentile	0.78***	0.369***	1.081***
Homeownership	−0.32***	−0.105***	−0.127***
General household capital			
Age (relative to 35–49 years old)			
18–34	0.51***	0.232***	0.608***
50–64	−0.186***	−0.068***	−0.044
65 and over	0.017	0.107***	0.269***
Education level (relative to high school/ GED)			
Less than high school	−0.034	−0.022	−0.307***
Some college	0.048*	0.031**	0.024
Bachelors or higher	0.286***	0.156***	0.322***
Married	0.057*	0.052***	0.156***
Financial resources			
Income (relative to 0 to 20 percentile)			
21–40 percentile	0.104***	0.055***	0.141***
41–60 percentile	0.368***	0.192***	0.523***
61–80 percentile	0.838***	0.418***	1.015***
81–100 percentile	1.288***	0.605***	1.797***
Net worth (relative to 0 to 20 percentile)			
21–40 percentile	0.751***	0.384***	0.817***
41–60 percentile	1.427***	0.706***	1.433***
61–80 percentile	1.843***	0.889***	1.929***
81–100 percentile	1.757***	0.802***	2.023***

(continued on next page)

Table 4 (Continued)

Variables	Number of positive financial behaviors (1)	Principle Component Index (2)	Above-average positive behavior (3)
Household size (relative to two person)			
One person	0.484***	0.284***	0.616***
Three or more	−0.135***	−0.073***	−0.194***
Presence of children under age 18	−0.375***	−0.234***	−0.428***
Other influences			
Female	−0.123***	−0.063***	0.008
Race and ethnicity (relative to White and "other")			
Black	0.036	−0.006	−0.121**
Hispanic	−0.203***	−0.105***	−0.634***
Economic expectations	0.057***	0.013	−0.007
Interest rate expectations	0.062***	0.006	0.078**
Risk tolerance (relative to no risk)			
Moderate risk	−0.017	−0.058***	−0.246***
Substantial risk	−0.324***	−0.213***	−0.601***

Coefficients from Ordinary Least Square regressions are reported in the first two columns, coefficients from logistic regression are reported in the last column. ***,**,* indicate significance at the 0.01, 0.05, and 0.10 levels, respectively.

that households cannot afford to repay. Using phone banking and computer banking seems to have negative effects on positive financial behaviors. A recent study by TransUnion showed that both the volume and balance of personal unsecured loans have been increasing significantly in the past few years as consumers become more likely to choose FinTech than traditional lenders for borrowing.[5] Overall, our results are consistent with these findings by showing that, though the convenience provided by transaction-based e-banking technology saves time and costs for households to complete financial transactions, it also increases the ease of accessing funds and can be detrimental to household financial well-being in the long run.

In contrast, the regression results in Models (1), (2), and (3) also indicate that planning-based financial technologies, including preauthorized debit, direct deposit, and computer software use, positively affect households' engagement in financial behaviors. Our results show that the coefficients of the planning technology usage index are significantly positive across all models. For example, the positive coefficient of 0.082 in Model (3) suggests that planning technology usage is more likely to be positively related to households' positive financial behaviors. The results hence support our hypothesis that planning-based financial technologies will have a positive impact on households' financial behaviors.[6] Planning-based financial technologies appear to create a more positive environment for enhancing household financial well-being. For example, preauthorized debit is used to set up future automatic payments on loans and bills while direct deposit makes it easier to save and budget. Computer software helps households plan for the future by providing financial knowledge, calculation help, and action plans. Our results hence are consistent with previous studies showing that planning behaviors have a significant impact on personal savings practices (Lusardi, 2010). Also, our findings are consistent with Shefrin and Thaler's (1981) theory that individuals will be more likely to save or become a "planner" when preferences or incentives are altered, behaviors are tracked, or the doer's set of choices is limited with constraints. Households with clear goals are more likely to save for the future, which will lead to higher levels of financial well-being and life satisfaction.

Consistent with other research findings (Smith, Finke, & Huston, 2011, 2012a, 2012b), we also find that financial sophistication significantly affects households' financial behaviors. Specifically, low financial sophistication in households is negatively related to positive financial behaviors, while high financial sophistication is significantly and positively associated with positive financial behaviors. Households with high education, high income, and high net worth are also related to high positive financial behaviors. Households with homeownership or less risk-averse (i.e., who are willing to take a substantial risk) are engaging in low positive financial behaviors. Consistent with our expectation, households with children under 18 are associated with low positive financial behaviors. For the impact of age, households with young individuals between ages 18 and 34 show higher positive financial behaviors than those with older individuals with ages between 50 and 64.

5. Conclusions and implications

Given the rapid growth of technology innovation in the finance sector, it is natural to ask whether these technologies help households engage in positive financial behaviors. Using

the 2013 Survey of Consumer Finances commissioned by the Federal Reserve Board, this study found that not all kinds of financial technologies are helpful for households' engagement in positive financial behaviors.

In this study, we use a life cycle and human capital theoretical framework to illustrate the impact of financial technology on household financial behavior. Consistent with the theoretical framework, we find that financial technology-specific household capital has a significant impact on positive financial behaviors but not all types of financial technology will enhance positive financial behaviors. Specifically, we found transaction-based financial technologies like ATM card use, credit card use, phone banking, and computer banking have a negative impact on the number of positive financial behaviors reported. Providing easy access to bank accounts may encourage people to overspend in current periods, especially for those with self-control issues. In contrast, planning-based financial technologies like direct deposit and computer software use have positive impact on the number of positive financial behaviors. Financial sophistication, general household capital such as age and education, financial resources, and other resources such as expectation on the economy and risk tolerance are also found to have a significant impact on positive financial behavior.

Given the findings of this study, we suggest financial planners and financial educators encourage clients and individuals to use planning-based financial technologies such as computer software. Financial planners must focus on improving clients' personal finance management skills by emphasizing the importance to think from a long-term perspective when making financial decisions. Although the effectiveness of financial education programs is mixed (Willis, 2008), it is important to educate households on the effective use of tools to change their financial behaviors, rather than simply delivering financial education. To take full advantage of financial technology, consumers and professionals that assist consumers need to be aware of what types of technology will help in achieving higher financial satisfaction over the long run. Our findings in this study suggest that simply providing financial technology to complete transactions does not appear to improve household financial well-being. Only planning-based financial technologies have a positive impact on household financial well-being and hence should be given more attention in terms of technology development and marketing perspectives. For example, hyperbolic consumers are those who know that they should save for the future but it is hard for them to give up current consumption (Angeletos et al., 2001). Guiding these myopic consumers through planning-based financial technology may be an effective way to enhance their financial behaviors because it helps them create commitment devices to realize the benefit from engaging long-term financial practices that are consistent with maximizing lifetime utility.

We realize that there are limitations in our study. Because of data constraints, the positive financial behavior indexes used in this study cover only a few, not all, positive financial behaviors. Also, we do not look at the various types of computer software that are used by households to help manage their finance use in this study. Future research could explore households that switch financial technology and examine the impact of this change on their positive financial behaviors engagement.

Notes

1 See https://newsroom.transunion.com/consumers-poised-to-continue-strong-credit-activity-this-holiday-season
2 The data is available on Federal Reserve at https://www.federalreserve.gov/econres/scfindex.htm
3 The 2013 SCF collect data using computer-assisted personal interviewing (CAPI). Thus, there is no questionnaire in the usual sense. SCF uses a dual-frame sample design consisting of a standard, geographically based random sample and an oversample of affluent households. Missing values are imputed by making multiple estimates of the missing data and creating five implicate data sets. We use all five implicates to avoid inaccurate results on the significant test (Rubin, 1987).
4 Two main techniques are available for this: (1) The doer can be given discretion in which case either his preferences must be modified or his incentives must be altered, or (2) the doer's set of choices may instead be limited by imposing rules that change the constraints the doer faces" (Shefrin & Thaler, 1981).
5 Available at https://www.transunion.com/blog/consumer-credit-origination-balance-and-deliquency-trends
6 In untabulated results, we also regress three dependent variables on individual financial technology variables instead of the composite indexes. The results are consistent with these reported in the main texts.

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