Financial Literacy and Fraud Detection*

Christian Engels† Kamlesh Kumar† Dennis Philip†

June 2019

*We would like to thank Neil Bhutta, Anamaria Lusardi, Georgios Panos, Carly Urban, Robert Wright and participants at the 5th Cherry Blossom Financial Education Institute and 3rd Int. Workshop on the Internet for Financial Collective Awareness & Intelligence, for helpful comments and suggestions.

†Durham University Business School, Mill Hill Lane, Durham, DH1 3LB, UK. Emails: christian.engels@durham.ac.uk, kamlesh.kumar@durham.ac.uk, dennis.philip@durham.ac.uk.

Abstract

Who is better at detecting fraud? This paper finds that more financially knowledgeable individuals have a higher propensity to detect fraud: a one standard deviation increase in financial knowledge increases fraud detection probabilities by 3 percentage points. The result is not driven by individuals' higher financial product usage and is observed to be moderated by individuals' low subjective well-being, effectively depleting skills to detect fraud. Interestingly, prudent financial behavior relating to basic money management is found to have negligible effects for detecting fraud. The findings attest to the fact that fraud tactics are increasingly complex and it is greater financial knowledge rather than basic money management skills that provides the degree of sophistication necessary to detect fraud. The paper draws policy implications for consumer education programs to go beyond cultivating money management skills, and provide advanced financial knowledge necessary for tackling fraud.

JEL Classification: D14, D18, D91

Keywords: consumer fraud, fraud victimization, financial literacy, financial knowledge, financial behavior, subjective well-being

1 Introduction

> "The 2018 Identity Fraud Study released today [February 6, 2018] by Javelin Strategy & Research, revealed that the number of identity fraud victims increased by eight percent (rising to 16.7 million U.S. consumers) in the last year, a record high since Javelin Strategy & Research began tracking identity fraud in 2003. The study found that despite industry efforts to prevent identity fraud, fraudsters successfully adapted to net 1.3 million more victims in 2017, with the amount stolen rising to $16.8 billion." (Javelin Strategy & Research, 2018)

With increased digitalization of financial services and use of plastic payments, recent years have seen an amplification in the volume of fraudulent activities, costing the economy billions of dollars. Particularly on the rise is consumer fraud, which refers to the unauthorized access to another's bank account or payment card details to carry out fraudulent transactions. Noteworthy is the high degree of sophistication with which consumer fraud is committed, such that many fraudulent activities remain undiscovered, with victims being rarely compensated. For instance, authorized push payment frauds, contactless card and card skimming frauds, to name a few, are emergent types of fraud that can continue unhindered for long periods, if detected at all. Banks' fraud detection and verification systems can miss illicit transactions that are designed to appear authentic; therefore, banks place emphasis on their customers to spot and report any fraudulent activities in their accounts.

In this paper, we study the importance of financial literacy – the ability to process economic information and make informed financial decisions (Lusardi & Mitchell, 2014) – for fraud detection. We focus specifically on the role of financial knowledge and financial behavior related to prudent money management.[1] Financial knowledge can provide the skills

[1]Financial knowledge refers to one's understanding of important financial concepts such as long-term returns on investments, stocks vs. bonds vs. savings volatility, benefits of diversification, and the relationship bond prices and interest rates, among others. For each individual a composite score representing their level of financial knowledge is derived from the number of accurate responses to the various survey questions. On the other hand, financial behavior is captured from questions on money management relating to their savings habits, their frugality, and how they plan and manage their budgets. The survey questions in this regard ask

to better disentangle genuine from fraudulent information, make an individual more attentive to fraud risk, reduce their relative ignorance to fraudulent too-good-to-be-true scams, and enable them to cultivate greater effectiveness in detecting fraud. Prudent financial behavior can reduce an individual's exposure to be a target for fraud.

Thus, the paper builds on the growing evidence that there is a strong relationship between financial literacy and economic outcomes. For example, financially literate individuals are observed to be more financially aware of financial products and services (Banerjee et al., 2019), better at engaging in day-to-day financial management activities such as retirement planning and wealth accumulation (Lusardi & Mitchell, 2007a,b, 2011; Klapper & Panos, 2011), more likely to participate in financial markets (Van Rooij et al., 2011; Yoong, 2011; Balloch et al., 2015) and better equipped to face macroeconomic shocks such as the financial crisis (Klapper & Panos, 2013).

Previous literature on consumer fraud identifies certain risk factors and social contexts associated with victimization. Van Wilsem (2011) observes that people with low self-control run substantially higher victimization risk from internet consumer fraud. DeLiema et al. (2018) find that fraud incidences are non-negligible at older ages as a consequence of poorer financial capability. Studying a sample of survey participants aged 50 or above, the paper documents evidence that older adults may be more susceptible to fraud due to greater asset accumulation and as fraudsters may consider them easier targets due to potential cognitive impairments associated with aging.[2] Financial knowledge can provide the skills required to improve individuals' attentiveness to fraudulent practices, increase their detection capabilities and empower them to deter fraud. In an experimental setup, Anderson (2016) observes that consumer literacy related to understanding various financial marketplaces significantly affect respondents' propensities to accurately identify fraudulent advertisements. Also, An-

respondents to rate their financial behaviors in a wide variety of dimensions such as setting and pursuing financial goals; setting and consulting your budget; whether bills are paid on time; whether statements, bills, and receipts are checked for errors; and whether the credit card balance is paid off in full each month, among others.

[2]For a review of the literature surrounding fraud victimization, refer to Financial Fraud Research Center (2012, 2013).

dreou & Philip (2018) find that the financially knowledgeable among the younger generation have a significantly higher propensity of declining an offer to engage in a Ponzi or fraudulent scheme than their peers, after being solicited.

To analyze the relationship between financial literacy and fraud detection, we use information from 5,698 US respondents to the National Financial Well-Being Survey (NFWBS), which was fielded in 2016 by the Consumer Financial Protection Bureau (CFPB) and designed to be representative of the adult US population. In addition to granular socioeconomic and demographic information, the survey asks respondents whether they have experienced fraud in the past, where someone has, without their permission, used or attempted to use any of their existing accounts, such as a credit or debit card, checking, savings, telephone, online, or insurance account. The NFWBS survey also captures respondents' financial literacy, financial product usage and financial behavior information.

The empirical analysis uncovers a positive and economically meaningful association between financial knowledge and fraud detection: the more financially knowledgeable the respondents, the more fraud they detect. The results corroborate that financial knowledge enhances the financial capability of individuals by being more aware of, and better at recognizing, fraud when it occurs. The significant positive relationship is found to not be driven by more financially knowledgeable individuals more intensively holding financial products and services, and thus exposing themselves to more fraud risk.[3] In fact, we observe that, no matter a low or high number of financial products and services held, the percentage of respondents detecting fraud increases as the level of financial knowledge increases.

Next, we proceed to investigate whether individuals exhibiting prudent financial behavior relating to basic money management are better at detecting fraud. We include in our analysis a battery of information relating to basic financial behaviors that enable individuals to

[3]We capture individuals financial product holdings information by the number of traditional and alternative financial products and services they utilize. Traditional financial products refer to savings accounts, life insurance, health insurance, retirement accounts, pensions, non-retirement investments, education savings account, and student or education loans. Alternative financial products refer to payday or cash advance loans, pawn or auto title loans, reloadable cards that are not linked to checking or savings accounts, or using non-banks for international money transfers or for check cashing or purchasing a money order.

manage their finances better. These include, among others, setting and pursuing financial goals; setting and consulting a budget; whether bills are paid on time; whether statements, bills and receipts are checked for errors; and whether the credit card balance is paid off in full each month. Interestingly, the test results indicate that prudent financial behaviors do not really matter when it comes to the ability to detect fraud. We observe marginal negative significance for the financial behavior dimensions, pursuing financial goals, staying within budget and having a savings habit, such that these prudent financial behaviors marginally reduce the propensity to detect fraud. However, overall we see that the positive effect of financial knowledge in detecting fraud remains the strong influencing factor.

The weak result for financial behavior suggests that efficient management of finances does not directly correlate with greater effectiveness in spotting fraudulent activities. This can be explained by the fact that fraud is becoming increasingly sophisticated and it is not financial behavior but financial knowledge that provides the degree of sophistication necessary to be able to detect consumer fraud. Financial knowledge strengthens one's capacity to recognize fraud risk and also empowers individuals to take necessary steps in detecting fraud when it happens.

We further find that the relationship between financial knowledge and fraud detection can be attenuated when individuals' subjective well-being is low, in effect reducing individuals' capacities to detect fraud due to the high cognitive loads that low well-being imposes. This is in line with previous studies that document a negative relationship between one's capacity to make sensible economic decisions and the impediments to an individual's cognitive function. For example, Mani et al. (2013), Haushofer & Fehr (2014), Deck & Jahedi (2015), Schilbach et al. (2016) show that economic decisions worsen with increases in cognitive load.

To empirically test this, we use survey information on three subjective well-being aspects of the individuals, namely, life satisfaction, optimism about the future, and the belief that works yield success. The results identify significant interactions between well-being and financial knowledge in a meaningful way. More specifically, we observe that the greater the life

dissatisfaction, the higher the pessimism about the future, and the greater the disagreement that work will yield success in the future, the weaker becomes the relationship between financial knowledge and fraud detection. By contrast, at higher levels of subjective well-being, we observe that financial knowledge emerges as a significant determinant of an individual's abilities to detect fraud. The results indicate that as well-being deteriorates, the beneficial effects of financial knowledge regarding fraud detection tamper off. Overall, the subjective well-being of an individual plays an important moderating role in the relationship between financial knowledge and fraud detection.

Our study has crucial policy implications given the recent interest in the importance of financial literacy for general consumers and retail investors from a behavioral perspective (IOSCO and OECD, 2018). As fraud is increasingly sophisticated, policy steps should emphasize consumer education programs to enhance financial knowledge on aspects such as risk and return. If consumers understand how financial products operate, they will be better able to identity and protect themselves from "too good to be true" offers. Further, training on aspects related to achieving prudent financial behavior must go beyond cultivating money management skills to also include training to detect and deter consumer fraud.

2 Data and variables

2.1 Data sample

We use data from the National Financial Well-Being Survey (NFWBS), fielded by the Consumer Financial Protection Bureau (CFPB) in 2016. The data were weighted to represent the U.S. adult population and key subpopulations. $6,394$ respondents participated in the survey, which forms a representative sample of the adult population from all 50 US states. With the intention of measuring individual-level financial well-being and its determinants, the cross-sectional survey records a rich set of individual and household characteristics at a high level of granularity. The survey captures individual attributes including socio-demographic

attributes, namely age, gender, civil-status, ethnicity; socio-economic attributes, namely education, income; and spatial attributes, namely census region and urban-rural linkages. Along with these individual-level attributes, the survey includes important information on financial fraud detection, level of financial knowledge, level of financial product usage, as well as respondents' financial attitudes and behavioral traits. After excluding respondents who did not reveal their information on the various questions that we study in the paper, we are left with a final sample of 5,698 individuals for our empirical investigation.

2.2 Variable constructions and descriptive analysis

In order to elicit information on whether the respondent detected attempted or actual fraud, the following survey question was asked:

> *In the past 5 years, has someone without your permission used or attempted to use an existing account of yours, such as a credit or debit card, checking, savings, telephone, online, or insurance account?*

Respondents were offered four choices of answers, namely, "Yes", "No", "I don't know", and "Refused". As additional follow-on questions on the specificity and the frequency of the fraud were not asked, we are unable to clearly distinguish the case where the respondent is experiencing more (or less) fraud. A clearer identification of an individual's fraud detection ability requires us to observe the conditional outcome space, where, given the individual is targeted for fraud, he/she is able to or not able to detect it. That is, we require to observe the fraud attempts made. However, in non-experimental data such as surveys, whether or not an individual has been targeted for fraud is unobservable. Thus, we are implicitly assuming that all individuals have a similar probability of being targeted for fraud, and we proceed to study whether, conditional on being targeted, they are able to detect fraud. This assumption is not unreasonable, as fraud victimization has been sharping rising in recent years, with fraudsters randomly hunting for vulnerable individuals on mass to catch those who fall prey to their

schemes. Furthermore, large-scale data breaches of corporations holding sensitive customer data have made individuals across the population vulnerable to fraud. Thus, it is likely that the respondents in our representative sample of households have all been subject to fraudulent attempts in the previous five years. Therefore, we interpret the responses to the survey question above as capturing fraud detection.

Table 1 reports the number of responses to the various response categories. We observe that around 26% report that fraud has been detected in their accounts, 65% do not consider that they have been subject to fraud, and a minority 9% of respondents report to be either unaware of fraud or refused to respond to the question. In the empirical analysis, we exclude those respondents who either choose "I don't know" or have refused to disclose.

Following Knoll & Houts (2012), we measure financial knowledge of respondents using nine survey questions, eliciting their understanding of financial concepts such as long-term returns on investments, stocks vs. bonds vs. savings volatility, benefits of diversification, and the relationship bond prices and interest rates. The actual wordings of the questions and responses choices of the nine questions are reported in Appendix A. For each individual a composite score representing their level of financial knowledge is derived from their responses to the nine questions using item response theory (for methodological details, see Knoll & Houts, 2012).

Panel A of Table 2 provides a descriptive analysis of the relationship between various levels of financial knowledge and fraud detection. We observe that the proportion of respondents detecting fraud increases with their financial knowledge. For instance, at the lowest financial knowledge score of -2.053, no respondents detect fraud; however, this increases to 36.61% for the case of respondents with the highest financial knowledge score of 1.267.

To measure the financial behavior of respondents, we make use of information from ten questions on money management that capture the financial behaviors relating to their savings habits, their frugality, and how they plan and manage their budgets. The actual wordings of the questions and the Likert response choices are reported in Appendix B. The questions ask

the respondents to rate their financial behaviors in a variety of dimensions such as setting and pursuing financial goals; setting and consulting your budget; whether bills are paid on time; whether statements, bills, and receipts are checked for errors; and whether the credit card balance is paid off in full each month. For each individual, we create a composite score of financial behavior by summing the response choices (which are first mapped to integers) from all ten behavior questions. Panel B of Table 2 reports the descriptive analysis of the relation between the level of financial behavior and fraud detection. Splitting individuals into terciles according to their financial behavior, we observe that, unlike financial knowledge, fraud detection across the various financial behavior groups are strikingly similar.

We capture individuals' financial product holdings information by the number of traditional and alternative financial products and services they utilize. Traditional financial products refer to savings accounts, life insurance, health insurance, retirement accounts, pensions, non-retirement investments, education savings account, and student or education loans. Alternative financial products refer to payday or cash advance loans, pawn or auto title loans, reloadable cards that are not linked to checking or savings accounts, or using non-banks for international money transfers or for check cashing or purchasing a money order.

Panels C and D of Table 2 report fraud detection rates for different levels of traditional and alternative financial product usage, respectively. We observe that fraud detection increases with the level of financial product usage: 14.67% of respondents utilizing none of the traditional financial products report detecting fraud, in contrast to 57.14% of respondents utilizing all the eight traditional financial products reporting fraud detection. We see a similar trend for the case of alternative financial product usage.

Overall, the descriptive analysis in Table 2 indicates that both financial knowledge and financial product usage have a positive relationship with fraud detection. To further investigate the relationship between these two confounding characteristics for fraud detection, Figure 1 provides a visual representation of the percentage of respondents detecting fraud

at various levels of financial knowledge, for the case of low and high financial product usage. Panel (a) of Figure 1 plots the case of traditional financial product usage, while Panel (b) plots the case of alternative financial product usage. For both instances, low and high usage is defined as holding fewer or more financial products, respectively, than the median number of financial products held within the sample. Two notable observations emerge. First, we find that the financial knowledge and fraud detection relationship is similar for both low and high financial product usage, and thus the relationship is not driven by the level of financial product utilization. Second, for traditional financial products, we see that individuals with high usage detect slightly more fraud when they possess higher levels of financial knowledge. In contrast, it is the low financial knowledge individuals that detect more fraud when they are also highly utilizing alternative financial products.

Next, we discuss the summary statistics of the individual- and household-level characteristics in our sample. Table 3 reports the distribution of the respondents' age groups, gender, marital status and ethnicity, in addition to their household's income, metropolitan residency status and census region. We observe that our sample is composed of individuals aged 18 to 75 years and older, with variability across all age groups, reflecting the representation of the survey. The distributions of gender, marital status and ethnicity show that the largest groups are male, married and white, respectively. Respondents are heterogeneous with respect to education: only a small fraction (6.14%) report less than high school education, and the remaining with high school (24.83%), some college/associate's degree (30.10%), bachelor's degree (21.02%) or graduate/professional degree (17.90%). Household income exhibits variability; however, the preponderance of households (57.65%) report earnings of $60,000 or more per year. The majority of respondents live in metropolitan areas, approximately evenly spread across the US census regions.

3 Empirical Analysis

3.1 Financial knowledge and fraud detection

We test the relationship between financial knowledge and fraud detection in a multivariate setting, accounting for a wide range of socio-economic and demographic attributes of the individuals. More specifically, we estimate the probit regression,

$$\begin{aligned} fraudDetectProp_i = \beta_0 + \beta_1(finKnow_i) + \beta_2(tradProducts_i) \\ + \beta_3(altProducts_i) + \sum_{k=1}^{K} c_k X_{i,k} + \varepsilon_i \end{aligned} \tag{1}$$

for $i = 1, \ldots, N$ respondents. The dependent variable is the latent fraud detection propensity related to the fraud detection indicator variable (taking the value one if the respondent has detected fraud, and zero otherwise) via the probit link function. ε_i is a i.i.d. standard normal error term. $finKnow$ denotes financial knowledge score (transformed to z-scores) and is the key explanatory variable of interest. To control for the level of financial product usage, we include $tradProducts$ and $altProducts$, which denote the degree of traditional and alternative financial product usage, respectively. Additionally, to account for the heterogeneity in the individual and household characteristics, we include a large set of control variables (denoted X) capturing age, gender, civil status, ethnicity, education, household income, metro residency status and census region. The definitions of all the control variables is provided in Appendix E.

Table 4 reports the estimation results. Column (1) presents the baseline results without accounting for the degree of financial product usage, while Columns (2) and (3) additionally include the usage levels of traditional and alternative financial products and services. We observe that the effect of financial knowledge is stable and strongly significant at the 1% level across all the specifications. For the final specification after controlling for financial product usage levels, we estimate the marginal economic significance of financial knowledge

by calculating the average marginal effect. We observe that a one standard deviation increase in financial knowledge is associated with a 3 percentage point increase in the probability of fraud detection. The additional number of fraud detection cases due to increased financial literacy will be sizeable, given the high volume of fraudulent activities recorded in recent years. The estimation results show that financial knowledge plays an important role in detecting fraud and the finding holds even after controlling for the individual's level of financial product usage. Further, the coefficients on traditional and alternative financial product usage show significance at the 5% and 1% levels, respectively. The coefficient magnitude for the degree of utilization of traditional financial products is observed to be greater than that of the alternative financial products and services. Although the exact mechanism remains unexplored due to data unavailability, the results support the conjecture that a higher degree of alternative financial product usage exposes individuals to more fraud incidences.

Among the demographic attributes, we observe that education and income play an important role in detecting fraud. Considering the civil-status of respondents, the individuals who are single detect relatively less financial fraud, as compared to the base case of married individuals. None of the spatial characteristics of respondents have a significant impact on the ability to detect financial fraud, suggesting that geographic locations are unimportant in the digital era.

3.2 Financial behavior and fraud detection

In the section, we explore whether the financial behavior of individuals relating to money management plays an important role in detecting fraud. To this end, we make use of a battery of survey questions that capture prudent financial behaviors, including active budgeting, setting and pursuing financial goals, paying bills on time, staying within budget, paying off credit card balances in full each month, checking accounts for errors, frugal spending and saving habits. Additionally, we create a composite financial behavior score for each individual by summing up the response choices from all the financial behavior questions. See Appendix

B for variables construction and definitions. To empirically test the relationship between financial behavior and fraud detection, we include the financial behavior variables (denoted $finBehav$) as additional regressors in the probit regression,

$$fraudDetectProp_i = \beta_0 + \beta_1(finKnow_i) + \beta_2(tradProducts_i) + \beta_3(altProducts_i) + \beta_4(finBehav_i) + \sum_{k=1}^{K} c_k X_{i,k} + \varepsilon_i \quad (2)$$

where the dependent variable is the latent fraud detection propensity related to the fraud detection indicator variable (taking the value one if the respondent has detected fraud, and zero otherwise) via the probit link function. Further, we include all the individual- and household-level control variables as in Equation (1).

Table 5 reports the estimation results. Columns (1) to (11) present the results for the financial behaviors added individually as regressors, while Column (12) shows the results for the financial behavior composite score variable. Interestingly, we observe that except for the financial behavior variables *Stayed within budget* and *Saving habit*, which are marginally significant at the 5% and 10% levels, respectively, none of the other financial behavior variables is significant. The test results indicate that prudent financial behavior relating to basic money management does not substantially matter when it comes to the ability to detect fraud. As found previously, the positive effect of financial knowledge in detecting fraud remains a strong influencing factor.

We conduct additional analysis to understand how financial behavior and financial knowledge interact in relation to detecting fraud. For instance, if individuals with the highest financial behavior, defined as individuals reporting fullest compliance with the respective prudent behavior, do not detect fraud when they also possess high financial knowledge, it may indicate that high prudence in financial behavior is preventing individuals from being targeted. On the other hand, if financially knowledgeable individuals with the highest financial behavior are still detecting fraud, the evidence indicates less of a case of prudent

financial behavior reducing being targeted for fraud. We test this premise in the data by considering individuals who have indicated the highest Likert response to the various financial behavior questions, and sorting them further into high and low financial knowledge. High (low) financially knowledgeable individuals are those with a financial knowledge score higher (smaller) than the sample average.

Table 6 reports the probit estimation results for the probability of fraud detection. For brevity, we report only the coefficients of interest. Columns (1) to (10) present results for the various financial behaviors considered separately and Column (11) aggregates information from all the financial behaviors to construct an overall highest financial behavior indicator variable, which takes the value of one for individuals reporting highest prudence in the number of financial behaviors above the average number in the sample, and zero otherwise.

We find that the estimates for the interaction of the highest self-reported financial behaviors with financial knowledge is significant only for the case of high financial knowledge, while it remains not significant when financial knowledge is low. The results indicate that individuals with the highest self-reported financial behavior detect fraud only when their financial knowledge is also high. The findings suggest that financial behavior related to money management skills is insufficient when it comes to preventing fraud; however financially knowledge provides the sophistication necessary for detecting fraud.

To confirm the findings further, we plot in Figure 2 the percentage of respondents detecting fraud, given the number of self-reported highest financial behaviors, and examine separately those with low and high financial knowledge and low and high financial product usage. It can be seen that fraud detection rates are remarkably similar for any number of highest financial behaviors. However, there is an upward shift in detection rates for high financial knowledge individuals. Similar patterns are observed both for low as well as high product usage.

Overall, the results suggest that efficient management of money through good financial behavior is inadequate when it comes to spotting fraud. The result attests to the fact that

consumer fraud is complex, and its incidences are unexpected. Thus a certain degree of financial sophistication through financial knowledge is necessary to detect fraud when it occurs.

3.3 Limits to financial knowledge and fraud detection

The findings so far establish a strong association between financial knowledge and fraud detection. Financially knowledgeable individuals have the skills to better detect fraud when it occurs. This relationship, however, may be weaker for individuals who possess a low cognitive assessment of their life or lower subjective well-being. That is, individuals with lower (higher) levels of subjective well-being will generally be less (more) attentive to their general well-being needs and have less (more) cognitive capacity to detect fraud. We test this premise in the data. To measure subjective well-being, we utilize three statements in the survey that invite Likert responses capturing respondents' subjective well-being:

1. *I am satisfied with my life*
2. *I am optimistic about my future*
3. *If I work hard today, I will be more successful in the future*

Responses to all the statements are measured on a 7-point Likert scale. We accordingly map the responses to integers from 1 to 7, where the higher the integer, the higher the degree of disagreement with the statement. To estimate the effect of financial knowledge on fraud detection probabilities, given the different levels of subjective well-being, we specify a probit regression with interaction effects,

$$fraudDetectProp_i = \beta_0 + \sum_{l=1}^{L} \beta_{1,l}(wellBeing_{i,l} \times finKnow_i) + \beta_2(tradProducts_i) + \beta_3(altProducts_i) + \sum_{k=1}^{K} c_k X_{i,k} + \varepsilon_i \quad (3)$$

for respondents $i = 1, \ldots, N$. The dependent variable is the latent fraud detection propensity

related to the fraud detection indicator variable (taking the value one if the respondent has detected fraud, and zero otherwise) via the probit link function. As independent variables, we include the interaction between financial knowledge ($finKnow$) and the various levels of well-being ($wellBeing$), specified by the integer values for the Statements (1) to (3) shown above. We also include all individual- and household-level control variables in the regression specifications.

Table 7 reports the estimation results. Columns (1) to (3) report the results for the three subjective well-being statements. We observe that the interactions between financial knowledge and well-being levels 1 to 3 are statistically insignificant. However, for levels 4 and above, which relates to greater well-being, the financial knowledge coefficient estimates start to show significance. The results indicate that low subjective well-being weakens the positive relationship between financial knowledge and individual propensities to detect fraud, while at higher levels of subjective well-being we observe that financial knowledge emerges as a significant determinant of an individual's abilities to detect fraud. Interestingly, however, we also observe that at very high levels of subjective well-being the relationship between financial knowledge and fraud detection breaks down. In this case, individuals appear too positive and optimistic to engage in effective fraud detection; as such, when it comes to detecting fraud it pays not being overly optimistic. Overall, subjective well-being of an individual plays an important moderating role in the relationship between financial knowledge and fraud detection.

3.4 Robustness analysis - instrumental variable approach

In estimating the effect of financial knowledge on the likelihood of detecting fraud, a potential source of concern might be a bias due to omitted variables influencing both financial knowledge and fraud detection. One such variable can be the respondents' digital literacy, which prior research has found to affect human capital accumulation and potentially financial literacy. For example, Servon & Kaestner (2008) find evidence of a possible link between

digital literacy and financial knowledge. Also, Lee (2018) argues that digital media literacy can help people better understand "issues of misinformation and privacy, cyber crimes such as phishing and other types of fraud" (p.465).

To test that the results concerning the relationship between financial knowledge and fraud detection are not driven by unobserved factors, we employ an instrumental variable approach. We instrument financial knowledge by an indicator variable that takes the value of one if the parent who raised the respondent attended graduate school, and zero otherwise. Graduate school degrees in the U.S. encompass master's degrees and PhD or other doctoral degrees, such as doctorates from medical and law schools. We argue that graduate parent as an instrument satisfies both the relevance and exclusion restrictions. First, individuals with graduate education, on average, earn higher incomes and acquire more wealth, subsequently investing in the acquisition of advanced financial knowledge. Over time, graduate parents will pass on their knowledge to their children, increasing also the children's financial knowledge. We thus expect a strong correlation between the respondents' parent having attended graduate school and their financial knowledge. Second, having a graduate parent will be, arguably, orthogonal to the respondents' fraud detection propensities, after controlling for various socio-economic and demographic characteristics. As the digital revolution is a recent phenomenon, the parents' graduate education will not entail the acquisition of digital literacy skills that can be readily passed onto their children. Moreover, we find in our analysis above that prudent financial behaviors, which can be effectively fostered by a parent with graduate education, are insignificant for fraud detection, thus also ruling out these indirect effects. Therefore, graduate parent, as an instrumental variable, extracts the exogenous part of the residual variation in fraud detection, identifying all relevant parameters.

Given that our outcome variable of interest is the fraud detection indicator variable, the standard two-stage least squares estimator is likely to be inappropriate. We therefore estimate a probit model in which we instrument financial knowledge in a Limited Information Maximum Likelihood (LIML) framework. The regression setup is a recursive set of

equations with the dependent variables fraud detection ($fraudDetect$) and financial knowledge ($finKnow$), in which the endogenous variable, financial knowledge, appears on the right-hand side of the fraud detection equation:

$$fraudDetectProp_i = \beta_0 + \beta_1(finKnow_i) + \sum_{k=1}^{K} \gamma_k X_{i,K} + \varepsilon_{i,1} \tag{4}$$

$$finKnow_i = \alpha_0 + \alpha_1(graduateParent_i) + \sum_{k=1}^{K} \delta_k X_{i,K} + \varepsilon_{i,2} \tag{5}$$

$$(\varepsilon_{i,1}\ \varepsilon_{i,2})' \sim \mathcal{N}(0, \Sigma) \tag{6}$$

$$\text{where } \Sigma = \begin{pmatrix} 1 & \sigma_2\rho \\ \sigma_2\rho & \sigma_2^2 \end{pmatrix} \tag{7}$$

where the error terms $\varepsilon_{i,1}$ and $\varepsilon_{i,2}$ for fraud detection and financial knowledge equations, respectively, are related in a Seemingly-Unrelated Regression specification. More specifically, Equations (6) and (7) show that they are assumed to be jointly drawn from a multivariate normal distribution with a mean vector of zeros and a covariance matrix Σ. The standard deviation σ_1 is standardized to unity to identify the probit equation. The correlation term ρ captures possible endogeneity of financial knowledge for fraud detection, a testable quantity. If the above identifying assumptions are satisfied, an estimate of β_1 yields the causal effect of financial knowledge on fraud detection.

Table 8 reports the estimation results. Column (1) reports the first-stage estimates relating to financial knowledge (Equation (5)), while Column (2) reports the second-stage estimates relating to fraud detection (Equation (4)). In Column (1), we observe that the graduate parent instrumental variable is significant at the 1% level, with a coefficient estimate of 0.162. The Kleibergen-Paap rk LM test indicates that we reject at the 1% level that the instrument relevance assumption is not satisfied. Overall, the use of graduate parent as an instrument provides a strong first-stage result, satisfying the instrumental variable relevance assumption.

The second-stage estimates in Column (2) show that the causal effect of financial knowledge on fraud detection is 0.564, with weak significance (p-value of 7%). Importantly, in contrast to the probit estimates in Table 4, we observe that the IV estimate of financial knowledge on fraud detection is approximately five times larger in magnitude. This is possibly a result driven by the subset of the population captured by the instrument. That is, respondents with a graduate parent may have significantly higher advanced financial knowledge than the rest of the population. Further, in addressing the initial concern of omitted variable bias, the Wald test of exogeneity finds no significant correlation between the errors of Equation (6) and (7) (H_0: $\rho = 0$), indicating that we cannot reject exogeneity of financial knowledge for fraud detection.

4 Conclusion

We study the role of financial literacy, measured through the dimensions of financial knowledge and financial behavior, for fraud detection. Consumer fraud is becoming increasingly complex such that detecting fraud requires a great deal of sophistication. As automated fraud detection systems do not always recognize fraudulent activities, banks place emphasis on their customers spotting and reporting fraudulent transactions in their accounts.

We study whether financially literate individuals, through greater financial knowledge and prudent financial behavior, will be more capable of assessing fraud risk and be better equipped to spot fraud incidences. Using a representative sample of US residents, we investigate this relationship and find strong evidence for the case of financial knowledge but not for prudent financial behaviors related to basic money management. More specifically, the results indicate that the more financially knowledgeable an individual, the greater is the fraud detection. This corroborates the conjecture that, with financial knowledge, individuals become more skilled in detecting fraud when it occurs. Financial knowledge provides the financial sophistication necessary to detect fraud.

Prudent financial behaviors related to money management, however, do not systematically matter when it comes to the ability to detect fraud. We proxy for prudence in financial behavior by measuring money management behaviors such as setting and pursuing financial goals; setting and consulting a budget; whether bills are paid on time; whether statements, bills and receipts are checked for errors; and whether the credit card balance is paid off in full each month. The weak result for financial behavior suggests that efficient management of finances does not directly correlate with greater effectiveness in spotting fraudulent behavior, and that it is indeed financial knowledge that provides the degree of sophistication necessary to be able to detect fraud.

We observe that the positive effect of financial knowledge in detecting fraud remains a strong influencing factor, even after accounting for the individuals' usage levels in traditional and alternative financial products and services. Further, we find that subjective well-being plays an important moderating role in the relationship between financial knowledge and fraud detection. Lower levels of subjective well-being can reduce attention to fraud occurrences due to greater cognitive loads, and thus attenuating the relationship between financial knowledge and fraud detection.

Our study has important policy implications considering the recent interest in the role of financial literacy for general consumers and retail investors from a behavioral perspective. The findings suggest policy steps that emphasize consumer education programs to enhance financial knowledge to help consumers detect fraud.

References

Anderson, K. B. (2016). *Mass-market consumer fraud: Who is most susceptible to becoming a victim?* (FTC Bureau of Economics No. 332). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2841286

Andreou, P., & Philip, D. (2018). Financial knowledge among university students and implications for personal debt and fraudulent investments. *Cyprus Economic Policy Review*, *12*(2), 3–23.

Balloch, A., Nicolae, A., & Philip, D. (2015). Stock market literacy, trust, and participation. *Review of Finance*, *19*(5), 1925-1963.

Banerjee, A., Hasan, I., Kumar, K., & Philip, D. (2019). The power of a financially literate woman. *SSRN Working Paper*.

Deck, C., & Jahedi, S. (2015). The effect of cognitive load on economic decision making: A survey and new experiments. *European Economic Review*, *78*(Supplement C), 97 - 119.

DeLiema, M., Deevy, M., Lusardi, A., & Mitchell, O. S. (2018). *Financial fraud among older americans: Evidence and implications* (NBER Working Paper No. 24803). Retrieved from https://www.nber.org/papers/w24803

Financial Fraud Research Center. (2012). *Scams, schemes & swindles: A review of consumer financial fraud research*. Retrieved from http://longevity.stanford.edu/2012/11/19/scams-schemes-and-swindles-a-review-of-consumer-financial-fraud-research/

Financial Fraud Research Center. (2013). *The scope of the problem: An overview of fraud prevalence measurement*. Retrieved from http://longevity.stanford.edu/2013/11/14/the-scope-of-the-problem-an-overview-of-fraud-prevalence-measurement/

Fujiwara, T., & Kawachi, I. (2009). Is education causally related to better health? A twin fixed-effect study in the USA. *International Journal of Epidemiology*, *38*(5), 1310-1322.

Haushofer, J., & Fehr, E. (2014). On the psychology of poverty. *Science*, *344*(6186), 862–867.

IOSCO and OECD. (2018). *The application of behavioural insights to financial literacy and investor education programmes and initiatives*. Retrieved from `http://www.oecd.org/finance/The-Application-of-Behavioural-Insights-to-Financial-Literacy-and-Investor-Education-Programmes-and-Initiatives.pdf`

Javelin Strategy & Research. (2018, February 6). *Identity fraud hits all time high with 16.7 million U.S. victims in 2017* [Press Release]. Retrieved from `https://www.javelinstrategy.com/press-release/identity-fraud-hits-all-time-high-167-million-us-victims-2017-according-new-javelin`

Klapper, L., & Panos, G. A. (2011). Financial literacy and retirement planning: The Russian case. *Journal of Pension Economics & Finance*, *10*(4), 599–618.

Klapper, L., & Panos, G. A. (2013). Financial literacy and its consequences: Evidence from Russia during the financial crisis. *Journal of Banking and Finance*, *37*(10), 3904–3923.

Knoll, M. A., & Houts, C. R. (2012). The financial knowledge scale: An application of item response theory to the assessment of financial literacy. *Journal of Consumer Affairs*, *46*(3), 381–410.

Lee, N. M. (2018). Fake news, phishing, and fraud: A call for research on digital media literacy education beyond the classroom. *Communication Education*, *67*(4), 460–466.

Lusardi, A., & Mitchell, O. S. (2007a). Baby boomer retirement security: The roles of planning, financial literacy, and housing wealth. *Journal of Monetary Economics*, *54*(1), 205–224.

Lusardi, A., & Mitchell, O. S. (2007b). Financial literacy and retirement preparedness: Evidence and implications for financial education. *Business Economics*, *42*(1), 35–44.

Lusardi, A., & Mitchell, O. S. (2011). *Financial literacy and planning: Implications for retirement wellbeing* (NBER Working Paper No. 17078). Retrieved from `https://www.nber.org/papers/w17078`

Lusardi, A., & Mitchell, O. S. (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature*, *52*(1), 5–44.

Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science*, *341*(6149), 976–980.

Schilbach, F., Schofield, H., & Mullainathan, S. (2016). The psychological lives of the poor. *American Economic Review: Papers & Proceedings*, *106*(5), 435–440.

Servon, L. J., & Kaestner, R. (2008). Consumer financial literacy and the impact of online banking on the financial behavior of lower-income bank customers. *Journal of Consumer Affairs*, *42*(2), 271–305.

Van Rooij, M., Lusardi, A., & Alessie, R. (2011). Financial literacy and stock market participation. *Journal of Financial Economics*, *101*(2), 449–472.

Van Wilsem, J. (2011). 'Bought it, but never got it' Assessing risk factors for online consumer fraud victimization. *European Sociological Review*, *29*(2), 168–178.

Yoong, J. (2011). Financial illiteracy and stock market participation: Evidence from the RAND American Life Panel. In O. S. Mitchell & A. Lusardi (Eds.), *Financial literacy: Implications for retirement security and the financial marketplace* (p. 76-97). Oxford: Oxford University Press.

5 Figures

Figure 1: **Rates of detected fraud for different levels of financial knowledge, plotted for low and high degrees of financial product usage.** The lines indicate the percentage of respondents that detected fraud given their levels of financial knowledge and degrees of product usage. Financial knowledge is defined as the composite score derived from nine financial knowledge questions, which elicit the respondents' understanding of various financial concepts. The financial knowledge composite score ranges from -2.053 to 1.267. Traditional and alternative financial product usage is the number of traditional or alternative products respondents hold, respectively. Low and high product usage is defined as holding fewer or more financial products, respectively, than the median number of financial products held in the sample.

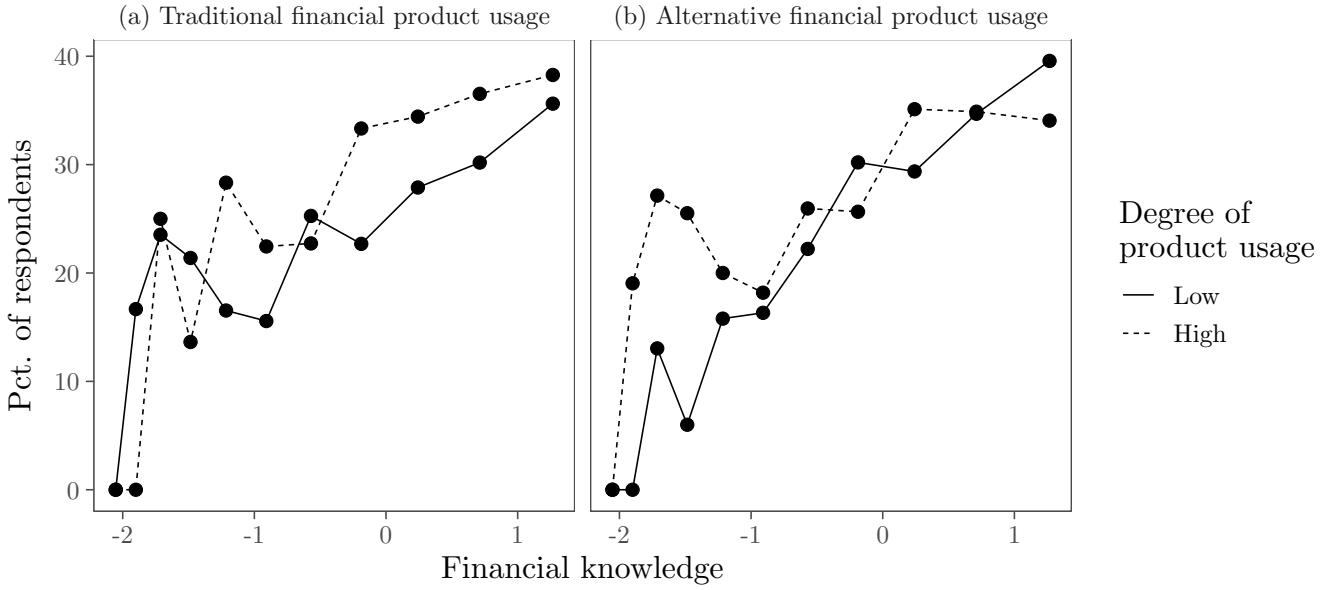
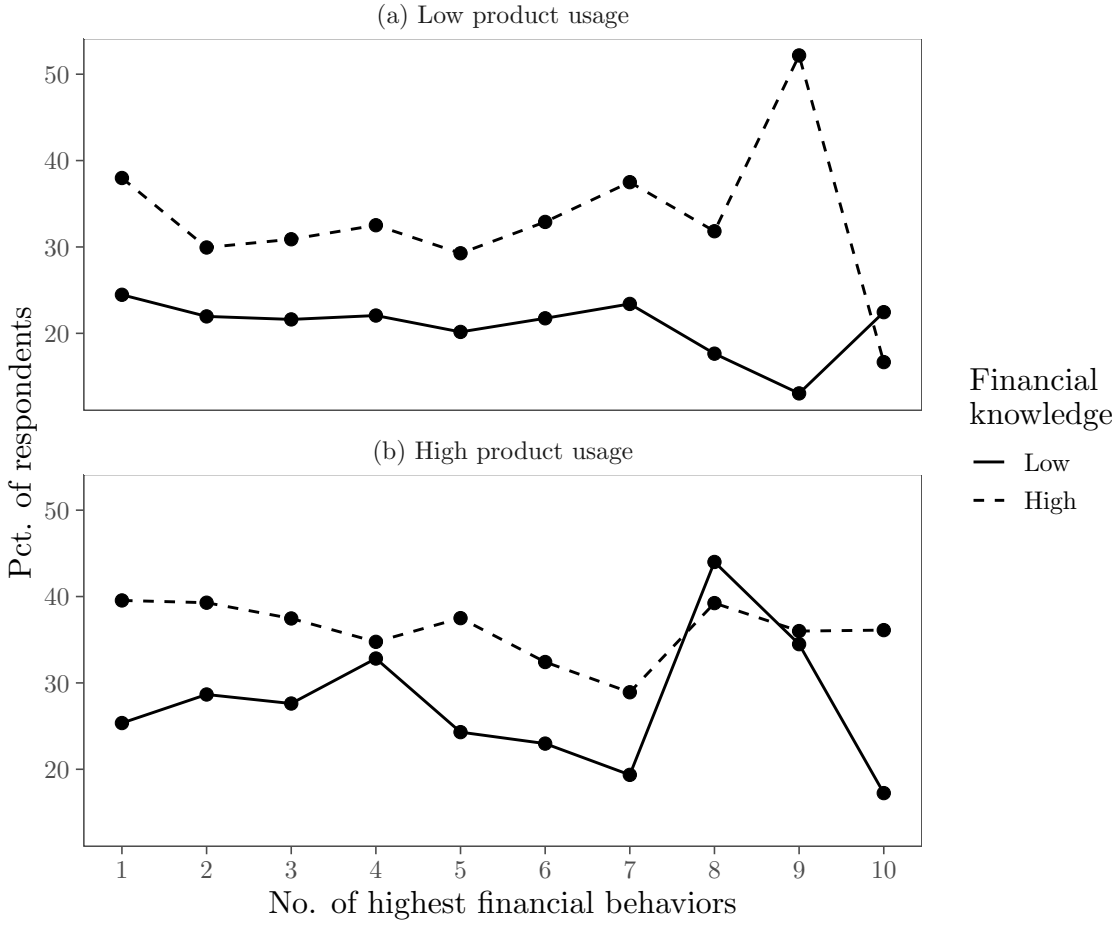


Figure 2: **Rates of detected fraud given number of highest self-reported financial behaviors.** The different lines indicate the percentage of respondents that detected fraud given their number of highest self-reported financial behaviors, split by low and high financial knowledge. A given financial behavior is defined as high if the respondent chooses the highest Likert response to the corresponding financial behavior question, and low otherwise. All financial behaviors considered are listed in Appendix B. Respondents' financial knowledge is defined as high if it is greater than the sample average, and low otherwise. The different panels show the corresponding lines for low and high degrees of financial product usage, which comprises both traditional and alternative financial product usage, defined as the number of traditional or alternative products respondents hold, respectively. Low and high product usage is defined as holding fewer or more financial products, respectively, than the median number of financial products held in the sample.



6 Tables

Table 1: **Detection of fraud.** This table reports the distribution (counts and percentages) of responses to the question: *In the past 5 years, has someone without your permission used or attempted to use an existing account of yours, such as a credit or debit card, checking, savings, telephone, online, or insurance account?*

Response	Count	Pct.
Yes	1,686	26.37
No	4,161	65.08
I don't know	512	8.01
Refused to answer	35	0.55
Total	6,394	100

Table 2: **Fraud detection, financial knowledge, financial behavior and financial product usage.** This table reports the counts and percentages of fraud detection given the different levels of financial knowledge (Panel A), financial behavior (Panel B), and financial product usage (Panels C and D), respectively. Financial knowledge is defined as the composite score derived from nine financial literacy questions. The financial knowledge scores range from -2.053 to 1.267. The financial behavior score is created by summing up the Likert responses (after mapping them to integers) to the financial behavior questions and is then divided into terciles. Traditional and alternative financial product usage is measured as the number of traditional or alternative financial products respondents hold or use, respectively. Traditional and alternative product usage range from 0 to 8 and 0 to 4, respectively.

	Fraud detected		No fraud detected	
	Count	Pct.	Count	Pct.
Panel A: Financial knowledge score				
-2.053	0	0.00	6	100.00
-1.900	3	14.29	18	85.71
-1.713	21	25.30	62	74.70
-1.485	38	20.77	145	79.23
-1.215	58	18.77	251	81.23
-0.909	92	17.97	420	82.03
-0.570	178	24.18	558	75.82
-0.188	261	28.00	671	72.00
0.242	372	32.10	787	67.90
0.712	394	34.99	732	65.01
1.267	231	36.61	400	63.39
Panel B: Financial behavior score				
$< 33^{th}$ percentile	457	27.06	1,232	72.94
33^{th} to 66^{th} percentile	608	29.64	1,443	70.36
$> 66^{th}$ percentile	583	29.78	1,375	70.22
Panel C: Traditional financial product usage				
0	27	14.67	157	85.33
1	155	21.12	579	78.88
2	158	24.35	491	75.65
3	236	26.58	652	73.42
4	389	32.18	820	67.82
5	409	33.47	813	66.53
6	213	31.65	460	68.35
7	53	42.40	72	57.60
8	8	57.14	6	42.86
Panel D: Alternative financial product usage				
0	1,337	28.93	3,284	71.07
1	258	27.74	672	72.26
2	38	33.04	77	66.96
3	12	48.00	13	52.00
4	3	42.86	4	57.14

Table 3: **Individual and household-level summary statistics.** This table reports the sample summary statistics (counts and percentage) of the demographic attributes including age, gender, civil status, ethnicity, education, income, residency status and census region.

Demographic attribute	Categories	Count	Pct.
Age	18 - 24	346	6.07
	25 - 34	952	16.71
	35 - 44	742	13.02
	45 - 54	952	16.70
	55 - 61	644	11.30
	62 - 69	944	16.57
	70 - 74	452	7.93
	75 or older	666	11.69
Gender	Male	3,012	52.86
	Female	2,686	47.14
Civil status	Married	3,480	61.07
	Windowed	325	5.70
	Divorced/Seperated	603	10.58
	Single	969	17.01
	Cohabiting	321	5.63
Ethnicity	White	4097	71.88
	Black	565	9.92
	Other	289	5.07
	Hispanic	748	13.13
Education	Less than high school	350	6.14
	High school	1,415	24.83
	Some college/Associate's degree	1,715	30.10
	Bachelor's degree	1,198	21.02
	Graduate/professional degree	1,020	17.90
Income	Less than $20,000	554	9.72
	$20,000 to $29,999	446	7.83
	$30,000 to $39,999	539	9.46
	$40,000 to $49,999	407	7.14
	$50,000 to $59,999	467	8.20
	$60,000 to $74,999	601	10.55
	$75,000 to $99,999	864	15.16
	$100,000 to $149,999	1,022	17.94
	$150,000 or more	798	14.00
Residency status	Non-metropolitan	764	13.41
	Metropolitan	4,934	86.59
Census region	Northeast	1,049	18.41
	Midwest	1,306	22.92
	South	1,998	35.06
	West	1,345	23.60
Sample size		5,698	

Table 4: **Financial knowledge and fraud detection.** This table reports probit regression estimates of financial knowledge, traditional and alternative financial product usage, together with a host of demographic and financial control variables. The dependent variable takes the value of one if the respondent has detected banking fraud in the last five years, and zero otherwise. Financial knowledge is defined as the composite score derived from nine financial knowledge questions. Traditional and alternative financial product usage is defined as the number of traditional and alternative products respondents hold or use, respectively. Definitions of all the variables are reported in the appendices. Robust standard errors are reported in parentheses, and the stars ***, ** and * denote the level of significance at 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)
Financial knowledge	0.104***	0.090***	0.104***
	(0.03)	(0.03)	(0.03)
Traditional financial product usage		0.064*	0.073**
		(0.03)	(0.03)
Alternative financial product usage			0.109***
			(0.02)
Age	0.036	0.028	0.036
	(0.02)	(0.03)	(0.03)
Female	0.017	0.012	0.019
	(0.04)	(0.04)	(0.04)
Widowed	-0.127	-0.117	-0.119
	(0.10)	(0.10)	(0.10)
Divorced	-0.032	-0.016	-0.017
	(0.07)	(0.07)	(0.07)
Single	-0.227***	-0.201**	-0.193**
	(0.07)	(0.07)	(0.07)
Cohabiting	0.078	0.094	0.088
	(0.10)	(0.10)	(0.10)
White	0.092	0.084	0.100
	(0.10)	(0.10)	(0.10)
Black	0.191	0.186	0.132
	(0.12)	(0.12)	(0.12)
Hispanic	0.206	0.216	0.198
	(0.11)	(0.12)	(0.12)
Education	0.150***	0.139***	0.143***
	(0.03)	(0.03)	(0.03)
Income	0.071**	0.055*	0.069**
	(0.02)	(0.03)	(0.03)
Metropolitan	0.021	0.020	0.019
	(0.06)	(0.06)	(0.06)
North-east	-0.053	-0.061	-0.057
	(0.06)	(0.06)	(0.06)
Midwest	-0.075	-0.084	-0.092
	(0.06)	(0.06)	(0.06)
South	-0.021	-0.025	-0.039
	(0.06)	(0.06)	(0.06)
Constant	-0.630***	-0.623***	-0.628***
	(0.12)	(0.12)	(0.12)
Observations	5,698	5,698	5,698
Pseudo R-squared	0.039	0.041	0.046

Table 5: **Financial knowledge, financial behavior and fraud detection.** This table reports probit regression estimates of financial knowledge, financial behavior and financial product usage, together with a host of demographic and financial control variables. The dependent variable takes the value of one if the respondent has detected banking fraud in the last five years, and zero otherwise. Financial knowledge is defined as the composite score derived from nine financial knowledge questions. The construction of the financial behavior variables used in Columns (1) to (11) are described in Appendix B. In Column (12), the composite financial behavior score is used, which is created by summing up the responses to the financial behavior questions. Traditional and alternative financial product usage is defined as the number of traditional and alternative financial products respondents hold or use, respectively. Definitions of all variables are reported in the appendices. Robust standard errors are reported in parentheses, and the stars ***, ** and * denote the level of significance at 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Financial knowledge	0.104***	0.104***	0.104***	0.105***	0.102***	0.104***	0.107***	0.104***	0.104***	0.102***	0.106***	0.105***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Traditional financial product usage	0.073**	0.073**	0.072**	0.076**	0.076**	0.072**	0.077**	0.071**	0.072**	0.073**	0.082**	0.076**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Alternative financial product usage	0.109***	0.109***	0.108***	0.109***	0.109***	0.109***	0.106***	0.109***	0.109***	0.109***	0.107***	0.108***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active budgeting 1		0.003										
		(0.02)										
Active budgeting 2			0.020									
			(0.02)									
Set financial goals				-0.027								
				(0.02)								
Pursue financial goals					-0.040							
					(0.02)							
Bills paid on time						0.007						
						(0.02)						
Stayed within budget							-0.051*					
							(0.02)					
Paid off CC balance								0.014				
								(0.02)				
Check accounts for errors									0.010			
									(0.02)			
Frugal spending										0.016		
										(0.02)		
Saving habit											-0.049*	
											(0.02)	
Financial behavior score												-0.018
												(0.02)

Table 5 contd.

Age	0.036	0.036	0.037	0.034	0.038	0.035	0.044	0.034	0.034	0.036	0.037	0.038
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Female	0.019	0.018	0.019	0.019	0.015	0.019	0.019	0.019	0.018	0.018	0.018	0.019
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Widowed	-0.119	-0.120	-0.121	-0.121	-0.120	-0.120	-0.123	-0.120	-0.120	-0.120	-0.124	-0.120
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Divorced	-0.017	-0.017	-0.017	-0.018	-0.020	-0.017	-0.021	-0.014	-0.016	-0.016	-0.020	-0.020
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Single	-0.193**	-0.193**	-0.190**	-0.198**	-0.198**	-0.192**	-0.192**	-0.193**	-0.192**	-0.189**	-0.196**	-0.197**
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Cohabiting	0.088	0.088	0.089	0.085	0.082	0.089	0.088	0.089	0.089	0.089	0.084	0.085
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
White	0.100	0.100	0.101	0.102	0.098	0.100	0.100	0.099	0.100	0.100	0.097	0.099
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Black	0.132	0.132	0.129	0.139	0.140	0.135	0.125	0.136	0.134	0.134	0.134	0.131
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Hispanic	0.198	0.197	0.195	0.205	0.209	0.197	0.208	0.196	0.198	0.198	0.206	0.202
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Education	0.143***	0.143***	0.143***	0.143***	0.144***	0.143***	0.144***	0.142***	0.143***	0.142***	0.145***	0.143***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Income	0.069**	0.069**	0.070**	0.070**	0.070**	0.069**	0.070**	0.067*	0.070**	0.071**	0.076**	0.069**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Metropolitan	0.019	0.018	0.018	0.020	0.021	0.019	0.020	0.017	0.018	0.019	0.021	0.020
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
North-east	-0.057	-0.057	-0.055	-0.060	-0.060	-0.057	-0.060	-0.057	-0.058	-0.056	-0.060	-0.059
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Midwest	-0.092	-0.091	-0.090	-0.094	-0.092	-0.091	-0.095	-0.091	-0.091	-0.091	-0.095	-0.093
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
South	-0.039	-0.039	-0.040	-0.038	-0.036	-0.039	-0.040	-0.039	-0.040	-0.039	-0.036	-0.039
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Constant	-0.628***	-0.628***	-0.628***	-0.630***	-0.629***	-0.628***	-0.629***	-0.627***	-0.628***	-0.629***	-0.628***	-0.628***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Observations	5,698	5,698	5,698	5,698	5,698	5,698	5,698	5,698	5,698	5,698	5,698	5,698
Pseudo R-squared	0.046	0.046	0.046	0.047	0.047	0.046	0.047	0.046	0.046	0.046	0.047	0.046

Table 6: **Fraud detection and the interaction of financial knowledge and financial behavior.** This table reports probit regression estimates of the interaction of financial knowledge and financial behavior. The dependent variable takes the value of one if the respondent has detected banking fraud in the previous five years, and zero otherwise. The variable FK takes the value of one if the respondent's financial knowledge score is greater than the sample average, and zero otherwise. The variable FB captures the highest self-reported prudence in financial behavior and takes the value of one if the respondent chooses the highest Likert response to the ten financial behavior questions, and zero otherwise. Columns (1) to (10) reports the results for the ten financial behaviors. Column (11) aggregates information from all the other columns and FB takes the value of one if the respondent self-reports highest prudence in the number of financial behaviors above the average number in the sample, and zero otherwise. Product usage variables comprise information on the number of traditional and alternative financial products respondents hold or use, respectively. Definitions of all variables are reported in the appendices. Robust standard errors are reported in parentheses, and the stars ***, ** and * denote the level of significance at 1, 5 and 10 percent, respectively.

	Active budgeting 1	Active budgeting 2	Set financial goals	Pursue financial goals
	(1)	(2)	(3)	(4)
FB=0 × FK=1	0.197***	0.187***	0.188***	0.199***
	(0.05)	(0.05)	(0.05)	(0.05)
FB=1 × FK=0	0.068	0.006	-0.027	-0.006
	(0.07)	(0.08)	(0.08)	(0.10)
FB=1 × FK=1	0.237***	0.229***	0.193**	0.127
	(0.07)	(0.08)	(0.08)	(0.09)
Product usage variables	Yes	Yes	Yes	Yes
Individual and household-level controls	Yes	Yes	Yes	Yes
Observations	5,698	5,698	5,698	5,698
Pseudo R-squared	0.046	0.046	0.046	0.046
	Bills paid on time	Stayed within budget	Paid off CC balance	Check accounts for errors
	(5)	(6)	(7)	(8)
FB=0 × FK=1	0.161*	0.195***	0.231***	0.232***
	(0.09)	(0.05)	(0.06)	(0.07)
FB=1 × FK=0	-0.040	-0.102	-0.000	-0.026
	(0.07)	(0.07)	(0.07)	(0.06)
FB=1 × FK=1	0.165**	0.086	0.147**	0.131**
	(0.07)	(0.07)	(0.06)	(0.06)
Product usage variables	Yes	Yes	Yes	Yes
Individual and household-level controls	Yes	Yes	Yes	Yes
Observations	5,698	5,698	5,698	5,698
Pseudo R-squared	0.046	0.047	0.047	0.047
	Saving habit	Frugal spending	Overall	
	(9)	(10)	(11)	
FB=0 × FK=1	0.188***	0.129**	0.211***	
	(0.05)	(0.06)	(0.06)	
FB=1 × FK=0	-0.085	-0.038	-0.025	
	(0.07)	(0.06)	(0.06)	
FB=1 × FK=1	0.131*	0.227***	0.149**	
	(0.07)	(0.06)	(0.06)	
Product usage variables	Yes	Yes	Yes	
Individual and household-level controls	Yes	Yes	Yes	
Observations	5,698	5,698	5,698	
Pseudo R-squared	0.047	0.047	0.046	

Table 7: **Financial knowledge, subjective well-being and fraud detection.** This table reports the probit regression estimates of financial knowledge interacted with levels of well-being, controlling for financial behavior and financial product usage, in addition to a host of financial and demographic variables. The dependent variable takes the value of one if the respondent has detected banking fraud in the last five years, and zero otherwise. Columns (1) to (3) report results for the three well-being statements, *I am satisfied with my life*, *I am optimistic about my future* and *If I work hard today, I will be more successful in the future,* respectively. The higher the integer value for the level of well-being, the higher the degree of agreement to the statement. Financial knowledge is defined as the composite score derived from nine financial knowledge questions. Definitions of all variables are reported in the appendices. Robust errors are reported in parentheses, and the stars ***, ** and * denote the level of significance at 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)
1 × Financial knowledge	-0.007	-0.031	0.093
	(0.13)	(0.15)	(0.13)
2 × Financial knowledge	-0.001	0.003	-0.162
	(0.14)	(0.13)	(0.15)
3 × Financial knowledge	-0.011	0.068	0.066
	(0.09)	(0.10)	(0.11)
4 × Financial knowledge	0.095	0.081	0.117
	(0.07)	(0.07)	(0.06)
5 × Financial knowledge	0.149**	0.127**	0.111*
	(0.05)	(0.05)	(0.05)
6 × Financial knowledge	0.122**	0.161***	0.138**
	(0.04)	(0.04)	(0.04)
7 × Financial knowledge	0.096*	0.076	0.097*
	(0.04)	(0.04)	(0.04)
Financial behavior score	-0.018	-0.019	-0.018
	(0.02)	(0.02)	(0.02)
Traditional financial product usage	0.077**	0.076**	0.075**
	(0.03)	(0.03)	(0.03)
Alternative financial product usage	0.107***	0.107***	0.107***
	(0.02)	(0.02)	(0.02)
Age	0.037	0.038	0.038
	(0.03)	(0.03)	(0.03)
Female	0.022	0.022	0.020
	(0.04)	(0.04)	(0.04)
Widowed	-0.120	-0.122	-0.122
	(0.10)	(0.10)	(0.10)
Divorced	-0.022	-0.024	-0.021
	(0.07)	(0.07)	(0.07)
Single	-0.197**	-0.195**	-0.195**
	(0.07)	(0.07)	(0.07)
Cohabiting	0.087	0.086	0.084
	(0.10)	(0.10)	(0.10)
White	0.105	0.100	0.100
	(0.10)	(0.10)	(0.10)
Black	0.129	0.131	0.128
	(0.12)	(0.12)	(0.12)

Table 7 contd.

	(1)	(2)	(3)
Hispanic	0.212	0.207	0.203
	(0.11)	(0.11)	(0.12)
Education	0.145***	0.145***	0.146***
	(0.03)	(0.03)	(0.03)
Income	0.068**	0.068**	0.067**
	(0.03)	(0.03)	(0.03)
Metropolitan	0.021	0.020	0.019
	(0.06)	(0.06)	(0.06)
North-east	-0.060	-0.062	-0.059
	(0.06)	(0.06)	(0.06)
Midwest	-0.092	-0.096	-0.094
	(0.06)	(0.06)	(0.06)
South	-0.039	-0.043	-0.041
	(0.06)	(0.06)	(0.06)
Constant	-0.638***	-0.634***	-0.628***
	(0.12)	(0.12)	(0.12)
Observations	5,698	5,698	5,698
Pseudo R-squared	0.047	0.047	0.047

Table 8: **Financial knowledge and fraud detection: instrumental variables approach.** This table reports the results for the instrumental variable (IV) probit regression. Column (1) reports the first stage of IV regression, where the dependent variable is the financial knowledge score of respondents. Column (2) reports the second stage of IV regression, where the dependent variable takes the value of one if the respondent has detected banking fraud in the last five years, and zero otherwise. We use graduate parent as an IV for financial knowledge, which takes the value of one if either of the respondent's parents is a graduate, and zero otherwise. Definitions of all the variables are reported in the appendices. Robust standard errors are reported in parentheses, and the stars ***, ** and * denote the level of significance at 1, 5 and 10 percent, respectively.

	Financial knowledge	Detected fraud
	(1)	(2)
Graduate parents	0.162***	
	(0.04)	
Financial knowledge		0.564*
		(0.31)
Traditional financial product usage	0.215***	-0.034
	(0.02)	(0.08)
Alternative financial product usage	-0.080***	0.138***
	(0.01)	(0.03)
Age	0.156***	-0.038
	(0.02)	(0.06)
Female	-0.332***	0.173
	(0.03)	(0.11)
Widowed	-0.024	-0.100
	(0.05)	(0.10)
Divorced	0.040	-0.034
	(0.04)	(0.07)
Single	0.045	-0.202***
	(0.04)	(0.06)
Cohabiting	-0.120**	0.138
	(0.06)	(0.10)
White	0.108*	0.043
	(0.06)	(0.11)
Black	-0.342***	0.287*
	(0.07)	(0.15)
Hispanic	-0.136*	0.250**
	(0.07)	(0.12)
Education	0.138***	0.062
	(0.02)	(0.07)
Income	0.160***	-0.014
	(0.02)	(0.07)
Metropolitan	-0.014	0.021
	(0.04)	(0.06)
North-east	-0.108***	0.001
	(0.04)	(0.07)
Midwest	-0.024	-0.069
	(0.04)	(0.06)
South	-0.054	-0.010
	(0.04)	(0.06)
Constant	0.153**	-0.666***
	(0.08)	(0.12)
Observations	5,698	5,698
R-squared	0.361	-
Kleibergen-Paap rk LM test	17.564***	-
Wald test of exogeneity	1.70	
P-value	0.192	

Appendices

A Wordings of financial knowledge questions

No.	Topic	Question	Responses
1	Understanding of long-term returns on investment	Considering a long time period (for example 10 or 20 years), which asset described below normally gives the highest return?	a. Savings accounts b. Bonds c. Stocks
2	Understanding of stocks vs bond vs savings volatility	Normally, which asset described below displays the highest fluctuations over time?	a. Savings accounts b. Bonds c. Stocks
3	Understanding of benefits of diversification	When an investor spreads his or her money among different assets, does the risk of losing a lot of money increase, decrease or stay the same?	a. Increase b. Decrease c. Stay the same
4	Understanding of possibility of stock market losses	Do you think the following statement is true or false? "If you were to invest $\$1,000$ in a stock mutual fund, it would be possible to have less than $\$1,000$ when you withdraw your money."	a. True b. False
5	Understanding of life insurance	Do you think the following statement is true or false? "Whole life' insurance has a savings feature while 'term' insurance does not."	a. True b. False
6	Understanding of possibility of housing market losses	Do you think the following statement is true or false? "Housing prices in the US can never go down."	a. True b. False
7	Understanding of credit card minimum payments	Suppose you owe $3,000 on your credit card. You pay a minimum payment of $30 each month. At an Annual Percentage Rate of 12% (or 1% per month), how many years would it take to eliminate your credit card debt if you made no additional new charges?	a. Less than 5 years b. Between 5 and 10 years c. Between 10 and 15 years d. Never, you will continue to be in debt
8	Understanding of relationship of bonds and interest rates	If interest rates rise, what will typically happen to bond prices?	a. They will rise b. They will fall c. They will stay the same d. There is no relationship between bond prices and the interest rate
9	Understanding of mortgage term length on total interest paid	Do you think the following statement is true or false? A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.	a. True b. False

B Wordings of financial behavior questions

No.	Variable Label	Question and Responses	Variable Construction
Panel A: To what extent do you agree or disagree with each of the following statements?			
1	Active budgeting 1	I consult my budget to see how much money I have left a. Strongly disagree b. Disagree c. Neither agree nor disagree d. Agree e. Strongly agree	Variables in Panel A take values 1-5, corresponding to the response choices a-e, respectively, and then transformed to z-scores.
2	Active budgeting 2	I actively consider the steps I need to take to stick to my budget a. Strongly disagree b. Disagree c. Neither agree nor disagree d. Agree e. Strongly agree	
3	Set financial goals	I set financial goals for what I want to achieve with my money a. Strongly disagree b. Disagree c. Neither agree nor disagree d. Agree e. Strongly agree	
4	Pursue financial goals	I prepare a clear plan of action with detailed steps to achieve my financial goals a. Strongly disagree b. Disagree c. Neither agree nor disagree d. Agree e. Strongly agree	
Panel B: Please indicate how often you have engaged in the following activities in the past six months			
5	Bills paid on time	Paid all your bills on time a. Not applicable b. Never c. Seldom d. Sometimes e. Often f. Always	Variables in Panel B take values 1-5, corresponding to the response choices b-f, respectively, and then transformed to z-scores.
6	Stayed within budget	Stayed within your budget or spending plan a. Not applicable b. Never c. Seldom d. Sometimes e. Often f. Always	
7	Paid off CC balance	Paid off credit card balance in full each month a. Not applicable b. Never c. Seldom d. Sometimes e. Often f. Always	
8	Check accounts for errors	Checked your statements, bills and receipts to make sure there were no errors a. Not applicable b. Never c. Seldom d. Sometimes e. Often f. Always	
Panel C: To what extent do you agree or disagree with the following statements:			
9	Saving habit	Putting money into savings is a habit for me a. Strongly disagree b. Disagree c. Disagree slightly d. Agree slightly e. Agree f. Strongly agree	Variables in Panel C take values 1-6, corresponding to the response choices a-f, respectively, and then transformed to z-scores.
10	Frugal spending	If I can re-use an item I already have, there's no sense in buying something new a. Strongly disagree b. Disagree c. Disagree slightly d. Agree slightly e. Agree f. Strongly agree	

C Wordings of financial product usage questions

Variable Label	Product Name	Variable Construction
Traditional financial product usage	Which of the following financial products and services do you currently have? a. Checking or Savings Account at a bank or credit union b. Life Insurance c. Health Insurance d. Retirement Account (such as a 401k or IRA) e. Pension f. Non-Retirement Investments (such as stocks, bonds or mutual funds) g. Education Savings Account (such as 529 or Coverdale) h. Student/Education Loan (for yourself or someone else)	Product usage score is the number of formal financial services the respondents utilize and then transformed to z-score.
Alternative financial product usage	Which of the following, if any, have you used in the past 12 months? a. Payday Loan or Cash Advance Loan b. Pawn Loan or Auto Title Loan[4]. c. A re-loadable card that is not linked with a checking or savings account[5] d. A place other than a bank or credit union to give or send money to relatives or friends outside the U.S e. A place other than a bank or credit union to cash a check or purchase a money order	Product usage score is the number of informal financial services the respondents utilize and then transformed to z-score.

[4]Auto title loan is a small loan for a short period of time (usually 30 days) where you give the lender your auto title.

[5]These cards may have logos such as MasterCard, VISA, Discover or American Express and you can keep adding money onto this card and use it to make purchases and pay bills anywhere credit cards are accepted or withdraw the cash from an ATM. This does not include phone cards, gift cards for a particular store or service or cards that you cannot add more funds onto.

D Wordings of subjective well-being questions

Variable Label	Question and Responses	Variable Construction
Please indicate the degree to which you agree or disagree with each of the following statements:		
Life satisfaction	I am satisfied with my life a. Strongly disagree ⋮ g. Strongly agree	Variables in Panel B take values 1-7, corresponding to the response choices a-g, respectively.
Optimism about future	I am optimistic about my future a. Strongly disagree ⋮ g. Strongly agree	
Work yield success	If I work hard today, I will be more successful in the future a. Strongly disagree ⋮ g. Strongly agree	

E Individual and household-level control variable definitions

Variable name	Variable definition
Age	The survey captures age of respondents in seven non-overlapping age brackets, between 18 and 74, and the eighth age bracket captures respondents older than 75. The variable "Age" for a respondent is equal to the midpoint age of the age bracket the respondents belong to. For respondents in the eighth age bracket, the variable takes values equal to the lower limit of the age bracket. The variable is then transformed to z-score.
Female	It takes the value of one if respondent is female, and zero otherwise.
Widowed	It takes the value of one if the respondent has reported their civil status as widow, and zero otherwise.
Married	It takes the value of one if the respondent has reported their civil status as married, and zero otherwise.
Divorced	It takes the value of one if the respondent has reported their civil status as divorced, and zero otherwise.
Single	It takes the value of one if the respondent has reported their civil status as single, and zero otherwise.
Cohabiting	It takes the value of one if the respondent has reported their civil status as cohabiting, and zero otherwise.
Black	It takes the value of one if the respondent has reported their ethnicity as black, and zero otherwise.
Hispanic	It takes the value of one if the respondent has reported their ethnicity as hispanic, and zero otherwise.
Other	It takes the value of one if the respondent has reported their ethnicity as other than white, black or hispanic, and zero otherwise.
Education	The survey captures the education level of respondents, classified into five categories. The variable "Education" takes values equal to the minimum number of schooling years required to attain the degree. To map the academic degrees to number of schooling years, we adapt the mapping in Fujiwara & Kawachi (2009). The variable is then transformed to z-score.
Income	The survey captures the income level of respondents, classified into nine non-overlapping income brackets and the ninth income bracket captures income of $150,000 or above. The variable "Income" for a respondent is equal to the midpoint income of the income bracket the respondents belong to. For respondents in the lower most income bracket, the variable takes values equal to the upper limit of the income bracket. Similarly, for the upper most income bracket, the variable takes values equal to the lower limit of the income bracket. The variable is then transformed to z-score.
Metropolitan	It takes the value of one if the respondent resides in a metropolitan residency area, and zero otherwise.
North-east	It takes the value of one if the respondent resides in the north-east census region, and zero otherwise.
Mid-west	It takes the value of one if the respondent resides in the mid-west census region, and zero otherwise.
South	It takes the value of one if the respondent resides in the south census region, and zero otherwise.