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Does financial knowledge affect borrower discouragement among various social categories? Evidence from the United States

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Abstract

A deficiency in financial knowledge often precipitates costly financial choices, affecting consumers' behavior and decision-making. We delve into how financial acumen influences borrower discouragement by utilizing data from the U.S. Federal Reserve's Survey of Household Economics and Decision-Making (2017–2022). Discouraged borrower describes creditworthy individuals who, despite a genuine need for credit, avoid applying due to anticipated rejection. Our research reveals that financial knowledge diminishes the likelihood of borrower discouragement after controlling for various societal groups. However, when we estimate the model separately, its impact is not uniform across these societal segments. Specifically, our study uncovers that the effects of financial knowledge are different on gender, race, and occupational status. Further analyses of various subgroups confirm that race and occupational status are consistent predictors of borrower discouragement, even when accounting for financial knowledge. These insights underscore the importance

of providing targeted financial education to address these disparities.

KEYWORDS

credit market, discouraged borrowers, financial knowledge, gender, race

1 | INTRODUCTION

Prior research on small firms has sought to identify the characteristics of firms and their owners that could make them more prone to be Discouraged Borrowers (DBs): "good" borrowers who need credit but avoid making formal applications due to fear of rejection (Kon & Storey, 2003). Discouragement can limit an individual's decisions regarding business opportunities and life-style choices (Bernthal et al., 2005; Lusardi, 2019; Rahaman, 2011), and potentially placing them at a disadvantage when seeking credit in the future due to an insufficient credit history. The concept of borrower discouragement has received fresh attention because the number of DBs appears to exceed the number of SMEs whose applications have been denied (Chakravarty & Xiang, 2013; Freel et al., 2012; Ladeira, 2023; Levenson & Willard, 2000).

When discouraged borrowers accurately evaluate their creditworthiness, their reluctance to apply for credit can serve as an effective sorting mechanism (Han et al., 2009). This not only conserves bank resources by reducing unnecessary application reviews through, for example, informal turndown (Rostamkalaei et al., 2018), but also protects individuals at high risk from the adverse effects of a formal credit denial, which could further damage their credit scores. In this context, the discouragement could serve as an efficient sorting mechanism. However, this self-imposed discouragement may also represent a miscalculation by potential applicants, leading to a screening error (Kon & Storey, 2003). That is, individuals who eschew credit applications may misjudge their creditworthiness and self-ration, while individuals with similar profiles might receive the credit they need. To this end, one might consider borrower discouragement to be market inefficiency, where discouragement would translate into unrealized profit for banks and lost opportunities for DBs (Kon & Storey, 2003). This phenomenon has significant implications for consumer behavior, as it affects the economy at large by influencing consumers' financial decisions and actions.

In this paper, we build upon prior research by integrating the theoretical framework of financial literacy to explore its role in consumer behavior within financial markets. Our study focuses on the consumer market, for which the DB phenomenon is understudied (Ladeira, 2023). Credit constraints significantly influence household financial decisions and consumption smoothing, especially when income is volatile due to shocks and disruptions (Baker & Yannelis, 2017). Misplaced discouragement could act as an implicit credit constraint, affecting consumer behavior by limiting access to financial resources. Hence, the starting point for this research is to leverage the financial literacy framework to examine whether the DB's "fear of rejection" is reasonable and whether discouragement is an efficient sorting mechanism. A high incidence of DBs might be one avenue that explains the lack of financial inclusivity (Hasan et al., 2021; Long, 2020). In doing so, we also discuss the relationship between occupational status, gender, and race with the propensity of DBs (Cavalluzzo et al., 2002; Hasan et al., 2021; Long, 2020; Neville et al., 2018). Different social categories (e.g., ethnic backgrounds

and gender) may form distinct norms that influence behavior and attitudes (Karolyi, 2016; Naegels et al., 2022; Neville et al., 2018). We argue that to effectively investigate the relationship between financial knowledge and DBs, it is crucial to account for these relevant variables and employ techniques that accommodate unobserved heterogeneity, thereby mitigating the risk of omitted variable bias.

This manuscript unfolds as follows: Initially, we review pertinent literature, drawing insights from the domain of financial literacy to inform our hypotheses. Subsequently, we delineate the data and methodologies employed in our study, leading to a presentation of the empirical findings and subsequent robustness checks. In particular, we engage in an in-depth analysis of our dataset, derived from six waves of the U.S. Survey of Household Economics and Decisionmaking, utilizing microeconometric techniques to adjust for potential selection bias. We also construct counterfactual scenarios for DBs to demonstrate the extent of concerns regarding discouraged borrowing. The manuscript concludes with a discussion of our findings, their broader implications, the inherent limitations of our research, and final reflections.

2 | LITERATURE REVIEW

Access to credit is a tool for consumption smoothing (Baker & Yannelis, 2017) and in the absence of a low-cost form of credit, individuals may resort to temporary but high-cost sources of credit to smooth household consumption (Dobridge, 2018; Zinman, 2010). Additionally, financial limitations may influence a business's investment choices, particularly in areas, such as innovation and expansion (Bellone et al., 2010; Saridakis et al., 2008) which can ultimately have a significant impact on the personal income and consumption levels of the owners. The restriction on access to credit does not always manifest itself in application rejection (Benvenuti et al., 2022). Applications for financing are subject to both information asymmetry and a likelihood of default on the promise of repayment (Jaffee & Stiglitz, 1990). In an efficient credit contract, price is the primary sorting mechanism: the risk of an application is reflected in the price. However, here, two forms of market inefficiency may arise. One form of inefficiency reflects that some borrowers are so risky that lenders cannot tolerate the costs associated with lending (Stiglitz & Weiss, 1981); such borrowers face rejections and are credit-rationed. Substantive literature examines the possibility of this form of market inefficiency by assessing whether credit applicants who have experienced credit rationing are observationally indistinguishable from those who received credit (Parker, 2002). However, information asymmetry may lead to a second form of market inefficiency: borrower discouragement. This occurs when creditworthy borrowers misjudge their creditworthiness and eschew loan applications despite needing credit (Jappelli, 1990).[1] The omission of "this group of consumers may lead to biased estimates ... the self-selection of applicants may induce intermediaries to adopt screening rules that differ from those that would prevail if also the discouraged borrowers were to apply" (Jappelli, 1990, p. 220). While Jappelli (1990) focused on individual financing, the seminal work of Kon and Storey (2003) has turned attention to firms.

Kon and Storey (2003) discuss a range of assumptions, '[S]creening errors of the banks, the scale of application costs and the extent to which the bank interest rate differs from that charged by the Money Lender' (Kon & Storey, 2003, p. 48), that could impact the magnitude of DB in financial markets. In a developed economy, such as the U.S.- the context of this research-information about lenders and borrowers is relatively transparent, and the scale of borrower discouragement should not be problematic (Bertrand & Mazza, 2022). However, in such a

market, banks' price advantage is relatively smaller, and application costs are higher. The psychological costs of making applications and facing rejections would intensify and subsequently increase the number of DBs. Given that forgoing financing can impede firm growth, Kon and Storey's work identified the potential for unrealized economic gains, thereby prompting a strand of literature about DBs heavily oriented toward small firm finance.

Previous research finds that the likelihood of DB (in the context of firms) depends on the market context, the ability to provide collateral, the banking relationship, credit score, gender, and ethnicity (Cavalluzzo et al., 2002; Chakravarty & Xiang, 2013; Cowling & Sclip, 2023; Ferrando & Mulier, 2015; Freel et al., 2012; Gama et al., 2017; Han et al., 2009; Neville et al., 2018). Discouragement seems dynamic and affected by the business climate (Bhaird et al., 2016; Rostamkalaei, 2017). Some reasons, such as being risky, could constitute a "valid" reason for not applying (Han et al., 2009); however, for some groups, information opacity about their creditworthiness or the convoluted nature of the application process might reflect the prevalence of DBs. More recent evidence of DBs shows that prior interaction with banks also affects the likelihood of discouragement (Cowling et al., 2022; Rostamkalaei et al., 2018). For example, prior loan rejection leaves a scarring effect (Cowling et al., 2022) to the extent that borrower expectations for a possible successful application would change and lead to discouragement.

Discouraged Borrowers are less studied in household markets. In one exception, Ladeira (2023) shows a relationship between credit scores and debt-to-income ratio such that the likelihood of DB is higher for individuals with lower credit scores or where the debt-to-income ratio is higher. Additionally, Ladeira (2023) research finds that DBs are relatively more likely to be individuals who do not keep themselves updated as to their credit scores. This finding may relate to information friction: individuals who are not financially sophisticated—proxied by outdated credit score reports—will have to work harder to assess their creditworthiness. They base their assessment on old information, which leads to self-rationing. Our theoretical background commences with a discussion on financial knowledge and theorizing the effect of financial knowledge on the development of borrower discouragement.

2.1 | The role of financial knowledge

The financial literacy framework, as established by the Organization of Economic Cooperation and Development, consists of three elements: financial knowledge, attitudes, and behaviors (Atkinson & Messy, 2012). The financial knowledge component proxies the individual's cognitive ability to understand financial matters such as numeracy, inflation, and risk management (Atkinson & Messy, 2012; Lusardi & Mitchell, 2014). The attitude component is concerned with an individual's preferences about a financial decision, such as postponing spending or seeking information and advice (Atkinson & Messy, 2012). Financial behaviors often pertain to saving, investing, financial planning and avoiding high-risk financial decisions. This paper examines the role of attitudes and financial knowledge in the propensity of discouragement. However, since we do not have direct measures of attitudes, we use various social categories that influence individuals' attitudes toward lending and potentially financial decisions.

Of the two antecedents of financial behaviors, financial knowledge has received the most attention in the literature. This may be because it equates to numeracy knowledge or perhaps because it is easier to proxy by posing a series of questions about knowledge of risk, inflation, saving, and interest. Measured in this way, financial knowledge is globally fundamentally low

(Clark, 2014; Lusardi, 2019). The extant literature identifies patterns in the variation of financial knowledge. For example, women (Bucher-Koenen et al., 2017; Lusardi et al., 2010; Lusardi & Mitchell, 2008; Mahdavi & Horton, 2014), less-educated individuals (Lusardi & Mitchell, 2007), and the youngest and oldest members of society (Agarwal et al., 2009; Lusardi & Mitchell, 2014) consistently show relatively low levels of financial knowledge. Location (Clark, 2014), family background (Mahdavi & Horton, 2014), and immigration status (Calvet et al., 2009; Rostamkalaei & Riding, 2020) also affect variations in the level of financial knowledge.

Extant research has established a link between low levels of financial knowledge and high-cost financial behaviors such as borrowing from payday agencies and pawn shops (Nitani et al., 2020). Conversely, high levels of financial knowledge are associated with "good" behaviors such as investment, saving, and retirement planning (Behrman et al., 2012; Jappelli & Padula, 2013; Lusardi, 2008; Lusardi & Mitchell, 2007; van Rooij et al., 2012). Furthermore, financial knowledge has been found to have an association with consumer financial capability, behaviors, and well-being (Rai et al., 2019; Xiao, 2016; Xiao & O'Neill, 2016). Interestingly, Imarhiagbe et al. (2017) link financial education to individuals' strengthened confidence in managing financial affairs. This increased confidence may subsequently affect the individual's propensity to pursue external financing and provide a better understanding of financial needs, improve the assessment of lending institutions' abilities, and enhance the preparation of loan applications (e.g., Bocchialini et al., 2023; Fornero & Prete, 2023; Lone & Bhat, 2024; Nam, 2023). All these factors arguably can diminish the probability of credit self-ration due to fear of rejection. Additionally, a higher level of cognitive ability, measured through the level of financial knowledge by (Burks et al., 2009), is linked with financial decisions that is in line with long-term economic success (Burks et al., 2009; Rustichini, 2009). financially educated individuals may be more likely to recognize the need for a financial expert (e.g., an accountant) to assist with advice and preparation (e.g., Lusardi, 2019). Therefore, arguably those with higher level of financial knowledge are less likely to self-ration themselves or make unsound financial decisions (Asaad, 2015) such as addressing their credit needs through high-cost forms of borrowing such as payday loans (Nitani et al., 2020).

Hence, we expect individuals with a higher level of financial knowledge to be more capable of navigating financial markets, applying for bank credit, and avoiding high-cost forms of borrowing when they need credit. Specifically, we hypothesize that:

Hypothesis 1. Individuals with a higher level of financial knowledge are less likely to show borrower discouragement.

2.2 | Borrower discouragement across different social categories

In this section, we explore how three social groups—occupation, gender, and race—affect attitudes toward discouragement. We begin with occupation. Most of the literature on DBs considers only small firms, which does not allow occupation status to be considered a potential predictor variable. It seems likely that discouragement among self-employed individuals would yield results similar to those of the discouraged owners of firms or business establishments. For example, in a review of the relationship between credit availability and self-employment, Herkenhoff et al. (2021) find that self-employment—that is, operating a non-employer business—is associated with less borrowing. However, once access to credit improves, the probability of terminating formal employment in favor of establishing an employer business

increases. Other research finds that financial constraints at the start-up phase leave an imprinting effect on the firms' strategies that can diminish their chances of survival (Saridakis et al., 2008). Availability of credit in self-employment increases the self-employment income (Binaté Fofana et al., 2015).

We theorize that several factors might raise the level of DB among self-employed individuals compared with wage-employed ones. Self-employment income is not constant, and it can presumably affect the "serviceability" for banks. That is, the variation in income may affect a potential applicant's mindset about their ability to repay loans as individuals plan their consumption according to long-term permanent income (Friedman, 1957) if volatility in income is anticipated (Baker & Yannelis, 2017). Self-employment is an uncertain activity, with access to and the management of finance being the factors that most influence the longevity of business activities (Saridakis et al., 2022). Arguably, compared to wage-employed individuals, self-employed ones may recognize the higher level of riskiness associated with their economic activities and refrain from making formal applications more frequently.

The types of borrowing by self-employed individuals versus the wage-employed might be different, with the self-employed relying more on the consumer finance market to fund their economic activities (Kneiding & Kritikos, 2013). In that case, the risk associated with borrowing will rise, especially if the purpose of the borrowing is to defer firm closure (Saridakis et al., 2022). Herkenhoff et al. (2021) propose an alternative explanation for the behavior of self-employed individuals: a precautionary model of credit building. They explain that self-employed individuals may envisage that a time may come when they need to apply for a larger loan, whether for an investment or to meet a need. Therefore, self-employed individuals may defer making formal applications as much as possible to build credit. In line with expectations around the higher level of risk associated with self-employment and the Herkenhoff et al. (2021) precautionary model of credit building, we further hypothesize that:

Hypothesis 2. Self-employed individuals are more likely to be discouraged from borrowing than employed individuals with similar characteristics and financial knowledge.

The relationship between borrowing practices and gender has been explained through several factors, such as financial knowledge and financial self-efficacy (Farrell et al., 2016; Furrebøe & Nyhus, 2022; Hasler & Lusardi, 2017), risk tolerance (Fisher & Yao, 2017; Sena et al., 2012), engagement with household decisions (Agnew & Cameron-Agnew, 2015), and negative perspectives about the borrowing process (Naegels et al., 2022). Women, in general, are perceived to be more risk-averse than men (Fisher & Yao, 2017). Several explanations of the role of gender in risk propensity have been proffered, such as biological reasons (Sapienza et al., 2009) or familiarity with situations that promote risk-taking behavior (Byrnes et al., 1999; Kahneman & Tversky, 1979). For example, compared to men, women generally engage in family financial discussions later in life (Agnew & Cameron-Agnew, 2015). It might, therefore, be argued that their level of familiarity with financial matters is lower or shaped later in life. Different roles in the family unit and division of financial decision-making inhibit the search for information and financial knowledge (Ward & Lynch, 2019). Their lower level of exposure to financial matters and risk-taking behaviors may arguably lead to a higher propensity to refrain from making loan applications (Naegels et al., 2022), which may subsequently influence their consumer behavior, household expenditure and pursuit of opportunities (Dang & Viet Nguyen, 2021; Hoddinott & Haddad, 1995).

Farrell et al. (2016) discuss the role of financial self-efficacy, which is the sense of self-belief in one's financial decision-making capabilities, an area in which women, in general, score lower (Lusardi & Mitchell, 2008). Robson and Peetz (2020) illustrate that while personality traits can explain many variations in financial decisions and attitudes, women who exhibit a higher level of financial self-efficacy are more likely to make decisions that benefit them in the long term. These results are valid after controlling for other factors, including risk tolerance. Looking at borrowing via the financial literacy framework, Nitani et al. (2020) have argued that women's lower level of financial knowledge, blended with their lower level of confidence in financial matters, may deter them from high-cost forms of borrowing. That is, despite not being particularly concerned with the costs associated with alternative financial services, a low level of financial confidence would be more likely to lead to prudent financial decision-making (Georgieva et al., 2021; Imarhiagbe et al., 2017; Nitani et al., 2020). In the context of firms, interestingly, Liu and Cowling (2024) found that among female entrepreneurs a modest level of confidence in getting credit from banks is linked with conservative demands for credit, and banks would also reward the modesty of female entrepreneurs with a higher rate of approval.

Within the context of DBs, however, we argue that the combination of lower levels of financial knowledge and confidence in financial matters could drive a higher level of DBs among women. This lower level of confidence, coupled with an anticipation of discrimination in lending to women (Alesina et al., 2013; Bellucci et al., 2010), might show itself in lower confidence about making successful applications. Anticipation of failure increases the risk of performing the task (Byrnes et al., 1999).

Another factor might be the availability of collateral and asset ownership, which affects the probability of being eligible for borrowing and, therefore, rightfully, affects the probability of discouragement (Kilic & Moylan, 2016). In the context of small firms, where discouragement has been primarily studied, some research points out gender differences (e.g., Forrester & Neville, 2021; Mijid, 2014; Naegels et al., 2022; Singh et al., 2014), with women being more likely to declare that their fear of rejection prohibits them from applying for credit despite their need for it. In line with these arguments, our third hypothesis suggests that:

Hypothesis 3. Women are more likely to be discouraged from borrowing than men with similar characteristics and financial knowledge.

On race and ethnicity, Neville et al. (2018) have employed the theory of mixed-embeddedness (Kloosterman & Rath, 2006) to explain different forms of discouragement among ethnic minority small business owners. In a discussion of whether the behaviors of individuals might be shaped by "co-racial social relationship as well as through their racial group's historical foundations and experiences" (2018, p. 429), Neville et al. (2018) argue that skepticism developed through social and economic discrimination may have left an imprinting effect on the mindset of ethnic minorities toward financial institutions and can drive discouragement. Their analytical work confirms that the probability of discouragement is, compared to Whites, higher among African and Hispanic American small business owners. This is in line with an earlier study conducted by (Fraser, 2009) showing that firms owned by ethnic minorities were more prone to experiencing discouragement compared to their counterparts from non-ethnic minority backgrounds under similar circumstances.

Bates and Robb (2016) find that ethnic minority-owned businesses are geographically concentrated in less affluent areas, which inhibits risk-averse institutions from operating in those areas and possibly constrains access to finance. In consumer markets, Faber, 2019 illustrates a

relationship between ethnic segregation in U.S. cities and the costs of finance. For example, traditional banking is less prevalent in ethnic neighborhoods. In the absence of traditional banking services, reliance on payday loans and cheque-cashers increases, creating a "Ghetto tax" and arguably increasing the costs of making and fear of rejection for formal loan applications. Overall, it can be therefore argued that limitations and the clustering of populations in economically disadvantaged areas, where traditional banking services are limited, can significantly influence economic decisions and behaviors pertaining to the consumption and investment of ethnic minority groups. As a consequence, ethnic minority groups may demonstrate a greater tendency toward experiencing discouragement. In line with these arguments, we hypothesize that:

Hypothesis 4. Individuals who identify as ethnic minorities are more likely to be discouraged than those who identify as White, controlling for various characteristics and financial knowledge.

3 | METHODS

We tested the hypotheses using six cross-sectional waves (2017 to 2022) of the U.S. Federal Reserve Survey of Household Economics and Decisionmaking (SHED)[2]. Survey of Household Economics and Decisionmaking measures the economic well-being and potential finance-related risks of U.S. households. The survey includes questions on access to credit and loans, saving and retirement planning, economic hardship, and socio-demographic information. The surveys include over 69,000 respondents, with our focus on 42,000 working individuals.

We first identify DB as a binary variable that equals 1 for individuals who, in the 12 months prior to the survey, indicated a need for credit but had not applied for it specifically because they feared rejection. For applicants, regardless of the outcome of their application, DB is set to 0. Since we only observe discouragement (or lack of it) for those who declare a demand for credit, we propose the following equation for estimation:

$$PDB_i = f(fk_i, female_i, race_i, occupation_i, X_i \mid demand = 1) \tag{1}$$

where PDB_i is the probability of discouragement for individual i, fk is a binary variable for a high level of financial knowledge of individual i, *female, race,* and *occupation* are the key independent variables for individual i, and X_i is the series of control variables explained below. We employed a bivariate probit model with sample selection (Heckman, 1979; Van de Ven & Van Praag, 1981) to correct for sample selection bias. The exclusion variables in the selection equation are household wealth, income, and size. We report the results of the first stage equation in Appendix A.

To measure financial knowledge (fk), we used respondents' answers to the three questions of the survey that assess respondents' knowledge of interest rates, inflation, and risk, which are consistently used in all surveys. The questions are listed in Appendix B. For each question, we define answers as binary variables equal to one if answered correctly and zero if the responses were incorrect or "do not know". Of the working individuals (self-employed and wage-employed), 47% answered three questions correctly, and 12% answered two questions correctly. We classified these groups as having a high level of financial knowledge because the number of questions they answered was more than the mean score of correct answers (1.87). In the

manner of (Allgood & Walstad, 2016; Asaad, 2015), we classified the rest of the respondents (41%) as having a low level of financial knowledge.

The variables of interest were occupational status (*occupation*) for which self-employed equals 1. The variable female equals 1 if the person identifies as such and zero if they identify themselves as men.[3] Race is a self-reported categorical variable, coded into four categories (Whites, Blacks, Hispanic, and bi-racial and other non-Hispanic ethnicities). The control variables included respondents' level of education and age; previous research has reported that these attributes are associated with the probability of discouragement (Chakravarty & Xiang, 2013; Freel et al., 2012). Other control variables included respondents' ability to provide collateral, such as house ownership and the subsequent change in credit behavior (Fulford & Stavins, 2022) and variables that may affect serviceability, such as income volatility and the ability to pay sudden expenses. Income volatility is a categorical question that shows whether there are occasional or frequent variations as opposed to stable household income.

4 | EMPIRICAL RESULTS

4.1 | Descriptive statistics

Table 1 illustrates the descriptive statistics. Columns 3 and 4 show the percentage of each variable within the categories of applicants for credit and DBs as defined above, followed by the statistical test of their difference. The univariate results show that applicants and DBs differ regarding the variables of interest. A higher proportion of applicants scored higher on financial knowledge tests; they are male, wage-employed, and White. A higher proportion of DBs are Black or Hispanic. Additionally, having a higher level of education, a stable income, being a house owner, and being married relate to making a credit application when needed.

4.2 | Main results

Table 2 shows the results of the second-stage model of DBs using pooled cross-section data. Individuals who are interviewed multiple times are treated as unique observations. The level of multicollinearity among the variables (mean Variance Inflation Factor = 2.06) is below the standard practice of 10. The first panel shows the base model. The second and third panels add the financial knowledge variable and the three key variables, respectively. The fourth panel includes all the variables.

The base model that includes only the control variables illustrates a negative relationship between education and the probability of being a DB. Additionally, having unpredicted income and age increases the probability of DB. House ownership decreases the probability of DB.

Turning to Model 2, we find that the coefficient of financial knowledge is negative but statistically not significant, whereas the rest of the findings from Model 1 remain robust. Model 2, therefore, does not support H1; however, this effect may be underestimated by omitting important variables that we introduce in Model 3: occupational status, gender, and race.

Model 3 contains social variables but not financial knowledge. As hypothesized, being self-employed (prob. = 0.001), female (prob. = 0.050) and being in an ethnic minority as opposed to White (Blacks/prob. = 0.000, Hispanic/prob. = 0.000, and biracial or mix/prob. = 0.008)

TABLE 1 Descriptive statistics.

Sample	All (1)	Need (2)	Applicant (3)	DB (4)	Diff (3) & (4). Prob.
Panel A- Categorical variable (%)					
High level of financial knowledge	59.80	59.18	61.21	41.91	0.000
Female (=1)	46.12	48.87	43.40	56.36	0.000
White	68.77	65.84	67.67	51.59	0.000
Black	10.03	11.64	10.54	21.02	0.000
Hispanic	12.97	13.96	13.25	18.74	0.000
Other and bi-racial	8.23	8.56	8.54	8.64	0.896
Self-employed (Ref: employed)	12.79	11.71	11.19	17.91	0.000
Married	62.31	60.95	63.04	42.12	0.000
Widowed	2.19	1.96	1.86	2.63	0.040
Divorced/Separated	11.81	12.97	12.23	21.92	0.000
Never Married	23.70	24.13	22.87	33.33	0.000
Stable income	68.89	67.02	68.49	52.18	0.000
Occasional variation in Income	22.46	23.81	23.22	28.83	0.000
Frequent variation in Income	8.65	9.17	8.29	18.99	0.000
Not being able to cover sudden expenses	8.44	10.69	8.44	37.21	0.000
Owning house (on mortgage or mortgage free)	72.14	67.77	70.00	45.44	0.000
No High school diploma or GED	2.57	2.38	2.02	5.62	0.000
High school graduate	20.91	19.15	17.70	32.90	0.000
Some college degree	32.31	35.26	34.42	42.09	0.000
Higher education degree	43.69	43.24	45.86	19.40	0.000
18–29 years of age	18.46	21.48	21.24	22.06	0.464
30–44 years of age	28.16	31.00	31.02	22.57	0.000
45–59 years of age	32.38	31.21	31.31	31.47	0.8997
+60 years of age	21.00	16.31	16.42	13.90	0.0125
Number of observations	**42,205**	**20,020**	**17,586**	**1446**	

Note: The number of observations in descriptive statistics and multivariate analyses are different because of some missing observations. Most missing observations are due to unwillingness to report wealth (which is the exclusion criterion for the first stage). The number of observations in the multivariate analyses are recorded in corresponding tables.

increase the probability of discouragement. The results presented in Model 3 confirm H2–H4. We augment this model by adding financial knowledge in Model 4.

Once financial knowledge is included in that model, gender ceases to be a significant variable.[4] However, race and self-employment remain statistically significant.

While the inclusion of financial knowledge can explain variations between genders and discouragement and even remove the effect of gender, being self-employed or a member of an ethnic minority group is related to a higher probability of discouragement. This last model provides significant support for H1 and also points toward the importance of including these

TABLE 2 Probit model of borrower discouragement, accounting for sample selection bias.

Models	Model 1			Model 2			Model 3			Model 4		
Variables	**Coef.**	**Std. Err.**	**Prob.**	**Coef.**	**Std. Err.**	**Prob.**	**Coef.**	**Std. Err.**	**Prob.**	**Coef.**	**Std. Err.**	**Prob.**
High level of financial knowledge				−0.0131	(0.0137)	(0.336)				−0.0936	(0.0333)	(0.005)
Self-employment							0.1497	(0.0464)	(0.001)	0.1519	(0.0466)	(0.001)
Female							0.0620	(0.0316)	(0.050)	0.0451	(0.0325)	(0.165)
Race- Ref: White												
Black							0.3075	(0.0433)	(0.000)	0.2957	(0.0437)	(0.000)
Hispanic							0.1589	(0.0433)	(0.000)	0.1528	(0.0435)	(0.000)
Bi-racial or mixed							0.1523	(0.0578)	(0.008)	0.1487	(0.0581)	(0.010)
Education- ref.: no high school												
High school graduate	−0.0599	(0.0539)	(0.266)	−0.0603	(0.0542)	(0.266)	−0.0127	(0.0843)	(0.881)	−0.0143	(0.0845)	(0.865)
Some college degree	−0.2868	(0.0531)	(0.000)	−0.2862	(0.0533)	(0.000)	−0.0977	(0.0907)	(0.281)	−0.0907	(0.0909)	(0.318)
University education	−0.3444	(0.0558)	(0.000)	−0.3442	(0.0562)	(0.000)	−0.4081	(0.0974)	(0.000)	−0.3854	(0.0976)	(0.000)
Age-Ref: 18–29 years												
30–44 years	0.1102	(0.0257)	(0.000)	0.1113	(0.0259)	(0.000)	0.0216	(0.0464)	(0.642)	0.0280	(0.0467)	(0.549)
45–59 years	0.2298	(0.0267)	(0.000)	0.2314	(0.0270)	(0.000)	0.0083	(0.0530)	(0.876)	0.0217	(0.0540)	(0.687)
+60 years	0.3852	(0.0314)	(0.000)	0.3863	(0.0316)	(0.000)	−0.1011	(0.0679)	(0.137)	−0.0834	(0.0695)	(0.230)
Marital status- ref.: Married												
Widowed	0.0113	(0.0575)	(0.844)	0.0120	(0.0580)	(0.837)	0.2046	(0.0973)	(0.035)	0.2009	(0.0976)	(0.039)
Divorced/separated	0.0035	(0.0292)	(0.904)	0.0058	(0.0298)	(0.845)	0.2941	(0.0435)	(0.000)	0.2931	(0.0436)	(0.000)
Never married	0.2149	(0.0227)	(0.000)	0.2162	(0.0230)	(0.000)	0.1467	(0.0467)	(0.002)	0.1506	(0.0472)	(0.001)
Not being able to pay sudden expenses	0.0608	(0.0364)	(0.095)	0.0638	(0.0376)	(0.090)	0.7010	(0.0417)	(0.000)	0.6913	(0.0414)	(0.000)
Owning a house	0.0178	(0.0237)	(0.453)	0.0158	(0.0244)	(0.516)	−0.3034	(0.0331)	(0.000)	−0.2992	(0.0332)	(0.000)
Income volatility- ref.: stable												

TABLE 2 (Continued)

Models	Model 1			Model 2			Model 3			Model 4		
Variables	Coef.	Std. Err.	Prob.	Coef.	Std. Err.	Prob.	Coef.	Std. Err.	Prob.	Coef.	Std. Err.	Prob.
Occasional variation	0.0548	(0.0152)	(0.000)	0.0557	(0.0156)	(0.000)	0.1378	(0.0360)	(0.000)	0.1352	(0.0361)	(0.000)
Frequent variation	0.1446	(0.0236)	(0.000)	0.1474	(0.0245)	(0.000)	0.2987	(0.0518)	(0.000)	0.3003	(0.0519)	(0.000)
Constant	−0.0233	(0.0639)	(0.716)	−0.0249	(0.0652)	(0.703)	−1.8313	(0.1112)	(0.000)	−1.7890	(0.1153)	(0.000)
Number of observations	32,098			32,098			32,098			32,098		

Note: The second stage model is reported. The models are also estimated with a time trend variable. We find the coefficient of the time variable to be negative, small in magnitude, and statistically significant. Including a time variable does not change the direction, magnitude, and statistical significance of other variables. We also estimate the model, including a squared value of the time trend variable, and the results remain robust. The models are additionally estimated with dummy variables for the COVID period (survey years of 2020, 2021, and 2022). In models 3 and 4, the coefficient of the COVID variable is found to be negative and statistically significant.

variables when we try to measure the effect of financial knowledge on borrowers' discouragement.[5]

When we run estimations for the interaction terms between the level of financial knowledge and the three variables related to individual characteristics, we find that self-employed individuals with a lower level of financial knowledge are more likely than self-employed individuals with a high level of financial knowledge to be DBs (coef. = 0.2111, prob. = 0.001). Occupation status and other lending variables may affect how financial knowledge influences borrower discouragement. Therefore, rather than using full interaction models, we examine the effect of financial knowledge in different sub-groups.

4.3 | Sub-sample estimations

Table 3 shows the results of separate estimations on data sub-samples by gender, race, and occupation. The first two columns show the estimation results for female and male respondents. While the original estimation showed that the inclusion of financial knowledge removes the effect of gender, having a high level of financial knowledge is related to a reduced probability of discouragement for the male subsample (coef. = −0.0804, prob. = 0.080). A possible reason is that men concentrate on high-growth sectors where external financing is more common and financial expertise is more crucial (Mijid, 2014).

Self-employment among women is related to a higher probability of discouragement (coef. = 0.1232, prob. = 0.001); presumably, this can be related to differences in the nature of male/female self-employment. There are also differences in the effect of marital status on the probability of discouragement of women versus men. For example, being divorced or separated has opposite effects on men and women. For women, being divorced is related to a reduced probability of DB (coef. = −0.0698, prob. = 0.047), whereas for men, being divorced is related to a higher probability of discouragement (coef. = 0.3435, prob. = 0.000). Divorce is associated with different economic behaviors by men and women: divorce has a stronger economic impact on women (Saridakis et al., 2018). Divorce might push women into applying for credit when needed, decreasing the likelihood of discouragement. Being never married increases the probability of DB among women (coef. = 0.1151, prob. = 0.000); however, the effect is not statistically significant for men. Interestingly, we find that race affects both the male and female equations, with positive effects for men and negative effects for women. With the absence of the credit adjudication models of banks, this result may imply differences between the search behavior of men and women in ethnic minority groups.

Table 3 presents the estimation results for each race (Models 3–6). Here, we point out the differences in the effect of financial knowledge, self-employment, and house ownership. The higher level of financial knowledge, as illustrated in the first analysis, is a negative significant factor only among Whites (Lusardi et al., 2010). Self-employment is statistically significantly and positively related to the probability of discouragement among Hispanics and biracial or mixed-race individuals. Again, this might be an effect of the nature and performance of their businesses. House ownership reduces the probability of DB among Whites and Blacks; however, it is not a statistically significant factor among the other two groups. This result may indicate that home equity, cultural preferences, and lending barriers vary by race, affecting the decision to use the home as collateral for a loan. Without data on these factors, we refrain from further speculation.

TABLE 3 The probit model of Borrower Discouragement for sub-samples after accounting for sample selection bias.

Variables	Female only Coef. (prob.) (Std. Err.)	Male only Coef. (prob.) (Std. Err.)	Whites only Coef. (prob.) (Std. Err.)	Black only Coef. (prob.) (Std. Err.)	Hispanic only Coef. (prob.) (Std. Err.)	Mixed or bi-racial Coef. (prob.) (Std. Err.)	Self-employment Coef. (prob.) (Std. Err.)	Wage employment Coef. (prob.) (Std. Err.)
High level of financial knowledge	−0.0110 (0.443)	−0.0804 (0.080)	−0.0871 (0.049)	−0.0253 (0.738)	0.0027 (0.936)	−0.1278 (0.116)	−0.0572 (0.167)	−0.0791 (0.025)
	(0.0143)	(0.0460)	(0.0441)	(0.0757)	(0.0341)	(0.0813)	(0.0414)	(0.0353)
Self-employment	0.1232 (0.001)	0.0778 (0.204)	0.0929 (0.129)	0.0547 (0.636)	0.1735 (0.017)	0.3300 (0.005)		
	(0.0359)	(0.0613)	(0.0613)	(0.1157)	(0.0725)	(0.1170)		
Female			0.0299 (0.487)	0.0958 (0.204)	−0.0551 (0.250)	−0.1005 (0.126)	−0.0037 (0.940)	0.0397 (0.252)
			(0.0431)	(0.0754)	(0.0478)	(0.0656)	(0.0492)	(0.0347)
Race- Ref: White								
Black	−0.0971 (0.009)	0.2968 (0.000)					−0.2202 (0.013)	0.3038 (0.000)
	(0.0371)	(0.0644)					(0.0883)	(0.0459)
Hispanic	−0.0335 (0.337)	0.1731 (0.004)					0.0089 (0.907)	0.1376 (0.003)
	(0.0349)	(0.0605)					(0.0764)	(0.0467)
Bi-racial or mixed	−0.0096 (0.820)	0.1227 (0.144)					0.2250 (0.030)	0.0774 (0.231)
	(0.0421)	(0.0840)					(0.1034)	(0.0646)

TABLE 3 (Continued)

Variables	Female only Coef. (prob.) (Std. Err.)	Male only Coef. (prob.) (Std. Err.)	Whites only Coef. (prob.) (Std. Err.)	Black only Coef. (prob.) (Std. Err.)	Hispanic only Coef. (prob.) (Std. Err.)	Mixed or bi-racial Coef. (prob.) (Std. Err.)	Self-employment Coef. (prob.) (Std. Err.)	Wage employment Coef. (prob.) (Std. Err.)
Education- ref.: no high school								
High school graduate	−0.1521	0.0972	−0.0138	−0.1369	−0.1639	0.0019	−0.0686	−0.0102
	(0.045)	(0.408)	(0.907)	(0.485)	(0.111)	(0.995)	(0.587)	(0.913)
	(0.0758)	(0.1174)	(0.1178)	(0.1959)	(0.1027)	(0.3308)	(0.1263)	(0.0936)
Some college degree	−0.3898	−0.0008	−0.0889	−0.0738	−0.3602	−0.2750	−0.2957	−0.0840
	(0.000)	(0.995)	(0.481)	(0.704)	(0.000)	(0.365)	(0.017)	(0.382)
	(0.0635)	(0.1169)	(0.1260)	(0.1944)	(0.1012)	(0.3036)	(0.1235)	(0.0961)
University education	−0.3691	−0.2797	−0.4033	−0.3204	−0.4399	−0.2200	−0.4497	−0.3481
	(0.000)	(0.021)	(0.003)	(0.114)	(0.000)	(0.467)	(0.001)	(0.001)
	(0.0774)	(0.1215)	(0.1358)	(0.2027)	(0.1149)	(0.3022)	(0.1371)	(0.1006)
Marital status- ref.: Married								
Widowed	−0.0082	0.3162	0.2098	0.2716	0.0528	0.0549	0.2098	0.1760
	(0.897)	(0.077)	(0.104)	(0.165)	(0.771)	(0.818)	(0.113)	(0.106)
	(0.0635)	(0.1790)	(0.1292)	(0.1958)	(0.1817)	(0.2378)	(0.1322)	(0.1090)
Divorced/ separated	−0.0698	0.3435	0.3135	0.1525	−0.0718	0.1461	0.0485	0.2644
	(0.047)	(0.000)	(0.000)	(0.145)	(0.341)	(0.271)	(0.568)	(0.000)
	(0.0352)	(0.0631)	(0.0580)	(0.1047)	(0.0754)	(0.1326)	(0.0848)	(0.0472)
Never married	0.1551	0.0679	0.1466	0.1345	0.1271	0.2718	0.2321	0.1387

(Continues)

TABLE 3 (Continued)

Variables	Female only Coef. (prob.) (Std. Err.)	Male only Coef. (prob.) (Std. Err.)	Whites only Coef. (prob.) (Std. Err.)	Black only Coef. (prob.) (Std. Err.)	Hispanic only Coef. (prob.) (Std. Err.)	Mixed or bi-racial Coef. (prob.) (Std. Err.)	Self-employment Coef. (prob.) (Std. Err.)	Wage employment Coef. (prob.) (Std. Err.)
Not being able to pay sudden expenses	0.0037 (0.000) (0.0300)	0.6633 (0.253) (0.0593)	0.8123 (0.054) (0.0760)	0.5305 (0.112) (0.0847)	0.1471 (0.030) (0.0585)	0.1380 (0.007) (0.1000)	−0.0229 (0.001) (0.0683)	0.715 (0.003) (0.0461)
Owning a house	0.0053 (0.922) (0.0379)	−0.3047 (0.000) (0.0641)	−0.3093 (0.000) (0.0559)	−0.3323 (0.000) (0.0839)	0.0172 (0.057) (0.0772)	−0.0190 (0.306) (0.1348)	0.0975 (0.793) (0.0874)	−0.3086 (0.000) (0.0446)
Income volatility- ref.: stable								
Occasional variation	0.0253 (0.851) (0.0282)	0.2006 (0.000) (0.0467)	0.1579 (0.000) (0.0443)	0.0637 (0.000) (0.0770)	0.0100 (0.761) (0.0565)	0.0592 (0.806) (0.0772)	0.0468 (0.137) (0.0656)	0.1369 (0.000) (0.0358)
Frequent variation	0.0856 (0.096) (0.0152)	0.3393 (0.000) (0.0494)	0.3647 (0.001) (0.0496)	0.2426 (0.424) (0.0796)	0.0361 (0.785) (0.0364)	0.1090 (0.376) (0.0668)	0.1053 (0.248) (0.0405)	0.3049 (0.000) (0.0380)
Age- ref.: 18–29 years								
30–44 years	0.1067 (0.000) (0.0243)	0.0268 (0.000) (0.0682)	0.0782 (0.000) (0.0742)	0.0736 (0.032) (0.1129)	0.0114 (0.514) (0.0553)	0.0550 (0.261) (0.0970)	−0.0370 (0.027) (0.0476)	0.0385 (0.000) (0.0571)

TABLE 3 (Continued)

Variables	Female only Coef. (prob.) (Std. Err.)	Male only Coef. (prob.) (Std. Err.)	Whites only Coef. (prob.) (Std. Err.)	Black only Coef. (prob.) (Std. Err.)	Hispanic only Coef. (prob.) (Std. Err.)	Mixed or bi-racial Coef. (prob.) (Std. Err.)	Self-employment Coef. (prob.) (Std. Err.)	Wage employment Coef. (prob.) (Std. Err.)
	(0.001)	(0.701)	(0.255)	(0.500)	(0.864)	(0.547)	(0.666)	(0.429)
	(0.0332)	(0.0698)	(0.0687)	(0.1092)	(0.0668)	(0.0915)	(0.0860)	(0.0487)
45–59 years	0.2715	0.0095	0.0189	0.1139	0.2871	0.2436	0.147	0.0353
	(0.000)	(0.897)	(0.808)	(0.318)	(0.000)	(0.016)	(0.091)	(0.517)
	(0.0351)	(0.0729)	(0.0779)	(0.1141)	(0.0721)	(0.1012)	(0.0871)	(0.0545)
+65 years	0.4056	−0.0582	−0.0735	0.0565	0.2796	0.3864	0.0587	−0.0250
	(0.000)	(0.499)	(0.483)	(0.667)	(0.009)	(0.002)	(0.559)	(0.726)
	(0.0418)	(0.0862)	(0.1048)	(0.1313)	(0.1069)	(0.1261)	(0.1005)	(0.0713)
Constant	0.1301	−1.9264	−1.8190	−1.5187	0.1163	−0.0315	0.2475	−1.8220
	(0.111)	(0.000)	(0.000)	(0.000)	(0.361)	(0.937)	(0.136)	(0.000)
	(0.0818)	(0.1348)	(0.1554)	(0.2290)	(0.1273)	(0.3996)	(0.1660)	(0.1126)
Observations	14,585	17,513	22,468	3183	3906	2541	4069	28,029

Note: Second stage models are reported. We also included a time trend in these models. However, the time trend coefficient is small in magnitude and statistically significant for only a few of the models. Including a squared value of the time trend does not offer additional insight into the models.

In the last two columns, we analyze DB by separating the sample based on occupation. A high level of financial knowledge showed the hypothesized effect among wage-employed individuals. Being Black or Hispanic (as opposed to White) is related to an increased probability of DB among wage-employed respondents (significant at 99%); however, this effect reverses for Black self-employed. Compared with White self-employed individuals, Black self-employed individuals show a lower probability of discouragement after controlling for the effect of other variables. Perhaps one can argue that risk attitudes and entrepreneurial ambition vary across groups, affecting their borrowing decisions. House ownership also shows a desirable outcome, reducing the probability of DB among wage-employed individuals, with no significant effect among the self-employed.

## 4.4 | Is discouragement an efficient sorting mechanism?

After discussing the relationship between variables of interest and the probability of discouragement, one important step is to estimate whether discouragement is an efficient sorting mechanism. To this end, we followed the steps of Ladeira (2023) and first estimated the probability of successful applications for applicants. Success here is defined as receiving full or scaled credit, for which we estimated two models. The first uses the same variables we used to estimate the DB, and the second augments these with the inclusion of a self-reported credit score.[6] Figure 1 depicts the area under the ROC curve. While including self-reported credit scores increases the area under the ROC curve from 77% to 86%, the number of observations drops from 13 to 8.9 K. Since the missing data on self-reported credit scores is related to the variables of interest, we calculate the counterfactual outcomes for both scenarios using the following steps. In the absence of the credit adjudication models of banks, we first calculate the probability of successful applications for all applicants and DBs.

Figures 2 and 3 show the probability distribution of successful applications for both models. Then, we specified some thresholds and compared the probability of successful applications for DBs to understand what proportion of DBs could have been approved, based on the observed variables, had they applied for credit. We present the results in Table 4. Since about 80% of applications get approved, we chose four thresholds: 80%, 85%, 90%, and above 95%. If DBs had a probability of success above these thresholds, we would consider them as successful applicants in the counterfactual.

Table 4, Model 1 shows that between 27.04% and 38.59% of discouraged borrowers would have received credit based on the observable variables. In the second model and for those who
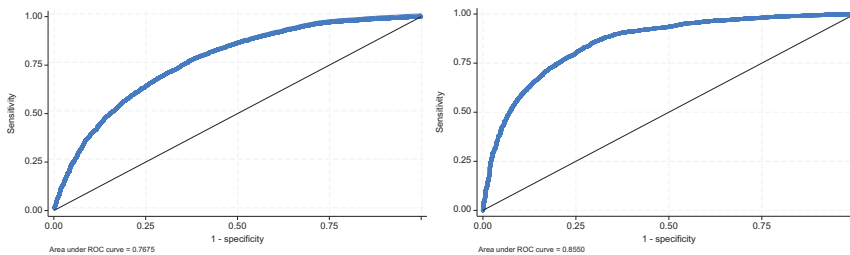
FIGURE 1 The area under the curve for the probit model of successful application. With variables explained in Equation (1). With variables explained in Equations (1) and self reported credit score.
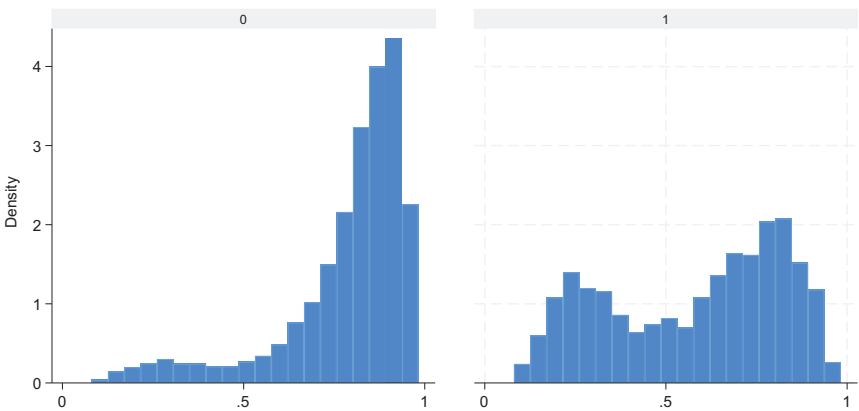
FIGURE 2 The distribution of the probability of success for applicants (Discouragement = 0) and DBs (Discouragement = 1).
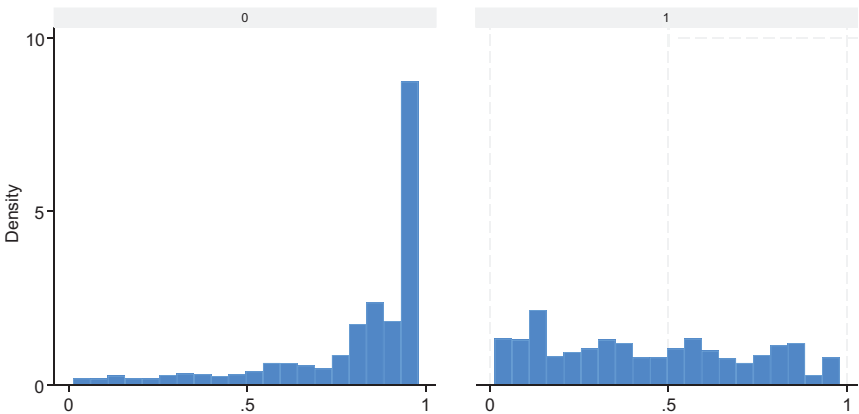
FIGURE 3 The distribution of the probability of success for applications (Discouragement = 0) and DBs (Discouragement = 1), model augmented with credit scores.

TABLE 4 Counterfactual successful outcomes for discouraged borrowers if they applied.

Model	80% cut off	85% cut off	90% cut off	95% cut off
Model 1	38.59%	34.72%	30.91%	27.04%
Model 2	23.54%	18.86%	14.4%	9.21%

presented a self-reported credit score, between 9.21% and 23.54% of discouraged borrowers had a chance of successful application. Thus, when creditworthiness is known, even in the most restricted scenario, between 9% and 24% of DBs have a chance of successful application.[7] In both cases, the analysis shows that there is a substantial percentage of DBs who could have been approved for credit if they did not fear rejection. We will return to this point in our concluding remarks (section 5).

4.5 | Robustness checks

We checked the results across a variety of different sub-samples and for multicollinearity among variables. Additionally, we confirmed the results using an alternative definition of DBs. In our original definition of DB, we focus on the "fear of rejection" to distinguish discouraged borrowers from all non-applicants who needed credit. As robustness checks, we relaxed the definition of DB to include all those who desired credit but did not apply. Appendix B shows the estimates' results. Like Table 2, the right panel (full model) shows that higher levels of financial knowledge and the probability of discouraged borrowing are inversely related. Additionally, self-employment and, compared with the Whites reference group, being Black, Hispanic or of mixed race are associated with a higher level of DB.

The next robustness check is concerned with the definitions of financial knowledge. First, instead of the binary variable explained above, we used categorical variables that show the number of correct responses. With the reference category being "answering all questions wrong", answering all three questions correctly is associated with the reduced probability of DB (coef. = −0.1719, prob. = 0.000). Second, we removed respondents who refused to answer at least one question (i.e., those who responded "I don't know"). The logic for this is that an inability to answer questions correctly might not be the same as providing a wrong answer. For those who answered all the questions correctly, high levels of financial knowledge were still associated with a lower likelihood of discouragement (coef. = −0.0594, prob. = 0.083) (Appendix C).

We then included a self-reported credit score measure, from very poor to excellent, on a 5-point scale. The inclusion of this variable reduces the number of observations to 21 thousand, as the questions were not asked in 2017 and 2018 and they were not answered well in subsequent years. Not surprisingly, higher self-reported credit scores were negatively related to the probability of discouragement (coef. = −0.3993, prob. = 0.000). The inclusion of credit scores eliminated the effects of financial knowledge. It is worth noting that the number of observations in the analysis reduced significantly. However, it seems that having a good understanding of credit scores can reduce information friction (Ladeira, 2023) and replace financial knowledge. Yet, being Black, Hispanic, or mixed race, compared with Whites, is still associated with a higher probability of discouragement (respectively, coef. = 0.1964, prob. = 0.001; coef. = 0.1751, prob. = 0.002; coef. = 0.1403, prob. = 0.075). In section 5, we reflect on the implications of these findings.

Although not shown here, we also separated data before the COVID-19 era and during COVID-19. The relationship between the variables of interest and the control variables is similar to the original analysis (Table 2), except for the effect of financial knowledge. A higher level of financial knowledge is negatively related to the probability of discouragement in the per-COVID-19 period but not during and after the COVID-19 period (results available upon request). It seems that in times of turbulence that affect the income level or job prospects or increase the costs of living (as followed by the onset of COVID-19), knowledge about financial matters is not related to the decision to make an application, and other factors come into play. For example, those with a lower level of financial knowledge might apply for credit due to pressing needs.[8]

5 | DISCUSSION

This study explores the influence of financial knowledge on borrower discouragement, defined as creditworthy individuals who refrain from seeking external financing due to fear of rejection,

as this perspective can shape consumer behavior and the exploration of market opportunities. Financial knowledge is becoming increasingly essential with the increase in the complexity of financial products and the transfer of the weight of responsibility for making financial decisions from shared institutions to individuals (Langley, 2008). The current low levels of financial knowledge are increasing the prevalence of overconsumption and over-indebtedness (Clark, 2014). Individuals with a low level of financial knowledge are often unable to comprehend the costs of the high-cost forms of borrowing and are thus more likely to borrow from nonbank institutions, taking on debts such as payday loans (e.g., Asaad, 2015; Lee et al., 2019; Nitani et al., 2020) to smooth household consumption. The high-cost forms of credit, such as payday loans, affect households' abilities to pay for rent, utilities, and mortgage (Melzer, 2011) and worsen off the financial situation of individuals (Zinman, 2010). The framework of financial knowledge provides a tool to study the mechanism of assessing financial products and how applicants choose from an increasing number of options (Clark, 2014).

Being a discouraged borrower is not a financially incorrect decision per se; some DBs have justifiable reasons for not applying for loans. For example, one might defer borrowing since they can calculate and realize that deferring an expenditure for a better price of credit might be a reasonable financial decision. Here, fear of rejection is not the reason behind discouragement; however, such reasons are mostly not captured in studies. Another evidence of this justifiable decision might be informal talks potential borrowers have with their banks (Rostamkalaei et al., 2018; Wynant & Hatch, 1991) where they are advised not to make formal applications to refrain from a negative record on their credit score. However, if the discouragement results from a misjudgment about one's creditworthiness, and if the phenomenon is widespread, it will translate into unrealized benefits for banks, cause credit constraints for individuals and push them into higher-cost forms of borrowing and stunt the growth potential of firms. We have explained several theoretical underpinnings of our hypotheses that discouragement will be higher among self-employed individuals, women, and ethnic minorities, which are three important social categories that can shape attitudes toward borrowing.

In a nutshell, we find that financial knowledge reduces borrower discouragement but that the effect varies across different groups of individuals. In particular, we find that financial knowledge is more likely associated with male DBs and with certain racial and occupational categories. We also find that financial knowledge alters the relationship between gender and borrower discouragement. When a proxy for financial knowledge is included in the specification, it removes the negative significant effect of gender. However, the results are persistent for ethnic minorities and self-employed. This finding might suggest the necessity for providing subject-tailored financial education to specific groups. For example, among the self-employed, a lower level of financial knowledge was associated with a higher probability of DBs. The results on race remained consistent. Prior research has established a relationship between the lack of access to bank products among Black and Hispanic neighborhoods, which pushes them to utilize high-cost alternatives (Long, 2020). This research echoes previous findings (Long, 2020; Neville et al., 2018) that members of ethnic minority groups are more likely to be discouraged.

Our analyses show that within the sub-sample of the respondents who were aware of their credit score, the proxy for financial knowledge is not a statistically significant variable. Arguably, those who are more financially savvy are in a better position to acquire their credit score. Accordingly, policymakers should consider whether offering education on the ways of building credit scores might be an avenue for improving DBs. As individuals shape attitudes and

knowledge about financial matters on a 'need-to-know' basis (Ward & Lynch, 2019), the provision of information and education should be tailored to the needs. The mere provision of information will not be sufficient to remedy the differences in discouraged behavior that this study has revealed. Understanding one's financial capability and having financial self-efficacy are necessary catalysts for acting upon information (Asaad, 2015).

Another area for public policy intervention might be around building banking relationships. Previous research evidence that a good relationship with banks and making soft inquiries about possible rejection (Rostamkalaei et al., 2018) would establish whether there is a "good" reason to be discouraged and could, therefore, make discouragement an efficient sorting mechanism in such cases. The findings of this study could inform discussions around financial inclusivity and extend the "banking for unbanked" discussions (Dupas et al., 2018; Long, 2020), extending the current solutions concerning product pricing to more informative actions that can help individuals make better decisions.

We also provide some evidence that the effect of financial knowledge weakens in times of economic uncertainty. Future research could investigate whether the usage of other forms of financing increases during such times; that is if high-cost lenders substitute banks or if an individual's search for financing increases (generating less discouragement and more rejection). Future studies should also investigate how financial knowledge influences borrowing behavior in the presence of various exogenous shocks.

The research has some limitations that warrant further investigation. The potential reasons for the differences in discouragement between individuals with higher and lower financial knowledge remain unknown. Our findings about the magnitude of the DBs are thus subject only to the observable factors. Arguably, some of the DBs who need credit might have a valid reason for not applying (such as their likelihood of rejection was disclosed in informal talks). This dataset does not capture the nature of the respondents' banking relationships or their banking history. Moreover, exploring other informal and formal financial channels and the role that the applicant's location plays in the lending market can provide more insights into this field. However, one of the limitations of this research is the lack of detailed data on the locations of individuals and their enclaves. Our analysis is based on pooled cross-sectional data. However, we recognize the importance of dynamics, which can be explored in a panel data framework. The current data only has a small fraction of panel components starting from 2019. These are points we leave for future research.[9]

AUTHOR CONTRIBUTIONS

Anoosheh Rostamkalaei: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; writing – original draft. **Allan Riding:** Conceptualization; investigation; writing – original draft. **George Saridakis:** Investigation; methodology; writing – original draft.

CONFLICT OF INTEREST STATEMENT

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ENDNOTES

[1] In practice, potential borrowers' creditworthiness level is not always observable to them. Some might have valid reasons for fear of rejection that is not always captured in surveys.

[2] (U.S. Federal Reserve Board, 2017, 2018, 2019, 2020, 2021, 2022).

[3] The survey captures gender as a binary choice. The choices of transgender and non-binary were added later to the survey, accounting for 0.5% of the 43,000 responses. The survey continues to capture a binary choice for all individuals. We worked with the original variable used in all waves and responded to by all individuals. We acknowledge the limitation of the research regarding the gender variable.

[4] We examined the correlation between these variables and found that they are small in magnitude, with an absolute value in the region of 0.1 or below. This ensures that the significance is not compromised by a potential high correlation between the financial knowledge and ethnicity variables.

[5] A seemingly unrelated bivariate probit regression of modeling DBs and financial knowledge was also conducted. In this model, parental education—the attainment of a university degree by either parent—is included in the vector of identifying restrictions. It is posited that parents with higher educational levels are more likely to exhibit favorable financial behaviors and attitudes, which may be imparted to their children. The outcomes of the models indicate that the coefficient associated with the financial knowledge variable remains negative and statistically significant, thus providing further empirical substantiation to H1. Additionally, the estimated correlation coefficient (ρ) is positive and statistically significant, suggesting that the unobserved heterogeneity influencing the probability of being a DB positively correlates with the unobserved factors that affect higher financial knowledge. For example, unobserved factors, such as beliefs in their own abilities and perceptions of the financial system, can simultaneously influence financial knowledge and the likelihood of being a discouraged borrower. These factors may lead financially literate individuals to make informed, rational decisions, including the choice to self-exclude from loan applications when they anticipate unfavorable outcomes. We are thankful for the reviewer to prompt us to reflect on these points.

[6] The inclusion of self-reported credit score decreases the number of observations. However, we have run the analysis in the robustness checks to include this variable, as explained below.

[7] Within the U.S. consumer market, Ladeira (2023) estimated this figure to be 44%.

[8] In additional analysis, prompted by a reviewer, we model the probability of rejection as a function of control variables and financial knowledge, conditional on the probability of demand. The coefficient of financial knowledge is negative and statistically significant. That means, a higher level of financial knowledge leads to a a higher probability of rational behavior. That is, submitting an application that face a lower probability of discouragement. We are thankful to reviewer for their suggestion.

[9] In this manuscript, we used the term financial literacy when we referred to the framework introduced by OECD.

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APPENDIX A: The estimation results of modeling for probability of need for credit

Variables	Coef.	(Std. Err.)	(prob.)
female	0.0348	(0.0114)	(0.002)
Education- ref.: less than high school			
High school graduate	0.0674	(0.0486)	(0.165)
Some college degree	0.2841	(0.0480)	(0.000)
University degree	0.2626	(0.0483)	(0.000)
Self-employed	0.0243	(0.0153)	(0.112)
Race -ref: whites			
Blacks	0.1351	(0.0201)	(0.000)
Hispanics	0.0571	(0.0158)	(0.000)
Bi-racial or mixed-race	0.0366	(0.0189)	(0.052)
Age- Ref: 18–29 years			
30–44 years	−0.0873	(0.0224)	(0.000)
45–60 years	−0.1874	(0.0234)	(0.000)
+60 years	−0.3634	(0.0268)	(0.000)
Marital status- ref.: Married			
Widowed	0.0538	(0.0490)	(0.273)
Divorced/Separated	0.1133	(0.0232)	(0.000)
Never married	−0.1515	(0.0196)	(0.000)
Household size (number of people)	0.0315	(0.0043)	(0.000)
Housing- ref.: owned			
Renting	0.1382	(0.0174)	(0.000)
Occupying for free	0.0917	(0.0421)	(0.029)
Not being able to pay sudden expenses	0.2512	(0.0269)	(0.000)
Household income (Ref: less than $25 K)			
Between $25 K to $50 K	0.0055	(0.0181)	(0.760)
Between $50 K to $100 K	−0.0324	(0.0184)	(0.079)
Above $100 K	−0.0696	(0.0209)	(0.001)
Total household wealth estimation in $ M.	−0.2101	(0.0216)	(0.000)
Arthrho	−2.2305	(0.1806)	(0.000)
Constant	−0.1993	(0.0581)	(0.001)
Number of observations	32,098		

Note: Dummy variables for survey years are suppressed.

APPENDIX B: The questions measuring financial knowledge in the Survey of Household and Economic Decisionmaking

1. Do you think the following statement is true or false? "Buying a single company's stock usually provides a safer return than a stock mutual fund."
   I do not know.
   True.
   False

2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?
   Do not know.
   More than Today.
   Exactly the same.
   Less than today

3. Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
   Do not know.
   More than $102.
   Exactly $102.
   Less than $102.

APPENDIX C: The estimation results of modeling discouraged borrowers (2nd definition) after accounting for sample selection bias

Variables	Coef.	(std. Err.)	(prob.)
High level of financial knowledge	−0.0999	(0.0321)	(0.002)
Self-employment	0.1443	(0.0442)	(0.001)
Female	0.0482	(0.0313)	(0.124)
Race- Ref: White			
Black	0.3102	(0.0431)	(0.000)
Hispanic	0.1634	(0.0428)	(0.000)
Bi-racial or mixed	0.1540	(0.0567)	(0.007)
Education- ref.: no high school			
High school graduate	−0.0064	(0.0823)	(0.938)
Some college degree	−0.0678	(0.0836)	(0.417)
University education	−0.3645	(0.0877)	(0.000)
Age- Ref: 18–29 years			
30–44 years	0.0179	(0.0446)	(0.689)
45–60 years	0.0115	(0.0483)	(0.812)
+60 years	−0.1019	(0.0582)	(0.080)
Marital status- ref.: married			
Widowed	0.2021	(0.0954)	(0.034)
Divorced/separated	0.2896	(0.0426)	(0.000)
Never married	0.1408	(0.0404)	(0.000)
Not being able to pay sudden expenses	0.6855	(0.0404)	(0.000)
Owning a house	−0.2989	(0.0327)	(0.000)
Income volatility- ref.: stable			
Occasional variation	0.1331	(0.0344)	(0.000)
Frequent variation	0.2882	(0.0473)	(0.000)
Constant	−1.8022	(0.0968)	(0.000)
Number of observations	31,364		