The role of financial literacy in consumer financial fraud exposure (via email) and victimisation: Evidence from Spain

Structured abstract

Purpose – The ongoing evolution of the Internet and the subsequent digitalization of financial services, along with the ever-increasing innovation of financial products, have rendered consumers more vulnerable to a wider range of fraud in the banking sector and, particularly, to consumer financial fraud (CFF). This paper aims to analyse the factors that may contribute to CFF exposure and victimisation among Spaniards, with a special focus on financial literacy.

Design/methodology/approach – This paper provides a comprehensive overview of leading publications on the topic, followed by empirical analyses using regression models with a sample of 6,207 Spanish individuals drawn from the *Survey of Financial Competences*.

Findings – Objective and subjective financial knowledge are positively correlated with CFF exposure via email but do not protect against CFF victimisation. Similarly, financial knowledge overconfidence is positively related to the former but fails to constitute a driver of the latter. Financial inclusion, measured by the number of financial products held, not only increases the risk of this exposure but also contributes to its subsequent victimisation.

Originality – To the best of the authors' knowledge, no previous paper has analysed the relationship between CFF and financial literacy by differentiating two types of vulnerabilities to fraud (exposure and victimisation) while considering different constructs of financial literacy. Dissecting these two domains may explain why the same financial literacy construct can have different effects at both stages of financial fraud and, furthermore, how different financial literacy constructs may affect the same stage of financial fraud.

Keywords: email financial scams, cybercrime, phishing, objective financial knowledge, subjective financial knowledge, financial inclusion, financial knowledge overconfidence.

Article classification: Research paper.

1. Introduction

Consumer financial fraud (CFF), which refers to the unauthorised access to someone's bank account or payment card details for fraudulent transactions (Engels et al., 2020), is one of the fastest-growing crimes in developed countries (Kadoya et al., 2020). The digitalisation of financial services, the widespread use of social media and electronic payment methods, and the increasing complexity of financial products allows fraudsters to target potential victims anywhere in the world (Goel, 2021; Näsi et al., 2023), creating difficult-to-avoid consumer financial scams (van Raaij, 2016). The COVID-19 pandemic further intensified this trend by increasing dependence on digital technologies (Levi and Smith, 2021), as well as consumers' feelings of loneliness, psychological distress and mental disorders caused by social-distancing and lockdown measures, which made consumers more vulnerable to fraud and more reliant on others (Zhang et al., 2022). As a result, "[consumer] fraud and scams have spread nearly as fast as the virus itself" [Zhang et al. (2022), p. 10]. Worse still, statistics may underestimate the magnitude of the problem (Kadoya et al., 2020), as victims are usually reluctant to admit that they have experienced financial fraud, or may not know how to report it, leading to a paucity of reliable data.

CFF poses a major challenge for both individuals and society (Fan and Yu, 2022). Financial fraud can have harmful effects on these unsuspecting victims' psychological, physiological, and

economic well-being (Shao et al., 2019). In addition to the economic losses, they may also struggle with health problems (e.g., sleep deprivation, anxiety, or depression), embarrassment, or diminished quality of life, which are intangible losses that are difficult to quantify (Gee et al., 2011). At the macro or societal level, financial fraud not only causes substantial economic losses (Engels et al., 2020), but also undermines consumer confidence in businesses and financial institutions, thereby threatening the overall efficiency of the market economy (Brenner et al., 2020).

These harmful effects mean that the risk factors of financial fraud must be identified urgently as a first step to preventing it from happening in the first place. However, current research on this issue remains inconclusive. While some studies suggest that fraudsters select their targets randomly (Kadoya et al., 2020; Wei et al., 2021), evidence shows that demographic and psychological factors influence the likelihood of becoming a victim. The controversy that the concepts of randomness and victim-profiling raises may be partly explained by the need to distinguish between two types of consumer vulnerabilities to financial fraud (Fan and Yu, 2022), namely, fraud exposure (decision-making by fraudsters) and fraud victimisation (decision-making by consumers). In a recent study, Fan and Yu (2022) have developed a conceptual framework that separates these two types of vulnerabilities, helping to explain why the same individual characteristics can have contrasting effects on fraud exposure and victimisation. To date, the distinction between CFF exposure and victimisation has only been made by Fan and Yu (2022). Building on this research, Xu et al. (2022) subsequently developed CFF exposure recognition and victimhood recognition models using machine learning techniques.

Factors conceptually associated with the victim profile include low financial literacy (Judges et al., 2017; Fan and Yu, 2022), but the empirical evidence on this matter also remains inconclusive. This may be due to the studies addressing this issue having mainly focused on objective financial knowledge, neglecting other dimensions of financial literacy, such as subjective financial knowledge, financial knowledge overconfidence, or financial inclusion. In contrast, the recent literature on financial capability (Xiao et al., 2022b) has examined these constructs separately to better understand the effect of each on financial decision-making. To our knowledge, this distinction of financial literacy constructs has not been made in the study of financial fraud except for by Gamble et al. (2013) and Xiao et al. (2022a), although these studies do not consider the financial behaviour construct.

This paper aims to analyse the effect of individuals' financial literacy on financial fraud, based on the conceptual framework proposed by Fan and Yu (2022). Using a sample of 6,207 individuals, we have analysed fraud exposure via email and fraud victimisation as two separate stages, while disaggregating all the constructs included in financial literacy (i.e., objective and subjective financial knowledge, overconfidence, and financial inclusion). Dissecting these two domains may help to clarify some of the contradictory findings on the relationship between financial literacy and fraud in the academic literature.

This study contributes to the literature in the following ways: Firstly, it applies the two-stage conceptual framework proposed by Fan and Yu (2022), which distinguishes between two distinct dimensions of consumer vulnerabilities to fraud, namely, fraud exposure and fraud victimisation - In so doing, the paper contributes to a better understanding of the risk factors of CFF, implying that exposure to it might be random to some extent, while there are some factors that make certain individuals more prone to being contacted by fraudsters -. This distinction not only makes it easier to understand the dynamics involved but also offers insights that may be helpful in designing or strengthening customer protection measures. Additionally, it enables a deeper exploration of the

initial stage of fraud that, according to Xu et al. (2022), has been largely overlooked in previous literature. Secondly, it provides preliminary results of the relationship between financial literacy and fraud by considering various constructs of financial literacy, whereas previous studies have mainly relied on objective financial knowledge - both contributions explain why the same financial literacy construct might have different effects at each stage of financial fraud and, furthermore, why different financial literacy constructs might have different effects at the same stage of financial fraud - accordingly, this paper helps to identify the specific financial literacy construct that needs to be addressed to reduce the risk of financial fraud. Thirdly, this paper expands upon the existing empirical evidence by presenting novel findings for Spain, a southern European country of particular interest for analysis due to its relatively low levels of financial literacy (Arrondel et al., 2021) and a non-negligible percentage of cases of attempted financial fraud – indeed, Spain ranked worldwide among the top three countries[1] attacked by mobile-banking trojans in 2021 and 2022 (Shishkova, 2023).

Following this introduction, the layout of this paper includes a review of the literature in section 2. Section 3 focuses on describing the data and variables and conducting a descriptive analysis. Section 4 presents and discusses the empirical evidence, and Section 5 concludes by highlighting the main findings and limitations and suggesting future lines of research.

2. Literature review

Consumer financial fraud (CFF) is characterised by the illicit acquisition of an individual's banking information or payment card details to engage in deceitful transactions (Engels et al., 2020). This topic has been extensively studied in academic literature. Research from various disciplines, including economics, criminology, and psychology, has primarily concentrated on profiling offenders and trying to comprehend the motives behind committing financial fraud (Brenner et al., 2020). However, the reasons why certain individuals become victims of fraud remain unclear (Gao et al., 2020), bearing in mind that studies in criminology have suggested that fraudsters select their targets randomly, resulting in there not being an identifiable victim profile. Within the specific domain of financial fraud, there are also studies that have adopted this hypothesis (see Kadoya et al., 2020; Wei et al., 2021). Nevertheless, emerging evidence has suggested that demographic and psychological factors may play an important role in explaining why certain individuals become victims of fraud (see Table I). Table I provides a chronological summary of key references that examine the relationship between financial literacy (or its various constructs) and fraud victimisation.

[Table I goes around here]

The lack of conclusive evidence in the debate between randomness and victim profiling may be because of the need to distinguish between two types of vulnerabilities to fraud: fraud exposure and fraud victimisation. Along these lines, Fan and Yu (2022) have developed a two-stage conceptual framework that separates fraud exposure from fraud victimisation after exposure. This theoretical approach is particularly useful for studying CFF, as fraud exposure (the first stage) entails that fraudsters are performing the decision-making, whereas fraud victimisation (the second stage) typically requires some cooperation from the victim, such as via the provision of personal details (Holtfreter et al., 2010; Reurink, 2018). Observing a difference between being a passive or a cooperative subject could elucidate why the same factors might yield contrasting effects on fraud exposure and victimisation. For instance, households with lower levels of education may initially face exclusion from specific banking services, leading to reduced exposure to fraud. However, once they gain access to more banking services, they might become

[1] These rankings exclude countries where there are relatively few users of *Kaspersky* mobile security (under 10,000).

more susceptible to fraud victimisation, as they could be more easily deceived. Similarly, older adults may be less exposed to online CFF due to their lower use of the Internet. Conversely, once targeted, they are more likely to be victimized, partly due to declines in their cognitive abilities, among other factors.

Conceptually, it is argued that the less financially literate individuals are, the more likely they are to become fraud victims (Judges et al., 2017; Fan and Yu, 2022). However, the empirical evidence on this matter is inconclusive (see Table I), possibly owing to many studies having primarily focused on analysing just one construct of financial literacy, predominantly objective financial knowledge, while overlooking other dimensions such as subjective financial knowledge, overconfidence, or financial inclusion. Recent literature on financial literacy has delved deeper by examining these constructs separately, aiming to gain a clearer idea as to the effect each of them has on one's financial decisions (Xiao et al., 2022b). Thus, objective financial knowledge empowers individuals with the "ability to act", whereas financial inclusion enhances financial literacy by providing them with the "opportunity to act" (Sherraden, 2013), or "learning by doing" (Fernández-López et al., 2023). Similarly, the literature has underlined how important it is to consider subjective financial knowledge (Xiao et al., 2022a) as it can measure financial confidence and impact financial decisions by way of mechanisms that extend beyond objective financial knowledge (Allgood and Walstad, 2016).

Based on the conceptual framework developed by Fan and Yu (2022), we have built on the existing literature and have proposed that financial literacy constructs relate differently to fraud exposure via email and victimisation.

2.1. Financial fraud exposure and financial literacy

Earlier studies in criminology have suggested that fraudsters often use a random selection approach when targeting individuals. By accessing the personal information they have at their disposal on the internet, including on *Facebook* and *LinkedIn*, among other platforms, along with banking details (van Raaij, 2016; Goel, 2021), these criminals are able to carry out their illicit activity on a global scale. Näsi et al. (2023) assert that the "technologization" of societies has not only enabled a new playground (i.e., cybercrimes) but also new forms of criminal behaviour.

During the exposure stage, potential targets often assume a passive role, enabling tactics to be employed such as the mass sending of bait emails and tailor-made scams to attract the more vulnerable or easily deceived. Consequently, the randomness hypothesis of consumer fraud exposure does not contradict the findings that certain "observable" socio-demographic factors, such as age (Kieffer and Mottola, 2016), gender (Fan and Yu, 2022; Kieffer and Mottola, 2016), marital status and education (Engels et al., 2020), can act as driving forces behind financial fraud exposure. However, observing individuals' objective or subjective financial knowledge, as well as their overconfidence in financial knowledge, presents challenges. This information is not publicly available on the internet, and many consumers may not even be aware of their own financial knowledge status. Consequently, fraudsters are unlikely to use such information to identify or filter potential targets. Based on these arguments, the following hypotheses have been proposed:

H1.a: Objective financial knowledge is not significantly related to CFF exposure via email.

H1.b: Subjective financial knowledge is not significantly related to CFF exposure via email.

H1.c: Financial knowledge overconfidence is not significantly related to CFF exposure via email.

The financial literacy construct of financial inclusion encompasses various activities, including savings, insurance purchasing and planning for retirement. Taking such financial action entails

establishing contractual relationships with financial institutions, particularly banks in Western countries, and thus gaining financial inclusion. We argue that financial behaviour can be more readily tracked than financial knowledge, especially when it takes place online. Consequently, the highly financially-included are more likely to maintain contractual relationships with various financial institutions and surf the web frequently, thus being exposed to a broader range of potential cyberscams. This online presence causes them to "passively" appear in more information sources, which fraudsters often exploit for either broad-scale targeting (the randomness hypothesis) or targeted filtering. The latter could involve identifying who is vulnerable, with credit constraints, for instance (Fan and Yu, 2022), or deemed "more profitable" by scammers due to being higher-income earners (Engels et al., 2020; Kieffer and Mottola, 2016). In either case, there are many financially-included individuals and there is ample financial information available on them online (Fan and Yu, 2020), making it easier for fraudsters to contact them (Wei et al., 2021) compared to the unbanked or underbanked. Moreover, some changes to online applications, such as an increase in anonymity in some financial transactions (e.g., blockchain applications), foster new avenues for fraud innovation, as acknowledged by Karpoff (2021), thereby increasing the possibility of individuals becoming fraud victims.

Stemming from previous arguments, the following hypothesis has been proposed:

H1.d: Financial inclusion is positively related to CFF exposure via email.

2.2. Financial fraud victimisation and financial literacy

The victimisation stage involves consumer decision-making, thereby underscoring the potential significance of one's financial literacy. Objective financial knowledge increases individuals' awareness of economic and financial information (Lusardi and Mitchell, 2014), aiding them in differentiating fraudulent financial schemes from legitimate investment opportunities (Engels et al., 2020) by way of the "information channel" (Wei et al., 2021), i.e., by promoting increased awareness of economic and financial news. With an increasing number of consumer financial scams being reported in the news, the financially-knowledgeable may become more alert to potential scams. Also, they may be more demanding when seeking financial advice and evaluating it (Calcagno and Monticone, 2015). In other words, objective financial knowledge offers a higher "ability to act" (Sherraden, 2013), enhancing one's ability to prevent being tricked by fraud when one has been targeted. Based on this, the following hypothesis has been proposed:

H2.a: Objective financial knowledge is negatively related to CFF victimisation.

Most research on financial fraud has overlooked subjective financial knowledge (see Table I). Only Cucinelli and Soana (2023), Gamble et al. (2013) and Xiao et al. (2022a) have brought it to the spotlight by focusing on the discordance between objective and subjective knowledge, allowing financial knowledge overconfidence (i.e., the overestimation of actual financial knowledge) to be analysed. These studies have found that consumers who are overconfident about this matter are more likely to fall victim to financial fraud, due in part to their being less likely to seek professional investment advice and more likely to take risks with financial investments (Xiao et al., 2022a). Based on these findings, the following hypotheses have been proposed:

H2.b: Subjective financial knowledge is positively related to CFF victimisation.

H2.c: Financial knowledge overconfidence is positively related to CFF victimisation.

Despite the above arguments, results on the relationship between financial knowledge and fraud are inconclusive. Some studies find that the more objective financial knowledge consumers have, the higher their propensity to detect fraud is (Engels et al., 2020; Wei et al., 2021) or to prevent themselves from becoming fraud victims is (DeLiema et al., 2023; Lokanan and Liu, 2021). In contrast, Fan and Yu (2022) and Xiao and Porto (2021) have found that fraud victims show higher

levels of objective financial knowledge, whereas non-statistically significant relationships between both variables have been found by Gamble et al. (2013), Kadoya et al. (2020), and Xiao et al. (2022a). Additionally, the few studies that have examined subjective financial knowledge have failed to establish a significant association with fraud victimisation. Instead, they have revealed that a greater disparity between subjective and objective financial knowledge (i.e., overconfidence) increases the likelihood of becoming a fraud victim (Cucinelli and Soana, 2023; Gamble et al., 2013; Xiao et al., 2022a).

Wei et al. (2021) have gone a step further by indicating that financial literacy is positively related with fraud detection via the "asset allocation channel". These authors have pointed out that financially-knowledgeable individuals find it easier to create a diversified and suitable investment portfolio (Abreu and Mendes, 2010; Lusardi and Mitchell, 2011) by investing in pension plans, increasing their involvement with commercial insurance policies, or allocating assets sensibly (van Rooij et al., 2012). This financially-savvy behaviour prevents wasteful spending and helps to improve knowledge about financial products and services (Banerjee et al., 2021). In this regard, Wei et al. (2021) have also agreed that financial knowledge leads individuals to adopt better financial behaviour, e.g., by owning diversified asset portfolios, and therefore less disposable income is available for at-will spending as soon as individuals become more aware of asset management. Our paper aligns with Wei et al. (2021) in linking financial behaviour with financial literacy. However, drawing on the most recent papers on financial literacy, we argue that financial behaviour enhances financial literacy as it helps consumers learn from experience, thus improving the likelihood of their being able to avoid falling victim to financial fraud. Based on this, the following hypothesis has been proposed:

H2.d: Financial inclusion is negatively related to CFF victimisation.

Previous evidence has demonstrated that financial inclusion is positively related to fraud detection (Engels et al., 2020; Wei et al., 2021), although there is no clear evidence of its relationship with financial fraud victimisation (Fan and Yu, 2022; Kadoya et al., 2020; Xiao et al., 2022a).

3. Data and variable measurement

3.1. Sample selection

To achieve the research objectives, we drew on data from the Spanish *Survey of Financial Competences* (abbreviated to ECF in Spanish, translated from "Encuesta de Competencias Financieras"), a joint initiative of the Bank of Spain (Banco de España) and the Spanish National Securities Market Commission (called CNMV, or "Comisión Nacional del Nercado de Valores" in Spanish [Banco de España and CNMV, 2018]). The ECF covers a regional and national representative sample of the population aged 18 to 80, aiming to assess individuals' financial knowledge, behaviour and attitudes. Data was elicited between late 2016 and early 2017 from the first and, to date, only edition of the survey.

The original sample consisted of 8,554 individuals. Following the data cleaning and processing procedures, the analytical sample comprised 6,207 individuals. Throughout this process, only the designated interviewees who had the most knowledge about their household finances were considered in our sample (8,038 individuals). The remaining observations were automatically excluded during the execution of the econometric models because not all interviewees answered to all the questions considered in this research. More in detail, the independent variables related to educational attainment and household income level exhibited the highest rates of item non-response, collectively representing over 90% of the excluded observations. Previous literature has consistently noted that individuals with lower educational attainment are less likely to respond to surveys (e.g., Smith, 1982). Additionally, Groves and Couper (1998) and Riphahn and Serfling

(2005) state that higher socio-economic status tends to be associated with lower survey compliance, potentially resulting in a greater number of missing data in questionnaires. Consequently, it is possible that individuals with lower levels of education and those with higher incomes could be underrepresented in our sample.

However, it is important to note that the analytical sample does not differ from the whole sample in terms of representativeness. The ECF also provided weights to adjust for the population structure by age, gender and nationality at the regional level, based on the 2011 population census (Bover et al., 2019). Hence, all the empirical results of this paper were adjusted by these cross-sectional parameters.

3.2. Variables

There were two dependent variables used in this study. The first dependent variable was dichotomous on individuals' fraud exposure via email, indicating whether a respondent had been approached by any fraudsters via email within the past two years (taking the value of 1 if the respondent had received any fraudulent emails seeking information about his/her finances or bank accounts, and 0 otherwise). The second variable was a dummy variable for consumer financial fraud victimisation, which indicated whether a respondent had been a victim of financial fraud in the past two years (taking the value of 1 if someone had used the respondent's bank account or payment card number to make an unauthorized payment, and 0 otherwise).

Financial knowledge and financial inclusion constituted the key variables of interest. Two variables of financial knowledge were defined: objective financial knowledge and subjective financial knowledge. The first one was defined as a categorical variable measuring the number of correct answers to four financial literacy questions dealing with the concepts of inflation, compounding interest, risk diversification and risk-return trade off. The second variable measured the respondents' self-rated overall knowledge about financial matters, compared with other adult Spaniards. Stemming from these two variables and following the proposal of Porto and Xiao (2016), a variable for financial knowledge overconfidence was defined as a categorical variable that groups individuals according to four levels of financial knowledge confidence: naïve (1), overconfident (2), underconfident (3), and competent (4). The "competent" individuals were the ones that scored higher than the average of the sample in both objective and subjective financial knowledge measures. The "overconfident" are the ones with above-average subjective financial knowledge but below-average objective financial knowledge, while the "underconfident" were the ones with above-average objective financial knowledge but below-average subjective financial knowledge. Finally, the "naïve" individuals were those that scored lower than the average in both objective and subjective financial knowledge measures.

Financial inclusion was defined as a continuous variable for the number of financial products that the respondent, personally or jointly, owned at the time of the interview or in the past two years. A maximum of 10 financial products were considered, including savings/investment products such as personal or occupational pension schemes, investment funds, stocks, public or private fixed-income assets, and savings or term deposit accounts, insurance plans such as life and medical insurance policies and debt products such as mortgages, personal loans, and credit cards.

A set of control variables covering heterogeneity for individual and household characteristics was also included. Table II summarises the definition of dependent, key independent and control variables.

[Table II goes around here]

3.3. Summary statistics

Table III reports the descriptive statistics of both of the dependent variables and the set of explanatory variables. The evidence shows that 7.71% of Spaniards were emailed by fraudsters at a certain point in the two years prior to the survey, while 2.28% ultimately fell victim to CFF. This represents a non-negligible percentage, especially when acknowledging that figures may potentially underestimate the magnitude of the problem, as noted by Kadoya et al. (2020).

In addition, these figures are similar to those found in other studies. Fan and Yu (2022), using a sample of 37,261 adults from the *China Household Finance Survey*, found that only 3.7% of the sample experienced economic losses due to frauds. A similar percentage (3.8%) was stated by Gao et al. (2020) for their sample of 25,635 Chinese urban inhabitants. Kadoya et al. (2020) noted that 3.01% of Japanese respondents were victims of financial scams in their sample, while Näsi et al. (2023) found that 2.2% of Finish individuals aged 15 to 74 years reported that, in the past year, their debit or credit card was used on the internet without their permission.

[Table III goes around here]

Regarding the key independent variables, the data in Table III demonstrates that, by and large, respondents self-assessed their financial knowledge (1.42) to be slightly below the average (2). Overall, the score for objective financial literacy was 2.39 out of 4, meaning that Spaniards were able to answer two out of the four financial literacy questions correctly. Taking a closer look, when respondents' financial knowledge was assessed by a set of four financial literacy questions that addressed key financial concepts, 16.24% of the sample were proven to have the ability to answer all the questions correctly but 17.59% could only do so with one of them. As for the remaining interviewees, 30.40% and 31.95% answered two and three out of the four questions correctly, respectively, whereas 3.81% could not answer any.

The variable for financial literacy overconfidence shows that 29.04% of Spaniards could be defined as "competent", as their levels of objective and subjective financial knowledge were above the average of these variables. However, this was closely followed by those considered "naïve" (27.64%), upon displaying below average levels for the sample. When examining respondents' financial inclusion, on average they had between 2 and 3 financial products out of a maximum of 10, although, after delving deeper into the variable, approximately 19% were revealed not to own any.

The sample was gender balanced, and the average age was close to 47 years. Most respondents (67.91%) lived with their partner or spouse, and less than one third (31.44%) lived with a child/children under 18 years of age. Almost half of the sample had completed at least the second stage of secondary education, and few people (1.98%) had not completed primary education. Roughly half of the respondents (50.76%) stated that their annual household income ranged between €14,500 and €45,000, followed by those earning below €14,500 (39.41%) then those with over €45,000 (9.84%).

Spaniards displayed a strong present bias. On a scale from 3 to 15, where 15 denoted the highest bias possible, the data revealed a score of 10.35. This tendency might imply impulsive decision-making (Strömbäck et al., 2017), such as believing fraudulent offers to be legitimate.

The respondents that admitted to being financially constrained constituted a small percentage of the sample (7.95%). Overall, they were satisfied with their current financial situation. On a scale ranging from 0 to 4, average financial satisfaction was 2.39, slightly over the average. There was also a relatively low percentage of respondents (11.93%) who had a household member that could not lead a normal life due to a health problem or an accident. Respondents were mostly risk averse when dealing with their savings and investments.

4. Empirical analyses

Following the conceptual framework of Fan and Yu (2022), we estimated the relationship between the constructs of financial literacy and fraud exposure and victimisation. Due to the dichotomous nature of the dependent variables, we opted for probit regressions, like Cucinelli and Soana (2023), Engels et al. (2020) and Wei et al. (2021):

$$DepVar_i = \beta_0 + \beta_1(finlit_i) + \sum_{k=1}^{K} c_k X_{i,k} + \varepsilon_i$$

For $i = 1, \ldots, N$ respondents. *DepVar* was the dependent variable (either consumer fraud exposure via email or consumer fraud victimisation). ε_i was an i.i.d. standard normal error term. *finlit* stood for financial literacy constructs (i.e., objective and subjective financial knowledge, overconfidence, and financial inclusion). To account for the heterogeneity in the individual and household characteristics, we included a large set of control variables (denoted by *X*) capturing demographic characteristics such as age, gender, marital status, dependent children, educational attainment and health status, economic variables such as household income and credit constraints and behavioural variables such as present bias. The definition of all variables has been provided in section 3.2. Two models were estimated: Model 1 (M1) included objective and subjective financial knowledge and financial behaviour, together with the control variables, and Model 2 (M2) replaced objective and subjective financial knowledge variables with the financial knowledge overconfidence variable.

According to the general rule of thumb for Variance Inflation Factors (VIF), these values are acceptable and, except for age and age^2, do not cause concern for multicollinearity (O'Brien, 2007).

4.1. Financial fraud exposure via email

Table IV reports the estimation results on financial fraud exposure via email.

[Table IV goes around here]

Our evidence suggests that the higher the levels of objective and subjective financial knowledge the interviewees had, the more susceptible they were to being approached by fraudsters, similar to the findings of Fan and Yu (2022) and Wei et al. (2021) concerning objective financial knowledge. Our results do not support *hypotheses 1.a* and *1.b* and reflect that, despite individuals' financial knowledge not being easily "observable" by fraudsters, there seem to be other mechanisms through which financial knowledge affects financial fraud exposure via email. In this regard, possible explanations for individuals with low (objective and/or subjective) financial knowledge are that they may not possess the skills to filter out or identify phishing emails effectively (which is how CFF exposure is measured in this paper, despite other vias for fraud exposure exist), may not read the smallprint in the financial information carefully enough (sometimes deceptive) or may more easily fall into riskier online behaviour (e.g., by clicking on unfamiliar links or providing personal information that would be sold onto or shared with cybercriminal networks).

Similarly, contrary to what was proposed in *hypothesis 1.c*, the results confirm a statistically significant relationship between financial knowledge overconfidence and financial fraud exposure via email. Overconfidence is a trait that is difficult to observe, especially online, thus making it difficult for fraudsters, based on web-based information alone, to distinguish consumers who are overconfident with financial literacy from those who are not. Even though the statistical evidence found is not robust enough, evidence suggests that "underconfident" individuals are less prone to becoming exposed to CFF than "competent" individuals. It appears to some extent that possessing below-average subjective financial knowledge (and above-average objective financial knowledge)

acts as a deterrent, restraining individuals from engaging in risky practices that could otherwise make them more exposed to financial fraud.

The estimates confirm that financial inclusion constitutes a driver of financial fraud exposure (*hypothesis 1.d*). The greater the number of financial products that one owns, the greater the likelihood of being targeted by fraudsters via email. This result is similar to that of Fan and Yu (2022), Wei et al. (2021) and Xu et al. (2022). These latter authors argue that fraudsters target wealthy individuals, as defrauding money is the primary aim of CFF. However, our econometric models control for income, so the arguments advocating a positive relationship between financial fraud exposure and inclusion may stem from the fact that highly financially-included individuals have more personal financial information available online (Fan and Yu, 2020), thereby making it easier for fraudsters to contact them (Wei et al, 2021), as compared to individuals who are unbanked or underbanked.

Control variables help in defining a profile of individuals who may be targeted by financial fraudsters. Far from what is typically expected, evidence from our sample denotes that the elderly are not the demographic group with the highest likelihood of being contacted by fraudsters in Spain via email. Burnes et al. (2017) and Kadoya et al. (2020) have affirmed that older adults are more vulnerable to fraud exposure due to factors such as owning more financial resources than those younger than them, living alone, and being at an age where there is a higher incidence of physical and cognitive decline, making them an easy target for fraudsters. However, our evidence indicates that the probability of risk exposure via email increases with age, but at a decreasing rate. In this regard, our findings align with those of Gao et al. (2020), who have reported that households headed by middle-aged individuals are more susceptible to being targeted by fraudsters than those who are younger or older than them. These authors attribute this association to the higher income levels or greater family responsibilities of the middle-aged, which may result in increased participation in social interactions with possible leaking of sensitive details. However, our evidence seems to discard this last reason, as individuals with dependent children at home, *ceteris paribus*, have a lower probability of exposure to fraud.

In any case, evidence for age needs to be interpreted with caution due to the cross-sectional nature of the data. Furthermore, it is important to note that our dependent variable only considers emails as the way of being contacted by fraudsters, while the elderly are more likely to be contacted via alternative methods, such as by telephone, text messages or door-to-door. Ultimately, older individuals are at a lower risk of being contacted by fraudsters via email, partly due to their reduced access to electronic media[2]. Indeed, Hauk et al. (2018) have stated that advanced age and lower levels of education are negatively related to technology sophistication.

Men are at a higher risk of financial fraud exposure via email. Household income fails to constitute a driver, even though as noted by Holtfreter et al. (2005), financial fraudsters, in their quest for monetary gain, target individuals with greater financial resources. Additionally, those with household members who have health problems preventing them from leading normal lives are also at a higher risk of financial fraud exposure. In this regard, Fan and Yu (2022) have indicated consumers with poor health may be more engaged in the marketplace, seeking cures for their fragile health and, indeed, Gao et al. (2020) have found that the Chinese with the most severe health conditions as well as those facing credit constraints are the most likely to be targeted by fraudsters.

[2] Data from Eurostat (2024) reveals that, in 2023, 95.45% of Spanish individuals reported using the Internet in the last three months. However, this percentage declines to 80.12% among individuals aged 64-74 and further drops to 40.78% among those aged over 75 years.

Spaniards facing credit constraints are more likely to be contacted by fraudsters via email, whereas if they are satisfied with their current financial situation, it is less likely to happen. The former may be more inclined to participate in less-regulated financial markets or to seek information on unreliable websites, thus being more exposed to potential scams. In this regard, Gao et al. (2020) have pointed out that relying on informal credit networks increases the risk of being vulnerable to financial fraud and to consequent losses.

4.2. Financial fraud victimisation

Table V displays the probit estimates for CFF victimisation. In this case, the sample was restricted to owners of at least one of the 10 financial products considered in the variable for financial inclusion, or a current account, savings account or other deposit scheme that could be used to make payments by card or cheque.

Overall, the results are fairly different from those obtained for fraud exposure risk. This outcome is relevant as it affirms the necessity of using Fan and Yu's (2022) theoretical framework, which distinguishes between the two types of consumer vulnerabilities to fraud. Therefore, it implies that the same individual characteristics can have different relationships with financial fraud exposure and victimisation.

Neither objective nor subjective financial knowledge variables showed any statistical significance in relation to consumer fraud victimisation. There was no evidence supporting *hypotheses 2.a*. or *2.b.* Although it had been expected that a higher level of objective financial knowledge would help individuals in distinguishing fraud schemes from genuine investments and be more attentive to fraud risks (Engels et al., 2020; Wei et al., 2021), the results from our research suggested that objective financial knowledge would not serve as a barrier to preventing financial fraud victimisation, consistent with the findings of Gamble et al. (2013) and Kadoya et al. (2020). Similarly, subjective financial knowledge did not exhibit any significant association with financial fraud victimisation (*hypothesis 2.b*). These results were in line with those of DeLiema et al. (2023), Gamble et al. (2013), and Xiao et al. (2022a). However, contrary to the latter two studies, we found no statistically significant relationship between financial knowledge overconfidence and financial fraud victimisation (*hypothesis 2.c*).

According to the evidence presented in Table V, the higher one's financial inclusion is, the higher the likelihood one has of becoming a victim of financial fraud. This finding, contrary to what was expected (*hypothesis 2.d)*, may indicate that being financially included (i.e., owning financial products) is what makes people more susceptible to CFF, whereas financial knowledge does not. This differs from the conclusions of Engels et al. (2020) and Wei et al. (2021), which have stated that the more financially included one is, the more likely one is to detect fraud. Therefore, the results far from support "learning by doing" via engagement with financial products acting as a protective barrier against financial fraud. Contrarily, the greater the number of financial products consumers have, the higher the risk they run of becoming financial scam victims. This positive association might be attributed to individuals with more assets often having more complex financial portfolios, creating opportunities for fraudsters to exploit intricacies that may go unnoticed within this complex financial landscape. Besides this, the greater the number of financial products holders have, the less carefully they may sometimes monitor their accounts, thus providing fraudsters with opportunities to conduct unauthorised activities.

[Table V goes around here]

Evidence is weak of there being a positive relationship between educational attainment and CFF victimisation. Specifically, the higher the level of formal education attained by Spaniards, the greater the probability of suffering consumer fraud, the results being statistically significant for the highest stage of formal education. Similarly, Bergmann (2018), Fan and Yu (2022), Milani et al. (2022), Näsi et al. (2023) and Titus et al. (1995) have found that the better educated individuals are, the more (frequently) victimised they are, suggesting that the "expert snare" may be applied to them, as proposed by van Raaij (2016). The lack of a statistically significant relationship between objective financial knowledge and fraud victimisation, coupled with the weak evidence of a positive association with educational attainment, suggests that financial fraud typically does not require complex calculations to reveal its deceptive nature, as Ross et al. (2014) have noted.

Our findings support the argument that anyone who is married or lives with one's partner is less likely to be victimised. This result aligns to some extent with those of Bergmann (2018) and Engels et al. (2020). One potential explanation is that married couples tend to make financial decisions in conjunction with each other, who may share warnings about offers which are "too good to be true", thereby reducing their risk of fraud victimisation. Family members can therefore act as capable guardians, as posited by the Routine Activity Theory (Cohen and Felson, 1979), which states that crimes occur when motivated offenders and suitable targets converge in space and time in the absence of capable guardians.

There is weak evidence of the relationship between experiencing health problems and fraud victimisation, even though data points out that individuals who have had an accident or suffer from a health issue that prevents them or any of their family members from leading a normal life are at a higher risk of becoming financial fraud victims, as Fan and Yu (2022) have found. Those affected might be tempted to seek funding to aim to gain quick fixes to their health and/or any financial vulnerabilities they may already be trying to deal with because of it (e.g., if they lack a stable source of income due to other responsibilities such as caring for family members). Consequently, their increased financial needs might make them more susceptible to falling into the fraud trap. Credit constraints do not appear to constitute a statistically significant driver of CFF victimization, consistent with the findings of Näsi et al. (2023). Similarly, Xu et al. (2022) found that individuals' financial status does not affect whether they are victimized once exposed to fraud.

Research demonstrates that present-biased consumers tend to perform desirable financial behaviour less than those who prefer delayed gratification, but our evidence does not find a statistically significant relationship regarding financial fraud victimisation. This result might be due to the fact that Spaniards display a high level of present bias, and as Xiao and Porto (2019) have stated, being "too" present-biased might lead consumers to ignore "too good to be true" offers, and therefore, to avoid becoming fraud victims.

Even though the statistical significance found is weak, evidence points to a negative relationship between financial satisfaction and fraud victimisation, i.e., those who are satisfied with their current financial situation are less likely to become fraud victims than those who are not. Similarly, Lichtenberg et al. (2013) argued that a lack of financial satisfaction may cause older adults to be at a higher risk of fraud victimisation, as many scams involve promises of money.

Finally, Model 3 (M3) and Model 4 (M4) in Table V confirm that those who have been exposed to financial fraud via email are more in danger of falling into the fraud trap.

5. Conclusion

The constant improvements in Internet technology and the digitalization of financial services, not to mention the ever-increasing complexity and innovativeness of financial products, have rendered consumers more vulnerable to a wider range of fraud in the banking sector. Particularly, consumer financial fraud (CFF), referred to as the unauthorised access to someone's bank account or payment card details to make fraudulent transactions, has increased in recent years, causing severe harm to households and worldwide economies (Engel et al., 2020). Despite continuous efforts by financial institutions to combat this pervasive problem, consumer fraud is becoming increasingly complex, making it difficult for everybody, even sophisticated investors, to steer clear of (Kadoya et al., 2020).

The first step in preventing financial fraud entails profiling those who are at high risk of suffering financial fraud. This paper has aimed to analyse the driving forces that may contribute to consumer fraud exposure (via email) and victimisation among Spaniards, with a special focus on financial literacy. The findings reveal that while both objective and subjective financial knowledge are positively related to fraud exposure via email, they do not act as a protective barrier against fraud victimisation. Similar results have been observed for financial knowledge overconfidence. Naïve, overconfident, and underconfident individuals are more likely, compared to competent individuals, to be contacted by fraudsters via email. However, the evidence reveals no statistically significant relationship in the case of financial fraud victimisation. It is important to note that our evidence requires careful interpretation. As acknowledged within the limitations, this paper relies on cross-sectional data, thus precluding firm conclusions on causal relationships.

Meanwhile, financial inclusion is positively associated with both CFF exposure via email and CFF victimisation. Highly financially-included individuals are more likely to be targeted by fraudsters via email and, surprisingly, the potential benefits of financial literacy that might be gained from experience (i.e., by dealing with financial products) do not necessarily pay off, as many have succumbed to fraud to a greater extent than the unbanked or underbanked.

The findings demonstrate that by breaking down financial fraud into two stages (i.e., exposure and victimisation) and by considering different constructs of financial literacy separately, the reasons for the mixed evidence found in the limited studies that have analysed the relationship between financial literacy and CFF are clearer, as are the causes for the differences in profiles between targeted individuals and actual victims. These findings have significant implications for academia. The future research agenda on CFF should adopt an empirical approach that differentiates financial fraud by splitting it into two stages (i.e., exposure and victimisation) and therefore break down the constructs of financial literacy even further. This approach requires that, at the outset of the data collection phase, especially via surveys developed by public organisations, specific questions should be designed to tell these two aspects apart. In such surveys, detailed enquiries should be made into online fraud, the use of handheld devices and computers and digital financial literacy. Taking into consideration these topics would enable a more comprehensive understanding of the phenomenon and significantly contribute to the advancement of knowledge in the field of financial fraud prevention.

Concerning the different profiles, middle-aged men living in households without dependent children, who are present-biased, face credit constraints, or have a family member with severe health problems, are more likely to be targeted by fraudsters via email. Among these characteristics, only the latter one shows a positive, but weak, relationship with fraud victimisation. In this second stage, the likelihood of becoming a fraud victim is higher the higher the level of education the potential purchaser has, while being married or living with a partner

and being satisfied with one's own current financial situation may serve as protective factors against falling victim to financial fraud.

Our findings also have some interesting policy implications. The results show that the most financially-literate (in terms of both objective and subjective financial knowledge) and financially-included are a target for online fraudsters. Therefore, financial education should include training to make consumers aware of how they may be providing information, even passively, and avoid becoming unnecessarily exposed. Thus, financial-literacy programmes could include practical exercises and simulations to educate individuals on telling the difference between legitimate communication from financial institutions and phishing attempts, as well as on using secure online platforms for financial transactions.

While technology enhances accessibility, it may also present new opportunities for (online) fraudsters. Its unstoppable evolution demands advanced fraud detection techniques to stay ahead of emerging threats. In this regard, preventing fraud is a shared responsibility between consumers, governments and financial institutions (DeLiema et al., 2020). As Ridho (2023) remarks, entities within the financial sector ought to invest in strengthening their security protocols and proactively engage with law enforcement agencies to collaborate in the investigation of financial scams. Besides, they should continue to remind their customers, as they have been doing for some time, of how important it is to refrain from providing information to third parties who could be sending out fraudulent messages often impersonating the institution itself. Tailored awareness campaigns are crucial and should align with the distinct sociodemographic profiles of customers. To optimise impact, these campaigns should employ diverse communication channels, ranging from in-app messaging on a banking application to face-to-face interactions, ensuring that potential targets of fraudsters receive the message. Retail banks that implement fraud prevention measures and effectively inform their customers may not only reduce the operating costs associated with fraud but also improve their customers' satisfaction and trust levels (Hoffmann and Birnbrich, 2012). This, in turn, could lead to an increase in customer loyalty (Monferrer-Tirado et al., 2016).

Financial inclusion is also a risk factor in fraud victimisation. Therefore, institutions could take advantage of the sign-up process for new customers to improve their financial literacy by insisting on aspects such as the risk-return trade-off. As Engels et al. (2020) have noted, if consumers understand how financial products operate, they will be better equipped to detect and protect themselves against "too good to be true" offers. These educational programs should also increase the public's awareness of the different types of frauds. As Xiao and Porto (2021) have pointed out, knowledge and behaviour regarding fraud prevention may differ from overall financial knowledge. In this line of reasoning, consumer-education programs should incorporate training to address present-bias issues.

Our paper contributes to the existing literature on CFF, which is rather limited due, in part, to a lack of credible data. Financial fraud is a complex phenomenon involving two types of consumer vulnerabilities (i.e., fraud exposure and victimisation). Using the novel conceptual framework proposed by Fan and Yu (2022), we have characterised the profile of individuals at higher risk of being approached by fraudsters via email and of being victimised. Moreover, we have analysed the constructs of financial literacy separately (i.e., objective and subjective financial knowledge, financial knowledge overconfidence, and financial inclusion), which have been found to have a different relationship with the two types of consumer vulnerabilities to fraud. Additionally, our study focuses on Spain, which constitutes an interesting country to examine not only because, to our knowledge, no previous paper has analysed CFF in this country, but also because it is in the top three countries most attacked by mobile banking trojans in the world (Shishkova, 2023).

The limitations of this paper should be acknowledged. Firstly, as it is based on cross-sectional data, it only allows for the study of relationships between financial literacy and financial fraud. Therefore, we cannot draw firm conclusions on causal relationships between these variables, but despite this drawback, evidence found suggests interesting policy recommendations. Secondly, the data is from only one country. While Spain constitutes an interesting country for study, subsequent research could expand on our paper by considering other countries in the analysis. Thirdly, the variables we were able to consider were limited to the definitions and categorisations available in the *Survey of Financial Competences*, which is, to date, the only database allowing CFF to be analysed in Spain. Fourthly, the high number of missing data in crucial independent variables could indicate the potential underrepresentation of individuals with lower levels of education and those with higher incomes, who may be more prone to item non-response. Last of all, fraud is an elusive and complex concept (Reurink, 2018) that can take multiple forms. This paper has aimed to gain a closer view of CFF, but in so doing, it has focused on two specific variables that are not exempt of certain limitations. To be precise, the dependent variable on financial fraud exposure only considers email (i.e., phishing) as a way of being contacted by fraudsters. This may exclude vulnerable consumers, such as older adults, who are, by and large, less tech-savvy and use digital devices very little, if at all, but are usually more susceptible to being contacted on the telephone or in-person interactions. Therefore, CFF exposure variable serves solely as a proxy for fraud exposure via email contact, disregarding other means through which fraudsters may contact potential victims, such as phone calls, text messages (or SMS), messages on social networks, or face-to-face interactions. Similarly, when approaching CFF victimisation, the paper has only focused on fraud committed by making unauthorised payments and not on other consumer financial scams.

Future studies could build on this paper by exploring this topic in more depth and could particularly benefit from using longitudinal data. The *Survey of Financial Competences*, used in this paper, has only released one edition so far, but a second edition is expected to be released in the near future, meaning that more data will be available and potential longitudinal analyses can be made. The use of dependent continuous variables for the total amount of economic losses caused by fraud might also help to better characterise fraud victims, letting different econometric techniques be applied. Further research should also benefit from studying the moderating effects on the relationship between financial literacy and CFF. Furthermore, the use of instrumental variables techniques may be recommendable. For instance, financial literacy may not be readily identifiable by motivated offenders in the cyberspace. It is not merely having higher financial knowledge what increases the risk of CFF exposure; rather, it could be the increased propensity to engage in online financial investments that underpins this correlation.

In conclusion, given the integral role of the Internet in our daily lives and the rising prevalence of fraud, it becomes imperative to identify both risk and protective factors associated with CFF exposure and victimisation to develop effective prevention strategies.

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***Table I**. Financial literacy and consumer fraud exposure and victimisation: Summary of studies*

Authors (Year)	Variable	Source Country (Years): sample	Dependent variable (measure) [*model*]	Financial literacy (measure): (relationship with dependent variable)	Other significant variables: (relationship with dependent variable)	
Cucinelli and Soana (2023)	V	Survey of the Bank of Italy Italy (2020): 2,036 individuals	Accepted advice to invest in a financial product later found to be a scam; accidently provided financial information in response to an email or phone call that was not genuine; and/or lost money as a result of hackers or phishing scams (0-1) [*probit*]	▪ OFK lower than the sample average (0-1): (+) ▪ No. of do not know answers (0 to 4): (n.s.) ▪ No. of incorrect answers (0 to 4): (+)	▪ Age [*46-65*]: (-) ▪ Risk propension: (+) ▪ Marital status [*divorced or widowed*]: (-) ▪ Income: (-)	▪ Employment status [*not employed; looking for a job*]: (-) ▪ North-East: (+)
DeLiema *et al.* (2023)	V	Own survey United States (2018): 108 individuals	▪ Answer to a scam sent by letter/email/phone… (0-1) ▪ Loss of money due to scam (0-1) [*SEM*]	▪ OFK* (0 to 5): (-) ▪ SFK (0 to 7): (n.s.)	▪ Loneliness: (+) ▪ Financially fragile: (+) ▪ Heard about scam before: (-) ▪ Choose not to discuss w/anyone: (+)	▪ No one available to discuss with: (+) ▪ Person/organization seemed official: (+) ▪ Person/organization seemed nice: (+)
Fan and Yu (2022)	V	Household Finance Survey China (2015): 20,433 individuals aged 18 or older	Loss of money due to fraud (0-1) [*logit*]	▪ OFK: (+) ▪ Amount of assets: (n.s.)	▪ Age [*>65 years old*]: (+) ▪ Migrants: (+) ▪ Educational attainment: (+) ▪ Area: rural (+)	▪ Disposable income [*log*]: (-) ▪ Debt [*log*]: (+) ▪ Chronic conditions: (+)
Fan and Yu (2022)	E	Household Finance Survey China (2015): 37,261 individuals aged 18 or older	Encountering different forms of consumer fraud and scams, including phishing schemes (0-1) [*logit*]	▪ OFK: (+) ▪ Amount of assets: (+)	▪ Age [*>75 years old*]: (-) ▪ Gender: women (-) ▪ Migrants: (+)	▪ Disposable income [*log*]: (+) ▪ Debt [*log*]: (-) ▪ Risk tolerance: (+) ▪ Lack of social support: (+)

Authors (Year)	Variable	Source Country (Years): sample	Dependent variable (measure) [*model*]	Financial literacy (measure): (relationship with dependent variable)	Other significant variables: (relationship with dependent variable)	
					▪ Educational attainment: (+) ▪ Area: rural (-) ▪ Chronic conditions: (+)	▪ Trust professionals: (-)
Mao and Liu (2022)	V	Household Finance Survey China (2015): 12,123 Chinese adults aged 60 or older	Financial loss due to any kind of financial fraud in the past year (0-1) [*path analyses*]	▪ OFK* (0 to 3) [*mediation effect*]: (+)	▪ Age: (+) ▪ Risk tolerance [*mediation effect*]: (+)	▪ Interest in financial matters [*mediation effect*]: (+)
Xiao *et al.* (2022a)	V	Family Panel Studies China (2014): 3,617 urban respondents	Investment because ads/relatives/ friends claim that there is an annual return rate at 50% (0-1) [*logit*]	▪ SFK (1 to 5): (+) ▪ OFK (0 to 13): (n.s.) ▪ Financial literacy overconfidence (0-1): (+) ▪ Total assets (standardized): (n.s.)	▪ Male: (+) ▪ Age: (-) ▪ Age squared: (+)	▪ Years of education: (-)
Lokanan and Liu (2021)	V	Investment Industry Regulatory Organization Canada (2006-2019): 452 individuals	Economic harm as result of an investment advisors' action (0-1) [*logit*]	▪ Poor knowledge (0-1): (-) ▪ Moderate knowledge (0-1): (n.s.) ▪ Good knowledge (0-1): (n.s.)	▪ Female: (+)	▪ Retired: (+)
Wei *et al.* (2021) [a]	E	Household Finance Survey China (2015): 21,030 households	Fraud detection (0-1) [*probit*]	▪ OFK* (continuous measure): (+) ▪ No. of financial products (0 to 5): (+) ▪ Financial literacy and financial inclusion [*interaction effect*] (-)		
Engels *et al.* (2020) [a]	E	National Financial Well-Being Survey United States (2016): 5,698 adults	Someone detected the financial fraud to which he/she was exposed (0-1) [*probit*]	▪ OFK (continuous measure): (+)	▪ Marital status [*single*]: (-) ▪ Education: (+) ▪ Income: (+) ▪ Traditional financial products usage (continuous measure): (+)	▪ Alternative financial products usage (continuous measure): (+) ▪ Stayed within budget and saving habit: (-)

Authors (Year)	Variable	Source Country (Years): sample	Dependent variable (measure) [*model*]	Financial literacy (measure): (relationship with dependent variable)	Other significant variables: (relationship with dependent variable)	
Kadoya *et al.* (2020)	V	Hiroshima Bank and Hiroshima University Japan (2017): 1,226 individuals	Victim of financial scam in the last three years (0-1) [*logit*]	▪ OFK* (0-1): (n.s.) ▪ Balance of financial assets [*below/above average*]: (n.s.)	▪ Male: (+) ▪ Financial satisfaction (-) ▪ Conscientiousness (-)	▪ Age: (-) ▪ Age squared: (+) ▪ Years of education: (-)
Kieffer and Mottola (2017)[a]	E	Own survey United States (not detailed): 1,573 individuals	Investment fraud targeting (0-1) [*logit*]	▪ OFK* (1 to 5): (+) ▪ Inability to identify red flags of fraud: (+)	▪ Age: (+) ▪ Income [*≥$50,000*]: (+) ▪ Male: (+) ▪ Too much debt: (+)	▪ College educated: (+) ▪ Risk tolerance: (+) ▪ Investment scam contacts: (+)
Gamble *et al.* (2013)	V	Rush Memory and Aging Project United States (2010): 731 individuals without dementia	Victim of financial fraud during a decision-making assessment period (0-1) [*logit*]	▪ OFK (1 to 9): (n.s.) ▪ SFK (0 to 3): (n.s.) ▪ Financial knowledge overconfidence: (+)	▪ Age: (-)	

Note: [a] The dependent variable primarily focuses on fraud detection, and thus the results of these studies are more closely aligned with those centred on fraud exposure. *E* and *V* stand for the dependent variables on consumer fraud exposure and victimisation, respectively. *SEM* stands for Structural Equation Modelling. *OFK* and *SFK* stand for objective and subjective financial knowledge, respectively. *(0-1)* refers to a dichotomous variable. *The questions used to measure OFK are similar to the "Big Three" or core questions on financial literacy proposed by Lusardi and Mitchell (2011). Some information has been omitted due to there being incomplete details in some studies. + / - / n.s. indicate a positive / negative / non-significant association, respectively. The column "Other significant variables" only displays the variables that have a statistically significant relationship with fraud victimisation.

Source: Authors own creation.

***Table II**. Definition of variables*

Variable	Definition
	Dependent variables
Consumer fraud exposure via email	Dummy variable: in the past two years, the respondent has received any fraudulent emails seeking information about his/her finances or bank accounts (1); otherwise (0)
Consumer fraud victimisation	Dummy variable: in the past two years, someone has used the respondent's bank account or payment card number to make a payment without his/her authorization (1); otherwise (0)
	Key independent variables
Objective financial knowledge	Categorical variable, ranging from 0 to 4, for the number of correct answers to the following four financial concepts: (a) Compound interest: *"Let's suppose you deposit €100 in a savings account with fixed interest of 2% per annum. In this account there are no commissions or taxes. If you make no deposit or withdrawal, once the interest has been paid to you how much money will there be in the account after five years?" [Over €110/Exactly €110/Less than €110/it is impossible to say with the information given/Other answers]* (b) Risk diversification: *"It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks and shares" [True/False]* (c) Inflation: *"Imagine that five siblings had to wait a year to obtain their share of €1,000, and that inflation that year was 1%. Within one year they will be capable of buying…" [More than they could today with their share of money/The same amount/Less than what they could buy today/…]* (d) Risk-return trade-off: *"An investment with a high return is also likely to be high-risk" [True/False]*
Subjective financial knowledge	Continuous variable for respondent's self-rated overall knowledge about financial matters ranging from very poor (0) to very high (4)
Financial knowledge overconfidence	Categorical variable on respondents' financial knowledge confidence: naïve (1), overconfident (2), underconfident (3), and competent (4). "Naïve" (1): respondents with below-average objective and subjective financial knowledge scores. "Overconfident" (2): respondents with above-average subjective financial knowledge but below-average objective financial knowledge. "Underconfident" respondents with above-average objective financial knowledge but below-average subjective financial knowledge. "Competent" (4): respondents with above-average objective and subjective financial knowledge scores.
Financial inclusion	Categorical variable for individuals' degree of financial inclusion, proxied by the number of financial products (out of a maximum of 10) they own personally or jointly
	Control variables
Age	Continuous variable for respondent's age
Age^2	Continuous variable for respondent's age squared
Gender: male	Dummy variable: male (1); female (0)
Marital status: cohabiting	Dummy variable: the respondent usually lives with her/his partner/spouse (1); otherwise (0)
Dependent children	Dummy variable: the respondent lives at home with her/his child(ren) under 18 years of age, or with those of her/his partner/spouse (1); otherwise (0)
Educational attainment	Categorical variable for the respondents' maximum educational attainment: no formal education (1); primary education (2); 1st stage of secondary education (3); 2nd

Variable	Definition
	stage of secondary education (4); postsecondary education–either vocational or university education (5)
Household income	Categorical variable for the household total annual gross income: below €14,500 (1); €14,500–45,000 (2); over €45,000 (3)
Present bias	Continuous variable created by aggregating the respondent's level of agreement, with the following three statements: (a) *"I tend to live for today, without thinking about the future"*; (b) *"I prefer spending money now to saving it for the future"*; (c) *"Money is there to be spent"*. Each statement is rated on a Likert type scale from 1 (full disagreement) to 5 (full agreement). As a result, the final variable ranges from 3 (lowest present bias) to 15 (highest present bias)
Credit constraints	Dummy variable: the respondent is unable to borrow money in the past two years (1); otherwise (0). Following Gao *et al.* (2020) constrained households are those unable to borrow money for any of the following reasons: (a) applied for a loan that was rejected outright; (b) applied for a loan but unable to obtain sufficient funds, as the among granted was less than that requested; or (c) did not apply for a loan because financial institutions would not grant it.
Health problem	Dummy variable: in the past 12 months a household member has had an accident or health problem preventing them from leading a normal life (1); otherwise (0)
Risk propensity	Continuous variable for respondents' risk preferences based their level of agreement with the following statement: *"I am prepared to risk a little money on saving or investing, if I can then obtain a better return in the future"*. It ranges from 0 (fully disagree) to 4 (fully agree)
Financial satisfaction	Continuous variable for respondents' satisfaction with their financial situation based their level of agreement with the following statement: *"I am satisfied with my current financial situation"*. It ranges from 0 (fully dissatisfied) to 4 (fully satisfied)

Source: Authors own creation.

***Table III**. Summary statistics*

Variable		Mean	Standard deviation	Minimum	Maximum
Dependent variables					
Consumer fraud exposure via email		7.71%	0.267	0	1
Consumer fraud victimisation		2.28%	0.149	0	1
Key independent variables					
Objective financial knowledge		2.39	1.07	0	4
Objective financial knowledge (No. of correct answers)	0	3.81%	0.191	0	1
	1	17.59%	0.381	0	1
	2	30.40%	0.460	0	1
	3	31.95%	0.466	0	1
	4	16.24%	0.369	0	1
Subjective financial knowledge		1.42	0.87	0	4
Financial inclusion		2.35	1.87	0	10
Financial literacy overconfidence	Naïve (1)	27.64%	0.447	0	1
	Overconfident (2)	24.16%	0.428	0	1
	Underconfident (3)	19.15%	0.394	0	1
	Competent (4)	29.04%	0.454	0	1
Control variables					
Age		48.20	15.32	18	80
Gender: male		51.02%	0.500	0	1
Married: cohabiting		67.91%	0.467	0	1
Dependent children		31.44%	0.464	0	1
Educational attainment	1	1.98%	0.139	0	1
	2	16.11%	0.368	0	1
	3	31.74%	0.465	0	1
	4	25.83%	0.438	0	1
	5	24.35%	0.429	0	1
Household income	<€14,500	39.41%	0.489	0	1
	€14,500-€45,000	50.76%	0.500	0	1
	>€45,000	9.84%	0.298	0	1
Present bias		10.35	2.73	2	15
Credit constraints		7.95%	0.271	0	1
Health problem		11.93%	0.324	0	1
Risk propensity		1.73	1.38	0	4
Financial satisfaction		2.19	1.30	0	4

Note: The descriptive statistics shown in Table III were limited to the observations that had data available (i.e., no missing values) for all analysed variables.

Source: Authors own creation.

***Table IV**. Financial fraud exposure via email: probit estimates*

		M1	M2
Objective financial knowledge		0.110***	
		(0.032)	
Subjective financial knowledge		0.113**	
		(0.036)	
Financial knowledge overconfidence [Ref. Competent (4)]	Naïve (1)		-0.338***
			(0.083)
	Overconfident (2)		-0.244***
			(0.078)
	Underconfident (3)		-0.137†
			(0.083)
Financial inclusion		0.081***	0.084***
		(0.018)	(0.018)
Age		0.023†	0.023
		(0.014)	(0.014)
Age^2		-0.0004*	-0.0004*
		(0.0001)	(0.0001)
Gender: male		0.278***	0.290***
		(0.061)	(0.061)
Marital status: married		0.024	0.023
		(0.076)	(0.075)
Children		-0.146†	-0.151*
		(0.076)	(0.076)
Educational attainment [Ref. 1]	2	-0.166	-0.110
		(0.322)	(0.315)
	3	-0.095	-0.025
		(0.310)	(0.305)
	4	0.219	0.313
		(0.311)	(0.306)
	5	0.481	0.570†
		(0.311)	(0.307)
Household income [Ref. <€14,500]	€14,500-€45,000	-0.074	-0.066
		(0.072)	(0.072)
	>€45,000	0.084	0.108
		(0.109)	(0.108)
Present bias		0.022†	0.024*
		(0.011)	(0.011)
Credit constraints		0.223*	0.218*
		(0.102)	(0.101)
Health problem		0.363***	0.365***
		(0.080)	(0.080)
Risk propensity		0.016	0.019
		(0.022)	(0.022)
Financial satisfaction		-0.054*	-0.052*
		(0.025)	(0.025)
Constant		-2.727***	-2.234***
		(0.444)	(0.445)
R-squared		0.1257	0.1232
N		6,013	6,013

Note: Table IV shows the probit estimates of the driving forces of CFF exposure via email. Robust standard errors are reported in parentheses. The level of statistical significance is given as † p <0.1, * p <0.05, ** p <0.01, *** p <0.001. The age^2 variable was included to capture potential non-linearities.

Source: Authors own creation.

***Table V**. Financial fraud victimisation: probit estimates*

		M1	M2	M3	M4
Objective financial knowledge		0.006		-0.003	
		(0.039)		(0.039)	
Subjective financial knowledge		-0.050		-0.052	
		(0.058)		(0.059)	
Financial knowledge overconfidence [Ref. Competent (4)]	Naïve (1)		0.160		0.168
			(0.110)		(0.112)
	Overconfident (2)		-0.112		-0.101
			(0.115)		(0.117)
	Underconfident (3)		-0.012		-0.017
			(0.123)		(0.125)
Financial inclusion		0.102***	0.105***	0.101***	0.103***
		(0.024)	(0.023)	(0.024)	(0.024)
Age		-0.004	-0.003	-0.001	-0.0002
		(0.018)	(0.018)	(0.018)	(0.018)
Age^2		0.00003	-0.0003	0.00002	0.0000002
		(0.0002)	(0.018)	(0.0002)	(0.0002)
Gender: male		0.062	0.064	0.033	0.033
		(0.086)	(0.087)	(0.087)	(0.088)
Marital status: married		-0.194†	-0.192†	-0.203†	-0.203†
		(0.103)	(0.104)	(0.105)	(0.105)
Children		0.036	0.028	0.039	0.031
		(0.105)	(0.104)	(0.107)	(0.106)
Educational attainment [Ref. 1]	2	0.161	0.156	0.163	0.151
		(0.380)	(0.379)	(0.383)	(0.380)
	3	0.481	0.495	0.482	0.488
		(0.366)	(0.367)	(0.370)	(0.370)
	4	0.529	0.552	0.513	0.525
		(0.367)	(0.367)	(0.371)	(0.370)
	5	0.707†	0.729*	0.682†	0.694†
		(0.371)	(0.371)	(0.375)	(0.374)
Household income [Ref. <€14,500]	€14,500-€45,000	0.070	0.073	0.075	0.078
		(0.101)	(0.101)	(0.102)	(0.102)
	>€45,000	0.074	0.070	0.077	0.070
		(0.150)	(0.150)	(0.152)	(0.152)
Present bias		-0.013	-0.011	-0.011	-0.010
		(0.015)	(0.015)	(0.015)	(0.015)
Credit constraints		0.032	0.030	-0.035	-0.035
		(0.149)	(0.151)	(0.152)	(0.154)
Health problem		0.189†	0.191†	0.169	0.172
		(0.113)	(0.113)	(0.117)	(0.117)
Risk propensity		0.032	0.033	0.038	0.039
		(0.030)	(0.030)	(0.031)	(0.031)
Financial satisfaction		-0.065†	-0.063†	-0.065†	-0.064†
		(0.037)	(0.037)	(0.038)	(0.038)
Fraud exposure				0.252*	0.248*
				(0.122)	(0.121)
Constant		-2.412***	-2.552***	-2.496***	-2.650***
		(0.562)	(0.577)	(0.573)	(0.588)
R-squared		0.0543	0.0584	0.0583	0.0629
N		6,207	6,207	6,161	6,161

Note: Table V shows the probit estimates of the driving forces of CFF victimisation. Robust standard errors are reported in parentheses. The level of statistical significance is given as † p <0.1, * p <0.05, ** p <0.01, *** p <0.001. The age^2 variable was included to capture potential non-linearities.

Source: Authors own creation.