

# Unlocking sustainable investing through digital financial literacy: the impact of advanced digital skills

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## Abstract

**Purpose** – This paper aims to investigate whether and how different levels of digital financial literacy (DFL) foster sustainable investing.

**Design/methodology/approach** – The authors use a large, representative sample of more than 5,000 Italian households (Edufin Report, 2023), representing individuals responsible for managing the family finances. A principal component analysis (PCA) is used to assess respondents' DFL, which reflects self-reported confidence in conducting financial transactions through digital devices. The paper adopts probit models to investigate the link between DFL and holding at least one sustainable asset in households' portfolio while controlling for certain socio-demographic and behavioural variables.

**Findings** – The results show that DFL has a positive and significant effect on the likelihood of holding sustainable investments, but only among investors with advanced digital skills that enable them to manage sophisticated financial activities (e.g. investing or pension management). The results are robust to alternative measures of DFL and to endogeneity concerns. In particular, the most predictive measures of DFL relate to investors' behaviours and attitudes towards, rather than awareness of, digital financial services. The behavioural dimension is further supported by the positive association between sustainable investment holding and self-assessed financial literacy, optimism and overconfidence.

**Originality/value** – To the best of the authors' knowledge, this is the first study to empirically connect DFL to sustainable investment holdings among individual investors. Building on previous insights on digitalisation and sustainability in the business context, this study identifies DFL as a critical enabler of households' sustainable investments. This study provides new evidence on how promoting advanced digital skills can foster financial inclusion and support the uptake of environmental, social and governance investments among households.

**Keywords** Digital financial literacy, Household sustainable investing, Financial literacy, Sustainable finance, Household financial behaviour

**Paper type** Research article

## 1. Introduction

The importance of studying sustainable investments has grown significantly in recent years, driven by the urgent need to address global environmental and social challenges. The World Commission on Environment and Development defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987, p. 37). Within the multiple dimensions of sustainable development (e.g. economic, social, resource, and environmental aspects; Giddings *et al.*, 2002), sustainable investing aims to integrate environmental, social, and governance (ESG) factors into investment decisions. The end goal, of course, is to generate long-term financial returns while fostering positive societal and environmental impacts.

A key challenge in this context is the transition from a linear to a circular economy: one of the most financially demanding shifts in sustainable development. This transition requires

**JEL Classification** — JEL, G11, Q59, Q50

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substantial investments in innovation, infrastructure, and industrial transformation. The financial sector plays a pivotal role here by directing capital into circular initiatives, supporting businesses in adopting sustainable practices, and driving systemic change towards a more resilient and resource-efficient economy (Pisano *et al.*, 2012; Weber, 2014). However, with financial services becoming increasingly digitalised, individuals need the knowledge and skills to effectively use digital tools and platforms so as to make informed investment decisions (Zhou, 2022). In fact, the G-20 has included “sustainable digital finance” as one of its 2030 workstreams in order to signal the importance of using technology to promote ESG or sustainability initiatives in the financial sector. In this sense, digital financial literacy (DFL) is a crucial component of financing sustainable development: DFL empowers investors to access, process, and integrate financial and sustainability-related data, enhancing their ability to evaluate and engage in sustainable investments.

There are indications that digital natives are recognising the bond between digitalisation and finance. For example, a 2023 Bank of Italy survey on the financial literacy and digital finance skills of young adults (aged 18 to 34) found that over 80% of the young respondents become informed about financial issues through social media, television, websites, or magazines (Marinucci *et al.*, 2024). This literacy will be important as financial digitalisation becomes a meaningful driver of the sustainable transition.

Despite the growing interest in sustainable investing, the link between DFL and retail investors’ participation in ESG investments remains largely unexplored. This is a critical area of inquiry, given that DFL shapes investment behaviours by improving investors’ ability to access, interpret, and effectively utilise both financial and sustainability-related information. By enhancing retail investors’ capacity to evaluate ESG criteria and assess long-term risks and opportunities, DFL can promote more informed investment decisions and, by extension, greater participation in sustainable finance.

While prior research has examined the role of financial literacy in sustainable investment decision-making, no studies have specifically connected DFL to sustainable investment choices among individual investors. Our study pioneers this connection by building on recent insights: Mutascu *et al.* (2023), for instance, proposed a theoretical framework maintaining that digitalisation can stimulate green preferences by reinforcing the factual image of a damaged environment and counteracting fatalistic environmental resignation. Aristei *et al.* (2024), meanwhile, empirically analysed digital financial literacy and sustainability within micro-enterprises. By extending these perspectives to retail investors, we argue that DFL serves as a critical enabler of ESG investment decisions by enhancing investors’ ability to access, process, and integrate financial and sustainability-related data.

To address this gap, we applied a recent Financial Education Planning and Coordination Committee survey to a sample of more than 5,000 households in Italy. Note that the data used in this study are not publicly available: They originate from a proprietary panel managed by BVA Doxa, which uses its own custom online platform and dedicated research team to conduct the data collection and interview process (for further details on the methodology and data access, please refer to the official BVA Doxa website: <https://www.bva-doxa.com>). By analysing that data with probit models, we found that digital skills for financial transactions significantly influence retail sustainable investments. However, this effect was only observed among investors with advanced digital skills. Our findings remained robust even when accounting for alternative measures of digital financial literacy and potential endogeneity concerns. In sum, our paper adds to the literature on the determinants of sustainability-related issues in investment choices and provides practical implications for policymakers. Our insights are especially relevant to Italy, which has been poorly studied in this domain. For example, Cucinelli and Soana (2023) demonstrated that socially responsible investors in Italy, especially those with high financial literacy, prefer socially responsible financial intermediaries.

The rest of the paper is organised as follows: Section 2 presents the literature review on sustainable investing and DFL, together with the theoretical background linking those two

topics. [Section 3](#) describes our data and methodology. [Section 4](#) highlights the empirical results and [section 5](#) concludes with a discussion of the paper's insights and implications.

## 2. Literature review and theoretical background

### 2.1 Sustainable investing

The academic literature often describes sustainable investment practices with overlapping and complementary terms (see [Cadman, 2011](#)) that lack clear conceptual boundaries ([Cunha et al., 2021](#)). Ethical and socially responsible investing (SRI) approaches were prominent in the 1970 and 1980s, but gradually moved towards more comprehensive strategies such as green finance, impact investing, climate finance, and ESG investing (for a review, see [Cunha et al., 2021](#)). In line with recent conceptual developments ([Sikken, 2011](#)) and with the framework proposed by [Cunha et al. \(2021\)](#), we define sustainable investing in terms of three fundamental characteristics that distinguish it from traditional finance. First, it moves beyond the conventional risk-return paradigm by prioritising social and environmental concerns in financial decision-making ([Gao and Bansal, 2013](#); [Richardson, 2009](#)). Second, it adopts a long-term perspective to address complex sustainability challenges such as climate change, social inequality, and resource scarcity ([Busch et al., 2016](#); [Campiglio, 2016](#); [Widyawati, 2020](#)). Third, it emphasises the tangible and quantifiable impacts (measurability) of financial instruments and investment strategies ([Höchstädter and Scheck, 2015](#)).

In short, we follow [Cunha et al. \(2021\)](#) in defining sustainable investing as “the management of financial resources and investments with the aim of promoting long-lasting, positive, and measurable social and environmental impacts.” However, the extent to which sustainability is incorporated into investment decisions varies based on investors' preferences (e.g. ESG-motivated, -aware, or -unaware; [Pedersen et al., 2021](#)) and asset classes.

### 2.2 Digital financial literacy

Digital financial literacy (DFL) reflects people's acquisition of “the knowledge, skills, confidence, and competencies to safely use digitally delivered financial products and services, to make informed financial decisions” ([Alliance for Financial Inclusion, 2021](#), p. 5). DFL is a multi-dimensional concept that combines financial and digital literacy ([Lyons and Kass-Hanna, 2021a](#)): Financial literacy is the ability to understand and employ various financial skills, including personal financial management, budgeting, and investing. Digital literacy reflects people's ability to effectively access and use digital financial services (DFS) ([Lyons and Kass-Hanna, 2021a](#)). According to [Lyons and Kass-Hanna \(2021b\)](#), DFL fuses both literacy types and adds elements related to the nature of DFS and their associated risks. Indeed, neither financial literacy nor digital literacy is sufficient to facilitate the adoption of DFS in the modern era. In other words, DFL helps investors access and use DFS ([Lyons and Kass-Hanna, 2021a](#)).

Against that background, a growing body of literature has sought to conceptualise and measure DFL ([Koskelainen et al., 2023](#); [Lyons and Kass-Hanna, 2021a, b](#); [Morgan et al., 2019](#); [Ravikumar et al., 2022](#)). [Lyons and Kass-Hanna \(2021a\)](#) highlighted that the assessment of DFL encompasses various competencies, such as conducting online purchases, using online and mobile banking services, navigating digital financial service platforms, executing transactions, and managing errors or cancellations. Recognising the increasing importance of DFL, the [OECD \(2022\)](#) expanded the framework of [Lyons and Kass-Hanna \(2021a\)](#) by incorporating questions about automatic payments, cryptocurrencies, transactions via stock trading platforms, and becoming victims of fraud in digital environments.

### 2.3 The linkage between financial literacy and sustainable investing

In recent years, scholars have widely explored the determinants of sustainable finance and investments. For instance, several studies have empirically examined the relationship between

financial literacy and sustainable finance decisions. Some authors have found a positive relationship between the two (Anderson and Robinson, 2022; Gutsche *et al.*, 2021): Financially literate investors are more likely to engage in sustainable investing because they are better equipped to understand and evaluate the long-term benefits and potential risks associated with these investments, and thus face lower information costs (Gutsche *et al.*, 2021; Gutsche and Zwergel, 2020). However, higher financial literacy might also entail a greater awareness of theoretical financial ideas, such as risk diversification, that lead to a rejection of sustainable investments (e.g. applying a sustainable investment strategy, like negative screening, limits the universe of investable assets and thus the opportunities for risk diversification) (Bauer and Smeets, 2015; D'hondt *et al.*, 2022; Riedl and Smeets, 2017; Rossi *et al.*, 2019).

That said, research on this subject is still inconclusive and marked by ambiguity—and one major reason why stems from how scholars measure financial literacy. Some studies use objective measures of financial literacy—such as the Big 3 (Kim *et al.*, 2021; Lusardi and Mitchell, 2014), Big 5 (Brunetti *et al.*, 2022; Collins, 2012), and Big 7 (Calcagno and Monticone, 2015; Guiso and Jappelli, 2008)—whereas other studies use self-assessed financial literacy. Gutsche *et al.* (2021) found that objectively measured financial literacy is associated with a higher likelihood of sustainable investing. By contrast, Riedl and Smeets (2017) and Rossi *et al.* (2019) reported mixed findings regarding the likelihood of sustainable investing when using subjective measures.

Against this background, the field needs further research to clarify the relationship between financial literacy and sustainable investing. Our work aims to contribute to this ongoing debate by providing additional empirical evidence on how different measures of financial literacy, both objective and self-assessed, affect the probability of holding sustainable investments.

#### *2.4 The linkage between digital financial literacy and sustainable investing*

Despite the growing interest in sustainable investing, scholars have yet to deeply explore the relationship between Digital Financial Literacy (DFL) and retail investors' engagement with ESG investments. While prior research has examined the role of financial literacy in sustainable investment decision-making (see above paragraph), no studies have specifically connected DFL to individual investors' sustainable investment choices. Our study pioneers this connection by building on recent insights: Mutascu *et al.* (2023), for instance, proposed a theoretical framework maintaining that digitalisation can stimulate green preferences by reinforcing the factual image of a damaged environment and counteracting fatalistic environmental resignation. Aristei *et al.* (2024), meanwhile, empirically analysed DFL and sustainability within micro-enterprises. By extending these perspectives to retail investors, we argue that DFL enhances investors' ability to access, process, and integrate financial and sustainability-related data. We theoretically substantiate this relationship through the Resource-Based View (RBV), Human Capital Theory, and Dual Process Theories.

From the perspective of the RBV (Barney, 1991), financial literacy and digital financial capabilities are considered intangible assets that enhance firms' financial performance, access to capital, and overall sustainability (Adomako *et al.*, 2016; Khan *et al.*, 2019; Siddik *et al.*, 2023). Here, we draw a parallel between entrepreneurs and retail investors, arguing that DFL serves as a key resource for individuals navigating complex investment decisions. Retail investors with higher DFL levels can leverage advanced financial tools and digital platforms, allowing them to identify and evaluate sustainable investment opportunities more effectively. Moreover, DFL reduces cognitive and behavioural barriers that often hinder engagement with ESG investments, such as misunderstanding ESG ratings or scepticism about long-term returns.

Additionally, the Human Capital Theory (Becker, 1975) suggests that financial literacy enhances an individual's stock of human capital, leading to more informed and responsible investment choices (Liu *et al.*, 2021). In the context of retail investing, higher levels of DFL

might equip investors with the necessary analytical skills to integrate sustainability considerations into their investment portfolios. In other words, by minimising information asymmetry and mitigating cognitive biases, DFL can promote the long-term strategic thinking that is essential in ESG investments.

Finally, insights from Dual Process Theories (see [Evans, 2008](#) for a review) highlight that decision-making is guided by both emotional and rational cognitive systems ([Kahneman, 2013](#); [Stanovich and West, 2000](#)). While ESG investments were historically perceived as emotionally driven (i.e. motivated by ethical concerns or social responsibility), recent studies ([Giglio et al., 2025](#)) have emphasised the growing importance of rational, data-driven considerations in actual ESG asset ownership. Retail investors with higher DFL are better equipped to integrate complex ESG-related information—such as sustainability reports, ESG ratings, and risk analyses—with traditional financial metrics. Moreover, DFL can help investors avoid behavioural biases and market trends, thereby ensuring that ESG investment decisions are grounded in financial viability rather than moral persuasion alone. Investors with advanced DFL levels also tend to utilise fintech innovations, such as robo-advisory services, AI-driven ESG screening tools, and digital investment platforms, further enhancing their ability to make rational, informed investment choices in the ESG domain ([Lim, 2024](#)).

By grounding our analysis in these theoretical perspectives, we hypothesise that higher levels of DFL significantly increase retail investors' likelihood of pursuing ESG investments.

### 3. Data and methodology

#### 3.1 Data

We based our analysis on the Edufin Report 2023, conducted by the Italian Financial Education Planning and Coordination Committee 2023 (edited in July 2023). The data utilised in this study originates from the fourth edition of a survey conducted in May 2023, with a sample size of 5,002 [\[1\]](#).

The respondents (aged 18 years and over) were responsible for managing the household's finances or were more informed about the family's economic/financial matters. The sample is representative of the investor population in Italy and was extracted from a proprietary BVA-Doxa panel that comprised about 120,000 enrollees. To ensure that the distribution of the interviewed sample adhered to the reference universe, the descriptive statistics refer to data weighted by: (1) age, municipality size, region, and level of education (source ISTAT); (2) presence of children 0–14 years, income and profession (source Doxa). The econometric analysis, however, relies on unweighted data ([Kim et al., 2021](#); [Solon et al., 2015](#); [Wooldridge, 1999](#)). The survey's sample size (5,002 cases) guarantees a maximum marginal error of 1.9%, at a 95% confidence level.

Our sample ([Table 1](#)) features 38.3% females and 61.7% males, with a higher share (51.9%) of middle-aged people (45–64) and a prevalence of salaried individuals (permanent and fixed-term workers making up 68.3% of the whole). From a descriptive point of view, respondents who were male, middle-aged, and well-educated possessed higher DFL than the rest of the sample.

#### 3.2 Methodology

**3.2.1 Core variables.** The Edufin 2023 Report includes a survey question designed to assess whether the respondent has sustainable investments in their portfolio. Specifically, respondents were asked the following question: “Which of the following financial, pension, or insurance instruments do you currently own?” Among the multiple-choice options, one explicitly referred to sustainable investment products: “Sustainable investment products (e.g. green bonds).” The associated variable (SUST\_INV) is a binary indicator: Respondents who selected this option (indicating that they currently hold at least one sustainable investment product) took the value of 1, and 0 otherwise.

**Table 1.** Sample description

	Digital financial literacy		
	DFL ≤ median	DFL > median	Total
<i>N</i>	2,562 (51.2%)	2,440 (48.8%)	5,002 (100.0%)
<i>Gender</i>			
Female	1,191 (46.5%)	724 (29.7%)	1,915 (38.3%)
Male	1,371 (53.5%)	1,716 (70.3%)	3,087 (61.7%)
<i>Age</i>			
18–44	952 (37.2%)	864 (35.4%)	1,816 (36.3%)
45–64	1,300 (50.7%)	1,295 (53.1%)	2,595 (51.9%)
>65	310 (12.1%)	281 (11.5%)	591 (11.8%)
<i>Marital status</i>			
Single	556 (21.7%)	427 (17.5%)	983 (19.7%)
Married	1,572 (61.4%)	1,760 (72.1%)	3,332 (66.6%)
Divorced	261 (10.2%)	153 (6.3%)	414 (8.3%)
Widower	73 (2.8%)	30 (1.2%)	103 (2.1%)
Cohabiting	100 (3.9%)	70 (2.9%)	170 (3.4%)
<i>Education</i>			
Primary school	5 (0.2%)	2 (0.1%)	7 (0.1%)
Secondary school	327 (12.8%)	141 (5.8%)	468 (9.4%)
High school	1,275 (49.8%)	1,093 (44.8%)	2,368 (47.3%)
Bachelor's degree	360 (14.1%)	341 (14.0%)	701 (14.0%)
Master's degree	432 (16.9%)	577 (23.6%)	1,009 (20.2%)
Post-graduate degree	163 (6.4%)	286 (11.7%)	449 (9.0%)
<i>Employment status</i>			
Self-employed	323 (12.6%)	357 (14.6%)	680 (13.6%)
Permanent	1,435 (56.0%)	1,655 (67.8%)	3,090 (61.8%)
Fixed-term	216 (8.4%)	111 (4.5%)	327 (6.5%)
Retired	281 (11.0%)	238 (9.8%)	519 (10.4%)
Unemployed	172 (6.7%)	33 (1.4%)	205 (4.1%)
Not seeking	63 (2.5%)	16 (0.7%)	79 (1.6%)
Other	72 (2.8%)	30 (1.2%)	102 (2.0%)
<i>Family income</i>			
<439	99 (3.9%)	15 (0.6%)	114 (2.3%)
440–539	33 (1.3%)	6 (0.2%)	39 (0.8%)
540–644	39 (1.5%)	7 (0.3%)	46 (0.9%)
645–749	41 (1.6%)	16 (0.7%)	57 (1.1%)
750–849	40 (1.6%)	9 (0.4%)	49 (1.0%)
850–954	67 (2.6%)	18 (0.7%)	85 (1.7%)
955–1,059	137 (5.3%)	46 (1.9%)	183 (3.7%)
1,060–1,159	157 (6.1%)	63 (2.6%)	220 (4.4%)
1,160–1,264	139 (5.4%)	59 (2.4%)	198 (4.0%)
1,265–1,369	142 (5.5%)	62 (2.5%)	204 (4.1%)
1,370–1,549	260 (10.1%)	169 (6.9%)	429 (8.6%)
1,550–1,939	420 (16.4%)	326 (13.4%)	746 (14.9%)
1,940–2,454	380 (14.8%)	479 (19.6%)	859 (17.2%)
2,455–3,875	436 (17.0%)	750 (30.7%)	1,186 (23.7%)
>3,875	172 (6.7%)	415 (17.0%)	587 (11.7%)
<i>Living with children</i>			
No	1,603 (62.6%)	1,315 (53.9%)	2,918 (58.3%)
Yes	959 (37.4%)	1,125 (46.1%)	2,084 (41.7%)

(continued)

**Table 1.** Continued

	Digital financial literacy		Total
	DFL $\leq$ median	DFL $>$ median	
<i>Geographical area</i>			
North-West	654 (25.5%)	719 (29.5%)	1,373 (27.4%)
North-East	476 (18.6%)	482 (19.8%)	958 (19.2%)
Centre	509 (19.9%)	508 (20.8%)	1,017 (20.3%)
South and Island	923 (36.0%)	731 (30.0%)	1,654 (33.1%)

**Note(s):** This table reports summary statistics of the variables. We use sampling weights to ensure that the statistics are representative of the population. Detailed definitions of all the variables are provided in [Appendix A1](#). DFL, digital financial literacy

**Source(s):** Authors' calculations

We thought it important that the survey question offered a concrete example of a sustainable investment product (e.g. green bonds), since that ensures a more uniform understanding and higher accuracy.

That said, we recognise that the ownership of sustainable investments does not necessarily reflect a deliberate investment decision or individual preference. These assets may be included in portfolios under financial advisors' recommendations or default options in investment products. Moreover, their subscription may be driven not only by sustainability considerations, but also by portfolio diversification and a more effective risk-return trade-off.

Next, we identified independent variables belonging to the DFL construct. While [Lyons and Kass-Hanna's \(2021a\)](#) original definition of DFL is broad (including five dimensions and eight subdimensions of financial and digital literacy), we chose to follow the narrower definition proposed by [Choung et al. \(2023\)](#) that encompasses financial knowledge, attitudes, and behaviours related to digital literacy. The reason for choosing [Choung et al. \(2023\)](#) is that their definition is more concise and therefore applicable in the financial industry context. This way we exploit the benefits of a one-dimensional variable directly revealing the skills and abilities required to use DFS properly.

We calculated DFL based on how comfortable respondents were with using smartphones, PCs, or other digital devices to conduct financial transactions (question 27 of the survey). Participants used a 4-point Likert scale (1 = not at all, 2 = a little, 3 = quite a lot, 4 = a lot) to report their comfort with each subdimension:

- (1) Transfer money/make payments.
- (2) Manage the checking account.
- (3) Enquire about obtaining a loan.
- (4) Take out an insurance policy.
- (5) Join or make contributions to a supplementary pension plan.
- (6) Pay with a payment card (ATM, credit, prepaid).
- (7) Purchase financial instruments through online trading platforms or robo-advisors.

Next, we conducted a principal component analysis (PCA) on the resulting scores of each subdimension. PCA is particularly useful when dealing with interrelated independent variables that can cause multicollinearity issues in regression models, thereby enhancing the model's robustness. This approach allowed us to reduce the data's dimensionality while still capturing the variability of the original information.

Following Kaiser (1960) and Jolliffe (1973, 1986), we only retained the two components with an eigenvalue greater than 1 and with a magnitude share of the explained variance higher than 0.7 (see Table A3 of the Appendix). We identified relevant factor loadings in each component by conducting an orthogonal rotation and retaining those with absolute values greater than 0.40 (see Table A4 of the Appendix).

The PCA revealed that the initial seven items were testing two underlying latent concepts, which we refer to as DFL\_HIGH and DFL\_LOW. The factor loadings for items 1, 2 and 6 had the strongest association with DFL\_LOW; the factor loadings for items 3, 4, 5 and 8 were most associated with DFL\_HIGH.

In general, rotated factor loadings should have a 0.4 value at the least, which is the value we choose for our analysis (a higher 0.70 cutoff would have worked except for factor loading 3, which was 0.68). Based on these suggested guidelines, our factor loadings revealed that items 1 (Transfer money/make payments), 2 (Manage the checking account) and 6 (Pay with a payment card such as ATM, credit, prepaid) are likely capturing a low digital financial literacy dimension (DFL\_LOW). On the contrary, item 3 (enquire about obtaining a loan), item 4 (Take out an insurance policy), item 5 (Join or make contributions to a supplementary pension plan) and item 8 (Purchase financial instruments through online trading platforms or robo-advisors) are likely capturing a high digital financial literacy dimension (DFL\_HIGH).

Therefore, we identified these two components as the two levels of DFL:

- (1) Low level of digital financial literacy (DFL\_LOW), a variable that measures digital skills for unsophisticated financial practices, such as money transfers or payments, credit card payments, and checking accounts.
- (2) High level of digital financial literacy (DFL\_HIGH), a variable that assesses digital skills for more sophisticated financial practices, like investments, enquiring about obtaining a loan, advisory services, insurance policies, and supplementary pension plans.

According to a recent survey published by the Bank of Italy (Marinucci *et al.*, 2024) the most frequent digital finance activities in Italy include making online payments, managing current accounts online, and using payment cards. Less common activities include subscribing to insurance policies online, seeking online loans, using online trading platforms, and accessing robo-advisor services—all of which are linked to higher levels of financial knowledge. Given this support for our classification, we decided to adopt these two variables (DFL\_LOW and DFL\_HIGH) as the independent variables of our baseline models [2].

We are aware that our DFL measure is a subjective one and therefore serves as a proxy of households' digital financial literacy. Unfortunately, no other questions in the 2023 EDUFIN report allow for an objective measure of DFL. However, previous literature has utilised self-assessed measures of DFL (see Choung *et al.*, 2023 as an example).

3.2.2 *Baseline models.* We estimated the impact of DFL on sustainable investing using a probit model taking the following form:

$$Pr(Y_i = 1|X_i) = \Phi(\beta DFL_i + \delta X_i) + \varepsilon_i \quad (1)$$

Where the dependent variable measures the probability of respondent  $i$  to hold sustainable investments in the portfolio ( $Y_i = 1$ ). We created a sustainable investments variable (SUST\_INV) that took the value 1 if the investor was currently holding a sustainable investment in their portfolio and 0 otherwise.

The term  $\Phi$  captures the standard normal cumulative distribution of the independent variables in the probit model. In detail, we constructed two respective models:

- (1) DFL\_LOW baseline model:

$$Pr(Y_i = 1|X_i) = \Phi(\beta DFL_{LOW_i} + \delta X_i) + \varepsilon_i \quad (2)$$

(2) DFL\_HIGH baseline model:

$$Pr(Y_i = 1|X_i) = \Phi(\beta DFL\_HIGH_i + \delta X_i) + \varepsilon_i \quad (3)$$

To mitigate potential confounding effects, we included control variables in the  $X_i$  vector.

**3.2.3 Control variables.** Our empirical specification accounts for additional determinants of household sustainable investing that have been widely recognised in previous studies (Guiso *et al.*, 2002; Löfgren and Nordblom, 2024; Nilsson, 2009; Riedl and Smeets, 2017). We included socio-demographic variables (e.g. gender, age, education, and marital status) to control for life cycle factors and household background. We gleaned the household’s economic and financial situation with several variables: income, savings, mortgage status, and self-employment. We adopted additional variables to account for investment horizon (e.g. having minor children, as families with children tend to engage in longer-term financial planning) and household investment behaviour (e.g. use of financial advisors, financial satisfaction, ownership of risky assets, and financial risk tolerance). Finally, we measured financial literacy using the “BIG 3” questions on interest rates, inflation, and risk diversification (Kim *et al.*, 2021; Lusardi and Mitchell, 2014), as well as a variable assessing the time spent weekly on financial matters to capture knowledge and interest in financial investing. For detailed definitions, see Table A1 in the Appendix.

Notably, we included fixed effects for both region of residence [3] and occupation [4] to control for unobserved heterogeneity across geographical areas and occupational categories. In this way, we sought to improve the accuracy and reliability of our estimations by mitigating confounds related to regional characteristics or employment factors.

Table 2 presents the descriptive statistics for the key variables used in this research. On average, only 5% of the households in our sample possessed sustainable investments. The mean values of DFL\_LOW and DFL\_HIGH were around 0, with respective ranges of –6.064–3.120 and –3.337–4.472. This result suggests that, on average, households feel more comfortable conducting less sophisticated digital financial transactions.

**Table 2.** Summary statistics of the key variables

	Variable	Obs	Mean	SD	Min	Max
Dependent variable	SUST INV	5,002	0.050	0.218	0	1
Independent variables	DFL_LOW	4,763	0.000	1.958	–6.064	3.120
	DFL_HIGH	4,763	0.000	1.085	–3.337	4.472
Control variables	MALE	5,002	0.617	0.486	0	1
	AGE	5,002	1.755	0.649	1	3
	EDU	5,002	4.717	1.158	2	7
	INCOME	5,002	11.680	3.225	1	15
	SAVINGS	5,002	2.390	0.682	1	3
	MORTGAGE	5,002	0.265	0.441	0	1
	SELF_EMPL	5,002	0.136	0.343	0	1
	MARRIED	5,002	0.666	0.472	0	1
	CHILDREN	5,002	0.148	0.355	0	1
	BIG3	5,002	2.067	1.071	0	3
	BANK	4,763	0.261	0.439	0	1
	TIME	4,749	5.761	10.719	0	258
	FRT	4,763	4.350	2.433	1	10
	FIN_SAT	5,002	6.026	2.036	1	10
	RISK_ASS	5,002	0.126	0.331	0	1

**Note(s):** This table reports summary statistics of the variables used in the models. SD, standard deviation; SUST INV, sustainable investments; DFL\_HIGH, high digital financial literacy; DFL\_LOW, low digital financial literacy; EDU, education; SELF\_EMPL, self-employed; FRT, financial risk tolerance; RISK\_ASS, risky assets. We use sampling weights to ensure that the statistics are representative of the population. Detailed definitions of all the variables are provided in Appendix A1

**Source(s):** Authors’ calculations

## 4. Empirical results

### 4.1 Baseline results

Table 3 shows the effects of DFL on the sustainable investments of Italian households. While both DFL\_LOW and DFL\_HIGH exerted a positive and significant effect on the probability of investing in sustainable products, the latter's significance was far more pronounced. While

**Table 3.** Baseline results of probit model regressions

Variables	(1) SUST INV	(2) SUST INV
DFL_LOW	0.038** (0.019)	
DFL_HIGH		0.148*** (0.036)
MALE	-0.062 (0.075)	-0.074 (0.075)
AGE	-0.095 (0.066)	-0.097 (0.066)
EDU	0.085*** (0.030)	0.084*** (0.031)
INCOME	0.007 (0.015)	0.014 (0.015)
SAVINGS	0.112* (0.063)	0.107* (0.064)
MORTGAGE	-0.134* (0.081)	-0.122 (0.081)
SELF_EMPL	-0.124 (0.133)	-0.120 (0.134)
MARRIED	0.122 (0.079)	0.102 (0.079)
CHILDREN	0.275*** (0.083)	0.263*** (0.084)
BIG3	-0.076** (0.037)	-0.037 (0.036)
BANK	0.159** (0.072)	0.160** (0.073)
TIME	0.005* (0.003)	0.004 (0.003)
FRT	0.065*** (0.015)	0.055*** (0.016)
FIN_SAT	0.067*** (0.023)	0.071*** (0.024)
RISK_ASS	0.350*** (0.086)	0.364*** (0.087)
REGION_FE	Yes	Yes
OCCUPATION_FE	Yes	Yes
Observations	4,587	4,587

**Note(s):** The table reports marginal effects and robust standard errors (in parentheses). SUST INV, sustainable investments; DFL, digital financial literacy; DFL\_HIGH, high digital financial literacy; DFL\_LOW, low digital financial literacy. Regressions controlled for: gender, age, education, income, savings, mortgage, self-employed, married, minor under 18, financial literacy as BIG 3 (Lusardi and Mitchell, 2014; Kim et al., 2021), bank, time, financial risk propensity, financial satisfaction and any risky assets. Results are also controlled for region and occupation fixed effects. See Appendix A1 for detailed definitions of all variables. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10% levels, respectively

**Source(s):** Authors' calculations

DFL\_LOW significantly increased the probability of having sustainable investments, with a marginal effect of 3.8%, that percentage rose to 14.8 T% for DFL\_HIGH. The standard deviations of DFL\_LOW and DFL\_HIGH were 1.958 and 1.085, respectively; thus, a one-unit standard deviation increase in DFL\_LOW and DFL\_HIGH was respectively associated with a 7.4% ( $3.8\% \times 1.958$ ) and 16% ( $14.8\% \times 1.085$ ) increase in the probability of holding sustainable investments. In other words, a sophisticated level of DFL seems to strongly affect the probability of making sustainable investment choices. For the sake of robustness, we ran additional estimations by clustering standard errors at the household level for variables: (1) Financial Satisfaction, (2) Financial Risk Tolerance, (3) Income and (4) Savings. However, the results did not significantly change.

Regarding the socio-demographic variables, both models showed that households with higher education levels have a larger probability of holding sustainable investments. A one-percent increase in household education leads to an 8% rise in the probability of holding sustainable investments. Households with minor children and those inclined towards saving were also more likely to own sustainable investments. Our results are consistent with the prior literature (Christiansen *et al.*, 2023; Gutsche *et al.*, 2021; Wins and Zwergel, 2016).

With regard to behavioural aspects, our results showed that those with higher risk propensity have a higher sustainability orientation in investments, aligning with previous findings (e.g. Christiansen *et al.*, 2023; Gutsche *et al.*, 2021; Nilsson, 2009; Riedl and Smeets, 2017; Yang *et al.*, 2021). We found that both objective (RISK\_ASS) and subjective (FRT) measures of risk propensity were positively and significantly linked to the probability of holding sustainable investments (with a marginal effect of around 35 and 6%, respectively). A possible explanation for these results is that risk-takers are more willing to accept sacrificing some risk diversification to support a sustainable investment strategy (e.g. negative screening) (Riedl and Smeets, 2017). Additionally, risk-seeking investors have a stronger tendency to search for new investment opportunities and are thus more likely to have heard of sustainable investment than risk-averse persons (Gutsche *et al.*, 2021). Meanwhile, financial advice (via a bank) (e.g. Linciano *et al.*, 2020) and financial satisfaction (e.g. Choung *et al.*, 2023) both exerted a positive and significant impact on the probability of sustainable investing.

Financial literacy exhibited more mixed results. In the DFL\_LOW baseline model in Table 3 (column 1), financial literacy (as measured with the BIG 3 method) was significantly and negatively related to the probability of sustainable investing, with a marginal effect of 7.6%. This finding corroborates previous evidence that financially literate people are more aware of theoretical financial ideas, such as risk diversification, which cannot always be pursued in sustainable investing (e.g. a strategy like negative screening limits the universe of investable assets and thus risk diversification) (Bauer and Smeets, 2015; D'hondt *et al.*, 2022; Riedl and Smeets, 2017; Rossi *et al.*, 2019). However, in the DFL\_HIGH baseline model (model 2 in Table 3), we observed no significant effects of financial literacy on the probability of holding sustainable investments.

The ambiguity of such evidence may be related to the fact that financial literacy is negatively associated with fintech use, as the latter is perceived as riskier than traditional finance in terms of data security, regulatory oversight, and potential hidden fees (Zhang and Fan, 2024). As already emphasised in section 3.2, our measure of DFL is linked more to skills and abilities related to digital financial behaviours than to financial competencies that are included in the financial literacy measure (BIG3). To further investigate this issue, we studied several measures of financial literacy (both objective and self-assessed) as a robustness test (see robustness tests section).

**4.1.1 Robustness tests.** We conducted a series of robustness tests to assess the validity of our results. First, we employed an IV approach to control possible endogeneity issues. Second, we tested for alternative measures of DFL and financial literacy.

**4.1.2 IV estimation.** Estimates of baseline models can be biased by unobservable omitted variables. DFL, for instance, could reflect some unobserved personal characteristics that might affect sustainable investing. As an example, sustainable investing might enhance investors'

DFL, which could then lead to more demand for sustainable investing. Such a dynamic could amplify the association between DFL and holding sustainable investments, causing the coefficients to overstate the effect of the independent variable on the dependent one.

To address potential endogeneity concerns, we undertook an instrumental variable (IV) analysis for our key explanatory variable (DFL) using the variable DIG\_KNOW. We evaluated digital knowledge with a binary variable that took the value 1 if the respondent's children used the Internet to help parents and/or grandparents with paperwork. The idea behind this choice is that respondents' DFL may depend on how much technological help they are receiving from their children. In short, we expect that digital knowledge transfer (DIG\_KNOW) affects the adult recipient's DFL but does not relate to sustainable investing.

We re-estimated our baseline models using the instrumental approach. Tables 4 and 5 present the IV probit estimates when the DFL measure is instrumented by DIG\_KNOW. Column 1 shows the coefficient from our first-stage regression of DFL on DIG\_KNOW, which indicates that only the DFL\_HIGH model strictly satisfied the relevance condition (i.e. the coefficient of the first-stage regression was significant at the 1% level). Column 2 presents the second-stage regression results of sustainable investing. Again, the results show that, whether high or low, DFL had a positive and statistically significant impact on the probability of holding sustainable investments. A 10-percentage points' increase in high digital financial literacy enhanced the probability of holding sustainable investing by 6.76% points (Column 2, Table 4). Meanwhile, a 10-percentage point increase in low digital financial literacy enhanced the probability of holding sustainable investing by 5.71% points (Column 2, Table 5). However, when we introduced diagnostic tools, only the IV results with DFL\_HIGH successfully passed the tests. For the weak IV test, the first-stage F-statistic was far above the threshold of 10 (i.e. 19.42), suggesting that our instrument is acceptable and has explanatory power (Stock and Yogo, 2005). In addition, the Wald tests for the exogeneity of the instrumented variable allowed us to reject the null hypothesis of no endogeneity. The same cannot be said for the DFL\_LOW F-statistic, which achieved a value of 0.05 and did not pass

**Table 4.** Instrumental variable probit model regression – DFL high

	(1) First-stage regression	(2) IV (2SLS) estimation
DFL_HIGH		0.676** (0.301)
DIG_KNOW	0.236*** (0.053)	
Other control variables	Yes	Yes
REGION_FE	Yes	Yes
OCCUPATION_FE	Yes	Yes
Observations	1,588	1,588
Kleibergen-Paap LM statistic <sup>a</sup>		19.53
Cragg-Donald Wald F statistic <sup>b</sup>		19.42

**Note(s):** The table reports marginal effects and robust standard errors (in parentheses). We estimate all the specifications using the instrumental variable (IV) probit estimator. DFL\_HIGH is high digital financial literacy and DIG\_KNOW is digital knowledge. Regressions controlled for the same variables as before: gender, age, education, income, savings, mortgage, self-employed, married, minor under 18, financial literacy, bank, time, financial risk propensity, financial satisfaction, and any risky assets. Results are also controlled for region and occupation fixed effects. See Appendix A1 for detailed definitions of all variables. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10% levels, respectively, <sup>a</sup>Kleibergen-Paap LM statistic for under identification test with a  $p$ -value = 0.0000\*\*\*, <sup>b</sup>Cragg-Donald Wald F statistic for weak identification test

**Source(s):** Authors' calculations

**Table 5.** Instrumental variable probit model regression – DFL low

	(1) First-stage regression	(2) IV (2SLS) estimation
DFL_LOW		0.559*** (0.025)
DIG_KNOW	0.061 (0.097)	
Other control variables	Yes	Yes
REGION_FE	Yes	Yes
OCCUPATION_FE	Yes	Yes
Observations	1,588	1,588
Kleibergen-Paap LM statistic <sup>s</sup>		0.0469
Cragg-Donald Wald F statistic		0.0488

**Note(s):** The table reports marginal effects and robust standard errors (in parentheses). We estimate all the specifications using the instrumental variable (IV) probit estimator. DFL\_LOW is low digital financial literacy and DIG\_KNOW is digital knowledge. Regressions controlled for the same variables as before: gender, age, education, income, savings, mortgage, self-employed, married, minor under 18, financial literacy, bank, time, financial risk propensity, financial satisfaction, and any risky assets. Results are also controlled for region and occupation fixed effects. See [Appendix A1](#) for detailed definitions of all variables. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10% levels, respectively. <sup>a</sup>Kleibergen-Paap LM statistic for under identification test with a  $p$ -value = 0.8257. <sup>b</sup>Cragg-Donald Wald F statistic for weak identification test

**Source(s):** Authors' calculations

the Wald tests for the exogeneity of the instrumented variable. Next, we assessed the strength of identification based on a Lagrange-Multiplier (LM) test for under-identification using the [Kleibergen and Paap \(2006\)](#)  $rk$  statistic. The Kleibergen-Paap  $rk$  LM test for instrument validity with DFL\_HIGH resulted in a test statistic of 19.53 with an associated  $p$ -value of 0.000. Given a significance level of 1%, this result indicates that we cannot reject the null hypothesis that the equation is under-identified. Moreover, the KP LM test for DFL\_LOW resulted in a test statistic of 0.0469; we cannot reject the null hypothesis of under-identification here either because the  $p$ -value was not significant (i.e.  $p$ -value of 0.8257). To conserve space, we only show the results for DFL\_HIGH, but the results from DFL\_LOW are in line with those shown and available upon request.

The diagnostic tests suggested that our instrument is adequate for identifying the equation with DFL\_HIGH. In short, our main results are robust in accounting for the potential endogeneity of high DFL: Investors with higher DFL are more likely to hold sustainable investments in their portfolios.

#### 4.2 Different measures of digital financial literacy

First, we verified if the results were robust to different proxies of DFL, as suggested by [Lyons and Kass-Hanna \(2021a\)](#). [Table 6](#) provides a description of each proxy, while [Table A2](#) in the [Appendix](#) provides more details on how we built the single variables. It is worth emphasising here that the robustness checks follow a slightly different methodological approach compared to the baseline models. The latter identified sophisticated and unsophisticated levels of DFL by pooling different questions/variables depending on the financial practices considered. By contrast, the robustness checks are based on single questions/variables that provide differentiated information and, therefore, cannot be pooled.

We calculated respondents' awareness of DFS through three items that captured their knowledge about online and mobile sources of information regarding households' economic and financial decisions. We assessed positive financial behaviours with eight items related to

**Table 6.** Different measures of digital financial literacy

<i>Awareness of DFS (A_DFS)</i>	Knowing about the specific purpose and usage of available DFS.
<i>Positive financial behaviours (PFBs)</i>	Adopting proactive financial behaviours, seeking financial information and advice, exploiting the benefits of long-term planning and being cautious with respect to the risks of borrowing
<i>Positive financial attitudes (PFAs)</i>	Managing day-to-day finances while setting future goals, making prudent and responsible borrowing decisions and preparing for emergencies and retirement
<i>Self-protection from digital scams (SELFs_PROT)</i>	Ability to detect scams and frauds associated with DFS (e.g. identity and credential theft, malware, phishing attacks) and avoid trap by protecting data and financial resources

**Source(s):** Our elaboration from [Lyons and Kass-Hanna \(2021a\)](#)

financial education (2 items), financial advice, reaction to inflation, pre-financial purchase behaviour, financial anxiety, hyperbolic discounting, and financial information. We evaluated positive financial attitudes with two items about supplementary retirement plans and financial resilience. Lastly, we conceptualised self-protection as the ability to protect sensitive data when purchasing financial services or making payments online.

[Table 7](#) presents the estimates based on cross-cutting measures of DFL. The results show that positive financial behaviours and financial attitudes were significantly and positively associated with the probability of sustainable investing, with a marginal effect of 3.9 and 12.6%, respectively. DFS awareness (A\_DFS) and self-protection (SELF\_PROT) did not present a significant effect.

**Table 7.** Baseline models with different measures of digital financial literacy

Variables	SUST INV (1)	SUST INV (2)	SUST INV (3)	SUST INV (4)	SUST INV (5)
A_DFS	-0.010 (0.049)				
PFB		0.039*** (0.012)			
PFA			0.126*** (0.039)		
DFL_HIGH				0.148*** (0.036)	
SELF_PROT					0.039 (0.044)
Other control variables	Yes	Yes	Yes	Yes	Yes
REGION_FE	Yes	Yes	Yes	Yes	Yes
OCCUPATION_FE	Yes	Yes	Yes	Yes	Yes
Observations	4,587	4,587	4,587	4,587	4,587

**Note(s):** The table reports marginal effects and robust standard errors (in parentheses). SUST INV, sustainable investments; A\_DFSs, awareness of digital financial services; PFB, positive financial behaviour; PFA, positive financial attitude; DFL\_HIGH, high digital financial literacy; SELF\_PROT, self-protection. Regressions controlled for the same variables as before: gender, age, education, income, savings, mortgage, self-employed, married, minor under 18, financial literacy (BIG 3) ([Lusardi and Mitchell, 2014](#); [Kim et al., 2021](#)), bank, time, financial risk propensity, financial satisfaction, and any risky assets. Results are also controlled for region and occupation fixed effects. See [Appendix A1](#) for detailed definitions of all variables. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10% levels, respectively

**Source(s):** Authors' calculations

Once again, the results confirm that DFL has a positive and statistically significant impact on the probability of holding sustainable investments, regardless of the way it is measured and the prevailing behaviours or attitudes among investors.

#### 4.3 Different measures of financial literacy

As mentioned before, researchers have yet to establish a conclusive link between financial literacy and sustainable investing. In this regard, there may be analytical discrepancies when considering objective (Gutsche *et al.*, 2023) and subjective (Riedl and Smeets, 2017; Rossi *et al.*, 2019) measures of financial literacy. Subjective evaluations of financial literacy could be affected by biases such as overconfidence that generate ambiguous results. For this reason, we applied four alternative measures of financial literacy. Three were objective measurements referring to the number of correct answers to three (BIG 3; Kim *et al.*, 2021; Lusardi and Mitchell, 2014), five (BIG 5; Brunetti *et al.*, 2022; Collins, 2012), and seven (BIG 7; Calcagno and Monticone, 2015; Guiso and Jappelli, 2008) questions regarding financial literacy. The fourth was a subjective variable reflecting individuals' estimation of their (over)confidence regarding their financial competencies (as in Collins, 2012). Here, we used the number of correct responses to calculate each respondent's financial literacy index. Table A1 in the Appendix offers a detailed description of the variables.

Table 8 shows that no objective measure of financial literacy (BIG3, BIG5, or BIG7) exerted a significant effect on the probability of holding sustainable investments. On the contrary, we observed a positive and significant effect of self-assessed financial literacy on the probability of holding sustainable investments (with a marginal effect of 4.2%). Such evidence can be explained by the role of overconfidence in the link between risk attitude and sustainable investing: Previous studies found that people with higher self-assessed financial literacy tend

**Table 8.** Different measures of financial literacy under the DFL\_HIGH model

Variables	(1) SUST INV	(2) SUST INV	(3) SUST INV	(4) SUST INV
DFL_HIGH	0.148*** (0.036)	0.149*** (0.036)	0.152*** (0.036)	0.147*** (0.037)
BIG3	-0.037 (0.036)			
BIG5		-0.023 (0.024)		
BIG7			-0.005 (0.018)	
SA_FL				0.042*** (0.011)
Other control variables	Yes	Yes	Yes	Yes
REGION_FE	Yes	Yes	Yes	Yes
OCCUPATION_FE	Yes	Yes	Yes	Yes
Observations	4,587	4,587	4,587	4,587

**Note(s):** The table reports marginal effects and robust standard errors (in parentheses). SUST INV, sustainable investments; BIG 3, 3 objective questions of financial literacy (Lusardi and Mitchell, 2014; Kim *et al.*, 2021); DFL\_HIGH, high digital financial literacy; BIG 5, 5 objective questions of financial literacy (Collins, 2012; Brunetti *et al.*, 2022); BIG 7, 7 objective questions of financial literacy (Guiso and Jappelli, 2008; Calcagno and Monticone, 2015); SA\_FL, self-assessed financial literacy. Regressions controlled for the same variables as before: gender, age, education, income, savings, mortgage, self-employed, married, minor under 18, financial literacy, bank, time, financial risk propensity, financial satisfaction, and any risky assets. Results are also controlled for region and occupation fixed effects. See Appendix A1 for detailed definitions of all variables. \*\*\*, \*\* and \* indicate significance at the 1, 5 and 10% levels, respectively

**Source(s):** Authors' calculations

to be more overconfident (Heath and Tversky, 1991). At the same time, overconfidence has been proven to boost risk attitude (Broihanne *et al.*, 2014), which might translate into a higher probability of investing in sustainable assets; our prior results seem to align with this view (see Table 3). In summary, we established that overconfidence, linked to self-assessed financial literacy, significantly and positively influences sustainable investment more than objective financial literacy.

## 5. Discussion and conclusion

Our study pioneers a link between DFL and retail investors' sustainable investment holdings. To the best of our knowledge, no prior work has analysed this relationship, despite the increasing relevance of digitalisation in the financial industry. DFL plays a crucial role in shaping investment behaviours by enhancing investors' ability to access, interpret, and effectively utilise both financial and sustainability-related information.

Our results confirm that sophisticated digital financial skills significantly influence households' ownership of sustainable investments. This aligns with recent literature emphasising the transformative role of digitalisation in personal finance, which highlights how digital tools and platforms empower retail investors, improve access to financial markets, and support more informed investment decisions (He *et al.*, 2025; Park *et al.*, 2024). Notably, our study extends this narrative by showing that DFL not only promotes general financial participation but also specifically fosters sustainable investing. This contribution also builds on the ongoing debate on the role of digitalisation in shaping individual financial behaviours (e.g. Barone *et al.*, 2024; Park *et al.*, 2024; Zhang and Fan, 2024). While these works focus primarily on digital engagement and financial decision-making, our study extends this literature by exploring how digital financial literacy influences the uptake of sustainable investing—an emerging yet underexplored dimension.

Moreover, while sustainable investing is often associated with environmental goals, the concept of sustainability should also encompass social dimensions, including equitable access to financial services. Recent research (Zaimovic *et al.*, 2025) highlights how digital financial literacy—particularly when supported by appropriate attitudes and behaviours—can enhance financial inclusion. This suggests that promoting advanced digital financial skills not only supports environmental goals through ESG investments but also contributes to the broader social objectives of sustainability, by empowering individuals to participate more fully in financial systems.

Importantly, our results remain robust in the face of endogeneity concerns and different measures of DFL. In particular, we observed that the most predictive measures of DFL were those capturing investors' behaviours and attitudes towards, rather than awareness of, DFS. This echoes the findings of Barone *et al.* (2024), who, in their systematic review, identify constructs like satisfaction, perceived usefulness, intention to use and trust as crucial to understanding the decision-making process underpinning the adoption of digital financial tools.

We can interpret such evidence through the lens of the dual process theory (Thaler and Sunstein, 2008): Specifically, the influence of DFL on sustainable investing is likely mediated by reflective and deliberative thinking, rather than automatic and instinctive decision-making. Indeed, it appears that reflective thinking—characterised by conscious information processing, self-awareness, and autonomy—is a key driver of retail investors' likelihood to hold sustainable investments.

Furthermore, our study provides additional empirical evidence regarding the relationship between financial literacy and sustainable investing. We demonstrate that no objective measure of financial literacy exerts a significant effect on the probability of holding sustainable investments. The only variable that has a positive and significant effect is self-assessed financial literacy, which is deeply connected to overconfidence (Heath and Tversky, 1991). Similar to what we observe with DFL, we also show that sustainable investments are primarily driven by behavioural dimensions, such as confidence, attitudes, and engagement—rather than by objective measures of financial literacy.

Of course, this study features some limitations that may inspire future research. First, while we observed the ownership of sustainable investments, this does not necessarily reflect a deliberate investment behaviour or individual preference. Indeed, investors can hold sustainable assets in their portfolios for reasons other than personal choice (e.g. recommendations from financial advisors; default options in investment products). Future research could explore the motivations behind sustainable investment ownership, distinguishing between intentional decisions and externally driven allocations. Second, since our research focused on the Italian context, the findings may not be directly generalisable to other countries with different financial literacy levels, digital infrastructure, and regulatory frameworks. Expanding the analysis to a cross-country perspective would provide a broader understanding of how digital competencies shape sustainable investments globally.

From a policy perspective, our findings underline the importance of prioritising the development of digital financial literacy alongside financial literacy to foster proactive financial behaviours aimed at sustainability. Proper educational programs should be designed to not only help students build basic financial knowledge, but also gain the necessary digital skills needed to apply traditional knowledge on digital platforms. In addition, our results imply that policymakers could generate positive spillover effects by building a higher level of DFL among the population and encouraging more sustainable investing. Not only could DFL promote financial inclusion and alleviate poverty among financially disadvantaged households, but it could help individuals make more informed digital financial decisions and contribute to a more secure digital financial environment.

In conclusion, this study affirms that DFL plays a crucial role in promoting sustainable investing among households, which will hopefully prompt more investments in digital financial education programs that target less digitally savvy individuals.

#### Notes

1. The first edition of the survey, conducted in June 2020, involved a nationally representative sample of 5,011 respondents. Subsequent editions of the study (2021, 2022, and 2023) recontacted the same households and, whenever possible, re-interviewed the same individuals. This approach provides a longitudinal nature to the survey, allowing for more precise analyses due to the panel structure of the data. However, this study does not perform a panel analysis, as the 2022 edition was specifically designed to map the COVID-19 emergency. Consequently, a longitudinal analysis could not be conducted due to the absence of certain variables essential to our analysis.
2. See [Table A5](#) of the [Appendix](#) for further analyses where the independent variable is: (i) a composite indicator (DFL\_AGGREG); and (ii) 7 raw variables about DFL questions (DFL\_1; DFL\_2; DFL\_3; DFL\_4; DFL\_5; DFL\_6; DFL\_8). For the sake of space, we did not extend this analysis because the results did not pass the IV probit robustness check.
3. Region: 1: Piemonte; 2: Valle d'Aosta; 3: Lombardia; 4: Trentino-Alto A.; 5: Veneto; 6: Friuli-Venezia G.; 7: Liguria; 8: Emilia-Romagna; 9: Toscana; 10: Umbria; 11: Marche; 12: Lazio; 13: Abruzzo; 14: Molise; 15: Campania; 16: Puglia; 17: Basilicata; 18: Calabria; 19: Sicilia; 20: Sardegna.
4. Occupation: 1: Entrepreneur; 2: Self-employed Professional (architect, engineer, accountant, lawyer, etc.); 3: Executive, Senior Official (public or private sector); 4: Intermediate Manager (office manager, service head, highly responsible technician); 5: Employee (public, private company, shop assistant, etc.) with a permanent contract; 6: Employee (public, private company, shop assistant, etc.) with other types of contract; 7: Shopkeeper/Business Manager; 8: Manual Worker/Craftsman; 9: University Lecturer/School Director; 10: Teacher (primary, middle, secondary school); 11: Army or Law Enforcement Officer; 12: Non-commissioned Officers/Simple Ranks in the Army or Law Enforcement; 13: General/Specialist Doctor; 14: Medical Trainee (enrolled in medical specialisation schools); 15: Farmer Owner/Farm Manager; 16: Employed Farmer/Farm Labourer; 17: Housewife (working only at home); 18: Pensioner; 19: Unemployed (or awaiting first job); 20: Student and 21: Other.

#### Supplementary material

The supplementary material for this article can be found online.

## References

- Adomako, S., Danso, A. and Ofori Damoah, J. (2016), "The moderating influence of financial literacy on the relationship between access to finance and firm growth in Ghana", *Venture Capital*, Vol. 18 No. 1, pp. 43-61, doi: [10.1080/13691066.2015.1079952](https://doi.org/10.1080/13691066.2015.1079952).
- Alliance for Financial Inclusion (2021), "Digital financial literacy. Guideline note No.45", May.
- Anderson, A. and Robinson, D.T. (2022), "Financial literacy in the age of green investment", *Review of Finance*, Oxford University Press, Vol. 26 No. 6, pp. 1551-1584, [10.1093/rof/rfab031](https://doi.org/10.1093/rof/rfab031).
- Aristei, D., Gallo, M. and Vannoni, V. (2024), "Preferences for ethical intermediaries and sustainable investment decisions in micro-firms: the role of financial literacy and digital financial capability", *Research in International Business and Finance*, Elsevier, Vol. 71, 102483, [10.1016/j.ribaf.2024.102483](https://doi.org/10.1016/j.ribaf.2024.102483).
- Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120, doi: [10.1177/014920639101700108](https://doi.org/10.1177/014920639101700108).
- Barone, M., Bussoli, C. and Fattobene, L. (2024), "Digital financial consumers' decision-making: a systematic literature review and integrative framework", *International Journal of Bank Marketing*, Vol. 42 No. 7, pp. 1978-2022, [10.1108/ijbm-07-2023-0405](https://doi.org/10.1108/ijbm-07-2023-0405).
- Bauer, R. and Smeets, P. (2015), "Social identification and investment decisions", *Journal of Economic Behavior and Organization*, Vol. 117, pp. 121-134, [10.1016/j.jebo.2015.06.006](https://doi.org/10.1016/j.jebo.2015.06.006).
- Becker, G. (1975), "Human capital: a theoretical and empirical analysis, with special reference to education", in *Human Capital: a Theoretical and Empirical Analysis, with Special Reference to Education*, New York, National Bureau of Economic Research.
- Broihaane, M.-H., Merli, M. and Roger, P. (2014), "Overconfidence, risk perception and the risk-taking behavior of finance professionals", *Finance Research Letters*, Vol. 11 No. 2, pp. 64-73, doi: [10.1016/j.frl.2013.11.002](https://doi.org/10.1016/j.frl.2013.11.002).
- Brunetti, M., Ciciretti, R., Gentile, M., Linciano, N. and Soccorso, P. (2022), "Attitude towards financial planning of Italian households", CEIS Working Paper.
- Busch, T., Bauer, R. and Orlitzky, M. (2016), "Sustainable development and financial markets: old paths and new avenues", *Business and Society*, Vol. 55 No. 3, pp. 303-329, doi: [10.1177/0007650315570701](https://doi.org/10.1177/0007650315570701).
- Cadman, T. (2011), "Evaluating the governance of responsible investment institutions: an environmental and social perspective", *Journal of Sustainable Finance and Investment*, Vol. 1 No. 1, pp. 20-29, doi: [10.3763/jsfi.2010.0004](https://doi.org/10.3763/jsfi.2010.0004).
- Calcagno, R. and Monticone, C. (2015), "Financial literacy and the demand for financial advice", *Journal of Banking and Finance*, Elsevier, Vol. 50, pp. 363-380, [10.1016/j.jbankfin.2014.03.013](https://doi.org/10.1016/j.jbankfin.2014.03.013).
- Campiglio, E. (2016), "Beyond carbon pricing: the role of banking and monetary policy in financing the transition to a low-carbon economy", *ecological economics*, Elsevier, Vol. 121, pp. 220-230, doi: [10.1016/j.ecolecon.2015.03.020](https://doi.org/10.1016/j.ecolecon.2015.03.020).
- Choung, Y., Chatterjee, S. and Pak, T.-Y. (2023), "Digital financial literacy and financial well-being", *finance research letters*, Elsevier, Vol. 58, 104438, doi: [10.1016/j.frl.2023.104438](https://doi.org/10.1016/j.frl.2023.104438).
- Christiansen, C., Jansson, T., Kallestrup-Lamb, M. and Noren, V. (2023), "Households' investments in socially responsible mutual funds", *The Quarterly Review of Economics and Finance*, Elsevier, Vol. 87, pp. 46-67, [10.1016/j.qref.2022.11.005](https://doi.org/10.1016/j.qref.2022.11.005).
- Collins, J.M. (2012), "Financial advice: a substitute for financial literacy?", *Financial Services Review, Academy of Financial Services*, Vol. 21 No. 4, pp. 307-322.
- Cucinelli, D. and Soana, M.G. (2023), "Investor preferences, financial literacy and intermediary choice towards sustainability", *Research in International Business and Finance*, Elsevier, Vol. 66, 102027, [10.1016/j.ribaf.2023.102027](https://doi.org/10.1016/j.ribaf.2023.102027).
- Cunha, F.A.F.d.S., Meira, E. and Orsato, R.J. (2021), "Sustainable finance and investment: review and research agenda", *Business Strategy and the Environment*, Vol. 30 No. 8, pp. 3821-3838, doi: [10.1002/bse.2842](https://doi.org/10.1002/bse.2842).
- D'hondt, C., Merli, M. and Roger, T. (2022), "What drives retail portfolio exposure to ESG factors?", *Finance Research Letters*, Elsevier, Vol. 46, 102470, [10.1016/j.frl.2021.102470](https://doi.org/10.1016/j.frl.2021.102470).

- Evans, J.S.B.T. (2008), "Dual-processing accounts of reasoning, judgment, and social cognition", *Annual Review of Psychology*, Vol. 59 No. 1, pp. 255-278, doi: [10.1146/annurev.psych.59.103006.093629](https://doi.org/10.1146/annurev.psych.59.103006.093629).
- Gao, J. and Bansal, P. (2013), "Instrumental and integrative logics in business sustainability", *Journal of Business Ethics*, Vol. 112 No. 2, pp. 241-255, [10.1007/s10551-012-1245-2](https://doi.org/10.1007/s10551-012-1245-2).
- Giddings, B., Hopwood, B. and O'Brien, G. (2002), "Environment, economy and society: fitting them together into sustainable development", *Sustainable Development*, Vol. 10 No. 4, pp. 187-196, doi: [10.1002/sd.199](https://doi.org/10.1002/sd.199).
- Giglio, S., Maggiori, M., Stroebel, J., Tan, Z., Utkus, S. and Xu, X. (2025), "Four facts about ESG beliefs and investor portfolios", *Journal of Financial Economics*, Vol. 164, 103984, doi: [10.1016/j.jfineco.2024.103984](https://doi.org/10.1016/j.jfineco.2024.103984).
- Guiso, L. and Jappelli, T. (2008), "Financial literacy and portfolio diversification", Economics Working Papers ECO2008/31, European University Institute, pp. 2-35.
- Guiso, L., Haliassos, M. and Jappelli, T. (2002), *Household Portfolios*, MIT press, pp. 1-508.
- Gutsche, G. and Zwergel, B. (2020), "Investment barriers and labeling schemes for socially responsible investments", *Schmalenbach Business Review*, Vol. 72 No. 2, pp. 111-157, doi: [10.1007/s41464-020-00085-z](https://doi.org/10.1007/s41464-020-00085-z).
- Gutsche, G., Nakai, M. and Arimura, T.H. (2021), "Revisiting the determinants of individual sustainable investment — the case of Japan", *Journal of Behavioral and Experimental Finance*, Vol. 30, 100497, [10.1016/j.jbef.2021.100497](https://doi.org/10.1016/j.jbef.2021.100497).
- Gutsche, G., Wetzel, H. and Ziegler, A. (2023), "Determinants of individual sustainable investment behavior—a framed field experiment", *Journal of Economic Behavior and Organization*, Vol. 209, pp. 491-508, [10.1016/j.jebo.2023.03.016](https://doi.org/10.1016/j.jebo.2023.03.016).
- He, H., Jones, L., Lu, Y. and Gepp, A. (2025), "Technology-enabled innovations in financial markets and retail investors: a systematic literature review", *Journal of Accounting Literature*. doi: [10.1108/JAL-11-2024-0331](https://doi.org/10.1108/JAL-11-2024-0331).
- Heath, C. and Tversky, A. (1991), "Preference and belief: ambiguity and competence in choice under uncertainty", *Journal of Risk and Uncertainty*, Vol. 4 No. 1, pp. 5-28, doi: [10.1007/BF00057884](https://doi.org/10.1007/BF00057884).
- Höchstädter, A.K. and Scheck, B. (2015), "What's in a name: an analysis of impact investing understandings by academics and practitioners", *Journal of Business Ethics*, Vol. 132 No. (2), pp. 449-475, doi: [10.1007/s10551-014-2327-0](https://doi.org/10.1007/s10551-014-2327-0).
- Jolliffe, I.T. (1973), "Discarding variables in a principal component analysis. II: real data", *Journal of the Royal Statistical Society - Series C: Applied Statistics*, Vol. 22 No. 1, pp. 21-31, doi: [10.2307/2346300](https://doi.org/10.2307/2346300).
- Jolliffe, I.T. (1986), "Principal component analysis and factor analysis", in *Principal Component Analysis*, Springer New York, New York, NY, pp. 115-128, doi: [10.1007/978-1-4757-1904-8\\_7](https://doi.org/10.1007/978-1-4757-1904-8_7).
- Kahneman, D. (2013), "A perspective on judgment and choice: mapping bounded rationality", in *Progress in Psychological Science Around the World*, Vol. 1, Neural, Cognitive and Developmental Issues, pp. 1-47.
- Kaiser, H.F. (1960), "The application of electronic computers to factor analysis", *Educational and Psychological Measurement*, Vol. 20 No. 1, pp. 141-151, doi: [10.1177/001316446002000116](https://doi.org/10.1177/001316446002000116).
- Khan, S.Z., Yang, Q. and Waheed, A. (2019), "Investment in intangible resources and capabilities spurs sustainable competitive advantage and firm performance", *Corporate Social Responsibility and Environmental Management*, Vol. 26 No. 2, pp. 285-295, doi: [10.1002/csr.1678](https://doi.org/10.1002/csr.1678).
- Kim, H.H., Maurer, R. and Mitchell, O.S. (2021), "How financial literacy shapes the demand for financial advice at older ages", *The Journal of the Economics of Ageing*, Vol. 20, 100329, doi: [10.1016/j.jeoa.2021.100329](https://doi.org/10.1016/j.jeoa.2021.100329).
- Kleibergen, F. and Paap, R. (2006), "Generalized reduced rank tests using the singular value decomposition", *Journal of Econometrics*, Elsevier, Vol. 133 No. 1, pp. 97-126, [10.1016/j.jeconom.2005.02.011](https://doi.org/10.1016/j.jeconom.2005.02.011).

- Koskelainen, T., Kalmi, P., Scornavacca, E. and Vartiainen, T. (2023), "Financial literacy in the digital age—A research agenda", *Journal of Consumer Affairs*, Vol. 57 No. 1, pp. 507-528, doi: [10.1111/joca.12510](https://doi.org/10.1111/joca.12510).
- Lim, T. (2024), "Environmental, social, and governance (ESG) and artificial intelligence in finance: state-of-the-art and research takeaways", *Artificial Intelligence Review*, Vol. 57 No. 76, 76, doi: [10.1007/s10462-024-10708-3](https://doi.org/10.1007/s10462-024-10708-3).
- Linciano, N., Soccorso, P., Capobianco, J. and Caratelli, M. (2020), "Financial advisor investor relationship. Mirroring survey on sustainability and investments", *CONSOB Statistics and Analyses*, pp. 1-23.
- Liu, B., Wang, J., Chan, K.C. and Fung, A. (2021), "The impact of entrepreneurs's financial literacy on innovation within small and medium-sized enterprises", *International Small Business Journal: Researching Entrepreneurship*, Vol. 39 No. 3, pp. 228-246, doi: [10.1177/0266242620959073](https://doi.org/10.1177/0266242620959073).
- Löfgren, Å. and Nordblom, K. (2024), "Reconciling sustainability preferences and behavior—The case of mutual fund investments", *Journal of Behavioral and Experimental Finance*, Vol. 41, 100880, doi: [10.1016/j.jbef.2023.100880](https://doi.org/10.1016/j.jbef.2023.100880).
- Lusardi, A. and Mitchell, O.S. (2014), "The economic importance of financial literacy: theory and evidence", *American Economic Journal: Journal of Economic Literature*, Vol. 52 No. 1, pp. 5-44, American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203-2425, doi: [10.1257/jel.52.1.5](https://doi.org/10.1257/jel.52.1.5).
- Lyons, A.C. and Kass-Hanna, J. (2021b), "A multidimensional approach to defining and measuring financial literacy in the digital age", in *The Routledge Handbook of Financial Literacy*, Routledge, pp. 61-76.
- Lyons, A.C. and Kass-Hanna, J. (2021a), "A methodological overview to defining and measuring 'digital' financial literacy", *Financial Planning Review*, Vol. 4 No. 2, e1113, doi: [10.1002/cfp2.1113](https://doi.org/10.1002/cfp2.1113).
- Marinucci, M., Stacchini, M. and Travaglino, F. (2024), "Indagini sull'alfabetizzazione finanziaria e le competenze di finanza digitale in Italia: giovani".
- Morgan, P.J., Huang, B. and Trinh, L.Q. (2019), "The need to promote digital financial literacy for the digital age", in *THE DIGITAL AGE*.
- Mutascu, M., Horky, F. and Strango, C. (2023), "Good or bad? Digitalisation and green preferences", *Energy Economics*, Vol. 121, 106640, doi: [10.1016/j.eneco.2023.106640](https://doi.org/10.1016/j.eneco.2023.106640).
- Nilsson, J. (2009), "Segmenting socially responsible mutual fund investors: the influence of financial return and social responsibility", *International Journal of Bank Marketing*, Vol. 27 No. 1, pp. 5-31, doi: [10.1108/02652320910928218](https://doi.org/10.1108/02652320910928218).
- OECD (2022), "OECD/INFE toolkit for measuring financial literacy and financial inclusion 2022".
- Park, J., Yoo, J.W., Cho, Y. and Park, H. (2024), "Understanding switching intentions between traditional banks and internet-only banks among generation X and generation Z", *International Journal of Bank Marketing*, Vol. 42 No. 5, pp. 1114-1141, doi: [10.1108/ijbm-06-2023-0338](https://doi.org/10.1108/ijbm-06-2023-0338).
- Pedersen, L.H., Fitzgibbons, S. and Pomorski, L. (2021), "Responsible investing: the ESG-Efficient Frontier", *Journal of Financial Economics*, Vol. 142 No. 2, pp. 572-597, doi: [10.1016/j.jfineco.2020.11.001](https://doi.org/10.1016/j.jfineco.2020.11.001).
- Pisano, U., Martinuzzi, A. and Bruckner, B. (2012), "Financial sector and sustainable development", ESDN Quarterly Report, Research Institute for Managing Sustainability Vienna University of Economics and Business, Vienna.
- Ravikumar, T., Suresha, B., Prakash, N., Vazirani, K. and Krishna, T.A. (2022), "Digital financial literacy among adults in India: measurement and validation", *Cogent Economics and Finance*, Vol. 10 No. 1, 2132631, doi: [10.1080/23322039.2022.2132631](https://doi.org/10.1080/23322039.2022.2132631).
- Richardson, B.J. (2009), "Keeping ethical investment ethical: regulatory issues for investing for sustainability", *Journal of Business Ethics*, Springer, Vol. 87 No. 4, pp. 555-572, [10.1007/s10551-008-9958-y](https://doi.org/10.1007/s10551-008-9958-y).
- Riedl, A. and Smeets, P. (2017), "Why do investors hold socially responsible mutual funds?", *The Journal of Finance*, Vol. 72 No. 6, pp. 2505-2550, doi: [10.1111/jofi.12547](https://doi.org/10.1111/jofi.12547).

- Rossi, M., Sansone, D., Van Soest, A. and Torricelli, C. (2019), "Household preferences for socially responsible investments", *Journal of Banking and Finance*, Vol. 105, pp. 107-120, doi: [10.1016/j.jbankfin.2019.05.018](https://doi.org/10.1016/j.jbankfin.2019.05.018).
- Siddik, A.B., Rahman, M.N. and Yong, L. (2023), "Do fintech adoption and financial literacy improve corporate sustainability performance? The mediating role of access to finance", *Journal of Cleaner Production*, Elsevier, Vol. 421, 137658, [10.1016/j.jclepro.2023.137658](https://doi.org/10.1016/j.jclepro.2023.137658).
- Sikken, B.J. (2011), "Accelerating the transition towards sustainable investing-strategic options for investors, corporations, and other key stakeholders", *Corporate Finance: Valuation*, World Economic Forum.
- Solon, G., Haider, S.J. and Wooldridge, J.M. (2015), "What are we weighting for?", *Journal of Human Resources*, Vol. 50 No. 2, pp. 301-316, doi: [10.3368/jhr.50.2.301](https://doi.org/10.3368/jhr.50.2.301).
- Stanovich, K.E. and West, R.F. (2000), "Advancing the rationality debate", *Behavioral and Brain Sciences*, Cambridge University Press, Vol. 23 No. 5, pp. 701-717, [10.1017/S0140525X00623439](https://doi.org/10.1017/S0140525X00623439).
- Stock, J.H. and Yogo, M. (2005), "Testing for weak instruments in linear IV regression", in Andrews, D.W.K. and Stock, J.H. (Eds), *Identification and Inference for Econometric Models*, 1st ed., Cambridge University Press, pp. 80-108, doi: [10.1017/CBO9780511614491.006](https://doi.org/10.1017/CBO9780511614491.006).
- Thaler, R.H. and Sunstein, C.R. (2008), *Nudge: Improving Decisions About Health, Wealth, and Happiness*, Yale University Press, pp. 1-293.
- Weber, O. (2014), "The financial sector's impact on sustainable development", *Journal of Sustainable Finance and Investment*, Vol. 4 No. 1, pp. 1-8, doi: [10.1080/20430795.2014.887345](https://doi.org/10.1080/20430795.2014.887345).
- Widyawati, L. (2020), "A systematic literature review of socially responsible investment and environmental social governance metrics", *A Systematic Literature Review of Socially Responsible Investment and Environmental Social Governance Metrics*, No. 29, pp. 619-637, doi: [10.1002/bse.2393](https://doi.org/10.1002/bse.2393).
- Wins, A. and Zwergel, B. (2016), "Comparing those who do, might and will not invest in sustainable funds: a survey among German retail fund investors", *Business Research*, Vol. 9 No. 1, pp. 51-99, doi: [10.1007/s40685-016-0031-x](https://doi.org/10.1007/s40685-016-0031-x).
- Wooldridge, J.M. (1999), "Asymptotic properties of weighted m-estimators for variable probability samples", *Econometrica*, Vol. 67 No. 6, pp. 1385-1406, doi: [10.1111/1468-0262.00083](https://doi.org/10.1111/1468-0262.00083).
- Yang, X., Meng, W., Chen, S., Gao, M. and Zhang, J. (2021), "Are people altruistic when making socially responsible investments? Evidence from a tDCS study", *Frontiers in Neuroscience*, Vol. 15, 704537, doi: [10.3389/fnins.2021.704537](https://doi.org/10.3389/fnins.2021.704537).
- Zaimovic, A., Omanovic, A., Nuhic Meskovic, M., Arnaut-Berilo, A., Zaimovic, T., Dedovic, L. and Torlakovic, A. (2025), "The nexus between digital financial knowledge and financial inclusion: digital financial attitudes and behaviour as mediators enhancing financial inclusion", *International Journal of Bank Marketing*, Vol. 43 No. 2, pp. 388-423, doi: [10.1108/IJBM-01-2024-0053](https://doi.org/10.1108/IJBM-01-2024-0053).
- Zhang, Y. and Fan, L. (2024), "The nexus of financial education, literacy and Mobile fintech: unraveling pathways to financial well-being", *International Journal of Bank Marketing*, Vol. 42 No. 7, pp. 1789-1812, doi: [10.1108/IJBM-09-2023-0531](https://doi.org/10.1108/IJBM-09-2023-0531).
- Zhou, Y. (2022), "The application trend of digital finance and technological innovation in the development of green economy", *Journal of Environmental and Public Health*, Vol. 2022 No. 1, 1064558, doi: [10.1155/2022/1064558](https://doi.org/10.1155/2022/1064558).

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