Digital Engagement Practices and Financial Assets Trading*

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ABSTRACT

This paper examines the association between the use of digital media to trade financial assets and the frequency with which these financial assets are traded. After concluding that there is a positive association between the use of digital media and the frequency with which investors trade financial assets, we then analyse the association between the existence of automatically generated messages on the platform through which transactions are made and the frequency with which investors trade online. The main conclusion is that the way trading platforms are designed and the continued contact they have with their users help to explain the higher number of trades made by investors who use digital media, particularly those who trade stocks, bonds and/or investment funds.

Keywords: Digital engagement practices; Financial assets.
JEL Codes: G10

I. Introduction

THE DEVELOPMENT of digital media has contributed to changing the way information reaches investors and how investors act on that information (Barber & Odean, 2001), particularly regarding how they transmit their orders to buy and sell financial assets.

Investors can access much more statistical data and other information through the internet. They often make financial decisions without any help from financial intermediaries. An increasingly common topic of research is how this different environment influences investors' decision-making.

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According to the statistical information published in the Portuguese Securities Market Commission's (CMVM) 'Long Series', the weight of orders received (and executed) on behalf of third parties in the spot market, transmitted by clients of financial intermediaries via the internet and other digital means, increased from 5% in 2005 to 46.9% in 2023 (Figure 1). This significant increase in the importance of digital means in transmitting orders indicates the growing importance of the internet in financial markets.

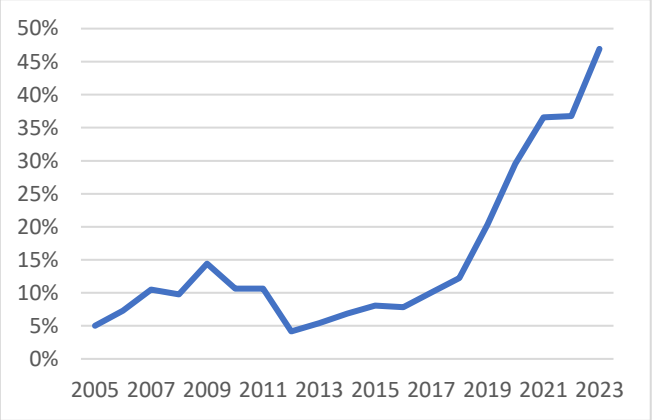

Figure 1
Weight of orders transmitted via the internet channel (and other digital means) in the total spot market. (Source: CMVM. Calculations: Author)

The use of digital media provides investors with easier access to their financial and investment accounts, lower costs, greater simplicity and ease of trading, and greater speed of execution, among other things. Several authors conclude that investors who use the internet to trade financial assets trade more frequently (Barber & Odean, 2015; Ozik et al., 2021), on stock trading; Choi et al. (2002), in the context of 401(k) retirement savings plans; Barber et al. (2022), on stock trading by users of the Robinhood platform). Fender (2022) states that around 75% of investors aged between 25 and 34 report that the use of digital media (apps) has increased their trading frequency. In Pan et al. (2023), the intensity of use of the online channel is associated with an increase in trading volume and trading frequency, but these effects differ between investors with different risk preferences. On a different note, Bogan (2008) concludes that the internet has had a positive effect on the stock market as it has allowed small investors to participate more in this market.

Among digital media, mobile apps favour increased trading. Cen and Li (2023), for example, conclude that the adoption of mobile apps leads to significant increases in investment fund transactions. In the same vein, the migration from using the internet on personal computers (for trading financial assets) to smartphones has had a pronounced effect on investor behaviour and is associated with an increase in the volume of investment funds traded (Cen, 2024).

Several factors may have contributed to the success of digital media in the trading of financial assets. The absence, sometimes only apparent, of transaction fees, which is common on electronic trading platforms, can encourage investors to trade more frequently (Chaudhry & Kulkarni, 2021; Welch, 2022). Even-Tov et al. (2022), for

example, show that investors notably react to changes in the transaction fees charged, trading more frequently after the removal of trading fees.

The internet has also made it possible to reduce information costs, which has contributed to transforming the trading activity of retail investors (Gao & Huang, 2019). Furthermore, it allowed investors access to a broader range of information, leading to excessive transactions (Havakhor et al., 2025).

In this context, the first research question addressed in this paper is the following:

RQ1: *Do individual investors who use the internet to trade financial assets trade more frequently?*

Linked with RQ1, we also address the question:

RQ1a: *Is online frequency of trading different for different types of financial assets?*

Digital media can increase users' illusion of knowledge and control, contributing to overconfidence, which can lead to less informed decisions. In addition, the conception, design and characteristics of digital trading platforms can influence investors' behaviour, encouraging an increase in the frequency of transactions and risk-taking in a way that is inconsistent with the investment objectives of the users of these platforms. The digital engagement practices (DEP)[1] that some electronic trading platforms use are an example of the influence that the conception and design of trading platforms can have on investor behaviour.

DEP are "tools that include behavioral techniques, differential marketing, gamification, design elements, or design features that intentionally or unintentionally engage retail investors on digital platforms" (Securities and Exchange Commission (SEC), 2021). Examples of DEP include notifications (frequent and unsolicited by users) with market news, other notifications via email and text, interface design that draws attention to specific information and social networking tools that allow users to interact (Securities and Exchange Commission (SEC), 2021). Among the concerns associated with the use of DEP by digital platforms is the possibility that increased user involvement in trading applications encourages increased trading frequency and risk-taking in a manner inconsistent with the investment objectives of the users of these platforms.

Among the DEP that academic literature has considered are those described in the following paragraphs.

Asset lists/ranking: The presentation of lists or rankings of assets or price changes has an impact on investor behaviour. Barber et al. (2022) document how app/platform notifications, such as lists of top movers, influence investors' trading decisions; in particular, focusing investors' attention on a small number of stocks contributes to promoting herding behaviour. According to OSC (2022a), in an online experiment, showing participants a list of the most traded stocks does not increase trading

[1] Designation given by the Securities and Exchange Commission (SEC).

frequency, but it does increase the likelihood that participants will trade popular stocks. Jacobs and Hillert (2015) present evidence that stocks that appear near the top of an alphabetical list are traded more. Wu and Wu (2024) analyse whether trading activity is different for investors using mobile devices compared to investors using personal computers and concluded that stocks that appear with a higher ranking are bought more by investors using mobile devices than those with a lower ranking; however, this is not the case for investors using personal computers. Frydman and Wang (2020) report that changes in the display of price information have an impact on intentions to sell shares and units in investment funds. Hong et al. (2025) report that the prominence given to lists of investment funds influences investors' fund choices.

Investor ranking: Investor ranking is an explicit form of social comparison. By providing the opportunity to see (and show) each investor's position in relation to other investors, ranking attempts to tap into the desire for recognition and the innate tendency towards social comparison and competition. Such comparison can be seen as a form of social influence in which an investor changes their behaviour as a result of observing the behaviour of other investors. This change in behaviour can have important repercussions on financial decision-making and risk-taking (Krull et al., 2024)[2]. Comparison with investors who obtain better returns on their investments (comparison with 'better' peers) can result in an increase in transactions made by investors who are ranked worse (Andraszewicz et al., 2023; Krull et al., 2024). In laboratory experiments, Gathergood et al. (2024) found no statistical evidence that the presentation of investor ranking was associated with an increase in the number of investor transactions, only an increase in the number of shares purchased.

Interaction with other investors: Social interaction on social trading platforms influences investors' trading frequency, either through comments posted on the platforms (Ammann & Schaub, 2021; Jin & Yu, 2022), or because the interest of other investors increases the level of gratification obtained from trading (Pelster & Breitmayer, 2019) or overconfidence (Breitmayer et al., 2018). Furthermore, the permanent observation and scrutiny of other investors impacts the disposition effect as individuals become more self-aware of their actions (Gemayel & Preda, 2018; Pelster & Hofmann, 2018). Bursztyn et al. (2014) present evidence that the knowledge that a colleague has bought an asset or that a colleague has a certain asset in the portfolio affects investment decisions, particularly in the case of less sophisticated investors.

Possibility of copying other investors' trades: Some trading platforms offer users (followers) the possibility of receiving information about trades made by other investors (signal providers) and making identical trades. Some academic research has concluded that followers tend to take on more risk (Broihanne, 2023) or overreact when signal providers take on more risk (Apesteguia et al., 2020). Pelster and Breitmayer (2019) report that signal providers who are followed have greater trading activity and Kourtidis et al. (2011) conclude that social influence through peer

[2] This comparison with 'better' peers is a form of upward social comparison (OSC, 2022b).

recommendations generally impacts trading frequency. Jin et al. (2019) also report that followers trade more frequently.

Receiving emails, SMS or other alerts/communications: Although some empirical work concludes that technologies that exogenously disseminate information allow investors to make more informed decisions (Farrell et al., 2022), other studies show that new technologies can trigger or amplify overconfidence in retail investors, which leads to excessive transactions that result, for example, from the attention induced on (specially) inexperienced investors (Barber et al., 2022). Cai and Lu (2019) conclude that the frequency of attention to matters of a financial nature promotes trading activity, increasing investors' net purchases. Havakhor et al. (2025) also point out that, for non-professional investors, the exposure allowed by technologies to price information promotes an illusion of knowledge and control, which contributes to excessive transactions. The existence of price alerts, for example, can lead to the neglect of long-term investment objectives because investors are led to focus their attention on short-term price fluctuations, creating a sense of urgency and fear of missing out (FOMO), resulting in increased pressure to carry out transactions (Chen et al., 2023). Moss (2022) documents that, compared to trading carried out by other investors, non-professional investors increase trading by at least 25% within fifteen minutes of receiving push notifications[3] regarding price changes of +-5%. Gathergood et al. (2024) concluded in laboratory experiments that the existence of push notifications increases the number of transactions made by investors, and Chapkovski et al. (2024) report that the receipt of commemorative messages is associated with an increase in trading volume.

Receiving scarcity messages: This type of message includes claims of scarcity (that a product or service will not be available for a long time due to limited supply, pending price increases, or other factors). These messages are based on the loss aversion and scarcity bias of human beings (Kahneman & Tversky, 1979), and can pressure investors to immediately make a transaction, without carrying out additional analysis or due diligence (OSC, 2022b).

Receiving messages with suggestions: Using data from an e-commerce platform, Zhu et al. (2023) examine the impact of suggestions issued about investment funds and conclude that suggested funds experience a significant increase in subscriptions, especially among investors with lower education and low income. This behaviour is associated with a significant reduction in the time spent searching for information on investment funds.

Variable prizes and insignificant rewards: The awarding of variable prizes (for example, 'scratch cards' or 'wheel of fortune') may be associated with the pleasure of gambling. Gathergood et al. (2024) found evidence that the existence of prizes helps to increase the number of trades. In the context of an experiment, OSC (2022a) concludes

[3] Push notifications are frequent pop-up notifications that inform users about market movements.

that participants who received points of negligible economic value for trading stocks significantly increased their trading activity. Chapkovski et al. (2024) conclude that awarding badges is associated with an increase in trading volume, and in Broihanne (2023) awarding badges with no economic value could increase the allocation of funds to the risky (safe) asset if such badges were awarded to achieve a risky (safe) portfolio.

Thus, the third and fourth research questions analysed in this paper are the following:

RQ2: *Is the existence of digital engagement practices positively associated with the frequency with which investors rebalance their investment portfolio online?*

RQ2a: *Do digital engagement practices have different impact for different types of financial products?*

This study begins by examining the association between the use of digital media to trade financial assets and the frequency with which these financial assets are traded. After concluding that there is a positive association between the use of digital media and the frequency with which investors trade different types of financial assets, we then analyse the association between the existence of automatically generated messages on the platform through which transactions are made and the frequency with which investors adjust their investment portfolio online. The main conclusion is that the way trading platforms are designed and the continued contact they have with their users help explain the greater number of transactions made by investors who use digital media, particularly investors who trade stocks, bonds and/or investment funds.

Our contributions to the literature are threefold. First, we show that the use of digital media to trade financial assets is positively associated with the trading frequency of various types of assets (and not only with the trading of more conventional ones, like stocks, bonds and investment funds). As far as we know, this paper is the first one to unveil such an association, in the case of more complex financial assets (such as warrants, CFD, ETC, for example) and also crypto assets. Second, we show that there is a positive association between the frequency with which investors trade online and the possibility to interact with other investors, the dissemination of information in relation to asset or company ratings, and the sending of automatic emails, SMS or other communications to investors via the app/platform. This positive association exists in the case of investors trading stocks, bonds and/or investment funds, but lacks statistical significance for those who trade crypto assets. Third, we also show that the information obtained on social media leads to more frequent trading by investors who trade stocks, bonds and/or investment funds, but not those who trade crypto assets.

The paper is structured as follows. Section 2 presents the database used in the study. Section 3 analyses the association between the use of digital media and the frequency with which financial asset transactions are carried out. Section 4 studies the association between the frequency of investment portfolio movements and the existence of automatically generated messages on trading platforms. The conclusions are presented in section 5.

II. Data

The database used in this paper comes from the survey carried out in 2023 by CMVM as part of the protocols signed with various higher education institutions in Portugal. This survey was published by the institutions associated with the university context with which the CMVM has established protocols, as well as by the CMVM (on its website and social networks).

The survey was conducted online between March 1 and April 13, 2023. The survey questions can be found in Annex I, none of which are compulsory. The number of valid responses was 1,458[4]. The majority of respondents identify themselves as men (54.9%), 44.1% are women and 1.0% indicate another gender or do not answer. More than half of the respondents are under 35 years of age (58.5%) - Table 1.

With regard to the highest level of education completed, 64.9% of respondents have completed at least a bachelor's degree; 29.6% are attending higher education (polytechnic or university) and 8.0% are attending a master's degree, a postgraduate course or doctorate (since they claim to have completed their bachelor's degree and to be students). The main area of study is economics, management or a related area for 15.1% of respondents.

Less than half of the respondents identified themselves as employees, while 50.6% are students or student-workers. Regarding net monthly household income, 14.5% of respondents indicate having less than €1,000, 46.5% indicate an income between €1,001 and €2,500, and 37.5% indicate an income of more than €2,500.

The analysis carried out in this study is based on responses obtained through a non-random convenience sampling procedure. Scientific sampling criteria were not followed when obtaining this sample, as only those individuals who were aware of the existence of the survey and who voluntarily accessed the websites on which the survey was published were able to respond. For this reason, the results and conclusions presented should be interpreted cautiously and not be mechanically extrapolated to the entire population.

III. The use of digital media for trading financial assets

A. Methodology

This text begins by analysing the association between the use of digital means to trade financial assets and the frequency with which these financial assets are traded. The dependent variable used is the frequency of financial portfolio rebalancing (*Mov_Portfolio*), which takes the value 1, if the respondent does not rebalance the financial portfolio; 2, if the respondent rebalances the portfolio at least once a year; 3, if rebalancing occurs at least once a month; 4, if rebalancing occurs at least once a week; and 5, if the respondent trades financial instruments[5] every day[6].

[4] The number of answers per question may be different as it is not compulsory to answer the survey questions.

[5] In this text, the terms "financial investments" and "financial assets" are used synonymously for the sake of convenience.

[6] Among the respondents, 569 respondents said they did not have a financial investment portfolio and 34

In the first approach, the independent variable corresponds to the use of digital media to rebalance the financial portfolio. Thus, the *Internet* variable is a binary variable, which takes on the value of 1 for respondents who say they use apps on the internet or a cell phone to trade shares, corporate bonds, investment funds, contracts-for-differences (CFD), exchange-traded certificates (ETC), warrants, options, futures, other complex financial products or crypto assets (and zero otherwise).

Table 1: Sample description.
(*) In the full sample (1,458).

Variables	Frequency	Percentage (*)
Gender	***1,446***	***99.2%***
Female	643	44.1%
Male	800	54.9%
Other	3	0.2%
Age	***1,447***	***99.2%***
Between 18 and 25 years old	596	40.9%
Between 26 and 35 years old	257	17.6%
Between 36 and 50 years old	352	24.1%
Over 50 years old	242	16.6%
Education	***1,449***	***99.4%***
Secondary school or less	71	4.9%
Attended higher education	432	29.6%
Higher education completed	426	29.2%
Master's/MBA/PhD	520	35.7%
Employment status	***1,450***	***99.5%***
Self-employed	71	4.9%
Employees	607	41.6%
Worker-student	223	15.3%
Student	514	35.3%
Other	35	2.4%
Monthly (net) household income	***1,436***	***98.5%***
Up to €500	41	2.8%
Between €501 and €1,000	171	11.7%
Between €1,001 and €2,500	678	46.5%
Between €2,501 and €5,000	434	29.8%
More than €5,000	112	7.7%

Since the dependent variable (*Mov_Portfolio*) reflects an (increasing) order in the frequency with which financial asset trades are carried out, the model

$$Mov\_Portfolio = f\,(Internet) \qquad (1)$$

cannot be estimated by ordinary least squares. This model has the characteristics of an ordered *Logit*, so it is estimated by maximum likelihood.

did not answer this question.

B. Results

Table 2 shows the results of estimating model (1). Column [1] of this table shows that the *Internet* variable is statistically significant, and its positive coefficient indicates a positive association between the frequency with which respondents trade financial assets and the use of the internet or mobile apps to trade financial assets. In other words, respondents who use digital media to trade financial assets rebalance their financial investment portfolio more often than those who do not use digital media, so using the internet is associated with a higher frequency of financial asset transactions.

Table 2: Trading of financial assets and the internet.
Notes: 1. The dependent variable is Mov_Portfolio, defined as 1, if the respondent does not rebalance the portfolio; 2, if they trade financial assets at least once a year; 3, if they trade financial assets at least once a month; 4, if they trade financial assets at least once a week; and 5, if they trade financial assets every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who say they have a financial investment portfolio. 4. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 5. Values in brackets correspond to z-stats. 6. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Variables	**[1]**		**[2]**		**[3]**	
Internet	0.991	***	0.890	***	0.865	***
	(5.70)		(4.95)		(4.71)	
Age			-0.002	*	-0.001	
			(-1.71)		(-1.52)	
Male			0.455	***	0.440	***
			(3.23)		(3.00)	
Income_High			0.068		0.093	
			(0.52)		(0.69)	
Income_Low			0.374		0.399	*
			(1.55)		(1.65)	
Occupation_Active			0.108		0.194	
			(0.72)		(1.03)	
LitFin_Self-Assessment					0.002	
					(0.38)	
LitDig_Self-Assessment					-0.021	**
					(-2.11)	
LitFin_High					0.201	
					(1.36)	
LitFin_Average					0.544	
					(1.26)	
Student					0.093	
					(0.55)	
Economy					-0.002	
					(-0.33)	
Num. Obs.	855		855		855	
Pseudo R2	0.011		0.018		0.022	
LR stat	24.8		42.6		50.7	
Prob.	0.000		0.000		0.000	

This conclusion is robust (in Table 2, column [2], the respondents' sociodemographic characteristics are included as independent variables). Several authors have concluded that age (Cen, 2024; Cen & Li, 2023; Choi et al., 2002; Fender, 2022; Gathergood et al., 2024; Ramachandran, 2022), gender (Cen, 2024; Cen & Li, 2023; Choi et al., 2002;

Gathergood et al., 2024), income (Abreu & Mendes, 2020; Choi et al., 2002; Zhu et al., 2023) and occupation (Abreu & Mendes, 2020; Choi et al., 2002) can influence investors' trading activity.[7] In the case of this paper, there is statistical evidence that men and young people trade more frequently than other investors (the variables *Age* and *Male* are statistically significant at 10% and 1% significance, respectively, in two-sided tests).

The various dimensions of literacy (financial and digital; objective knowledge[8] and self-assessment; schooling and area of education) can also influence trading activity (see, for example, Abreu & Mendes, 2020; Cen, 2024; Gathergood et al., 2024; Havakhor et al., 2025; Zhu et al., 2023), therefore, they are also considered in this study (Table 2, column [3]).[9] The results indicate that financial literacy and schooling are not relevant, whereas digital literacy is more relevant, in that investors with a better self-assessment of their digital literacy trade less frequently than others.

We have concluded that the use of digital media to trade financial assets is associated with more frequent transactions. Consequently, it is worth questioning whether this association is stronger in the case of individuals who use digital media more intensively, as they may enjoy greater advantages/more convenience in using the internet to trade financial assets. In contrast, those who use digital media only occasionally will enjoy fewer advantages/less convenience in using these media, given their reduced use. As a result, there should be no significant differences in the frequency of trading in financial assets by investors who occasionally use digital means to trade compared to those who use the telephone or go in person to the counters of their financial intermediary.

The results reported in Table 3 show that investors who use the internet intensively trade more frequently than those who use the internet more occasionally. The estimated coefficient of the *Internet_higher use* variable is around 6 times that of the *Internet_lower use* variable, so the frequency of transactions is much higher in the case of investors who use digital media at least once a day.

The positive association between the use of digital media and the frequency of trading in financial assets may be due to the existence of investors in crypto assets.[10] Given the specific characteristics of crypto assets, as well as their greater (historical) volatility compared to the generality of the other financial assets considered in this study, it is more likely that respondents who hold crypto assets trade more frequently and that this trading is carried out through digital means.

[7] Ramachandran (2023), for example, concludes that compared to older investors, younger investors are more likely to use digital trading platforms and rely on digital *stimuli*, and report that digital platforms increase their trading frequency.

[8] The survey does not provide an indicator of objective digital literacy, which is why this aspect is not considered in the analysis. Questions 19, 20, 21 and 22 of the survey (see Annex I) are used to compute objective financial literacy.

[9] Only the variable relating to self-assessment of digital literacy (*LitDig_Self-assessment*) is statistically significant at the usual levels of significance.

[10] For the sake of simplicity, this study considers crypto assets to be financial assets.

Table 3: Trading of financial assets and the internet - robustness.
Notes: 1. The dependent variable is Mov_Portfolio, defined as 1, if the respondent does not rebalance the portfolio; 2, if they trade financial assets at least once a year; 3, if they trade financial assets at least once a month; 4, if they trade financial assets at least once a week; and 5, if they trade financial assets every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who say they have a financial investment portfolio. 4. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 5. Values in brackets correspond to z-stats. 6. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Variables	**[1]**		**[2]**		**[3]**	
Internet - lower use	0.481	***	0.371	**	0.328	*
	(2.61)		(1.98)		(1.72)	
Internet - higher use	1.976	***	1.944	***	1.921	***
	(8.05)		(7.31)		(7.08)	
Sociodemographics	No		Yes		Yes	
Literacy	No		No		Yes	
Num. Obs.	855		855		855	
Pseudo R2	0.017		0.025		0.029	
LR stat	40.1		59.1		67.5	
Prob.	0.000		0.000		0.000	

Splitting the sample into three sub-samples (respondents who hold stocks, corporate bonds or investment funds; respondents who hold CFD, ETC, warrants, options, futures or other complex financial products; respondents who hold crypto assets or investments in crowdfunding) allows us to assess the relevance of this conjecture.

The results presented in Table 4 show that the positive association previously reported between the frequency of trading in financial investments and the use of digital means to carry out these transactions is not exclusive to trading in crypto assets.

Table 4: Trading of financial assets and the internet – by type of asset.
Notes: 1. The dependent variable is Mov_Portfolio, defined as 1, if the respondent does not rebalance the portfolio; 2, if they trade financial assets at least once a year; 3, if they trade financial assets at least once a month; 4, if they trade financial assets at least once a week; and 5, if they trade financial assets every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who say they have a financial investment portfolio. 4. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 5. Values in brackets correspond to *z*-stats. 6. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Variables	**[AOF]**		**[PFC]**		**[CRYPTO]**	
Internet - lower use	0.481	***	0.371	**	0.328	*
	(2.61)		(1.98)		(1.72)	
Internet - higher use	1.976	***	1.944	***	1.921	***
	(8.05)		(7.31)		(7.08)	
Sociodemographics	No		Yes		Yes	
Literacy	No		No		Yes	
Num. Obs.	855		855		855	
Pseudo R2	0.017		0.025		0.029	
LR stat	40.1		59.1		67.5	
Prob.	0.000		0.000		0.000	

In fact, whether trading more traditional financial products (shares, corporate bonds or investment funds - column AOF), trading in complex financial products (column PFC) or trading in crypto assets or crowdfunding (column CRYPTO), the estimated coefficient

of the variable *Internet - higher use* is positive and statistically significant (at less than 1% significance), which means that in all cases there is a positive association between the use of digital media and trading in financial investments, particularly for those who use the internet more intensively.

IV. Digital engagement practices and online trading of financial assets

The analysis in section 3 shows that there is a positive association between the use of digital media for trading various types of financial assets and the frequency with which investors carry out transactions. It is now important to ascertain, focusing the analysis only on trading through digital means, whether, in addition to the convenience that the use of digital means provides (greater ease of access, simplicity and ease of trading, lower costs, greater speed of execution, among others), there are other factors that drive investors' trading activity. Barber and Odean (2015), for example, state that the increase in trading by online investors can be explained by overconfidence (which is increased by self-attribution bias, the illusion of knowledge and the illusion of control).[11]

This section analyses the association between the frequency with which investors move their investment portfolio online and the existence of automatically generated messages or *pop-ups* on the platform through which financial asset transactions are made.

A. Digital engagement practices in the survey

In the survey, respondents were presented with a number of statements which, in essence, correspond to possible DEP to which digital media users may be subject. These statements are as follows:

"*Please indicate how much you agree/disagree*[12] *with the following statements:*

When I trade financial assets via the internet or an app on my phone,

- *i) I am given the opportunity to carry out the same transactions as other investors;*
- *ii) I am allowed to interact with other investors (by sharing what I do, selling what they do, or contacting them directly);*
- *iii) I am provided with information on the profitability rankings of the app/platform's users;*
- *iv) I am awarded prizes of varying amounts (e.g., 'scratch cards' or 'wheels of fortune') when I make more transactions, or when I indicate other people's names as possible investors, or when I promote the app on social networks;*
- *v) I am given insignificant or non-economic rewards (e.g., points or badges) for carrying out certain tasks or achieving certain goals;*

[11] "Overconfidence - augmented by self-attribution bias and the illusions of knowledge and control - can explain the increase in trading and reduction in performance of online investors." (Barber & Odean, 2002, Abstract).

[12] On a scale of 1 (totally agree) to 5 (totally disagree).

vi) I receive pop-ups stating that the price at which I am willing to buy/sell will only be available for a limited period of time (a few seconds or minutes);

vii) I am provided with information on rankings of financial assets or companies that have been most frequently traded on the app/platform; and

viii) I often receive suggestions to invest in financial assets that I have never traded in".

The survey also included another statement, which asked for the degree of agreement/disagreement on a scale of 1 (totally agree) to 5 (totally disagree):

ix) "Even when I am not using the app on the internet or on my cell phone to trade, I receive emails, SMS or other communication indicating, for example, that the price of a certain asset has gone up, down or changed a lot, or that I have not traded in a while."

In all these cases, agreeing (or completely agreeing) with one of these statements means that the respondent has experienced (or been exposed to) the situation described in that statement.

A binary variable is created for each of these statements, which is coded as 1 if the respondent completely agrees or agrees with the statement in question, and is equal to zero in all other situations (i.e. if the respondent completely disagrees, disagrees or neither disagrees nor agrees with the statement). These variables are named "*Copy*", "*Interact*", "*Ranking Users*", "*Reward", "Insignificant Reward*", "*Immediacy*", "*Ranking Assets*" and "*Suggestions*", respectively, for cases i) to viii). In addition, the variable "*SMS*" is related to statement ix).

Finally, the sum of the 9 binary variables, called "*All*", is calculated. The results of this calculation are shown in Table 5. It can be concluded that 124 respondents said they had not experienced/been exposed to any of the situations described, and 73 said they had already experienced (or been exposed to) one of the situations described in those statements. On the other hand, 18.89% (82 respondents) agreed or completely agreed with at least 5 of the statements produced, which means that they had experienced/been exposed to at least 5 of the 9 situations described.

Table 5: Digital engagement practices.

Note: The variable *All* represents the number of different types of automated messages received by the digital media user to trade financial assets.

All	Number	%	Cumulative %
0	124	28.57	28.57
1	73	16.82	45.39
2	65	14.98	60.37
3	54	12.44	72.81
4	36	8.29	81.11
5	39	8.99	90.09
6	21	4.84	94.93
7	12	2.76	97.70
8	2	0.46	98.16
9	8	1.84	100.00
Total	434	100.00	100.00

B. Digital engagement practices and the frequency of trading

Given the impact that the use of digital media has on the frequency of trading, trading activity exclusively through digital media is now analysed. In other words, respondents who rebalance their financial investment portfolio exclusively by means other than digital means are excluded from the analysis in this section.

The dependent variable used is the frequency of trading of financial assets (*Mov_Portfolio*) via the internet or mobile app, defined above. As an independent variable, we start by considering the variable *All* (which, as previously defined, corresponds to the number of different types of automatic messages received by the user of the trading platform).

Since the dependent variable reflects an order in the frequency with which financial instrument transactions are carried out, the model

$$Mov\_Portfolio = f(All) \qquad (2)$$

cannot be estimated by ordinary least squares. This model has the characteristics of an ordered *Logit*, so it is estimated by maximum likelihood.

Table 6: Frequency of trading and DEP.

Notes: 1. The dependent variable is Mov_Portfolio, defined as 1, if the respondent does not rebalance the portfolio; 2, if they trade financial assets at least once a year; 3, if they trade financial assets at least once a month; 4, if they trade financial assets at least once a week; and 5, if they trade financial assets every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who say they have a financial investment portfolio. 4. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 5. Values in brackets correspond to *z*-stats. 6. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Variables	**[1]**	**[2]**	**[3]**
All	0.188 ***		
	(4.33)		
5 or more		0.648 ***	
		(2.76)	
Social pressure			0.461 **
			(2.27)
Gamification			0.132
			(0.48)
Biases			0.374 *
			(1.73)
Num. Obs.	434	434	434
Pseudo R2	0.019	0.007	0.014
LR stat	21.2	8.0	15.4
Prob.	0.000	0.005	0.002

The results of estimating model (2) are shown in Table 6, and we can conclude (column [1]) that the variable *All* has a positive influence on the frequency with which investors make transactions. Thus, the more investors are exposed to the situations described in the statements above, the more frequently they trade. It follows that there is a positive association between exposure to the situations described and the frequency of portfolio rebalancing.

In order to analyse the robustness of this result, a new binary variable was constructed (called "*5 or more*"), defined as 1 in the case of respondents who agree or completely agree with at least 5 of the statements in question. This variable therefore corresponds to respondents who have been exposed to at least 5 of the situations described when trading financial assets via the internet or an app on their cell phone. The results of the model's estimation can be found in column [2] of Table 6 and confirm the existence of a positive association between the frequency of portfolio rebalancing and more intense exposure to these messages.

The DEP being analysed correspond to situations with different characteristics. We can group the 9 practices considered into 3 groups: a group relating to practices associated with what can be called 'social pressure', including "*Copy*", "*Interact*" and "*Ranking Users*"; a second group of practices associated with the 'gamification' of financial transactions, including "*Reward*" and "*Insignificant Reward*"; and finally, a third group of practices associated with the existence of other behavioural biases by investors, including "*Immediacy*", "*Ranking Assets*", "*Suggestions*" and *"SMS"*.

Thus, three new binary variables were created, described as follows:

1. *Social pressure* is equal to 1 if the respondent agrees or totally agrees with statements i) or ii) or iii), which means that they have been exposed to at least one of the three situations described in those statements. In other words, *Social pressure* = 1 if *Copy* = 1, or if *Interact* = 1, or if *Ranking Users* = 1;
2. *Gamification* is equal to 1 if the respondent agrees or totally agrees with statements iv) or v), which means that they have been exposed to at least one of the two situations described in those statements. In other words, *Gamification* = 1 if *Reward = 1*, or if *Insignificant Reward* = 1;
3. *Biases* is equal to 1 if the respondent agrees or totally agrees with statements vi), or vii), or viii), or ix), which means that they have been exposed to at least one of the 4 situations described in these statements. In other words, *Biases* = 1 if *Immediacy* = 1, or *Ranking Assets* = 1, or *Suggestions* = 1, or *SMS* = 1.

In order to try to identify the type of practices to which investors are more exposed and whether this greater exposure is associated with greater trading frequency, these three variables are used as independent variables in the model. The results of the estimation can be found in column [3] of Table 6 and allow us to conclude that the existence of social pressure and other behavioural biases is positively associated with greater trading activity in financial assets through digital means. The variables *Social pressure* and *Biases* are statistically significant (at 5% and 10% significance, respectively, in two-sided tests), with positive coefficients in both cases. On the other hand, exposure to gamification techniques is not associated with trading frequency, since the hypothesis that the coefficient of the *Gamification* variable is null is not rejected.

Table 7: Frequency of trading and DEP (2).

Notes: 1. The dependent variable is Mov_Portfolio, defined as 1, if the respondent does not rebalance the portfolio; 2, if they trade financial assets at least once a year; 3, if they trade financial assets at least once a month; 4, if they trade financial assets at least once a week; and 5, if they trade financial assets every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who say they have a financial investment portfolio. 4. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 5. Values in brackets correspond to *z*-stats. 6. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Variables	[1]	[2]	[3]	[4]
Copy	-0.190			-0.273
	(-0.79)			(-1.03)
Interact	1.043 ***			0.862 ***
	(3.34)			(2.79)
Ranking Users	0.253			0.032
	(1.15)			(0.13)
Prize		0.330		-0.044
		(0.95)		(-0.01)
Insignificant Reward		0.472		0.287
		(1.48)		(0.86)
Immediacy			0.165	0.034
			(0.73)	(0.16)
Ranking Assets			0.549 ***	0.462 **
			(2.74)	(2.17)
SMS			0.634 ***	0.540 ***
			(3.32)	(2.75)
Suggestions			-0.169	-0.205
			(-0.83)	(-0.96)
Num. Obs.	434	434	434	434
Pseudo R2	0.017	0.005	0.024	0.032
LR stat	19.0	5.9	26.9	36.1
Prob.	0.000	0.051	0.000	0.000

Another relevant issue is the identification of situations that may be more associated with investors' trading activity. Table 7 shows the results of estimating the model using the variables identified with situations i) to ix) as independent variables, by groups of variables (columns [1] to [3]) and the totality of these variables (column [4]).

The essential conclusion to be drawn from this set of results is that there is three DEP that have an impact on trading activity. In fact, only the variables *Interact*, *Ranking Assets* and *SMS* are statistically significant, at 5% significance or less, and with positive estimated coefficients in all three cases. This means that the possibility of interacting with other investors, the dissemination of information on rankings of assets or companies that were most frequently traded on the app/platform and the sending by the app/platform of emails, SMS or other types of communication to investors indicating, for example, that the price of a particular asset has gone up, down or had a large variation, or that the investor has not traded for some time, are situations associated with greater frequency of trading financial assets by digital means. These conclusions do not change if the control variables for investors' sociodemographic characteristics and literacy are introduced into the model (see tables AII.1 and AII.2 in Annex II).

C. Robustness analysis

An additional robustness analysis was carried out in consideration of the possibility that the estimates obtained were conditioned by other behavioural characteristics of the investors, not included in the sociodemographic or literacy factors.

Some authors point out that the financial market, and in particular the capital market, may be considered by some people to be a game. Mosenhauer et al. (2021), for example, conclude that behavioural addiction to gambling-like activities is associated with frequent trading on the stock market, while Abreu and Mendes (2020) report that investors who are looking for the pleasure of gambling trade warrants more frequently.

In this context, the fact that there are individuals who derive utility/pleasure from gambling may lead them to trade more frequently, as they derive utility from the fact that they frequently buy and sell financial assets. The survey has a question to assess the (non-)existence of this characteristic in the respondents: "*indicate how much you agree/disagree with the statement "I get pleasure from gambling - e.g., playing the lottery, EuroMillions, totoloto, scratch cards, etc.*". The response alternatives were "totally agree", "agree", "neither disagree nor agree", "disagree" and "totally disagree". Respondents who said they totally agree or agree with this statement are considered to have gambling characteristics, and the binary variable "*Pleasure in gambling*" was created, defined as 1 in the case of respondents who totally agree or agree with this statement (and zero otherwise).

On the other hand, the use of the internet allows for a presence in social networks. For Shiller (1984), investing in speculative assets is a social activity; investors spend a substantial part of their free time talking or reading about investments, or talking about the successes or failures of other investors. Age, gender and income are sociodemographic characteristics that can have an impact on the reliance on social networks for financial advice (Florendo & Estelami, 2019).

Social networks allow anyone with a phone or computer, regardless of their experience or incentives, to share information or investment advice, which implies that the quality of information varies significantly between and within social media platforms (Drake et al., 2017; Wang et al., 2015). Investors seem to access and trust investment advice given on social media, even when it has little or no predictive value (Wang et al., 2015). Although there is quality information on social media, the fact is that many investors trust the advice given on social media even when that advice is of poor quality (Kadous et al., 2025).

Ammann and Schaub (2021) find no evidence that the information contained in comments posted on social networks justifies investors making transactions, but they do report that posting comments on social networks is associated with a significant increase in trading by followers, mainly unsophisticated individuals who rely on investment-related posts on the internet to make investment decisions. For their part, Reiter et al. (2023) report that social media users trade more frequently than those who do not use social media.

The survey looks at the relevance of information obtained on social media to the frequency with which investors trade financial assets. In one of the survey questions, respondents are asked to indicate, on a scale of 1 (not at all important) to 5 (extremely important), the degree of importance of information obtained on social networks (Facebook, Instagram, LinkedIn, SnapChat, TikTok, Twitter-X and the like) in choosing their financial investments. With this information, the binary variable "*Social networks*" was created, defined as 1 in the case of respondents who considered this information to be very or extremely important (values 4 or 5) in choosing their financial investments.

Table 8: Frequency of trading and DEP - robustness.

1. The dependent variable is *Mov_Portfolio*, defined as 1, if the respondent does not rebalance the portfolio; 2, if they trade financial assets at least once a year; 3, if they trade financial assets at least once a month; 4, if they trade financial assets at least once a week; and 5, if they trade financial assets every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who claim to have a financial investment portfolio and use digital means to trade financial assets (column Full sample), or shares, corporate bonds or units in investment funds (column AOF), or crypto assets or crowdfunding (column CRYPTO). 4. The model is not estimated for the sub-sample of complex financial products due to insufficient number of observations. 5. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 6. Values in brackets correspond to *z-stats*. 7. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Variables	**Full sample**		**AOF**		**CRYPTO**
Copy	-0.053		-0.095		-0.346
	(-0.20)		(-0.30)		(0.93)
Interact	0.621	**	0.784	**	0.562
	(1.99)		(2.07)		(1.30)
Ranking Users	0.012		-0.086		0.253
	(0.05)		(-0.29)		(0.72)
Reward	0.052		0.041		-0.183
	(-0.14)		(0.09)		(-0.36)
Insignificant Reward	0.326		0.399		0.766
	(0.96)		(0.94)		(1.33)
Immediacy	0.012		-0.160		-0.054
	(0.05)		(-0.59)		(-0.14)
Ranking Assets	0.507	**	0.529	**	0.402
	(2.30)		(2.16)		(1.19)
SMS	0.517	**	0.503	**	0.260
	(2.45)		(2.22)		(0.84)
Suggestions	-0.218		-0.169		-0.154
	(-0.97)		(-0.66)		(-0.51)
Pleasure in Gambling	-0.028		-0.028		0.037
	(-0.09)		(-0.08)		(-0.08)
Social Networks	0.639	*	0.902	***	0.318
	(1.90)		(3.70)		(0.88)
Sociodemographics	Yes		Yes		Yes
Literacy	Yes		Yes		Yes
Num. Obs.	434		358		198
Pseudo R2	0.054		0.045		0.034
LR stat	60.9		38.9		16.2
Prob.	0.000		0.000		0.299

The results obtained by estimating this (extended) model are shown in Table 8 (column 'Full sample'). In this Table 8 we also present results for the subsamples of

investors who trade less complex financial products (column AOF) and for investors who trade crypto assets and crowdfunding (column CRYPTO).

A quick look at this Table 8 allows us to conclude that investors for whom information obtained on social networks is very or extremely important (particularly those who trade stocks, bonds and investment funds – column AOF) trade more frequently than others, but the pleasure of gambling is not associated with more frequent transactions. However, more important than this conclusion is that, on the one hand, this additional analysis reinforces the previous findings that there is a positive association between interaction with other investors, the dissemination of information in relation to asset or company rankings and the sending of emails, SMS or other communication to investors via the app/platform, and on the other hand, the frequency of trading financial assets via digital means. This is clear for investors who trade stocks, bonds and investment funds (column AOF). However, this association lacks statistical significance for investors who trade crypto assets (column CRYPTO), meaning that these investors do have different trading behaviour and react to different *stimuli*.

V. Conclusions

The results presented in this article allow us to draw the following key conclusions: i) there is a positive association between the use of digital means to trade financial assets and the frequency with which investors trade financial instruments; ii) this positive association does not occur exclusively when trading digital assets, as is the case with crypto assets and crowdfunding investments. It also occurs in the trading of simpler assets (stocks, bonds and investment funds) and more complex ones (warrants, CFD, etc.); iii) the continued contact that trading platforms have with the users of those platforms helps to explain, at least partially, the greater number of transactions made by investors who use digital media to trade simpler assets; iv) investors for whom the information obtained on social media is very or extremely important trade stocks, bonds and/or investment funds more frequently than others.

This set of results is clearly relevant for investors, companies, regulators and supervisory authorities. Indeed, the practices designed and adopted by platforms to engage investors more intensively may lead those investors to make decisions that are inconsistent with their investment objectives or their risk tolerance. Practices designed to motivate users of electronic platforms to trade more frequently, for example, may result in excessive trading, detrimental to investor welfare. Other practices that promote or direct investors towards securities, investment strategies or services that are more profitable for the company or may be riskier for the investor can also be detrimental to the investor.

Similarly, the positive association between the existence of notifications received by users of digital media and the frequency of transactions raises the question of to what extent and how the companies that own the digital platforms monitor these notifications and to what extent these notifications are directed at the target segment(s) and not at other segments of users of the platform. In addition, the notifications and messages received by investors must be clear and not misleading.

The relevance of social media in the frequency with which financial asset transactions are carried out raises the question of the quality of information circulating on social media. Filtering the information circulating on social media is increasingly important, especially as rumours and fake news spread faster than quality information and non-professional investors may find it difficult to identify and distinguish fake news from reliable information.

Finaly, the survey used in this paper is the only one that we know of that analyses the digital engagement practices used by trading platforms in Portugal. Given that scientific sampling criteria were not followed when obtaining the sample, our conclusions should be interpreted cautiously and recommend further scrutiny.

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ANNEX I - 4th CMVM/Universities Survey

Welcome to this CMVM survey, a tool of the utmost importance in pursuing our investor protection mission. The CMVM and the participating universities guarantee the confidentiality and anonymity of your answers. Please answer as accurately and honestly as possible.
Thank you for taking part in this survey, which lasts approximately 15 minutes.

1. Please indicate your gender.

   Female
   Male
   Other

2. What is the highest level of education you have completed?

   I did not complete elementary school
   I have completed primary education (4th grade/4th class)
   I have completed basic education (9th grade)
   I have completed secondary education (12th grade)
   I attended higher education
   I have completed higher education (polytechnic or university)
   I have a Master's degree, an MBA or a PhD

3. Indicate your main area of schooling/studies: _____

4. Indicate your age, in years _____ (*Accepted values: between 18 and 99*)

5. What employment or occupational situation are you in?

   Self-employed
   Employees
   Worker-Student
   Student
   Unemployed
   Retired
   Other (Which?)

6. What net monthly income bracket is your household in?

   Up to €500
   Between €501 and €1,000
   Between €1,001 and €2,500
   Between €2,501 and €5,000
   More than €5,000

7. How do you rate your knowledge of financial markets and products?

   Not at all knowledgeable
   Not very knowledgeable
   Moderately knowledgeable
   Knowledgeable
   Very knowledgeable

8. How do you rate your knowledge of the internet and new technologies compared to the average Portuguese population?

   Well below average
   Below average
   Equal to the average
   Above average
   Well above average

9. Indicate which of the following financial assets you currently hold:

   Current/term deposits
   Structured deposits
   Savings or treasury certificates/treasury bonds
   Stocks
   Corporate bonds/commercial paper
   Investment funds (excluding retirement savings and venture capital funds)
   Venture capital funds
   Retirement savings funds (FPR)
   Retirement savings plans (PPR)
   Pension funds
   PRIIP/Complex financial products, including warrants, ETC, CFD and other derivatives
   Insurance (health, multi-risk, life or car)
   Crowdfunding investments
   Bitcoins and/or other crypto assets
   Other (Which?)

10. When was the first time you invested money in the following financial assets? (possible answers: in the last year; more than 1 year ago, but less than 3 years ago; more than 3 years ago; I have never invested)

    Current/term deposits
    Structured deposits
    Savings or treasury certificates/treasury bonds
    Stocks
    Corporate bonds/commercial paper

Investment funds (excluding retirement savings and venture capital funds)
Venture capital funds
Retirement savings funds (FPR)
Retirement savings plans (PPR)
Pension funds
PRIIP/Complex financial products, including warrants, ETC, CFD and other derivatives
Insurance (health, multi-risk, life or car)
Crowdfunding investments
Bitcoins or other crypto assets

11. Your current securities portfolio (i.e., shares, corporate bonds, treasury bonds, investment fund units, futures, options, CFD/contracts for differences, ETC, other derivative products, complex financial products, among others, but Bitcoins and other crypto assets are not included here) represents approximately what percentage of your total assets?

I have no securities
Between 0% and 25%
Between 26% and 50%
Between 51% and 75%
More than 75%

12. Your current portfolio of Bitcoins and other crypto assets represent approximately what percentage of your total assets?

I have no crypto assets
Between 0% and 5%
Between 6% and 15%
Between 16% and 25%
Between 26% and 50%
More than 50%

13. My objectives when trading or investing in financial assets are (select all that apply):

I have no financial assets
Keeping the amount of money I have in real terms (i.e., the money I have in this account changes with inflation)
Saving and increasing my money with short-term goals in mind (in the next 1 or 2 years)
Saving and growing my money with medium- and long-term goals in mind
Testing and practising the knowledge I have acquired in my studies
To have fun
Other (please specify)

14. Suppose you are going to buy the following financial assets. Choose the option that applies most to you (Options: I prefer to do it myself, without involving any financial professional (e.g., account manager); I prefer to do it myself with the help of a financial professional; I prefer to have a financial professional handle everything for me)

    Investments (buying/selling/trading) in stocks, corporate bonds and/or investment funds
    Investments (buying/selling/trading) in warrants, ETC, CFD, derivatives and other complex financial products
    Investments (buying/selling/trading) in Bitcoins and other crypto assets

15. Indicate the degree of importance of the following sources of information in choosing your financial investment(s) [Scale from 1 (not at all important) to 5 (extremely important)]

    Advice at the counter of the financial institution where you purchase the product or from a person who provides financial advice
    Advice from family or friends
    Information disclosed by securities issuers
    Information obtained from the internet, including YouTube and others, but not from social networks
    Information obtained from social networks (Facebook, Instagram, LinkedIn, Snapchat, TikTok, Twitter and similar)
    Advice or opinion from influencers

16. Indicate how much you agree/disagree with the following statements (Options: totally agree; agree; neither disagree nor agree; disagree; totally disagree)

    I trust the financial markets to make my investments
    I enjoy gambling (e.g., playing the lottery, EuroMillions, lotto, scratch cards, etc.).
    I trust the financial services provided by online banks and FinTechs
    I try to keep up to date with matters relating to money and finance

17. How often do you rebalance your financial investments portfolio?

    Every day
    At least once a week
    At least once a month
    At least once a year
    No movement
    I do not have a financial investment portfolio

18. Suppose you have €100,000 to invest in the following options. How much would you invest in each of them (total value must be €100,000)?

    Bank deposits or similar products with capital guarantee

Savings or treasury certificates or treasury bonds
Debt securities (bonds) or investment funds with only this type of security
Equity investment funds
Shares in one or more companies you know well
PRIIP/Complex financial products (including warrants, ETC, CFD, other derivatives)
Bitcoins and other crypto assets
Gold, silver, oil or other commodities
Crowdfunding
Real estate, land and other non-financial assets

19. Suppose you have €100 in a bank account with an interest rate of 2% per year. After 5 years, how much will the account balance be if you do not withdraw any money from the account and there are no commissions or taxes associated with it (i.e. at the end of each year, the interest received stays in the same bank account)?

    More than €110
    Exactly €110
    Less than €110
    I do not know

20. Suppose you have €100 in a bank account with an interest rate of 2% per year and inflation of 3% per year. In a year's time, what do you think you could buy with the money in that account, knowing that you do not make any more deposits, you do not withdraw any money from the account and there are no taxes or commissions?

    I would be able to buy more things than I do today
    I would buy exactly the same things as I do today
    I would buy fewer things than I do today
    I do not know

21. You have invested in a bond that pays a fixed coupon rate. In the meantime, market interest rates have risen. If you sell this bond after this rise, the price of the bond should be:

    Lower than the price you bought it for
    Equal to the price at which you bought it
    Higher than the price you bought it for
    I do not know

22. In your opinion, indicate whether the following statements are true or false (options: true; false; I do not know).

A 15-year loan usually requires higher monthly payments than a 30-year loan, but the total interest paid over the life of the loan will be lower
Investing in the shares of a single company generally offers a safer return than investing in a mutual fund
Cryptocurrencies have the same legal tender status as banknotes and coins

23. Indicate how often you use digital media (apps on the internet or a cell phone) in the following situations (answer options: never; at least once a year; at least once a month; at least once a week; once a day; more than once a day)

Checking bank balances
Payment for purchases and services
Trading (buying and selling) shares, corporate bonds, investment funds
Trading (buying and selling) CFD, ETC, warrants, options, futures and other complex financial products
Trading (buying and selling) Bitcoins and other crypto assets

24. Say how you identify with the following statements (options: totally agree; agree; neither disagree nor agree; disagree; totally disagree)

I regularly change my passwords for the websites I use to shop online and manage my personal finances
I think it is safe to shop online using public wi-fi networks (in cafés, airports, shopping centres)
I am influenced by the opinions and suggestions of influencers when I trade financial assets through apps on the internet or on my cell phone

25. Please indicate how much you agree/disagree with the following statements (options: I do not trade financial assets via the internet or mobile app; totally agree; agree; neither disagree nor agree; disagree; totally disagree).

When I trade financial assets via the internet or an app on my phone ...
... I receive *pop-ups* stating that the price I am willing to buy/sell at will only be available for a limited period of time (a few seconds or minutes)
... I am allowed to interact with other investors (by sharing what I do, seeing what they do, or contacting them directly)
... I am awarded prizes of varying amounts (e.g., 'scratch cards' or 'wheels of fortune') when I make more transactions, or when I indicate other people's names as possible investors, or when I promote the app on social networks
... I am provided with information on rankings of financial assets or companies that have been most frequently traded on the app/platform
... I am provided with information on the profitability rankings of the app/platform's users

26. Please indicate how much you agree/disagree with the following statements (options: I do not trade financial assets via the internet or mobile app; totally agree; agree; neither disagree nor agree; disagree; totally disagree).

    When I trade financial assets via the internet or an app on my phone …
    … I often receive suggestions to invest in financial assets that I have never traded in before
    … I am given the opportunity to carry out the same transactions as other investors
    … I am given insignificant or non-economic rewards (e.g., points or badges) for carrying out certain tasks or achieving certain goals
    … I am concerned about guaranteeing adequate levels of cybersecurity protection

27. Indicate how much you agree/disagree with the following statement: Even when I am not using the internet or mobile app to trade, I receive emails, SMS or other communication indicating, for example, that the price of a certain asset has gone up, down or has had a big change, or that I have not traded for some time (options: I do not trade financial assets via the internet or mobile app; totally agree; agree; neither disagree nor agree; disagree; totally disagree).

28. Suppose you flip a coin 10 times. If in the first 9 tosses it always comes up heads, what is the probability (in %) that it will come up heads on the tenth toss? _____ *(accepted values: between 0 and 100).*

29. Suppose you invested in a financial product with a risk of losing the money you invested. After 1 year, this investment shows a loss compared to the money invested initially. You now have two options: A: Keep the investment for another year. At the end of that year, you can make a gain or a loss on the money you initially invested; B. Liquidate the investment now and receive the remaining money after the loss. Which option would you choose?

30. Suppose you invested in a financial product with the risk of losing the money you invested. After a year, this investment shows a gain compared to the money invested initially. You now have two options: A. Keep the investment for another year. At the end of that year, you can make a gain or a loss on the money you initially invested; B. Liquidate the investment now and receive the gains. Which option would you choose?

31. How often do you check the value of your investment portfolio when the market is in negative territory/going down (if you do not have an investment portfolio, answer as if you did)?

    Rarely or never
    Less than once a month
    A few times a month
    Once a week
    Two to three times a week
    Once a day

More than once a day

32. How often do you check the value of your investment portfolio when the market is in positive territory/rising (if you don't have an investment portfolio, answer as if you did)?

    Rarely or never
    Less than once a month
    A few times a month
    Once a week
    Two to three times a week
    Once a day
    More than once a day

33. Suppose you have the option of investing in a financial product that gives you an equal chance of losing 50 euros or gaining X euros. What is the minimum amount you would require for X gain in order to invest in this financial product? (*Minimum accepted value: 0*)

34. Say how you identify with the following statements (options: I do not trade financial assets via the internet or mobile app; totally agree; agree; neither disagree nor agree; disagree; totally disagree)

    For me, investing money in crypto assets (digital assets) gives me as much pleasure as playing the EuroMillions or the casino
    For me, investing money in shares, bonds or investment funds gives me as much pleasure as playing the EuroMillions or the casino
    For me, investing money in futures, options, warrants, CFD, ETC, complex financial products or other derivatives gives me as much pleasure as playing the EuroMillions or the casino

35. Suppose you have received a cash prize. This prize can be paid to you today. However, you are asked to wait 1 year to receive the value of that prize, and you are rewarded for waiting. What is the minimum amount you would demand to receive in 1 year's time, in order to forgo receiving the prize today, if the value of the prize is

    If received today: 50 euros - minimum amount required in 1 year's time: _____
    If received today: 500 euros - minimum amount required in 1 year's time: _____
    If received today: 5000 euros - minimum amount required in 1 year's time: ____

36. In the last 12 months, how often have you done the following? (options: 1 (never); 2; 3; 4; 5 (very often))

    Participated in social networks (Facebook, Instagram, LinkedIn, SnapChat, TikTok, Twitter, other)

Searched for information online (such as reading the news or looking for information about goods and services)

37. Which social networks are you currently active on?

Facebook
Instagram
LinkedIn
SnapChat
TikTok
Twitter
Other
I do not have any active social networks

38. If you have ever lost money on investments in the securities markets, please indicate the reason (you can choose more than one).

I have never invested in securities
I have never lost money
Market vicissitudes
Little experience
Luck or lack of it
Bad advice
Lack of technical knowledge about these markets
Other (please specify)

Thank you very much for your participation.

If any processing of personal data takes place, it will be carried out in the exercise of the public interest function that characterises CMVM and will be carried out in an anonymous and confidential manner.
For more information on how CMVM processes and protects personal data, please visit https://www.cmvm.pt/pt/priv_seg/Pages/tratamento-de-dados.aspx.

ANNEX II - Additional regressions

Table AII.1.

Notes: 1. The dependent variable is *Mov_Portfolio*, defined as 1, if the respondent does not move their financial investment portfolio; 2, if they move their financial investment portfolio at least once a year; 3, if they move their financial investment portfolio at least once a month; 4, if they move their financial investment portfolio at least once a week; and 5, if they move their financial investment portfolio every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who claim to have a financial investment portfolio and use digital means to transact these financial investments. 4. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 5. Values in brackets correspond to *z-stat*. 6. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Copy	-0.160	
	(-0.60)	
Interact	0.729	**
	(2.44)	
Ranking Users	0.021	
	(0.09)	
Reward	0.070	
	(0.20)	
Insignificant Reward	0.372	
	(1.09)	
Immediacy	0.036	
	(0.16)	
Ranking Assets	0.471	**
	(2.17)	
SMS	0.530	***
	(2.64)	
Suggestions	-0.223	
	(-1.01)	
Age	-0.023	**
	(-2.53)	
Male	0.178	
	(0.80)	
Income_High	0.475	**
	(2.41)	
Income_Low	0.374	
	(1.19)	
Occupation_Active	0.668	***
	(2.59)	
Num. Obs.	434	
Pseudo R2	0.045	
LR stat	51.0	
Prob.	0.000	

Table AII.2.

Notes: 1. The dependent variable is *Mov_Portfolio*, defined as 1, if the respondent does not move their financial investment portfolio; 2, if they move their financial investment portfolio at least once a year; 3, if they move their financial investment portfolio at least once a month; 4, if they move their financial investment portfolio at least once a week; and 5, if they move their financial investment portfolio every day. 2. The independent variables are described in Annex III. 3. The number of observations corresponds to the number of respondents who claim to have a financial investment portfolio and use digital means to transact these financial investments. 4. Models estimated by maximum likelihood, with variance/covariance matrix calculated using the Huber-White method. 5. Values in brackets correspond to *z-stat*. 6. ***, ** and *: statistical significance at 1%, 5% and 10% respectively (two-sided tests).

Copy	-0.089	
	(-0.33)	
Interact	0.668	**
	(2.19)	
Ranking Users	0.026	
	(0.11)	
Reward	-0.005	
	(-0.01)	
Insignificant Reward	0.360	
	(1.05)	
Immediacy	0.032	
	(0.14)	
Ranking Assets	0.513	**
	(2.35)	
SMS	0.560	***
	(2.68)	
Suggestions	-0.220	
	(-0.97)	
LitFin_Self-Assessment	-0.009	
	(-1.09)	
LitDig_Self-Assessment	0.142	
	(1.00)	
LitFin_High	-1.052	
	(-1.22)	
LitFin_Average	-0.913	
	(-1.03)	
Student	-0.257	
	(-1.03)	
Economy	0.001	
	(0.32)	
Sociodemographics	Yes	
Num. Obs.	434	
Pseudo R2	0.050	
LR stat	56.3	
Prob.	0.000	

ANNEX III – Definition of variables

Male	Binary variable, equal to 1 if the respondent is male
Age	Age of respondent, in years
Occupation_Active	Binary variable, equal to 1 if the respondent is a worker (self-employed or employee) or student-worker
Income	
High	Binary variable, equal to 1 if the household's net monthly income is above €2,500
Low	Binary variable, equal to 1 if the household's net monthly income is less than or equal to €1,000
Student	Binary variable, equal to 1 if the respondent is a student or a student-worker
Economy	Binary variable, equal to 1 if the main area of study is economics, management or a related area
Financial Literacy (LitFin)	
Average	Binary variable, equal to 1 if the number of correct answers to the 6 financial literacy questions is 3 or 4
High	Binary variable, equal to 1 if the number of correct answers to the 6 financial literacy questions is 5 or 6
Self-assessment	Equals 1 if the respondent is not at all knowledgeable about matters relating to financial markets and products; 2 if not very knowledgeable; 3 if moderately knowledgeable; 4 if knowledgeable; and 5 if very knowledgeable
Digital Literacy - Self-assessment	Equal to 1, if the respondent's knowledge of subjects related to the Internet and new technologies is well below the average for the Portuguese population; 2, if below average; 3, if equal to the average; 4, if above average; and 5, if well above the average
Internet	Binary variable, equal to 1 if the respondent uses digital media (apps on the internet or cell phone) to trade shares, corporate bonds, investment fund units, CFD, ETC, warrants, options, futures, other complex financial products or crypto assets
Internet - Lower use	Binary variable, equal to 1 if the respondent uses digital media at least once a year or month to trade financial assets
Internet - Higher use	Binary variable, equal to 1 if the respondent uses digital media at least once a week or every day to trade financial assets
Copy	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on my cell phone, I am given the opportunity to carry out the same transactions as those carried out by other investors"
Interact	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on my cell phone, I am allowed to interact with other investors (by sharing what I do, seeing what they do, or contacting them directly)"
Ranking Users	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on my cell phone, I am provided with information on the profitability rankings of the users of the app/platform"
Reward	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on my cell phone, I am awarded prizes of variable amount (e.g., 'scratch cards' or 'wheels of fortune') when I make more transactions, or when I indicate other people's names as possible investors, or when I promote the app on social networks"
Insignificant Reward	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on

	my cell phone, I am given insignificant or non-economic rewards (e.g., points or badges) for performing certain tasks or achieving certain goals"
Immediacy	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on my cell phone, I receive pop-ups stating that the price at which I am willing to buy/sell will only be available for a limited period of time (a few seconds or minutes)"
Ranking Assets	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on my cell phone, I am provided with information on rankings of financial assets or companies that were most frequently traded on the app/platform"
Suggestions	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "When I trade financial assets via the internet or an app on my cell phone, I often receive suggestions to invest in financial assets that I have never traded"
SMS	Binary variable, equal to 1 if the respondent agrees or totally agrees with the statement "Even when I'm not using the app on the internet or cell phone to trade, I receive emails, SMS or other communication indicating, for example, that the price of a particular asset has gone up, down or has had a big change, or that I have not traded for some time"
All	Continuous variable, equal to Copy + Interact + Ranking Users + Reward + Insignificant Reward + Immediacy + Ranking Assets + Suggestions + SMS
5 or more	Binary variable, equal to 1 if All ≥ 5
Social Pressure	Binary variable, equal to 1 if Copy = 1 or Interact = 1 or Ranking Users = 1
Gamification	Binary variable, equal to 1 if Reward = 1 or Insignificant Reward = 1
Biases	Binary variable, equal to 1 if Immediacy = 1 or Ranking Assets = 1 or Suggestions = 1 or SMS =1
Pleasure in Gambling	Binary variable, equal to 1 if the respondent indicates agreeing or totally agreeing with the statement "I enjoy gambling - for example, playing the lottery, EuroMillions, lotto, scratch cards, etc."
Social Networks	Binary variable, equal to 1 if the respondent indicates that the information they receive from social networks (Facebook, Instagram, LinkedIn, SnapChat, TikTok, Twitter/X and the like) is very or extremely important when choosing their financial investments