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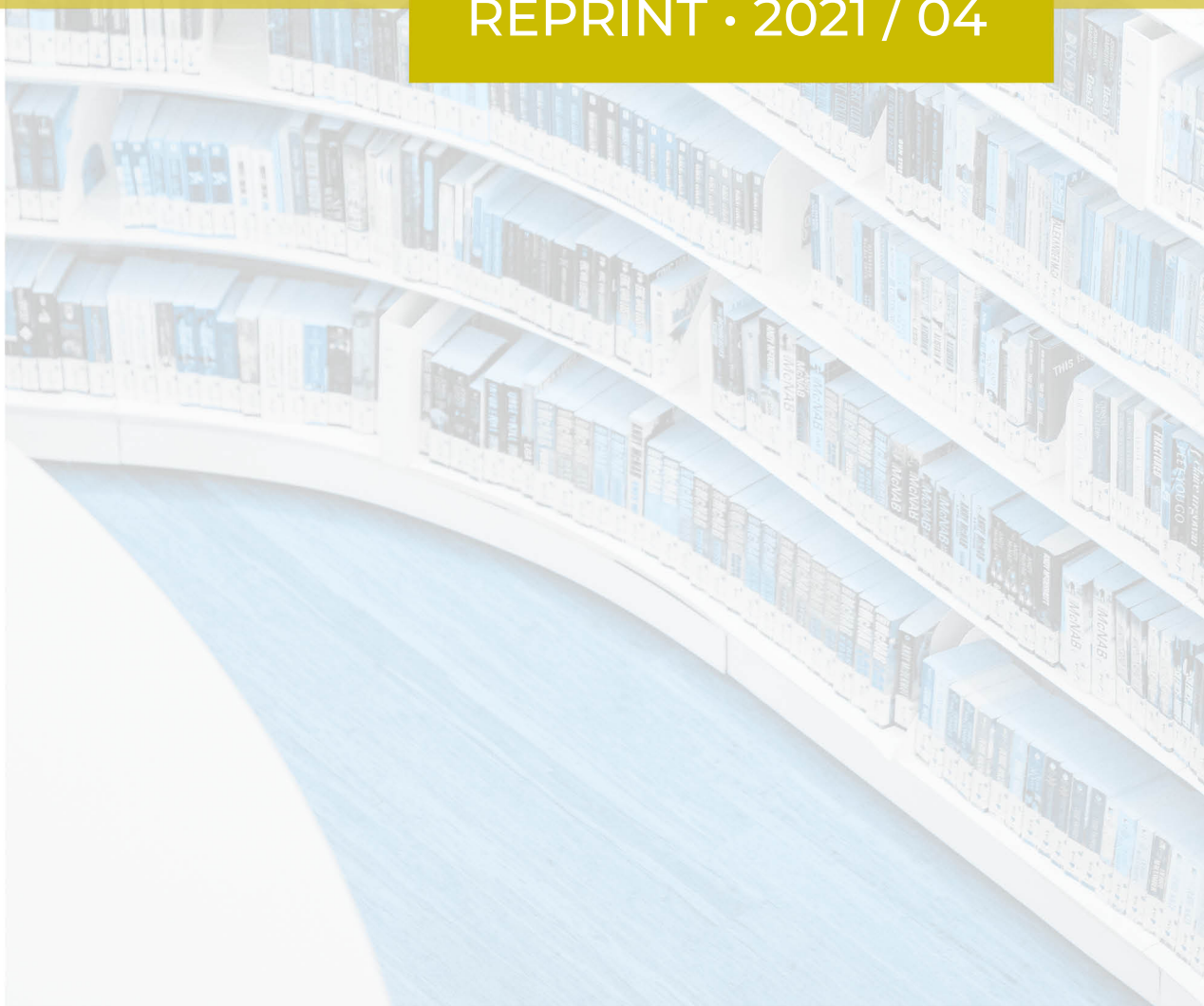
REPRINT • 2021 / 04



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The Quarterly Review of Economics and Finance 80 (2021) 287–302

Contents lists available at ScienceDirect

The Quarterly Review of Economics and Finance

journal homepage: www.elsevier.com/locate/qref

Trading leveraged Exchange-Traded products is hazardous to your wealth☆

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ARTICLE INFO

Article history:
Received 13 October 2020
Received in revised form
18 December 2020
Accepted 8 February 2021
Available online 20 February 2021

JEL classification:
G11
G28
G40

Keywords:
Leverage
ETPs
Retail investors
Gambling
Skewness

ABSTRACT

Using a large set of both trading and survey data, we sketch the profile of the typical retail investor who trades Leveraged Exchange-Traded Products (LETPs). Our findings show that the typical user of LETPs looks like an overconfident gambler willing to take a high risk, though some highly loss averse investors use inverse leveraged Exchange-Traded Products (ILETPs) for hedging purposes. Aggregating holdings in both stocks and Exchange-Traded Products (ETPs), users of LETPs get a lower performance than retail investors who invest in vanilla ETPs (VETPs). The reason is twofold: they trade too much and hurt their returns when investing in LETPs. Though trading LETPs could be interpreted as rational gambling, the skewness of the monthly portfolio returns of LETP users does not offset the risk-return sacrifice in the mean-variance space.

"When you combine ignorance and leverage, you get some pretty interesting results." Warren Buffett

Introduction

Over the last twenty-five years, Exchange-Traded Products (ETPs)[1] have become popular among both retail and institutional investors. In particular, Exchange-Traded Funds (ETFs) reached the threshold of $5 trillion in assets under management (AUM) in July 2018. This amount even experienced a double-digit growth last year to reach more than $6 trillion at the end of 2019.[2] Not everybody considers this development as good news. In a somewhat ironic complaint, Jack Bogle, the late founder of the Vanguard Group, the world's largest passive manager, has asserted in a Financial Times article,[3] the annual turnover of the shares in the biggest ETFs "takes its toll on investor wealth". Yet, there has been little written on the retail ETP investor. Even the reference book on ETFs (Madhavan, 2016) devotes only a few pages to retail investors. The only academic study[4] analyzing the performance of retail investors with ETFs we are aware of is Bhattacharya, Loos, Meyer, and Hackethal (2017), which finds empirical evidence that these investors do not improve their performance by using ETFs.

☆ The authors acknowledge the financial support of the Portfolio Construction Forum and the Investment Management Research (IMR) Program in Sydney. They are grateful to the online brokerage house for providing the data. Patrick Roger gratefully acknowledges the support of the Chair in Behavioral Finance at EM Strasbourg Business School. This paper was partly written when he was CNRS fellow at CEE-M, University of Montpellier. We thank the editor and two anonymous referees for insightful comments which helped improve the paper. We also thank A. Bellofatto, H. Orkut and T. Roger for useful comments on previous versions of the paper and technical assistance, as well as Y. El Hichou and F. Roccazzella for their help in some data collection. Any errors are the full responsibility of the authors.

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[1] The market of exchange-traded products includes mainly exchange-traded funds (ETFs), exchange-traded commodities (ETCs), and exchange-traded notes (ETNs).

[2] According to the 2020 Factbook of the Investment Company Institute (ICI), the U.S Exchange-Traded Funds (ETF) market comprised 2,096 funds and $4.4 trillion in total net assets at the end of 2019, accounting for 70 percent of the $6.3 trillion in ETF net assets worldwide (https://www.ici.org/pdf/2020_factbook.pdf).

[3] https://www.ft.com/content/855c1152-be37-11e6-8b45-b8b81dd5d080.

[4] A 2019 ICI report (chapter 4 is devoted to ETPs) provides the profile of ETP-owning households in the U.S. (see http://www.icifactbook.org).

https://doi.org/10.1016/j.qref.2021.02.012

The authors provide two reasons for this poor performance. First, retail investors exhibit a poor market timing, and second, they do not select the ETFs they invest in, wisely. Additionally, of particular importance, is the limited information on who invests in ETPs. Using the 2015 NFCS[5] Investor Survey, Enete, Reiter, Usrey, Scott, and Seay (2019) report that both subjective and objective financial literacy are associated with a higher likelihood of owning ETFs. These authors also find that investors who are risk tolerant, financially satisfied, and under 45 years old are more likely to be ETF users.

ETPs differ from mutual funds in several aspects beyond the possibility of trading ETPs several times a day, while turnover at mutual funds would rarely occur. The design of some ETPs, such as leveraged ETPs (LETPs) and/or inverse ETPs (IETPs), allows investors to make bold bets on the market trend but generates return processes that are difficult to understand by retail investors. On the one hand, ETPs give investors some freedom to either gamble or diversify risks (or even hedge). On the other hand, ETPs are investment vehicles with risks that may be difficult to estimate.

The reasons for the duality goals, namely both the freedom to trade and to manage risk, are technical and behavioral. On the technical side, the underlying assets (or baskets of assets) of ETPs are now very diverse (equities, bonds, currencies, commodities, volatility indexes, industrial sectors, etc.). As mentioned above, the mechanism of LETPs[6] is difficult to understand. The 2008 global financial crisis (GFC) and the more recent Covid-19 crisis gave simple illustrations of the LETP problems. As volatility spiked upwards during crises, the performance of LETPs held for more than one day can be very different from what is expected by retail investors from the stated leverage. After the GFC, some investors launched lawsuits, arguing that they had not been correctly warned about the large potential divergence between expected returns and "possibly naive" expectations. As a consequence, the Financial Industry Regulatory Authority (FINRA) and the Securities and Exchange Commission (SEC) published an alert about the specific risks carried by LETPs.[7] In a nutshell, when holding LETPs, investors are exposed to what Guedj, Li, and McCann (2011) call the "constant leverage trap" due to the daily reset. To avoid this trap and keep in line return and leverage, ETP portfolio managers have to trade at the end of the day. They buy after increases in price of the underlying asset and sell after decreases. On the contrary, a retail investor who keeps unchanged her position gets a return depending, not only on the underlying asset return, but also on its volatility. More recently, several LETPs experienced serious troubles and were liquidated or close to liquidation. Credit Suisse closed its ILETP *Daily Inverse VIX Short Term ETN (XIV)* after it lost more than 95% of its value in a single day.[8] In March 2020, oil-based PLETPs also experienced serious problems (Pessina & Whaley, 2020). For instance, Citigroup's PLETP *VelocityShares 3× Long Crude Oil exchange-traded note (UWT)* almost collapsed on March 9, losing more than 70% of its value on a single day.[9]

The aforementioned alert published by market authorities provides a good transition to the behavioral side of the freedom-risk duality. Retail investors can falsely believe their investments in most ETPs are relatively safe. This feeling can be caused by overconfidence in their own financial literacy and skills, or it can come from an illusion of control (Langer, 1975) due to the possibility of trading at any moment. On top of these elements, LETPs have a strong behavioral drawback illustrated by Ensthaler, Nottmeyer, Weizsäcker, and Zankiewicz (2018). In an experimental study, these authors show that the human brain has a hard time to understanding compound returns over more than two or three periods, especially when there are random shocks. The larger the shock, the larger the error in computing the median future price. The experimental setting of these authors is exactly what investors face when they hold LETPs.

The purpose of this paper is twofold. First, using a large set of both hard and soft data on a sample of more than 40,000 retail investors (including 6408 ETP users), we sketch the profile of LETP users (compared to vanilla ETP users, i.e., VETP users). Given the scarce literature on retail ETP investors, our first contribution is to combine demographics, individual characteristics based on survey-data (such as financial literacy, loss aversion and appetite for information), trading behavior, and portfolio features including performance, to build the profile of the typical LETP user. Of primary interest, we are able to analyze individual portfolios in terms of diversification, market value, turnover, and distribution of returns. Our data also enable us to rebuild single asset class portfolios (distinguishing stock holdings and holdings of different categories of ETPs) and aggregate portfolios of all holdings. By doing so, we highlight the impact of both VETPs and LETPs on the distribution of portfolio returns. Second, using a panel data model wherein we control for both market-based and investor-based variables, we investigate the impact of LETP holdings on individual portfolio returns. Building on (1) the freedom-risk duality inherent to ETPs, which is especially prevalent for LETPs, and (2) the findings of Bhattacharya et al. (2017), showing that retail investors suffer from both poor market timing and an inefficient ETF picking strategy, our hypothesis is that LETP users are gamblers (i.e., skewness-seekers) who use leveraged products as lottery-like assets in the hope of hitting a very high return on the leveraged part of their portfolio (Bali, Cakici, & Whitelaw, 2011; Kumar, 2009).

Several models outside the framework of expected utility of investor behavior induce skewness-seeking. In particular, skewness-seeking is often linked to the distortion of probabilities by investors. Shefrin and Statman (2000), in their Behavioral Portfolio Theory, consider that investor decisions are guided by a mix of hope and fear. Hope (fear) tends to transform probabilities in an optimistic (pessimistic) way. Therefore, a decision-making process consistent with Behavioral Portfolio Theory could justify an inferior performance in the mean-variance space, if compensated by a higher skewness of returns. Models based on Cumulative Prospect Theory (Tversky & Kahneman, 1992) lead to similar results (Barberis & Huang, 2008). Brunnermeier and Parker (2005) go one step further by introducing the distorted probability measure as a decision variable, referring to optimal expectations or optimal beliefs. They consider a forward-looking investor who maximizes the average of her current utility and her expected future utility. But the current utility is higher when the investor is optimistic about future prospects (anticipatory utility). This distortion of beliefs leads to suboptimal investment decisions in terms of resource allocation and portfolio choice. Nevertheless, these authors show that a slightly optimistic change in beliefs generates a first-order gain in current utility, but only a second-order loss in future utility due to suboptimal investment decisions. In the same vein, Gollier (2005) shows that optimal expectations correspond to beliefs focusing on the best and the worst state. An investor obeying optimal expectations theory does not select her portfolio under the real probability measure (as so-called rational agents do). Brunnermeier, Markus, Christian Gollier, and Parker (2007), building on Brunnermeier and

[5] National Financial Capability Study.

[6] We use LETPs to denote all products with a leverage coefficient (i.e., multiplier) greater than 1 in absolute value. In addition, we use the acronym PLETPs for 'pure' LETPs, i.e., products with a multiplier greater than 1, and ILETPs for inverse LEPTs, i.e., products with a multiplier lower than -1.

[7] See http://www.sec.gov/investor/pubs/leveragedETFs-alert.htm.

[8] https://www.bloomberg.com/news/articles/2018-02-06/credit-suisse-is-said-to-consider-redemption-of-volatility-note

[9] Six days later, ProShares announced the liquidation of its PLETP *UltraPro 3× Crude Oil up (OILU)* and its ILETP *UltraPro -3× Crude Oil down (OILD)*. The former was down 91.1% since the start of the year.

Parker (2005), propose a simple model of a complete market of Arrow-Debreu securities,[10] and conclude that the probability of one state is overvalued while the probabilities of the other states are undervalued by such investors. The authors achieve an optimal portfolio close to the one found by Shefrin and Statman (2000), which is a risk-free asset combined with a positively skewed asset (equivalent to a lottery ticket).

In this paper, we show that the typical LETP user does not succeed in compensating the loss of mean-variance performance by a larger positive skewness of returns. More specifically, our main findings can be summarized as follows. Compared to VETP users, LETP users are less educated, though they self-report a higher level of financial literacy. They are more loss tolerant and show a lower appetite for information and professional recommendations, compared to VETP users. Moreover, they trade more intensively almost all available assets (stocks, ETPs, options/warrants), except mutual funds. When analyzing portfolios, we find that the typical LETP user gets a lower return and a higher variance on her portfolio. In addition, the typical LETP user does not manage to extract a positive skewness of returns on the leveraged part of her portfolio. Finally, our panel data model provides clear-cut evidence that holding LETPs hurts individual portfolio returns, even after controlling for market factors, individual characteristics and trading behavior. Based on our main findings, we conclude that (1) the typical LETP user looks like an overconfident gambler willing to take a high risk; (2) her inferior performance (compared to the performance of the typical VETP user) comes mainly from two sources: first, excessive trading and, second, poor performance on the leveraged part of her portfolio; and (3) some highly loss averse investors use ILETPs to hedge their portfolio.

The paper is organized as follows. Section 1 describes our data and provides descriptive statistics on the subsets of investors in our sample (VETP users vs. LETP users), mainly based on trading behavior and portfolios. Section 2 compares the self-declared individual characteristics of VETP and LETP users (through the MiFID[11] questionnaires). Section 3 provides a comparison of both single asset class and aggregate portfolios, with a distinction between VETP and LETP users. Section 4 investigates the profile of the typical LETP user, compared to VETP users. Section 5 is devoted to the impact of holding LETPs on individual aggregate portfolio performance. Section 6 concludes.

1. Data and descriptive statistics

Our study combines three types of data: 1) time series of stock and ETP prices, as well as Fama-French factors for the European market; 2) trading records and end-of-month portfolios for a large set of retail investors at an online Belgian brokerage house; and 3) matched demographics and subjective investor characteristics that are survey data collected by the brokerage house within the context of the MiFID regulation. The latter came into force in November 2007 in European Union (EU) member states. MiFID I (2004/39/EC) is the first version of this piece of regulation that has been updated as MiFID II in January 2018 (known as MiFID II (2014/65/UE)). The European Commission website provides a complete description of this MiFID regulation.[12]

1.1. Stocks and ETPs

Stock and ETP prices allow us to calculate end-of-month portfolio values over the sample period, from January 2008 to March 2012.[13] European stock prices and Fama-French factors come from Eurofidai.[14] U.S. stock prices come from the Center for Research on Security Prices (CRSP) database and ETP prices from Bloomberg.

Bloomberg data include multipliers that induce a typology of the ETPs used by investors in our sample. The multiplier is equal to 1 for vanilla ETPs (VETPs); these ETPs simply track the underlying index (or basket of assets). Inverse ETPs (IETPs hereafter) have a multiplier equal to -1. Finally, an ETP multiplier larger than 1 in absolute value implies leverage or inverse leverage, depending on the sign of the multiplier. In this paper, we use LETPs to denote all products with a multiplier greater than 1 in absolute value, while ETPs with a multiplier larger than 1 are denoted PLETPs for 'Pure' Leveraged Exchange-Traded Products and ETPs with a multiplier lower than -1 are denoted ILETPs for 'Inverse' Leveraged Exchange-Traded Products. For example, the most traded ETP in our sample (*Lyxor CAC 40 Daily Double Short*) is an ILETP with the French CAC40 index as underlying and a multiplier equal to -2. Such a heavy use of an ILETP is not really surprising because our sample period includes the 2008 financial crisis, a potentially fruitful period for investors making bold bets on market trends. LETPs were rather new financial instruments at the beginning of 2008, since the first LETF was launched by Rydex at the end of 2006 (Avellaneda & Zhang, 2010). The size of the industry was only $1.3 trillion in 2012 (ICI Factbook 2013), corresponding to 10% of the mutual fund industry. The ETPs bought and sold by the investors in our sample belong to three categories: ETFs replicating an equity index (with or without a multiplier), ETCs replicating a commodity index (with or without a multiplier, but no inverse leveraged ETC) and, marginally, ETNs replicating a bond index. Further details are provided in Section 1.3. Different replication methods are used on ETP markets. For equity-based ETPs, replication can be full (the issuer holds exactly the basket of stocks constituting the index), based on optimized sampling (for large indices, the ETF issuer holds a subset of stocks such that the reduced portfolio is highly correlated with the index), or synthetic (replication is realized through a total return swap).

1.2. Individual investor data

We have detailed information[15] about trades of each investor in our sample, i.e., the asset traded, the number of shares traded, the trade price, the trade direction, the trade currency, time-stamps, etc. These trading records allow us to rebuild end-of-month individual portfolios, and to distinguish stock portfolios, ETP portfolios, and aggregate portfolios. Similarly, we are able to characterize the leveraged part of any ETP portfolio (by distinguishing holdings in LETPs from those in VETPs and IETPs). In addition, we match demographics and survey-based data to these trade-based and portfolio-based data.

Demographics encompass age, gender, level of education, and spoken language. Belgium has three official languages (French, Dutch and German), of which French and Dutch are the most common. Nevertheless, our retail investors may choose one among three languages available on the online trading platform: French, Dutch or English (because of the presence of several European

[10] An Arrow-Debreu security (from its origins in the Arrow-Debreu model), also called a state-price security, can be defined as a contract that agrees to pay one unit of a currency (or a commodity) if a particular state occurs at a particular time in the future and pays zero in all the other states. The price of this security is the state-price of this particular state of the world. The state-price vector is then the vector of state-prices for all states.

[11] MiFID stands for Markets in Financial Instruments Directive.

[12] See https://ec.europa.eu/info/law/markets-financial-instruments-mifid-ii-directive-2014-65-eu_en.

[13] Our period of study includes the Global Financial Crisis; it is therefore interesting to study the behavior of retail investors during this period (Cardak, Martin, & McAllister, 2019; Economou, Gavriilidis, & Gregoriou, 2017; Lippi & Rossi, 2020).

[14] http://www.eurofidai.org

[15] Each investor is anonymized but registered with a unique code allowing us to select all the information related to a given investor in the sample.

Table 1
Aggregate statistics on ETP users

Panel A: Statistics on investors				
	VETP users	LETP users	Total	LETP users (in %)
Investors	4793	1615	6408	*25%*
Males	4224	1415	5639	*25%*
French-speaking investors	1964	975	2939	*33%*
Investors with univ. degree	3899	1229	5128	*24%*
S-investors	2966	965	3931	*25%*
Panel B: Statistics on trades across instruments				
	VETP users	LETP users	Total	LETP users (in %)
Trades on stocks	436,085	309,080	745,165	*41%*
Vol. on stocks (K€)	3,015,154	3,025,281	6,040,436	*50%*
Trades on ETPs	29,074	51,063	80,137	*64%*
Volume on ETPs (K€)	278,368	1,237,439	1,515,807	*82%*
Trades on options &warrants	209,584	159,493	369,077	*43%*
Trades on funds (not ETPs)	84,706	27,877	112,583	*25%*
Panel C: Statistics on trading volumes per ETP underlying type				
	Commodities (107)			
	Nb of trades	Volume(K€)	Nb of investors	
VETPs	16,553	170,062	3,212	
IETPs	83	1693	24	
PLETPs	1223	26,841	121	
	Equities (275)			
	Nb of trades	Volume(K€)	Nb of investors	
VETPs	23,735	254,310	3475	
IETPs	5041	49,112	716	
PLETPs	9,291	217,608	679	
ILETPs	23,274	785,743	1228	

This table reports aggregate information about the ETP users and the ETPs traded in our sample. Panel A focuses on investor characteristics, Panel B on investor trading activity across instruments, and Panel C on trading volumes per ETP underlying type. We distinguish ETPs based on their multiplier. For vanilla ETPs (VETPs), the multiplier is equal to one, meaning that the ETP simply tracks the underlying asset (or basket of assets). When the multiplier differs from one, the ETP can be leveraged, inverse, or even inverse-leveraged depending on the multiplier value. Inverse ETPs (IETPs) have a multiplier just equal to -1. When the multiplier is strictly either greater or lower than 1, the ETP is leveraged (pure LETPs denoted as PLETPs) or inverse-leveraged (inverse LETPs denoted as ILETPs). In this paper, LETPs include both leveraged and inverse-leveraged ETPs, unless otherwise specified. LETP users refer to investors who traded at least once a LETP. By contrast, VETP users only traded VETPs. "S-investors" refers to investors who completed both MiFID tests (i.e., the A-test and the S-test). Panel A provides the number of both VETP and LETP users, and highlights the proportion of LETP users. Panels B and C provides statistics expressed either in number of trades or in monetary volume (K€). Panel C also indicates the number of investors who traded at least once the corresponding ETP type. Panel C focuses only on equities or commodities-linked ETPs. For the other types of underlying that are not reported here, we count only 937 trades in total (676 for ETPs on bonds, 21 for ETPs on foreign exchange, and 240 for ETPs on real estate.)

institutions in Brussels). In this study, we keep only French and Dutch-speakers, who represent 95% of the initial sample.

The survey-based data are self-declared investor characteristics collected by the brokerage house within the context of the MiFID regulation. In short, this piece of regulation makes it compulsory for investment firms to collect specific information about retail clients' needs and preferences. Accordingly, investment firms operating in the EU are obliged to submit questionnaires (that are then referred to as 'MiFID tests') to their clients in order to assess their knowledge and experience, their investment objectives as well as their financial capacity.[16]

The information asked for in the MiFID tests depends on the service required by the client. Three types of services are identified (CESR, 2008): execution of orders, financial advice and portfolio management services. Investors who only ask for order execution on "complex" instruments, have to fulfill the Appropriateness test (hereafter the A-test). This test aims at ensuring that the investor has the necessary experience and knowledge to understand the risks involved in these "complex" financial instruments.[17] Investors who ask for financial advice or portfolio management services have to fulfill the Suitability test (hereafter the S-test). Assessment of suitability aims at ensuring that the instruments and services offered by the investment firm meet the investor's objectives, his/her financial capacity as well as his/her knowledge and experience in financial instruments. Therefore, MiFID requirements offer a research opportunity to investigate the relationship between the use of ETPs and some subjective characteristics of investors, including their appetite for information (i.e., asking for general financial advice (Bellofatto, Broihanne, & D'Hondt, 2018)).

All investors in our sample completed the A-test but only half of them decided to also fulfill the S-test.[18] We refer to the investors who completed both tests as 'S-investors', while the others are flagged as 'A-investors'. It is worth noticing that the brokerage house that provided us with the data provided neither individual financial advice nor portfolio management services during the sam-

[16] Such items are usually covered in Investment Policy Statements (IPS) used in portfolio management delegation. MiFID tests can then be viewed as a kind of regulated IPS, required when a retail investor asks for financial advice and/or portfolio management services. For more details on the MiFID tests, see Bellofatto, D'Hondt, and De Winne (2018).

[17] We write the word complex in quotation marks because no clear definition has been given for this word by the European regulator. As a consequence, banks have a tendency to apply a kind of precaution principle leading to consider that almost all financial securities with random returns are complex.

[18] Appropriateness can be viewed as a "lighter" form of suitability. As a result, the A-test could be a sub-case of the S-test. The brokerage house that provided us with the data used two distinct tests for assessing appropriateness and suitability.

Table 2
Statistics of stock trading activity for ETPs users (VETP and LETP users) and non-users.

	Non-users of ETPs				VETP users				LETP users			
	Mean	Q3	Median	Q1	Mean	Q3	Median	Q1	Mean	Q3	Median	Q1
Nb. trades on stocks	42	38	13***	4	91	92	37***	13	191	191	86	30
Traded volume on stocks (K€)	344	138	33***	8	629	382	112***	31	1873	1066	308	87
Nb. different stocks	10	13	6***	2	24	33	16***	7	37	46	24	11
Nb. trading months on stocks	25	40	25***	8	34	48	39***	24	37	49	41	28
Average trade size on stocks (€)	5	5	2***	1	5	5	3***	2	7	7	4	2
Duration between stock trades (Nb.days)	74	81	32***	11	51	56	24***	10	27	28	13	6
Nb. purchases on stocks	25	23	8***	3	54	56	23***	8	108	107	48	17
Nb. sales on stocks	17	15	4***	1	37	37	13***	4	83	83	37	12
Buying volume on stocks (K€)	182	80	20***	4	333	213	67***	19	976	544	166	49
Selling volume on stocks (K€)	162	59	11***	1	296	1630	43***	9	897	501	145	37

This table provides cross-sectional means, medians, lower and upper quartiles about stock trading activity, with a distinction between non-users of ETPs, VETP users and LETP users. ETPs are distinguished by their multiplier. VETPs refers to ETPs whose the multiplier is equal to one (meaning that these ETPs simply tracks their underlying asset (or basket of assets)). When the multiplier differs from one and from minus one, the ETP is leveraged or even inverse-leveraged depending on the multiplier. We refer to them as LETPs. Accordingly, VETP users only trade in VETPs while LETP users trade both in VETPs and LETPs. For the sake of readability, figures are rounded to the closest integer but statistical tests are performed with the true values. In the median column of non-users of ETPs, stars refer to a significant difference between the median values for ETP users (VETP and LETP users are then combined) and non-users. In the median column of VETP users, stars refer to significant differences between the median values for VETP users and LETP users.

*** indicate statistical difference at the level of 1%, respectively.

ple period under scrutiny. Nevertheless, fulfilling the S-test granted a free access to a web platform providing general information on stocks, analysts' reports, and professional recommendations. Hence, the cost to access general financial advice was almost zero, because it took only a few minutes to complete the S-test. We then consider that investors who did not complete the S-test neglected free information on purpose.[19]

1.3. Descriptive statistics

There are 41,826 investors in our database, 269 among them trading stocks and IETPs only. We disregard these investors since we focus on the comparison of VETP users and LETP users. The remaining 41,557 retail investors completed the A-test (either in French or in Dutch), and 20,533 investors also filled in the S-test.[20] In the broad sample, 6408 investors (about 15%) trade ETPs, in addition to stocks.[21] Approximately 25% of these ETP users (i.e., 1615 investors) traded at least once one LETP over the period under scrutiny.

In total, our investors traded 18 billion euros in stocks over the sample period (01/2008-03/2012). One third of this amount was traded by ETP users and two thirds by non-users. This preliminary statistic shows that ETP users are more active on the stock market because they represent only 15% of the sample. This observation is in line with Bhattacharya et al. (2017) who find similar results on a different period (08/2005 to 03/2010). ETP users are somewhat older than non-users (median age of 49 vs. 47 years) and the universe of ETPs they trade contains 436 different ETPs. This dispersion of trades on a large number of ETPs is, however, somewhat artificial because 57% of the trades and 74% of the trading volume in euros are executed on a subset of only 10 ETPs. Among these 10 most traded ETPs, five are LETPs (among which three are ILETPs), four are VETPs and one is an IETP. The trading volume in ETPs amounts to an aggregate value of 1.5 billion euros for 80,137 trades.

Among the 1615 investors who traded at least one LETP over the sample period, we count 400 investors who trade both PLETPs and ILETPs, 386 investors who trade only PLETPs, and 829 investors who trade only ILETPs. All LETP users executed in total 33,791 trades across 34 different LETPs, for an aggregate value of 1.03 billion euros, which represents two thirds of the total trading volume in ETPs in our sample.

Descriptive statistics based on trading volumes are available in Tables 1–3 . Table 1 gives aggregate information about ETP users, divided in three panels. Panel A focuses on investor characteristics, Panel B on investor trading activity across instruments, and Panel C on trading volumes per ETP underlying type. Panel A shows that LETP users account for 25% of ETP users in the sample. Such a proportion of LETP users is still valid when focusing on males, holders of a university degree, and S-investors, respectively. The proportion is however higher (33%) among French speaking investors. Cultural differences between Dutch and French speakers might explain this difference. The most likely driver is that French speaking investors trade more French securities (i.e., listed on the Euronext Paris Stock Exchange) while Dutch speaking investors trade more Dutch securities (i.e., listed on the Euronext Amsterdam Stock Exchange). Such a kind of "familiarity bias" mixing both home bias and language proximity could generate the above difference because there are more LETPs traded in Paris, compared to Amsterdam. In particular, Lyxor is an especially active ETP provider in this segment in Paris and the Lyxor ETPs are the most traded in our sample.

When compared to non-users, ETP users are more active on all non-ETP instruments (i.e., stocks, options/warrants and funds other than ETPs). Panel B of Table 1 shows that LETP users are significantly more active than VETP users on all instruments, except mutual funds. LETP users generate 50% (82%) of the aggregate monetary volume on stocks (ETPs), though they represent only 25% of the ETP users, as reported in Panel A. Such figures lead us to expect that for LETP users, a lower portfolio performance is due to excessive trading and transaction costs.

The ETPs in our sample are mainly equities-linked (275 ETPs) or commodities-linked (107 ETPs), as reported in Panel C of Table 1.[22]

[19] Using the same data, D'Hondt and Roger (2017) show that the trading behavior of A-investors is influenced more by sentiment, compared to S-investors.

[20] Bellofatto, D'Hondt, et al. (2018) used a similar subsample to show that investors who score high on self-reported financial literacy questions generally behave as smarter investors. These S-investors concentrate their trades on a lower number of stocks but manage diversification through fund trading.

[21] The 2018 factbook of the Investment Company Institute (ICI) reports that 95% of U.S. ETP-owning households also invest in stocks either directly or through mutual funds or variable annuities.

[22] We find 5 different types of underlying asset (or basket of assets): equities, commodities, bonds, foreign exchange, and real estate. Only the first two, however, are significant in terms of trading volume (i.e., they represent more than 99% of the aggregate monetary volume). This is the reason why we focus on them in Table 1. For the others, we count only 937 trades in total (676 for ETPs on bonds, 21 for ETPs on foreign exchange, and 240 for ETPs on real estate.)

Table 3
Statistics about ETP trading activity for VETP users and LETP users.

	VETP users				LETP users			
	Mean	Q3	Median	Q1	Mean	Q3	Median	Q1
Nb. trades on ETP	6.06	6.00	3***	2.00	32.00	28.00	11.00	4.00
Traded volume on ETP (K€)	58.08	34.21	10***	3.80	766.22	210.16	54.15	15.56
Nb. different ETP	2.03	2.00	1***	1.00	4.00	5.00	2.00	1.00
Nb. trading months on ETP	11.88	20.00	7***		18.00	30.00	16.00	5.00
Duration between ETP trades (Nb.days)	111.53	137.00	55***	7.0	52.00	62.00	29.00	12.00
Average trade size on ETP (K€)	6.83	6.29	3***	1.74	10.49	9.47	4.74	2.44
Nb. purchases on ETP	3.86	4.00	2***	1.00	18.00	17.00	7.00	3.00
Nb. sales on ETP	2.19	2.00	1***	0.00	13.00	12.00	5.00	2.00
Buying volume on ETP (K€)	33.02	20.29	6***	2.27	389.70	113.07	29.52	8.44
Selling volume on ETP (K€)	25.06	13.40	3***	0.00	376.52	97.38	24.78	6.46
Nb. trades on LETP					20.93	16.00	5.00	2.00
Traded volume on LETP (K€)					637.90	108.95	24.25	7.60
Nb. different LETP					1.53	2.00	1.00	1.00
Nb. trading months on LETP					10.59	17.00	5.00	1.00
Duration between LETP trades (Nb.days)					47.85	54.01	20.51	7.21
Average trade size on LETP (K€)					10.58	9.47	4.69	2.36
Nb. purchases on LETP					11.69	9.00	3.00	1.00
Nb. sales on LETP					9.22	7.00	2.00	1.00
Buying volume on LETP (K€)					322.12	57.96	12.65	4.35
Selling volume on LETP (K€)					315.77	50.22	11.00	3.00

This table provides cross-sectional means, medians, lower and upper quartiles about ETP trading activity, with a distinction between VETP users and LETP users. ETPs are distinguished by their multiplier. VETPs refers to ETPs whose the multiplier is equal to one (meaning that these ETPs simply tracks their underlying asset (or basket of assets)). When the multiplier differs from one and from minus one, the ETP is leveraged or even inverse-leveraged depending on the multiplier. We refer to them as LETPs. Accordingly, VETP users only trade VETPs while LETP users trade both VETPs and LETPs. For the sake of readability, figures are rounded but statistical tests are performed with the true values.
*** indicate statistical difference at the level of 1%, respectively.

For each type of underlying asset, we distinguish at most 4 sub-categories.[23] As mentioned earlier, VETPs are neither leveraged nor inverse. In total, we have 17,859 trades for ETPs on commodities and 61,341 trades for ETPs on equities. LETPs are predominant in the aggregate trading volume (10,514 trades on PLETPs and 23,274 trades on ILETPs, corresponding to 244 M€ and 786M€, respectively). This feature pertains to our sample period. At the end of 2008 and the beginning of 2009, taking short leveraged positions through ETPs on equities might have appeared very profitable. We will see later on that such an expectation has not come true for the typical LETP user. Moreover, the impressive trading volume related to commodities-linked ETPs has to be taken with a pinch of salt, since the most traded ETP in this category is a VETP on gold (*Gold Bullion Securities ETC*). Any financial instrument with gold as the underlying asset is usually very popular during financial crises.

Table 2 provides cross-sectional statistics about the stock trading activity for the three sub-samples of investors: non-users of ETPs, VETP users and LETP users. Because some heavy and/or wealthy investors drive means upward (especially in the distribution of trading volumes), we focus on median values that are more representative of the typical investor. In the median column of non-users of ETPs, stars refer to a significant difference between the median values for ETP users (VETP and LETP users are then combined) and non-users. In the median column of VETP users, stars refer to significant differences between the median values for VETP users and LETP users. Table 2 confirms that ETP users trade significantly more in stocks than non-users. The trading volumes in euros are significantly larger for ETP users, i.e., the typical non-user trades about 33K€ in stocks when the typical VETP (LETP) user trades about 112K€ (308K€). The universe of stocks is also larger for ETP users since the typical VETP (LETP) user trades 16 (24) different stocks, while the typical non-user trades only six different stocks. Even if we take into account the median tenure of investors on the stock market, i.e., 39 (41) months for VETP (LETP) users, compared to 25 months for non-users, the ratio users/non-users remains around three. The different trading intensity on stocks among the three subsets of investors also appears when looking at the duration between two consecutive trades. The typical non-user of ETPs trades once per month, while the typical user of VETPs (LETPs) trades every 24 (13) days. Without any deeper analysis, Table 2 indicates that the profiles of ETP users and non-users differ, especially in terms of stock trading intensity. Although differences are statistically significant, the median trade size does not vary much across categories (2.4K€ for non-users, 2.86K€ for VETP users, 3.69K€ for LETP users). When considering trading direction, they all appear net buyers of stocks, even if it is slightly weaker for LETP users.

Table 3 reports cross-sectional statistics about trading activity in ETPs, with a distinction between VETP and LETP users. Several striking differences emerge. First, the typical VETP (LETP) user trades 10K€ (54K€) in ETPs over a period of 7 (16) months. Hence, the typical user of LETPs trades five times more in ETPs than the typical user of VETPs. When based on the number of trades, this multiplicative factor is still greater than 3. Second, trading volumes are shared differently between purchases and sales. VETP users are undoubtedly net buyers of ETPs since the median number of purchases is twice the corresponding number of sales. By contrast, for LETP users, the difference between the median number of purchases and sales is significantly lower, which leads to a smaller buy-sell imbalance (not reported here). This observation remains valid when considering monetary volumes. These preliminary results suggest that the typical LETP user trades more in ETPs and does not follow a buy-and-hold strategy. Such a behavior would be rational if it was related to LETPs only, because of the usual daily reset. It is different for VETPs because trading too much deteriorates net returns, such as for stocks. When focusing on LETP trades, Table 3 shows that investors do not really take into account the daily reset of these instruments. The median duration between trades is 21 days and the average duration is 48 days. Avellaneda and Zhang (2010) tested different holding strategies for LETPs. Though they show that even for leveraged products with a daily reset a daily rebalancing is not

[23] For some underlying types, sub-categories are missing. For example, we have no trades for ILETPs on commodities.

Table 4
MiFID questionnaires: Appropriateness and Suitability Tests.

Panel A: Appropriateness test (A-test)	
(Q1)What is your knowledge of financial markets?	
Level 0	I know a few things but I am interested by the financial markets.
Level 1	I have sufficient experience to understand well the importance of a good diversification of risks.
Level 2	I understand the functioning of the financial markets. I know that fluctuations can be important and that the various sectors and categories of products have different characteristics relating to their revenue, growth and risk profile.
Level 3	I consider myself as an experienced investor who manages any aspect of the financial markets.
Panel B: Suitability test (S-test)	
(Q2)What is your knowledge of financial markets?	
Level 0	I know very little about it and I am not really interested in it.
Level 1	I am not familiar with investments, but I am interested in it.
Level 2	I have sufficient experience to acknowledge the importance of risk diversification.
Level 3	I have a good knowledge of the financial markets. I am aware that the financial markets can strongly fluctuate, that sector and asset categories have different characteristics regarding revenue, growth and risk profile.
Level 4	I consider myself as an experienced investor who thoroughly masters all the aspects of the financial markets.
(Q3)What would you do if you noticed that 6 months after having invested, this investment (in line with the market situation), shows a drop of 20%?	
Level 0	A total disaster! The security of my investments is my most important criterion. I do not want to take any risks!
Level 1	You will sell at a loss and transfer the money in safer investments.
Level 2	You are anxious but will not move until the situation improves.
Level 3	This was a calculated risk. You leave your investments as they are and will wait until the situation improves.
Level 4	You take advantage of the market situation (low prices) to invest even more. By doing so you reduce your average buy price

This table reports the details for the main questions of the MiFID tests under scrutiny. Panel A refers to the single question about financial knowledge (Q1) in the A-test. Panel B presents the questions about financial knowledge (Q2) and loss aversion (Q3) in the S-test. The other questions used in our empirical analysis are defined directly in the text.

necessary, they argue that a good quality of replication requires a weekly rebalancing.

2. Individual characteristics

Our investor database contains demographics and some self-declared data based on the A-test for 41,557 investors. We mainly focus on education and financial literacy, which is based on the subjective knowledge of financial markets. Additional characteristics are available for the 20,533 investors who also completed the S-test, namely investment amount, annual net income, investment horizon, financial literacy, and loss aversion. Among ETP users, 6408 investors filled in the A-test only while 3931 investors completed both tests. The exact wording of the main questions under scrutiny (i.e., financial literacy and loss aversion) is available in Table 4.

The individual data at hand allow us to compare the profiles of LETP and VETP users. For each item, we test whether there is a significant difference between VETP and LETP users. For that purpose, we first perform a standard independence Chi-2 test for the pair of subsamples (VETP users versus LETP users). Since we deal with ordinal variables, we complete the Chi-2 test by a Stochastic Dominance test (hereafter FOSD) using a Kolmogorov–Smirnov formula as in Heathcote, Brown, Wagenmakers, and Eidels (2010).

Let us denote $\hat{F}_Y$ the empirical cumulative distribution of a random variable Y based on a sample $y_1, \ldots, y_k$ is defined by

$$\hat{F}_Y(x) = \frac{1}{k}\sum_{i=1}^{k} \mathbf{1}_{\{y_i \leq x\}} \tag{1}$$

To test the dominance (FOSD) of $\hat{F}_{LETP}$ over $\hat{F}_{VETP}$, the Kolmogorov–Smirnov statistic is defined by

$$KS = \frac{mn}{m+n} Sup_{x \in \mathbf{R}}(\hat{F}_{VETP}(x) - \hat{F}_{LETP}(x)) \tag{2}$$

where m (n) is the sample size of the set of VETP (LETP) users and $\hat{F}_{VETP}(\hat{F}_{LETP})$ is the empirical CDF of the variable under scrutiny on the set of VETP (LETP) users. Dominance is obtained if the difference of empirical CDFs is always positive and if KS is sufficiently large. The p-value of the test is approximated by $\exp(-2 \times KS^2)$, as in Heathcote et al. (2010). To test the reverse dominance, it is enough to change the order of CDFs in the definition of KS.

Table 5 provides the results, where $FOSD = 1(-1)$ means that the distribution of LETP (VETP) users dominates the distribution of VETP (LETP) users. $FOSD = 0$ indicates that neither distribution dominates the other. For education (Panel A), the Chi2 test rejects the null hypothesis with a value of 24.48, meaning that the distribution of VETP users differs from the distribution of LETP users. The CDF of VETP users lies below the CDF of LETP users (FOSD = -1). These two indicators show that LETP users are less educated than VETP users. In particular, there is a significant difference in the percentages of investors holding a university degree (Education = 2). 81.4% of VETP users hold a university degree, compared to 76.09% for LETP users. This difference is highly significant (p-value lower than 0.1%) in a standard test comparing proportions.

Panels B and C in Table 5 compare the amount invested in financial markets (Panel B) and income (Panel C), respectively. Both items are defined on five ranges of monetary values; from less than 20,000€ to more than 1,000,000€ for investment amount and from less than 20,000€ to more than 150,000€ for income. No significant difference appears for investment amount while we observe a small statistical difference for income.[24] Panel D refers to investment horizon, which is also built on 5 ranges (from less than two years to more than seven years). It clearly appears that VETP users self-declare a longer investment horizon than LETP users. This result is consistent with the difference noticed earlier on the buy-sell imbalance (significantly smaller for LETP users, compared to VETP users).

As far as subjective financial literacy is concerned, Panels E and F in Table 5 reveal consistent results. Panel E refers to the knowledge of financial markets in the A-test, wherein investors have to select one of the four available levels, from a basic knowledge to an excellent knowledge (see Q1 in Table 4). The Chi-2 test and the

[24] In the multivariate analysis of Section 4, we disregard income because this variable is strongly correlated with investment amount.

Table 5
Demographics and survey-based data.

Panel A: Education						
Code	0	1	2	Total	Chi^2	FOSD
VETP users	200	694	3,899	4,793	24.48***	−1***
LETP users	69	317	1,229	1,615		

Panel B: Investment amount (in K€)								
Code	<20	20-50	50-250	250-1,000	>1,000	Total	Chi^2	FOSD
VETP users	566	497	1,028	680	195	2,966	0.36	0
LETP users	180	159	337	221	68	965		

Panel C: Income (in K€)								
Code	<20	20-40	40-75	75-150	>150	Total	Chi^2	FOSD
VETP users	336	954	1,024	495	155	2,966	8.35*	−1**
LETP users	128	338	320	137	42	965		

Panel D: Investment horizon (in years)								
Code	h <2	2≤ h <3	3≤ h <5	5≤ h <7	h ≥7	Total	Chi^2	FOSD
VETP users	192	278	696	506	1294	2,966	13.52***	−1**
LETP users	94	110	227	140	394	965		

Panel E: Financial literacy (A-test)							
Code	0	1	2	3	Total	Chi^2	FOSD
VETP users	535	1,111	2,290	857	4,793	40.63***	1***
LETP users	169	308	737	401	1,615		

Panel F: Financial literacy (S-test)								
Code	0	1	2	3	4	Total	Chi^2	FOSD
VETP users	59	216	801	1,491	399	2,966	13.28***	1**
LETP users	19	53	233	493	167	965		

Panel G: Loss aversion								
Code	1	1	2	3	4	Total	Chi^2	FOSD
VETP users	67	112	479	1,434	874	2,966	25.31***	0
LETP users	30	48	144	393	350	965		

This table compares the distributions of VETP users and LETP users on some demographics and items in the MiFID tests. Panel A refers to education level, Panel B to investment amount, Panel C to annual net income, Panel D to investment horizon, Panel E to financial literacy in the A-test (see Q1 in Table 4), Panels F and G to financial literacy (see Q2 in Table 4) and loss aversion (see Q3 in Table 4) in the S-test, respectively. Chi-2 gives the results of a standard independence test for the pair of subsamples while FOSD provides the results of a stochastic dominance test. FOSD= 1 (versus -1) means that the distribution of LETP users (versus VETP users) dominates the distribution of VETP users (versus LETP users).

* Statistical difference at the level of 10% respectively.
** Statistical difference at the level of 5% respectively.
*** Statistical difference at the level of 1% respectively.

FOSD test show that the use of VETPs/LETPs is not independent of this self-reported financial literacy. LETP users declare a much better knowledge, compared to VETP users (Chi-2 = 40.63). The framing of this question (detailed in Table 4) holds a special interest. 1258 ETP users (857 VETP users + 401 LETP users) out of 6408 selected the highest level, meaning they consider themselves as "experienced investors who manage any aspect of financial markets". They represent 19.63% (1258/6408) of the set of ETP users. Moreover, decomposing this percentage among the two subsamples shows that 24.83% of LETP users (401/1615) self-declare the highest level of knowledge, compared to 17.88% for VETP users (857/4793). These findings might suggest a higher overconfidence among LETP users, compared to VETP users. Panel F in Table 5 focuses on subjective financial literacy assessed in the S-test, which relies on five possible levels (see Q2 in Table 4).[25] The Chi-2 and FOSD tests provide consistent results with Panel E. Despite both items not being strictly comparable, it appears that ETP users who completed the S-test seem less prone to overconfidence than the ones who neglect this test (and general financial advice associated to it). In Panel F, 13.4% (399/2966) of VETP users and 17.3% (167/965) of LETP users selected the highest level of financial literacy.

Last but not least, Panel G in Table 5 refers to loss aversion, which is assessed on a five-level scale ranging from high aversion to high tolerance (see Q3 in Table 4).[26] The result is significant only for the Chi-2 test. Though there is no strict dominance, there is a large difference between VETP users (29.46%) and LETP users (36.2%) for the highest level of loss tolerance. At the other end of the spectrum, we observe 8.08% of LETP users choosing Level 0 or 1 (most loss averse) and only 6% for VETP users.

3. Comparison of portfolios

In this section, we compare the characteristics of individual portfolios in terms of diversification, market value, turnover and distribution of returns. To calculate portfolio returns, we opt for an approximation of the Modified Dietz Method, aiming at delivering a return close to the money-weighted rate of return (e.g., Shestopaloff and Shestopaloff (2007)). Specifically, we compute

[25] As the test was designed by the broker, it is unclear why they chose to change the number of possible levels of knowledge.

[26] In fact, only the highest level characterizes people with a large tolerance to losses.

Table 6
Comparison of single asset class portfolios of VETP and LETP users.

	VETP users				LETP users			
	Mean	Q3	Median	Q1	Mean	Q3	Median	Q1
Panel A: Stock portfolios								
Monthly stocks in ptf	9.89	13.24	6.42***	2.80	10.90	12.45	5.58	2.35
Monthly stock ptf market value (in K€)	88.13*	59.05	20.10	6.66	166.08	62.40	21.67	7.24
Monthly stock ptf turnover	9.43	0.35	0.16***	0.07	160.19	1.03	0.35	0.15
Monthly gross return on stocks (in %)	−0.03	0.40	−0.24	−0.79	0.34	0.48	−0.24	−0.87
Monthly net return on stocks (in %)	−0.21	0.24	−0.35***	−0.90	0.09	0.23	−0.43	−1.06
Std_monthly returns on stocks(in %)	9.44**	9.92	7.15***	5.59	12.80	11.21	7.72	5.89
Skn_monthly returns on stocks	−0.06***	0.32	−0.21***	−0.63	0.17	0.57	−0.07	−0.59
Panel B: VETP portfolios								
Monthly VETP in ptf	1.29**	1.25	1.00	1.00	1.47	1.50	1.00	0.94
Monthly VETP ptf market value (K€)	11.71**	9.37	3.83***	1.77	14.92	11.73	4.92	2.40
Monthly VETP ptf turnover	0.69**	0.51	0.20***	0.09	1.08	1.01	0.42	0.19
Monthly gross return on VETP (in %)	0.38	1.21	0.26*	−0.60	0.37	1.38	0.37	−0.66
Monthly net return on VETP (in %)	0.13	1.04	0.11	−0.77	0.02	1.14	0.12	−0.91
Std_monthly returns on VETP (in%)	8.33	7.89	6.22	4.69	9.41	7.94	6.22	4.88
Skn_monthly returns on VETP	0.23	0.50	0.04	−0.35	0.21	0.48	0.04	−0.38
Panel C: IETP portfolios								
Monthly IETP in ptf	0.99***	1.00	1.00	0.77	0.90	1.00	1.00	0.67
Monthly IETP ptf market value (K€)	9.60	10.48	4.65	2.31	13.47	11.88	5.10	2.41
Monthly IETP ptf turnover	1.06**	1.08	0.75***	0.50	1.56	1.92	0.98	0.66
Monthly gross return on IETP (in %)	−0.97	0.11	−1.03	−1.90	−0.91	0.11	−1.00	−1.87
Monthly net return on IETP (in %)	−1.30	−0.18	−1.46	−2.15	−1.32	−0.36	−1.36	−2.19
Std_monthly returns on IETP (in%)	4.07**	5.00	3.87**	2.95	4.52	5.05	4.20	3.40
Skn_monthly returns on IETP	0.27	0.72	0.25	−0.21	0.23	0.69	0.27	−0.14
Panel D: PLETP portfolios								
Monthly PLETP in ptf					0.94	1.00	1.00	0.96
Monthly PLETP ptf market value(in K€)					11.71	10.54	4.66	2.06
Monthly PLETP ptf turnover					3.84	2.05	1.63	0.50
Monthly gross return on PLETP (in %)					−0.54	1.47	−0.28	−1.87
Monthly net return on PLETP (in %)					−1.08	0.97	−0.72	−2.50
Std_monthly returns on PLETP (in %)					10.10	12.53	10.05	7.27
Skn_monthly returns on PLETP					−0.04	0.48	−0.15	−0.56
Panel E: ILETP portfolios								
Monthly ILETP in ptf					0.83	1.00	1.00	0.60
Monthly ILETP ptf market value(in K€)					11.75	10.26	3.97	1.91
Monthly ILETP ptf turnover					169.64	2.86	1.86	0.67
Monthly gross return on ILETP (in %)					−1.33	0.49	−1.23	−3.18
Monthly net return on ILETP (in %)					−1.78	0.03	−1.62	−3.66
Std_monthly returns on ILETP (in %)					7.86	10.04	7.57	4.97
Skn_monthly returns on ILETP					0.26	0.79	0.29	−0.28

This table provides cross-sectional statistics about the characteristics of single asset class portfolios (in terms of diversification, market value, turnover, and distribution of returns), with a distinction between VETP and LETP users. It distinguishes holdings in stocks (Panel A), in VETPs (Panel B), in IETPs (Panel C), in PLETPs (Panel D), and in ILETPs (Panel E). We compute monthly turnover as the average of the absolute values of all the purchases and sales in a given month divided by the average of the portfolio values at the beginning and the end of this month. 'Std_monthly returns' refers to the standard deviation of monthly portfolio returns and 'Skn_monthly returns' to the skewness of these monthly portfolio returns.

* Statistical difference at the level of 10% respectively.
** Statistical difference at the level of 5% respectively.
*** Statistical difference at the level of 1% respectively.

portfolio gross returns per investor and month assuming that all the purchases (sales) executed in a given month take place on the first (last) day of the month. Mathematically, it gives: $R_t = (EMV_t - EMV_{t-1} - P_t + S_t)/(EMV_{t-1} + P_t)$ where R_t is the portfolio gross return for month t, EMV_t is the end-of-month portfolio value at month t, EMV_{t-1} is the end-of-month portfolio value at month $t-1$, P_t and S_t are the aggregate monetary value of all purchases and sales executed during month t. When calculating net returns, we subtract from the numerator the aggregate monetary value paid on transaction costs during month t.

The cross-sectional portfolio characteristics are reported in Table 6 for single asset class portfolios and in Table 7 for aggregate portfolios. The first (last) four columns of each table focus on VETP (LETP) users and provide the mean, the median, and the lower and upper quartiles for each variable under scrutiny. Again, we mainly comment median values because of the large asymmetry in most distributions.[27]

3.1. Single asset class portfolios

Table 6 provides a comparison of single asset class portfolios, wherein Panel A refers to stock portfolios, Panel B to VETP portfolios, Panel C to IETP portfolios, Panel D to PLETP portfolios, and Panel E to ILETP portfolios.

3.1.1. Stock portfolios

Panel A of Table 6 shows that, in our sample, the diversification of stock portfolios is in line with previous empirical findings. The

[27] As usual, ***, **, * indicate significance at 1%, 5% and 10%, respectively.

Table 7
Comparison of portfolios of VETP and LETP users when aggregating asset classes.

	VETP users				LETP users			
	Mean	Q3	Median	Q1	Mean	Q3	Median	Q1
Panel A: Stock portfolios								
Monthly stocks in ptf	9.89	13.24	6.42***	2.80	10.90	12.45	5.58	2.35
Monthly stock ptf market value (in K€)	88.13*	59.05	20.10	6.66	166.08	62.40	21.67	7.24
Monthly stock ptf turnover	9.43	0.35	0.16***	0.07	160.19	1.03	0.35	0.15
Monthly gross return on stocks (in %)	−0.03	0.40	−0.24	−0.79	0.34	0.48	−0.24	−0.87
Monthly net return on stocks (in %)	−0.21	0.24	−0.35***	−0.90	0.09	0.23	−0.43	−1.06
Std_monthly returns on stocks(in %)	9.44**	9.92	7.15***	5.59	12.80	11.21	7.72	5.89
Skn_monthly returns on stocks	−0.06***	0.32	−0.21***	−0.63	0.17	0.57	−0.07	−0.59
Panel B: Stocks + VETPs portfolios								
Monthly assets in ptf	9.74	12.92	6.12***	2.55	10.61	11.80	4.92	1.96
Monthly ptf market value (K€)	89.39*	60.68	20.37	6.76	165.30	60.21	19.81	5.88
Monthly ptf turnover	9.36	0.35	0.16***	0.08	159.22	1.03	0.35	0.15
Monthly gross return (in %)	−0.01	0.36	−0.23	−0.71	0.34	0.50	−0.23	−0.83
Monthly net return (in %)	−0.17	0.21	−0.35***	−0.83	0.09	0.26	−0.40	−1.02
Std_monthly returns(in%)	8.87	9.23	6.78***	5.35	12.59	11.01	7.42	5.77
Skn_monthly returns	−0.09	0.27	−0.23***	−0.65	0.18	0.58	−0.10	−0.60
Panel C: Stocks + VETPs + IETPs portfolios								
Monthly assets in ptf	9.75	12.96	6.12***	2.55	10.64	11.80	4.94	1.96
Monthly ptf market value (K€)	89.53*	60.98	20.40	6.77	165.91	60.37	19.88	5.88
Monthly ptf turnover	9.37	0.35	0.16***	0.08	159.23	1.03	0.36	0.15
Monthly gross return (in %)	−0.01	0.35	−0.24	−0.71	0.34	0.48	−0.24	−0.83
Monthly net return (in %)	−0.17	0.21	−0.35***	−0.83	0.08	0.26	−0.42	−1.02
Std_monthly returns (in%)	8.85	9.20	6.76***	5.34	12.55	11.01	7.40	5.73
Skn_monthly returns	−0.09	0.27	−0.23***	−0.65	0.18	0.58	−0.10	−0.60
Panel D: Aggregate portfolios (Stocks + all ETPs)								
Monthly assets in ptf	9.75	12.96	6.12***	2.55	10.81	11.98	5.16	2.10
Monthly ptf market value (K€)	89.53*	60.98	20.40	6.77	168.59	64.93	21.70	7.00
Monthly ptf turnover	9.37	0.35	0.16***	0.08	352.39	1.20	0.41	0.17
Monthly gross return (in %)	−0.01	0.35	−0.24	−0.71	0.20	0.36	−0.28	−0.87
Monthly net return (in %)	−0.17	0.21	−0.35***	−0.83	−0.06	0.14	−0.48	−1.11
Std_monthly returns (in%)	8.85	9.20	6.76***	5.34	11.88	10.58	7.27	5.56
Skn_monthly returns	−0.09	0.27	−0.23***	−0.65	0.18	0.53	−0.13	−0.61

This table provides cross-sectional statistics about the characteristics of aggregate portfolios (in terms of diversification, market value, turnover, and distribution of returns), with a distinction between VETP and LETP users. It distinguishes stock portfolios (Panel A), portfolios wherein holdings in stocks and VETPs are aggregated (Panel B), portfolios wherein holdings in stocks, VETPs and IETPs are aggregated (Panel C), aggregate portfolio based on holdings in stocks and all ETPs (Panel D). We compute monthly turnover as the average of the absolute values of all the purchases and sales in a given month divided by the average of the portfolio values at the beginning and the end of this month. 'Std_monthly returns' refers to the standard deviation of monthly portfolio returns and 'Skn_monthly returns' to the skewness of these monthly portfolio returns.

* Statistical difference at the level of 10% respectively.
** Statistical difference at the level of 5% respectively.
*** Statistical difference at the level of 1% respectively.

typical ETP user holds a six-stock portfolio (i.e., 6.42 for VETP users and 5.58 for LETP users).[28] Since the 70s, under-diversification of individual stock portfolios is well-documented in the literature (Blume & Friend, 1975; Lease, Lewellen, & Schlarbaum, 1974). This under-diversification bias is still confirmed in more recent empirical evidence showing that individual investors tend to hold less than five stocks on average (Goetzmann & Kumar, 2008; Kumar, 2007; Mitton & Vorkink, 2007; Odean, 1999).[29]

A significant difference in the number of stocks held in portfolios is not sufficient to conclude that VETP and LETP users behave differently. This is especially true when this difference is significant but tiny, and the median portfolio values are similar (close to 20K€). The large difference between average portfolio values, combined to a larger asymmetry of the distribution of returns, however, indicates that a number of LETP users are much wealthier and more active in stocks, compared to VETP users. The significant difference in median portfolio turnovers (0.35 vs. 0.16) confirms that LETP users trade more stocks than VETP users.[30]

As expected, the higher trading intensity of LETP users negatively impacts the net return of their stock portfolios. Though the median gross returns of VETP and LETP investors are similar (i.e., −0.24% on a monthly basis), the difference between median net monthly returns is highly significant and amounts to seven basis points. The higher transaction costs incurred by the typical LETP user lead to a lower performance on stocks, which is consistent with Odean (1999) and Barber and Odean (2000). The typical LETP user not only earns a lower portfolio return, he also takes significantly more risk, as illustrated by the higher median stock portfolio volatility (7.72% for LETP users versus 7.15% for VETP

[28] In our sample, non-users of ETPs hold approximately 3 stocks in portfolio (unreported).

[29] Calvet, Campbell, and Sodini (2007) obtained the same results for Sweden, except that Swedish investors seem to have slightly more diversified portfolios than U.S. investors.

[30] The monthly portfolio turnover is calculated as the average of the absolute values of all the purchases and sales in a particular month, divided by the average of the portfolio values at the beginning and the end of this particular month. It turns out that the average portfolio value can sometimes be close to zero (even for an active trader), which can lead to some extreme values for turnover. It is the reason why we use median turnover and not average turnover, which can be very high and without any economic meaning.

users). The median skewness of portfolio returns also significantly differs, although being negative in both subsets of investors.

3.1.2. VETP portfolios and IETP portfolios

Panels B and C in Table 6 report some results consistent with Panel A. The typical LETP user is more active in both VETPs and IETPs, compared to VETP users. Median portfolio turnover is 0.42 for VETPs and 0.98 for IETPs for LETP users, in comparison with 0.20 and 0.75, respectively. On the contrary, net returns from VETPs do not really differ (0.12% for LETP users vs. 0.11% for VETP users), though the typical LETP user gets a superior gross performance from VETPs. In particular, the typical LETP user invests more in VETPs (median portfolio value of 4.92K€ vs. 3.83K€) and earns a higher gross return (0.37% vs. 0.26%). This advantage, however, is lost in transaction costs. The story slightly differs for IETP portfolios since median gross and net returns are similar and negative for both subsets of investors, indicating that the typical user of VETPs or LETPs loses money when investing in IETPs.

For both VETP and IETP portfolios, standard deviation and skewness of returns appear almost identical. VETP portfolio monthly volatility is approximately 6.2% and the skewness is 0.04 in each subset of investors. For IETP portfolios, the typical LETP user is more risk-taking with a monthly volatility of 4.2%, compared to 3.87% for VETP users.

The comparison of Panels B and C shows a large difference of returns, regardless of the type of investor. The median net return is slightly positive for VETP portfolios (0.11% and 0.12%) while largely negative for IETP portfolios (−1.46% and −1.36%). Such results suggest a wrong market timing for investors who trade IETPs. Because our sample period covers the 2008 financial crisis, we could have expected a better performance on IETPs. Conversely, our findings indicate that investors in our sample invested too late in these instruments (or at least misused them).

3.1.3. LETP portfolios

Our sample period starts in January 2008, that is just a few months before the bankruptcy of Lehman Brothers. As previously explained, investing in LETPs with a daily reset can be very risky in turbulent periods. The average return may deviate from the return anticipated on the basis of the leverage coefficient. Such deviations, combined with the large asymmetry in the distribution of returns in Panel D and E of Table 6, suggest that our sample of leveraged and inverse leveraged ETP users contains a majority of unlucky gamblers. They probably either tried to benefit from the crisis by investing in ILETPs or bought PLETPs because they thought the market would recover quickly.[31] Unfortunately, poor market timing generated large losses for LETP users. It is worth recalling that the most traded ETP in our sample is an ILETP on the French CAC40 index. From a bottom of 2500 points in January 2009, this index reached 4000 points one year later, leading to huge negative returns on ILETPs. This example shows that errors in market timing cost a lot of money on leveraged securities, especially when market volatility is high. Table 6 reports that the typical LETP user earns a monthly net return of −0.72% on PLETPs (Panel D) and −1.62% on ILETPs (Panel E).

Standard deviation and skewness of monthly portfolio returns reinforce our interpretation. The median volatility on LETP portfolios is significantly larger than on VETP or IETP portfolios, i.e., 10.05% for PLETPs and 7.57% for ILETPs, compared to 6.22% for VETPs and 4.20% for IETPs. In the gambler's view, a higher volatility can be compensated for by a higher skewness. Unfortunately, this interpretation is not backed by the findings of Table 6. In particular, the median skewness of IETP portfolios is the same as the median skewness of ILETP portfolios. Moreover, VETP portfolios exhibit a higher median skewness (0.04) than PLETP portfolios (−0.15).

3.2. Aggregate portfolios

Table 7 refers to portfolios wherein we sequentially aggregate asset classes to finally obtain aggregate portfolios, which include holdings in stocks and all types of ETPs (in Panel D). Therefore, for both LETP and VETP users, the impact of a given asset class on portfolio characteristics and its contribution to the distribution of returns can be estimated through the differences across panels.

Comparing Panels A and B of Table 7 shows that the addition of VETPs does not change much the characteristics of portfolios in terms of median value or turnover. By contrast, the inclusion of VETP holdings changes some moments of the return distribution. For VETP users, the median portfolio volatility falls to 6.78% in Panel B, compared to 7.15% in Panel A, while the net expected portfolio return remains the same (−0.35%). For the typical LETP user, both portfolio expected return and volatility decrease, i.e., combining stocks and VETPs pushes down the monthly return by 0.03% and reduces the volatility by 0.3% on a monthly basis. The effect on the skewness of returns is almost negligible. The median portfolio return skewness decreases slightly in both subsets of investors, a not too surprising effect because aggregating holdings in stocks and VETPs improves portfolio diversification. It therefore decreases the skewness of returns (Albuquerque, 2012; Broihanne, Merli, & Roger, 2016).

Panel C refers to portfolios wherein IETPs are added to stocks and VETPs. The effect is negligible because the trading volume on these instruments is very low over our sample period. Consequently, IETPs tend to represent a small part of individual portfolios. As expected, adding IETPs somewhat reduces the volatility of portfolio returns.

The contribution of LETPs to the performance of individual aggregate portfolios emerges in Panel D of Table 7. Two levels of comparison are important here. First, focusing on Panel D only, we can compare the aggregate portfolios of VETP and LETP users. The diagnostic is clear-cut. LETP users trade too much and get a poor performance on the LETPs they invest in. In fact, their propensity to overtrading was already visible in their stock portfolios, i.e., the difference between median gross and net returns in Panel A is 0.11% for VETP users and 0.19% for LETP users. Panel D reveals that the difference is almost the same on aggregate portfolios. It remains 0.11% for VETP users and even increases to 0.20% for LETP users. On a yearly basis, this means a loss larger than 1% for the typical LETP user, which is economically significant. When comparing the median skewness of portfolio returns, the typical LETP user exhibits a higher skewness but the latter remains negative (i.e., −0.13). Second, for LETP users only, the comparison of Panel C with Panel D illustrates the contribution of LETPs to the risk-return trade-off of individual portfolios. The inclusion of LETPs leads to a decrease of 0.06% in median monthly net returns. However, this median return decrease is associated with a slight decrease of both median volatility and median skewness. Therefore, it is still unclear whether the typical LETP user is an overconfident gambler penalized by a bad market timing or a hedger aiming at reducing his portfolio risk. Nevertheless, combining the results in Tables 6 and 7 makes the first explanation more likely. In particular, the very high turnover of ETP portfolios (except for VETPs) is consistent with overtrading due to overconfidence. To dig deeper in this direction, we devote the next section to the profiling of LETP users (compared to VETP users), using a multivariate analysis including investor individual characteristics.

[31] In Table 1, PLETPs and ILETPs represent approximately 75% of the trading volume on ETPs.

4. LETP user profile

We estimate two binary logit models in order to sketch the profile of the typical LETP user, compared to VETP users. The first model is implemented on the entire sample of ETP users, i.e., including A- and S-investors. The second model is a replication on the subsample of S-investors, which allows us to consider additional individual characteristics such as loss aversion and investment amount.

4.1. Logit model on the entire sample

In order to assess the main determinants of LETP trading in our sample of ETP users, we estimate a binary logit model wherein the dependent variable is a dummy response variable called $Trading\_LETP_i$ that captures the event "investor i is a LETP user":

$$Prob(Trading\_LETP_i = 1|\boldsymbol{x_i'}) = \frac{\exp(\boldsymbol{x_i'\beta})}{1+\exp(\boldsymbol{x_i'\beta})},$$

where $Trading\_LETP_i$ is the response variable which equals 1 if investor i has traded at least one LETP over the whole sample period and 0 otherwise, $\boldsymbol{x_i'}$ is a $1 \times (k+1)$ vector of the k explanatory variables (including intercept), $\boldsymbol{\beta}$ is a $(k+1) \times 1$ vector of coefficients (including intercept) and

$$\begin{aligned}\boldsymbol{x_i'\beta} &= \beta_0 + \beta_1 Age_i + \beta_2 Male_i + \beta_3 FR_i + \beta_4 High\_educ_i \\ &+\beta_5 Mid\_literacy_i + \beta_6 High\_literacy_i \\ &+\beta_7 S\_test_i + \beta_8 LOG\_N\_isin_i + \beta_9 LOG\_N\_options_i \\ &+\beta_{10} LOG\_N\_funds_i + \beta_{11} Experience_i + \beta_{12} Trade\_duration_i\end{aligned} \quad (3)$$

In Eq. (3), Age_i is the age of investor i at the end of the sample period, $Male_i$ is a dummy variable set to 1 if investor i is a man, FR_i is a dummy variable set to 1 if investor i is French-speaking, $High\_educ_i$ measures the level of education of investor i and is set to 1 when investor i holds a university degree, $Mid\_literacy_i$ is a dummy variable set to 1 if investor i selected level 1 or 2 on the scale available (see Q1 in Table 4), $High\_literacy_i$ is a dummy variable set to 1 if investor i selected the highest level on the scale (see Q1 in Table 4), S_test_i is a dummy variable set to 1 if investor i completed the S-test, $LOG\_N\_isin_i$ is the natural logarithm of the number of different stocks traded by investor i, $LOG\_N\_options_i$ and $LOG\_N\_funds_i$ is the natural logarithm of the number of trades executed by investor i in options and mutual funds, respectively, $Experience_i$ is the time length (expressed in months) between the first and the last trade in stocks executed by investor i, and $Trade\_duration_i$ is the average delay (expressed in days) between two consecutive trades executed by investor i in stocks.

The results of the above model are reported in Panel A of Table 8.[32] Our set of independent variables covers three dimensions: 1) demographics (age, gender, language, education), 2) self-declared financial literacy in the A-test and participation to the S-test, and 3) trading behavior (universe of stocks traded, number of trades in options or mutual funds, experience on the stock market, and trade duration). Differences in the profiles of LETP and VETP users appear in each of these three dimensions. For the sake of brevity, we focus our comments on the odds ratios.[33] The typical LETP user in our sample is much more likely to speak French (odds ratio =2.412, meaning that the probability that an investor trades

Table 8
Profiling LETP users vs. VETP users.

Variable	Estimate	Std. Error	Wald Chi2	p-value	Odds ratio
Panel A: Logit model on the complete sample					
Intercept	−1.39***	0.21	44.15	0.00	
Age	−0.01***	0.00	8.18	0.00	0.99
Male	−0.09	0.09	0.91	0.34	0.91
FR	0.88***	0.06	197.35	0.00	2.41
High_educ	−0.36***	0.08	22.42	0.00	0.70
Mid_literacy	−0.12	0.10	1.39	0.24	0.89
High_literacy	0.07	0.12	0.30	0.59	1.07
S_test	−0.16**	0.06	5.98	0.01	0.85
LOG_N_isin	0.29***	0.05	28.61	0.00	1.34
LOG_N_options	0.18***	0.02	121.14	0.00	1.19
LOG_N_funds	−0.12***	0.02	32.74	0.00	0.89
Experience	−0.00	0.00	2.09	0.15	1.00
Trade_duration	−0.00***	0.00	16.26	0.00	1.00
Nobs	6,267				
Pseudo R^2	0.09				
Panel B: Logit model on S-investors					
Intercept	−1.81***	0.30	36.01	0.00	
Age	−0.01**	0.00	4.86	0.03	0.99
Male	−0.09	0.13	0.45	0.50	0.91
FR	0.79***	0.08	97.50	0.00	2.21
High_educ	−0.34***	0.10	12.87	0.00	0.71
Mid_literacy	0.24	0.16	2.30	0.13	1.27
High_literacy	0.37**	0.19	3.89	0.05	1.44
Low_aversion	0.20**	0.09	5.45	0.02	1.22
High_aversion	0.40**	0.16	6.44	0.01	1.49
Mid_invest	−0.12	0.10	1.45	0.23	0.89
Large_invest	−0.21*	0.11	3.41	0.06	0.81
LOG_N_isin	0.34***	0.07	23.07	0.00	1.40
LOG_N_options	0.18***	0.02	81.48	0.00	1.20
LOG_N_funds	−0.10***	0.02	17.90	0.00	0.90
Experience	−0.01**	0.00	5.55	0.02	0.99
Trade_duration	−0.00***	0.00	6.81	0.01	0.00
Nobs	3,876				
Pseudo R^2	0.09				

This table reports the results of two binary logit models wherein the dependent variable captures the event "investor i is a LETP user". Panel A refers to the first model (see Eq. (3)) implemented on the entire sample of ETP users, while Panel B refers to the second model (see Eq. (4)) estimated on the subsample of S-investors. *Age* is the investor age at the end of the sample period, *Male* is a dummy variable set to 1 for men, *FR* is a dummy variable set to 1 for French-speakers, *High_educ* is a dummy variable set to 1 for investors who hold a university degree, *LOG_N_isin* is the natural logarithm of the number of different stocks traded, *LOG_N_options* and *LOG_N_funds* is the natural logarithm of the number of trades executed on options and mutual funds, respectively, *Experience* is the time length (in months) between the first and the last trade on stocks, and *Trade_duration* is the average delay (in days) between two consecutive trades on stocks. In Panel A, *Mid_literacy* is a dummy variable set to 1 for investors who selected level 1 or 2 (see Q1 in Table 4), *High_literacy* is a dummy variable set to 1 for investors who selected the highest level (see Q1 in Table 4), and *S_test* is a dummy variable set to 1 for investors who completed the S-test. In Panel B, *Mid_literacy* is a dummy variable set to 1 for investors who selected level 0 or 1 (see Q2 in Table 4), *High_literacy* is a dummy variable set to 1 for investors who selected the highest level (see Q2 in Table 4), *Low_aversion* is a dummy variable set to 1 for investors who selected level 4 (see Q3 in Table 4), *High_aversion* is a dummy variable set to 1 for investors who selected level 0 or 1 (see Q3 in Table 4), *Mid_invest* is a dummy variable set to 1 for investors who self-reported an investment amount between 20 and 250K€, and *Large_invest* is a dummy variable set to 1 for investors who declared an investment amount exceeding 250K€.

* Statistical significance at the level of 10% respectively.
** Statistical significance at the level of 5% respectively.
*** Statistical significance at the level of 1% respectively.

LETPs increases by a factor of 2.412 when she is French-speaker). This result is consistent with the "familiarity bias" due to both home bias and language proximity; French-speaking ETP users are more likely to invest in LETPs, which are mostly traded in Paris, compared to Amsterdam. The typical LETP user trades a broader universe of stocks and trades more in the option market (odds ratio of 1.34 and 1.19, respectively). By contrast, she trades less in mutual funds (odds ratio = 0.89). The typical LETP user is also less educated (odds ratio = 0.7) and less eager for information and professional recom-

[32] These results are based on a sample of 6,267 ETP users. We had to disregard 141 investors in the initial sample of ETP users because they do not trade stocks at all (i.e., they trade only ETPs). Therefore, we cannot calculate some of the independent variables for these investors.

[33] calculated as the exponential of the coefficient estimates.

mendations (odds ratio = 0.85 for the S-test variable). In short, the typical LETP user looks more like an investor following her intuition and making bets on market trends and less like a perfectly rational homo economicus who tries to save transaction costs and considers free general financial advice to make sound investment decisions.

4.2. Logit model on S-investors

Focusing on S-investors who have a stronger appetite for information and professional recommendations, we replicate our binary logit model in order to include additional individual characteristics.[34] Accordingly, the set of explanatory variables is now given by:

$$\begin{aligned}\boldsymbol{x_i'\beta} &= \beta_0 + \beta_1 Age_i + \beta_2 Male_i + \beta_3 FR_i + \beta_4 High\_educ_i \\ &+\beta_5 Mid\_literacy_i + \beta_6 High\_literacy_i \\ &+\beta_7 Low\_aversion_i + \beta_8 High\_aversion_i + \beta_9 Mid\_invest_i \\ &+\beta_{10} Large\_invest_i + \beta_{11} LOG\_N\_isin_i \\ &+\beta_{12} LOG\_N\_options_i + \beta_{13} LOG\_N\_funds_i + \beta_{14} Experience_i \\ &+\beta_{15} Trade\_duration_i\end{aligned} \tag{4}$$

Comparing Eqs. (4) and (3), only the following six variables differ. $Mid\_literacy_i$ is a dummy variable set to 1 if investor i selected level 0 or 1 on the scale available for that item in the S-test (see Q2 in Table 4), $High\_literacy_i$ is a dummy variable set to 1 if investor i selected the highest level on the scale (see Q2 in Table 4),[35] $Low\_aversion_i$ is a dummy variable set to 1 if investor i selected level 4 on the scale available (see Q3 in Table 4), $High\_aversion_i$ is a dummy variable set to 1 if investor i selected level 0 or 1 on the scale (see Q3 in Table 4), Mid_invest_i is a dummy variable set to 1 if investor i self-reported an investment amount between 20 and 250K€, and $Large\_invest_i$ is a dummy variable set to 1 if investor i declared an investment amount exceeding 250K€.

Panel B of Table 8 provides the results for the subsample of S-investors. For the sake of brevity, we mainly focus on the variables built on the S-test that reveal interesting features. First, the coefficient estimates of the two dummies linked to loss aversion are significant at the 5% level but does not show opposite signs. This means that the use of LETPs may be motivated by both hedging (when used by investors who declare a high loss aversion) and gambling (when used by investors who self-report a low loss aversion). Looking at the odds ratios, the probability to trade LETPs increases by a factor of 1.49 (versus 1.22) for highly (versus little) loss averse ETP users who completed the S-test. Second, compared to what we observe in Panel A for financial literacy, the coefficient estimate is positive and significant for the dummy variable capturing the highest level of literacy in the S-test. Specifically, the probability to invest in LETPs increases by a factor of 1.44 when the ETP user views himself as "an experienced investor who masters all the aspects of financial markets". Third, though the level of significance is weak, LETP users are less wealthy, compared to VETP users (odds ratio = 0.81 for *Large_invest*). For the remaining variables, the findings are consistent with those of Panel A.

Table 9
Logit model on the subset of LETF S-investors for the exclusive use of ILETPs.

Variable	Estimate	Std. Error	Wald Chi2	*p*-value	Odds Ratio
Intercept	0.31	0.51	0.37	0.54	
Age	−0.00	0.01	0.15	0.70	1.00
Male	−0.17	0.23	0.58	0.45	0.84
FR	−0.30**	0.14	4.73	0.03	0.74
High_educ	−0.07	0.16	0.21	0.65	0.93
Mid_literacy	0.33	0.27	1.48	0.22	1.39
High_literacy	0.44	0.32	1.90	0.17	1.55
Low_aversion	0.17	0.14	1.44	0.23	1.19
High_aversion	0.81***	0.27	9.32	0.00	2.26
Mid_invest	0.03	0.17	0.03	0.86	1.03
Large_invest	−0.38**	0.19	3.96	0.05	0.68
LOG_N_isin	0.00	0.11	0.00	0.98	1.00
LOG_N_options	0.06*	0.03	3.38	0.07	1.06
LOG_N_funds	−0.05	0.04	1.20	0.27	0.96
Experience	−0.01	0.01	0.79	0.38	0.99
Trade_duration	0.00	0.00	0.89	0.35	1.00
N observations	961				
Pseudo R^2	0.05				

This table reports the results of a binary logit model estimated on the subsample of S-investors who use LETPs, wherein the dependent variable set to 1 for investors using only ILETPs (and 0 otherwise). Among the 961 S-investors who use LETPs, 499 investors use ILETPs only. *Age* is the investor age at the end of the sample period, *Male* is a dummy variable set to 1 for men, *FR* is a dummy variable set to 1 for French-speakers, *High_educ* is a dummy variable set to 1 for investors who hold a university degree, *LOG_N_isin* is the natural logarithm of the number of different stocks traded, *LOG_N_options* and *LOG_N_funds* is the natural logarithm of the number of trades executed on options and mutual funds, respectively, *Experience* is the time length (in months) between the first and the last trade on stocks, and *Trade_duration* is the average delay (in days) between two consecutive trades on stocks. *Mid_literacy* is a dummy variable set to 1 for investors who selected level 0 or 1 (see Q2 in Table 4), *High_literacy* is a dummy variable set to 1 for investors who selected the highest level (see Q2 in Table 4), *Low_aversion* is a dummy variable set to 1 for investors who selected level 4 (see Q3 in Table 4), *High_aversion* is a dummy variable set to 1 for investors who selected level 0 or 1 (see Q3 in Table 4), *Mid_invest* is a dummy variable set to 1 for investors who self-reported an investment amount between 20 and 250K€, and *Large_invest* is a dummy variable set to 1 for investors who declared an investment amount exceeding 250K€.

* Statistical significance at the level of 10% respectively.
** Statistical significance at the level of 5% respectively.
*** Statistical significance at the level of 1% respectively.

Comparing Panels A and B of Table 8 leads us to conclude that LETP users who neglect the S-test (and the access to free information and general advice it provides) are more likely to be gamblers than VETP users. Nevertheless, among the subset of S-investors, LETPs might also be used to hedge some portfolios, especially by highly loss averse investors. To test this conjecture, we estimate another binary logit model restricted to S-investors who used LETPs. Among this subset of investors, we distinguish S-investors who used only ILETPs (499 investors) and those who traded both PLETPs and ILETPs (462 investors). Accordingly, the dependent variable in this additional logit model is a dummy set to 1 for investors using only ILETPs (and 0 otherwise). The set of explanatory variables is the same as in Eq. (4). Focusing on our dummy variable of interest (i.e., high loss aversion), Table 9 shows that, among S-investors who use LETPs, investors who are strongly loss averse have a much higher probability (odds ratio = 2.2572) to invest only in ILETPs. This result is arguably consistent with the use of ILETPs for hedging purposes.[36]

[34] The subset of S-investors is not a random subsample. Nevertheless, S-investors are interesting because they answered more questions, in particular about loss aversion and investment amount.

[35] The literacy variables in Eq. (4) are not exactly defined as in Eq. (3) because Q2 has more possible answers than Q1 in Table 4. An increase in possible answers generates a lower proportion of extreme answers, compared to what we obtained on the complete sample. It is, however, difficult to know what is due to a non random subsample and what comes from the design of the question. Bellofatto, D'Hondt, et al. (2018) show that the answers to the two questions related to financial literacy (the one in the A-test and the one in the S-test) are consistent in the sample of S-investors.

[36] Two additional results may been stressed in Table 9. The first one refers to *FR* that is a dummy variable set to one for French speakers. This variable is highly significant in Table 8 (Panel B) with an odds ratio equal to 2.21, meaning that French speakers are more likely to trade LETPs than VETPs. By contrast, Table 9 shows that, among S-investors who use LETPs, French speakers are less likely to invest only in ILETPS. These two results taken together point to a higher probability for French speakers

5. Impact of LETPs on individual performance

Section 3 provides general insights on the influence of LETPs on portfolio returns. In this section, we deepen the analysis at the individual level to test whether, on a monthly basis, LETP holdings deteriorate or improve portfolio performance. We estimate a first panel data model, which enables us to directly test the impact of LETPs on performance while controlling for both market factors and individual characteristics. This model is the following:

$$r_{i,t} = \alpha + \beta_1 d\_LETP_{i,t} + \beta_2 d\_VETP_{i,t} + \beta_3 d\_IETP_{i,t} + \beta_4 MF_t + \beta_5 IFE_i + \varepsilon_{i,t} \quad (5)$$

wherein the dependent variable is $r_{i,t}$, the aggregate portfolio return of investor i at month t. To characterize the presence of ETPs in portfolio, we define three dummy variables: $d\_LETP_{i,t}$ is set to 1 when investor i holds at least one LETP (either PLETP or ILETP) at month t, $d\_VETP_{i,t}$ is set to 1 when investor i holds at least one VETP at month t, and $d\_IETP_{i,t}$ is set to 1 when investor i holds at least one IETP at month t. To control for market factors, we include MF_t as a vector of Fama–French–Carhart factors at month t for the European market. This vector includes the usual four factors, namely Market risk premium, Size, Book-to-Market, and Momentum.[37] In addition, IFE_i is an individual control vector for investor i, which includes the investor-based variables used in Eq. (3). When estimating this panel data regression, we cluster standard errors by month as in Bhattacharya et al. (2017).[38]

The results are reported in Table 10. The coefficient $d\_LETP_{i,t}$ is equal to −0.95, significant at the 1% level (p-value = 0.008). By contrast, the dummies linked to the two other types of ETPs (VETPs and IETPs) are not significant (p-values= 0.15 and 0.30, respectively). This result leads to conclude that holding LETPs deteriorates the portfolio return of the retail investors in our sample. As for the control variables, only a few of them are significant. Not surprisingly, the two market factors Market risk premium and Size, exhibit positive and highly significant coefficient estimates. Among the investor-based variables, only three are significant for explaining individual performance. First, financial literacy is positively related to monthly returns. Both dummy variables *Mid_literacy* and *High_literacy* have positive coefficients, but only the coefficient estimate of the first one is significant at the 5% level. This means that, all else being equal, being financially literate is associated with a better performance. However, the absence of significance for the *High_literacy* dummy might appear to be unexpected. It is worth remembering that any investor for who *High_literacy* is set to 1 agrees with the sentence "I consider myself as an experienced investor who manages any aspect of financial markets". Hence, the *High_literacy* dummy variable might be a sign of overconfidence. Alternatively, this variable might be insignificant because of the presence of our proxy for experience (measured by the investor tenure on the stock market). The latter displays a positive coefficient estimate that is significant at the 10% level (p-value=0.0528). Finally, the coefficient estimate of the *S_test* dummy variable is negative and significant at the 5% level. This suggests that the ETP users who completed the S-test (and have a higher appetite for information) tend to get a lower performance.

Table 10
Panel data analysis of individual aggregate portfolio returns - Model 1.

Variable	Estimate× 100	Std. Error× 100	t-stat	p-value
Intercept	−0.17	0.56	−0.3	0.76
d_LETP	−0.95***	0.34	−2.78	0.01
d_VETP	−0.29	0.20	−1.48	0.15
d_IETP	−0.49	0.47	−1.04	0.30
Risk premium	83.42***	6.28	13.28	0.00
Size	26.00***	9.13	2.85	0.01
BM	15.78	13.85	1.14	0.26
MOM	−7.76	6.60	−1.18	0.25
Age	0.00	0.01	0.02	0.98
Male	−0.01	0.13	−0.08	0.94
FR	−0.09	0.16	−0.59	0.56
High_educ	−0.10	0.11	−0.93	0.36
Mid_literacy	0.27**	0.11	2.51	0.02
High_literacy	0.52	0.36	1.45	0.15
S_test	−0.33**	0.14	−2.27	0.03
LOG_N_isin	−0.11	0.13	−0.83	0.41
LOG_N_options	0.03	0.04	0.68	0.50
LOG_N_funds	−0.04	0.04	−0.91	0.37
Experience	0.02*	0.01	1.99	0.05
Trade_duration	0.00	0.00	0.7	0.49

This table reports the results of a panel data regression wherein the dependent variable is the aggregate portfolio return of investor i at month t (see Eq. (5)). The presence of ETPs in the investor aggregate portfolio is characterized using three dummy variables: $d\_LETP_{i,t}$ is set to 1 when investor i holds at least one LETP at month t, $d\_VETP_{i,t}$ is set to 1 when investor i holds at least one VETP at month t, and $d\_IETP_{i,t}$ is set to 1 when investor i holds at least one IETP at month t. *Riskpremium*, *Size*, *BM*, and *MOM* constitute a vector of Fama-French-Carhart factors at month t for the European market. All the investor-based variables used in Eq. (3) constitute an individual control vector for investor i. Standard errors are clustered by month.
* Statistical significance at the level of 10% respectively.
** Statistical significance at the level of 5% respectively.
*** Statistical significance at the level of 1%, respectively.

To complement the above results and further distinguish between holdings in PLETPs and in ILETPs, we estimate this second panel data model:

$$r_{i,t} = \alpha + \beta_1 d\_PLETP_{i,t} + \beta_2 d\_ILETP_{i,t} + \beta_3 d\_VETP_{i,t} + \beta_4 d\_IETP_{i,t} + \beta_5 MF_t + \beta_6 IFE_i + \varepsilon_{i,t} \quad (6)$$

Equation (6) is similar to Equation (5), except that the dummy variable $d\_LETP_{i,t}$ is replaced by the two distinct dummies $d\_PLETP_{i,t}$ and $d\_ILETP_{i,t}$. Hence $d\_PLETP_{i,t}$ is set to 1 when investor i holds at least one PLETP at month t while $d\_ILETP_{i,t}$ is set to 1 when investor i holds at least ILETP at month t.

The results for the second panel data regression model are reported in Table 11. The coefficient estimates of the two dummies of interest ($d\_PLETP_{i,t}$ and $d\_ILETP_{i,t}$) are negative and significant at the 10% level. These additional results confirm that, whatever the direction of the LETP (i.e., inverse or not), holding such leveraged products penalizes individual portfolio returns.

6. Conclusion

This paper explores the behavior of retail investors who invest in leveraged ETPs (LETPs). For that purpose, we investigate the profile of investors who hold such LETPs and their aggregate portfolio returns, compared to investors who invest in vanilla ETPs (VETPs). This comparison is made possible thanks to our proprietary database that enable us to match investor trading records with demographics and survey-based individual characteristics.

In our broad sample, 6408 investors (about 15%) trade ETPs and about 25% of these ETP users (i.e., 1615 investors) traded at least once one LETP over the period January 2008-March 2012. The trading volume in ETPs amounts to an aggregate value of 1.5 billion euros for 80,137 trades across 486 ETPs. However, 57% of these

to use LETPs for gambling purposes. As for the variable *Large_invest* that is a dummy variable set to 1 for investors who declared an investment amount exceeding € 250K, its odds ratio is lower than 1 in Table 9. This result is similar with what was found in Table 8 (Panel B). While these large investors are less likely to trade LETPs (compared to VETPs) than small investors, they appear more likely to trade both ILETPs and PLETPs when we focus on the subsample of S-investors who trade LETPs.

[37] Market factors for the European market are provided by Eurofidai (http://www.eurofidai.org).

[38] The main objective is to address potential issues due to cross-sectional correlation (Seasholes & Zhu, 2010).

Table 11
Panel data analysis of individual aggregate portfolio returns - Model 2.

Variable	Estimate× 100	Std. Error× 100	*t*-stat	*p*-value
Intercept	−0.18	0.56	−0.32	0.75
d_VETP	−0.30	0.20	−1.49	0.14
d_PLETP	−0.49*	0.25	−1.95	0.06
d_ILETP	−1.13*	0.60	−1.88	0.07
d_IETP	−0.48	0.47	−1.03	0.31
Riskpremium	83.41***	6.28	13.28	0.00
Size	26.00***	9.12	2.85	0.01
BM	15.84	13.85	1.14	0.26
MOM	−7.75	6.59	−1.18	0.25
Age	0.00	0.00	0.02	0.98
Male	−0.01	0.13	−0.09	0.93
FR	−0.09	0.16	−0.58	0.56
High_educ	−0.10	0.11	−0.95	0.35
Mid_ literacy	0.27**	0.11	2.55	0.01
High_literacy	0.52	0.36	1.47	0.15
S_test	−0.33**	0.14	−2.28	0.03
LOG_N_isin	−0.11	0.13	−0.81	0.42
LOG_N_options	0.03	0.04	0.69	0.50
LOG_N_funds	−0.04	0.04	−0.91	0.37
Experience	0.02	0.01	1.98	0.05
Trade_duration	0.00	0.00	0.70	0.48

This table reports the results of a panel data regression wherein the dependent variable is the aggregate portfolio return of investor i at month t (see Eq. (6)). The presence of ETPs in the investor aggregate portfolio is characterized using four dummy variables: $d\_LETP_{i,t}$ ($d\_ILETP_{i,t}$) is set to 1 when investor i holds at least one PLETP (ILETP) at month t, $d\_VETP_{i,t}$ is set to 1 when investor i holds at least one VETP at month t, and $d\_IETP_{i,t}$ is set to 1 when investor i holds at least one IETP at month t. *Riskpremium*, *Size*, *BM*, and *MOM* constitute a vector of Fama-French-Carhart factors at month t for the European market. All the investor-based variables used in Eq. (3) constitute an individual control vector for investor i. Standard errors are clustered by month.

* Statistical significance at the level of 10% respectively.
** Statistical significance at the level of 5% respectively.
*** Statistical significance at the level of 1% respectively.

trades and 74% of the corresponding trading volume in euros are executed on a subset of only 10 ETPs, among which five are LETPs. Actually, LETPs are the most traded ETPs in our sample.

Our univariate analysis of survey data reveals that LETP users are less educated and more active on most instruments (stocks, ETPs, options/warrants), compared to VETP users. LETP users declare a shorter investment horizon, which is consistent with their significantly smaller buy-sell imbalance in both stocks and ETPs. LETP users also self-report a much better financial literacy, compared to VETP users. The univariate comparison for loss aversion delivers, however, less meaningful results.

Thanks to our detailed trading data, we rebuild end-of-month individual portfolios with a distinction across asset holdings. This approach allows us to focus on both single asset class portfolios and aggregate portfolios. When comparing single asset class portfolios, the typical LETP user exhibits higher turnovers, which indicates that LETP users trade more than VETP users. Consequently, the higher transaction costs they incur lead to a lower performance. The typical LETP user not only earns lower net returns, but he also tends to hold riskier portfolios. When comparing aggregate portfolios, we confirm that the typical LETP user trades too much (in both stocks and ETPs) and particularly, gets a poor performance from the LETPs he invests in.

Nevertheless, the contribution of LETPs to the risk-return trade-off of individual portfolios is not trivial, since the inclusion of LETPs is associated with a decrease in net return, volatility and sknewness. Combined with the high portfolio turnover that is consistent with overtrading, our findings suggest that the typical LETP user looks like an overconfident gambler (1) who is penalized by a bad market timing, and (2) does not succeed in compensating the loss of mean-variance performance by a larger positive skewness of returns.

Our logit models, performed to sketch the profile of LETP users in a multivariate framework, reveal that the typical user of LETPs in our sample is more likely to be a French speaker (and not a Dutch speaker). This result is consistent with the "familiarity bias", since French-speaking ETP users are more likely to invest in LETPs, which are mostly traded in Paris, compared to Amsterdam. More importantly, the typical user of LETPs trades a broader universe of stocks, trades more in options but less in mutual funds. She/He is also less educated and less prone to look for general advice and professional recommendations. When focusing on the subsample of ETP users who have a stronger appetite for information (i.e., investors who completed both MiFID tests), our findings indicate that the use of leverage might be motivated by both hedging (when used by investors who declare a high loss aversion) and gambling (when used by investors who self-report a low loss aversion). The typical LETP user also seems more financially literate and somewhat less wealthy, compared to VETP users. We conclude that LETP users are overall more likely to be gamblers than VETP users. It is however noteworthy that among the subset of investors with a stronger appetite for information and general advice, inverse-leveraged ETPs are sometimes used for hedging purposes, especially by highly loss-averse investors.

Our panel data analysis of individual monthly returns enables us to directly test whether LETPs hurt performance, while controlling for both market factors and individual characteristics. Our results are clear-cut and show that aggregate portfolio returns are significantly deteriorated when investors hold LETPs. Our final conclusion is then summarized in the title of this paper, i.e., trading LETPs is hazardous to retail investor wealth.

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