Investor attention and the use of leverage

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Abstract

We investigate the effects of the use of different sources of investment leverage, i.e. securities with embedded leverage and traditional margin accounts, on the portfolio performance of retail investors, recognizing that these effects may be conditional on investor attention. We find that investors who trade on margin underperform those who do not have margin accounts, but we also find that investors who trade securities with embedded leverage show an even poorer performance than investors who trade on margin. The negative effect of leverage usage decreases with greater investor attention, measured by portfolio monitoring frequency. These results suggest that more attentive investors gain more from the use of investment leverage.

Keywords: investor attention, investment leverage, margin trading, embedded leverage, portfolio performance

JEL classification: G11, G29, G40

1. Introduction

Financial leverage has been extensively used by investors to amplify the anticipated benefits from stock price fluctuations. It enables arbitrageurs and informed traders to exploit opportunities in mispriced securities, while their activities should presumably contribute to market efficiency. Frazzini and Pedersen (2014), for instance, show that leverage-constrained investors tend to bid up the prices of riskier high-beta stocks, leaving less risky low-beta stocks underpriced. Investors who, in turn, use financial leverage unconstrainedly may benefit from such a low-risk anomaly and earn higher returns for the same level of risk by opening a leveraged position in low-beta stocks. These benefits typically come with increased risk exposure and, therefore, financial leverage is considered to be more valuable in less risky asset classes (e.g. fixed income securities) and well-diversified portfolios. However, during the long history of margin accounts, the market has witnessed many investors going bankrupt due to heavy debt burden and market conditions failing to meet expectations. As a result, many professional investors advocate being averse to leverage, citing Warren Buffet, who once referred to investment leverage as: *"If you're smart you don't need it. If you're dumb you got no business using it"*.

Despite its notorious reputation, appetite for financial leverage recently broke a new record, with margin debt reaching an all-time-high in the US and elsewhere.[1] Such remarkable growth can be partly attributed to the ease of access to financial leverage via the evolving trading platforms for retail investors such as "Robinhood". The ready availability of margin debt on favorable terms[2] for investors on Robinhood has resulted in an astonishing increase in the amount of Robinhood's margin lending, which grew by more than five times during 2020

[1] As of February 2021, investors in the US had borrowed over $813 billion, almost 50% growth since the previous year according to the Financial Industry Regulatory Authority (FINRA) https://www.finra.org/investors/learn-to-invest/advanced-investing/margin-statistics

[2] As of March 2021, investors on Robinhood could borrow up to $1,000 for just $5 a month and 2.5% for anything above $1,000.

alone.[3] Clearly, such growth is associated with the increased riskiness of retail investors' portfolios, which may affect their overall performance.

While margin debt is subject to certain regulatory requirements and limitations that put some constraints on margin use, the recent developments in financial instruments have allowed investors to alleviate these constraints by investing in widely available leverage-embedded securities such as Exchange Traded Funds (ETFs) or Certificates. These securities sometimes increase market exposure by up to twenty times and limit potential losses to 100% without the need to actively rebalance leveraged positions. The attractiveness of these features may tempt investors to trade in these instruments even if they are unable or unwilling to use outright margin debt.

In this paper, we explore the determinants of using different sources of leverage, i.e. embedded leverage securities and traditional margin accounts, in a rich dataset on retail investors. In particular, we assess the effects of leverage on portfolio performance accounting for investor-specific characteristics and differences in trading behavior. A growing body of research suggests that leverage may contribute to poorer trading decisions caused by behavioral bias (see, e.g. Bailey, Dávila, Kuchler and Stroebel, 2017; Ben-David, 2019; Barber, Huang, Ko and Odean, 2020; Heimer and Imas, 2021). Another stream of the literature suggests that investors make better investment decisions by paying more attention and by acquiring more information (e.g. Peress, 2004; Gargano and Rossi, 2018). Dierick, Heyman, Inghelbrecht and Stieperaere (2019) suggest that more attentive investors gain a comparative advantage from understanding and incorporating financial information into their investment decisions. As a result, these investors' trading is increasingly less exposed to the disposition effect. Thus, if more attentive investors can process financial information better, they should be able to benefit

[3] According to the company's filing with the SEC, Robinhood's net margin loans to their customers increased from approximately $638 mill. in 2019 to $3.35 billion in 2020
https://www.sec.gov/edgar/browse/?CIK=1699855

more from employing leverage in their investment decisions, regardless of the behavioral bias associated with the use of leverage. While controlling for investor demographic characteristics, we test whether the joint effect of investor attention and the use of leverage has a positive effect on portfolio performance. Hence, our main objective is to assess whether the impact of using margin accounts and instruments with embedded leverage on investment performance is conditional on portfolio monitoring frequency.

We contribute to the previous literature in the following ways: first, we differentiate between investors who use margin accounts and those who trade in embedded leverage securities. To the best of our knowledge none of the previous studies have compared the effects of the sources of leverage on investor performance. This analysis synthesizes two research streams on leverage usage: it is related to the recent studies of D'Hondt, McGowan and Roger (2021) and Devault, Turtle and Wang (2021), who show that the use of leveraged exchange-traded products is associated with poor investment performance. And it is also related to Barber et al. (2020), who examine whether investment performance is different for those who use margin and those who do not use it. It is noteworthy that the analysis in Barber et al. (2020) is based on a different investment environment, as their sample covers the period 1991 to 1996. Clearly, technological advancement and reduced trading costs have made retail trading simpler and more accessible since that period. Our analysis covers the more recent period 2016 to 2018, and is based on approximately 1 million observations made on over half a million individual investors. By examining the intensity of investment leverage, we also contribute to the findings of Heimer and Imas (2021), who suggest that the possibility of using leverage rather than its actual use leads to poorer investment decisions.

Second, we add to a growing number of studies that suggest investor attention is an important determinant of financial market outcomes by positing that it plays a key role in determining retail investors' ability to benefit from the use of leverage. Several studies show

how changes in investor attention can affect stock prices and/or volatility (Da, Engelberg and Gao, 2011; Vlastakis and Markellos, 2012; Andrei and Hasler, 2015). In a closely related study, Gargano and Rossi (2018) show evidence that greater investor attention is associated with better investor performance. We extend this finding by showing that more attentive investors not only perform better, but also benefit relatively more from using leverage. In relation to Heimer and Imas (2021), who suggest that restrictions on providing leverage to retail investors discipline their behavioral bias, we show evidence that less attentive investors in particular should avoid the use of leverage.

In line with the recent evidence of Heimer and Imas (2021), and Barber et al. (2020), we find that the use of leverage, both trading on margin and in securities with embedded leverage, is associated with poorer investment performance. However, we also find that investors are better off trading on margin compared to trading in securities with embedded leverage. This finding is consistent with the studies of Frazzini and Pedersen (2012), and Frazzini and Pedersen (2014), suggesting that leverage-constrained investors underperform on average. The observed difference in performance between the users of the two sources of leverage also adds to previous findings that link the use of investment leverage with a lack of investor patience (Cremers and Pareek, 2016) and self-control (Uhr, Meyer and Hackethal, 2019). Finally, our results show that more attentive investors are better users of leverage compared to less attentive ones. However, this finding does not apply to the most aggressive traders of embedded leverage securities. The intensity of investor attention also matters, as we find that investors who pay very close attention to their portfolios benefit even more from using leverage.

The remainder of our study is organized as follows. We present the hypotheses concerning the effects of leverage usage and investor attention in Section 2. We describe our

study's data and methodology in Section 3, and then present the empirical results in Section 4. Section 5 concludes our study.

2. Hypotheses development

Frazzini and Pedersen (2012) show that asset classes with high embedded leverage offer low risk-adjusted returns, as leverage-constrained investors may bid up the prices of securities with embedded leverage. Thus, leverage-constrained investors who trade in securities with high embedded leverage earn lower risk-adjusted returns. According to Frazzini and Pedersen (2014), investors who use financial leverage unconstrainedly can, in turn, exploit the low-risk anomaly and earn higher returns at the same level of risk by investing in low-beta stocks using financial leverage. Consistent with the evidence on embedded leverage, D'Hondt et al. (2021) find that users of leveraged exchange-traded products underperform other investors who invest in vanilla exchange-traded products. More recently, DeVault et al. (2021) show evidence that institutional holdings of leveraged ETFs predict weak future performance of institutional investors.

While this evidence indicates that having access to investment leverage should have a positive influence on investment outcomes, the recent empirical literature suggests that investment leverage may lead to poorer investment performance. Heimer and Simsek (2019), for example, study the effects of leverage constraints regulations in the U.S. retail foreign exchange market and show that investors are better off with less leverage. Their model and empirical results show that the 2010 leverage constraints policy improved traders' expected returns by reducing their intermediation costs via bid-ask spreads. Another strand of the literature related to investor behavior documents that leverage may be associated with individual optimism, which may result in excessive risk-taking. Using the U.S. housing market

as a natural laboratory, Bailey et al. (2017) document that individual beliefs affect leverage choices by showing that more pessimistic homebuyers use less leverage to buy smaller houses. Ben-David (2019) reaches similar conclusions by showing that homebuyer optimism is associated with higher leverage in the U.S. housing market.

Behavioral bias other than optimism can also be problematic when taken together with using leverage. Heimer and Imas (2021) study the effects of regulatory restrictions on the amount of leverage in financial decisions. They find that leverage restriction results in a smaller disposition effect, which is the behavioral bias of holding onto losing investments for too long and selling winning investments too quickly, and in improved market timing. In turn, Barber et al. (2020) find that investors who use margin debt are more overconfident, leading to more speculation and poorer investment decisions. Overall, the existing literature suggests that leverage usage, regardless of whether embedded leverage or margin account is used, is not associated with better performance. This discussion leads to our first hypothesis:

H1a: Investors who trade on margin underperform.

H1b: Investors who trade securities with embedded leverage underperform.

If the use of leverage by an average investor should be associated with poorer investment performance, as Hypotheses 1a and 1b state, are there any benefits from leverage at all? We postulate that investors may offset any negative effects by paying more attention when using investment leverage. There are at least two reasons why more attentive investors may gain from using leverage. First, previous studies suggest that investors make better investment decisions by paying more attention and acquiring more information. Peress (2004) proposes that wealthier investors acquire more information, thus leading to a higher Sharpe ratio. Gargano and Rossi (2018) show evidence that investor attention is positively related to investor performance, and those who pay more attention tend to buy attention-grabbing and

well-performing stocks. Therefore, broader information acquisition by more attentive investors can result in more informed decision making, which may offset the negative behavioral effects of leverage usage.

Second, one of the key perspectives of Dierick et al. (2019) is that more attentive investors are likely to be more sophisticated investors who have a comparative advantage in understanding and incorporating financial information into their decision-making processes. The idea is that more sophisticated investors have a greater payoff from allocating attention to their portfolio as their optimal point where the marginal benefits equal to the marginal costs of attention is relatively higher. Thus, more attentive investors who are also more sophisticated should be able to make more informed investment decisions, while leverage enables them to make more use of their informational advantage.

Building on this evidence, we hypothesize that more attentive investors should be relatively better off from using leverage:

H2: *The performance of leverage users improves with greater investor attention.*

3. Data and methodology

We obtain the data from the Internet-based bank 'Avanza', which is the largest bank in Sweden for retail investors. The data include 981,242 investor-year observations for the years 2016 to 2018. The sample covers the portfolio performance and demographic characteristics of more than 525,000 individual investors, implying that we are dealing with an unbalanced panel dataset. We consider the Sharpe ratio, the annualized standard deviation of returns, and the annual return as the performance indicators. We clean the data by removing the following observations from the data for each year: (1) investors with a missing value for annualized standard deviation or annual return, (2) investors with a zero value for standard deviation, and

(3) investors with values for annualized standard deviation and/or annual return at the 0.5 and 99.5 percentiles of the distribution. To construct the variables for embedded leveraged usage, we consider turnover in leveraged ETFs and leveraged certificates as the indicator for using products with embedded leverage. For our variable of margin use, we consider investors who have traded on margin during a given year as margin users.

3.1 Descriptive statistics

As can be seen in Table 1, which presents our data's summary statistics, the absolute majority of our sample investors are male (70%). An average trader is slightly over 43 years old with approximately six years of account tenure (2,242 days). We also observe large heterogeneity across investors in most of their investment activity characteristics. For example, the average number of trades is approximately 70 trades per year, varying from 0 to 111,316 per year, while the average trade size ranges from 0 to 103 million SEK with a mean value of almost SEK 37,500. The variation in performance metrics between individual investors is also considerable. It is noteworthy that the average annual return (*Return)* on individual investors' portfolios is relatively low. The statistics suggest that an average investor in our sample earns 0.2% in return with a median value of approximately 2% per year. In turn the average riskiness of individual investors' portfolios measured as the standard deviation of returns is 19%, while the Sharpe ratio is 0.28.

(INSERT TABLE 1)

Regarding the variables of interest, the statistics for our proxy for investor attention – *Logins*, suggest that an average investor logs into his/her account on 111 days a year. The measures of leverage usage indicate that relatively few investors rely on investment leverage. In particular, *AnyLev use* – a measure of the use of any leverage (embedded or margin) has a

mean value of 0.07. This statistic suggests that only 7% of our sample investors trade on margin and/or trade securities with embedded leverage. Nevertheless, given the large scale of our dataset, 7% of the observations imply that we are able to identify over 67,000 observations for more than 44,000 individual investors who use investment leverage.

Notably, the number of investors who trade on margin in our sample is much lower than corresponding numbers documented in previous studies. For example, in the sample of Barber et al. (2020), 65.9% of investors had margin accounts, while the corresponding number in our data is only 3% of all the observations. However, it should be noted that the study of Barber et al. (2020) used records for only approximately 43,000 investors, while our dataset covers more than half a million individual investors. Hence, 3% of the observations provide approximately 20,000 individual investors who trade on margin, which is comparable to the sample of Barber et al. (2020).

Finally, the number of investors who trade instruments with embedded leverage is marginally higher than those trading on margin. Approximately 4% of our observations contain records of positive turnover in instruments with embedded leverage. The ratio of turnover in embedded leverage securities to total turnover has a value of 0.01, suggesting that securities with embedded leverage account for approximately 1% of all trading. These statistics suggest that investors generally do not prefer to trade securities with embedded leverage.

3.2 Methodology

Given that our sample includes a relatively small proportion of investors who trade with leverage, the choice of using investment leverage in retail trading may not be exogenous. More experienced, less risk-averse or sensation-seeking investors may choose to use leverage more often, which, in turn, may affect the results in the analysis of the role of attention and leverage

usage in portfolio performance. Therefore, in order to understand the relationship between individual investor characteristics and the use of investment leverage, we first investigate the determinants of leverage product usage and trading on margin with the following logistic regression model:

$$Leverage_{i,t} = \alpha_{i,t} + Demographic_{i,t} + Activity_{i,t}, + \varepsilon_{i,t}, \quad (1)$$

where $Leverage_{i,t}$ includes three of our measures of using investment leverage: *(i)* a dummy variable for trading on margin account by investor *i* during the year *t* – $Margin_i$; *(ii)* a dummy variable for using products with embedded leverage by investor *i* during the year *t* – $EmbedLev_{i,t}$; and *(iii)* a dual variable indicating both types of investors who trade on margin and/or use products with embedded leverage during a year – $Margin\&EmbedLev_{i,t}$. $Demographic_{i,t}$ includes the natural logarithm of age in years for investor *i* – $Age_{i,t}$ and a dummy variable for the gender of investor *i* (male = 1) – $Gender_{i,t}$. $Activity_{i,t}$ includes the natural logarithm of the account tenure of investor *i* in days – $AccountTenure_{i,t}$, the natural logarithm of an average value of transaction made by investor *i* in year *t* – $TradeSize_{i,t}$ and the number of trades made by the investor during the year – $Trades_{i,t}$. As the information on the portfolio values cannot be accessed, we consider $TradeSize_{i,t}$ as a proxy for investor size.[4] Clearly, past investment performance may affect retail investors' decision whether to use leverage. Therefore, in some specifications we also include a lagged Sharpe ratio to account for the previous performances of individual investors. In all the regression specifications, we control for the time-fixed effect.

[4] The General Data Protection Regulation (GDPR) restricts access to portfolio values, as investment income is public information in Sweden which may be used to identify individual investors.

We proceed with our analysis by turning to our study's hypotheses and investigating how the investor attention and leverage use variables explain investor performance with the following regression model:

$$F_{i,t} = \alpha_i + Demographic_{i,t} + Activity_{i,t,} + Login_{i,t,} + Leverage_{i,t} + Leverage_{i,t} \times Login_{i,t} + \varepsilon_{i,t} \quad (2)$$

where the dependent variable $F_{i,t}$ is either the Sharpe ratio, the annualized standard deviation of returns or annual return for an investor *i*. $Demographic_{i,t}$ *and* $Activity_{i,t}$ are the same variables as in Equation (1) and include an investor's age, gender, account tenure, number of trades and trade size. Following Davydov, Khrashchevskyi and Peltomäki (2021), we use $Login_{i,t}$ as a proxy for general investor attention to portfolio information, which is defined as the natural logarithm of the number of days investor *i* was logged into his/her investment account in a year. $Leverage_{i,t}$ includes two of our measures of investment leverage usage: *(i)* a dummy variable for trading on margin account by investor *i* during the year – $Margin_i$, and *(ii)* a dummy variable for using products with embedded leverage by investor *i* during the year – $EmbedLev_{i,t}$. $Margin_i$, $EmbedLev_{i,t}$ and $Login_{i,t}$ are the primary variables of interest in this study. We also include dummy variables for the years 2017 and 2018 similar to the analysis the determinants of leverage usage using Equation 2. Hypotheses 1a and 1b suggest that we should expect the coefficients for $Leverage_{i,t}$ in Equation (2) to be negative and significant. In addition, we estimate different specifications of Equation (2), where we test our variables of interest with and without the interaction effects: $Leverage_i \times Login_i$, which are meant to test our second hypothesis that *the performance of leverage users improves with greater investor attention.*

4. Results

4.1 Univariate analysis

We begin our analysis with simple mean comparisons between traders based on their use of leverage during our sample period. The statistics reported in Table 2 suggest that the majority of investors in our sample are leverage averse, as more than 92% of the observations are coded as non-leverage users, implying that investors have neither traded on margin nor invested in securities with embedded leverage. Nevertheless, we identify over 67,000 observations for more than 44,000 individual investors (Column 2) who traded on margin or securities with embedded leverage during our sample period. On comparing these investors with those who do not use leverage (Column 1), we observe significant differences in all characteristics, which suggests that the users of investment leverage are a quite distinct group of investors. In particular, we see that older, more experienced male investors are more likely to trade with leverage. Barber et al. (2020) suggest that investors who have margin accounts are more speculative and demonstrate a poorer investment performance compared to investors who do not have margin accounts. Our results in Table 2 are consistent with this idea, as the average number of trades by the leverage users (Column 2) is significantly higher than the corresponding number for investors who do not use leverage (Column 1), 226.76 versus 57.77 per annum.

(INSERT TABLE 2)

Column 2 in Table 2 shows the users of any leverage source and does not distinguish between margin traders and investments in products with embedded leverage. Given that the source of leverage may define a particular type of investor, we split the sample further into three types of leverage user: *(i)* Investors who trade on margin and do not use embedded leverage (Column 4); *(ii)* investors who trade products with embedded leverage and do not use margin accounts (Column 6); and *(iii)* investors who use both sources of leverage simultaneously (Column 9). Several interesting findings are related to this sub-sample analysis. First, we observe that there are relatively more investors who trade products with embedded

leverage – 26,988 (Column 6) than investors who trade on margin – 16,933 (Column 4), and only a small fraction of investors use both types of leverage simultaneously – 2,615 (Column 9). These statistics imply that investors tend to choose only one type of leverage if they decide to use investment debt.

Second, the differences between margin users and embedded leverage users (Columns 4 and 6) also suggest that they are two very different groups of investors. Investors who trade on margin as the only source of leverage have 1079 days longer account tenure, they are more than nine years older and their average trade size is SEK 53,435 higher than for investors who only access leverage by investing in securities with embedded leverage. These statistics suggest that margin debt is preferred to embedded leverage by, on average, older, more experienced investors who make larger transactions. In addition, the statistics show that embedded leverage users trade more than twice as much as investors who trade on margin as their only source of leverage, 270.52 versus 130.26 trades per annum.

Third, there are interesting patterns in individual investor attention behavior. Specifically, the users of both sources of leverage (Column 9) seem to be logged into their accounts for most of the days of a year - 239.3, which is more than 95% of all trading days and more than 2.2 times higher than for the non-leverage users in Column 1.[5] Given that these investors also have the highest number of trades and the largest trade size relative to all the other investors, such frequent account access can be attributed to active trading rather than intentional attention and portfolio monitoring. On comparing investor attention between investors who trade on either source of leverage (Columns 4 and 6), margin traders appear to be logged on for 15 days more. This finding, together with the differences in trading frequency between the two types of investor, suggests that margin traders pay more attention even though

[5] The average number of trading days on the Stockholm Stock Exchange was 251.3 in 2016-2018.

they trade less frequently than embedded leverage users. This feature may indicate investor patience (Cremers and Pareek, 2016) and self-control (Uhr et al., 2019), as documented in the previous literature. Overall, a sub-sample comparison reveals that leverage users monitor their portfolios much more often, while investors who prefer margin debt to embedded leverage pay the most attention, apart from very active investors who trade both on margin and securities with embedded leverage.

Considering the performance across investors, the comparison in Table 2 suggests that investors who use either of the two sources of leverage, embedded or margin, as in Column 2, have an average Sharpe ratio of 0.22, which is slightly less than for investors who opt out from investment leverage (0.29 in Column 1). The leverage-averse investors also have an approximately two-percentage point higher average annual return on their investments than the leverage users, while the standard deviation is nine percentage points lower. These statistics imply that investors are better off both in terms of profitability and riskiness of their portfolios if they do not use leverage.

However, when considering investors who trade only on margin and do not trade products with embedded leverage (Column 4), we observe that the average Sharpe ratio of this group is 0.46, which is significantly higher than for any other group of investors. These traders' annual return is approximately 300 basis points higher than for non-leverage users and 800 basis points higher for investors who use products with embedded leverage. On the other hand, investors who trade securities with embedded leverage but do not use margin (Column 6) exhibit a poorer performance with an average Sharpe ratio of 0.08, an annual return of -5% and a standard deviation of 29% compared to both margin users (Column 4) and investors who do not use any leverage (Column 1). Thus, the poorer performance associated with the use of leverage appears to be related more to users of embedded leverage products. These differences

highlight the importance of differentiating between the sources of leverage and other investor-specific characteristics in the multivariate analysis.

Taken together, the results in Table 2 suggest that the observed difference in performance between users and non-users of leverage may be driven by a group of investors who use only embedded leverage or a small group of very active investors who use both sources of leverage. In relation to the existing evidence, Barber et al. (2020), for instance, using a sample over the period 1991-1996 document that margin investors have poorer trading abilities due to overconfidence and, as a result, underperform compared to cash investors. However, leveraged ETFs and many other similar products with embedded leverage were not available during this sample period. Furthermore, in experimental research, Heimer and Imas (2021) provide evidence suggesting that access to leverage should lead to poorer investment performance. However, they do not differentiate between margin debt and embedded leverage products. These results are also consistent with the evidence of Frazzini and Pedersen (2012) suggesting that products with embedded leverage offer low risk-adjusted returns. The outperformance of margin investors relative to other groups of investors is also consistent with the idea that leverage-constrained investors bid up the prices of securities with embedded leverage and, therefore, underperform by holding these securities. According to Frazzini and Pedersen (2014), investors who are leverage-unconstrained can exploit the low-risk anomaly and earn higher returns for the same level of risk by investing in low-beta stocks using financial leverage.

It is also possible that margin trading and products with embedded leverage are used by different types of investors, which explains the difference in the performance of margin users and users of securities with embedded leverage. For example, sensation-seeking leverage users, who are also more likely to make poorer investment decisions, may have chosen to use embedded leverage securities instead of margin trading. As younger investors tend to be more

sensation-seeking (see, e.g. Zuckerman, Eysenck and Eysenc, 1978), this idea is consistent with the statistics in Table 2 showing that leverage users who have chosen only margin debt (Column 4) are on average 9.18 years older than those who have only chosen to trade in products with embedded leverage (Column 6). These results for embedded leverage can also be related to the findings of D'Hondt et al. (2021), who explain the poor performance of users of leveraged exchange-traded products by their motivation to use these securities more for gambling. On the other hand, this finding may be linked to the evidence of Korniotis and Kumar (2011), which suggests that older investors are less effective at applying new investment knowledge even though they may benefit from their wider experience. Many leveraged investment products such as leveraged ETFs are relatively new, so older investors may not be inclined to trade these products, as new knowledge has to be acquired.

4.2 Analysis of leverage usage

The univariate tests in Table 2 indicate that in addition to the significant differences between leverage users and non-users, there are substantial differences between the users of margin accounts and embedded leverage. Given that the choice to rely on a particular source of leverage may not be exogenous, a natural first step is to examine what investor characteristics determine leverage usage and the preferences of the source of leverage. Related to the streams of the literature on the two types of leverage usage: *i)* research on embedded leverage (see, e.g. Frazzini and Pedersen, 2012) and *ii)* research on margin trading (see, e.g. Barber et al., 2020; Heimer and Imas, 2021), this analysis aims to shed more light on how the users of these two types of leverage are different. The estimation results are reported in Table 3.

(INSERT TABLE 3)

The results suggest that men are more likely to use leverage than women regardless of the source. The coefficient on *Gender* is positive and highly statistically significant in every regression specification. As more leverage increases portfolio risk, this finding is consistent with several studies (e.g. Jianakoplos and Bernasek, 1998; Barber and Odean, 2001; Davydov et al., 2017), showing evidence that women take less risks than men. Furthermore, the results for *Account Tenure* show that more experienced investors are more likely to use leveraged products and have a margin account. While Nicolosi, Peng and Zhu (2009) report that investment performance increases with investors' trading experience, the finding that leverage usage is associated with investor experience is, to the best of our knowledge, novel to the literature on investor experience. We also find that investors with larger than average trade sizes and higher numbers of trades are more likely to trade on margin and to trade securities with embedded leverage.

Remarkably, the coefficient estimates for *Age* suggest that there is a negative relationship between investor age and the decision to use leverage. However, once we decompose the leverage source on margin debt and embedded leverage, we observe a significant inverse relationship relative to the overall negative effect for margin debt users. Specifically, the positive and significant coefficients for *Age* in Models 3 and 4 in Table 3 imply that older investors are more likely to trade on margin, while the negative and significant coefficients in Models 5 and 6 suggest that younger investors are more likely to trade products with embedded leverage.

Table 3 also reveals that prior investment performance has a significant effect on the decision to use leverage regardless of the source of debt. The coefficient estimates for the Sharpe ratio in Models 3, 4 and 6 are negative and highly statistically significant, suggesting that individual investors are less likely to use leverage after a successful investment year.

4.3 Use of leverage, attention and investment performance

Next, we test the hypotheses of our study by estimating the different specifications of Equation (2), where the dependent variable is investor performance measured by the Sharpe ratio, annual return or standard deviation of returns. The results of these estimations are presented in Table 4. The key explanatory variables are the two dummy variables for leverage usage, *Margin* and *EmdebLev*, and a proxy for investor attention, *Login*. The dummy variables for leverage usage have a value of one if an investor has a margin account or trade in products with embedded leverage, respectively, while the proxy for attention is the average number of days an investor is logged into his/her trading account during a year. The evidence from the univariate tests in Table 2 supports the view that margin users and users of embedded leverage are rather different groups of investors, whereas a very small group of investors use both sources of leverage. Thus, we consider investors who trade on margin and those who trade securities with embedded leverage as two distinct groups of leverage users.[6] To gauge the effects of investor attention and leverage usage on performance, we interact the attention variable with the measures of trading activity and leverage usage.

(INSERT TABLE 4)

In Models 1, 3 and 5 in Table 4, we analyze the effects of the different sources of leverage on portfolio performance while controlling for investor demographics and trading characteristics. The coefficient estimates for $Margin_{i,t}$ provide evidence that supports our Hypothesis 1a and indicates that investors who trade on margin tend to underperform compared to those who do not use investment leverage. Although the overall effect on the Sharpe ratio is negative and statistically significant, we observe that this effect is primarily driven by a higher standard deviation of returns (Model 5), while the total return is not affected by using margin

[6] In additional unreported robustness tests we also exclude a small group of investors who use both source of leverage. The results remain virtually unchanged.

(Model 3). Moreover, the magnitude of the coefficient suggests that margin users, on average, obtain a 0.04 lower Sharpe ratio (Model 1) than non-users after controlling for investor characteristics. This result is less economically significant than the magnitude of the coefficient for *Gender*, which suggests that males, on average, obtain a 0.124 lower Sharpe ratio. Nevertheless, this evidence is consistent with Barber et al. (2020), who find that investors with margin accounts have a poorer investment performance than those who do not have margin accounts.

A much more sizable economic effect can be observed for the users of embedded leverage. Models 1, 3 and 5 in Table 4 show that investors who trade in securities with embedded leverage obtain, on average, a 0.25 lower Sharpe ratio, a 5.6 percentage-point lower return, and a 10.2 percentage-point higher standard deviation of returns than those who do not invest with embedded leverage. These results provide evidence in support of our Hypothesis 1b, that *investors who trade securities with embedded leverage underperform*. The difference between the magnitude of coefficients for $Margin_{i,t}$ and $EmbedLev_{i,t}$ from Model 1, -0.040 vs. -0.251, suggests that investors are still better off trading on margin than investing in securities with embedded leverage even though neither is associated with a better performance relative to investors who do not use leverage.

With regard to the role of investor attention in using leverage, in Models 2, 4 and 6 we include our proxy for attention and interaction terms with leverage and trading activity. In every specification, we observe that portfolio monitoring frequency has a statistically highly significant but economically modest positive effect on investment performance. One standard deviation increase in *Logins* (the standard deviation of *Ln (Logins*) is 1.51 in our sample) leads to a 0.76% increase in the Sharpe ratio (Model 2), a 0.3% increase in annual return (Model 4), and a 0.6% increase in the annualized standard deviation of returns (Model 6). Nevertheless,

these results indicate that investor attention is beneficial to investment performance, which is broadly consistent with the evidence of Gargano and Rossi (2018).

It is noteworthy that the coefficient values for $Margin_{i,t}$ and $EmbedLev_{i,t}$ for explaining the Sharpe ratio are more negative in Model 2 than in Model 1, suggesting that adding investor attention as a control variable alters the result. More interestingly, the results of the analysis with investor attention suggest the joint effects of leverage and investor attention are also significant factors for explaining investment performance. For both margin trading and embedded leverage users, the coefficients for the interaction variables with investor attention are highly statistically significant and positive for the Sharpe ratio and return (Models 2 and 4) and negative for standard deviation (Model 6). These results suggest that the negative effect of leverage usage on investment performance decreases with greater investor attention, which is in line with our Hypothesis 2, that *the performance of leverage users improves with greater investor attention.* This result is consistent with the literature, suggesting that investors make better investment decisions by paying more attention and acquiring more information (see, e.g. Peress, 2004; Gargano and Rossi, 2018), and supports the idea that more attentive investors have a comparative advantage (see, e.g. Dierick et al., 2019) which can offset the negative behavioral effects of leverage use (see, e.g. Bailey et al., 2017; Ben-David, 2019; Heimer and Imas, 2021; Barber et al., 2020).

Regarding the control variables, most of the investor demographics and trading characteristics appear to be significant determinants of investment performance throughout all the regression specifications, and are in line with the previous literature. We document that male investors significantly underperform compared to female investors, while older and more experienced traders tend, on average, to perform better. Trade size seems to be negatively related to the Sharpe ratio and positively associated with standard deviation, while the number of trades is, in general, positively associated with performance. Interestingly, the interaction

term of *Logins* with the number of trades in Model 2 in Table 4 is negative and highly statistically significant, suggesting that an investor who frequently logs into his/her account and makes more transactions obtains, on average, a lower Sharpe ratio than one who often logs in but trades less.

4.4 Intensity of using leverage, investor attention and portfolio performance

Our results so far suggest that using leverage has a significant negative effect on investment performance, which may be diminished by frequent portfolio monitoring. While we observe distinct differences in trading behavior between leverage users and non-users, it is important to acknowledge that there are potential differences within the group of leverage users. Therefore, the next step of our analysis is to distinguish between extensive and intensive margins and examine the role of intensity of leverage usage among margin account and embedded leverage users. Specifically, we estimate the different specifications of Equation (2), where we replace the dummy variables for using investment leverage with two continuous variables: *(i)* the average loan-to-value ratio (LTV) for investor *i* during year *t* – $LTV_{i,t}$, and *(ii)* the ratio of turnover in securities with embedded leverage to the total turnover for investor *i* during year *t* – $TurnEmbedLev_{i,t}$. The estimates of these measures of intensity are reported in Table 5.

(INSERT TABLE 5)

Panel A in Table 5 presents the mean and percentile statistics for the LTV ratio and turnover in embedded leverage securities among investors who trade on margin and/or who trade securities with embedded leverage. The LTV ratio of 48% for the 95th percentile suggests that there are very few investors with large leverage positions, while the majority of margin users have moderate or low levels of leverage with a mean of 9%. With regard to the turnover

in embedded leverage securities, which shows the percentage of turnover in securities with embedded leverage in the total turnover, the 100% turnover at the 95th percentile suggests that some investors trade exclusively in securities with embedded leverage. The median share of turnover in embedded leverage securities is 8%, suggesting that securities with embedded leverage do not dominate the trading of a median investor who trades with leverage.

Panel B in Table 5 reports the regression results of the analysis of the effects of the intensity of leverage usage on the Sharpe ratio, annual return and annualized standard deviation of returns. The results are broadly consistent with our previous results. For margin trading, we observe a negative effect from LTV on investment performance for all three measures. The higher the loan-to-value ratio, the lower the Sharpe ratio and annual return, and the higher the standard deviation of returns. The statistically significant and positive coefficient for the joint effect of investor attention and margin usage intensity, $LTV_{i,t} \times Login_{i,t}$, is also similar to the joint effect of investor attention and margin trading, $Margin_{i,t} \times Login_{i,t}$, as shown in Table 4, which confirms our finding on the power of attention in alleviating the negative effect from leverage on performance. However, while we also observe a negative effect of turnover in securities with embedded leverage, the coefficient for the joint effect of investor attention and turnover in embedded leverage products, $TurnEmbedLev_{i,t} * Login_{i,t}$, is statistically significant and negative in regressions with the Sharpe ratio and return, and positive with standard deviation. These estimates imply that a higher level of trading intensity in embedded leverage products together with a higher level of attention is associated with even poorer performance, which is the opposite of the joint effect with the dummy variable for use of embedded leverage securities observed in Table 4. The difference between the extensive and intensive margins may indicate that investors who trade exclusively in securities with embedded leverage potentially exhibit different trading behavior.

While the above analysis considers the intensity of leverage use, it does not consider any potential nonlinearity in the relationship between the degree of leverage and performance. Hence, in the additional tests, we substitute the LTV ratio and turnover in the embedded leverage securities ratio with four dummy variables for low and high values of LTV and turnover share in the embedded leverage securities. We define these dummy variables as low (high) if the underlying ratio is below (above) the mean values reported in Panel A in Table 5. In addition, we introduce another pair of variables that capture the intensity of the embedded leverage usage given the degree of leverage in the underlying securities. Specifically, we calculate the share of turnover in instruments with high leverage (STHL), i.e. instruments with a multiplier of times three or higher, and the share of turnover in instruments with low leverage (STLL), i.e. instruments with a multiplier of less than times three. Table 6 presents the results of this analysis.

(INSERT TABLE 6)

As can be seen in the table, the results are in line with the findings reported in Tables 4 and 5, suggesting that investors who trade on margin and who trade securities with embedded leverage underperform regardless of the degree of leverage usage. On comparing the degree of leverage usage in margin trading, we find that investors with a high degree of leverage (High LTV) underperform compared to those with a low degree of leverage (Low LTV). Similar to the findings in Table 5, more active monitoring of these portfolios still helps diminish the negative effect of leverage in both cases of high and low LTV ratios (Model 1). Regarding leverage-unconstrained investors, we observe that trading in securities with embedded leverage still has a significant negative effect on portfolio performance, regardless of the degree of leverage. However, investors who have a higher turnover in securities with embedded leverage (High turnover in EmbedLev) or a larger share of turnover in instruments with high embedded leverage (STHL) actually perform somewhat better than those who have a low turnover in

securities with embedded leverage (Low turnover in EmbedLev) or a larger share of turnover in securities with low embedded leverage (STLL) (Models 2 and 3). Interestingly, we also observe that investor attention alleviates the negative effect of leverage use, but only in the case of low turnover in securities with embedded leverage (Logins×Low turnover in EmbedLev) and a higher share of turnover in securities with low embedded leverage (Logins×STLL). This finding supports the notion that aggressive embedded leverage users, measured either by high turnover in securities with embedded leverage or a higher share of turnover in securities with high embedded leverage, may be subject to behavioral bias that causes leverage usage and investor attention to have a negligible joint effect on investor performance in their case.

Collectively, the results in Tables 5 and 6 provide evidence suggesting that trading with leverage has a negative effect on portfolio performance, which can be diminished if an investor pays attention and does not trade excessively on margin, and in instruments with embedded leverage in particular.

4.5 Intensity of investor attention, leverage usage and portfolio performance

As the final step of our analysis, we consider the role of the intensity of investor attention in the usage of leverage and portfolio performance. Specifically, we test whether the extreme levels of portfolio monitoring frequency have a different effect on portfolio performance given the leverage usage. To perform these tests, we estimate the different specifications of Equation (2) with several alternative measures of investor attention. First, we generate dummy variables for high and low investor attention for the top and bottom 33rd percentiles of Logins frequency. In the top 33rd percentile (High attention), the minimum number of days an investor is logged into his/her account in a year is 131, which is slightly over 50% of a typical number of trading

days. In contrast, in the bottom 33rd percentile (Low attention) of the Logins distribution in our sample, investors are logged in for no more than 28 days. Next, in order to be more conservative, we specify another pair of dummy variables for extreme values of intensity of investor attention: Close attention and Neglected attention. We define investors who are logged into their accounts on almost every trading day (at least 250) as those who are paying close attention to their portfolios. Similarly, investors who log into their accounts very infrequently (not more than 12 days a year) are considered to be traders with neglected attention. We report the estimation results of this analysis in Table 7.

(INSERT TABLE 7)

Models 1 to 3 in Table 7 present the results for the first set of attention proxies, i.e. the dummy variables for the top and bottom 33rd percentiles. We note the same negative effect from the margin and embedded leverage usage on the Sharpe ratio, as well as a positive effect from the higher portfolio monitoring frequency documented in the previous sections of this paper. However, the joint effect of investor attention and leverage usage on performance becomes more pronounced. The coefficient estimate for the interaction term of the high attention dummy and margin use is positive and statistically significant, and has a greater magnitude than the coefficient for the margin use variable. In the case of low investor attention, the effect on the Sharpe ratio becomes even more negative than from margin use alone. These results imply that investors who pay more attention to their portfolios are able to benefit from using margin debt.

In Models 4 to 6 we report the estimation results for the more conservative measures of intensity of investor attention: Close attention and Neglected attention. In this part of the analysis, we observe an even more pronounced effect of attention on portfolio performance. Investors who pay close attention to their portfolios are able to significantly improve their

investment performance by using margin debt, while investors who trade on margin and do not pay attention significantly undermine their portfolio performance.

In the case of securities with embedded leverage, we observe similar results to those in Table 4. Investors who pay high levels or very close attention to their portfolios are able to diminish the negative effect of embedded leverage usage on investment performance, while investors who pay less attention lose even more from using embedded leverage securities. This result confirms our previous finding on the damaging effect of the leverage-unconstrained feature of securities with embedded leverage, but closer investor attention may alleviate this negative effect.

5. Conclusion

In this study, we examine whether the leverage usage together with investor attention, measured as portfolio monitoring frequency, determines investor performance. We consider investor attention as an indicator of investor sophistication in line with Dierick et al. (2019) and expect investor attention to offset the negative effects of leverage usage on investor performance. Our analysis of the determinants of leverage use suggests that margin accounts and embedded leverage securities are preferred by different types of investors. Older and more tenured investors are more likely to use margin accounts than to trade securities with embedded leverage. In addition, margin traders monitor their portfolios more frequently, but they trade less actively, which may be also an indication of self-control and patience.

Our findings from the analysis of investor performance are in line with the results of Heimer and Imas (2021), and of Barber et al. (2020), showing that investors who trade on margin underperform in terms of having lower Sharpe ratios than those who do not have margin accounts. As an addition to this stream of the literature, we present evidence that investors who

trade securities with embedded leverage also underperform and show even poorer performances than investors who use margin debt. This is consistent with the evidence related to embedded leverage by Frazzini and Pedersen (2012), and Frazzini and Pedersen (2014), that leverage-constrained investors trade in securities with high embedded leverage which have low risk-adjusted returns. Alternatively, this finding may be explained by more patience (Cremers and Pareek, 2016) and self-control (Uhr et al., 2019) investors who choose to trade on margin instead of trading securities with embedded leverage. Overall, our study lends support to the idea that investors are better off trading on margin than investing in securities with embedded leverage.

In relation to the literature on investor attention (e.g. Dierick et al., 2019), we show that investors who use leverage perform better if they are more frequently logged into their investment accounts, i.e. they are more attentive investors. Thus, our study suggests that more attentive investors may have a comparative advantage in using leverage, offsetting the negative behavioral effects of leverage use (see, e.g. Bailey et al., 2017; Ben-David, 2019; Heimer and Imas, 2021; Barber et al., 2020). From a practical point of view, our study suggests that using leverage and investor inattention is an especially poor combination.

Furthermore, our dataset also allows us to measure the intensity of investments in securities with embedded leverage and to differentiate between investors' choices of the intensity of using margin debt. Our results imply that more frequent portfolio monitoring does not alleviate the poorer performance associated with trading embedded leverage securities with the higher level of trading intensity in these products. Therefore, our finding that more attentive investors are relatively better users of leverage does not seem to apply to the most aggressive traders of securities with embedded leverage. For investors with larger turnover shares in instruments with high embedded leverage, we find that paying more attention leads to even poorer performance. In turn, when we consider the intensity of investor attention, our results

suggest that paying closer attention to investment portfolios is especially beneficial in terms of portfolio performance.

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Table 1. Summary statistics

The table presents the descriptive statistics for the common sample of the variables used in this study. *Age* is investor age. *Gender* is the dummy variable for the investors' gender (male=1). *Margin use* is the dummy variable for trading on a margin during a year. *EmbedLev use* is the dummy variable for the use of embedded leverage products during a year. *Account Tenure* is the number of days an investor is customer of a bank. *Number of trades* is the number of trade transactions made by an investor in a year. *Trade size* is the average value of transactions made by an investor in a year. *Logins* is the number of days an investor was logged into an investment account during a year. The variables *Return*, *StDev* and *Sharpe* are the annual return, annualized standard deviation and Share ratio, respectively, denoted in decimals.

	N	mean	min	p25	p50	p75	p95	max	sd
Gender	982,878	0.70	0.00	0.00	1.00	1.00	1.00	1.00	0.46
Age (years)	982,878	43.27	18.00	31.00	40.00	54.00	72.00	111.00	15.46
Account tenure (days)	981,235	2,242.30	3.00	775.00	1,459.00	3,374.00	6,285.00	7,024.00	1,836.50
Trade size (SEK)	982,878	37,462.74	0.00	1,662.20	7,613.67	26,596.63	145,696.70	103,000,000.00	216,830.60
Number of trades p.a.	982,878	69.36	0.00	7.00	22.00	67.00	246.00	111,316.00	289.74
Sharpe ratio	982,878	0.28	-1.75	-0.26	0.14	0.79	1.86	3.84	0.87
Return	982,878	0.002	-0.90	-0.04	0.02	0.09	0.25	1.61	0.21
StDev	982,878	0.19	0.00	0.08	0.12	0.22	0.60	22.31	0.25
Logins p.a.	982,878	111.39	0.00	19.00	73.00	199.00	300.00	366.00	103.98
AnyLev use	982,878	0.07	0.00	0.00	0.00	0.00	1.00	1.00	0.25
Margin use	982,878	0.03	0.00	0.00	0.00	0.00	0.00	1.00	0.17
EmbedLev use	982,878	0.04	0.00	0.00	0.00	0.00	0.00	1.00	0.20
Loan to value ratio (on margin accounts)	939,131	0.004	0.00	0.00	0.00	0.00	0.00	1.00	0.04
Turnover in EmbedLev/Total turnover	982,878	0.01	0.00	0.00	0.00	0.00	0.00	1.00	0.08

Table 2. Mean comparison across traders

The table presents comparisons between investors based on their use of leverage. *Age* is investor age. *Gender* is the dummy variable for the investors' gender (male=1). *Account Tenure* is the number of days an investor is customer of a bank. *Number of trades* is the number of trade transactions made by an investor in a year. *Trade size* is the average value of transactions made by an investor in a year. *Logins* is the number of days an investor was logged into an investment account during a year. The variables *Return*, *StDev* and *Sharpe* are the annual return, annualized standard deviation and Share ratio, respectively, denoted in decimals.

	No leverage users	Any leverage (margin or embedded) users	Diff in means (2)-(1)	Margin account users, no embedded leverage	Diff in means (4)-(1)	Embedded leverage users, no margin accounts	Diff in means (6)-(1)	Diff in means (6)-(4)	Margin and embedded leverage users	Diff in means (9)-(1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
N. of obs.	915,506	67,372		24,365		39,642			3,365	
N. of investors	509,534	44,119		16,993		26,988			2,615	
Gender	0.69	0.88	0.19*** (150.2)	0.87	0.18*** (84.5)	0.88	0.19*** (120.2)	0.01*** (4.9)	0.93	0.24*** (56.4)
Age	43.06	46.02	2.96*** (48.3)	51.62	8.56*** (86.1)	42.44	-0.62*** (8.4)	-9.18*** (75.5)	47.72	4.66*** (18.8)
Account tenure	2,173.84	3,172.45	998.60*** (130.2)	3,808.92	1,635.10*** (130.2)	2,729.53	555.68*** (56.3)	-1,079.39*** (69.6)	3,774.19	1,600.34*** (49.7)
Trade size (SEK)	33,966.52	84,972.28	51,006.09*** (32.1)	116,122.70	82,156.51*** (21.0)	62,687.60	28,721.41*** (26.7)	-53,435.10*** (13.2)	121,949.90	87,983.71*** (13.9)
Number of trades p.a.	57.77	226.76	168.98*** (49.6)	130.26	72.49*** (32.5)	270.52	212.75*** (39.7)	140.26*** (24.2)	409.95	352.18*** (18.7)
Sharpe ratio	0.29	0.22	-0.07*** (18.7)	0.46	0.17*** (27.1)	0.08	-0.21*** (46.9)	-0.38*** (50.5)	0.23	-0.06*** (3.9)
Return	0.004	-0.02	-0.02*** (19.4)	0.03	0.03*** (16.8)	-0.05	-0.05*** (35.6)	-0.08*** (36.5)	-0.01	-0.01*** (3.6)
Standard deviation	0.19	0.27	0.09*** (58.2)	0.24	0.05*** (30.7)	0.29	0.10*** (47.7)	0.05*** (20.4)	0.29	0.10*** (19.4)
Logins p.a.	105.33	193.70	88.37*** (58.3)	200.67	95.34*** (140.2)	185.54	80.21*** (150.2)	-15.13*** (17.5)	239.30	133.97*** (86.4)

Table 3. Determinants of leverage usage

The table presents the estimates of the analysis of the determinants of leverage product use and trading margin account. The empirical ordinary least squares (OLS) model is as follows:

$$Leverage_{i,t} = \alpha_i + Demographic_{i,t} + Activity_{i,t} + \varepsilon_{i,t},$$

where $Leverage_{i,t}$ is one of the three dummy variables for the use of leverage: $Margin_{i,t}$ is a dummy variable for trading on margin account by investor *i* during a year, $EmbedLev_{i,t}$ is a dummy variable for the use of products with embedded leverage by investor *i* during a year, or $AnyLev_{i,t}$ - a dual variable indicating both trading on margin and/or use of products with embedded leverage by investor *i* during a year. $Demographic_{i,t}$ includes the natural logarithm of age in years for investor *i* – $Age_{i,t}$, and a dummy variable for the gender of investor *i* (male=1) – $Gender_{i,t}$. $Activity_{i,t}$ includes the natural logarithm of the account tenure of investor *i* in days ($AccountTenure_{i,t}$), the natural logarithm of an average value of transaction made by investor *i* in a year ($TradeSize_{i,t}$) and the natural logarithm of the number of trades by the investor during a year ($NumberofTrades_{i,t}$). *Lagged Sharpe ratio* is the measure of investor performance in a previous year. All models includes dummy variables for the years 2017 and 2018 to control for time effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	AnyLev	AnyLev	Margin	Margin	EmbedLev	EmbedLev
Gender	0.861***	0.810***	0.841***	0.804***	0.790***	0.757***
	(0.013)	(0.018)	(0.019)	(0.028)	(0.016)	(0.023)
Ln (Age)	-0.076***	-0.121***	0.767***	0.587***	-0.701***	-0.610***
	(0.014)	(0.021)	(0.022)	(0.032)	(0.017)	(0.025)
Ln (Account tenure)	0.611***	0.672***	0.932***	0.899***	0.393***	0.480***
	(0.006)	(0.010)	(0.010)	(0.015)	(0.007)	(0.012)
Ln (Trade size)	0.166***	0.183***	0.087***	0.104***	0.246***	0.245***
	(0.003)	(0.005)	(0.005)	(0.008)	(0.003)	(0.005)
Ln (Number of trades)	0.522***	0.527***	0.315***	0.293***	0.660***	0.663***
	(0.003)	(0.005)	(0.004)	(0.007)	(0.004)	(0.006)
Lagged Sharpe ratio		-0.257***		-0.074***		-0.330***
		(0.007)		(0.011)		(0.008)
Constant	-10.516***	-11.273***	-15.720***	-14.877***	-8.325***	-9.805***
	(0.053)	(0.082)	(0.085)	(0.128)	(0.062)	(0.098)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.155	0.141	0.151	0.112	0.165	0.160
N. of obs.	981,235	447,072	981,235	447,072	981,235	447,072
N. of traders	527,876	321,433	527,876	321,433	527,876	321,433

Table 4. Leverage usage and portfolio performance

The table presents the estimates of the analysis of the effects of investors' attention and leverage use on the Sharpe ratio, annualized standard deviation of returns and annual return. The empirical ordinary least squares (OLS) model is as follows:

$$F_{i,t} = \alpha_i + Demographic_{i,t} + Activity_{i,t} + Login_{i,t} + Leverage_{i,t} + Leverage_{i,t} \times Login_{i,t} + \varepsilon_{i,t},$$

where the dependent variable $F_{i,t}$ is either the Sharpe ratio, annualized standard deviation of returns or annual return for an investor *i*. $Demographic_{i,t}$ includes the natural logarithm of age in years for investor *i* – $Age_{i,t}$ and a dummy variable for the gender of investor *i* (male=1) – $Gender_{i,t}$. $Activity_{i,t}$ includes the natural logarithm of the account tenure of investor *i* in days ($AccountTenure_{i,t}$), the natural logarithm of an average value of transaction made by investor *i* in a year ($TradeSize_{i,t}$) and the natural logarithm of the number of trades made by the investor during a year ($NumberofTrades_{i,t}$). $Login_{i,t}$ is the natural logarithm of the number of days investor *i* was logged into an investment account in a year. $Leverage_{i,t}$ includes a dummy variable for trading on margin account by investor *i* during a year – $MarginUse_{i,t}$ and a dummy variable for using products with embedded leverage by investor *i* during a year – $EmbedLevUse_{i,t}$. All models includes dummy variables for the years 2017 and 2018 to control for time effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sharpe ratio	Sharpe ratio	Return	Return	StDev	StDev
Margin use	-0.040***	-0.232***	-0.001	-0.044***	0.054***	0.129***
	(0.006)	(0.022)	(0.002)	(0.007)	(0.002)	(0.011)
Logins×Margin use		0.044***		0.009***		-0.017***
		(0.004)		(0.001)		(0.002)
EmbedLev use	-0.251***	-0.559***	-0.056***	-0.124***	0.102***	0.215***
	(0.005)	(0.020)	(0.001)	(0.006)	(0.002)	(0.015)
Logins×EmbedLev use		0.068***		0.015***		-0.025***
		(0.004)		(0.001)		(0.003)
Ln (Logins)		0.005***		0.002***		0.004***
		(0.001)		(0.000)		(0.000)
Gender	-0.124***	-0.089***	-0.026***	-0.021***	0.057***	0.042***
	(0.002)	(0.002)	(0.000)	(0.000)	(0.001)	(0.001)
Ln (Age)	0.117***	0.119***	0.020***	0.020***	-0.043***	-0.044***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Ln (Account tenure)	0.064***	0.065***	0.015***	0.015***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Ln (Trade size)	-0.007***	-0.003***	-0.000	0.000***	0.006***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln (Number of trades)	0.046***	0.129***	0.006***	0.017***	-0.012***	-0.042***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Logins×Number of trades		-0.017***		-0.002***		0.005***
		(0.000)		(0.000)		(0.000)
Constant	-0.699***	-0.823***	-0.154***	-0.172***	0.324***	0.356***
	(0.010)	(0.011)	(0.003)	(0.003)	(0.003)	(0.004)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.185	0.190	0.042	0.044	0.033	0.043
N. of obs.	981,235	981,235	981,235	981,235	981,235	981,235
N. of traders	527,876	527,876	527,876	527,876	527,876	527,876

Table 5. Intensity of leverage usage, attention and portfolio performance

This table presents the statistics and analysis of the intensity of leverage usage, investor attention and portfolio performance. Panel A presents the descriptive statistics for two variables of the intensity of leverage use – Loan-to-Value (*LTV*) ratio and turnover in embedded leverage securities to total turnover (*Turnover in EmbedLev*). Panel B presents the estimates of different specifications of the following ordinary least squares (OLS) model:

$$F_{i,t} = \alpha_i + Demographic_{i,t} + Activity_{i,t} + Login_{i,t} + Intensity_{i,t} + Intensity_{i,t} \times Login_{i,t} + \varepsilon_{i,t},$$

where the dependent variable $F_{i,t}$ is either the Sharpe ratio, annualized standard deviation of returns or annual return for an investor *i*. $Demographic_{i,t}$ includes the natural logarithm of age in years for investor *i* – $Age_{i,t}$ and a dummy variable for the gender of investor *i* (male=1) – $Gender_{i,t}$. $Intensity_{i,t}$ includes an $LTV_{i,t}$ ratio for investor *i* during a year and a variable for the ratio of turnover in securities with embedded leverage for investor *i* during a year – $TurnEmbedLev_{i,t}$. $Activity_{i,t}$ includes the natural logarithm of the account tenure of investor *i* in days ($AccountTenure_{i,t}$), the natural logarithm of an average transaction value made by investor *i* in a year ($TradeSize_{i,t}$) and the natural logarithm of the number of trades made by the investor during a year ($NumberofTrades_{i,t}$). $Login_{i,t}$ is the natural logarithm of the number of days investor *i* was logged into an investment account in a year. All models includes dummy variables for the years 2017 and 2018 to control for time effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

Panel A. Intensity of leverage usage among margin debt and embedded leverage users

	N. of obs.	mean	min	p25	p50	p75	p95	p99	max	sd
LTV	27,271	0.09	0.00	0.00	0.00	0.10	0.48	0.71	0.98	0.16
Turnover in EmbedLev	43,007	0.24	0.00	0.02	0.08	0.35	1.00	1.00	1.00	0.32

Panel B. Intensity, attention and portfolio performance

	(1)	(2)	(3)	(4)	(5)	(6)
	Sharpe ratio	Sharpe ratio	Return	Return	StDev	StDev
LTV	-0.750***	-1.158***	-0.189***	-0.268***	0.487***	0.981***
	(0.021)	(0.057)	(0.009)	(0.029)	(0.015)	(0.049)
Logins×LTV		0.119***		0.022***		-0.126***
		(0.012)		(0.006)		(0.010)
Turnover in EmbedLev	-0.663***	-0.550***	-0.183***	-0.118***	0.338***	0.252***
	(0.012)	(0.037)	(0.005)	(0.014)	(0.009)	(0.036)
Logins×Turnover in EmbedLev		-0.020**		-0.014***		0.017**
		(0.008)		(0.003)		(0.008)
Gender	-0.127***	-0.090***	-0.025***	-0.021***	0.058***	0.042***
	(0.002)	(0.002)	(0.000)	(0.000)	(0.001)	(0.001)
Ln (Age)	0.127***	0.127***	0.020***	0.020***	-0.040***	-0.040***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Ln (Account tenure)	0.066***	0.067***	0.015***	0.015***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Ln (Trade size)	-0.010***	-0.004***	-0.000***	0.000**	0.005***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln (Logins)		0.004***		0.002***		-0.000
		(0.001)		(0.000)		(0.000)
Ln (Number of trades)	0.045***	0.132***	0.006***	0.018***	-0.013***	-0.048***
	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)
Logins×Number of trades		-0.017***		-0.002***		0.007***
		(0.000)		(0.000)		(0.000)
Constant	-0.729***	-0.858***	-0.159***	-0.180***	0.310***	0.355***
	(0.010)	(0.011)	(0.003)	(0.003)	(0.003)	(0.004)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.186	0.192	0.045	0.046	0.045	0.059
N. of obs.	937,501	937,501	937,501	937,501	937,501	937,501
N. of traders	503,346	503,346	503,346	503,346	503,346	503,346

Table 6. Degree of leverage, attention and portfolio performance

This table presents the estimates of the ordinary least squares (OLS) analysis of the effects of investors' leverage usage on the Sharpe ratio, annualized standard deviation of returns and annual return. The analysis is based on different specifications of Equation (2), where the dependent variable is either the Sharpe ratio, annualized standard deviation of returns or annual return for an investor. High (Low) LTV is a dummy variable, which equals to 1 for values above (below) the mean loan-to-value ratio on margin accounts. High (Low) turnover in EmbedLev is a dummy variable, which equals to 1 for values above (below) the mean turnover share in embedded leverage securities in the total turnover. STHL (STLL) is the turnover share in instruments with a leverage multiplier equal to or above three (below three). All the models include control variables for investor demographics and investment activity. *Logins* is the natural logarithm of the number of days an investor was logged into an investment account in a year. All models includes dummy variables for the years 2017 and 2018 to control for time effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1) Sharpe ratio	(2) Sharpe ratio	(3) Sharpe ratio	(4) Return	(5) Return	(6) Return	(7) StDev	(8) StDev	(9) StDev
High LTV	-0.520***			-0.112***			0.386***		
	(0.024)			(0.010)			(0.016)		
Low LTV	-0.285***			-0.056***			0.215***		
	(0.021)			(0.007)			(0.009)		
Logins×High LTV	0.073***			0.015***			-0.057***		
	(0.005)			(0.002)			(0.003)		
Logins×Low LTV	0.042***			0.007***			-0.032***		
	(0.005)			(0.002)			(0.002)		
High turnover in EmbedLev		-0.423***			-0.089***			0.174***	
		(0.027)			(0.009)			(0.021)	
Low turnover in EmbedLev		-0.587***			-0.115***			0.176***	
		(0.031)			(0.008)			(0.019)	
Logins×High turnover in EmbedLev		0.003			-0.006***			0.007	
		(0.006)			(0.002)			(0.004)	
Logins×Low turnover in EmbedLev		0.088***			0.018***			-0.026***	
		(0.006)			(0.002)			(0.004)	
Share of turnover in instr. with high leverage (STHL)			-0.385***			-0.091***			0.238***
			(0.035)			(0.013)			(0.034)
Share of turnover in instr. with low leverage (STLL)			-0.611***			-0.087***			0.005
			(0.079)			(0.018)			(0.021)
Logins×STHL			-0.062***			-0.027***			0.040***
			(0.008)			(0.003)			(0.007)
Logins×STLL			0.057***			0.009**			-0.014***
			(0.018)			(0.004)			(0.005)
Ln (Logins)	0.005***	0.005***	0.006***	0.003***	0.002***	0.002***	-0.000	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.831***	-0.828***	-0.823***	-0.174***	-0.175***	-0.173***	0.339***	0.350***	0.346***
	(0.011)	(0.011)	(0.011)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Other investor-specific controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.189	0.190	0.190	0.042	0.046	0.047	0.048	0.046	0.051
N. of obs.	937,501	981,235	981,235	937,501	981,235	981,235	937,501	981,235	981,235
N. of traders	503,346	527,876	527,876	503,346	527,876	527,876	503,346	527,876	527,876

Table 7. Intensity of attention, leverage usage and portfolio performance

This table presents the estimates of the ordinary least squares (OLS) analysis of the intensity of investor attention, leverage usage and portfolio performance. The analysis is based on different specifications of Equation (2), where the dependent variable is either the Sharpe ratio, annualized standard deviation of returns or annual return for an investor. *MarginUse* is a dummy variable for trading on a margin account, *EmbedLevUse* is a dummy variable for using products with embedded leverage. High (Low) attention is a dummy variable for investors on the top (bottom) 33rd percentile of Logins frequency. Close (neglected) attention is a dummy variable for investors who monitor their portfolios for at least 250 days (not more than 12 days) a year. All the models include control variables for investor demographics and investment activity. All models includes dummy variables for the years 2017 and 2018 to control for time effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sharpe ratio	Return	StDev	Sharpe ratio	Return	StDev
Margin use	-0.076***	-0.014***	0.042***	-0.066***	-0.011***	0.047***
	(0.013)	(0.004)	(0.003)	(0.008)	(0.002)	(0.002)
High attention	0.069***	0.016***	-0.005**			
	(0.006)	(0.002)	(0.002)			
Low attention	-0.002	-0.005***	-0.018***			
	(0.005)	(0.001)	(0.002)			
High attention	0.087***	0.022***	-0.006			
×Margin use	(0.015)	(0.004)	(0.004)			
Low attention	-0.041**	-0.003	0.058***			
×Margin use	(0.021)	(0.006)	(0.008)			
Close attention				0.072***	0.023***	0.006**
				(0.008)	(0.002)	(0.003)
Neglected attention				-0.021***	-0.005***	-0.007***
				(0.004)	(0.001)	(0.002)
Close attention				0.103***	0.025***	-0.018***
×Margin use				(0.012)	(0.003)	(0.004)
Neglected attention				-0.062***	-0.005	0.082***
×Margin use				(0.022)	(0.006)	(0.010)
EmbedLev use	-0.276***	-0.068***	0.125***	-0.275***	-0.065***	0.118***
	(0.009)	(0.003)	(0.005)	(0.006)	(0.002)	(0.003)
High attention	0.095***	0.025***	-0.051***			
×EmbedLev use	(0.011)	(0.003)	(0.005)			
Low attention	-0.113***	-0.013**	0.022*			
×EmbedLev use	(0.016)	(0.005)	(0.011)			
Close attention				0.136***	0.035***	-0.069***
×EmbedLev use				(0.010)	(0.003)	(0.004)
Neglected attention				-0.136***	-0.021***	0.041***
×EmbedLev use				(0.020)	(0.006)	(0.016)
Constant	-0.802***	-0.164***	0.379***	-0.762***	-0.160***	0.362***
	(0.011)	(0.003)	(0.003)	(0.010)	(0.003)	(0.003)
Other investor-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.189	0.044	0.043	0.188	0.044	0.040
N. of obs.	981,235	981,235	981,235	981,235	981,235	981,235
N. of traders	527,876	527,876	527,876	527,876	527,876	527,876