Selling Winners, Buying Losers: Mental Decision Rules of Individual Investors on Their Holdings[*]

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ABSTRACT

We extend the study of the disposition effect – the preference for selling current winning rather than losing stocks - by introducing a new component in this decision process: the investors' preference to increase their holdings on the losing stocks. Using a unique database of 4,428 individual investors, we find that investors prefer to sell their winning stocks and, simultaneously, keep and increase their exposure to the losing ones. We also find that this behavior is pervasive across investors, but stronger for less sophisticated investors. Our evidence suggests that reference prices, prior stock returns, stock visibility, and investor performance and sophistication are determinants of the trading decision behavior.

JEL classification: G02; G11; G14

Keywords: Disposition effect; securities trading; portfolio choice; individual investors; mental accounting; trading decision.

1. Introduction

One of the most well-documented patterns in the literature on individual investor trading behavior is the disposition effect: the investors' preference for selling stocks that are at a gain and holding stocks in their portfolios that are at a loss (Shefrin and Statman, 1985). We extend the study of the disposition effect by introducing an additional component to this trading pattern, namely, the preference to purchase additional stocks that investors currently hold at a loss in their portfolios. Investors can either sell, keep, or make additional purchases of the stocks they currently hold in their portfolios. The literature on the disposition effect essentially addresses the first two dimensions of the investors' trading behavior by exploring the reasons why investors sell or keep the stocks they own, which are shown to the related to the prior performance of their holdings. However, the literature has neglected the fact that the prior performance of investors' current holdings may also affect another aspect of their trading behavior – the decision to make additional purchases of those same stocks. In this paper we contribute to the literature by showing that past performance of investors' holdings affects their trading behavior in a broader way than what is described by the disposition effect. For instance, we argue that not only investors have a preference for selling winning stocks, but they also reveal a preference for increasing their exposure to stocks in which they are currently losing. The additional purchase of losing stocks is an extension of the tendency to hold on to losing investments. Investors may justify their decision to reinforce the exposure to their current loosing stocks based on the current stock price being lower than the initial price at which they first bought the stocks. In terms their mental accounting, they are in a better off situation than if they had purchased all units at the initial price. Moreover, by additionally purchasing units of a losing stock, investors lower the average acquisition price – the natural reference price – and consequently facilitate the breakeven.

We study the stock portfolios of 4,428 individual investors over a four-year period from August 2003 to July 2007. The data were provided by a well-known Portuguese brokerage house and the individual investors under analysis are their discount brokerage clients (with online accounts). These investors, mainly Portuguese, have easy access to international markets through NYSE Euronext. Nevertheless, their portfolios are biased towards the Portuguese stock market, in line with the literature that reports home bias (Coval and Moskowitz, 1999; Graham, Harvey and Huang, 2009). Motivated by the studies that suggest that individual investors trade too much (Odean, 1998a) but are under-diversified (Goetzmann and Kumar, 2008), we question whether and why investors express preferences for selling and/or reinforcing their current holdings, depending on the previous experienced price, i.e., depending on whether the initial prices at which the stocks were bought are above or below the current prices. Reference prices are critical because investors are making their decisions based on past experienced prices (eventually, updated to some extent)

instead of expected future prices. Once different investors have different reference prices, they may decide differently, not because they have different expectations about the security, but because they have a different past experience with it.

We analyze the buying and selling of current holdings in three decision-making frameworks: (1) the buying and selling of current holdings compared against the holdings that were not, but could have been, traded (additionally purchased or sold), in a trading day; (2) the additional purchases of current holdings versus the opportunities to do so that were not realized; and (3) the additional purchases of current holdings versus all other purchases.. We use reference prices, stock characteristics, investor-trading characteristics, and investor-demographic characteristics as variables of interest.

Our results indicate that individual investors exhibit a preference for selling current winners and for increasing the holdings of current losers. This result is consistent in different empirical settings – using aggregate or investor-level trading data. We also find that this trading behavior is less frequent among more sophisticated investors. Other stock- and investor-related characteristics, such as reference prices, prior stock returns, visibility, and investor performance can partially explain the investor's additional purchasing behavior. Moreover, to analyze whether the investor's trading preferences with respect to their holdings are good trading strategies, we measure and compare (1) the post-performance of the stocks additionally purchased with the post-performance of the stocks newly bought and (2) the post-performance of the stocks sold with the post-performance of the stocks that could have been sold but were kept in account. Our results suggest that the investors' trading behavior in both cases is associated with poor future performance.

In sum, our paper contributes to the literature by extending the concept of the disposition effect: investors not only sell their winners and keep their losers, but they also increase their exposure to the losing stocks. This is a topic of interest considering that 36.59% of all purchases in our sample are additional purchases of stock that investors currently hold in their portfolios. Additionally, we also contribute to the literature on investor trading behavior by exploring several stock characteristics, as well as investor trading and demographic characteristics that are helpful to explain this phenomenon.

The paper proceeds as follows. Section 2 discusses the relevant literature. Section 3 describes the data and section 4 describes the methodology. Section 5 presents the main empirical results. Section 6 concludes.

2. Literature review

The disposition effect - the preference for holding losing investments for too long and selling the winning ones to soon - identified by Shefrin and Statman (1985) is well documented in the literature in various countries (e.g., Odean (1998a) use data from the U.S.; Shapira and Venezia (2001) from Israel; Grinblatt and Keloharju (2001) from Finland; Feng and Seasholes (2005) from China; Leal, Armada and Duque (2010) from Portugal, among many others) and across different investor classes (e.g., Locke and Mann (2005) use a sample of professional futures traders; Grinblatt and Keloharju (2001) use various classes of investors; Genesove and Mayer (2001) study homeowners and Jin and Scherbina (2011) mutual fund managers). The reasoning for the disposition effect is that investors aim to lock gains, while holding their losses with the expectation of a recovery. The mistaken belief that unrealized gains and losses are not real, as they are not yet effective, triggers the disposition behavior.

An extension to the behavior of holding losing stocks is to increase the exposure to those stocks by purchasing additional units. Thus, instead of a non-action that could be justified by decision paralysis or an attempt to ignore poor investments, investors can actively purchase more of their current losers. The rationale behind this behavior is that by buying more units of the losing stock the average acquisition price decreases and the potential for a future gain on that stock, should the price recover, increases[3]. Thaler and Johnson (1990) call it the break-even effect, where in a loss situation, a possibility of breakeven is very attractive. In this setting, mental accounting editing and framing become particularly relevant. Counterfactual thinking[4] occurs naturally as investors compare their current situation with the situation that could have happened, if a larger initial purchase had been made. In the case of losses, an additional purchase at lower price can be framed as "a better situation" than the total purchase at the initial price. Therefore, investors prefer to additionally purchase stocks that are decreasing in price after its purchase. Furthermore, investors may buy at a lower price aiming to lower the acquisition average price. Despite the theoretical warn that it may be a bad strategy to allocate more resources to a poor investment, it is very common that individual investors refer it as a strategy to breakeven more easily. We can explain this behavior through the S-value Prospect Theory function (Kahneman and Tversky, 1979). Due to decreasing sensitivity of the function in face of new gains or losses, in the losses zone, additional losses are not so painful but a possible recovery, and an eventual potential breakeven, is much valuable. Investors also exhibit loss aversion, which is represented in the value function by a steeper losses zone than the gains zone. In this context, investors

[3] This type of explanation was given by some investors that we interviewed to justify their behavior of holding on to losers and, simultaneously, increasing their exposure to them. These interviews, merely exploratory, with some of our investors were important to strengthen the motivation of our study.
[4] Counterfactual thinking is a mental construction of "what might have been" (Roese, 1996; 1997).

may accept very risky bets aiming to lower the acquisition price and consequently achieve the breakeven faster. In the gains zone, the investment is doing well and investors tend to be more risk averse. Hence, investors may decide to behave more conservatively and do not additionally invest in the winning stock because the perceived additional gain is less valuable but a possible reduction in price is highly appreciated (they would move to the steeper zone of gains).

3. Data

We use a unique database of trades of 5,128 individual investor accounts from 1st August 2003 to 31st July 2007. These investors are the discount brokerage clients of a well-known Portuguese brokerage house who traded stocks at least once in the data period. We focus on stock trades and exclude from the sample all other security trades. Based on the trading information, we construct daily stock portfolios, for each individual, following a procedure similar to Odean (1998b) and Grinblatt and Keloharju (2001). As the initial price is a key anchor in our study, we depart from a zero initial balance. We net all trades for the same investor on the same day and security. We disregard all sells for which the purchase price is unknown because the purchase occurred before the beginning of our sample period. We also adjust for every corporate action that occurs within the sample period (through the entire sample period there are 1,167 corporate actions, 840 of which refer to dividends).

Table 1 describes the data after constructing the portfolios. We end up with 4,428 investors with suitable trades and holding positions, 111,616 net trades, involving 1,604 different stocks, with a global trading value of 1,487,800,379€. The sells represent almost half of the trades (45.24% of the total number of trades and 44.43% of the value), but only 1,463 investors are classified as sellers. The additional purchases (a subset of the total purchases) are a substantial part of the total trades. There are 22,362 trades that can be classified as additional purchases (the purchase of additional units of a current holding). Additional purchases are somehow a pervasive trading behavior: about 20% of all investors (846 individual investors) make additional purchases, which represents 37% of the total number of purchases and 40% of the total value. This also means that additional purchasers are the most active traders among all investors. In fact, this group of investors alone accounts for 91% (55,372) of the number and 93% (766,530,732€) of the euro value of all purchase trades.

In general, investors in our sample are under-diversified with respect to their stock accounts: on average, an investor holds 2.34 different stocks. Under-diversified individual investors are frequently described in the literature; for instance, Barber and Odean (2000) report portfolios of four stocks for their average individual

investor. Besides the vast range of possibilities, these investors focus only on a small number of stocks that they can easily track and use their mental accounting to make trading decisions (higher level of diversification makes mental accounting more difficult to implement). Moreover, investors in our sample exhibit a preference for Portuguese stocks. On average (and ignoring day trading – we net all daily trades), each investor has 25.21 trades in the period and trades 4.73 different stocks, which means that they trade frequently the same stock. However, there are substantial differences across investors.

Table 2 shows the average number of trades (sells, purchases, and additional purchases) made by the 846 investors that have purchased additional units of stocks they hold, at least once throughout the sample period (from now on we designate these investors as "additional purchasing investors"). The table also shows the average number of different stocks traded and the level of investor diversification (number of different stocks in the investor's account). We split the sample of additional purchasing investors into quartile according to the number of additional purchases they made. The majority (74%) of the additional purchasing investors made more than one additional purchase and, on average, they made 26.03 additional purchases over the sample period. Investors in the top quartiles of additional purchases exhibit a higher ratio of additional-to-total purchases, trade a larger number of different stocks and are more diversified. For instance, the average investor in the lowest quartile makes, on average, one additional purchase, trades 6.5 different stocks and holds a portfolio with 1.77 stocks; while the average investor in the top quartile makes 93.73 additional purchases, trades 39.13 different stocks and holds a portfolio with 7.08 stocks. Overall, we observe a monotonic increase from the lowest to the highest quartiles in terms of number of additional purchases, different stocks traded and investor diversification, albeit weaker for the latter. We may expect some mechanical relation between trading activity and diversification, but less so when the trading activity is more dominated by additional purchases. For additional purchasing investors the correlation between trading activity and diversification is 46%, but it is smaller for additional purchasing investors in any quartile: 23%; 34%; 41% and 34%, from lowest to top quartiles, respectively.

4. Methodology

We measure investors' preferences by comparing their effective behavior with all the opportunities when that behavior could have been taken. By doing so, we prevent our results to be driven by market tendencies. This concept of investor preference and its measurement was introduced by Odean (1998a) in the context of disposition effect. We apply the same procedure to both the disposition effect and the additional purchase. Thus, to test whether investors have a preference for selling winners rather than losers, or a preference for purchasing additional units of their current losers rather than winners, we compute the ratio of the investors'

realized behavior to the opportunities to do so (the opportunities include both effective and potential behavior).

To examine the presence of a disposition effect[5] in our sample, we first compute the number of sells per investor that resulted in a realized gain or a realized loss by comparing the average acquisition price with the selling price. Then, we compute for each account, in each selling day, the potential sells that could have been done with a potential gains or a potential losses, measured by the difference between the average acquisition price and the closing price of the day. Finally, we compute the Proportion of Gains Realized (PGR) and the Proportion of Losses Realized (PLR) as follows:

$$PGR = \frac{Realized\ Gains}{Opportunities\ to\ Realize\ Gains\ (Realized\ Gains + Potential\ Gains)}$$

And,

$$PLR = \frac{Realized\ Losses}{Opportunities\ to\ Realize\ Losses\ (Realized\ Losses + Potential\ Losses)}$$

We analyze the presence of a disposition effect by testing the difference in the proportions using a t-test, where under the null hypothesis the difference in the proportions is zero.

Similarly, we also calculate the proportions of winners and losers additionally purchased. We compute the number of winners and losers additionally purchased by comparing the additional purchase price with the initial price at which the stocks were primarily bought. Then, to compute the potential additional purchases, whenever there is an additional purchase, we look at every stock in that account for which there was no additional purchase and verify if it is a current winner or loser, by comparing the average acquisition price to the closing price of the day. The potential additional purchases of current winners or losers are only calculated if an additional purchase occurs in that account on that day. The Proportion of Winners Additionally Purchased (PWAP) and the Proportion of Losers Additionally Purchased (PLAP) are calculated as follows, where opportunities again include both effective and potential behavior:

$$PWAP = \frac{Winners\ Additionally\ Purchased}{Opportunities\ to\ Additionally\ Purchase\ Winners}$$

[5] See Leal, Armada and Duque (2010) for more details on the methodology.

$$PLAP = \frac{Losers\ Additionally\ Purchased}{Opportunities\ do\ Additionally\ Purcahse\ Losers}$$

We test the difference in the proportions using a t-test, where under the null hypothesis the difference in theses proportions is equal to zero. Finding a significant difference indicates that investors exhibit a preference for one type of behavior. These are summary proportions that aggregate the entire number of effective and potential trades of all investors throughout the sample period. Realized trades and potential trades are considered to be independent across investor and over time. Although, to some extent, this may be a strong assumption, its violation does not bias the computation of the proportions. Therefore, for high degree of statistical significance the assumption of independence is not problematic. Alternatively, instead of computing summary proportions for the entire sample, we compute the same proportions for each single investor and test the differences in means between the same pairs of proportions.

In addition to the analysis of ratios of effective trading versus potential trading, we also perform a multivariate analysis to understand which investor and stock characteristics are associated with the trading behavior. We use probit models where the dependent variable is a binary variable that assumes the value of one when the investor trades (buys or sells, depending on the model) and zero otherwise. We analyze the trading behavior in four different decision-making frameworks. Firstly, we analyze jointly the buying and selling of current holdings compared with all holdings of the same investor that could have been traded that day but were not. Secondly, for each investor we analyze the additional purchasing behavior compared with the opportunities of additional purchases that were not realized in that day. Thirdly, we analyze the additional purchasing behavior of each investor compared with all his other purchases, using the subsample of investors that realize both types of trades. . The independent variables of interest to explain the trading of current holdings are the reference prices (used to classify the stock as a winner or loser), stock characteristics, investor-trading characteristics, and investor-demographic characteristics.

Moreover, we analyze the post-performance of the different types of trading behavior. For instance, we compare the market adjusted returns of the stocks additionally purchased with the new purchases, as well as, the market adjusted returns of the stocks sold with the ones that could have been sold but were not.

5. Empirical analysis

5.1 Selling winners and buying current losers: Ratio analysis

Table 3 shows the proportion of winners additionally purchased (PWAP) and the proportion of losers additionally purchased (PLAP) and tests their difference. In Panel A of Table 3 we show summary proportions, where we aggregate all trades and potential trades of the entire sample in one single ratio; while in Panel B we compute the proportions per investor and then test the difference in means. In both panels, we find an investor preference for purchasing additional units of the current losers rather winners (difference of 0.041 and t-statistic of 23.386 in panel A, and difference of 0.1067 and t-statistical of 60.1590 in panel B). This result supports the idea that investors will accept riskier bets when they are in the losses zone, as an attempt to breakeven more easily, should the stock prices rise in the near future. This preference is based on mental accounting thinking, where investors keep for each security a mental reference price (the average acquisition price). This behavior, based on mental accounting and anchored on past prices, is a risky strategy, as many times it is just a consequence of the investor's inability to accept losses, rather than a true expectation about an increase in the stock price. As Langer (1975, page 311) states "there is much overlap between skill and luck" and when accessing their own skills, individuals let themselves be carried away by the illusion of controllability. The success of past strategies (winning situations), gives individual investors a sense of control and superior expertise about current situations that might be similar to the ones where they have shown to be successful. This illusion induces response to familiarity and makes individuals more confident and more likely to accept risk (Langer, 1975).

Table 4 shows investors preferences regarding the disposition effect. In panel A, we test the difference in the Proportion of Gains Realized (PGR) and the Proportion of Losses Realized (PLR). In this panel we use summary ratios, i.e., we aggregate all effective and potential trades of our sample to compute a single ratio of each type – PGR and PLR. The results show that the difference between PLR and PGR is negative and statistically significant (difference of -0.1494; t-statistic of -95.5615), meaning that investors reveal a preference for selling winners rather than losers. In panel B, we compute the ratios per investor and compare the difference in means of the two ratios. By using investor-level ratios, we attenuate the concern that the result uncovered above might be driven by a small number of very active investors. The result is the same as before; we still find that investors have a clear preference for selling their current winners. The difference between PLR and PGR is -0.3249, statistically significant at the 1% significance level.

The findings about additional purchasing behavior and disposition effect reveal an intriguing puzzle. These results support the idea that investors' anchors are arbitrary and very dependent of framing and mental accounting. If individual investors engage in disposition effect, we can expect that they have more opportunities to additionally purchase their current losers (because they hold them expecting a possible recovery).

5.2 Selling winners and buying current losers: Multivariate analysis

In Table 5 we perform a multivariate analysis to test the presence of the typical disposition effect among our traders, as well as proposed extension of a preference for buying additional units of the current losing stocks. We consider a subsample of 1,125 investors that trade on their holdings (sell or additionally purchase) in the sample period. To test the disposition effect (models (1) to (3)) we estimate probit models where the dependent variable is a binary variable that is equal to 1 when the investor sells a stock that he currently holds in a given day (net sell), and zero if the investor could have sold a stock he holds in a given trading on holdings day, but didn't do so. Our main variable of interest is the dummy Winner that equals 1 if the stock is a current winner and zero if it is a current loser. The coefficient on this variable is positive and statistically significant in all models, meaning that investors are indeed more likely to sell their current winners. The effect is also economically significant; taking model (3) as an example, current winning stocks are 18.2% more likely to be sold than current losers. All regressions include year dummies and standard errors are clustered by investor. The literature also reports some variation on the incidence of the disposition effect depending on investor sophistication. Characteristics as frequency of trading and diversification may induce different levels of disposition effect (see, e.g., Leal, Armada and Duque (2010)). In models (2) and (3) we test the existence of different responses to the disposition effect depending on the intensity of investors trading and their level of diversification, respectively. We use these variables separately in each regression to avoid problems of multicollinearity as they show a correlation higher than 50%. The intensity of investor trading is measured by the logarithm of the number of total trades; the results in model (2) show that the coefficient of the interaction term (Winner*Log of Investor Total Trades) is negative (-0.012) and statistically significant (at the 10% significance level), meaning that more active traders are less likely to sell their current winners than their counterparts. The Diversification Index is given by 1 minus the Herfindahl–Hirschman Index (HHI)[6] for portfolio concentration. In model (3) we test whether more diversified investor are more or less prone to the disposition effect. The coefficient of the interaction term Winner*Diversification Index is negative (-0.198) and strongly significant, meaning that more diversified

[6] $HHI = 1 - \sum_{i=1}^{n} (w_i)^2$, where HHI is the Herfindahl–Hirschman Index for portfolio concentration; wi the proportion of portfolio value invested in security i, in decimal form; and n the number of securities in the portfolio.

investor are less likely to sell their current winners. These results are in line with the literature that shows that more sophisticated investors exhibit a lower level of disposition effect in their trading behavior. In models (4) to (6), we test our extension of the disposition effect by analyzing the behavior of purchasing additional units of the current winners/losers. In these regressions, the dependent variable is 1 if the investor purchases additional units of a current holding in a given day, and zero for any possibility of buying additional units of a current holding, in a given trading on holdings day, that was not realized. The results show a clear preference for purchasing additional units of the current losers, as the coefficient on the dummy variable Winner is negative and statistically significant in all three regressions. Taking model (4) as an example, investors are 1% more likely to purchase additional units of their current losers than of any other stocks of they currently hold. Similarly, we test whether investor trading activity and diversification affect this behavior. The results show that more active traders (model (5)) are less likely to purchase additional units of their current stocks, in particular their current losers. Notice that the regression includes the interaction term Winner*Log Inv. Total Trades, which happens to be positive and statistically significant. Therefore, the coefficient on Log Inv. Total Trades captures the marginal effect of investor trading activity on the likelihood of purchasing additional units of current losers; thus, a 1% increase in the number of trades reduces the likelihood of an additional purchase of a current loser by 1.3%. In terms of investor diversification (model (6)), we find that more diversified investors are also less likely to purchase additional units of their current holdings, in particular their current losers, as the coefficient on the Diversification Index is negative (-0.132) and statistically significant (at the 1% significance level), whereas the coefficient on the interaction term Winner*Diversification Index is not statistically significant. Overall, these results show that investor sophistication reduces not only the behavior of selling winners, associated with the typical disposition effect, but also the behavior of buying additional units of their current losers.

5.3 Determinants of the propensity to buy current holding stocks

We now analyze several stock and investor characteristics to measure their impact on the propensity of purchasing additional units of the investors' current holdings. In Table 6 we estimate probit models where the dependent variable is 1 if the investor purchases additional units of a current holding in a given day, and zero for any possibility of doing so that was not realized. By comparing the additional purchasing behavior with the opportunities to do so, we attempt to find patterns of preferences in that behavior and how they relate to the investors' experienced prices anchors, stock characteristics, stock past performance, investor account characteristics and their demographics.

Table 6 reports the marginal effects of the probit estimations. The regressions include year and investor dummies, and standard errors are clustered by investor and stock as indicated. In Panel A, we test the impact

of prior experienced price anchors. For instance, we include as explanatory variables the Winner dummy (1 if the stock is a current winner, zero otherwise) and the magnitude of the gain or loss, i.e. the natural logarithm of the absolute value of the gain or of the loss multiplied by the dummy variables "Positive" (1 if the stock is a winner, zero otherwise) or "Negative" (1 if the stock is a loser, zero otherwise). The results show a negative coefficient on the dummy Winner, statistically significant in all models, meaning that investors are less likely to purchase additional units of their current winning stocks. Moreover, the magnitude of the current gain also matters; the coefficient on Log of gain*Positive is negative and statistically significant ate the 1% level in all models, suggesting that the larger is the gain on the winning stocks the less likely (about 0.6%) is the investor to buy additional units of that stock. As for losing stocks, we do not observe a significant sensitivity to the magnitude of the loss. Panel B of Table 6 shows the impact of stock characteristics on the decision of an additional purchase when compared to the opportunities to do so. Namely, we use the daily volume of trading (Log of Daily Stock Volume, in Euros) and whether the stock belongs to the Portuguese main market index (PSI20 Index Dummy) as proxies for stock visibility. To account for home bias we include in the regressions a dummy variable that identifies Portuguese stocks (PT Dummy) and to account for currency bias we include another dummy that identifies stocks of companies from the Euro zone (Euro Currency Dummy). We find that investors are more likely to additionally purchase domestic and more visible stocks. Being a Portuguese stock increases the probability of an additional purchase in 5.2% and doubling the daily volume of the stock increases that probability in 1.4%. To reflect the impact of past stock performance on the decision to additionally purchase the stock, we consider, in Panel C, the prior market-adjusted returns of the stock multiplied by the dummies "Positive" and "Negative" using three windows of trading days before the purchase: prior week (days [-5;-1]); prior quarter (days[-60;-6]) and prior year (days[-240;-61]). We find evidence that investors react strongly to negative previous stock market-adjusted return in the shortest window: the more negative is the prior market-adjusted return in the prior week, the more likely the investor is to additionally purchase the stock. The literature suggests that individual investors are particularly prone to contrarian behavior (e.g., Grinblatt and Keloharju, 2001) and this evidence also suggests strong contrarian behavior associated with additional purchases of stock currently owned. Panel D of Table 6 includes characteristics of the investors' accounts, namely, the Diversification Index (as defined earlier); the investor performance (Mean of the Investor Daily Market Adjusted Return during the data period multiplied by the dummies Positive/ Negative); the stock account value (natural logarithm of the mean of the stock account value during the data period) and account age, expressed in years at the beginning of the data period. We find a negative and statistically significant relation between additional purchases and the diversification of investors' accounts. We also find that better performing investors over the entire sample period (i.e. those that exhibit a larger positive mean market-adjusted return) are less likely to engage in additional purchases of the same stocks they hold, whereas the

incidence of additional purchases is greater among investors with larger negative mean abnormal returns in their accounts during the period. These variables proxy for investor sophistication and, overall, we conclude that more sophisticated investors (more diversified and with better performance) are more likely to purchase additional units of their current stocks. Moreover, we find that investors with older accounts are more likely to engage in additional purchasing behavior, meaning that investor experience does not mitigate this type of behavior. In Panel E, we control for investors' demographic characteristics, such as gender, age, marital status, and professional occupation. In model (5) we exclude investor account characteristics because they are somehow correlated with investor demographic characteristics. Since the investor-specific characteristics are not reported for every investor, some investors are excluded and the number of observations is reduced. The results show that none of the demographic variables can contribute to explain the additional purchasing behavior, meaning that the results uncovered above are pervasive across investors and independent of their demographic characteristics. In sum, from Table 6 we conclude that investor use past experienced prices as anchors that affect their decision to purchase additional units of their current stocks. The larger is the magnitude of the loss on a current holdings, the larger is the probability of purchasing more of the same stocks. We also find that the additional purchasing behavior has a high incidence among domestic stocks, stocks that are more visible, and those with poor performance in the previous week. This type of behavior is less predominant among more sophisticated investors.

In Table 7 we study the additional purchasing behavior using a different approach. Instead of comparing effective additional purchases to the opportunities to do so that were not realized, we compare effective additional purchases to effective purchases of new stocks that the investor does not currently hold. In this case, investors frame their decision-making process in a different way: buying more of the same stocks versus buying new stocks. Therefore, under this approach, we analyze the determinants of the propensity to purchase additional units of the stocks currently held by estimating probit regressions where the dependent variable is 1 when the investor makes an additional purchase, and zero when the investor makes a "new purchase" (i.e. the purchase of a stock that is not currently held in the investor's account). It means that for each day an investor purchases a stock, we code it as 1 if the investor currently holds that stock and as zero otherwise. The independent variables are the same as the ones used in Table 6 for stock characteristics, prior performance, and investor account characteristics. All regressions include year and investor dummies and standard errors are clustered by stock. We only consider the 846 investors that have both additional purchases and new purchases in the sample. Panels A and B of Table 7 show probit regressions on stock characteristics and prior stock performance, respectively. We find that the coefficient of "Log of Daily Stock Volume, in euros" is negative and statistically significant (coefficient of -0.011 with a z-stats of -3.98), meaning that stock visibility is more relevant for general new purchases than for additional purchases of

current holdings. This is so because in additional purchases, the ignition trigger is the possession of the stock and consequently general visibility decreases is less important. In addition, in terms of visibility, the volume trading appears to be more relevant than the stock being part of the main market index, since volume can better capture changes in investor attention and trading catching activities. Moreover, we also find no home bias or euro currency bias in the decision of additional purchasing when compared with new purchases. To reflect the impact of past stock performance on the decision to additionally purchase a stock, we use prior market-adjusted returns of the stock multiplied by the dummies Positive/Negative, calculated for the same time windows used in Table 6. We find that investors are less likely to purchase additional units of their current stocks that performed better in the previous week as the coefficient on Stock MAR days[-5;-1]*Positive is negative (-0.135) and statistically significant at the 5% significance level. This is not relevant, however, when the positive past performance happened longer ago, as investors do not seem to keep memory of it. In line with this result, we find that stocks that performed poorly in the past – in any of the considered windows – are more likely to be additionally purchased when compared to the odds of a new purchases. The literature reports that individual investors act as contrarians (Grinblatt and Keloharju, 2000; Kaniel, Saar and Titman, 2008). We find that when it comes to additional purchasing the contrarian behavior is even stronger: investors are even more likely to avoid stocks with recent positive performance (prior week) and to choose those with negative performance (in the prior week, quarter or year) when they currently own the stock. In Panel C we estimate the probit model including the same investor account characteristics described above. We find that more diversified investors are less likely to make additional purchases when compared to new purchases. The coefficient on the Diversification Index is negative (-4.115) and statistically significant at the 1% significance level. Although diversified investors have more opportunities to make additional purchases – as they hold a larger variety of stocks -, they do not do so. We argue that since these investors are more diversified, they are less attached to individual stock mental accounting and references prices. Therefore, those investors will feel less tempted to purchase additional units of their own stocks and will rather to buy new stocks (which also reinforces their diversification). As for the investor performance, we find that the investor that on average perform poorly are the ones that are more likely to purchase more of their current stocks than new stocks, as the coefficient on Mean Inv. Daily MAR*Negative is positive (0.429) and strongly significant. Account value and age are not relevant to explain the preference for additional purchases against new purchases. In unreported results, we also add to the regression the demographic characteristics of investors. The results show that none of the demographic variables – age, gender, status and professional occupation – can partially explain the additional purchasing behavior as defined in this analysis.

To analyze whether the trading preferences documented above are in fact good trading decisions, we measure their post-performance. To analyze the additional purchasing behavior, we measure the post-performance of the stocks additionally purchased and compare it to the post-performance of the stocks newly bought. To analyze the selling behavior, we measure the post-performance of the stocks additionally purchased and compare it to the post-performance of the stocks newly bought. In Panel A of Table 8, we do a univariate analysis of the post-purchase performance by testing the difference in means of the market-adjusted returns of stocks that were additionally purchased and those that were newly purchased. The post-purchase market-adjusted returns are measured for four different periods after the trade: [+1; +5], [+1; +20], [+1; +60], and [+1; +240] trading days. The results show that, on average, stocks that were additional purchased tend to perform worse than stocks that were newly purchased. The difference in the mean post-market-adjusted return between the two groups of trades is statistically significant for all post-trade periods considered. Depending on the time window, the difference can range from 50 to 720 basis points. Overall, the evidence suggests that the investors' behavior of purchasing additional units of their current stocks, which tends to happen when those stocks are trading at lower prices, is not a good trading strategy as it is associated with poor future performance. In Panel B of Table 8, we analyze the post-selling performance by testing the difference in means of the market-adjusted returns of stocks sold and the ones that were potential sells (the ones that could have been sold but were kept in account), for the same periods after the trade. The results show that, on average, stocks sold perform better than the ones that were kept in account. The difference in the mean post-market-adjusted return between the two groups of trades is statistically significant for all post-trade periods considered and increasing on the time window: from 10 points basis in the window [+1; +5] to 610 points basis in the window [+1; +240] trading days after the trade. The evidence also suggests that the investors' selling preference, which tends to favor current winners, is an inadequate trading strategy that conducts to poor future performance.

6. Conclusions

Based on a unique database of 4,428 individual investors trading in the period from 1st August 2003 to 31st July 2007, we study investors trading on their holdings. We confirm the disposition effect – the preference for selling stocks that are at a gain and holding stocks that are at a loss - and extend the concept, introducing a new component to this trading pattern: the preference for additionally purchase stocks currently hold that are at a loss. We find that investors prefer to sell their winning stocks and, simultaneously, keep and increase their exposure to their losing stocks. This evidence is robust to using aggregate or investor-level trading data. We study the effect of stock and investor characteristics on this trading behavior and find that the preferences for selling winners and buying additional units of their current losers are stronger for more

visible stocks and for less sophisticated investors. Both the disposition effect and the additional purchase of losers are less frequent among more active and diversified traders. When comparing the propensity of additional purchase against the potential additional purchases, the results suggest that (i) investors avoid the additional purchase of winning stocks and (ii) the larger the current gain is, the less likely investors are to additionally purchase. We also find that investors are more likely to additionally purchase domestic, more visible stocks (i.e., with higher volume of trading), and with recent negative performance. Moreover, investors that are more sophisticated (i.e., more diversified and better performing investors) are less likely to engage in this behavior. When comparing the propensity of additional purchase against new purchases, the results are in the same line: (i) more visible stocks and stocks with recent negative performance are more likely to be additionally purchased; (ii) less diversified and poor-performing investors are more likely to make additional purchases. To understand whether investors' trading preferences on their holdings are a good trading decision, we analyze the post-performance of the preferences compared with the alternative behavior. We conclude that (i) the post-performance of the stocks additionally purchased is worse than the post-performance of the stocks newly bought and (ii) the post-performance of the stocks sold is better than the post-performance of the stocks that could have been sold but were kept in account. Overall, the results suggest that these investors' trading preferences on their holdings lead to poorer future performance.

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Appendix A - List of variables

- **Account's Age:** Elapsed time since account opening in years (decimal), at the beginning of the data period.
- **Diversification:** Number of different stocks in the investor's account, determined based on days that investor has holdings in account.
- **Diversification Index**: Mean of the Daily Diversification Index by investor, determined each day the investor has holdings in account. The Daily Diversification Index takes into account the amount invested in each stock and captures the degree of investor portfolio diversification, determined for each investor each day he has holdings in account, given by the following formula: $1\text{- HHI} = 1\text{-}\sum_{i=1}^{n}(w_i)^2$, where HHI is the Herfindahl–Hirschman Index for portfolio concentration; w_i the proportion of portfolio value invested in security i, in decimal form; and n the number of securities in the portfolio.
- **Euro Currency Dummy:** Dummy variable that equals 1 if the stock is denominated in Euro currency, zero otherwise.
- **Gender:** Dummy variable that equals 1 if the investor is a men and 0 she is a women.
- **Log of Age:** Natural logarithm of the investor age in years at the beginning of the data period.
- **Log of Daily Stock Volume, in Euros:** Natural logarithm of the daily stock volume, expressed in Euros. It is determined every stock trading day and is used as a proxy for stock visibility at that moment.
- **Log of Gain/Loss:** Natural logarithm of the absolute value of the outcome (gain or loss) by comparing the average acquisition price with the selling price, expressed in Euros.
- **Log of Investor Total Trades:** Natural logarithm of the number of the investor's total trades in the sample period.
- **Log of the Mean of Stock Account Value:** Natural logarithm of the mean of the investor's stock account value, expressed in Euros. Proxy of investor wealth.
- **Mean of Inv. Daily MAR:** Mean of the investor's daily market-adjusted returns in the sample period. We use PSI20 index as the proxy for the market returns.
- **Negative**: Dummy variable that equals 1 if the stock is a loser (or neutral), zero otherwise.
- **Positive**: Dummy variable that equals 1 if the stock is a winner, zero otherwise.
- **PSI20 Index Dummy:** Dummy variable that equals 1 if the stock belongs to the PSI20 index, zero otherwise.
- **PT Dummy:** Dummy variable that equals 1 if the stock is Portuguese, zero otherwise.
- **Status:** Dummy variable that equals 1 for the specified status category, zero otherwise.
- **Stock MAR [day(s)]**: Stock market-adjusted return in the given interval of trading days, before (Tables 6 and 7) or after (Table 8) the purchase decision. We use PSI20 index as the proxy for the market returns.
- **Winner/Loser Dummy:** Dummy variable that equals 1 if the stock is a winner (i.e., current price > weighted average acquisition price), zero otherwise.

Table 1: Summary Statistics

This Table describes the data after the process of daily portfolio construction, for the 4,428 investors with suitable trades and holding positions, in which trades are determined ignoring the intra-day trading and the sells without matching purchase.

	# observations	# investors	Mean	St. Deviation	Maximum	€ value
Trades (Buys and Sells)	111,616	4,428	25.21	125.45	3,516	1,487,800,379
Sells	50,493	1,463	34.21	99.38	1,579	661,071,567
Purchases	61,123	4,428	13.80	66.37	1,936	826,728,812
Additional Purchases	22,362	846	26.43	88.66	1,392	331,358,121
Different Stocks Traded	1,604	4,428	4.73	12.14	287	1,487,800,379

Table 2: Description of all trades made by additional purchasing investors

This Table describes the trades for the 846 investors that have additional purchases (subset of purchases) in the period. We split the additional purchasing investors into quartiles according to the number of additional purchases made during the sample period. Diversification is the number of different stocks in the investor's account. All statistics are mean values for the investors in that particular category.

	Q1	Q2	Q3	Q4	Total
Trades	17.06	33.90	77.06	372.02	123.45
Sells	7.32	15.31	35.51	170.32	56.40
Purchases	9.74	18.59	41.55	201.70	67.05
Additional Purchases	1.00	2.74	9.83	93.73	26.43
Additional Purchases to Purchases Ratio	10.27%	14.72%	23.67%	46.47%	39.42%
Diversification	1.77	2.22	3.40	7.08	3.59
Different Stocks Traded	6.50	10.38	17.38	39.13	18.18

Table 3: Preference for additionally purchasing current winners/losers

This table shows the Proportion of Winners Additionally Purchase (PWAP) and the Proportion of Losers Additionally Purchased (PLAP) from 1-8-2003 to 31-07-2007. Panel A aggregated all trades across accounts and days; trades are assumed to be independent. Panel B presents the mean of the same figures determined per investor and averaged out across days. *, **, and *** stand for statistical significance at 10%, 5%, and 1%, respectively.

Panel A: aggregate trades		
Number of Winners Additionally Purchased	8,870	
Number of Losers Additionally Purchased	12,852	
Number of Opportunities to Additionally Purchase Winners	75,571	
Number of Opportunities to Additionally Purchase Losers	81,388	
Proportion of Losers Additionally Purchased (PLAP)	0.158	
Proportion of Winners Additionally Purchase (PWAP)	0.117	
PLAP-PWAP	0.041	***
t-statistic	(23.386)	
Panel B: investor-level trades		
Mean of Winners Additionally Purchased	10.804	
Mean of Losers Additionally Purchased	15.654	
Mean of Opportunities to Additionally Purchase Winners	91.754	
Mean of Opportunities to Additionally Purchase Losers	99.044	
Mean of the Proportion of Losers Additionally Purchased ($\overline{\text{PLAP}}$)	0.4412	
Mean of the Proportion of Winners Additionally Purchase ($\overline{\text{PWAP}}$)	0.3345	
$\overline{\text{PLAP}} - \overline{\text{PWAP}}$	0.1067	***
t-statistic	(60.1590)	

Table 4: Disposition Effect

This table shows the Proportion of Gains Realized (PGR) and the Proportion of Losses Realized (PLR) from 1-8-2003 to 31-07-2007. Panel A aggregated all trades across accounts and days; trades are assumed to be independent. Panel B presents the same figures per investor and averaged out across days.*, **, and *** stand for statistical significance at 10%, 5%, and 1%, respectively.

Panel A: aggregate trades		
Number of Realized Gains	29,522	
Number of Realized Losses	11,666	
Number of Opportunities to Realize Gains	120,823	
Number of Opportunities to Realize Losses	122,867	
Proportion of Losses Realized (PLR)	0.0949	
Proportion of Gains realized (PGR)	0.2443	
PLR-PGR	-0.1494	***
t-statistic	(-95.5615)	
Panel B: investor-level trades		
Mean of Realized Gains	29.8806	
Mean of Realized Losses	11.8077	
Mean of Opportunities to Realize Gains	122.2702	
Mean of Opportunities to Realize Losses	123.6255	
Mean of the Proportion of Losses Realized ($\overline{\text{PLR}}$)	0.1653	
Mean of the Proportion of Gains Realized ($\overline{\text{PGR}}$)	0.4902	
$\overline{\text{PLR}} - \overline{\text{PGR}}$	-0.3249	***
t-statistic	(-343.0083)	

Table 5: Determinants of the propensity to additionally purchase versus to sell current holdings

This table shows the estimation of probit models for the propensity to trade (additional purchase or sell) a stock current owned versus the opportunities to do so (stocks currently owned that could have been traded but were not). The sample period is from 1-8-2003 to 31-07-2007. The dependent variables are dummies representing the binary outcome: 1 for additional purchase (and for sell) and 0 for current holding that could have been traded (either additionally purchase or sold) that day but were not. All the independent variables are defined in Appendix A. Robust z-stats are shown in parenthesis. *, **, and *** stand for statistical significance at 10%, 5%, and 1%, respectively.

	Disposition Effect			**Additional Purchase**		
	(1)	(2)	(3)	(4)	(5)	(6)
Winner/Loser Dummy	0.130***	0.212***	0.182***	-0.010**	-0.064***	-0.026**
	(11.63)	(5.14)	(10.64)	(-2.50)	(-4.80)	(-2.48)
Log of Investor Total Trades		-0.020***			-0.013***	
		(-5.26)			(-7.38)	
Winner*Log of Inv. Total Trades		-0.012*			0.009***	
		(-1.71)			(3.61)	
Diversification Index			-0.198***			-0.132***
			(-10.71)			(-9.89)
Winner*Diversification Index			-0.073**			0.024
			(-2.34)			(1.48)
Year dummy	yes	yes	yes	yes	yes	yes
Standard error clustered by investor	yes	yes	yes	yes	yes	yes
Observations	343,183	343,183	343,183	343,183	343,183	343,183
Pseudo R-squared	0.0552	0.0727	0.0964	0.00358	0.00927	0.0300
Actual Prob.	0.122	0.122	0.122	0.0652	0.0652	0.0652

Table 6: Determinants of the propensity to additionally purchase (versus potential additional purchases)

This table shows the estimation of probit models for the propensity to additionally versus potential additional purchases. The values in the table are marginal effects. The sample period is from 1-8-2003 to 31-07-2007. The dependent variable is a dummy representing the binary outcome: 1 for additional purchase and 0 for potential additional purchase. All the independent variables are defined in Appendix A. The variables generated by interaction with "Positive" and "Negative" dummies are reported in absolute values. Robust z-stats are shown in parenthesis. *, **, and *** stand for statistical significance at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)
Panel A: Prior experienced prices anchors					
Winner/Loser Dummy (1=Winner)	-0.016**				
	(-2.30)				
Log of Gain/Loss*Positive		-0.006***	-0.006***	-0.006***	-0.010***
		(-4.70)	(-4.76)	(-4.76)	(-5.58)
Log of Gain/Loss*Negative		0.002	0.001	0.001	-0.002
		(1.51)	(1.03)	(1.03)	(-1.14)
Panel B: Stock characteristics					
Log of Daily Stock Volume, in Euros		0.014***	0.014***	0.014***	0.019***
		(7.27)	(7.29)	(7.29)	(8.65)
PSI20 Index Dummy		-0.019	-0.019	-0.019	-0.030*
		(-1.24)	(-1.29)	(-1.29)	(-1.87)
PT Dummy		0.052***	0.052***	0.052***	0.043**
		(3.29)	(3.36)	(3.36)	(2.31)
Euro Currency Dummy		0.012	0.013	0.013	0.004
		(0.87)	(0.95)	(0.95)	(0.12)
Panel C: Market adjusted return of the stock in the given interval of trading days before being additionally purchased					
Stock MAR days[-5;-1]*Positive			0.002	0.002	0.003
			(0.94)	(0.94)	(1.45)
Stock MAR days[-60;-6]*Positive			0.001	0.001	0.001
			(0.95)	(0.95)	(0.63)
Stock MAR days[-240;-61]*Positive			0.004	0.004	0.004
			(1.18)	(1.18)	(0.98)
Stock MAR days[-5;-1]*Negative			0.405***	0.405***	0.440***
			(6.92)	(6.92)	(6.37)
Stock MAR days[-60;-6]*Negative			-0.030*	-0.030*	-0.043*
			(-1.74)	(-1.74)	(-1.78)
Stock MAR days[-240;-61]*Negative			-0.030	-0.030	-0.053**
			(-1.55)	(-1.55)	(-2.19)
Panel D: Investor account characteristics					
Diversification Index				-3.122***	
				(-7.35)	
Mean of Inv. Daily MAR*Positive				-0.051**	
				(-2.14)	
Mean of Inv. Daily MAR*Negative				0.401***	
				(6.95)	
Log of the Mean of Stock Account				0.014	
				(0.45)	
Account's Age				0.189***	
				(5.69)	
Panel E: Investor demographic characteristics					
Gender (1=Male)					-0.045
					(-0.09)
Log of Age					0.058
					(0.34)
Married Dummy					0.083
					(0.26)
Occupation:					
- Manager					-0.143
					(-0.68)
- Self-employed					-0.137
					(-1.18)
- Other					-0.446
					(-0.66)
Year dummy	yes	yes	yes	yes	yes
Investor dummy	yes	yes	yes	yes	yes
Considering clustering by stock	yes	yes	yes	yes	yes
Observations	181,295	160,746	160,746	160,746	77,757
Pseudo R-squared	0.0904	0.108	0.112	0.112	0.113
Actual Prob.	0.122	0.136	0.136	0.136	0.155

Table 7: Determinants of the propensity to additionally purchase (versus new purchases)

This table shows the estimation of probit models for the propensity to additionally purchase versus new purchase. The values in the table are marginal effects. The sample is for the period from 1-8-2003 to 31-07-2007. The dependent variable is a dummy representing the binary outcome: 1 for additional purchase and 0 for new purchase. All the independent variables are defined in Appendix A. The variables generated by interaction with "Positive" and "Negative" dummies are reported in absolute values. Robust z-stats are shown in parenthesis. *, **, and *** stand for statistical significance at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)
Panel A: Stock characteristics			
Log of Daily Stock Volume, in Euros	-0.011***	-0.011***	-0.011***
	(-4.28)	(-3.98)	(-3.98)
PSI20 Index Dummy	-0.007	0.002	0.002
	(-0.24)	(0.08)	(0.08)
PT Dummy	0.024	0.043	0.043
	(0.73)	(1.27)	(1.27)
Euro Currency Dummy	0.021	0.023	0.023
	(0.85)	(0.95)	(0.95)
Panel B: Market adjusted return of the stock in the given interval of trading days before being additionally purchased			
Stock MAR days[-5;-1]*Positive		-0.135**	-0.135**
		(-2.14)	(-2.14)
Stock MAR days[-60;-6]*Positive		0.001	0.001
		(0.05)	(0.05)
Stock MAR days[-240;-61]*Positive		-0.013	-0.013
		(-0.82)	(-0.82)
Stock MAR days[-5;-1]*Negative		0.532***	0.532***
		(6.12)	(6.12)
Stock MAR days[-60;-6]*Negative		0.193***	0.193***
		(4.15)	(4.15)
Stock MAR days[-240;-61]*Negative		0.101***	0.101***
		(3.81)	(3.81)
Panel C: Investor account characteristics			
Diversification Index			-4.115***
			(-15.73)
Mean of Inv. Daily MAR*Positive			0.011
			(0.89)
Mean of Inv. Daily MAR*Negative			0.429***
			(7.30)
Log of the Mean of Stock Account Value			-0.002
			(-0.16)
Account's Age			0.005
			(0.31)
Year dummy	yes	yes	yes
Investor dummy	yes	yes	yes
Considering clustering by stock	yes	yes	yes
Observations	53,802	53,802	53,802
Pseudo R-squared	0.163	0.166	0.166
Actual Prob.	0.416	0.416	0.416

Table 8: Differences in the Market Adjusted Return (MAR) of additionally purchased stocks versus new purchases and of stocks sold versus potential sells

This Table reports the difference in means of Market-Adjusted Returns over four time horizons after the (additional) purchase. In panel A, we compare additional purchases against new purchases. In panel B, we compare actual sells with potential ones. The sample period is from 1-8-2003 to 31-07-2007. We consider only investors that trade at least twice in the data period. *, ** and *** stand for statistical significance at 10%, 5%, and 1%, respectively.

	Interval of trading days after the trade			
Difference in means t-test:	**[+1;+5]**	**[+1;+20]**	**[+1;+60]**	**[+1;+240]**
Panel A: Additionally purchased stocks vs. new purchases				
Mean of the MAR of stocks additionally purchased - Mean of the MAR of new purchases	-0.005***	-0.010***	-0.007***	-0.072***
t-statistic	(-8.31)	(-10.37)	(-4.24)	(-13.22)
Panel B: Stocks sold vs. potential sells				
Mean of the MAR of stocks sold - Mean of the MAR of potential sells	0.001***	0.005***	0.011***	0.061***
t-statistic	(2.79)	(8.94)	(10.43)	(14.94)