Financial Loss Aversion Illusion*

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Abstract

We test the proposition that investors' ability to cope with financial losses is much better than they expect. In a panel survey with real investors from a large UK bank, we ask for subjective ratings of anticipated returns and experienced returns. The time period covered by the panel (2008-2010), with frequent losses and gains in the portfolios of investors, provides the required background to analyze the involved hedonic experiences. We examine how the subjective ratings behave relative to expected portfolio returns and experienced portfolio returns. Loss aversion is strong for anticipated outcomes with investors reacting over twice as sensitive to negative expected returns as to positive expected returns. However, when evaluating experienced returns, the effect diminishes by more than half and is well below commonly found loss aversion coefficients. It seems that a large part of investors' financial loss aversion results from a projection bias.

JEL-Classification Codes: D03, D14, D81, G02, G11

Keywords: Loss Aversion, Individual Investors, Expectations, Affective Forecasting, Projection Bias.

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1 Introduction

Loss aversion has been frequently documented in psychology and economics, with the conclusion that losses loom larger than gains and that "fair" lotteries (from an expected value perspective) are generally not accepted when they involve potential losses. The magnitude of this effect has been experimentally identified with loss aversion coefficients close to or even above two. In finance, loss aversion has been suggested to explain, for instance, the equity premium puzzle and low stock market participation.

In the evaluation of gains and losses, one has to distinguish between anticipated and experienced outcomes. Most experiments on gambles or lotteries focus on the trade-off between anticipated gains and losses. However, this implies that people are able to perfectly forecast the hedonic impact of gains and losses. In contrast, recent evidence suggests that people's ability to cope with losses is much better than they predict (Kermer, Driver-Linn, Wilson, and Gilbert, 2006). When actually experienced, losses seem not to hurt as much as people expected.

Using a unique dataset, we test this proposition in the financial domain. In a panel survey with real investors from a large UK bank, we ask for subjective ratings of anticipated returns and experienced returns. Within the time period covered by the panel (2008-2010), we observe frequent losses and gains in the stock market and in investors' portfolios. This provides the required background to analyze the involved hedonic experiences. We examine how the subjective ratings of outcomes behave relative to expected portfolio returns and experienced portfolio returns. To this end, we define several potential reference points investors might use.

Loss aversion is strong for anticipated outcomes. From regressions of subjective ratings on expected returns, we infer a loss aversion coefficient of about 2.2 for a reference point of zero. This means that investors react more than twice as sensitive to negative expected returns as to positive expected returns. While for different reference points and model specifications loss aversion coefficients vary slightly, they are almost always close to two and statistically significant.

However, when evaluating experienced returns, the loss aversion coefficient decreases to about 1.2 and is statistically indistinguishable from one (loss neutrality). There is no reference point or model for which we find loss aversion for experienced outcomes. Investors do not react more sensitive to losses than to gains when they are confronted with realized portfolio performance.

The loss aversion they show ex ante seems to be partly or fully a projection bias. The result is independent of whether we use percentage return or monetary profits as the outcome variable.

As a second property of reference-based utility, we also test for diminishing sensitivity with respect to outcomes more distant from the reference point. We indeed find that investors' reaction is strongest for returns close to the reference point. An improvement from 2% to 4% in portfolio return has a greater impact on subjective ratings than moving from 12% to 14%. This is true both for expected as well as for experienced outcomes. But while for expected returns the sensitivities in each interval are far greater for losses than for gains, this is not the case for experiences.

Our findings have far-reaching implications for individual investing. While loss aversion itself is not necessarily a judgment bias, but can be a legitimate part of people's preferences, the financial loss aversion illusion we document clearly is. If investors systematically overestimate their personal loss aversion when thinking about financial outcomes, their investment decisions will differ from what is justified by their experience of these outcomes. In particular, they will invest less riskily than they probably should and will avoid potential losses unless they receive a substantial compensation.

To provide some evidence of the consequences of loss aversion for investment behavior, we analyze the portfolio risk investors take. We split the sample by portfolio volatility and indeed find that higher loss aversion in expectation is associated with far less risky portfolios. This suggests that the loss aversion coefficients we measure are meaningful for participants' investing behavior. We assume that with greater awareness of their gain and loss experiences, investors would be prepared to take on higher portfolio volatility. A more definite result is precluded by the aggregate nature of the loss aversion estimates.

We further investigate the nature of financial loss aversion illusion by considering the effects of learning and sophistication. We find that anticipated loss aversion is reduced after previous losses. Investors seem to learn from the immediate experience of a loss to better predict their response to anticipated outcomes. Financial literacy and investment experience are among individual factors that mitigate financial loss aversion illusion.

Our work is mainly related to two strands of the literature. We contribute to research in decision theory and psychology on estimating loss aversion (Tversky and Kahneman, 1992; Abdellaoui, Bleichrodt, and Paraschiv, 2007), and apply it to the domain of individual investing. In particular, we test the prediction of differences in anticipated and experienced loss aversion (Kermer, Driver-

Linn, Wilson, and Gilbert, 2006), which belongs to the class of projection biases (Loewenstein, O'Donoghue, and Rabin, 2003). Secondly, we contribute to the literature on loss aversion in finance (Benartzi and Thaler, 1995; Haigh and List, 2005) by showing that the high loss aversion potentially responsible for the high equity premium and low stock market participation results from a misprediction of the actual experience of losses and gains.

2 Theory and Literature

When confronting a bet with equal chances for a gain and a loss, people typically require a gain that is much larger than the loss to accept the bet. Samuelson (1963) reports offering such a bet to colleagues, which was often declined even when the potential gain was $200 compared to a potential loss of $100. This cannot be explained by risk aversion alone, as for gambles completely in the gain domain, risk premia are generally much lower. Instead, it seems that losses loom larger than gains, in the example more than twice as large. At the same time, this means that outcomes are viewed from a reference point, which defines gains and losses relative to this reference. The idea of people adapting to a reference level can be found in psychology already around the time of Samuelson's observation (Helson, 1964).

The term "loss aversion" describes the greater sensitivity to losses as compared to gains; the expected negative feeling associated with a loss is larger than the expected positive feeling with a gain of equal size. Loss aversion is not necessarily a judgment error, it might as well reflect the true preferences of people, who strongly dislike losses. Alternatively, it is argued that loss aversion represents an emotional overreaction towards losses driven by fear (Camerer, 2005). Loss aversion is a prominent feature of prospect theory (Kahneman and Tversky, 1979), which formalizes several empirical observations in choice behavior. In prospect theory, the value function is steeper for losses than for gains, representing the greater sensitivity towards losses. The value function can be expressed in the following parametrized form (Tversky and Kahneman, 1992):

$$u(x) = \begin{cases} x^{\alpha} & \text{if } x \geq 0 \\ -\lambda(-x)^{\beta} & \text{if } x < 0 \end{cases} \tag{1}$$

In equation 1, λ represents the loss aversion coefficient. For any $\lambda > 1$ an individual is said to be loss averse. Közegi and Rabin (2006) propose a more general model of reference-dependent preferences, where overall utility is the sum of consumption utility and gain-loss utility. In their case, λ is the ratio of marginal gain-loss utility for losses and gains approaching the reference point from below and above. Again, loss aversion is present if $\lambda > 1$. A similar definition is given by Köbberling and Wakker (2005). Under the assumption of linear utility, it simplifies to the ratio of the slopes of gain-loss utility for losses and gains (cp. Közegi and Rabin, 2006):

$$u(x) = \begin{cases} \eta x & \text{if } x \geq 0 \\ \eta \lambda x & \text{if } x < 0 \end{cases} \tag{2}$$

Loss aversion coefficients have been empirically estimated mostly by using monetary lotteries. Tversky and Kahneman (1992) report a median coefficient of 2.25, while earlier Fishburn and Kochenberger (1979) find a median coefficient of 4.8. Abdellaoui, Bleichrodt, and Paraschiv (2007) calculate median coefficients between 1.53 and 2.52, depending on the estimation method. Abdellaoui, Bleichrodt, and L'Haridon (2008) report coefficients between 2.24 an 3.01 for different prospects. Booij and van de Kuilen (2009) observe loss aversion coefficients between 1.73 and 2.00 depending on the estimation method and whether the lotteries involve high or low stakes. Lower loss aversion coefficients are found in other experiments: 1.43 (Schmidt and Traub, 2002), 1.8 (Pennings and Smidts, 2003), 1.23 and 1.46 (Zeisberger, Vrecko, and Langer, 2012), and 1.58 (Booij, van Praag, and van de Kuilen, 2010). Many of these studies also examine individual loss aversion and conclude that a large majority of participants is loss averse.

For these measurements of loss aversion, people have to think about the future and have to anticipate how different outcomes would feel. Or more technically, they have to assign the anticipated utility to each outcome. Possibly, the experience with an actual outcome will differ from the expectations ex ante. These two different concepts have also been labeled "decision utility" and "experienced utility" (Kahneman, Wakker, and Sarin, 1997). Experimental evidence suggests that, while people predict a greater emotional impact of losses compared to gains, they do not feel an experienced loss more strongly than a gain (Kermer, Driver-Linn, Wilson, and Gilbert, 2006). Their ability to come to terms with losses seems to be better than they expected. Loss aversion would then be a projection bias, as people are inaccurate in assessing beforehand the personal hedonic consequences of a risky decision involving gains and losses. In particular, they might avoid potential losses to a greater degree than justified. Similar forecasting errors are quite common in evaluating future utility (Loewenstein, O'Donoghue, and Rabin, 2003).

We aim to test both predictions in a financial context, i.e. whether investors are loss averse with respect to their expected portfolio returns (hypothesis 1) and whether this loss aversion declines or even disappears when evaluating experienced portfolio returns (hypothesis 2). This is motivated by the importance of loss aversion in financial decisions. Most investments involve potential gains and losses and are thus a (more complex) form of the mixed gambles analyzed in decision theory.

There are some prominent applications of loss aversion in finance. Benartzi and Thaler (1995) introduce loss aversion as an explanation for the equity premium puzzle. Combined with frequent evaluation of portfolios (myopia), loss aversion renders stock investments unfavorable relative to riskless investments. Because of the frequent losses in the short term, investors demand a high premium to invest in stocks. Haigh and List (2005) experimentally confirm the presence of myopic loss aversion for professional traders. Under the additional assumption of narrow framing, high loss aversion can even prompt people to completely abstain from the stock market (Barberis, Huang, and Thaler, 2006). This addresses a second financial puzzle, which exists in the globally low participation in stock markets. Dimmock and Kouwenberg (2010) empirically find lower equity market participation for households with higher loss aversion. Their study based on a Dutch household survey is among the very few to use a direct measure of loss aversion.

The relevance of loss aversion extends to portfolio choice and diversification (Dimmock and Kouwenberg, 2010; Polkovnichenko, 2005). It may also have far-reaching consequences for retirement investing (Benartzi and Thaler, 1999). In a simulation study, Barberis and Huang (2001) find support for loss aversion over individual stocks, as compared to overall portfolios. In their framework, loss aversion is able to explain a variety of stock market phenomena such as excess volatility and the value premium. Investors typically hold on to their losing investments and sell their winning investments, which constitutes the disposition effect (Shefrin and Statman, 1985; Odean, 1998; Weber and Camerer, 1998). This behavior also implies an evaluation of each individual asset relative to a reference level, which is then supposed to alter the preferences of investors. In the loss domain, they act risk seekingly in an attempt to avoid the loss and to break even. In a different interpretation involving realization utility (Ingersoll and Jin, 2013), loss aversion is a reason to postpone realizing a loss.

3 Data

We conduct a panel survey with direct brokerage clients at Barclays Stockbrokers, one of the largest brokerage providers in the UK. Participants are self-directed retail investors holding mostly stocks and mutual funds in these portfolios. The survey was designed in collaboration with the Behavioural Finance team at Barclays and covers a time period from 2008 to 2010. During that time the survey took place quarterly, which results in a total of nine survey rounds. With the volatile stock markets over that period resulting in frequent losses and gains, the panel provides a unique opportunity to analyze loss aversion from investors' perspective.

In a first step, a sample of clients was selected based on a stratified sampling procedure, which undersampled clients with little trading activity and low portfolio value and excluded clients with $<$1 trade per year or a portfolio value of $<$£1000. Apart from these modifications the selection was random and the final sample of 19,251 investors is largely representative of the Barclays Stockbrokers client base. These investors were invited via e-mail to participate in the online questionnaire. 617 investors participate in the panel for at least one round and we have a total of 2,135 investor-round observations, which means that respondents on average participated about 3.5 times. For each of the nine rounds we have a minimum of 130 observations.

This corresponds to a response rate of 3%, which is not much lower than in similar surveys (cp. Dorn and Huberman, 2005; Glaser and Weber, 2007). The demographics of investors are shown in Panel A of Table 1. The participants are predominantly male, older, and more affluent than the overall UK population. In this respect, they closely resemble the investor population in other studies on online brokerage clients. The financial literacy among participants is also reasonably high (on average 3.5 correct responses out of 4 questions taken from van Rooij, Lusardi, and Alessie, 2011), which suggests that potential biases we find are not just a result of an insufficient understanding of financial market.

The two main survey questions we focus on in this survey are subjective ratings of expected returns and experienced returns:

1. *How would you rate the returns you expect from your portfolio held with us in the next three months?*
   Seven-point scale from "extremely bad" to "extremely good".

2. *How would you rate the returns of your portfolio (all investments held with us) over the past three months?*
   Seven-point scale from "extremely bad" to "extremely good".

The first questions asks investors to provide a rating of their expected portfolio returns over the next three months. This corresponds to the time interval between two survey rounds. Weber, Weber, and Nosić (2012) interpret the responses as subjective return expectations. We emphasize the subjective component and treat them as individual evaluations of how good expected returns will feel. It is common in psychology to assess the hedonic meaning of an item on a simple good-bad scale (Kahnemann, Diener, and Schwarz, 1999). In economic terms, the ratings express at least to some degree the anticipated utility with a return in asking how "good" a certain outcome is expected to be. This link between subjective evaluations and utility is advocated by economic happiness research (Frey and Stutzer, 2003).

The second question is the mirror image of question one, now for past portfolio returns. As McGraw, Larsen, Kahneman, and Schkade (2010) point out, a common scale is important when comparing different evaluations of gains and losses. This is why we use the exact same format for both questions. The good-bad ratings provide a subjective evaluation of experienced outcomes over the previous quarter. Merkle, Egan, and Davies (2013) use these evaluations as experienced happiness ratings. We are somewhat more conservative in assuming that they provide some information of hedonic quality or felt utility of experienced returns. In equations 1 and 2 the ratings represent the $u(x)$, the subjective evaluation of the portfolio return x.

Panel B of Table 1 shows descriptive statistics for responses to these questions. The average expected portfolio return rating is 4.2 and slightly above the middle-point of the scale, while the average experienced return rating is 3.6. The poor performance of the stock market during our survey period certainly contributed to the low experience ratings. Quite reasonably, experienced return ratings are more dispersed than the expected return ratings as one can see from standard deviations and the percentiles. When thinking ahead it would be bold to expect extremely positive or extremely negative outcomes, while ex post (in particular between 2008 and 2010) participants often experience such extreme outcomes.

It is central to our approach to link the subjective ratings to numerical portfolio return data. For the anticipated ratings, we use the numerical expected portfolio returns, and for the experienced ratings the numerical perceived past portfolio returns, which correspond to the x in the equations.

We also calculate actual past portfolio returns directly from investors portfolios, but—as Merkle, Egan, and Davies (2013) show—perceived values have a higher relevance for participants. Expected portfolio return and past portfolio return are elicited in the following way:

3. *We would like you to make three estimates of the return of your portfolio held with us by the end of the next three month. Your best estimate should be your best guess. Your high estimate should very rarely be lower than the actual outcome of your portfolio (about once in 20 occasions). Your low estimate should very rarely be higher than the actual outcome of your portfolio (about once in 20 occasions).*
   Please enter your response as a percent change, i.e. a rise as X%, or a fall as -X%.
4. *What do you think your return (percentage change) with us over past three months was? Please enter your response as a percent change, i.e. a rise as X%, or a fall as -X%.*

From question 3 we use the best estimate as our value for expected portfolio return. As Table 1 shows, quarterly portfolio return expectations are quite high, the median estimate is 5%. They vary widely, including also negative return expectations (n=173). One might question, whether it is rational to expect negative returns for a stock portfolio. On the other hand, the frequently observed negative realized returns over that period make it hard to argue that investors should not be allowed to hold negative return expectations. As the table reveals, realized portfolio returns are on average indeed negative for survey participants (−1.9% perceived and −5.1% actual).[1] While participants clearly overestimate their past returns, the correlation between perceived and actual returns is nevertheless high (0.62).

For a reference-dependent model it is important to define an appropriate reference point. The most obvious reference point is 0, which means that negative portfolio returns imply a loss and positive returns a gain. Other possible reference points include the risk-free interest rate, inflation, or stock market returns. A loss would then be defined as underperformance of the own portfolio over the last quarter compared to one of these benchmarks. In contrast to the fixed reference point at 0, the other reference points are time-varying, with the degree of variation of course largest for stock market returns.

Table 1 shows descriptive statistics for these benchmarks on a quarterly basis again conditional on survey participation. Inflation as reported by the UK Office for National Statistics was 0.8% on average, which corresponds to an average annual inflation of 3.2% (the UK has a relatively high

[1] One reason for this result is that we report portfolio returns conditional on survey participation, which is highest for the early rounds of the survey during the immediate financial crisis. Unconditionally, over the whole period of the panel, quarterly portfolio returns are only slightly negative (−0.3%).

inflation rate compared to other European countries). Short-term interest rates represented by the three month LIBOR were on average 0.6% on a quarterly basis. Stock market returns were −2.6%, which is in line with investors' negative realized portfolio returns. Again, we also consider perceived stock market returns, elicited in analogy to question 4. Perceived market returns were on average −0.8%.

In particular for anticipated loss aversion, expectations are an important reference level. Market return expectations are a natural reference to compare portfolio return expectations with. They are elicited in the same way as portfolio return expectations (see question 3). Market return expectations are considerably lower than portfolio return expectations, which means that investors on average expect to outperform the market. With the expected market return as a reference point, this outperformance would be considered an anticipated gain and an underperformance an anticipated loss.

A third class of reference points relies on investors' individual benchmarks. We ask in each round of the survey, what benchmark investors currently use, represented as a combination of interest rates and stock market returns (question see appendix). In the entry questionnaire of the survey, we offer a broader menu of potential benchmarks, but we find that other benchmarks such as foreign or global stock market indices or British government bonds are rarely used as a benchmark. We therefore mainly use the personally chosen combination of UK interest rates and UK stock market returns. Again, two separate benchmarks can be constructed, one backward-looking based on realized stock market returns and interest rates of the last quarter, and the other forward-looking based on expected market returns and interest rates for the next quarter. While the averages for these benchmarks of course lie between stock market returns and interest rate, they capture more closely the individually used reference point.

4 Results

4.1 Anticipated loss aversion

Higher returns feel better subjectively, they provide higher utility to investors. It is therefore not surprising that the relationship between expected portfolio returns and the subjective ratings of these returns is positive (correlation 0.40). Figure 1 displays the average subjective rating for each value of expected returns. The dots in the graph mostly represent multiple observations, as specific values of expected portfolio returns occur many times in the panel. To represent the subjective ratings by their averages allows for an easier interpretation.

Negative expected returns are mostly rated below 4, which is the middle point of the rating scale, while positive returns are mostly rated above 4. The point where expected returns cross the neutral rating appears to be somewhere between 0% and 5%. With respect to the functional form it is difficult to derive definite conclusions from the figure alone, but it seems that the slope is steeper for the lower range of expected returns and flatter for the higher range of returns. This is consistent with loss aversion. With a keen eye, one might even identify the tendency of a concave relationship for positive expected returns and a convex relationship for losses.

To substantiate these first impressions, we begin with a piecewise linear regression of expected return ratings on numerical return expectations. This corresponds to equation 2 in which the loss aversion coefficient λ represents the ratio between the slopes below and above the reference point. We only estimate loss aversion on aggregated level, as for individual loss aversion the number of observations is to small with a maximum of nine rounds per participant. We initially use 0 as a reference point, but will also report results for other potential reference points.

In the first column of table 2, we estimate a simple pooled OLS model with robust standard errors for the anticipated subjective ratings of returns with expected portfolio returns a sole explanatory variable. The coefficient is positive and strongly significant. To separate the effect for the gain and loss domain of the relationship, we construct two dummy variables for expected gains and losses. By interacting these dummies with expected portfolio returns, we estimate two independent coefficients conditional on whether a loss or gain is expected. For the same regression as before, the coefficient is 7.5 for losses and 3.5 for gains (see column 2). The slope for losses is much steeper than for gains indicating strong loss aversion.

The loss aversion coefficient λ can be calculated by dividing the coefficient for losses by the coefficient for gains ($\lambda = \frac{\eta\lambda}{\eta}$, see equation 2). As a result we get a λ of 2.1, which is in the upper range of the values typically found in experiments based on lotteries. In experiments, the decisions are either hypothetically or the participants receive some money upfront to wager. They normally cannot loose their own money, which might attenuate loss aversion. As a caveat, in our setting only the most pessimistic investors hold negative return expectations. When those investors are also most loss averse, this might inflate our estimate.

To make use of the panel structure of our data, we estimate panel regressions in the remaining columns of table 2. The results remain unchanged in a GLS regression with random effects and standard errors clustered by participants (column 3), and they are robust to the inclusion of survey round fixed effects (column 4). Finally, we run a fixed effects regression to control for all time-invariant individual effects (columns 5-7). While the size of coefficients changes, their ratio expressed in loss aversion λ is unaffected. We also control for investors' risk tolerance, their subjective portfolio risk perception, portfolio volatility, portfolio value, and turnover of investors, as these might influence subjective ratings of returns. We find that only risk tolerance and risk perception have an effect on subjective ratings, which is positive for risk tolerance meaning that risk tolerant investors rate a given return better, and negative for risk perception meaning that higher portfolio risk results in a more negative rating for a given return.

Loss aversion coefficients are significantly larger than one in all regressions with $p<0.01$ (Wald-test). The economic magnitude of the effect is such that for an additional 5% in expected portfolio return in the gain domain the subjective rating rises by about 0.15. But in the loss domain the identical 5% result in a change of 0.3. This illustrates the greater sensitivity of investors towards losses.

We now turn to other potential reference points for which we repeat the same regression specifications. Table 3 only reports the loss aversion coefficients resulting from these regressions. A first alternative is that investors evaluate expected portfolio returns relative to the risk-free interest rate that can be earned over the same horizon. The current interest rate for a three-month horizon thus is the reference point for the first set of loss aversion coefficients. The results are very close to those for a reference point at 0, as quarterly interest rates are mostly below 1%. The same holds for inflation as a reference point, for which we use the three-month ahead inflation as a proxy for inflation expectations (results for current inflation are very similar).

For market expectations as a reference point, the results change to some extent. As market expectations are on average about 3%, the reference point is shifted to the right. As a consequence, a greater fraction of expected portfolio returns are in the loss region (24%). But secondly, the reference point is now also personalized, as the market return expectation of each participant is used. This is the reason, why the fixed effects regressions now make a difference. We find significant loss aversion coefficients around 1.8 in these specifications, while the results for the other models are between 1.3 and 1.4 and insignificant. For the final reference point, we not only take into account the individual market return expectations, but also which benchmark investors report to use. For these individual benchmarks we again find significant loss aversion for all regression models.

It must remain open, which benchmark is the "true" reference point. Most likely, some investors will use 0, others their market expectations, and still others the benchmark they report in the survey question. Given the results in Table 3 it is save to conclude, however, that loss aversion is present in the return expectations of investors supporting our first hypothesis. Its magnitude varies for different reference points and model specifications, but is almost always around 2. It should be noted that a possible misspecification of the reference point tends to result in an underestimation of loss aversion.

4.2 Experienced loss aversion

Anticipated loss aversion has been the primary concern of previous research, as it is relevant for evaluating possible courses of actions such as choosing a lottery or making an investment. The question is whether loss aversion is also reflected in the experience of outcomes. According to our estimates, losses are expected to be twice as painful as gains of equal size are pleasurable. The survey question for a subjective rating of past portfolio returns corresponds to this hedonic evaluation (the u(x)). Past returns in numerical terms are the associated outcomes (the x).

The correlation between perceived past portfolio returns and the rating of these returns is 0.67, which is higher than it was for the respective expectations. The linkage between the levels of returns and their subjective evaluation is very close. Figure 2 shows this almost monotonous relationship, which appears to be more linear than in the case for expectations. There is no kink easily identifiable in the graph. The correlation of the subjective ratings with actual past returns calculated from investors' portfolios is somewhat lower (0.53), which confirms that for the experience of investors, their own estimate of returns is more important than the realized value.

It is important that we run the same regressions as before to exclude the possibility that some changes in the regression specification are responsible for changes in the result. The parallel approach also satisfies the conditions of McGraw, Larsen, Kahneman, and Schkade (2010). Therefore, we start again with a pooled OLS model and a reference point of 0 represented in columns 1 and 2 of Table 4. Perceived past portfolio returns have a positive impact on subjective ratings with a coefficient of about 6. In economic terms, 5%-points in return change the rating by 0.3. The effect is only slightly larger in the loss domain than in the gain domain.

In a panel model with random effects (columns 3-4), this result remains unchanged. The coefficients slightly drop when time-fixed effects are included, as they control for the overall stock market performance over time. While expectations may remain relatively stable over different market environments, in retrospect the survey round effect is more important as it strongly influences individual portfolio returns and return ratings. However, the loss aversion coefficient is unaffected by this. For the individual-fixed effects regressions (columns 5-7), we find loss aversion even closer to one depending on the controls.

We again perform a Wald-test whether loss aversion is present in the sample, i.e., whether the loss aversion coefficient λ is significantly different from one. Only for one out of six cases we find significance at 5%-level, for two cases significance at 10%-level. Even if some tendency towards loss aversion remains, it is much reduced to about 1.2, while the corresponding regressions for expectations yielded loss aversion coefficients around 2.

It is possible that investors use a different reference point when analyzing realized returns. Merkle, Egan, and Davies (2013) show that relative returns are important for investor happiness in the sense that they compare themselves to the market return. Table 5 shows the estimated loss aversion coefficients for alternative reference points. Interest rate or inflation make no difference as a reference point, as they are close to each other and close to 0 over a three-month horizon. More interesting are the results for past perceived market return and the individual benchmarks, as the coefficients are even smaller than those estimated before. They are all in direct vicinity of one.

For experienced returns we consider an additional reference point based on investors' previous expectations. Falling short their own portfolio return expectations might be disappointing for investors, which is why they might define gains and losses relative to their expectations. Loss aversion coefficients for this reference point are also close to one. For all results in Table 5, the hypothesis that $lambda = 1$ can only rarely be rejected.

We conclude that loss aversion in return expectations has no equivalent in return experiences, which confirms our second hypothesis. Survey participants seem to be subject to a projection bias.

They believe that negative returns will be very painful, but once they are confronted with actual outcomes, they are not more sensitive towards losses than towards gains. Investors are able to cope with their losses much better than they expected.

4.3 Diminishing sensitivity

A property of the Prospect theory value function and of other reference-based utility functions is diminishing sensitivity. This means that the impact of a change in an outcome decreases with its distance from the reference point (Tversky and Kahneman, 1992). The condition is met, if the utility function is concave in the domain of gains and convex in the domain of losses. In equation 1, α and β are assumed to be less than one. Empirical estimates for these parameters often vary between 0.5 and 1 (Abdellaoui, Bleichrodt, and Paraschiv, 2007; Tversky and Kahneman, 1992).

We would like to directly estimate the parameters of equation 1. However, our dependent and independent variable are measured on completely different scales. This would make it necessary to make some arbitrary adjustments to one side of the equation. Instead, we continue the piecewise linear approach and split the loss and gain domain further up into a region close to the reference point and another region more distant to the reference point. To provide for a relatively even split of observations, we define returns of up to 5%-points around the reference point as close. Our results are robust to other choices.

Table 6 shows results for this piecewise linear approach both for expected portfolio returns and experienced portfolio returns. We only estimate the individual-fixed effects models, the results hold for the other specifications as well. For expected return, sensitivity is largest for small losses with a coefficient of about 20. A change in expected portfolio return of 1%-point here has an effect of 0.2 on the rating of that return. Moving from -5% to 0 thus improves the rating by a whole point. For larger losses the effect is far less strong with a coefficient around 5. A portfolio return of -10% instead of -15% improves the rating only by 0.25.

The diminishing sensitivity in the loss domain is mirrored in the gain domain, with a larger coefficient for small gains than for large gains. However, the coefficients are smaller than their counterparts in the loss domain, once more a sign for loss aversion. This allows for an alternative measurement of loss aversion. While we before took the ratio of the average slopes for gains and losses, another definition proposes loss aversion should be the ratio between the left and right derivative of the utility function at the reference point (Köbberling and Wakker, 2005). Empirically, the decreasing number of observations prohibits indefinitely small intervals around the reference point, but we take the 5%-interval as an approximation. Calculating loss aversion by the ratio of the coefficients for small gains and losses results in a value for λ between 2.8 and 3.7. This is considerably larger than for the full range of outcomes. At the same time, the estimates have larger variability due to the lower number of observations. For this reason we do not attempt to decrease intervals further.

For experienced returns we again find loss aversion close to one and statistically mostly insignificant. In particular for column 6, the coefficients for gains and losses are almost identical. This confirms that loss aversion illusion, the contrast between loss aversion in expectations and in experiences, is also present for this alternative measurement. Additionally, this provides some evidence that not extreme observations for expected return or experienced return drive the result, but that the effect is present also for the range of returns commonly observed over quarterly horizons.

Diminishing sensitivity is also present for the other reference points. However, the alternative loss aversion measurement does not always produce significant loss aversion in expectations. The reason is that a shift in the reference point has a particularly strong effect on the narrow intervals around it. Taking market expectations as a reference point means to shift the reference level upwards by on average 3.1%. As a consequence small gains (0-5%) are often redefined as small losses, a transformation loss aversion does not survive. One may interpret this as an indication that 0 is the more genuine reference point, as results line up perfectly with the theory. We do not find loss aversion for experienced returns for any of the reference points.

4.4 Monetary outcomes

As our independent variable, we chose the portfolio returns of investors. Returns are a relative performance measure as they reflect the change in portfolio value corrected for inflows and outflows. In contrast, the lotteries typically used to analyze loss aversion involve monetary outcomes. Based on their portfolio values, we can also calculate the amount of money investors earn or expect to earn. Of course, the caveat to this approach is that the portfolio size of investors differs widely. A gain of £1,000 may be good if the portfolio is worth £20,000, but rather meager if the portfolio is worth £200,000. To partly address this, we drop extremely large portfolios with a value of more than 1 million pounds from the sample.

The median expected portfolio profit is £1,539 per quarter of the survey (mean £4,920), its correlation with portfolio return expectations is 0.53. The median perceived realized profit is £0 (mean £$-1,255$) with a correlation to perceived portfolio past return of 0.56. Naturally, absolute returns in monetary terms and relative returns are closely related, but due to the different portfolio sizes the relationship is not perfect. We again define two separate variables for monetary losses and monetary gains.

We run the same panel fixed-effects regressions as before, now with monetary profits (in £1,000) as the independent variable. The unconditional coefficient for expected portfolio profits on subjective ratings is 0.02, which means that an additional £5,000 move ratings by about 0.1. Table 7 shows in columns 1-3 the conditional results for losses and gains. The effect for losses is more than twice as large. Loss aversion coefficients are around 2.7 and strongly significant.

The effect sizes for (perceived) experienced profits are similar (columns 4-6). However, loss aversion is not present in the evaluation of past returns, the effect even turns around in the final two regressions. A reason could be that large monetary losses are shouldered by investors with large portfolios, who are able to cope with these losses well. Therefore in the loss domain, the slope would be flatter than in the case for relative returns. This requires, however, that a similar argument is not valid for the gain domain.

A general observation from Table 7 is that, while t-values and effect sizes are still high and statistical significance is strong, they weaken compared to the return regressions. The R^2 is also considerably lower, and the economic significance of the results is smaller. Investors seem to orient themselves primarily at their returns, while the absolute size of profits mostly adds noise to the equation. The monetary outcomes have a very different impact on unequally wealthy investors, while a 10% return might be interpreted fairly similar. Therefore, we rest our main analysis on portfolio returns with the results on monetary outcomes providing additional robustness.

4.5 Loss aversion and risk taking

A framework which is designed to examine the aggregated loss aversion in a panel is not best suited to analyze its role in individual investor behavior. Nevertheless we aim to provide some evidence whether loss aversion in expectation has any consequences for investing. The two main claims associated with loss aversion are that participants do not participate in the stock market at all due to loss aversion, or that they underinvest in stocks despite the high equity premium. In both cases, investors shy away from risky investments beyond what reasonable risk preferences would suggest (cp. Benartzi and Thaler, 1995).

The portfolio holdings of the investors in our sample are primarily in equity, almost all of them hold stocks or stock funds. We thus cannot address stock market participation, as we only deal with participants (unlike, e.g., Dimmock and Kouwenberg, 2010). Due to their unknown overall wealth composition, it is also difficult to determine, whether they are underinvested in stocks. However, the riskiness of their portfolios gives an indication of their risk taking behavior. We expect the more loss averse investors to take on less portfolio risk. Importantly, for this decision expected loss aversion should play a role as this is the perspective investors take in before allocating their money.

As measures for portfolio risk, we calculate the one-year volatility of investors portfolios and the average volatility of portfolio components (ACV, cp. Dorn and Huberman, 2010). We then split the sample into less risky and risky portfolios, in case of portfolio volatility the cut-off is at 30% and for ACV at 50% to generate approximately equal samples. The high values are due to elevated levels of volatility during the survey period (other cut-offs produce similar results). We then repeat the panel fixed-effects regression for the influence of expected gains or losses on subjective return ratings for the less risky and riskier sample.

Table 8 shows the results of these regressions. Columns 1 and 2 present the split by portfolio volatility and reveal that there is strong loss aversion among investors with less risky portfolios. The coefficient for losses is with 7.2 far larger than for the group of investors with riskier portfolios (4.5); the difference is significant at p=0.04 (Wald-test). At the same time, the sensitivity towards gains is similar in both samples. This results in a loss aversion coefficient of about 3.0 for the less risky investors and of 1.8 for the risky investors. The magnitude of this difference is large, suggesting that the higher loss aversion might play a part in risk taking behavior. The difference between the loss aversion coefficients is not statistically significant (p=0.14), as four estimated coefficients with their respective standard errors enter the equation.

For average component volatility, the results are similar (see columns 3 and 4). In this case, both the sensitivity towards gains and losses is higher for the group with less risky portfolios, but significantly so only for losses (p<0.01). Again, this produces a large difference in loss aversion coefficients. We run a similar regression for portfolio beta as portfolio risk measure (not reported). Separated by beta, we do not find any differences between those with risky and less risky portfolios. However, Merkle and Weber (2011) suggest that findings for portfolio beta are generally weak, as individual investors do not orient themselves at beta.

Next, we test whether there is any discrepancy between the split samples in how they experience gains and losses. Less risky portfolios could be justified, if one group experienced losses more painful than the other. But for average component volatility, experienced loss aversion coefficients are about the same, while for portfolio volatility they are even reversed, with a larger coefficient for risky portfolios. There is thus no evidence that based on their subjective experience of losses, investors should have chosen the portfolios they did. But high anticipated loss aversion potentially provoked their less risky portfolio choice.[2]

4.6 Learning and sophistication

When observing a bias, a natural question is whether it can be avoided by sophistication or learning. We can reject the idea of fast and simple learning in the sense that in later rounds of the survey the loss aversion illusion would be lower than in earlier rounds. This result is intuitive as, if significant learning occured over the relatively short survey period, we should not observe the bias in the first place. Instead, learning might depend on past outcomes. After a loss, by experiencing the associated feelings with it, investors should be aware that too high loss aversion is unjustified. Additionally, if investors perceive their portfolios being in the loss domain, further losses are not worse than potential gains. This of course depends on when the reference point is adjusted, and whether the utility function is convex for losses (as in prospect theory). We therefore assume that anticipated loss aversion will be lower after a loss.

[2]Of course, there are many other factors influencing portfolio risk (see Merkle and Weber, 2011). Unfortunately, we cannot control for these factors as this requires a regression with portfolio risk as the dependent variable. As we only estimate aggregated loss aversion, we lack a way to introduce it as an explanatory variable in such regressions.

We follow the same strategy as before in the analysis of risk by splitting the sample into those participants, who experienced a negative perceived past return and those with returns greater or equal zero. For those with negative past returns we find a coefficient for anticipated loss aversion of 1.6 (table 9, column 1). In comparison, after a gain investors show a much higher loss aversion of 3.7 (column 2). To see whether this effect is lasting longer than one period, we calculate the cumulative portfolio return starting with the beginning of the survey.[3] Again we find moderate loss aversion after severe losses, but very high loss aversion after gains or less severe losses. The difference between the two groups is significant.

To test whether this difference is also reflected in experienced outcomes, we repeat the analysis for the ratings of past returns. For the sample split, we have to take one lag in past perceived returns (table 9, columns 5 and 6). Alternatively, we use cumulative actual portfolio returns as before (columns 7 and 8). After losses, further losses are not experienced more severely than gains, while after gains there is an experienced loss aversion of about 1.8. However, as for all our other results this ex post loss aversion is far smaller than its anticipated counterpart. We define the magnitude of financial loss aversion illusion as the difference between the two coefficients ($FLAI = \lambda_{ant} - \lambda_{exp}$). We obtain a baseline financial loss aversion illusion of 1.04 ($2.19 - 1.15$) for the overall sample using the loss aversion coefficients calculated from regression (6) in tables 2 and 4. After a loss FLAI is reduced to 0.91 and 0.49 respectively, while after a gain FLAI rises to 1.91 and 4.36. This suggests that experiencing a loss contributes to evaluate anticipated gains and losses more in line with the experience of outcomes.

Loss aversion illusion may also be mitigated by investor sophistication, which includes their individual knowledge, skill, and experience. Financial literacy is often argued to improve financial decision making (Lusardi and Mitchell, 2013). We use the finacial literacy measure reported earlier to test whether more financially literate investors are less subject to financial loss aversion illusion. We follow the same strategy as before by splitting the sample into those participants who correctly answered all four financial literacy questions and those with less correct responses. We find a FLAI indistinguishable from 0 for financially literate investors, while it is high and significant for the less literate (see table 10). The difference in FLAI between the two groups is also significant.

[3] In this case we use actual portfolio returns as perceived returns are only available for rounds in which an investor participated in the survey. Predominant negative returns in the course of the financial result in a median cumulative loss close to -20%, which we use to split the sample (columns 3 and 4).

Wealth is also considered as a proxy for investor sophistication (Vissing-Jorgensen, 2004; Dhar and Zhu, 2006). We compare investors with high financial wealth ($> £150,000$) to those with lower financial wealth. We again find that less sophisticated (low wealth) investors exhibit a higher FLAI. In this case the difference between the two groups is not significant. As a final sophistication variable, we employ self-reported financial market experience in years. As it was not part of the survey entry questionnaire, this variable is available only for a subset of investors. Among them, investors with an experience of at least 20 years show no FLAI, while it is high for less experienced investors and significantly differs beween group. As this could be a effect of age, we repeat the test for age and find a similar but weaker effect. We conclude that experience is the driver in the reduction of FLAI.

5 Discussion and Conclusion

We show that financial loss aversion is an illusion. It is an illusion in the sense that the existence of loss aversion in the expectations of investors is not backed by a similar observation for their experiences. Regarding portfolio return expectations, investors react much more sensitive to losses as compared to gains. In a linear model, we establish loss aversion coefficients around two for several different reference points and specifications. On the contrary for experiences of portfolio returns, there is no significant loss aversion. The subjective rating of returns is almost monotonous over losses and gains.

Diminishing sensitivity, the other defining feature of reference-based utility or value functions, is also present in our data. Investors react less to changes in outcomes that are distant from the reference point. This is true for gains and losses, which implies concavity in the domain of gains and convexity in the domain of losses. While diminishing sensitivity can be observed for expectations and experiences alike, again only for expectations are the slopes for the different intervals in the loss domain steeper than their counterparts in the gain domain.

These findings illustrate the important distinction between anticipated utility and experienced utility. In anticipation, investors have to think about potential future outcomes of their investments and have to determine how they will feel about these outcomes. Anticipated utility is also known as decision utility, reflecting the fact that to make a decision one has to be aware of its consequences. And the consequences entail not only the factual outcome in terms of return or monetary profit or loss, but also the hedonic feelings associated with it. Loss aversion applies to this decision context, not only in the choice of monetary lotteries but also for financial decisions.

Experienced utility can differ from anticipated utility widely if investors are subject to projection biases. The financial loss aversion illusion we document is a particular form of projection bias, where people overestimate the negative experience associated with a loss. Projection biases can misguide decisions, as a choice might be optimal given the anticipated utility but not the experienced utility (cp. Loewenstein, O'Donoghue, and Rabin, 2003). In particular, an investment portfolio selected under the impression of losses looming twice as large as gains, will look quite different from a portfolio chosen with loss neutrality.

Some tentative evidence comes from the portfolios in our panel, for which we find that riskier portfolios are held by investors with lower anticipated loss aversion. But as we find no differences in experiences of losses or gains, it probably would have been optimal for investors with high anticipated loss aversion to likewise invest more riskily. As the overestimation of loss aversion is systematic, this would suggest that participation in stock markets or the equity share in portfolios is generally too low. Financial loss aversion illusion could then at least partly explain the stock market participation puzzle and the equity premium puzzle.

The projection bias adds to the traditional explanation of these puzzles by loss aversion, as loss aversion per se does not need to be judgment bias. Similar to risk aversion it can be part of people's preferences; and economics is rather cautious to challenge the content of preferences. In contrast, the divergence of anticipated and experienced loss aversion qualifies as a bias, as people are time-inconsistent with regard to their preferences. It is not even necessary to assume that experienced utility should be the only that counts, possibly the worries and fears for potential bad outcomes are also an element of the overall hedonic experience.

An interesting question that we cannot answer empirically is, why anticipated and experienced evaluations of portfolio returns differ so much. An answer might lie in the process of coping with a loss. When confronted with an outcome, people engage in rationalizing it and in finding reasons and explanations for it. They then also adapt emotionally to this outcome and learn to accept it. For negative events the effect is particularly strong as part of a psychological defense mechanism (cp. Wilson and Gilbert, 2005). Related to this, we show that after a loss experience there is a reduction in anticipated loss aversion. The immediate awareness of the process of coping seems to help in predicting one's reaction to future losses.

We provide tentative evidence that financial literacy and experience can mitigate loss aversion illusion. For the related endowment effect a positive influence of learning has been documented (List, 2003; Novemsky and Kahneman, 2005). However, investors need to recognize the similarity of past investment experiences with their current expectations (cp. Kermer, Driver-Linn, Wilson, and Gilbert, 2006). This is complicated by the tendency to attribute especially negative outcome to situational causes (Langer and Roth, 1975), which might be very specific (e.g., the financial crisis for the time period of our sample). Future research might address this and related questions by an assessment of individual loss aversion which is able to determine the magnitude of the projection bias for each investor. This would also allow to pinpoint the effects on risk taking and other aspects of investing behavior.

A remedy to the observed financial loss aversion illusion might come from educated financial advice. It has been shown that simulations of potential investment outcomes can illustrate associated experience to investors and improve their decision process (Kaufmann, Weber, and Haisley, 2013). In particular, Bradbury, Hens, and Zeisberger (2013) experimentally find that in a choice among structured products with loss protection, participants opt for less protection after simulated experience. They realize that losses might not be as bad (and as frequent) as they thought. Such simulation techniques can support the financial decision process and should be adopted by financial advisors.

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Appendix

Description of variables

Variable	Origin	Description
Gender	Bank data	Gender of participants, dummy variable 1 if male, 0 if female
Age	Bank data	Age of participants in years
Couple	Survey (initial)	Marital status using the following response alternatives: Single; Married; Divorced; Widowed; Cohabiting. Dummy variable (=1) if married or cohabiting, zero otherwise.
Wealth	Survey (initial)	Self-reported wealth using 9 categories: £0–10,000; £10,001–50,000; £50,001–100,000; £100,001–150,000; £150,001–250,000; £250,001–400,000; £400,001–600,000; £600,001–1,000,000; > £1,000,000. Missing values were imputed.
Income	Survey (initial)	Self-reported income using 8 categories: £0–20,000; £20,001–30,000; £30,001–50,000; £50,001–75,000; £75,001–100,000; £100,001–150,000; £150,001–200,000; > £200,000. Missing values were imputed.
Fin. literacy	Survey (initial)	Number of correct responses in a 4-item financial literacy test using questions by van Rooij, Lusardi, and Alessie (2011).
Experience	Survey (round 2)	Response (in years) to the question: *"For how long have you been investing directly, i.e. using a stock brokerage service to make investments?"*
Rating of expected returns	Survey (all rounds)	Rating on a scale 1-7 (extremly bad to extremely good) in response to question: *"How would you rate the returns you expect from your portfolio held with us in the next 3 months?"*
Rating of experienced returns	Survey (all rounds)	Rating on a scale 1-7 (extremely bad to extremely good) in response to question: *"How would you rate the returns of your portfolio (all investments held with us) over the past three months?"*
Portfolio return expectation	Survey (all rounds)	Return in % in response to survey question: *"We would like you to make three estimates of the return of your portfolio held with us by the end of the next three month. Your best estimate should be your best guess."*
Market return expectation	Survey (all rounds)	Return in % in response to survey question: *"We would like you to make three estimates of the return of the UK stock market (FTSE all-share) by the end of the next three month. Your best estimate should be your best guess."*
Past portfolio return (perceived)	Survey (all rounds)	Return in % in response to survey question: *"What do you think your return (percentage change) with us over past three months was? Please enter your response as a percent change, i.e. a rise as X%, or a fall as -X%."*
Past market return (perceived)	Survey (all rounds)	Return in % in response to survey question: *"What do you think the UK stock market (FTSE all-share) return (percentage change) over past three months was? Please enter your response as a percent change, i.e. a rise as X%, or a fall as -X%."*
Past portfolio return (actual)	Bank data	Return in % of investors' actual portfolios calculated over past three months.
Past market return (actual)	Datastream	Return in % of the UK stock market (FTSE all-share) over past three months.

Description of variables (continued)

Variable	Origin	Description
Subj. portfolio risk	Survey (all rounds)	Rating on scale 1-7 in response to question *"Over the next 3-months, how risky do you think your portfolio is?"*
Interest rate	Datastream	London interbank offered rate (LIBOR) for three months. As the interest rate is expressed in annual terms divided by 4.
Inflation	National Statistics	Annual change of the UK consumer price index CPI reported in the month of the survey round. Adjusted to a quarterly rate.
Individual benchmark (past)	Survey (all rounds)	Rating on a scale 1-7 (1=bank interest rates, 4=a mix, 7=the market) in response to question: *"When evaluating the performance of your portfolio do you compare it to the interest rate you would have received by putting the money in a bank account, or the return you would have received by investing the money in the stock market?"* The response is converted in the following way: 1 = 100% (lagged) interest rate, 2 = 83.3% interest rate and 16.6% realized stock market return, 3 = 66.6% interest rate and 33.3% stock market return, 4 = 50% interest rate and 50% stock market return, 5 = 33.3% interest rate and 66.6% stock market return, 6 = 16.7% interest rate and 83.7% stock market return, 7 = 100% stock market return.
Individual benchmark (expectation)	Survey (all rounds)	Calculated the same way as "individual benchmark (past)", with stock market return expectations instead of realized returns and current interest rates instead of past interest rates.
Portfolio volatility	Bank data	One-year historical portfolio volatility at the time of each survey round.
Risk tolerance	Survey (all rounds)	Agreement on Likert scale 1-7 to statement *"It is likely I would invest a significant sum in a high risk investment."*
Portfolio value	Bank data	Total value of investors' portfolio value in pounds at current market prices (or if no current price is available for an asset, the last available price) at the time of each survey round.
Portfolio turnover	Bank data	Portfolio turnover is trading volume in pounds between two survey rounds divided by the sum of portfolio value at the beginning and end of survey round (we exclude portfolios <£5,000 and winsorize turnover from above at the 5%-level). The convention to use twice the portfolio value (or half of trading volume) has been introduced by (Odean, 1999).

Table 1: Descriptive statistics

Panel A	n	Mean	Median	Std.Dev.	5q	95q
Gender (male=1)	617	0.93	1	0.25	0	1
Age (in years)	613	51.4	53	12.9	29	72
Couple	616	0.74	1		0	1
Wealth (9 categories, see below)	502	4.80	5	2.39	2	9
Income	494	3.88	4	1.80	1	8
Financial literacy (4 questions)	614	3.49	4	0.68	2	4
Experience (in years)	197	19.5	20	10.3	6	38
Panel B	**n**	**Mean**	**Median**	**Std.Dev.**	**5q**	**95q**
Rating of expected return	2107	4.18	4	1.16	2	6
Rating of experienced return	2115	3.61	4	1.73	1	7
Portfolio return expectation	2108	0.061	0.050	0.112	−0.050	0.200
Past portfolio return (perceived)	2115	−0.019	0.000	0.193	−0.300	0.250
Past portfolio return (actual)	2070#	−0.051	−0.027	0.242	−0.523	0.249
Market return expectation	2121	0.031	0.030	0.103	−0.100	0.150
Past market return (perceived)	2108	−0.008	0.000	0.178	−0.250	0.220
Past market return (actual)	2135#§	−0.026	−0.081	0.128	−0.196	0.205
Interest rate	2135#§	0.006	0.004	0.005	0.001	0.014
Inflation	2135#§	0.008	0.008	0.003	0.003	0.013
Individual benchmark (past)	2135	−0.007	0.002	0.079	−0.126	0.114
Individual benchmark (expectations)	2135	0.023	0.017	0.089	−0.065	0.100

Notes: The table shows descriptive statistics (number of observations, mean, median, standard deviation, 5%-percentile and 95%-percentile) for the main survey variables. Panel A shows demographics of participants. Number of observations varies due to refusals. Gender is a dummy variable taking a value of one for male participants. Age is reported in years. Couple is a dummy variable taking the value of one for married or cohabiting participants.
Wealth categories: (1) 0–10,000£ (2) 10,000–50,000£ (3) 50,000–100,000£ (4) 100,000–150,000£ (5) 150,000–250,000£ (6) 250,000–400,000£ (7) 400,000–600,000£ (8) 600,000–1,000,000£ (9) >1,000,000£.
Income categories: (1) 0–20,000£ (2) 20,000–30,000£ (3) 30,000–50,000£ (4) 50,000–75,000£ (5) 75,000–100,000£ (6) 100,000–150,000£ (7) 150,000–200,000£ (8) >200,000£.
One £ was approximately 1.60 $, average gross yearly income in the UK was about 30,000£. Financial literacy uses 4 questions (2 basic, 2 advanced) from van Rooij, Lusardi, and Alessie (2011). Experience is self-reported investing experience in years.
Panel B shows participants' subjective ratings for expected portfolio return and experienced portfolio return. It further displays numerical estimates of expected portfolio return and perceived past portfolio return. Past actual portfolio return is calculated from investors' portfolios. For the UK stock market, the actual and perceived performance of the FTSE all-share index is displayed, as well as expectations for three months returns of the same index. Interest rates is the three-month LIBOR, inflation is based on the UK CPI. Individual benchmarks are calculated as described in the appendix. Observations denoted by # are reported conditional on survey round participation, observations denoted by § are constant in the cross-section. For details on the used survey questions, see appendix.

Table 2: Anticipated loss aversion

	Subjective rating of expected return						
	Pooled OLS		GLS with RE		GLS with FE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Expected portfolio return	4.152						
	(11.40)***						
Expected portfolio return		7.463	6.446	5.927	6.249	5.560	5.898
(if < 0)		(8.69)***	(7.28)***	(6.96)***	(9.00)***	(8.11)***	(7.72)***
Expected portfolio return		3.538	3.051	2.917	2.683	2.543	2.603
(if > 0)		(9.25)***	(7.75)***	(7.68)***	(8.87)***	(8.58)***	(8.06)***
Risk tolerance							0.041
							(1.98)**
Subj. portfolio risk							–0.057
							(–2.19)**
Portfolio volatility							0.198
							(0.78)
Log portfolio value							0.035
							(1.48)
Log portfolio turnover							0.094
							(1.24)
Constant	3.925	3.994	3.935	3.699	4.044	3.792	3.432
	(135.91)***	(122.81)***	(95.68)***	(67.80)***	(134.70)***	(71.60)***	(11.17)***
R^2	0.159	0.171	0.171	0.215	0.171	0.212	0.227
Observations	2107	2107	2107	2107	2107	2107	1866
Time-fixed effects	No	No	No	Yes	No	Yes	Yes
Individual-fixed effects	No	No	No	No	Yes	Yes	Yes
Loss aversion coefficient λ	—	2.11	2.11	2.03	2.33	2.19	2.27
P-value Wald-test ($\lambda = 1$)	—	<0.001	<0.001	0.002	<0.001	<0.001	<0.001

Notes: The table shows regressions of subjective ratings of expected portfolio return on numerical expected portfolio return and controls. Columns 1-2 are estimated by pooled OLS, the remaining columns contain results of panel regressions with random effects (columns 3-4) or fixed effects (columns 5-7). Expected portfolio return is split for gains and losses with 0 as a reference point. Risk tolerance and subjective portfolio risk are self-reported, survey-based measure as defined in the appendix. Portfolio volatility is the one-year historical volatility of investors' portfolios at the time of each survey round. Log portfolio value is the natural logarithm of the value of the investors' portfolios at Barclays in pounds. Log turnover is the natural logarithm of trading volume divided by the sum of portfolio value at the beginning and end of survey round. Time-fixed effects are included in form of round dummies for each round of the survey. Standard errors are robust and for random effects models clusteres by participant. Coefficients are significant at $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$, t-values are shown in parentheses. The loss aversion coefficient is the ratio between the coefficients for expected portfolio losses and gains. The Wald-test tests for equality of these coefficients ($\lambda = 1$).

Table 3: Anticipated loss aversion for alternative reference points

	Based on regression model #					
	(2)	(3)	(4)	(5)	(6)	(7)
λ (interest rate)	2.09	2.09	2.02	2.29	2.16	2.24
	(<0.001)	(<0.001)	(0.002)	(<0.001)	(<0.001)	(<0.001)
λ (inflation)	2.11	2.11	2.03	2.32	2.18	2.27
	(<0.001)	(<0.001)	(0.002)	(<0.001)	(<0.001)	(<0.001)
λ (market expectations)	1.30	1.42	1.32	1.89	1.79	1.74
	(0.238)	(0.135)	(0.253)	(<0.001)	(0.004)	(0.017)
λ (individual benchmark)	1.60	1.71	1.62	2.37	2.23	2.31
	(0.034)	(0.013)	(0.030)	(<0.001)	(<0.001)	(<0.001)

Notes: The table shows loss aversion coefficients for different reference points. Regressions were estimated using the specifications of Table 2. λ (interest rate) takes the current three-months interest rate as a reference point, λ (inflation) the rate of inflation three-month ahead, λ (market expectations), the market return expectation of participants, and λ (individual benchmark) the individual benchmark of participants. In parentheses the p-values of a Wald-test are reported, testing for $\lambda = 1$.

Table 4: Experienced loss aversion

	Subjective rating of past return						
	Pooled OLS		GLS with RE		GLS with FE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Past portfolio return (perc.)	5.984						
	(22.00)***						
Past portfolio return (perc.)		6.662	6.519	4.951	6.844	4.848	4.932
(if < 0)		(20.38)***	(18.11)***	(14.85)***	(22.60)***	(13.77)***	(12.49)***
Past portfolio return (perc.)		5.200	5.394	3.875	5.674	4.212	4.618
(if > 0)		(8.34)***	(8.22)***	(6.43)***	(19.15)***	(13.78)***	(12.60)***
Risk tolerance							–0.031
							(–1.13)
Subj. portfolio risk							–0.051
							(–1.49)
Portfolio volatility							–0.400
							(–1.22)
Log portfolio value							0.053
							(1.71)*
Log portfolio turnover							0.078
							(0.80)
Constant	3.723	3.820	3.753	3.281	3.807	3.315	3.156
	(125.04)***	(72.94)***	(68.07)***	(53.11)***	(88.95)***	(46.84)***	(7.93)***
R^2	0.449	0.452	0.452	0.517	0.452	0.515	0.529
Observations	2115	2115	2115	2115	2115	2115	1864
Time-fixed effects	No	No	No	Yes	No	Yes	Yes
Individual-fixed effects	No	No	No	No	Yes	Yes	Yes
Loss aversion coefficient λ	—	1.28	1.21	1.28	1.21	1.15	1.07
P-value Wald-test ($\lambda = 1$)	—	0.079	0.186	0.130	0.020	0.221	0.605

Notes: The table shows regressions of subjective ratings of past portfolio return on numerical perceived past portfolio return and controls. Columns 1-2 are estimated by pooled OLS, the remaining columns contain results of panel regressions with random effects (columns 3-4) or fixed effects (columns 5-7). Past portfolio return is split for gains and losses with 0 as a reference point. Risk tolerance and subjective portfolio risk are self-reported, survey-based measure as defined in the appendix. Portfolio volatility is the one-year historical volatility of investors' portfolios at the time of each survey round. Log portfolio value is the natural logarithm of hte value of the investors' portfolios at Barclays in pounds. Log turnover is the natural logarithm of trading volume divided by the sum of portfolio value at the beginning and end of survey round. Time-fixed effects are included in form of round dummies for each round of the survey. Standard errors are robust and for random effects models clusteres by participant. Coefficients are significant at $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$, t-values are shown in parentheses. The loss aversion coefficient is the ratio between the coefficients for past portfolio losses and gains. The Wald-test tests for equality of these coefficients ($\lambda = 1$).

Table 5: Experienced loss aversion for alternative reference points

	Based on regression model #					
	(2)	(3)	(4)	(5)	(6)	(7)
λ (interest rate)	1.28	1.21	1.28	1.21	1.15	1.07
	(0.079)	(0.187)	(0.129)	(0.020)	(0.221)	(0.604)
λ (inflation)	1.28	1.21	1.28	1.21	1.15	1.07
	(0.079)	(0.187)	(0.129)	(0.020)	(0.221)	(0.604)
λ (market past return)	1.13	1.10	1.03	1.05	0.88	0.85
	(0.257)	(0.361)	(0.825)	(0.500)	(0.234)	(0.161)
λ (individual benchmark)	1.11	1.07	1.04	1.06	0.92	0.95
	(0.399)	(0.605)	(0.798)	(0.395)	(0.414)	(0.636)
λ (portfolio expectations)	0.93	0.93	0.94	1.03	0.97	0.99
	(0.589)	(0.620)	(0.677)	(0.598)	(0.715)	(0.915)

Notes: The table shows loss aversion coefficients for different reference points. Regressions were estimated using the specifications of Table 4. λ (interest rate) takes the lagged three-months interest rate as a reference point, λ (inflation) the rate of inflation, λ (market past returns), the past market return as perceived by participants, λ (individual benchmark) the individual benchmark of participants, and λ (portfolio expectations) the expected portfolio return of the previous survey round. In parentheses the p-values of a Wald-test are reported, testing for $\lambda = 1$.

Table 6: Diminishing sensitivity

	Subjective rating of expected return			Subjective rating of past return		
	(1)	(2)	(3)	(4)	(5)	(6)
Expected or past portfolio return	5.388	4.794	5.076	6.679	4.802	4.843
(if $< -5\%$)	(7.70)***	(6.94)***	(6.59)***	(21.07)***	(13.27)***	(11.94)***
Expected or past portfolio return	19.652	19.546	19.910	18.300	10.243	9.020
(if $\geq -5\%$ and < 0)	(6.53)***	(6.68)***	(6.42)***	(7.04)***	(4.04)***	(3.31)***
Expected or past portfolio return	7.066	5.616	5.336	12.005	8.014	8.642
(if > 0 and $\leq 5\%$)	(5.45)***	(4.43)***	(4.00)***	(5.61)***	(3.88)***	(3.87)***
Expected or past portfolio return	2.761	2.575	2.624	5.567	4.239	4.688
(if $> 5\%$)	(9.09)***	(8.65)***	(8.11)***	(18.30)***	(13.60)***	(12.52)***
R^2	0.192	0.231	0.247	0.469	0.520	0.533
Observations	2107	2107	1866	2115	2115	1864
Set of controls	No	No	Yes	No	No	Yes
Time-fixed effects	No	Yes	Yes	No	Yes	Yes
Individual-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Loss aversion coefficient λ (returns close to reference point)	2.78	3.48	3.73	1.52	1.28	1.04
P-value Wald-test ($\lambda = 1$)	<0.001	<0.001	<0.001	0.097	0.536	0.922

Notes: The table shows panel fixed-effects regressions with subjective ratings of portfolio return as dependent variable (columns 1-3 for expected portfolio return and columns 4-6 for past portfolio return). Independent variable is either numerical expected portfolio return (columns 1-3) or numerical past perceived portfolio return (columns 4-6). Both numerical return variables are split up in four intervals ($< -5\%$; $\geq -5\%$ and < 0; > 0 and $\leq 5\%$; $> 5\%$). The set of control variables is the same as before. Coefficients are significant at $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$, t-values are shown in parentheses. The loss aversion coefficient is the ratio between the coefficients for portfolio losses and gains for the return intervals close to the reference point. The Wald-test tests for equality of these coefficients ($\lambda = 1$).

Table 7: Monetary outcomes

	Subjective rating of expected return			Subjective rating of past return		
	(1)	(2)	(3)	(4)	(5)	(6)
Expected portfolio profit	0.046	0.040	0.041			
(if $<$ 0)	(6.44)***	(5.78)***	(5.85)***			
Expected portfolio profit	0.017	0.015	0.015			
(if $>$ 0)	(6.18)***	(5.71)***	(5.31)***			
Past portfolio profit				0.032	0.011	0.010
(if $<$ 0)				(10.84)***	(4.38)***	(3.56)***
Past portfolio profit				0.031	0.018	0.021
(if $>$ 0)				(10.86)***	(7.46)***	(7.00)***
R^2	0.071	0.118	0.164	0.154	0.384	0.401
Observations	1990	1990	1778	1998	1998	1776
Set of controls	No	No	Yes	No	No	Yes
Time-fixed effects	No	Yes	Yes	No	Yes	Yes
Individual-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Loss aversion coefficient λ	2.77	2.69	2.72	1.00	0.61	0.48
P-value Wald-test ($\lambda = 1$)	<0.001	<0.001	0.001	0.990	0.068	0.018

Notes: The table shows panel fixed-effects regressions with subjective ratings of portfolio return as dependent variable (columns 1-3 for expected portfolio return and columns 4-6 for past portfolio return). Independent variable is either expected portfolio profit (in £1,000, columns 1-3) or past perceived portfolio profit (in £1,000, columns 4-6). Both profit variables are split up in losses and gains. The set of control variables is the same as before. Coefficients are significant at $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$, t-values are shown in parentheses. The loss aversion coefficient is the ratio between the coefficients for portfolio losses and gains for the return intervals close to the reference point. The Wald-test tests for equality of these coefficients ($\lambda = 1$).

Table 8: Loss aversion and portfolio risk

	Subjective rating of expected return			
	(1) Portfolio volatility <0.3	(2) Portfolio voltility >0.3	(3) ACV <0.5	(4) ACV >0.5
Expected portfolio return (if < 0)	7.211 (5.53)***	4.495 (4.75)***	7.052 (7.28)***	2.840 (2.51)**
Expected portfolio return (if > 0)	2.412 (3.77)***	2.467 (6.53)***	2.694 (5.54)***	1.876 (4.57)***
R^2	0.201	0.222	0.225	0.178
Observations	937	1170	1212	895
Time-fixed effects	Yes	Yes	Yes	Yes
Individual-fixed effects	Yes	Yes	Yes	Yes
Loss aversion coefficient λ	2.99	1.82	2.62	1.51
P-value Wald-test ($\lambda = 1$)	0.002	0.059	<0.001	0.445
P-value ($\lambda_{risky} = \lambda_{less\,risky}$)	0.143		0.128	

Notes: The table shows panel fixed-effects regressions with subjective ratings of expected portfolio return as dependent variable. The sample is split into less risky and risky portfolios by portfolio volatility (columns 1 and 2) or average component volatility (ACV, columns 3 and 4). Coefficients are significant at $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$, t-values are shown in parentheses. The loss aversion coefficient is the ratio between the coefficients for expected portfolio losses and gains. The Wald-test tests for equality of these coefficients ($\lambda = 1$) and in addition whether the loss aversion coefficient for the less risky portfolios is equal to the coefficient for the riskier portfolios.

Table 9: Loss aversion and previous outcomes

	Subjective rating of expected return				Subjective rating of past return			
	Past pf. return		Cumulative pf. return		Lagged past pf. return		Cumulative pf. return	
	<0	≥0	<-0.2	≥-0.2	<0	≥0	<-0.2	≥-0.2
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Expected portfolio return	5.694	7.905	4.835	7.837				
(if < 0)	$(5.56)^{***}$	$(5.37)^{***}$	$(4.98)^{***}$	$(5.44)^{***}$				
Expected portfolio return	3.547	2.118	3.093	1.280				
(if > 0)	$(5.95)^{***}$	$(5.44)^{***}$	$(6.66)^{***}$	$(2.97)^{***}$				
Past portfolio return (perc.)					4.350	9.113	6.335	9.191
(if < 0)					$(5.62)^{***}$	$(8.67)^{***}$	$(15.65)^{***}$	$(12.24)^{***}$
Past portfolio return (perc.)					6.210	5.003	5.922	5.229
(if > 0)					$(9.00)^{***}$	$(8.86)^{***}$	$(13.44)^{***}$	$(11.31)^{***}$
R^2	0.201	0.180	0.227	0.194	0.561	0.502	0.468	0.425
Observations	992	1115	1106	1001	567	640	1113	1002
Time-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loss aversion coefficient λ	1.61	3.73	1.56	6.12	0.70	1.82	1.07	1.76
P-value Wald-test ($\lambda = 1$)	0.090	<0.001	0.126	<0.001	0.097	0.002	0.566	<0.001
P-value ($\lambda_{loss} = \lambda_{gain}$)	0.035		0.028		0.002		0.006	

Notes: The table shows panel fixed-effects regressions with subjective ratings of expected and past portfolio return as dependent variable. The sample is split by last period perceived return (columns 1, 2, 5, and 6) or by actual cumulative return starting June 2008 (columns 3, 4, 7, and 8). Coefficients are significant at $^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$, t-values are shown in parentheses. The loss aversion coefficient is the ratio between the coefficients for expected portfolio losses and gains. The Wald-test tests for equality of these coefficients ($\lambda = 1$) and in addition whether the loss aversion coefficient after previous losses is equal to the coefficient after superior portfolio performance.

Table 10: Financial loss aversion illusion and sophistication

Group variable		Anticipated λ	Experienced λ	FLAI ($\lambda_{ant} - \lambda_{exp}$)	Δ FLAI groups
Full sample		2.19	1.15	1.04	
		(<0.001)	0.221	0.007	
Financial literacy	low	4.49	1.18	3.31	3.17
		(<0.001)	(0.450)	(0.048)	(0.028)
	high	1.26	1.12	0.14	
		(0.277)	(0.368)	(0.322)	
Wealth	low	3.29	1.55	1.74	0.91
		(0.002)	(0.036)	(0.080)	(0.217)
	high	1.74	0.91	0.83	
		(0.008)	(0.554)	(0.010)	
Experience	low	3.56	0.74	2.82	2.88
		(<0.001)	(0.072)	(<0.001)	(<0.001)
	high	0.81	0.86	-0.06	
		(0.491)	(0.462)	(0.428)	

Notes: The table shows anticipated and experienced loss aversion coefficients for different groups of investors and reports the financial loss aversion illusion (FLAI) as difference between the two coefficients. In parentheses the p-values of a Wald-test are reported, testing for $\lambda = 1$, or of a one-sided t-test testing for $FLAI = 0$ or $\Delta FLAI = 0$, respectively. Low financial literacy includes all investors with less than 4 correct responses in the financial literacy test, low wealth are investors with financial wealth of less than £150,000, and low experience are investors with less than 20 years of investment experience (self-reported).

Figure 1: Portfolio return expectations and subjective ratings

Numerical expected portfolio returns and the associated average subjective rating of these returns. Most dots represent multiple obseravations.

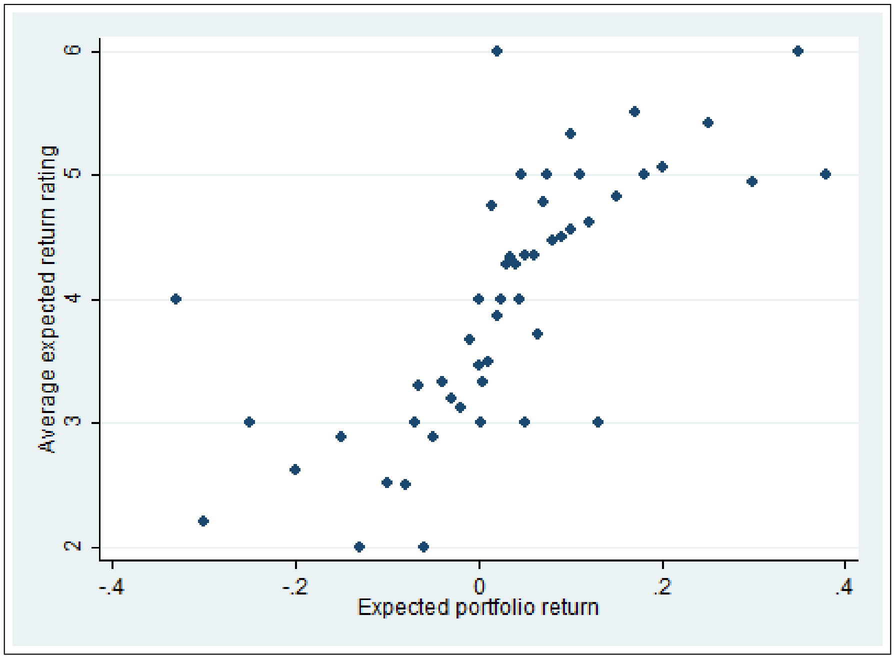

Figure 2: Past portfolio returns and subjective ratings

Numerical perceived past portfolio returns and the associated average subjective rating of these returns. Most dots represent multiple obseravations.