Skewness Seeking in a Dynamic Portfolio Choice Experiment

Isabelle Brocas
University of Southern California
IAST and CEPR
brocas@usc.edu

Juan D. Carrillo
University of Southern California
IAST and CEPR
juandc@usc.edu

Aleksandar Giga
TU Delft
Technology, Policy and Management
a.giga@tudelft.nl

Fernando Zapatero
Boston University
Questrom School of Business
fzapa@bu.edu

May 2026

Abstract

We conduct a controlled laboratory experiment in which subjects dynamically choose to allocate their portfolio between (i) a safe asset, (ii) a risky asset, and (iii) a skewed asset with a negative expected value (a "bet"). Subjects repeat this process over multiple independent investment cycles and can sometimes acquire information about the performance of their peers. In this informationally rich environment, skewness seeking emerges as predominantly context- and state-dependent, rather than driven by risk preference traits. Although more than half of subjects persist in buying the bet, there is substantial learning to avoid it. Purchases are most frequent when subjects have more funds available and at the very end of the investment cycle. Subjects also show interest in their relative standing and buy more bets when their investment performs well but they unexpectedly learn that their peers are outperforming them.

Keywords: laboratory experiment, portfolio allocation, skewed asset, relative performance.
JEL Classification: C91, D03, D81, G02, G11.

1 Introduction

The behavior of agents under risk is known to often depart from predictions of the classical expected utility theory. In particular, the tendency to invest in skewed assets with negative expected value is a pervasive behavioral anomaly. Lotteries, race-tracks, and financial markets provide evidence of skewness seeking behavior.[1] However, little is known as to why this occurs, whether preferences for skewness are intrinsic traits, whether subjects learn to avoid unfavorable bets, whether they are more likely to show it in conjunction with specific circumstances, and/or whether they are driven by social concerns. For instance, it has been evidenced that the demand for lotteries increases at the last minute in race-track betting (McGlothlin (1956); Ali (1977); Asch et al. (1982)) and in response to environmental stressors (Chew et al. (2021)), suggesting that observed preferences for skewness might be triggered by certain events. It is also known that subjects in experiments sometimes react to relative wealth concerns and may buy more lottery tickets when they feel poorer than their peers (Haisley et al. (2008); Dijk et al. (2014), Schwerter (2024)). This indicates that observed preferences for skewness may be tied to social comparisons.

In this study, we design a controlled laboratory experiment that tests *what triggers skewness seeking*. We expose subjects to variation in wealth, position in the investment cycle, and social comparisons, and analyze how these contextual state variables shape the decision to invest in a skewed asset. More precisely, we want to answer the following questions. How pervasive are preferences for skewness in the population and can frequent exposure help individuals realize the negative expected value of such investment? Is skewness seeking driven by stable risk preferences or by investor sentiment decoupled from the risk attitudes they display when the skewed asset is absent? Are social concerns driving to some extent preferences for skewness? Is the "last hour" effect an anomaly specific to race betting or do we observe a last period effect irrespective of the unit of time?

To address these questions, we design a dynamic portfolio allocation experiment in which each subject (she) allocates money at each date between different types of assets. We consider a within-subject design with three treatments. In **NoBet**, the subject allocates wealth between a safe asset and a risky asset with higher expected return.[2] This control

[1] For evidence of skewness seeking in lotteries and race-track betting see Garrett and Sobel (1999) and Golec and Tamarkin (1998), respectively. For proposed evidence in the financial markets, see Mitton and Vorkink (2007), Kumar (2009), Boyer et al. (2009), Bali et al. (2011), Green and Hwang (2012), Conrad et al., (2013), and Boyer and Vorkink (2014).

[2] In what follows, and for the lack of a better succinct expression, we refer to the amount of money available for investment at any given point as the subject's *wealth*. This should not be confused with her financial situation outside of the experimental setting.

treatment allows us to structurally estimate the risk attitude of subjects. The results of this treatment are analyzed in Brocas et al. (2019) and used for comparison in this paper.[3] In **Bet**, subjects can also buy "a bet" (a third, skewed asset with negative expected payoff) in each period. In **Bet&Box**, subjects are additionally given the option to learn at specific points in time the minimum, average or maximum current wealth of other participants. They can also choose to remain ignorant. In all treatments, feedback regarding the returns of all assets is provided at the end of each period. We obtain four main results.

First, we find substantial heterogeneity in betting behavior. About 16% of our subjects never purchase the bet perhaps because they realize its negative expected value. Some others (29%) buy the bet at first but stop purchasing it half-way through the experiment. Finally, half of the subjects (55%) purchase bets throughout the entire experiment. This echoes the results from other experiments in the literature that evidence preference for skewness.[4] However, none of the previous studies allow for learning about one's own reaction to the outcome of the lottery. The dynamic aspect of our experiment permits us to investigate the robustness of the preference for skewness. We show that such preferences are indeed quite robust but also find that many subjects learn to avoid these gambles. This, in turn, implies that estimates of preferences for skewness based on one or a limited number of gamble opportunities may be biased upwards.

Second, the propensity to purchase the skewed asset is largely uncorrelated with subjects' standard risk attitudes as measured in the **NoBet** treatment. Subjects who invest heavily in the risky asset when only safe and risky assets are available are no more likely to buy the skewed bet when it becomes available, and risk attitudes remain stable across treatments. This decoupling between risk preferences and skewness seeking implies that the demand for the skewed asset cannot be attributed to trait-level risk-loving behavior, and must instead be explained by context- and state-dependent factors.

Third, subjects who buy the skewed asset exhibit a strong last period effect, with purchases two to four times higher in the last opportunity than in any other period. An

[3] For overviews regarding static empirical and experimental risk elicitation procedures, see Harrison and Rutström (2008), Charness et al. (2013), and Friedman et al. (2014). Dynamic experimental frameworks have been used in Kroll et al. (1988), Kroll and Levy (1992), Levy (1994), Sundali and Guerrero (2009), and in game show replications summarized by Andersen et al. (2008)

[4] Testing higher order-risk preferences (prudence and temperance), Deck and Shlesinger (2010), Brünner et al. (2011), Ebert and Wiesen (2011) and Ebert (2015) find preference for skewness when choosing among pairs of lotteries with the same mean and variance but different degrees of skewness. Grossman and Eckel (2015) and Astebro et al. (2014) also find skewness seeking behavior in experiments with modified multiple price list paradigms. Dertwinkel-Kalt and Köster (2020) further demonstrate that this preference depends on the salience of the skewed outcome. Lastly, in the asset market experiments of Ackert et al. (2006) and Huber et al. (2014), subjects exhibit stronger initial overpricing of skewed assets.

increase in betting on long-shots in the last race of the day has been observed in the field (McGlothlin (1956); Ali (1977); Asch et al. (1982)) and our study shows that the effect can also be generated in a controlled laboratory setting.[5] These results are consistent with a state-dependent account of skewness seeking: purchases respond systematically to the position in the investment cycle and to the level of wealth accumulated. Also, while we find that the effect is strongest when subjects accumulate highest levels of wealth, it is also present in the mirror image case of lowest levels of wealth. The results are consistent with loss aversion (Kahneman and Tversky (1979) and Thaler and Johnson (1990)), whereby bettors who have lost or not accumulated much wealth may try to catch up at the end of the day. It also supports the intuitive idea that subjects who accumulate large amounts of cash are more willing to bet with house money.

Fourth, our subjects are curious about the wealth of others. While they are mostly interested in learning what is the highest wealth in the session, their choice is strongly affected by their own performance, looking at the minimum, average and maximum wealth whenever the accumulate low, medium and high wealth, respectively. Interestingly, subjects tend to buy more bets when they discover that they are lagging, especially if this information is unexpected.[6] Taken together, these results paint a coherent picture in which skewness seeking is not primarily a trait of risk-loving individuals, but rather a behavioral response that varies systematically with environment and social contexts.

The paper is organized as follows. In section 2, we describe the experimental setting. In section 3, we discuss the general propensity to purchase the skewed asset and the effects of wealth and end of period. In section 4, we study the willingness to obtain information on the performance of others. In section 5, we offer some concluding remarks.

2 Experimental Design

The experiment consists of 13 sessions run in the Los Angeles Behavioral Economics Laboratory (LABEL) at the University of Southern California. Each session has between 7 and 10 subjects for a total of 120 recruited subjects, of which 3 are omitted from

[5] In a much larger sample size of horse races, Snowberg and Wolfers (2010) show that this effect, albeit present, is statistically insignificant. However, drawing stimuli from a real day of racing, the experimental study by McKenzie et al. (2016) still finds a significant last race effect.

[6] This result is consistent with the existing literature. Haisley et al. (2008) find that participants buy more lottery tickets when they feel relatively poorer, while Dijk et al. (2014), Schwerter (2024), and Kuziemko et al. (2014) show that lagging individuals take more risk or invest more in skewed assets. Relatedly, Bursztyn et al. (2014) document peer-driven investment behavior, and Schoenberg and Haruvy (2012) show that information about top performers increases asset prices in experimental markets.

the analysis due to software malfunction. All subjects participate in three treatments presented always in the same order. In the first treatment (**NoBet**), subjects allocate wealth between two assets, a 'safe' and a 'risky', during 15 investment *paths* consisting of 10 *periods* each. The results of this treatment are reported in Brocas et al. (2019). The second treatment (**Bet**) is identical except that, in each period, subjects can also invest in a third asset, the bet, which costs \$1 and gives a return of \$20 with probability 0.04. The third and last treatment (**Bet&Box**) is identical to the **Bet** treatment, except that subjects can check in some periods either the minimum wealth ('Min'), the average wealth ('Ave'), or the maximum wealth ('Max') among all participants in the session. We report here the results of treatments **Bet** and **Bet&Box** and compare them with the results obtained in the **NoBet** treatment whenever relevant.[7]

2.1 Treatment 1: benchmark portfolio allocation (NoBet)

In the **NoBet** treatment, each subject (she) starts each path in period 1 with an endowment of \$3, which she allocates between two assets, a risky asset A and a safe asset B. After period 1 ends, each subject earns a return on her portfolio and moves to period 2. She then reallocates her portfolio and earns new returns. This process continues for a total of 10 periods. After period 10, the investment path ends and the subject's final payoff in that path is recorded. Each subject then moves to the next investment path, where her endowment is reset to \$3. Subjects have 10 seconds to make their decision in period 1 of each path and 6 seconds in periods 2 to 10 of each path. They all begin and end investment paths at the same time. Finally, all subjects go through 15 investment paths for a total of 150 choices. Subjects know at the beginning of the treatment the number of paths and periods ahead.

The return of the safe asset B is 3% while the return of asset A is drawn from a log-normal distribution with mean 23.5% and standard deviation 73.4%.[8] These parameters

[7] Fixing the order of treatments may have an effect on choices (Charness et al., 2012), especially since there is a significant chance that participants learn during the experiment about their willingness to accept risk. However, in our setting there was a natural order for an already reasonably difficult problem: start with a two-asset portfolio allocation, add the third asset, and finally add the social comparison.

[8] This (unrealistically high) mean and standard deviation ensure enough volatility in returns for generating interesting wealth effects and comparative statics. In the discrete version of the experiment, the evolution of wealth is:

$$X(t+1) = X_B(t)(1+r) + X_A(t)\, e^R$$

where $X_i(t)$ is the dollar amount invested in asset $i \in \{A, B\}$ and R is normally distributed with a mean of 0.06 and standard deviation of 0.55. Note that the return of the risky asset, e^R, is log-normally distributed, so the worst case for the subject is to lose her investment in A. In a part of the instructions

do not change throughout the experiment. The draw of the return is presented in the form of a multiplier, that is, the number that multiplies the allocation to that asset (so the multiplier of asset B is always 1.03 whereas the mean multiplier of asset A is 1.06). All participants in a session are subject to the same draws but we insist that the draw of the return of the risky asset is in no way affected by her past allocation decision or by the allocation decision of the other subjects.

Figure 1 provides a screenshot that describes what a subject sees in a given period of a path. Current wealth is represented by the vertical bar positioned above the current period number (4 in this example). When gray, the bar is not active and wealth is not allocated to either asset. Subjects need to click on the bar to activate it and move a horizontal slider to divide their current wealth between assets A and B. The upper and lower portion of the bar represent the money invested in A and B, respectively. The figures on the right side of the bar show the current allocation. To facilitate their reasoning, subjects may change the display of the allocation at any time between percentage in each asset (box labeled " % " as in this screenshot) and total amount in each asset (box labeled " $ "). After the period ends, returns are applied and subjects move to the next period. A new bar with a height corresponding to the new wealth appears to the right of the previous one for the new period and becomes inactive again. Subjects need to reactivate the bar in order to choose a new allocation, otherwise they earn no extra earnings in that period and their account just carries over. This helps prevent subjects' inertia and a bias towards a status quo allocation. Level of inactivity in our experiment was negligible. Subjects observe bars to the left of the current one (periods 1 to 3 in this screenshot) that reminds them of their past allocations and returns. These bars accumulate up to period 10, at which point earnings are recorded and a new investment path is started in period 1 with the endowment reset to \$3. Finally, the left hand side of the screen has a summary information of the main ingredients of the experiment: (i) the current path and period; (ii) a reminder of the characteristics of each asset; (iii) the time left to make a choice in the current period; (iv)

and on the upper left corner of the screen, we described in words the parameters of the return on asset A as being normally distributed with a mean of 6% and standard deviation of 55%, when it should have read log normally distributed with a mean of 23.5% and a standard deviation of 73.4%. In other words, we accidentally described R instead of e^R. Nevertheless, we are confident that this did not impact the results, as the rest of the instructions and accompanying slides vividly and correctly describe the entire distribution of Asset A through graphical and video examples. Moreover, students are shown a correctly specified interactive projection bar at the end of the screen that informs them of the possible distribution of payoffs at the end of the path as they change their current allocation. Previous research shows the importance of visual and interactive tools for financial literacy (Lusardi et al. (2017)). Lastly, students had five practice paths and a quiz before starting their paid trials.

the accumulated wealth in the current path; and (v) the multiplier of assets A and B in the last period of the current path.

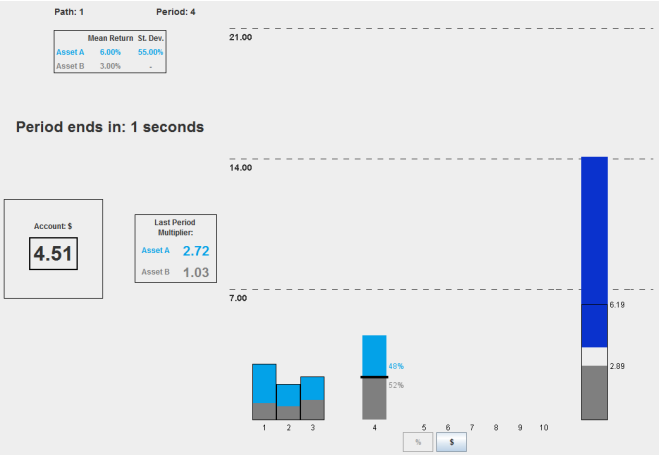

Figure 1. Screenshot of path 1 / period 4 in **NoBet** treatment

This dynamic wealth allocation problem is challenging and may require substantial learning. To facilitate understanding, we employ a highly illustrative 40 minute instructions period using neutral language, numerical examples, videos, 5 practice paths and a comprehension quiz (see the instructions in the appendix). In addition, to help with the cognitive strain, we add a projection bar placed on the right end of the screen (see Figure 1) that tells the subject what she would expect if she were to keep her current investment strategy until the last period. The bar shows the accumulated earnings from asset B and identifies the 20th, 50th and 80th percentile of the earning distribution from asset A. As the participant changes her allocation the projection bar automatically adjusts.[9]

The results of the **NoBet** treatment are analyzed in Brocas et al. (2019), including a structural estimation of the participants' risk attitude assuming they are expected utility maximizers and a discussion of the frequency and severity of behavioral biases. These findings form a benchmark for comparison.

2.2 Treatment 2: allocation in the presence of a skewed asset (Bet)

After completing the **NoBet** treatment, subjects move to the **Bet** treatment, which introduces two changes to the environment described in section 2.1. First, subjects go through

[9] We carefully explain the function of the bar by simulating potential period-by-period trajectories of wealth coming from a given allocation strategy. The screenshot of the video shown during the instructions can also be found in the appendix.

10 (rather than 15) investment paths of 10 periods each, for a total of 100 new choices. Second, and most importantly, we add a new asset C, the "bet", which costs \$1 and yields \$20 with probability 0.04 (naturally, in the experiment we never refer to this asset as a bet). Figure 2 presents the screenshot from the **Bet** treatment, which is identical to Figure 1 except for the lower left corner where asset C is introduced.

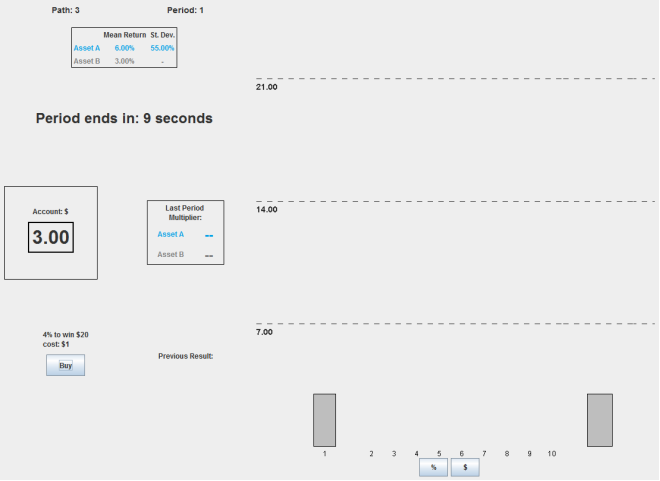

Figure 2. Screenshot of path 3 / period 1 in **Bet** treatment. Compared to **NoBet**, there is a new bet box in the lower left corner of the screen that the participant can "Buy".

Asset C is purchased by clicking on the button below the description of its cost and potential return. Subjects can buy at most one bet per period. If they have less than \$1 in their account, they cannot afford the bet and the box button is grayed out and inactive. If they buy a bet, the cost is withdrawn from the other two assets keeping constant the proportion invested in assets A and B. Overall, subjects make two decisions per period: whether to buy the bet C and how to allocate the rest of the money between A and B. At the end of each period, subjects learn the outcome of the bet at the same time as the returns of A and B. Importantly, subjects are informed that bets are independent across individuals and across periods, in contrast with the return on asset A which is the same for all subjects in a given a period. They go through one practice path before commencing the **Bet** treatment.

2.3 Treatment 3: skewed asset with feedback (Bet&Box)

The environment in **Bet&Box** is identical to **Bet**, with one exception. In periods 5 and 9 of each path, 3 boxes labeled 'Lowest', 'Average' and 'Highest' appear on the lower left

corner of the subjects' screens (see Figure 3) and contain information about the minimum, average, and maximum amount held by subjects in the session. They do not disclose their identity. Subjects may open at most one box at the time it is offered.

Figure 3. Screenshot of path 4 / period 5 in **Bet&Box** treatment. Compared to **Bet**, there is a new set of comparison boxes in the lower left corner of the screen.

Overall, in periods 5 and 9, subjects make three decisions: whether to obtain feedback about earnings of subjects in the session, whether to purchase the bet C, and how to allocate the rest of the money between assets A and B. In the other periods, subjects make only the second and the third decision, just like in the **Bet** treatment.

2.4 Payments

At the end of the experiment we collect answers to education, demographics and income, as well as their own description of the strategies employed. Each participant receives a \$5 show-up fee and her final earnings in the final period of *two* paths, one path randomly selected from **NoBet** and one path randomly selected from **Bet** and **Bet&Box**. Sessions last for 2 hours and the average payoff is \$23, with a maximum payoff of \$244.

3 Betting Behavior

Since asset C has negative expected value, a risk-neutral or risk-averse expected utility maximizer should never buy it.[10] From the behavior in the **NoBet** treatment we found

[10] C's return is independent from A and B, thereby bringing no offsetting diversification benefits.

that no subject exhibits risk-loving attitudes (Brocas et al., 2019). We should therefore expect zero or minimal levels of bet purchases. Furthermore, since a risk-loving attitude is necessary for the willingness to buy asset C, any expected utility maximizer subject who purchases that asset should invest the remaining of her wealth in the risky asset A, which has higher expected return and higher variance than the safe asset B.

3.1 Heterogeneity in demand and learning

Figure 4 (left) depicts the aggregate frequency of bet purchases over time conditional on subjects having the option to buy them (in 3.9% of the observations, subjects could not afford them).

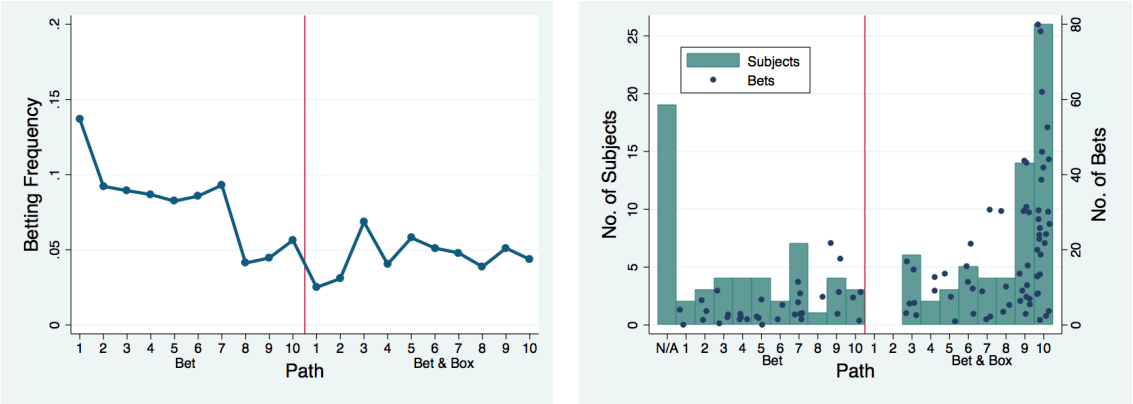

Figure 4. Aggregate frequency of bet purchase over time (left) and distribution of paths where the subject stopped betting, which we call "stopping times" (right). The histogram shows the distribution of stopping times across subjects (with the number of subject variable represented in the left vertical axis), and the dots show the total number of bets bought by the subject who stopped betting in that path (with the number of bets variable represented in the right vertical axis). For example, the top right dot represents a subject who bet all the way until the end and bought 80 bets in total.

Contrary to the theoretical predictions, 6.3% of the available bets are purchased. We notice, however, a significant decline over time in these purchases: 8.1% in **Bet** against 4.5% in **Bet&Box** (z-test, $p < 0.001$). The trend is decreasing over the course of the **Bet** treatment and stabilizes afterwards. Overall, it suggests that on aggregate subjects realize over the course of the experiment that the bet is not profitable.

Out of the 1416 instances of bets purchased, only in 6.8% of cases subjects choose to put more than 98% of the remaining wealth in the risky asset. This indicates that subjects do not behave as risk loving expected utility maximizers. There is a large heterogeneity

in betting behavior. We can informally classify subjects into three groups. There are 19 subjects who never bet (group 1 or G1), 34 subjects who bet a few times and stop purchasing bets before the end of the **Bet** treatment (group 2 or G2), and 64 subjects who bet in both parts (group 3 or G3). Figure 4 (right) shows the distribution of stopping times, that is, the last path where a subject chooses to bet (histogram, axis on the left) and, for each subject, the total number of bets bought before stopping (circle, axis on the right). The majority of subjects in G2 bet only a few times before stopping (4.7 on average per subject). By contrast, many subjects in G3 bet significantly more (19.6 on average, t-test, $p < 0.001$) and keep betting throughout the entire experiment. These subjects also purchase significantly more bets in the **Bet** treatment than subjects in G2 (11.6 on average, t-test, $p < 0.001$). In short, a significant proportion of subjects keeps using the bet as a part of their investment strategy.

We also investigate whether the outcome of the bet (win vs. loss) has an impact on the behavior immediately after and, to our surprise, find no effect. One possible reason is that very few bets are won (2.9%). In particular, no subject in G2 ever won, which partly accounts for their behavior in **Bet&Box**. However, even in G3 where bets are sometimes won, the percentage of bet purchases at a given period following a win and a loss the period before are high and remarkably similar (35% vs. 36.2%, z-test, $p = 0.880$). Overall, persistence in behavior does not seem to depend on the outcome of the bet.

3.2 Relationship to risk attitudes

We look at the relationship between risk attitude (measured by the relative allocation between assets A and B) and betting in C, and also examine the consistency of choices compared to the **NoBet** treatment. This comparison must be taken with a grain of salt. Indeed, the investment environment is complex, so we expect some learning over the course of the experiment both about the tasks and the subject's own risk tolerance. Differences in choices across treatments may simply reflect such knowledge acquisition (remember that treatment orders are not randomized). Second, even though a risk-neutral or risk-averse individual should never buy asset C in the **Bet** and **Bet&Box** treatments, we do observe purchases of the bet. Buying a bet (or simply being offered a bet) is likely to affect the allocation of wealth between the other two assets.

Figure 5 (left) presents a histogram with the average proportion of wealth allocated by each subject to the risky asset A in the **Bet** and **Bet&Box** treatments. Half the individuals put between 40% and 60% of their wealth in the risky asset and very few

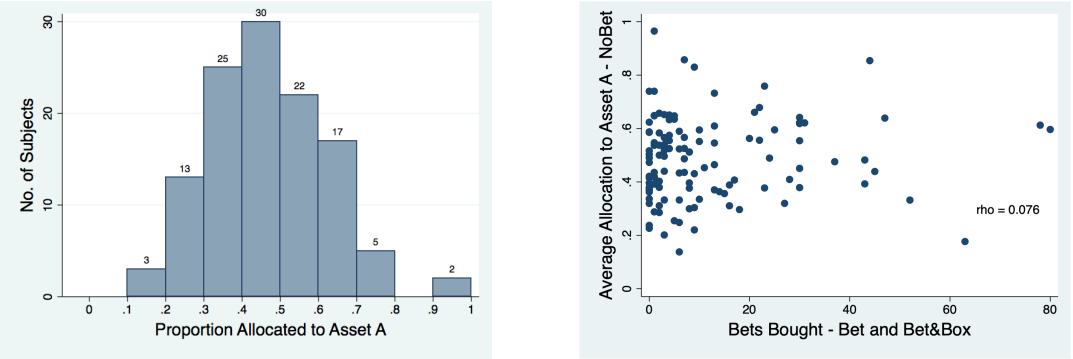

Figure 5. Histogram with average proportion of wealth in asset A in **Bet** and **Bet&Box** treatments (left). Correlation between average amount allocated to asset A in **NoBet** and number of bets purchased (right)

choose to put all their wealth in one. On average we observe more investments in the safe than in the risky asset, consistent with reasonable levels of risk aversion (Brocas et al., 2019). We only observe 2 participants who put all (or almost all) their wealth in asset A and therefore could potentially be labeled as risk-loving. Therefore, the demand for the skewed asset cannot come from the subjects' affinity towards risk. Furthermore, as depicted in Figure 5 (right), subjects' propensity to buy bets in the **Bet** and **Bet&Box** treatments is largely uncorrelated with risk attitudes in the **NoBet** treatment, with a correlation coefficient that is not statistically different from zero ($\rho = 0.076$, p $= 0.42$).

We then compare wealth allocation across treatments. Figure 6 presents for each subject the average proportion of wealth allocated to the risky asset in **NoBet** and in **Bet** and **Bet&Box** pooled together (left). It also presents the standard deviations of the portfolios in those same two cases (right).[11]

There is a very strong correlation across treatments both in the average proportion of wealth allocated to each asset and in the standard deviation of the allocations ($\rho = 0.81$, p < 0.001 and $\rho = 0.64$, p < 0.001 respectively).[12] It indicates that subjects behave consistently over the course of the experiment and that the levels of risk identified in the analysis of the **NoBet** treatment apply reasonably well also to the **Bet** and **Bet&Box** treatments. In addition, the dots in both graphs are positioned close to the 45 degree line, suggesting that betting does not lead to eccentric risk taking with their remaining

[11]The standard deviation is calculated using the ex-ante variances of all the assets and their respective weights in the portfolio.

[12]The correlations between the **Bet** and **Bet&Box** treatments are also high (0.86 for the average allocation to the risky asset and 0.79 for the standard deviation).

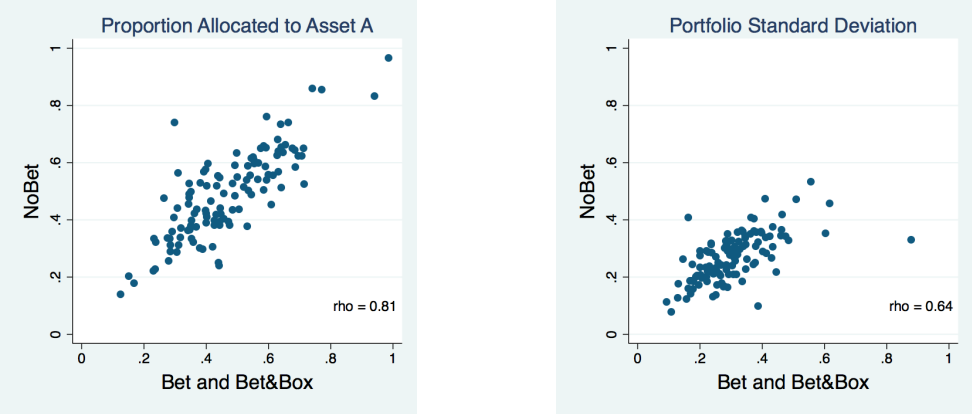

Figure 6. Comparison of subjects' allocation of risk between treatment **NoBet** and treatments **Bet** and **Bet&Box** (pooled): proportion allocated to the risky asset A (left) and average overall standard deviation of the portfolio (right)

wealth. In sum, the results suggest that the overall risk attitudes are fairly consistent in the experiment and decoupled from the decision to purchase lottery-like assets.

3.3 Effects of wealth and end of period

Subjects in our experiment buy more bets when they are richer. To see this, we study within-subject heterogeneity in bet purchases as a function of wealth. More precisely, for each individual we remove the observations where she has less than \$1 (and therefore cannot buy a bet) and group all her other observations in wealth quintiles. We then determine the frequency of bet purchases when her wealth falls in each of these quintiles.[13] Figure 7 (left) depicts this information separately for **Bet** and **Bet&Box**. In both treatments, the frequency of bet purchases is significantly higher when subjects are in their top wealth quintile (t-test, $p < 0.001$ for all pairwise comparisons between the top quintile and the others). Interestingly, it is also significantly higher in the bottom quintile compared to second and third in **Bet** (t-test, $p < 0.001$ for first v. second quintile and $p = 0.003$ for first v. third quintile, respectively). This indicates a tendency in that treatment to invest in the skewed asset when wealth is "extreme." However, the fact that this happens only in the **Bet** treatment prevents us from drawing stronger conclusions.

One striking result is the tendency of subjects to buy bets in the last period of every path, a feature that persists throughout the experiment. This is illustrated in Figure 7

[13] We opt for a within-subject quintile analysis to mitigate the confounding of wealth heterogeneity with subject heterogeneity.

(right) which shows that the bet frequency is significantly higher in period 10 than in any other period (t-test, $p < 0.001$ for a comparison between bet frequency in period 10 and any earlier period, overall and by treatment).

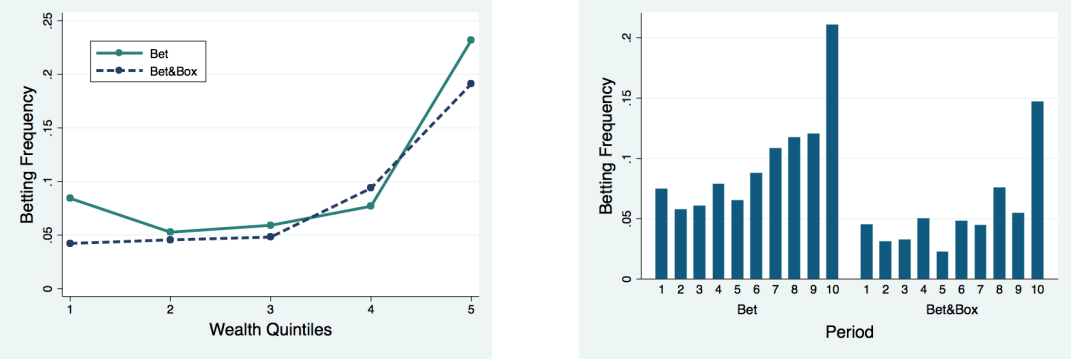

Figure 7. Frequency of bet purchase by wealth level with observations grouped in within-subject wealth quintiles (left) and frequency of bet purchases by period in the **Bet** and the **Bet&Box** treatments (right).

A possible explanation for this trend could be that subjects bet more at the last minute simply because they are richer at that point. After all, wealth substantially accumulates over the periods of a path. However, we find that the last period effect is independent of wealth. Figure 8 depicts the frequency of bet purchases in periods 8, 9 and 10 by wealth quintile, as defined previously. A test of differences shows that the last period effect is present in all wealth quintiles, with the exception of periods 8 v. 10, quintile 4 v. 5. (t-test, $p < 0.005$ for the comparisons between periods 9 and 10 in all quintiles and between 8 and 10 in quintiles 1 through 4).

3.4 Summary

Our analysis delivers two main results. First, there is significant betting that decreases over the course of the experiment as well as large heterogeneity in betting behavior across individuals. This suggests that studies based on one (or few) opportunities for skewed investments may provide an upward biased estimate of the willingness to gamble. Second, and most importantly, subjects who bet often do not behave as risk lovers with the remaining wealth, as the associated risk preferences would prescribe. Instead, they treat the bet as a small disposable income, while they "wisely" invest the rest. Betting is also more frequent when wealth is higher and at the end of the path. This behavior indicates that bet purchases are driven by sentiment rather than stable risk preferences.

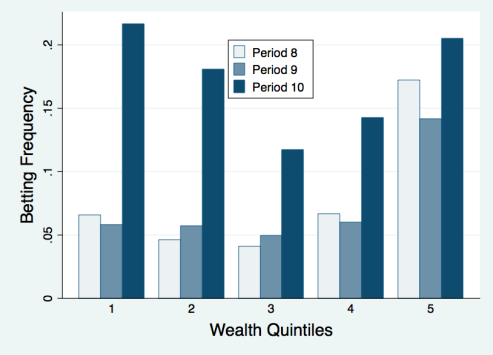

Figure 8. Comparison of betting frequency in periods 8, 9 and 10 of each path, separated by wealth quintile.

4 Feedback

We next analyze the relationship between observing the performance of other subjects and their subsequent portfolio allocation decisions. From the perspective of expected utility maximization, relative wealth is irrelevant to portfolio choice: since subjects' asset returns are statistically independent across individuals, information about peers' holdings carries no decision-relevant content. Feedback collection depends on whether we think there is a (small) cost of opening boxes or a (small) benefit of satisfying curiosity. Either way, it should not impact subsequent choices.

Instead, we find that the vast majority of our subjects open a box whenever the option is available. Indeed, only 2 subjects never open a box. On the other extreme, 65% of subjects open a box in all 20 occasions and 86% open at least 90% of the boxes. Subjects open boxes with equal frequency in periods 5 and 9 and in all investment paths.

4.1 Wealth and feedback

We study the reasons why subjects decide to collect feedback, why they choose a particular type of feedback, and how it affects their subsequent behavior. Only 17 subjects open always the same box while 98 switch between boxes (and 2 never open any). A natural possibility is that subjects try to figure out how far they are from a situation of interest, which may be a specific position (e.g., the average) or it may depend on the subject's own performance (e.g., check that they are not the poorest when they fear it might be the case, and figure out if they are the wealthiest when they are likely to be). To test this hypothesis, we study lookup patterns of subjects by wealth quintile (we keep all

observations in **Bet&Box**, including those in which wealth is smaller than \$1). Figure 9 depicts the lookups in each box.

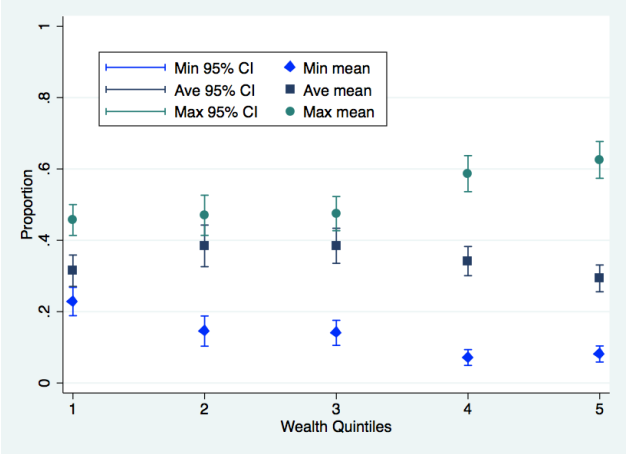

Figure 9. Proportion of times that the Min, Ave and Max boxes are opened by wealth quintile (mean and 95% confidence interval).

Subjects are systematically more likely to open Max than Ave and Ave than Min. This trend holds independently of wealth levels. However, the likelihood of opening Min decreases with wealth, the likelihood of opening Ave is hump-shaped in wealth, and the likelihood of opening Max increases with wealth. This suggests a relationship between wealth and lookups and provides some support for the two hypotheses previously mentioned: subjects are intrinsically more interested in finding out what is the maximum wealth currently held in the session while, at the margin, they look more often at the box they believe is closest to their own wealth. To investigate more formally this effect we create three dummy variables (Min, Ave, Max) and regress each of them separately on wealth and a number of control variables. We find that wealth has a significant positive effect on Max lookup, no significant effect on Ave lookup, and a significant negative effect on Min lookup (results omitted for brevity but available upon request).

4.2 Effect of feedback on bet purchases

The first noticeable result is a negative relationship between viewing feedback and betting. Indeed, the percentage of bets purchased in **Bet&Box** is significantly higher in period 4 than in period 5 (0.041 vs. 0.018, p-value = 0.001) and marginally higher in period 8 than in period 9 (0.059 vs. 0.043, p-value = 0.074).

We next study whether feedback is associated with the subsequent decision to purchase a bet. To this purpose we consider a very simple binary partition of feedback. For subjects who open the Min, Ave and Max boxes, we say they "lead", if they learn that they are above minimum, above average and at maximum, respectively. By contrast, we say they "lag" if they learn that they are at minimum, below average and below maximum, respectively.[14] Figure 10 reports the percentage of times subjects bet when they lag vs. lead as a function of the box they open.

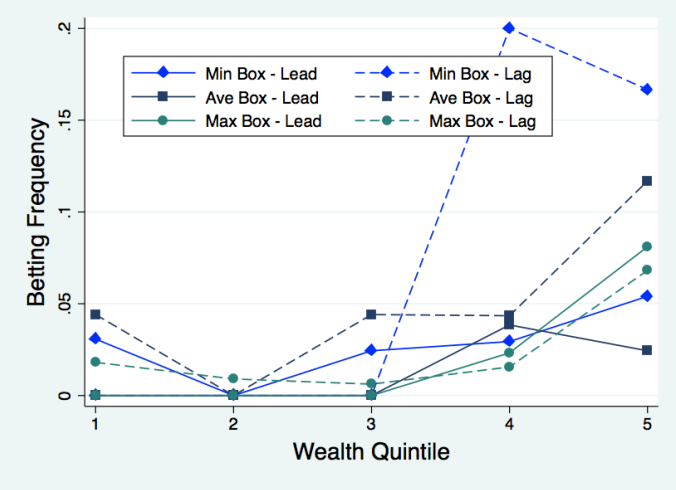

Figure 10. Betting frequency in periods when the boxes have been viewed (5 and 9) by wealth quintiles and lookup when lag (dashed lines) vs. lead (solid lines).

Consistent with previous results, subjects rarely bet when their wealth is low (first and second quintile) independently of their information. Subjects with average wealth (third quintile) increase moderately their betting activity when they learn that they are below average (t-test of lag-lead difference, $p = 0.032$). Most of the increase, however, occurs for high levels of wealth and unexpected news. A subject in the top quintile bets more when she discovers that her wealth is below average (t-test of difference, $p = 0.001$) or at the minimum, although that difference is not statistically significant due to the small number of observations. This last result becomes significant if we combine quintiles 4 and 5 (t-test, $p = 0.035$).

[14] Obviously, a subject who opens Max is likely to be coded as "lag" even when she has high wealth a subject who opens Min is likely to be coded as "lead" even when she has low wealth. In that respect, this is just one simple, imperfect cut of the data. We have performed a similar analysis where we look at distance between wealth and information and obtained similar conclusions.

Finally, we present a Probit regression of the probability of purchasing a bet on the feedback obtained (lead or lag) controlling for wealth, box opened (Min, Ave, Max) and different sources of heterogeneity. We capture the intrinsic risk attitude with the average fraction of wealth invested in the risky asset in the **NoBet** treatment, and we control for the period where the box is open (5 or 9). The results are presented in Table 1.

	Prob. of bet purchase	
Lead (dummy)	-0.324 *	-0.304*
	(0.168)	(0.160)
Wealth	0.043 ***	0.039 ***
	(0.011)	(0.010)
Ave (dummy)	-0.048	-0.038
	(0.222)	(0.228)
Max (dummy)	-0.336	-0.332
	(0.227)	(0.242)
Period 9 (dummy)	—	0.405***
		(0.143)
% asset A in **NoBet**	—	-0.141
		(0.665)
Constant	-1.552***	-1.707 ***
	(0.210)	(0.364)
N	1099	1099

*, **, ***: significant at the 10%, 5% and 1% level.

Table 1. Behavior following feedback. Results are from a probit model with bet purchases as the dependent variable. Standard errors clustered at the subject level are reported below the coefficients. Results are similar if we include in the sample the subjects that did not place bets in the last treatment (N = 2061).

Consistent with the previous evidence, subjects are more likely to purchase bets when their wealth is high and they learn they are lagging behind. Bet purchases are also higher in period 9 than in period 5. By contrast, the type of box open and the risk attitude in the first treatment are not predictive of bet purchases. We obtain similar findings when, instead of using the lead/lag binary variable, we consider the actual difference between own wealth and wealth revealed in the box (results not reported here but available upon request).[15]

[15] Although we control for box selection and subjects' risk attitudes, whether an individual receives lag or lead feedback is endogenously determined by her prior choices and outcomes, rather than randomly assigned. Therefore, the estimates in Table 1 should be interpreted as conditional associations rather than causal effects.

4.3 Summary

Our subjects are curious about the performance of others. They have a preference to learn the highest payoff in the population but also the wealth of the individual closest to their perception of their own standing.

On aggregate, opening boxes decreases the likelihood of betting. However, subjects who are in an investment path where they accumulate equal or more wealth than they typically do and nevertheless learn that they are below average or the poorest in the session significantly increase their tendency to buy the bet. Overall, the evidence suggests that subjects use the lottery asset as a tool to outstrip their peers. This result is in line with the predictions that portfolio choices may be driven by the quest to attain status or higher aspiration levels (Roussanov (2010), Krasny (2011), Aristidou et al. (2025)).

5 Conclusion

In this paper, we design a controlled laboratory experiment in which subjects dynamically allocate their portfolio among a safe asset, a risky asset, and a skewed asset with negative expected value. We document substantial heterogeneity across subjects: 16% never purchase the skewed asset, 29% learn to stop purchasing it over the course of the experiment, and 55% continue to buy it throughout. Interestingly, skewness seeking does not vary systematically with subjects' risk preferences. Indeed, those who allocate heavily to the risky asset in the absence of the bet are no more likely to buy the bet when it is available. Risk attitudes remain stable across treatments, but are simply not predictive of skewness demand. On the other hand, bet purchases among persistent buyers are significantly more frequent in the last period of each investment cycle, when subjects are wealthiest and, to a lesser extent, when they are poorest. These patterns are best understood as state-dependent responses heavily driven by investors' sentiments.

We also find that subjects care deeply about their social standing. They systematically seek information about the performance of others, with the type of feedback they request varying with their own wealth level. In particular, subjects who have accumulated relatively high wealth but discover they are lagging behind their peers significantly increase their propensity to buy the skewed asset. This social-comparison effect is a further illustration of context dependence: skewness seeking is triggered not by an intrinsic preference but by a specific combination of absolute wealth and relative standing.

While our design is not intended to (nor suitable for) a structural estimation of existing

non expected utility models that generate a preference for skewness (such as, for example, Epstein and Zin (1989), Chew and Tan (2005) or Koszegi and Rabin (2009)), we think that some of our findings may open avenues for future research. First, in our experiment the initial demand for a skewed asset drops, suggesting that the experience of lottery outcomes affects its subsequent demand. This result should be instructive for future experiments assessing preference for skewness. More broadly, it should be informative when estimating the demand for financial products incorporating lottery-like features such as state lotteries or prize-linked savings (PLS) accounts. Recent field evidence from Lockwood et al. (2025) reveals that a substantial portion of lottery demand is strongly positively associated with behavioral biases, specifically innumeracy and poor statistical reasoning. While their findings highlight the important role of cognitive errors in driving demand, our results suggest that these biases may not be permanent.

Second, the substantially higher purchases in the last period raise the question of what is deemed to be the "last period," especially in the cases where the end point may not be a salient feature of the investment cycle.[16] More broadly, our findings suggest that any institutional or contractual feature that creates a salient end-point, such as annual performance reviews, fiscal year-end accounting, or tournament-based compensation, may trigger elevated skewness-seeking behavior.

Third, while our results are consistent with a role for wealth in driving skewness-seeking behavior, our design does not provide sufficient variation to identify this effect causally at the individual level. Future research could address this limitation by exogenously varying subjects' wealth endowments, thereby enabling a cleaner test of the relationship between wealth and skewness seeking.

Lastly, we find that subjects are primarily interested in monitoring their expected relative standing and frequently use bets as a means of narrowing the gap with their peers. An important question for future research is whether this behavior is driven by concerns about aspirations and status or by a desire to reduce inequality.

[16] For example, Thaler and Ziemba (1988) suggested that underperforming portfolio managers may take more long-shot investments as the year draws to a close. For the analysis of investment funds on this topic, see Brown et al. (1996) and Lin (2011).

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Appendix A. Instructions

Note: The following instructions are accompanied by a slideshow presentation. Slides available upon request.

We are about to begin. Please put your cell phones and other electronic devices in your bag and do not use them until the end of the experiment.

Dear Participants,

Welcome and thank you for coming to this experiment. You will be paid for your participation, in cash, at the end of the experiment. You will remain anonymous to me and to all the other participants during the entire experiment; the only person who will know your identity is the person in the other room who is responsible for paying you at the end. Everyone will be paid in private and you are under no obligation to tell others how much you earned. The entire experiment will take place through the computer terminals.

Let us begin with a brief instruction where you will be given the complete description of the experiment and shown how to use the software. Please, pay attention to the instructions, as it is important for you to understand the details of the experiment. There will be a quiz at the end of the instructions that everyone needs to answer correctly before we can proceed to the actual experiment. Participants who are unable to answer the quiz will not be allowed to participate in the experiment. If you have any questions during the instruction period, raise your hand and your question will be answered so everyone can hear. If any difficulties arise after the experiment has begun, raise your hand, and an experimenter will come and assist you. If you cannot see the entire projection screen, please come forward as it is important for you to see the entire screen.

Today, we will ask you to make investment decisions. Your final payment consists of a $5 show-up fee plus your investment earnings. Those earnings depend both on the choices you make and on luck. The choices of other participants do not affect your payoff in ANY way, at ANY point in the experiment and your choices do not affect their payoff. The entire experiment is split in 3 parts. I will now give you instructions for Part 1. You will get additional instructions before Part 2 and Part 3.

PART 1

Let me first summarize the investment process and then we will go through each step in more detail. You will start with an initial amount of money that you will be able to invest in two assets, A and B. You will have 10 periods to invest. At each period you will decide how to allocate your money between the two assets. At the end of each period, you will earn returns from that period's investment in each asset. The two assets will pay differently, and later in the instructions I will explain what to expect from each asset. After period 10, the process ends and the computer will record your final money amount. This process of 10 investment periods is called an investment path. At the start of each path, your money will be reset to the initial amount.

In Part 1 you will complete 15 of these paths. Consequently, there will be 15 final amounts of money, one for each path. The computer will randomly select one of these 15 final amounts. The selected amount will be your payoff for Part 1. Are there any questions? Let me now walk you through the procedure step by step.

The Initial Endowment: This is a screenshot of what you will see on your computer at the beginning of each path, that is, in period 1 of each path. In each path you start with $3, this is your initial endowment. This amount is displayed on the left side of the screen in the box labeled "Account". It is also represented by the height of the bar in the middle of the screen. There is a grid in the background to help you get a sense of the bar's height.

Periods and Timing: As mentioned earlier a path is made of 10 periods, starting at 1 and ending at 10. The sequence is displayed on the bottom of the screen and your current period is displayed in the upper left corner. Each period is an opportunity for you to invest. A period ends when the time runs out. You can see the timer on the left hand side. For the first period in each path you will have 10 seconds to make your investment decision. For the other periods in the path, that is, periods 2 to 10, you will have 6 seconds to make your investment decision.

Investing: Let me show you with a short video how to make your investment.

Step 1. Choose display. To start your investment, you first need to click on one of the two boxes at the bottom, the ones labeled with percentage and dollar signs. These boxes control how your allocation between assets A and B is displayed: in percentages or dollar terms. You have to click one of the boxes in period 1 of each path. You can also change the display anytime simply by clicking on the other box. Select whichever box you find convenient and change it anytime you want.

Step 2. Activate the bar. Now you can activate the investment bar. Click anywhere on the light gray bar to activate it. Notice when the bar is light gray it means that your money is not invested in either asset. If the bar stays that way after the period ends, you will earn zero interest on your money: the same amount will just be transferred to the next period.

Step 3. Choose the allocation. Once you activate the bar you will notice that it is split between two colors: the top is light blue, and the bottom is gray. The top represents the amount of money allocated to Asset A, and the bottom represents the amount of money allocated to Asset B. Now you can see the display I previously mentioned. It shows how much money you have allocated to A and B either in dollar or in percentage terms. This example shows the dollar display. You can change the allocation between A and B in two ways: by holding the horizontal bar and moving it up or down or by clicking on the bar, as you can see in the video. Once you are satisfied with the allocation wait until the period ends.

Step 4. Proceed to the next period. When the period ends, a new gray bar will appear showing you the new amount. Here is the transition from period 1 to period 2. Your new amount will be the sum of the money you earned on both assets A and B and it will be shown on the left where your initial money amount was displayed. The new height of the bar will also represent this amount. Be aware that the background grid can be re-scaled to accommodate changes in the bar, so pay attention to the figures written on the grid. The last period's bar will become inactive but you will still be able to see your past allocation between assets A and B. Remember that you need to activate the bar and choose an allocation between A and B at every period, otherwise you earn no interest. Here is a period 2 allocation process and the transition to period 3. Notice how I changed the display from dollars to percentages. This process continues until period 10. After period 10, the path ends. Here is a screenshot of one path end. Your final amount will be shown in the box on the left and by the height of a green bar on the right. A message will appear informing you that the path ended. You need to click the "OK" button to continue. A new path will start shortly thereafter.

Assets A and B: Let me show you what to expect from the investment in each asset. In the upper left corner of your screen there is a box that reads "Asset A: mean return 6%, standard deviation 55%"; "Asset B mean return 3%". These numbers show how your investment in each asset grows and they will not change during the entire experiment.

Asset B: The 3% next to Asset B in the box means that, once the period ends, the amount allocated to Asset B will grow by 3% for sure. The interest rate of 3% will not change throughout the duration of the experiment. A reminder: money in Asset B is represented by the bottom,

GRAY portion of your active bar. Here is an example: if you have 2 dollars invested in B you will have 2 dollars and 6 cents in the next period. If you keep that money in B you will then have 2 dollars and 12.2 cents the period after. You can think of your money in Asset B being multiplied by 1.03. Note that 2 dollars is just an example. In the experiment you can choose any allocation you want provided it does not exceed your total amount.

Asset A: Contrary to asset B, your return on asset A is uncertain. Technically, the return on asset A has a Normal distribution with mean 6% and standard deviation 55%, as shown in the upper left box. This means that asset A grows by 6% on average. However, it may be more or it may be less. In particular, the growth rate could be negative. In this case the money you invested in Asset A will shrink. Although the return can be negative, the amount of money you hold on asset A can never go below zero. A reminder: money in Asset A is represented by the top, LIGHT BLUE portion of your active bar.

Another way to think about the return on this asset is that the amount you put in asset A will be multiplied by some positive number. On average, this number will be 1.06 which corresponds to a 6% growth. Let us call this number a multiplier. If the multiplier is less than 1, it means that your investment in Asset A shrinks. For example, if you allocate $2 to asset A and the multiplier turns out to be 0.8, you will have $1.6 in the next period. If the multiplier turns out to be 1.5, you will have $3 the next period. Here is a chart showing the probability of your multiplier being in a given range. With 20% chance it will be somewhere between 0 and 0.67. With 30% chance it will be somewhere between 0.67 and 1.06. With another 30% chance it will be somewhere between 1.06 and 1.7. Finally, with 20% chance it will be above 1.7. Once the period ends and you receive the returns on your assets, the box on the left marked "Last Period Multiplier" will show what turned out to be the multiplier for asset A in that period. The box will show always 1.03 as the multiplier for asset B.

Projection Bar: The returns from asset A obtained after several periods depend on many factors. In order to help you get an idea of the range of outcomes, we placed a projection bar at the end of the screen. Let me explain how the projection bar works. Suppose for example that in the first period you invest $2 in Asset A. If you keep the returns on that same asset, how much money will you have at the end of the 10th period? Observe what happens on the left hand side of the graph. It is a simulation of your return. The vertical axis represents dollars and the horizontal axis the periods. It begins with 2 dollars in the first period and it ends after 10 periods. Here is one potential final amount of money. But it can also be this. Or this. Or this. Notice that each time a path ends, we keep track where it lands by adding a dot on the right graph. Each dot represents a possible final amount of money. If we run enough paths, all with $2 invested in asset A, we will get a bunch of dots on the right end. The more dots each dollar region has, the more likely your amount of money will end up there. And that's exactly what the bar represents: the likelihood of your earnings ending up in a certain amount.

Now look at the example in the picture. It is period 4. Look at the projection bar. For the current investment strategy, the lower gray part is the projection of how much you will earn on asset B if you don't change the allocation between assets until the end of the path. In this case, you will earn 1.89 dollars on asset B. This amount is for sure since there is no uncertainty on this asset. The upper part shows the projected earnings on asset A if you don't change the allocation between assets until the end of the path. They correspond to the dots shown in the video. There is a 20% chance that the final amount lands in the white area above the gray one, a 60% chance that it lands in the dark blue area and another 20% chance that it lands above the dark blue area. Finally, there is a thick line showing the median, in this example, 16 dollars and 64 cents. This

means that with a 50% chance your final amount will be somewhere below that number and with a 50% chance it will be somewhere above that number.

Notice also from our demonstration that probabilities are different within a segment. For example, receiving an amount above the dark blue area has a 20% chance, but within this 20% it is more likely to be close to the dark blue area than further away. In other words, it is more likely to get this payoff [point to the slide] than this payoff [point to the slide], although both are possible. You can see this point more clearly on the frequency table. Based on the number of circles, it is more likely that your payoff will end up here [point to the slide] rather than [point to the slide] here, even though both of these areas correspond to the 20% region above the projection bar.

Important Points:

1. The projection bar shows the likelihood of different final earnings at the end of the path ASSUMING the amount you receive from each asset is reinvested in the same asset in all the following periods. However, you can change the allocation between assets at every period.
2. At each period, the projection bar recalculates the probabilities. If you move the cursor up and down within a period, the bar shows instantly the new projection.
3. The multipliers on asset A are independent across periods. In other words, the multipliers of previous periods will in no way impact the multiplier in the current period. For example, if the multiplier in a previous period was very high, it does not mean it will be high again. The new multiplier will simply follow the rules of uncertainty described before.
4. All the participants start and end the paths at the same time. The clock starts as soon as the screen appears, so pay attention.
5. The multiplier for asset A in each period is the same for all participants. So, for example if the computer chooses 2 as a multiplier in period 4, it means that all participants will have their investment in asset A doubled.

Are there any questions? If not, let us proceed to 5 practice paths. What you earn on these paths will not count towards your payment; these are meant only for you to familiarize yourself with the entire process of allocating money between assets A and B. Feel free to explore as many investment strategies as possible to better understand the different options.

Please double click on the icon on your desktop that says ABC STUDY. When the computer prompts you for your name, type a 4 digit number that you can easily remember. Please do not forget the number you typed. Then click SUBMIT and wait for further instructions.

Pay attention to the screen. The first practice path will be starting soon. Focus on understanding how to choose the display between percentage and dollars, how to activate the bar, and how to change the allocation between assets. Reminder: Once a path ends, you need to click the OK button in order to proceed to the next path.

[START game] [Complete practice path 1]

You have now completed practice path 1. Are there any questions? Let's proceed to practice paths 2 and 3. Now try to explore different investment strategies to get a good understanding of the investment process.

[Complete practice paths 2 and 3]

You have now completed 3 practice paths. Are there any questions? If not, we will proceed to a short quiz. Please pay close attention to answering the questions, as you will not be permitted

to continue with the experiment if you do not answer the questions correctly. Raise your hand if you have any question during the quiz.

[Complete quiz]

You have now completed the quiz. Let us proceed to the last 2 practice paths.

[Complete practice path 4 and 5]

You have now completed practice paths 4 and 5. Are there any questions? Before we start please write down your ID on your record sheet in front of you. You will locate your ID on the left side of your window bar. You will have to present the record sheet to get paid at the end of the experiment. Did everyone right their IDs down?

Let me remind you how you will be paid for Part 1. At the end of the experiment, the computer will randomly select one of the 15 paths and you'll be paid the final amount you earned in that path. Are there any questions? If there are any problems or questions from this point on, raise your hand and an experimenter will come and assist you. We are ready to start the experiment. Please pull out your dividers.

PART 2

You have now completed Part 1 of the experiment. Please push in the dividers.

You will now undertake 10 paths in Part 2 and another 10 paths in Part 3 of the experiment. At the end of Part 3, the computer will randomly select one of these 20 paths and you'll be paid the final amount in that path. This amount will be added to your show-up fee and to the final amount in the randomly selected path from part 1.

The rules in part 2 are similar to the rules in part 1. You start each path with \$3, there are 10 periods in each path, and you allocate your money between the same assets A and B as before. There are however two differences. First and as already mentioned, there will be 10 paths rather than 15. Second, besides investing in assets A and B, you can now use part of your money to invest in a third asset, asset C, located on the lower left side of the screen. You can buy at most one unit of asset C in each period. You can make this investment by clicking the 'buy' button [S 18c]. Asset C costs \$1. So, if you decide to invest in it, \$1 will be deducted automatically from your current amount of money, and the bar will shrink accordingly. In case you had already made your allocation between A and B prior to purchasing the asset, the money will be taken out of your two investments proportionally. For example, if you had 60% in Asset A and 40% in Asset B, 60 cents will be deducted from Asset A and 40 cents will be deducted from Asset B. Once the asset is purchased the button is disabled. The button is also disabled if you do not have enough funds to buy the asset, that is, if the amount of money you currently have is less than \$1.

If you purchase asset C, you will have a 4% chance of receiving \$20 and a 96% chance of not receiving anything. This information together with the cost of the asset is displayed above the 'buy' button and will remain constant for the rest of the experiment. At the end of the period, you will find out if you received the \$20. The result will be displayed under the label 'previous result'. If you receive the \$20, that amount is automatically added to your next periodÕs amount of money. You can then re-invest that money between assets A, B and C under the same set of rules.

Important point. Suppose several participants purchase asset C in the same period. Then, whether one participant receives \$20 or not is independent of whether the other participants receives the \$20. In other words, knowing the outcome of your asset C does not tell you anything about the outcome of asset C for the other participants. It does not tell you either about the likelihood of receiving \$20 in a future period: this chance is always 4% independently of past realizations.

Are there any questions? If not, please pull out the dividers and let us proceed to 1 practice

path. What you earn on this path will not count towards your payment. Please use this practice path to familiarize yourself with the new asset, asset C.

We have now completed the practice path. Are there any questions? If not, let us proceed to 10 paths in Part 2.

PART 3

You have now completed part 2 of the experiment. Please push in the dividers.

This is the last part of the experiment. It consists of 10 paths. It has the same rules as Part 2, with one addition. In Part 3, you can learn about the performance of other participants in the experiment. More precisely, in the lower left corner of the screen, there are 3 boxes labeled, 'Lowest', 'Average', 'Highest'. They hold the information as to how much is the lowest, the average, and the highest current amount of money among the participants in this session. The boxes, however, do not reveal the identity of the participants with those amounts. If you wish, you can open one of these boxes by clicking on it. You will be able to open one of the boxes only in periods 5 and 9. In those periods, you can open always the same box or you can open different boxes each time. You can open at most one box but you can also decide not to open any box. Opening boxes is for information only. They do not affect the returns on your assets in any way or the returns on the assets of any other participant. When available, the boxes will appear in the lower left corner of the screen just as shown here.

Remember that you can only open a box in periods 5 and 9. In periods 1, 2, 3, 4, 6, 7, 8 and 10 the boxes will not appear on the screen.

Are there any questions? If not, pull out the dividers and let us proceed to 10 paths in Part 3.

The experiment is now over. Your payoff is displayed on the screen. Please write down the payoff from both Part 1, displayed as subset 1, and Parts 2 & 3, displayed as subset 2, onto your record sheet. Write down the total by adding the $5 show-up fee to the sum. We will round up to the nearest quarter.

Lastly, please fill out the questionnaire you see on the screen. Reminder: You remain anonymous to the experimenter. Please submit your answers once you are finished. Once you submit your answers, please put the mouse on the side of the computer and do not use either the mouse or the keyboard.

QUIZ (accompanied by a display print-out):

1. Look at the display on the paper in front of you. What is the current period?

   (a) 1
   (b) 2
   (c) 6 (correct)
   (d) 8

2. Had the person not chosen any allocation between assets A and B, how much would she have in the next period?

   (a) $1.44
   (b) $4.16
   (c) $5.60 (correct)
   (d) $7.29

3. In this period, how much has the person invested in Asset A?

   (a) $5.60
   (b) $4.16 (correct)
   (c) $1.44
   (d) $0.81

4. Assume this person keeps reinvesting the returns of asset A in A and the returns of asset B in B until the end of the path. Given the current allocation, how much money will this person have in asset B after the path ends?

   (a) $1.67 (correct)
   (b) $1.44
   (c) $1.03
   (d) $7.29

5. Assume this person keeps reinvesting the returns of asset A on A and the returns of asset B on B until the end of the path. Given the current allocation, how much money will this person have in asset A after the path ends?

   (a) $7.29
   (b) $5.60
   (c) $18.00
   (d) Cannot be determined with certainty (correct)

6. Forget about the display. Imagine you invest $1 in Asset A and $1 in Asset B and suppose the multiplier on Assets A and B are 2.00 and 1.03 respectively. How much money will you have in the next period?

   (a) $3.03 (correct)
   (b) $4.00
   (c) $5.03
   (d) Cannot be determined from the information given.

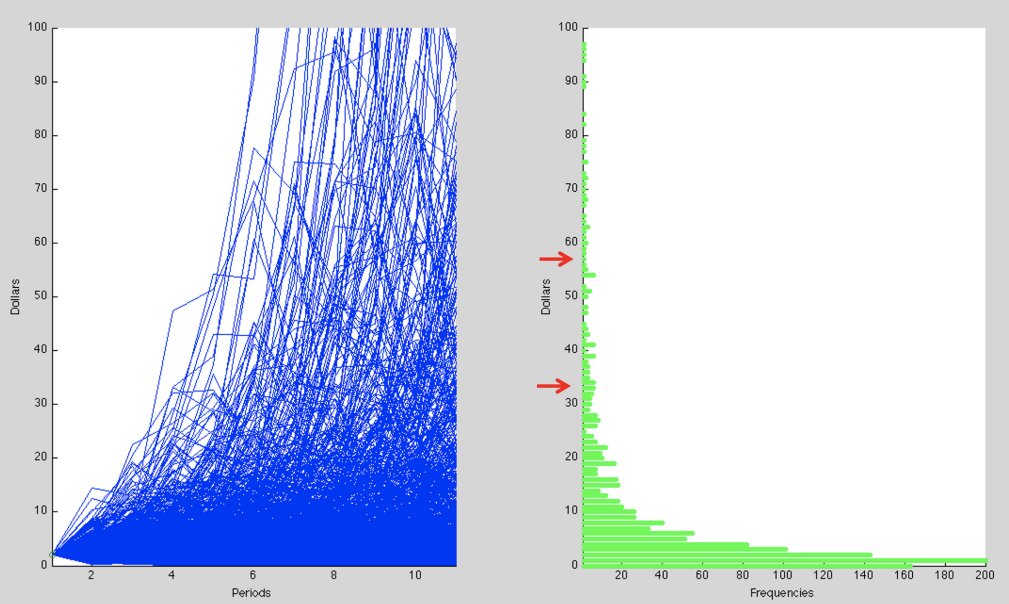

Figure 11. Screenshot from the instructional video explaining the function of the projection bar (see instructions above), which displays the potential distribution of final payoffs. The video simulated numerous possible investment paths generated by a given investment strategy. After each simulated path concluded, a dot was placed at the endpoint representing the corresponding final payoff. Repeating this process generated an empirical distribution of possible outcomes, which participants could then compare to the projection bar displayed during investment decisions. Two red arrows are pointing to corresponding lines on the bar that split the distribution.

Appendix B. Standard Deviation of the Portfolios

To better understand the differences in behavior, we compute the standard deviation of the portfolio of each subject in each treatment. The standard deviation is calculated using the ex-ante variances of all the assets and their respective weights in the portfolio. The left graph of Figure 12 reports the average results by groups G1-G3, defined in the main text. Although the differences in variance across groups in the **NoBet** treatment are statistically significant (t-test, $p < 0.001$), the levels are very similar (0.24, 0.28 and 0.27). When comparing across treatments, we notice that for G1 the variance is nearly constant for the entire experiment. The standard deviation actually fell a little in the latter two treatments (from 0.24 to about 0.23, t-test, $p < 0.001$). For G2 it increases between **NoBet** and **Bet** from 0.28 to 0.3 and then and then levels down in **Bet&Box** to 0.27 (for all differences t-test $p < 0.002$). For G3 it increases from 0.27 to 0.36, and then falls down somewhat to 0.33 which is still considerably higher than the **NoBet** treatment (t-test across all differences, $p < 0.001$). Overall, variance mimics the evolution of bet purchasing behavior in the groups, which suggests that when subjects invest in asset C they do not change significantly the allocation of their remaining wealth between assets A and B, although the bet purchases do increase the average variance of the portfolios. This jump in the variance is especially prominent in period 10. The right graph of Figure 12 shows that for the last two treatments subjects from groups G2 and G3 increase significantly the volatility of their portfolio in the last period (t-test $p < 0.001$ significantly higher for latter two treatments compared to the **NoBet**).

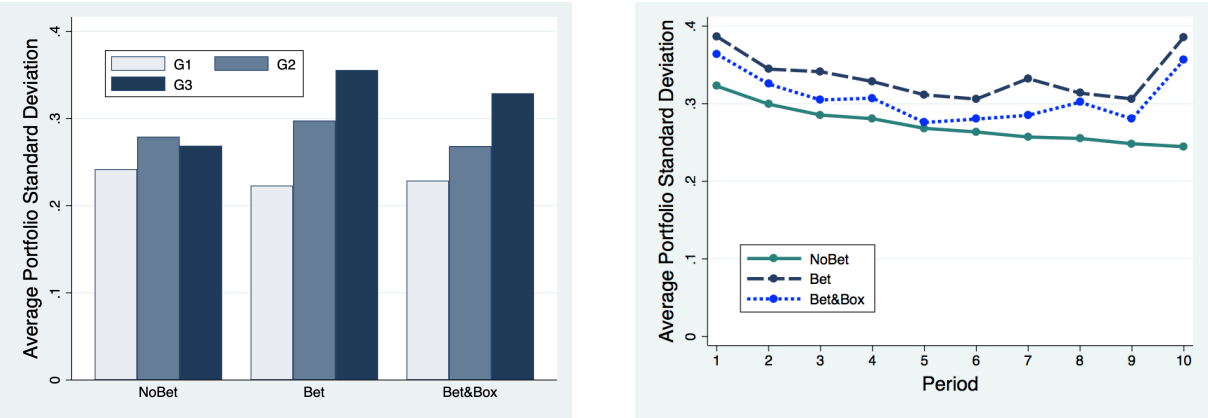

Figure 12. Standard deviation of portfolios across three treatments and groups (left) and across periods (groups G2 and G3)