Perceived Attractiveness of Structured Financial Products: The Role of Presentation Format and Reference Instruments

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Abstract

Structured equity-linked products hold a strong position in the asset universe in Europe although they are often considered to be overly complex. Their risk and return profile is typically presented by simple payoff diagrams and verbal descriptions. We propose to complement the payoff diagrams with information on the payoff's probability distribution and study different presentation formats in an experimental setting with multiple investment decisions. We introduce a flexible framework for designing tailor-made products, which allows us to implement a part of the experiment as an interactive exploration in which the participants experience the risk-return tradeoff and the role of different features of structured products. We find that displaying probability histograms can have a strong effect on the perceived attractiveness of the products by revealing the loss probability. In contrast to common practice, our results suggest that the reference instrument shown in graphical displays should be risk-adjusted to match the risk of the structured product. Otherwise, a preference for lower risk might be misinterpreted as a preference for a specific return profile. These findings can be used to improve information documents for investors such as the "Key Information Document" required by European regulation.

JEL classification: D81, G11, G14, G24

Keywords: Structured products, investment decisions, presentation format, risk perception, asset allocation

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1 Introduction

Even though structured equity-linked products attracted a considerable amount of criticism during the financial crisis of 2007 to 2009, they have maintained a strong position in the asset universe in Europe, accounting for a market value of USD 650 billion at the end of 2014 (SRP, 2015). The variety of structured products has increased strongly since their inception in the early nineties, and some of the most popular products have a complex, nonlinear payoff structure. This raises the question whether investors fully understand the product characteristics. When the structured products issued by Lehman Brothers defaulted in the wake of the bank's bankruptcy, it became evident that many investors had not been aware of the credit risk involved. Prior research also provides evidence that investors generally do not have a balanced view of products' risk and return characteristics (Lindauer and Seiz, 2008; Rieger, 2012; Rieger et al., 2014; Wallmeier and Diethelm, 2009, 2012). The issuers might even have an incentive to choose a product design that exploits the behavioral biases of investors (Ofir and Wiener, 2012; Hens and Rieger, 2014; Kunz et al., 2017).

Whereas new products have become increasingly complex, the way they are presented – typically by means of a simple payoff diagram and a verbal description of the investment risks involved – has hardly changed. In recent years, following a proposition of the German Derivatives Association and the Swiss Structured Product Association, a risk score has been introduced in Germany and Switzerland, which is now available for most of the structured products traded on the Swiss and German exchanges. The score ranges from 1 to 5 in Germany and 1 to 6 in Switzerland. It is based on a value-at-risk (VaR) approach using historical simulation with daily returns, a confidence level of 99% and a holding period of ten days (DDV, 2017; SVSP, 2015). This risk score appears to be easy for even inexperienced investors to grasp. However, VaR does not capture the particular shape of the return distribution of structured products, and the holding period of ten days does not correspond to the typical investment horizon, which is much longer. Therefore, VaR is of limited use in characterizing the risk-return profile of structured products.[1] A natural way to illustrate this profile would be to complement the payoff diagram with information on the payoff's probability distribution. This approach has been followed in asset allocation studies (see, e.g., Weber et al., 2005) but not in investment decisions about

[1] See Cao and Rieger (2013) for an extended discussion on the limitations of VaR as a risk measure for structured products.

structured products. This extension is the focus of our paper.

Our first research question is: Do investors perceive the attractiveness of structured products differently when the payoff profile is complemented with an illustration of the payoff probability distribution, and is the way in which the probability distribution is shown important? We hypothesize that the probability distribution matters and allows for a better understanding of the risk-return profile than the payoff diagram and verbal descriptions alone. The presentation must be intuitive and easy to comprehend.

Our second research question is as follows: Does an adequate illustration of probability distributions help investors differentiate between a particular structured product and a simpler strategy in which the underlying asset is combined with a risk-free asset to achieve a similar combination of risk and return? We hypothesize that one reason for the perceived attractiveness of structured products is that they are evaluated with respect to an inadequate reference instrument. For example, payoff diagrams and verbal descriptions often compare a capital protection product with a pure investment in the underlying asset. If investors prefer the capital protection instrument in this comparison, this might simply indicate a preference for lower risk. Thus, a suitable reference point would be a combination of the underlying asset with a risk-free asset. The presentation format can help to highlight the remaining differences and identify the better alternative.

To study our research questions, we conduct two experiments, both of which use the same between-subject design with the presentation format as the treatment variable. This design can be described as follows. The first group, which serves as the control group, sees only the payoff diagrams. The two treatment groups see additional illustrations of the payoff probability distribution – the first treatment group in the form of a probability histogram and the second treatment group in the form of a chart with ordered payoffs that represent the same probability.

The experiments consist of three parts. In the first part, the participants assess the attractiveness of three structured products that correspond to the three main product types: a stock investment providing a linear payoff, a capital protection product characterized by limited downside risk, and a reverse convertible characterized by limited upside potential. The participants rate the products' attractiveness and decide how to distribute a given investment amount among the three instruments. In the second part, we let the participants design a tailor-made structured product from a wider range of possibilities. The participants were allowed to specify the desired capital protection level, the maximum payout and the slope of the linear profile

between the chosen capital protection level and maximum payout. These parameters uniquely determine the structured product with a fixed price. The parameters also allow the participants to create a broad range of payout profiles that include the main products listed in the derivative map of the European Structured Investment Products Association (Eusipa).[2] The participants manipulate the parameters with sliders and can immediately see the resulting changes in the payoff diagram; if the participant belongs to one of the treatment groups, the probability graph can also be viewed. As part of the first research question, we test whether the chosen products are different between the three groups. In the third part, we combine the underlying asset and a risk-free asset in such a way that the portfolio has the same volatility as the structured product individually designed in the last step. We then let the participants rate this portfolio with respect to their optimal portfolio. The participants see only the graphs corresponding to their group but do not know how the products were created. If participants were indifferent between the alternatives, this would mean that a simple combination of underlying asset and risk-free asset is sufficient to provide the desired risk-return combination.

In the current interest rate environment, the minimum payoff of a capital protection product is necessarily lower than the initial investment. Otherwise, there would be an arbitrage opportunity, because a product that guarantees a repayment of 100% and still offers some upside potential would clearly be superior to a risk-free asset with an interest rate of zero. Our first experiment is based on the current interest environment and correspondingly assumes a capital protection level of only 90%. A serious shortcoming of this setting is that the results might be driven by an aversion of investors against likely losses.[3] Loss probability aversion is a phenomenon that is well known in practice (Rieger, 2016) and also well documented in the recent literature (Zeisberger, 2016). Therefore, our results for the capital protection product might not be applicable to situations in which the issuers can provide a guarantee level of 100%. To account for this concern, we repeat the first experiment (Experiment 1) with a new population of subjects for a risk-free interest rate of 4% and a capital protection level of 100% (Experiment 2). We hypothesize that presentation formats that make the loss probability of the capital protection product clearly visible will lead to a downgrade of the product in Experiment 1 but not in Experiment 2.

[2]The Eusipa derivative map divides structured products into different categories and provides a payoff profile and brief description for every category to support a uniform categorization among European markets and thus to improve the transparency and understandability of structured products, (see Eusipa, 2016).

[3]We would like to thank an anonymous referee for pointing this out.

Our results are consistent with this hypothesis. Showing probability histograms has a strong effect on the perceived attractiveness of the capital protection product in Experiment 1 but not in Experiment 2. This finding confirms that loss probability aversion plays an important role in investment decisions and it suggests that the presentation mode is important to reveal the loss probability. When presenting probability histograms, we also find an important role of the reference instrument. In almost all graphical displays used in practice, the underlying asset is used as a reference instrument for comparison. We follow this practice when designing tailor-made products. When the individually designed product is then compared with a risk-adjusted linear instrument based on probability histograms, the participants no longer express a preference for one or the other. This result is the same in both experiments. It suggests that the preference for certain structured products might be due to a preference for lower risk rather than a particular structure of the payoff profile.

Our study is related to the previous literature showing that the presentation format affects investor decisions in a systematic and non-trivial way. Weber et al. (2005) examined the impact of the presentation format on investors' asset choices and their assessments of the risk involved in portfolios of stocks and bonds. Depending on whether a probability density or a chart of historical returns was shown, investors' risk assessments were significantly different. Kaufmann et al. (2013) studied an asset allocation decision combining a stock index with a risk-free asset. The results showed that experience sampling, in which participants drew returns from the relevant return distribution, increased the willingness to take risks. Bradbury et al. (2015) confirmed the relevance of experience sampling in a setting in which the number of draws was fixed, and the sample, by construction, reproduced the shape of the underlying distribution. In two stages, the subjects were asked to choose between structured products with capital protection levels from 0% to 100%. The first-stage decision took place after showing a verbal description and a payoff diagram; the second-stage decision occurred after an additional experience sampling. More than half of the subjects changed their initial product choice, and most of them switched to a riskier product.

Vrecko et al. (2009) analyzed how the presentation format affects the revealed skewness preferences of investors. Using combinations of stocks, calls and a risk-free asset, they constructed one symmetrical, one left-skewed and one right-skewed return distribution, all with the same volatility. The display of probability density functions led to a pronounced preference for the

left-skewed product[4], while the display of cumulative distribution functions seemed to favor the right-skewed product.

Döbeli and Vanini (2010) tested whether easily understandable explanations of structured products are effective. Subjects were confronted either with traditional, rather technical term sheets or with fact sheets that explained the products in simple terms. The main finding was that the simple fact sheets highly encouraged people to invest, especially first-time buyers and women. This conclusion resulted from both a questionnaire with hypothetical products and a field experiment with real products.

Our intended contribution to the prior literature is threefold. First, we present a flexible framework for designing tailor-made structured products, which will allow us to implement part of the experiment as an interactive exploration. In our setting, experience sampling is difficult to apply because the return profiles studied are highly nonlinear; a large number of drawings would be required to capture the particular shape of the return distribution. In addition, the process is cumbersome if it has to be repeated for several products. Therefore, we propose and implement an alternative interactive tool in which investors can experience important aspects of the risk-return tradeoff. Second, we study the importance of the presentation format by comparing the main types of structured products available in real markets. This comparison spans a wider range of nonlinear payoff profiles than previous studies. Third, the role of the reference instrument and the case for displaying it in risk-adjusted terms have not gained much attention in the literature so far. Overall, our findings can be used to improve information documents for investors.

The remainder of the paper is structured as follows. Section 2 introduces our presentation formats. Section 3 explains our framework for designing tailor-made products. Sections 4 to 6 present the experimental design, describe the data sample and report our results. The last section concludes.

[4]As Ibrekk and Morgan (1987) show, people tend to regard the mode of a probability density function as the expected value, which could explain why the left-skewed product appeared attractive.

2 Presentation formats

We employ three different presentation formats in our study.[5] The first format (PF 1) consists of payoff diagrams and is shown to all groups of subjects equally. The payoff diagrams used in the study are similar to those used by Eusipa and many issuers with one noteworthy difference. Eusipa and the issuers typically show a stylized payoff diagram for all products within a product group, for example, reverse convertibles. Thus, specific product characteristics such as the coupon rate are not apparent. To ensure that the products are correctly displayed, we always use the specific parameters of the presented products. Figure 1 shows the payoff diagrams of Experiment 1 (left side) and Experiment 2 (right side) for three products: a stock investment (upper graph), a capital protection product (CPP, middle graph) and a reverse convertible (RC, lower graph). The stock of the first graph is also the underlying asset of the CPP and RC. The value of the stock investment at the maturity date T is shown on the horizontal axis. All products are designed such that they have an initial value of 10 000. The CPP has a minimum payout that is 10% below (Experiment 1) or equal to (Experiment 2) the initial investment. The RC provides a coupon of 10%, so that the maximum profit is 1 000. For better comparison, the payoff diagrams of CPP and RC also show the linear profile of the underlying stock in grey lines. We assume an expected stock excess return of 5% p.a., a return volatility of 30% p.a. and an investment horizon of one year. We further assume that the stock return is log-normally distributed, as it is in the Black-Scholes model. Thus, we ignore stochastic volatility, jumps and fat tails. These factors are important for option pricing but less so in a comparison of the return distributions of different types of products. The characteristic shapes of the return distributions of the CPP and RC are so different that the details of the return generating process do not play an important role in our graphical displays.

The second illustration used in our study (PF 2) includes probability histograms as shown in the left graphs of Figure 2 (Experiment 1) and Figure 3 (Experiment 2) for the same three products as before. This diagram represents the most common way of presenting probability distributions. The horizontal axis indicates the gains and losses in dollar amounts, and the vertical axis indicates the probability of a gain or loss falling into the interval of the respective bar. To facilitate the risk and return comparison, gains are shown in blue, while losses are

[5] See Wallmeier (2011) for a comprehensive discussion of ways to present the risk-return profile of structured products.

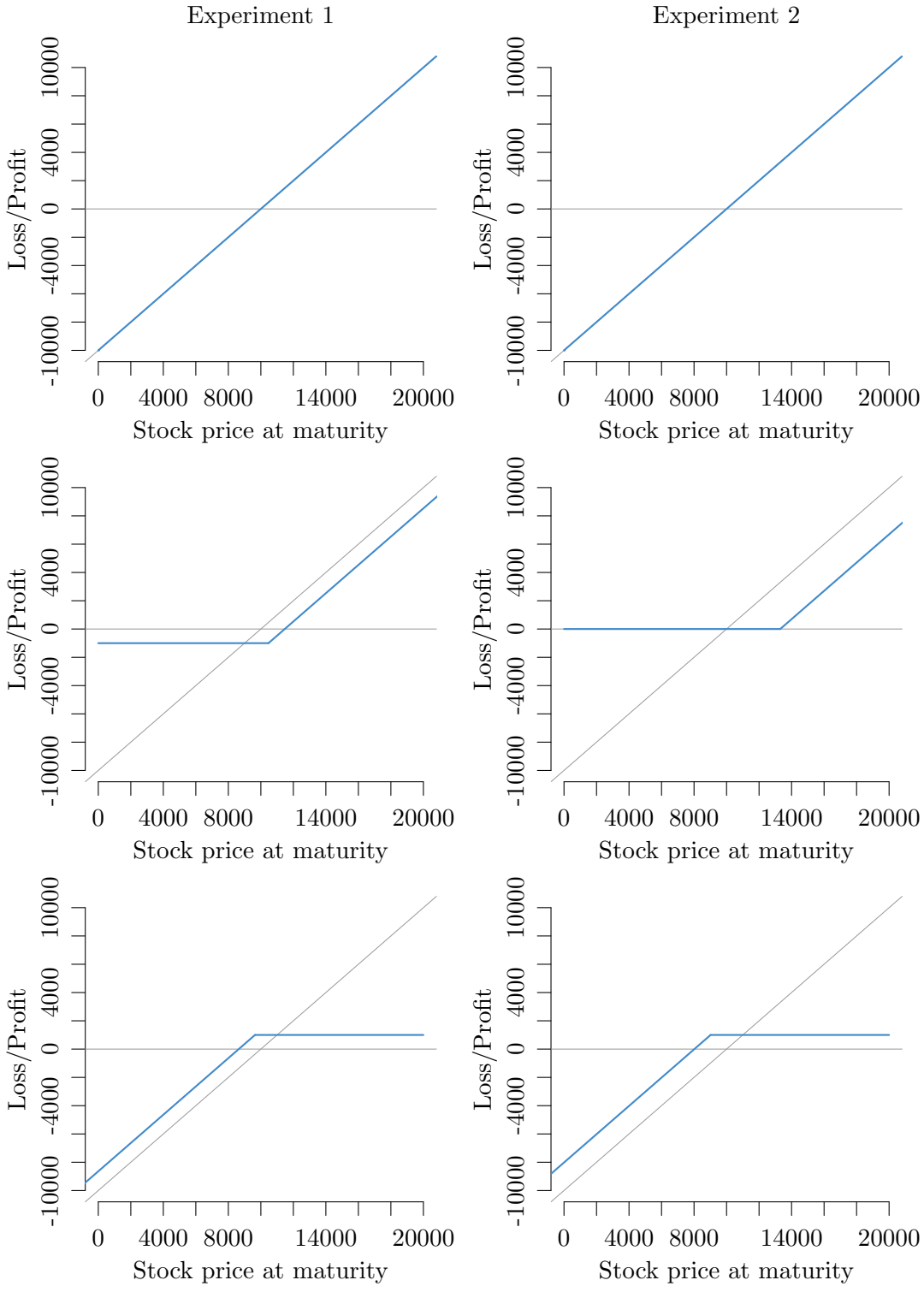


Figure 1: Payoff diagrams of the three base products (stock, CPP and RC) from the first (left) and second (right) experiment. The blue lines represent the payoffs of the three products. The gray, diagonal lines represent the payoffs of the underlying asset.

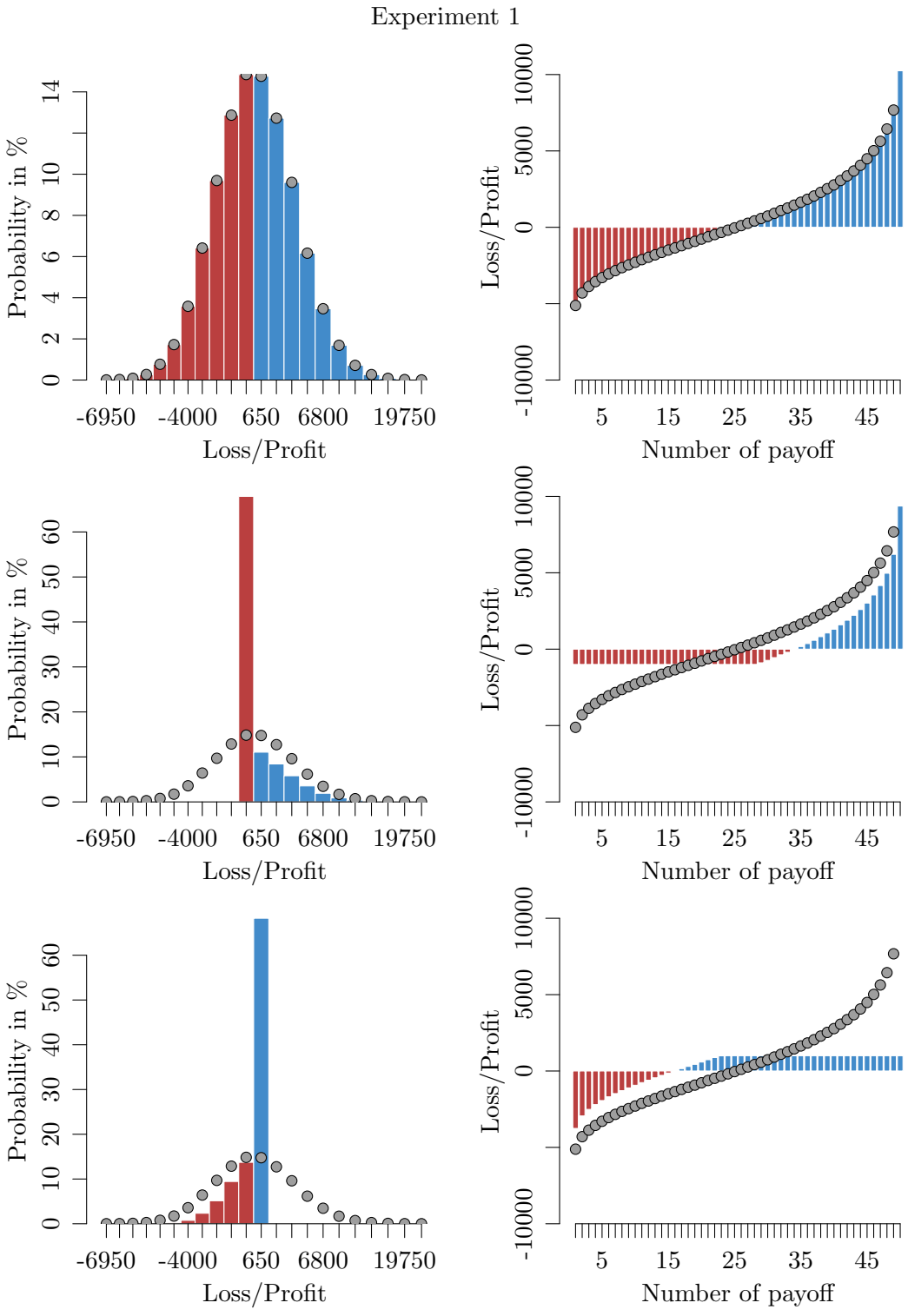


Figure 2: Risk and return characteristics of the three base products (stock, CPP and RC) from the first experiment illustrated with histograms (left) and charts with fifty ordered payoffs (right). The gray dots represent the underlying stock.

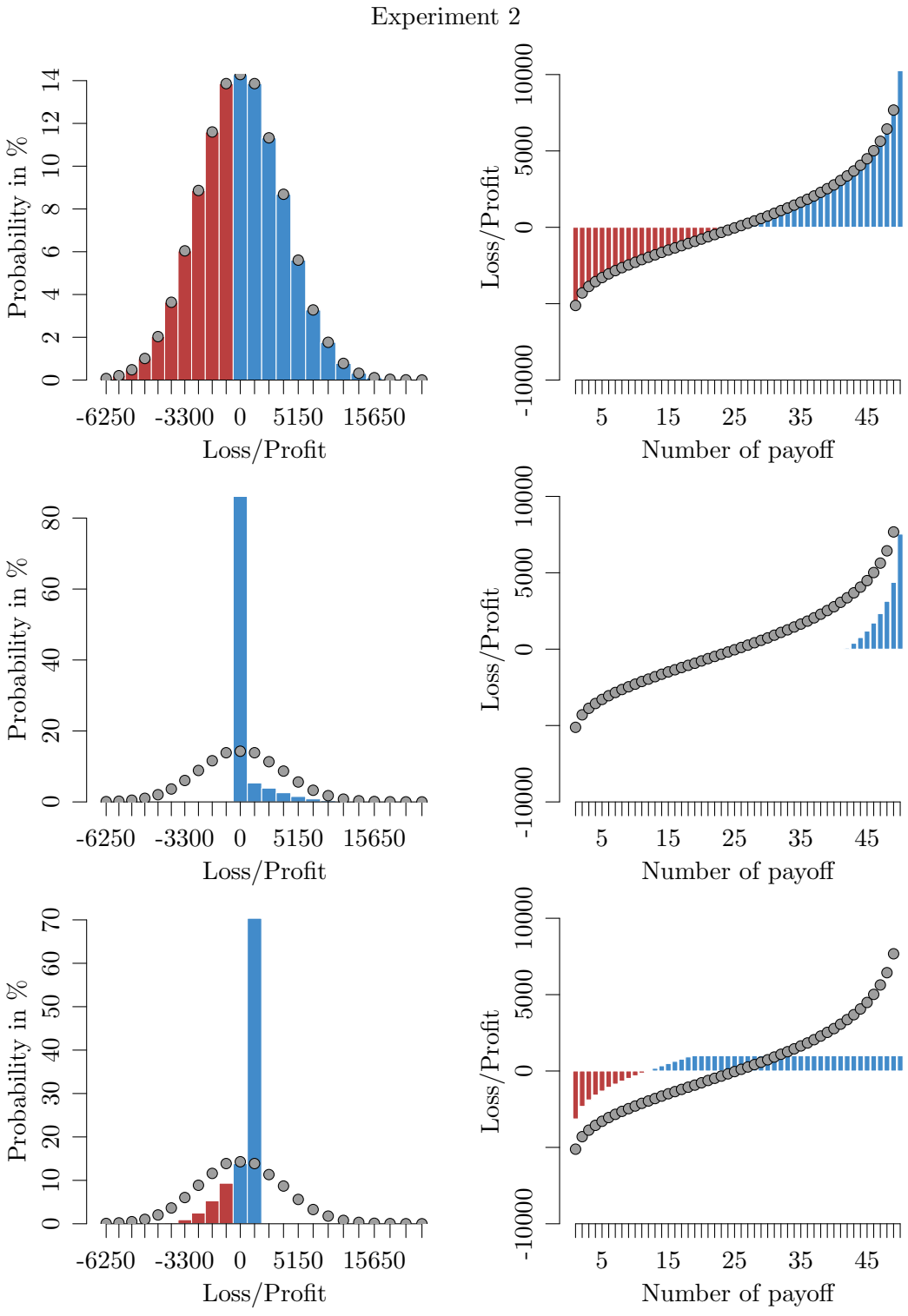


Figure 3: Risk and return characteristics of the three base products (stock, CPP and RC) from the second experiment illustrated with histograms (left) and charts with fifty ordered payoffs (right). The gray dots represent the underlying stock.

shown in red. For a better comparison, all graphs in Figures 2 and 3 include the outcome of the underlying stock investment in grey dots.

Our third illustration (PF 3) is a bar chart with fifty ordered payoffs, as shown in the right graphs of Figures 2 and 3. Each ordered payoff represents a probability of 2% and is defined as the expected value over the respective interquantile range. To explain the diagram, investors could be told that buying this product is similar to drawing from an urn with 50 balls, where the values on the vertical axis show which values of profit or loss the balls represent. It is important to note that this diagram includes more information than the payoff diagram but is nevertheless somewhat similar. For example, the straight line for the stock investment in PF 1 becomes a curved but still monotonically increasing profile in PF 3. The maximal loss of CPP and the maximal gain of RC are visible in PF 3 in the same way as in PF 1; the only difference is that in PF 3, the exact probability of this maximal loss or gain can be inferred from the number of bars with this value. It is not clear whether this will be important additional information for investors. Due to the similarity in profiles between PF 1 and PF 3, we might suspect that the added value of PF 3 is small.

3 Designing tailor-made structured products

In a part of our experiment, the participants are asked to design their own structured product. The participants specify the minimum payoff, the maximum payoff and the slope of the straight line between the minimum and maximum payoffs (see Figure 4). On this basis, the thresholds between the three sections of the payoff diagram are determined in such a way that the product value is equal to 10 000. Technically, the resulting profile corresponds to a collar instrument, which can be decomposed into a long position in the underlying stock, a long put option with a strike price X_1 and a short call option with a strike price $X_2 > X_1$. The instrument is sufficiently flexible to include our previous products as special cases: the collar is equal to a stock investment for $X_1 = 0$ and $X_2 \to \infty$; it corresponds to a CPP for $X_1 > 0$ and $X_2 \to \infty$ and to a RC for $X_1 = 0$ and limited X_2.

We use the following symbols for the formal derivation of the collar: T is the investment horizon and $t \leq T$ the valuation time; S_t is the share price of the underlying stock and $C_t(X)$ and $P_t(X)$ are the values of calls and puts, respectively, with strike price X and time to maturity $T - t$. We define n as the number of shares of the underlying stock that have an aggregate value of 10 000: $n = 10\,000/S_t$. Finally, A_t is the risk-free investment at time t, and r is the risk-free

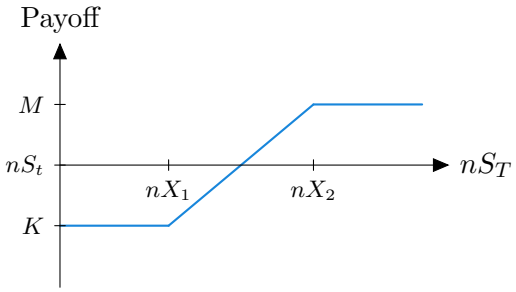


Figure 4: Payoff diagram of a collar

interest rate (continuously compounded).

The participants specify three parameters: The minimum payoff $K \geq 0$, the maximum payoff $M > K$ and the slope s in the middle section of the payoff diagram ($X_1 < S_T < X_2$). The corresponding collar can then be derived from three formal conditions.

The first condition is to achieve the specified slope s, which means that the collar must include ns shares of the underlying stock. The slope is then equal to (see Figure 4):

$$s = \frac{M - K}{n\left(X_2 - X_1\right)}, \tag{1}$$

which is equivalent to:

$$X_2 = X_1 + \frac{M - K}{sn}. \tag{2}$$

The second condition is to ensure the minimum payoff K in case of $S_T \leq X_1$. In this case, the put option is exercised, while the call option expires worthless. Thus, the value of the stock position, the put option payoff and the risk-free asset at T must add up to K:

$$snS_T + sn\left(X_1 - S_T\right) + A_t e^{r(T-t)} = K. \tag{3}$$

The third condition requires that in the case of $S_T \geq X_2$, the aggregate value of the stock position, the short call and the risk-free asset is equal to the maximum payoff M:

$$snS_T - sn\left(S_T - X_2\right) + A_t e^{r(T-t)} = M. \tag{4}$$

Solving Eq. (3) for A_t gives:

$$A_t = \left(K - snX_1\right) e^{-r(T-t)}. \tag{5}$$

This is the same value that we obtain when solving Eq. (4) for A_t and inserting X_2 from Eq.

(2).

Finally, the time t value of the collar must be equal to the investment amount of 10 000. Formally:

$$snS_t + snP(X_1) - snC\left(X_1 + \frac{M-K}{s}\right) + (K - sX_1)\, e^{-r(T-t)} = 10\,000 \tag{6}$$

We solve this equation for the only unknown, which is X_1. Thus, the collar is unambiguously specified. When the participants change their input parameters, the calculations are rerun and the collar is adjusted accordingly.

Our approach is related to other tools proposed in the literature. In the "distribution builder" of Sharpe et al. (2000), Goldstein et al. (2008) and Sharpe (2011), investors can build and explore different probability distributions for end-of-period wealth by arranging 100 markers on a digital board. Only distributions that satisfy a given budget constraint are allowed. The cost of different marker positions is derived from an equilibrium asset pricing model. This builder is designed for a single use to find the best distribution; it is less suitable for our study, which requires repeated comparisons of different shapes of distributions.

Rieger and Hens (2012) propose a tool for designing structured products in which people were able to create their own desired payoff profile as the connecting line of a number of points that could be moved on a touch screen. After each move, the payoff profile was automatically shifted upwards or downwards to ensure the budget constraint was applied. While this tool allows for almost any shape of the probability distribution, our builder focuses on conventional payoff profiles within the scope of the Eusipa derivative map.

4 Experimental design

We use a between-subject design with three groups, where the presentation format serves as between-subject variable. The first group with PF 1 (only payoff diagram) serves as the control group. The second group is treated with PF 2 (payoff diagram and probability histogram) and the third group with PF 3 (payoff diagram and chart with fifty ordered payoffs). The subjects are assigned randomly to the three groups. A within-subject design is not possible because it would suffer from the problem of irreversible treatments. The presentation format of the previous stages would presumably carry over to the current choices because subjects would still have the prior presentation format in mind.

In the general introduction, participants were informed that the study would take about 15

minutes and that they could quit at any time. We then collected information about the subjects' financial knowledge and experience. Specifically, subjects were asked about their familiarity with statistics and structured financial products and whether they had already invested in structured products, stocks, mutual funds, bonds or derivatives.

In the next step, the subjects' risk preferences were identified. For this purpose, we used five different measures. The first two measures represent certainty equivalents for hypothetical lotteries derived from Rieger et al. (2014), where we determine the subjects' willingness to pay either to participate in a lottery with gains or to avoid a lottery with losses. The latter is used to elicit subjects' risk preferences in the domain of losses. The other three measures are taken from the domain-specific risk-taking (DOSPERT) scale of Blais and Weber (2006). While this scale contains multiple questions to assess risk attitudes in different domains, we only consider those related to investment decisions. In these questions, subjects are asked to indicate the likelihood of investing a certain percentage of their annual income in different alternatives on a seven-step scale. The five risk attitude measures, together with the four experience measures, are used as control variables.

The main part of the experiment consists of three investment choices. For the first decision, the subjects were introduced to three investment products using the graphical display of their assigned presentation format. These products are identical to the three hypothetical products presented in Section 2, namely, a stock, a CPP with a minimum payoff of 90% (Experiment 1) or 100% (Experiment 2) respectively and a RC with a maximum payoff of 110% of the initial investment amount. The stock serves as the underlying asset of the CPP and RC. Owing to its essential role, the stock is always displayed first on the left side. The order of the two structured products is then determined randomly. To measure the perceived attractiveness of the three products, we apply two different measures. First, the subjects were asked to rate the attractiveness of each product on a five-step scale from very unattractive to very attractive. Second, the attractiveness was determined in a hypothetical investment decision, where the subjects could allocate an investment budget of 10 000 CHF over an investment period of one year.

In the second investment decision, the participants designed their own structured product based on the collar framework presented in Section 3. They were again asked to imagine having to invest an amount of 10 000 CHF in the created product for one year. As a consequence, the subjects designed the most attractive product according to their perception based on the

assigned presentation format. The starting point of the individual product design is a product with a linear payoff profile. Using sliders, the participants could change three parameters: 1) the minimum payoff or capital protection level within a range of 0% to 100% of the investment budget; 2) the maximum payoff within the range of 100% to 200% of the invested amount; and 3) the slope between the minimum and maximum payoff within a range of 0.2 to 3.2. On the basis of these input parameters, the threshold values between the three sections of the payoff profile were determined as presented in Section 3 (X_1 according to Eq. 6 and X_2 according to Eq. 2). The resulting collar was displayed in the graphs of the assigned presentation format. The changes could be seen in real time. The graphs react smoothly to the slider control so that the participants could explore the effects of the input parameters.

In the third investment decision, the individually designed product was compared to a linear product with the same volatility. This linear product consisted of a simple combination of the stock and the risk-free asset. The underlying idea is to introduce a reference instrument that entails a similar risk as the structured product. In the previous graphs, the underlying stock without risk adjustment always had served as a reference instrument (see the grey lines in Figure 1 and the grey dots in Figures 2 and 3). This is in line with generally accepted practices. However, compared to this reference point, a CPP might look attractive not because of its particular payoff structure but because of its lower risk compared to the underlying stock. For this reason, we tested whether the perceived attractiveness of the tailor-made product survives when the alternative is to adjust the risk level of the linear profile in the most simple way.

As in the first investment decision, the subjects rated the perceived attractiveness of both products on a five-step scale before they set the investment weights in a hypothetical investment decision with a budget of 10 000 CHF and an investment period of one year. The individual product was introduced as new structured product; we did not reference it as the individual product of the previous part because the participants might have otherwise tended to adhere to their earlier choice even if this new product was inferior in light of the new situation. The placement of the two products (left or right on the screen) was again determined randomly.

In the last step, subjects were asked about different demographic attributes such as age, income, education, profession and gender. These attributes are used as additional control variables. Appendix A gives an overview over all variables included in the study. Appendix B shows screenshots of the different stages of the experiment. The second experiment has the same design. The only differences are a higher risk-free interest rate (4% instead of 0%) and a higher

protection level of the CPP in the first investment decision (100% instead of 90%).

5 Participants

To identify the required sample size for our experimental design, we conducted a power analysis based on our regression models using the software G*Power 3 of Faul et al. (2007). For a medium standardized effect size of 0.15 (Cohen, 1988, p. 477–478), the required sample size ranges from 36 to 106 for each experiment, depending on the power, which we vary from 0.5 to 0.95.

This study was conducted with undergraduate and graduate students, mostly with a background in finance. We carried out two sessions per experiment, each with approximately 30 to 40 students, in a controlled environment (laboratory with separate workplaces). Experiment 1 was also conducted online with additional participants. The total sample size is 108 for Experiment 1 and 71 for Experiment 2. We incentivised participants with monetary compensation for each investment decision. In the compensation scheme, the hypothetical investment budget of three times 10 000 CHF was broken down to three times 5 CHF. To calculate the subjects' payoff, the returns of the three investment choices were simulated and applied to the base value of 5 CHF.

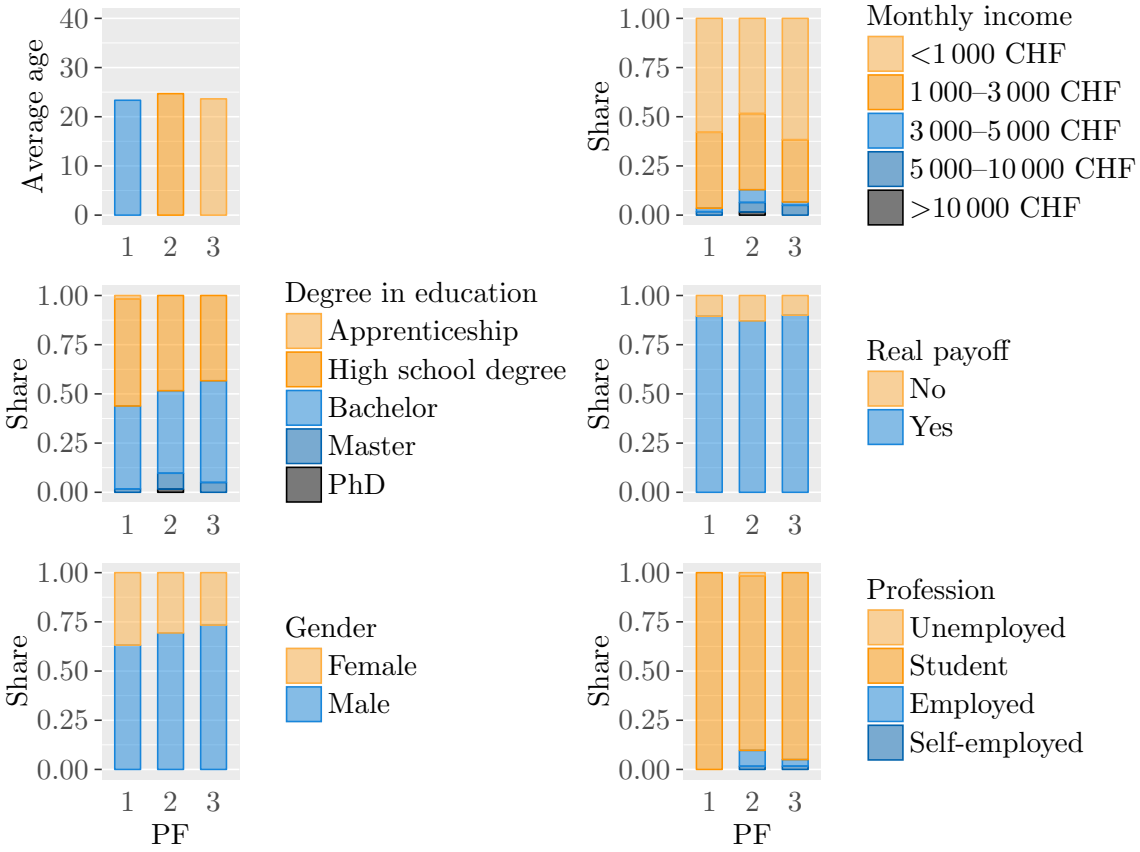


Figure 5: Demographical characteristics of the sample by presentation format groups

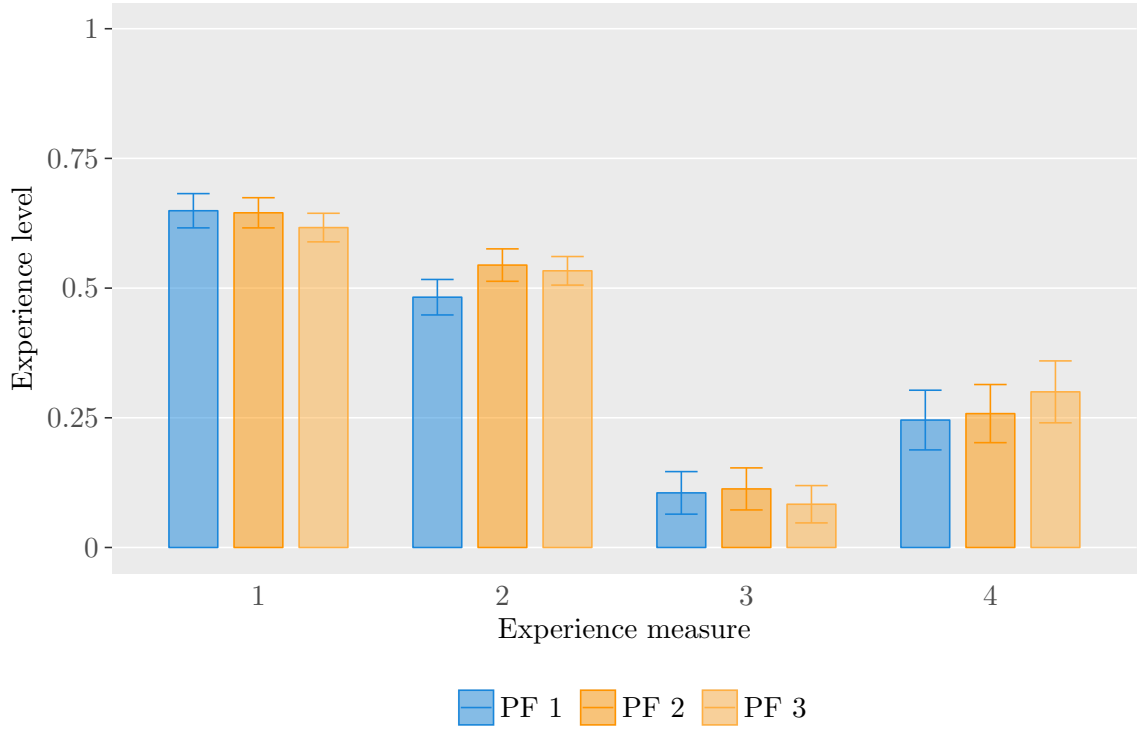


Figure 6: Level of (financial) experience. The graph compares the means and standard errors of different measures of subjects' investment experience across the three groups.

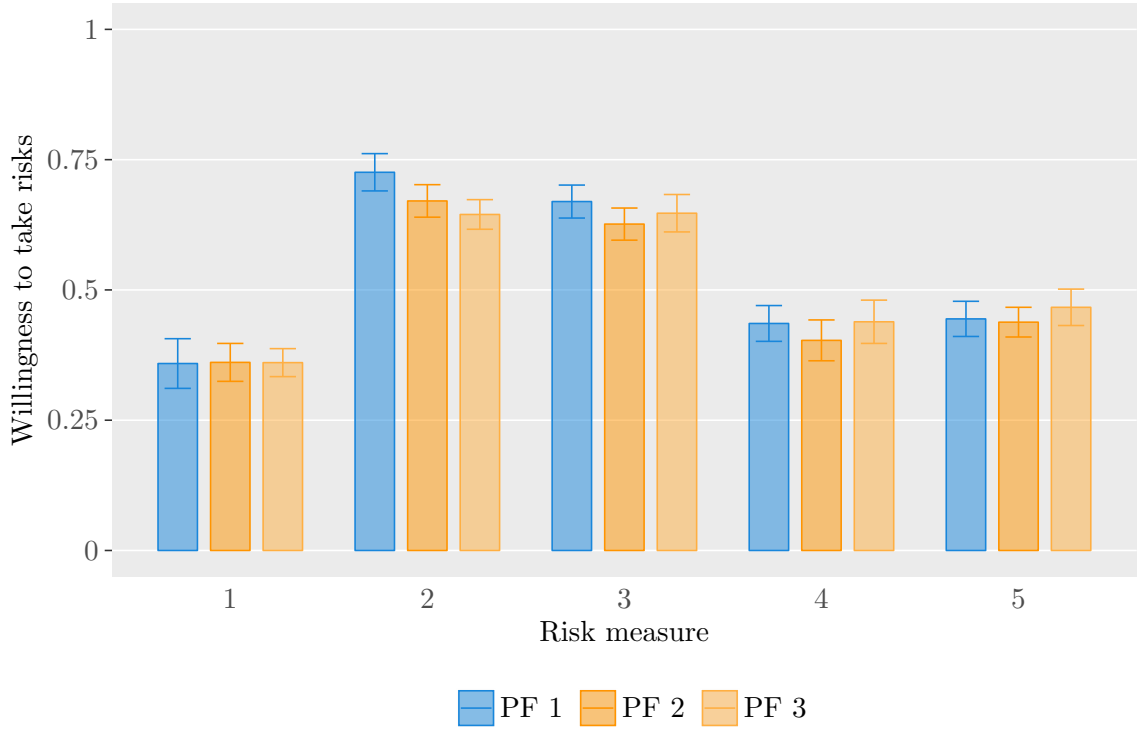


Figure 7: Willingness to take risks. The first two measures of subjects' risk preferences are based on certainty equivalents of lotteries with gains (risk preference measure 1) and losses (risk preference measure 2). The remaining three measures are derived from the DOSPERT scale of Blais and Weber (2006).

The average compensation was 15.8 CHF; the minimum and maximum amounted to 6 CHF and 30 CHF, respectively; and the volatility was 4.1 CHF.

57 subjects were assigned to PF 1, 62 subjects to PF 2, and 60 subjects to PF 3. The average age of the sample is 23.9 years. Of the participants, 55.9% have a monthly income lower than 1 000 CHF and 36.3% have a monthly income between 1 000 and 3 000 CHF. Most of the subjects reported that their highest degree is either a high school diploma (48.6%) or a bachelor's degree (45.2%). 68.7% are male, 87.7% are Swiss citizens and 97.2% are unmarried. All subjects reported that they either had basic statistical knowledge (71.5%) or were very familiar with statistics (27.9%). Only a few subjects had never heard of structured financial products before (6.7%). A minority have invested in structured products (10.1%) or other assets (26.8%) before. The subjects are on average risk averse in the domain of gains and risk seeking in the domain of losses. Of the participants, 70.9% reported that it is likely that they will invest 10% of their annual income in a moderate growth diversified fund. However, only 37.5% (31.3%) indicated that they will likely invest 5% (10%) of their annual income in a very speculative stock (a new business venture).

Figure 5 shows the average values of different demographical variables for each group. The control group with PF 1 has a greater share of women than the other two groups (36.8% v. 30.6% and 26.7%). In addition, profession or rather income seems to be somewhat unevenly distributed. For instance, while there are only 48.4% with a monthly income below 1 000 CHF in the group with PF 2, the share in the other two groups is 57.9% and 55.9%, respectively. Apart from that, the groups are similar in terms of demographics. Figure 6 and Figure 7 show the average outcomes and standard errors of the four experience measures and the five risk preference measures. To increase comparability, these measures were linearly transformed to a scale from 0 to 1. The risk preference measures are all defined in such a way that a higher value indicates a higher willingness to take risks.[6]

[6]For this reason, the risk preference measure 2 is defined as 1 minus the certainty equivalent for the lottery with losses.

6 Results

6.1 Attractiveness of the Three Types of Products

In the first investment choice, the participants evaluated the attractiveness of the three base products: stock, CPP and RC. In the following, for ease of presentation, the attractiveness scores and other ordinal measures are transformed to a scale from 0 to 1. All statistics are based on these transformed variables.

Figure 8 shows the means and standard deviations of the attractiveness scores and investment weights for the three presentation formats. In Experiment 1 (upper panel), four observations stand out: 1) For the stock investment, the results are very similar across the presentation formats. 2) The results of the presentation format PF 3 (fifty ordered payoffs) are similar to those of PF 1 (only payoff diagram). A natural explanation is that the structural aspects of the two graphs are similar (see Section 2). Apparently, the additional probability information embedded in PF 3 does not strongly affect the product assessments. 3) The ordering of the products is clear in PF 1 and PF 3: the CPP is perceived to be more attractive than the stock investment, and the stock investment is perceived to be more attractive than the RC. 4) PF 2 (probability histogram) has a substantial effect on the products' perceived attractiveness. From the point of view of participants who have access to the probability histograms, the CPP appears to be much less attractive and the RC much more attractive. As a result, the stock investment, CPP and RC all obtain roughly the same attractiveness score in PF 2.

In Experiment 2 (lower panel), the results for PF 1 and PF 3 are similar to Experiment 1. The only noteworthy difference is that the RC is regarded as more attractive when presented in PF 3 compared to PF 1. Owing to the higher interest rate, the expected stock return (interest rate + risk premium) is higher in Experiment 2 than in Experiment 1. This means that the maximum payoff of the RC is more likely, which is clearly visible in PF 3 but not in the payoff diagram PF 1. The additional probability information appears to be helpful in this case. The main difference between the results of Experiments 1 and 2, however, is that the CPP no longer loses its attractiveness when presented in PF 2. This is consistent with the notion that loss probability plays an important role in investment decisions. In the setting of Experiment 1, PF 2 highlights the large probability of losing 10% when investing in the CPP (bar shown in red), while in Experiment 2 no losses can occur so that all bars are shown in blue. We conclude that the additional information of PF 2 affects the perceived attractiveness of the CPP only if the

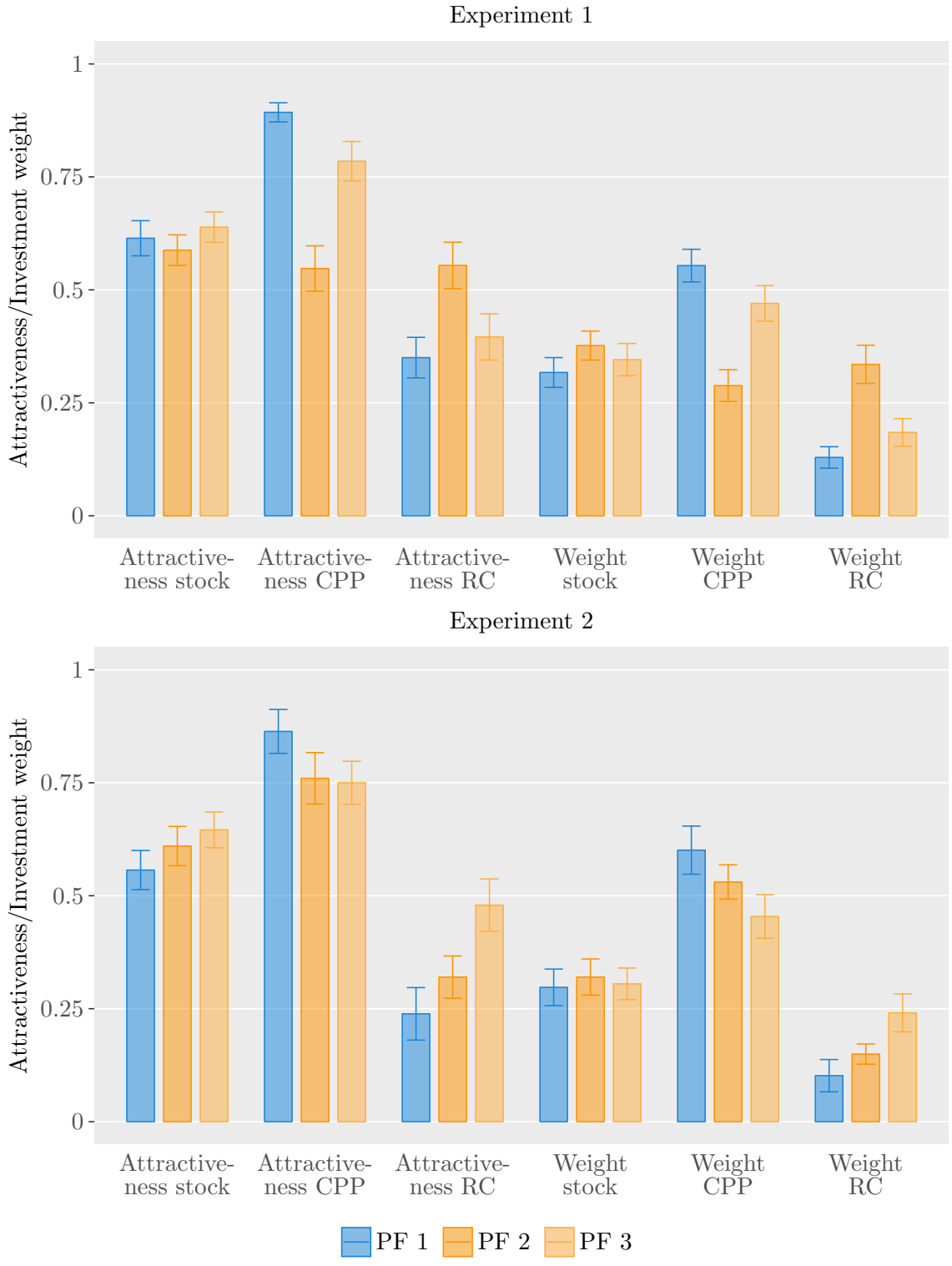


Figure 8: Perceived attractiveness and investment weights across the three presentation formats for study 1 (upper graph) and study 2 (lower graph)

protection level is below 100% so that a substantial loss probability becomes apparent.

These results are confirmed in a regression analysis including control variables. Let A_i^p denote the attractiveness of product $p \in \{\text{stock, CPP, RC}\}$ from the perspective of subject i. For each p, we run a separate regression:

$$A_i^p = \beta_0 + \beta_1 D_{i,PF2} + \beta_2 D_{i,PF3} + \beta_3 D_{i,PF1} D_{i,Exp2} + \beta_4 D_{i,PF2} D_{i,Exp2} + \beta_5 D_{i,PF3} D_{i,Exp2} + \gamma Z_i + \varepsilon_i^p, \tag{7}$$

where β_0, ..., β_5 and the elements in vector γ are regression coefficients; Z_i is a vector of control variables; $D_{i,PF1}$, $D_{i,PF2}$ and $D_{i,PF3}$ are dummy variables that take on the value of 1 if subject i is exposed to presentation format PF 1, PF 2 or PF 3, regardless of whether the subject participates in Experiment 1 or 2; and $D_{i,Exp2}$ is a dummy variable that takes on the value of 1 if subject i participates in Experiment 2.

The intercept β_0 in Eq. (7) captures the base effect of PF 1 in Experiment 1 (minus the mean effect of the control variables). The coefficients β_1 and β_2 capture the additional effects of PF 2 and PF 3 in Experiment 1, respectively. Finally, the coefficient β_3 shows the additional effect of PF 2 in Experiment 2 compared to PF 2 in Experiment 1, and analogously for β_4 and β_5.

The first part of Table 1 shows the regression results. We run the same regressions with the dependent variable A_i^p replaced by the investment weight W_i^p attributed by subject i to product p. These results are shown in the second part of Table 1.

The table includes regression specifications with and without control variables. We find that the control variables do not have a strong impact on perceived attractiveness or the investment weights with the exception of three variables that are significant in at least some of the specifications. The first is a dummy variable that takes the value of 1 if participants collected their monetary compensation and is zero for the few participants who did not collect their gains. The subjects who received a real monetary payoff preferred the CPP more than the subjects who did not receive a real payoff. At the same time, the subjects invested less in the stock, which is the most risky investment option. This finding shows that subjects tend to invest more carefully when real money is at stake and supports the importance of monetary incentives in financial decisions. Second, men seem to have different preferences than women. For example, men perceive the RC to be more attractive. This result cannot be explained by the different risk preferences between men and women because the effect does not disappear when including risk preferences in the model and because the stock is riskier than the RC and is nonetheless rated

	Attractiveness stock		Attractiveness CPP		Attractiveness RC	
Intercept	0.31	0.61^{***}	0.81^{**}	0.89^{***}	-0.24	0.35^{***}
	(0.32)	(0.04)	(0.36)	(0.04)	(0.43)	(0.05)
PF 2	-0.03	-0.03	-0.35^{***}	-0.35^{***}	0.20^{***}	0.20^{***}
	(0.05)	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)
PF 3	-0.02	0.02	-0.10	-0.11^{*}	0.03	0.05
	(0.05)	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)
PF 1 × Exp. 2	-0.05	-0.06	-0.09	-0.03	-0.22^{*}	-0.11
	(0.09)	(0.06)	(0.10)	(0.07)	(0.11)	(0.08)
PF 2 × Exp. 2	0.01	0.02	0.16^{*}	0.21^{***}	-0.31^{***}	-0.23^{***}
	(0.08)	(0.05)	(0.10)	(0.06)	(0.11)	(0.07)
PF 3 × Exp. 2	0.04	0.01	-0.06	-0.03	-0.03	0.08
	(0.09)	(0.06)	(0.10)	(0.07)	(0.12)	(0.07)
Control variables	yes	no	yes	no	yes	no
Observations	179	179	179	179	179	179
R^2	0.11	0.02	0.34	0.19	0.25	0.12
Adjusted R^2	-0.04	-0.01	0.22	0.17	0.11	0.09
F Statistic	0.72	0.64	2.83^{***}	8.36^{***}	1.82^{**}	4.59^{***}

	Investment weight stock		Investment weight CPP		Investment weight RC	
Intercept	0.31	0.32^{***}	0.72^{**}	0.55^{***}	-0.03	0.13^{***}
	(0.30)	(0.03)	(0.32)	(0.04)	(0.28)	(0.03)
PF 2	0.05	0.06	-0.28^{***}	-0.27^{***}	0.23^{***}	0.21^{***}
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)
PF 3	0.002	0.03	-0.07	-0.08	0.07	0.06
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)
PF 1 × Exp. 2	-0.01	-0.02	0.01	0.05	-0.003	-0.03
	(0.08)	(0.05)	(0.08)	(0.06)	(0.07)	(0.05)
PF 2 × Exp. 2	-0.03	-0.06	0.24^{***}	0.24^{***}	-0.21^{***}	-0.19^{***}
	(0.08)	(0.05)	(0.08)	(0.06)	(0.07)	(0.05)
PF 3 × Exp. 2	-0.001	-0.04	-0.04	-0.02	0.04	0.06
	(0.08)	(0.05)	(0.09)	(0.06)	(0.08)	(0.05)
Control variables	yes	no	yes	no	yes	no
Observations	179	179	179	179	179	179
R^2	0.16	0.02	0.38	0.18	0.30	0.16
Adjusted R^2	0.005	-0.01	0.27	0.16	0.17	0.14
F Statistic	1.03	0.71	3.47^{***}	7.80^{***}	2.38^{***}	6.67^{***}

*p<0.1; **p<0.05; ***p<0.01

Table 1: Regression analysis of perceived attractiveness and investment weights for the stock, the CPP and the RC

similarly. Third, risk preferences seem to have at least some importance. The subjects who are willing to pay a large amount to participate in a risky lottery with losses (risk preference measure 2) invest less in the CPP, which is consistent with the view that loss aversion leads to a preference for capital protection. However, surprisingly, there is no consistency among the five risk preference measures. When looking at the results, it is difficult to predict which product is preferred by risk-seeking or risk-averse individuals.

The most striking result in Experiment 1 apparent from Table 1 is that the CPP is very attractive for subjects in PF 1 and PF 3, while PF 2 makes the CPP appear much less attractive for the benefit of the RC (significantly negative PF 2 coefficients for the CPP and significantly positive PF 2 coefficients for the RC). However, these effects are not observed in Experiment 2 as the inverse signs of the coefficients for the interaction term PF 2 $\times$ Exp. 2 show. The attractiveness of the CPP is still smaller in PF 2 than in PF 1, but the difference is no longer significant.

6.2 Tailor-made structured product

Figure 9 and Table 2 show the results of the second investment decision, where subjects had to design their own structured product. An overall observation is that the subjects limited the upside and downside potential but both at a large distance from the investment amount.[7]

In Experiment 1, as in the first investment decision, the choices of the PF 2 group deviate significantly from the other two groups. On average, the subjects from the second group chose a maximum payoff that is lower by 1 433 when compared to the PF 1 group. In addition, their chosen minimum payoff is on average lower by 585. This result is consistent with the finding in the first part that participants exposed to PF 2 find the capital protection feature less attractive and the reverse convertible characteristic more attractive than other participants. However, PF 2 does not seem to have a significant effect on the choice of the slope in the middle area. This coefficient is mostly above 1. As before, there is no significant difference between PF 1 and PF 3.

In Experiment 2, subjects chose a higher minimum payoff, which is consistent with the lower price of capital protection in this high-interest setting. The slope coefficient in PF 2 and PF 3 is close to one and therefore significantly smaller than in Experiment 1. A natural explanation

[7]The shape is similar to the average product resulting from the structured product design tool in Rieger and Hens (2012). The capital protection level, however, is higher in Rieger and Hens (2012) than in our study.

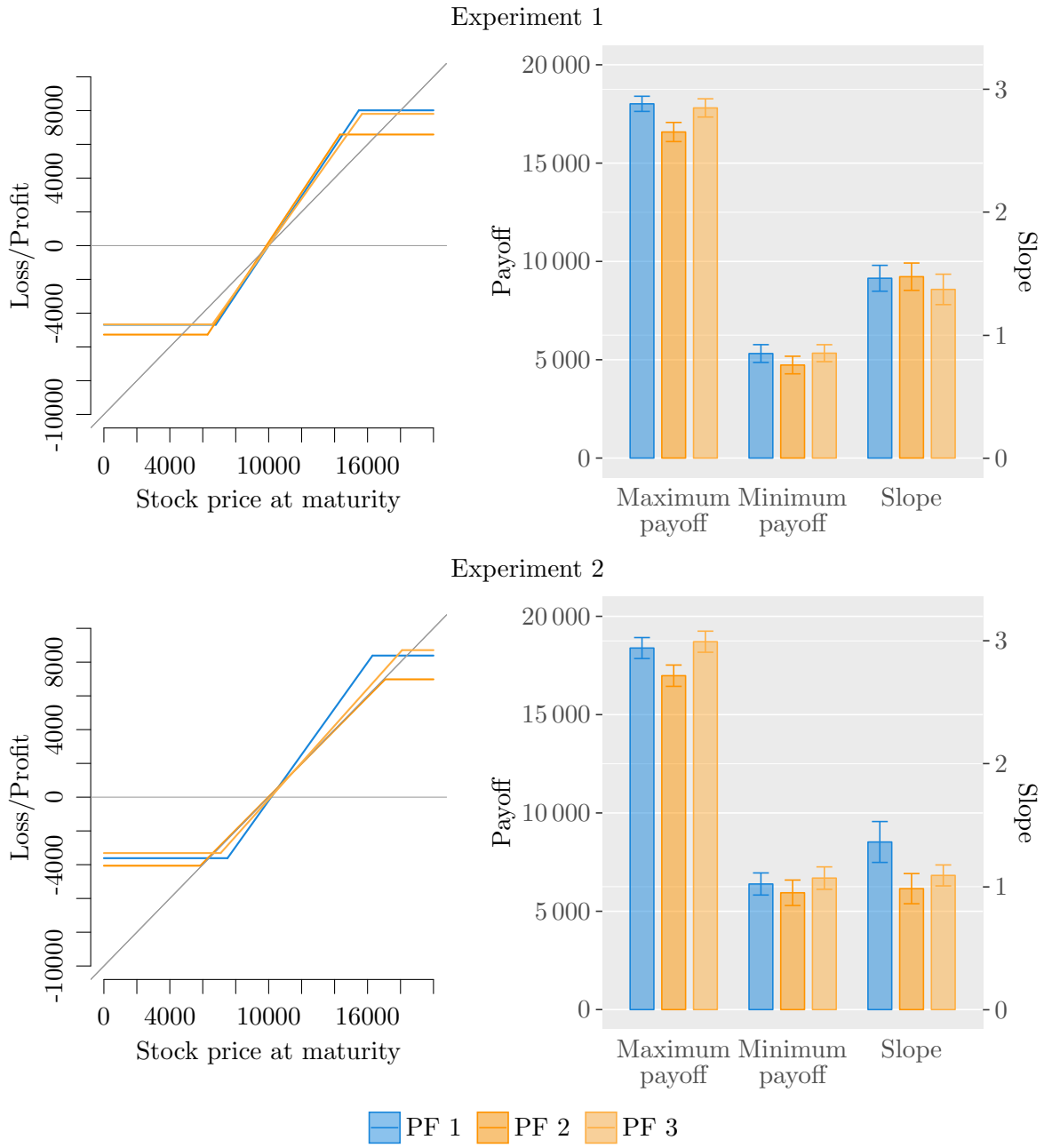


Figure 9: Properties of tailor-made structured products

is that subjects used a large slope in Experiment 1 to compensate for the low protection level, which is no longer necessary in Experiment 2.

There is some evidence that risk preferences play a role in the individual product design. Subjects who are likely to invest 5% of their annual income in a speculative stock (risk preference measure 4) choose a significantly lower minimum payoff. The other risk preference measures mostly indicate that a high willingness to take risks results in a preference for a low capital protection level, a low maximum payoff and a high slope, but the coefficients are not significant.

Interestingly, subjects who are familiar with structured products (experience measure 2)

	Minimum payoff		Maximum payoff		Slope	
Intercept	6 710	5 314***	11 738***	18 014***	−1.04	1.46***
	(4 057)	(467)	(3 963)	(450)	(0.97)	(0.11)
PF 2	−1 011	−585	−1 350**	−1 433**	0.02	0.01
	(666)	(652)	(650)	(628)	(0.16)	(0.15)
PF 3	277	19	3	−209	−0.13	−0.09
	(681)	(656)	(666)	(633)	(0.16)	(0.16)
PF 1 × Exp. 2	653	1 072	186	372	0.34	−0.10
	(1 079)	(752)	(1 054)	(725)	(0.26)	(0.18)
PF 2 × Exp. 2	666	1 210*	−403	399	0.03	−0.49***
	(1 064)	(715)	(1 039)	(690)	(0.25)	(0.17)
PF 3 × Exp. 2	233	1 354*	327	903	0.24	−0.28
	(1 104)	(728)	(1 079)	(702)	(0.26)	(0.17)
Control variables	yes	no	yes	no	yes	no
Observations	179	179	179	179	179	179
R^2	0.23	0.06	0.22	0.07	0.23	0.07
Adjusted R^2	0.09	0.03	0.08	0.05	0.10	0.05
F Statistic	1.65**	2.05*	1.60**	2.75**	1.71**	2.70**

*p<0.1; **p<0.05; ***p<0.01

Table 2: Regression analysis of the properties of tailor-made products

prefer products with a high maximum payoff. Other variables that seem to have an impact on the individual product design are age, gender and income. Older subjects chose a higher capital protection level. Men chose a significantly lower maximum payoff than women. Men's preference for a limited upside potential was already apparent in the first investment decision. Additionally, men chose a higher slope. Subjects with higher income tend to favor a high maximum payoff.

6.3 Risk-adjusted reference instrument

In the last part of the experiments, subjects compare the individually designed product with the volatility-adjusted combination of the stock and the risk-free asset. An important observation is that the results of Experiments 1 and 2 shown in Figure 10 and Table 4 are practically identical.

In PF 1 and PF 3, the subjects perceived the individual product as more attractive. On average, they invest approximately 65% in the individual and only 35% in the volatility-adjusted product. In contrast, the PF 2 group does not show a preference for the tailor-made product on average, neither in the attractiveness score nor in the investment weights. Apparently, the simple linear product consisting of the stock and the risk-free asset is as attractive as the much more complicated structured product. This result suggests that the reference instrument is important,

at least in the PF 2 mode, and it should be risk-adjusted to allow for a better comparison of the probability histograms.

The higher level of protection chosen in the high interest environment of Experiment 2 does not make the subjects hold on to their individual product more strongly than in Experiment 1. The risk-adjustment of the alternative product takes the protection level into account, and the alternative product is also more attractive owing to the higher expected stock return. In both settings, PF 2 levels out the attractiveness of the individual and adjusted product.

It is important to note that it is the first moment of the distribution of the difference in attractiveness (delta attractiveness) and investment weights (delta weight) that shifts in PF 2. The second moment, however, is not systematically smaller in this presentation format, as can be seen from the standard deviations in Table 4. Thus, the individual preferences for one or the other product still appear to be strong in PF 2.

The results from the regression analysis in Table 3 suggest that education has an impact as well. Highly educated subjects seem to prefer the volatility-adjusted product more than less educated subjects.

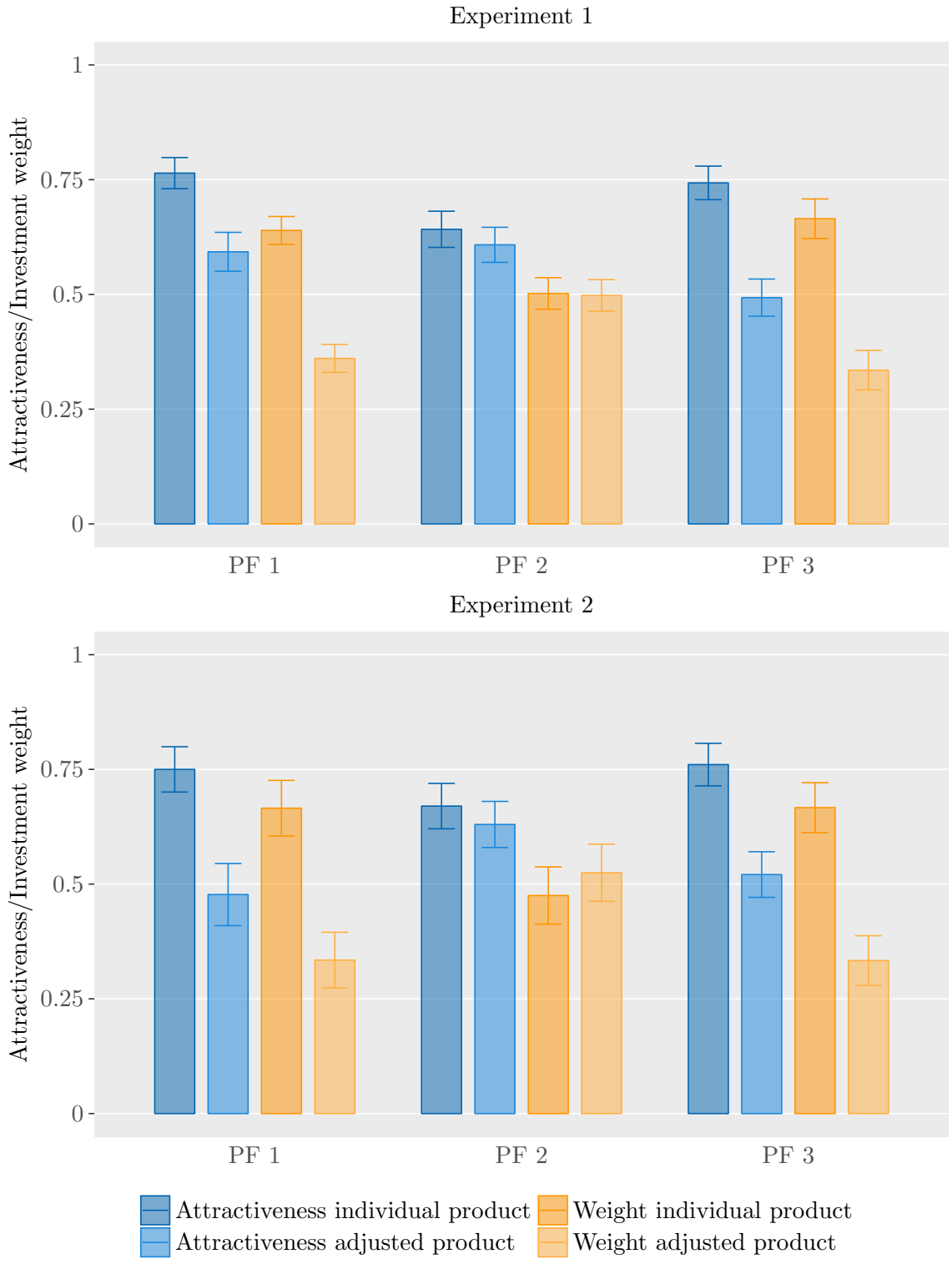


Figure 10: Perceived attractiveness and investment weights for the individual (tailor-made) and risk-adjusted product

	Attractiveness ind. product		Attractiveness adjusted product		Delta attractiveness	
Intercept	1.11***	0.76***	0.12	0.59***	0.99	0.17**
	(0.34)	(0.04)	(0.39)	(0.04)	(0.61)	(0.07)
PF 2	−0.09*	−0.12**	0.03	0.02	−0.13	−0.14
	(0.06)	(0.05)	(0.06)	(0.06)	(0.10)	(0.09)
PF 3	−0.02	−0.02	−0.11*	−0.10*	0.09	0.08
	(0.06)	(0.05)	(0.07)	(0.06)	(0.10)	(0.09)
PF 1 × Exp. 2	0.01	−0.01	−0.09	−0.12*	0.11	0.10
	(0.09)	(0.06)	(0.10)	(0.07)	(0.16)	(0.11)
PF 2 × Exp. 2	0.04	0.03	0.02	0.02	0.01	0.01
	(0.09)	(0.06)	(0.10)	(0.07)	(0.16)	(0.10)
PF 3 × Exp. 2	0.05	0.02	0.04	0.03	0.01	−0.01
	(0.09)	(0.06)	(0.11)	(0.07)	(0.17)	(0.10)
Control variables	yes	no	yes	no	yes	no
Observations	179	179	179	179	179	179
R^2	0.18	0.05	0.14	0.05	0.17	0.06
Adjusted R^2	0.04	0.02	−0.02	0.02	0.02	0.03
F Statistic	1.27	1.69	0.90	1.84	1.13	2.12*

	Weight ind. product		Weight adjusted product		Delta weight	
Intercept	1.06***	0.64***	−0.06	0.36***	1.11	0.28***
	(0.38)	(0.04)	(0.38)	(0.04)	(0.76)	(0.08)
PF 2	−0.12*	−0.14**	0.12*	0.14**	−0.24*	−0.27**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.12)	(0.12)
PF 3	0.03	0.03	−0.03	−0.03	0.06	0.05
	(0.06)	(0.06)	(0.06)	(0.06)	(0.13)	(0.12)
PF 1 × Exp. 2	0.01	0.03	−0.01	−0.03	0.02	0.05
	(0.10)	(0.07)	(0.10)	(0.07)	(0.20)	(0.14)
PF 2 × Exp. 2	−0.07	−0.03	0.07	0.03	−0.15	−0.05
	(0.10)	(0.06)	(0.10)	(0.06)	(0.20)	(0.13)
PF 3 × Exp. 2	−0.02	0.002	0.02	−0.002	−0.05	0.003
	(0.10)	(0.07)	(0.10)	(0.07)	(0.21)	(0.13)
Control variables	yes	no	yes	no	yes	no
Observations	179	179	179	179	179	179
R^2	0.20	0.10	0.20	0.10	0.20	0.10
Adjusted R^2	0.06	0.07	0.06	0.07	0.06	0.07
F Statistic	1.42*	3.74***	1.42*	3.74***	1.42*	3.74***

*p<0.1; **p<0.05; ***p<0.01

Table 3: Regression analysis of perceived attractiveness and investment weights for the individual (tailor-made) product ("ind. product") and the risk-adjusted reference instrument

		Experiment 1				Experiment 2			
Variable	PF	n	$\hat{\mu}$	$\hat{\sigma}$	t-value	n	$\hat{\mu}$	$\hat{\sigma}$	t-value
Delta attractiveness	1	35	0.17	0.35	2.88***	22	0.27	0.49	2.62**
Delta attractiveness	2	37	0.03	0.34	0.61	25	0.04	0.43	0.46
Delta attractiveness	3	36	0.25	0.41	3.70***	24	0.24	0.41	2.88***
Delta attractiveness	all	108	0.15	0.37	4.18***	71	0.18	0.45	3.38***
Delta investment weight	1	35	0.28	0.36	4.59***	22	0.33	0.57	2.73**
Delta investment weight	2	37	0.00	0.42	0.06	25	−0.05	0.62	−0.40
Delta investment weight	3	36	0.33	0.52	3.83***	24	0.33	0.53	3.07***
Delta investment weight	all	108	0.20	0.46	4.60***	71	0.20	0.60	2.79***

*p<0.1; **p<0.05; ***p<0.01

Table 4: Deviation between the attractiveness (or, alternatively, the investment weights) of individual (tailor-made) products and risk-adjusted reference instruments for different subject groups

7 Conclusion

There is an ongoing debate on how to present the risk and return characteristics of financial instruments in general and structured equity-linked products in particular. The large variety of structured products, their complexity and the non-linear payoff profiles make it difficult for investors to get a balanced view of risk and return. There is some evidence that behavioral biases play an important role in the success of structured products. The products are mostly illustrated with only a payoff diagram, and they are often compared to the underlying asset, although they are, by construction (limited downside or upside potential), less volatile. Information on the probability of possible outcomes appears to be crucial but is typically not provided. We argue that additional risk and return displays and risk-adjusted reference instruments can help to de-bias investors and improve investment decisions. Thus, we propose different presentation formats for the probability distribution and test their effect on the perceived attractiveness of structured products.

Using a between-subject design for the presentation format, the participants rated the attractiveness of a stock, a capital protection product and a reverse convertible and took multiple investment decisions. In Experiment 1, the capital protection level was 90% while Experiment 2 assumed higher interest rates so that a protection level of 100% could be offered.

In Experiment 1, the presentation format has a significant impact on both investment weights and perceived attractiveness. A bar chart with fifty ordered payoffs appears to convey only marginal probability information beyond payoff diagrams. Probability histograms, however, lead to a much more critical assessment of the capital protection product. The reason is that this presentation format reveals the high loss probability implied. When losses can no longer occur as in Experiment 2, the capital protection product stays attractive in the different presentation formats. This result is consistent with prior literature on loss probability aversion and the observation in practice that capital production products are only popular in situations in which full protection can be offered.

We find strong evidence that the presentation format plays an important role when investors compare a tailor-made structure with a simple combination of the underlying stock and the risk-free asset. While the subjects clearly prefer the tailor-made structure when confronted with payoff diagrams, the two alternatives are assessed as equally attractive in the presentation format with probability histograms. This result is the same in both experiments. Our interpretation is that participants who are confronted with probability histograms are more aware of the balance of risk and return in fairly priced products and less inclined to focus on individual aspects.

A limitation of our study is that we were not able to model both the presentation format and the reference instrument as between-subject variables. This would have required a subdivision of each presentation format group by reference instrument and a much larger sample size. Thus, our results on the reference instrument are indicative but inconclusive.

References

Blais, A.-R. and Weber, E. U. (2006). A domain-specific risk-taking (DOSPERT) scale for adult populations. *Judgment and Decision Making*, 1(1):33–47.

Bradbury, M. A., Hens, T., and Zeisberger, S. (2015). Improving investment decisions with simulated experience. *Review of Finance*, 19(3):1019–1052.

Cao, J. and Rieger, M. O. (2013). Risk classes for structured products: mathematical aspects and their implications on behavioral investors. *Annals of Finance*, 9(2):167–183.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*, volume 2. Lawrence Erlbaum Associates.

DDV (2017). Value at Risk (VaR). Retrieved from `https://www.derivateverband.de/ENG/Transparency/ValueAtRisk`.

Döbeli, B. and Vanini, P. (2010). Stated and revealed investment decisions concerning retail structured products. *Journal of Banking & Finance*, 34(6):1400–1411.

Eusipa (2016). Eusipa derivative map. Retrieved from `http://www.eusipa.org/images/Presse/European_map_20160530_2016.pdf`.

Faul, F., Erdfelder, E., Lang, A.-G., and Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods*, 39(2):175–191.

Goldstein, D. G., Johnson, E. J., and Sharpe, W. F. (2008). Choosing outcomes versus choosing products: Consumer-focused retirement investment advice. *Journal of Consumer Research*, 35(3):440–456.

Hens, T. and Rieger, M. O. (2014). Can utility optimization explain the demand for structured investment products? *Quantitative Finance*, 14(4):673–681.

Ibrekk, H. and Morgan, M. G. (1987). Graphical communication of uncertain quantities to nontechnical people. *Risk Analysis*, 7(4):519–529.

Kaufmann, C., Weber, M., and Haisley, E. (2013). The role of experience sampling and graphical displays on one's investment risk appetite. *Management Science*, 59(2):323–340.

Kunz, A. H., Messner, C., and Wallmeier, M. (2017). Investors risk perceptions of structured financial products with worst-of payout characteristics. *Journal of Behavioral and Experimental Finance*, 15:66–73.

Lindauer, T. and Seiz, R. (2008). Pricing (multi-) barrier reverse convertibles. Working Paper.

Ofir, M. and Wiener, Z. (2012). Investor sophistication and the effect of behavioral biases in structured products investment. SSRN Working Paper No. 2193287.

Rieger, M. O. (2012). Why do investors buy bad financial products? Probability misestimation and preferences in financial investment decision. *Journal of Behavioral Finance*, 13(2):108–118.

Rieger, M. O. (2016). *Optionen, Derivate und strukturierte Produkte*. Schäffer-Poeschel.

Rieger, M. O. and Hens, T. (2012). Explaining the demand for structured financial products: Survey and field experiment evidence. *Zeitschrift für Betriebswirtschaft*, 82(5):491–508.

Rieger, M. O., Wang, M., and Hens, T. (2014). Risk preferences around the world. *Management Science*, 61(3):637–648.

Sharpe, W. F. (2011). *Investors and markets: portfolio choices, asset prices, and investment advice*. Princeton University Press.

Sharpe, W. F., Goldstein, D. G., and Blythe, P. W. (2000). The distribution builder: A tool for inferring investor preferences. *preprint*.

SRP (2015). Research report for OIC. Analysis on structured products and listed equity options in Europe, Part 1: An executive summary, research and survey findings, Part 2: European structured product market overview.

SVSP (2015). SVSP Risikoklassifizierung (Value at Risk) – FAQ. Retrieved from `http://www.svsp-verband.ch/wp-content/uploads/2015/08/SVSP_Risikokennzahl_FAQ_de_2013-02-01.pdf`.

Vrecko, D., Klos, A., and Langer, T. (2009). Impact of presentation format and self-reported risk aversion on revealed skewness preferences. *Decision Analysis*, 6(2):57–74.

Wallmeier, M. (2011). Beyond payoff diagrams: How to present risk and return characteristics of structured products. *Financial Markets and Portfolio Management*, 25(3):313–338.

Wallmeier, M. and Diethelm, M. (2009). Market pricing of exotic structured products: The case of multi-asset barrier reverse convertibles in Switzerland. *Journal of Derivatives*, 17(2):59–72.

Wallmeier, M. and Diethelm, M. (2012). Multivariate downside risk: Normal versus variance gamma. *Journal of Futures Markets*, 32(5):431–458.

Weber, E. U., Siebenmorgen, N., and Weber, M. (2005). Communicating asset risk: How name recognition and the format of historic volatility information affect risk perception and investment decisions. *Risk Analysis*, 25(3):597–609.

Zeisberger, S. (2016). Do people care about loss probabilities? *Available at SSRN 2169394*.

Appendix A Overview of variables and measures

Dependent variables

Attractiveness adjusted product. Ordinal variable that indicates the perceived attractiveness of the volatility-adjusted product in the third investment decision.

Attractiveness CPP. Ordinal variable that indicates the perceived attractiveness of the CPP in the first investment decision.

Attractiveness individual product. Ordinal variable that indicates the perceived attractiveness of the self-designed structured product in the third investment decision.

Attractiveness stock. Ordinal variable that indicates the perceived attractiveness of the stock in the first investment decision.

Attractiveness RC. Ordinal variable that indicates the perceived attractiveness of the RC in the first investment decision.

Investment weight adjusted product. Investment weight of the volatility-adjusted product in the third investment decision.[8]

Investment weight CPP. Investment weight of the CPP in the first investment decision.[9]

Investment weight individual product. Investment weight of the self-designed structured product in the third investment decision.[8]

Investment weight stock. Investment weight of the stock in the first investment decision.[9]

Investment weight RC. Investment weight of the RC in the first investment decision.[9]

Maximum payoff. Chosen upper payoff limit of the self-designed structured product in the second investment decision ranging from 10 000 (investment budget) to 20 000.

Minimum payoff. Chosen capital protection level of the self-designed structured product in the second investment decision ranging from 0 to 10 000 (investment budget).

Slope. Chosen slope in the middle section of the payoff diagram between the minimum and maximum payoff of the self-designed structured product in the second investment decision ranging from 0.2 to 3.2.

[8] The sum of the two investment weights (adjusted and individual product) in the second investment decision is equal to 1.

[9] The sum of the three investment weights (stock, CPP and RC) in the first investment decision is equal to 1.

Treatment variables

PF. Categorical variable that indicates the PF to which the subject is assigned (PF 1, PF 2 or PF 3).

Risk preference measures

Risk preference measure 1. Certainty equivalent to a lottery with a 60% chance to win 100.

Risk preference measure 2. 100 deducted by the (absolute value of the) certainty equivalent for a lottery with a 60% chance to lose 100.

Risk preference measure 3. Ordinal variable that indicates the likelihood of investing 10% of the annual income in a moderate growth diversified fund.

Risk preference measure 4. Ordinal variable that indicates the likelihood of investing 5% of the annual income in a very speculative stock.

Risk preference measure 5. Ordinal variable that indicates the likelihood of investing 10% of the annual income in a new business venture.

Experience measures

Experience measure 1. Ordinal variable that indicates familiarity with statistics.

Experience measure 2. Ordinal variable that indicates familiarity with structured financial products.

Experience measure 3. Dummy variable that takes the value 1 if the subject has already invested in structured financial products and 0 if not.

Experience measure 4. Dummy variable that takes the value 1 if the subject has already invested in stocks, funds, bonds or derivatives and 0 if not.

Demographic variables

Age. Age in years.

Education. Ordinal variable that indicates the highest degree.

Gender. Categorical variable that indicates whether the subject is male or female.

Income. Ordinal variable that indicates the monthly net income.

Profession. Categorical variable that indicates whether the subject is unemployed, in school, employed, self-employed or retired (main activity).

Other control variables

Experiment 2. Dummy variable that takes the value 1 if the subject participated in Experiment 2 and 0 if the subject participated in Experiment 1.

Language. Categorical variable that indicates whether the experiment was completed in German or in English.

Order 1. Categorical variable that indicates whether the CPP is displayed on the left and the RC on the right in the first investment decision or the opposite way around.

Order 2. Categorical variable that indicates whether the adjusted product is displayed on the left and the individual product on the right in the third investment decision or the opposite way around.

Payoff. Dummy variable that takes the value 1 if the subject received a real monetary payoff and 0 if the subject has not picked up the payoff.

Survey type. Categorical variable that indicates whether the experiment was completed online and or in a controlled setting.

Appendix B Experiment

Instructions

Dear participant

The following is a survey on structured financial products. Structured financial products are popular innovative investment instruments. They are mostly issued by banks and offered to (private) customers for investment.

The survey takes about 20 minutes. Participation in the survey is voluntary.

The survey is anonymous, which means that the answers cannot be assigned to the participants at any time. The data will be treated confidentially and used only for research purposes.

Please make sure your screen is not too narrow. A mobile phone is not suitable for the survey.

For participation in the survey, you will receive a compensation with an expected value of CHF 15. **The amount paid is proportional to a simulated return on the assets you have selected.** You will get more information about the payoff at the end of the survey.

Many thanks in advance for your participation!

Attention: There is no "back" button.

NEXT

Page 1: Financial knowledge and experience

Are you familiar with statistics?

- Yes, I am very familiar with statistics.
- I know the basics.
- No, I have never dealt with it.

Are you familiar with structured financial products?

- Yes, I am very familiar with structured financial products.
- I could roughly explain structured financial products.
- I know roughly what they are.
- I have already heard of them.
- No, I have never heard of them.

Have you already invested in structured financial products?

- Yes
- No

Have you already invested in shares, funds, bonds or derivatives/options?

- Yes
- No

NEXT

Page 1 of 7

Page 2: Risk preferences

For each of the following statements, please indicate the likelihood that you would engage in the described activity or behavior if you were to find yourself in that situation.

Investing 10% of your annual income in a moderate growth diversified fund.

- ○ Extremely unlikely
- ○ Moderately unlikely
- ○ Somewhat unlikely
- ○ Not sure
- ○ Somewhat likely
- ○ Moderately likely
- ○ Extremely likely

Investing 5% of your annual income in a very speculative stock.

- ○ Extremely unlikely
- ○ Moderately unlikely
- ○ Somewhat unlikely
- ○ Not sure
- ○ Somewhat likely
- ○ Moderately likely
- ○ Extremely likely

Investing 10% of your annual income in a new business venture.

- ○ Extremely unlikely
- ○ Moderately unlikely
- ○ Somewhat unlikely
- ○ Not sure
- ○ Somewhat likely
- ○ Moderately likely
- ○ Extremely likely

Imagine you are offered the lottery below.

With a probability of 60% you get CHF 100
and with a probability of 40% you get CHF 0.
Please indicate the maximum amount you are willing to pay to participate in the lottery.

The following lottery includes losses. Imagine you have to participate in the lottery, unless you pay a certain amount before the lottery.

With a probability of 60% you lose CHF 100
and with a probability of 40% you lose CHF 0.
Please indicate the maximum amount you are willing to pay to avoid the lottery.

NEXT

Page 2 of 7

Page 3: Introduction of the stock, CPP and RC

In the following, you will have the possibility to invest in three investment options: a stock and two different structured products. Imagine that the investment period is one year and the investment capital amounts to CHF 10'000.

First, the three assets are explained. A diagram shows the profit or loss of the products as a function of the stock price at the end of the investment period. More information about the charts appears when you move the cursor over the respective chart.

If you understand the assets, click on "next".

STOCK

Stocks are assets that represent shares in a company. The value of stocks can rise (unlimited) or fall (in extreme cases down to zero).

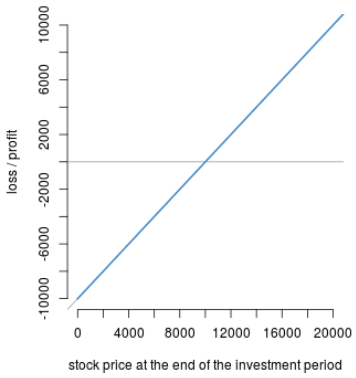
STRUCTURED PRODUCT A

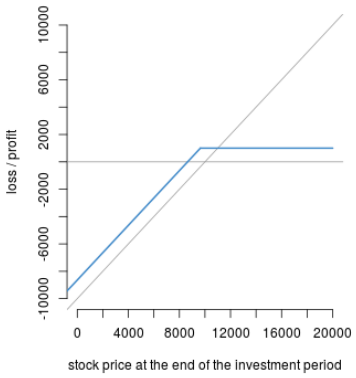
The values of the structured products A and B depend on the development of the stock price (same stock as on the left).

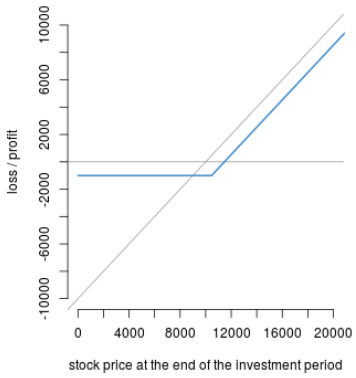
Structured product A has a limited upside potential. The value at the end of the investment period is at most 110% of the original value. The product therefore has a limited profit in the case of a favorable development of the stock price, but the loss in the case of an unfavorable stock price development is lower than the loss of holding the stock.

STRUCTURED PRODUCT B

Structured product B has a limited loss in value. The value at the end of the investment period is at least 90% of the original value. The product is therefore protected against large losses in the case of an unfavorable development of the stock price, but the profit is lower compared to holding the stock in the case of a favorable development of the stock price.







NEXT

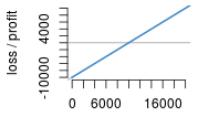
Page 3 of 7

Page 4: First investment decision

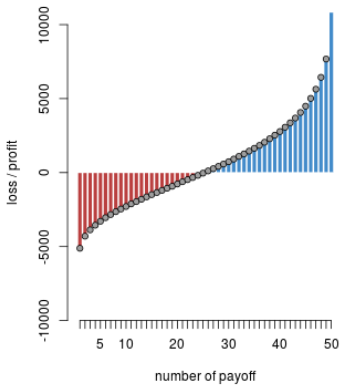
An analysis of the assets generated new findings regarding the probability of the level of profit or loss.

The additional chart below shows a representative selection of 50 payoffs, all of which occur with the same probability of 2%. The profit or loss level is shown on the vertical axis. The red and blue bars of this chart represent the respective product, and the gray dots represent the stock.

STOCK



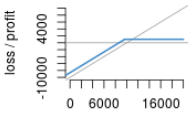
ock price at the end of the investment



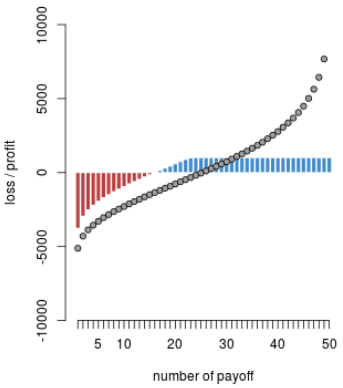
How attractive is the stock to you in comparison to the other assets?

- Very attractive
- Rather attractive
- Mediocre
- Rather unattractive
- Very unattractive

STRUCTURED PRODUCT A



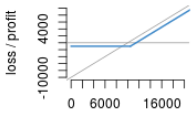
ock price at the end of the investment



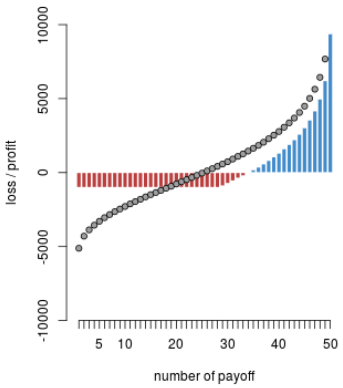
How attractive is structured product A to you in comparison to the other assets?

- Very attractive
- Rather attractive
- Mediocre
- Rather unattractive
- Very unattractive

STRUCTURED PRODUCT B



ock price at the end of the investment

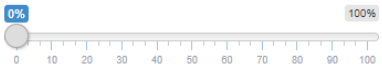


How attractive is structured product B to you in comparison to the other assets?

- Very attractive
- Rather attractive
- Mediocre
- Rather unattractive
- Very unattractive

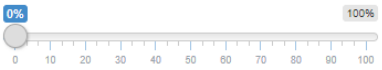
Imagine that you invest CHF 10'000 in the assets for one year. What percentage of your capital would you invest in which asset?
Use the sliders to specify the result. The total percentage must be 100%.

Percentage in stocks



Percentage in structured product A

Percentage in structured product B



Total investment: 0%

NEXT

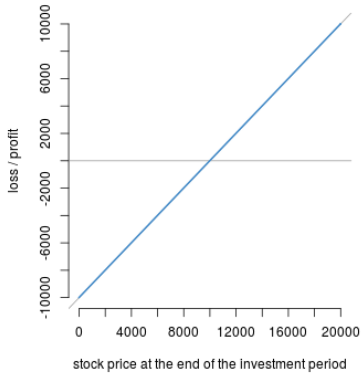
Page 4 of 7

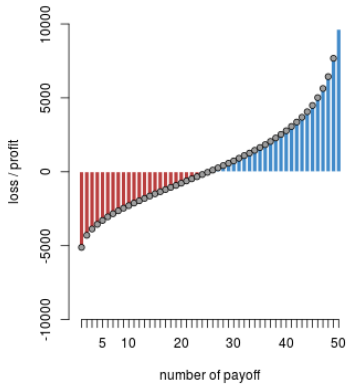
Page 5: Second investment decision/tailor-made structured product design

In the following, you have the possibility to design your own structured financial product.

To do so, use the sliders to determine the minimum payoff, the maximum payoff and the slope between them. For more information about this, move the cursor over the respective setting.

Again, imagine that you invest CHF 10'000 for one year in the designed product.





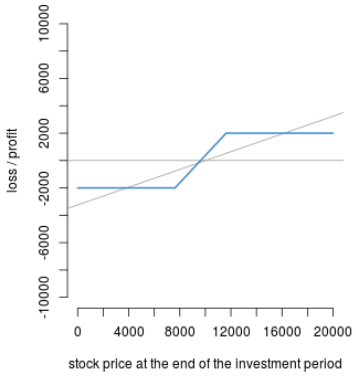
NEXT

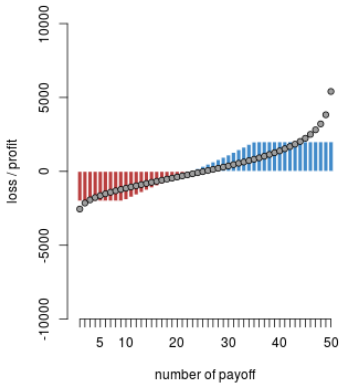
Page 5 of 7

Page 6: Third investment decision

In the following, you once more have the possibility to invest in two different products: product C and product D.
More information about the charts appears when you move the cursor over the respective chart.

PRODUCT C

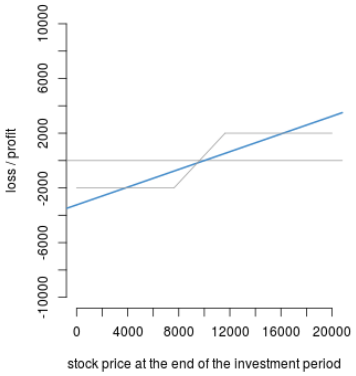


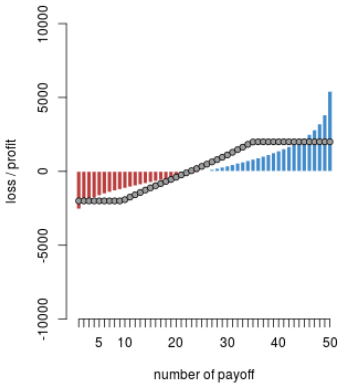


How attractive is product C to you?

- Very attractive
- Rather attractive
- Mediocre
- Rather unattractive
- Very unattractive

PRODUCT D



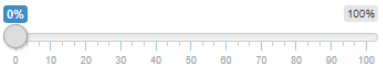


How attractive is product D to you?

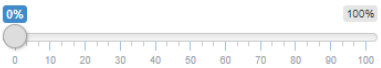
- Very attractive
- Rather attractive
- Mediocre
- Rather unattractive
- Very unattractive

Again, imagine that you invest CHF 10'000 in the products for one year. What percentage of your capital would you invest in which product?
Use the sliders to specify the result. The total percentage must be 100%.

Percentage in product C



Percentage in product D



Total investment: 0%

NEXT

Page 6 of 7

Page 7: Demographics

Finally, we would like to ask you a few questions about yourself.

Please indicate your gender.

- Male
- Female

How old are you?

Please indicate your marital status.

- Unmarried
- Married
- Divorced
- Widowed

Please indicate your nationality.

Please indicate your highest degree.

- No degree
- Elementary school graduation
- Completed apprenticeship
- High school degree
- Bachelor's degree or equivalent
- Master's degree or equivalent
- Doctor's degree or equivalent

Please indicate your profession (main activity).

- Unemployed
- Student or in school
- Employed
- Self-employed
- Retired

Please indicate your average monthly net income.

- < CHF 1'000
- CHF 1'000 - 3'000
- CHF 3'000 - 5'000
- CHF 5'000 - 10'000
- > CHF 10'000

SUBMIT

Page 7 of 7