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Investors' risk perceptions of structured financial products with worst-of payout characteristics

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ABSTRACT

We conduct an experiment to investigate how investors assess the risk of reverse convertibles that link their payouts to the worst performing stock of a pool of underlying assets. Based on theory from psychology, we conjecture that investors' risk perception can be systematically biased downwards via the strategic selection and composition of the underlying assets. We predict and find that adding relatively safe assets to a risky underlying asset *decreases* perceived investment risk despite the fact that the risk always strictly *increases*. Investment experience and expertise alleviate but do not eliminate the bias. Our findings contribute to the understanding of the puzzling success of structured products that link their payouts to the worst performing underlying asset. They also provide important implications for investor protection in a market in which financial institutions can tailor financial products to exploit behavioral biases of retail investors.

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1. Introduction

Structured equity-linked products have become an important element of the available asset universe for institutional and retail investors. The European market is by far the largest in the world, representing a market value of \$650 billion at the end of 2014 (SRP, 2015, 26). Reverse convertibles are the most popular type of structured products on the European markets (SRP, 2015, Part 2, 16). They provide a seemingly attractive, fixed interest payment in exchange for bearing considerable downside risk on the investment. Barrier reverse convertibles (BRCs) include a barrier feature in which the invested capital is protected as long as the assets that underlie the product do not breach a downside barrier. Typically, BRCs link their final payouts to the *worst* performing stock in a pool of underlying assets. The risk associated with this worst-of payout characteristic is difficult to assess for BRC investors (Lindauer and Seiz, 2008; Hens and Rieger, 2014; Rieger, 2012). Biased risk perceptions might therefore have contributed to the success of BRCs on European markets.

In this paper, we hypothesize that investors' risk perception can be systematically biased downwards via the strategic selection and composition of the assets that underlie a BRC. We derive our

hypothesis from research of a misconception known in psychology as the "dieter's paradox" (Chernev, 2011, 2010; Chernev and Gal, 2010). According to this paradox, people tend to erroneously believe that adding healthy food (e.g., a salad) to an unhealthy meal (e.g., a hamburger) decreases calorie intake. Researchers explain the paradox by peoples' inclination to categorize different options according to opposing, semantically loaded categories (e.g., good-bad) and their propensity to evaluate combinations of options of opposing categories in a compensatory manner (Chernev, 2011, 2010; Chernev and Gal, 2010). As a consequence, people tend to average rather than total the calories contained in an "unhealthy" burger and a "healthy" salad (Chernev and Gal, 2010). We posit that a conceptually similar misperception can occur when retail investors assess the risk of BRCs. Due to the worst-of payout characteristic of BRCs, a larger pool of underlying assets always strictly increases investors' loss risk, similar to adding additional food to a meal always increases calories. Market participants broadly agree on coarse risk classifications (e.g., low risk, high risk) of stocks that are familiar to them (Blitz and van Vliet, 2007; Ortiz et al., 2015).¹ Anecdotal evidence suggests that BRCs based on multiple underlying stocks often include at least one stock that investors generally

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¹ Coarse risk classifications of stocks are also provided by finance portals such as www.cash.ch.

consider as a safer investment (Wallmeier and Diethelm, 2009). Applying the dieter's paradox to BRCs, we therefore hypothesize that adding relatively safe assets to a risky underlying asset will induce investors to erroneously believe that the overall risk of the BRC decreases when the risk in fact always *increases*.

Studying this analog of the dieter's paradox in financial markets is interesting because BRCs enjoy a widespread popularity, particularly among retail investors (Wallmeier and Diethelm, 2009). The overwhelming success of BRCs is puzzling for two reasons. First, BRCs involve considerable downside risk, which appears to conflict with investors' well-documented loss aversion (Kahneman and Tversky, 1984; Breuer and Perst, 2007). Second, independent financial experts typically advise against investments in BRCs, primarily because they are seen as overly complex and largely overpriced (e.g., Leisinger, 2014; Deng et al., 2015; Swedroe, 2015).² However, BRCs may be popular because they may be designed to exploit behavioral biases of retail investors. In support of this claim, prior research provides evidence that investors seem to base their investment decisions too narrowly on the fixed interest that BRCs offer (Wallmeier and Diethelm, 2009) and that conjunction errors can cause investors to underestimate the loss risk of multivariate BRCs (Rieger, 2012). Further corroborating evidence comes from analytical research by Hens and Rieger (2014). They show that rational investors have no incentive to invest in structured products unless they suffer from incorrect market beliefs or are sufficiently loss-averse to engage in gambling behavior to avoid *sure* losses.

We intend to contribute to the literature by providing a novel explanation as to why investors underestimate the loss risk of BRCs. We investigate whether experienced retail investors are deceived by the dieter's paradox. More specifically, we investigate whether the strategic selection and composition of the financial assets that underlie a BRC can be used to bias investors' risk perception downwards despite the fact that the product's risk increases. Following the dieter's paradox, we hypothesize that investors engage in semantic anchoring and an averaging bias when assessing BRCs (Chernev, 2011, 2010; Chernev and Gal, 2010). We conjecture that investors will anchor on a dichotomous risk-safe categorization of stocks, and that they will evaluate the BRC's overall risk based on the average risk of its underlying stocks. We therefore predict that investors will systematically underestimate the risk of BRCs that comprise *differentially* risky stocks, while we predict no such misjudgment effect when the BRC comprises stocks that all belong to the same risk category.

Our research extends prior studies of misjudgments related to structured products. In Rieger (2012), investors misestimate the loss probability of a BRC because their context-specific experience causes them to rely on a *non-predictive* cue that triggers intuitive impressions of security and safety (i.e., Swiss investors underestimate the loss risk of a BRC based on the Swiss market index vis-à-vis a BRC based on a non-Swiss market index).³ Extending Rieger (2012), we investigate misjudgments that occur when investors

are provided with *predictive* information that is *unrelated* to their personal experience (i.e., investors assess the loss risk of BRCs based on hypothetical stocks that differ in terms of their risk profile).⁴ On a construct level, our study differs from Rieger (2012) in that the conjunction fallacy and the dieter's paradox describe different psychological processes. The conjunction fallacy identifies misjudgments due to the reliance on non-predictive information that alludes to peoples' experience with similar contexts (Tversky and Kahneman, 1983). However, the dieter's paradox detects misjudgments that result from peoples' tendency to aggregate predictive information that is organized in opposing mental categories in a compensatory manner (Chernev, 2011, 2010; Chernev and Gal, 2010). Consequently, whereas the conjunction fallacy exposes the danger that investors' context-specific *experience* may cause them to overweight *non-predictive* cues, the dieter's paradox additionally identifies misjudgments that can occur when investors are provided with *predictive* information that is *unrelated* to their experience.⁵

In Hens and Rieger (2014), investors misestimate loss probabilities because they suffer from incorrect market beliefs or because they are sufficiently loss averse to engage in gambling behavior to avoid *sure* losses. Extending Hens and Rieger (2014), we provide investors with objective information concerning the volatilities of the underlying assets. In addition, we investigate only payout profiles that are common in practice. This allows us to exclude by design that misjudgment effects are driven by misestimations concerning the underlying assets' volatilities or by investors' gambling behavior to avoid *sure* losses as in Hens and Rieger (2014).

In our experiment, retail investors take the role of prospective investors who consider investing in BRCs that are either based on a single hypothetical stock (univariate BRC) or three hypothetical stocks (multivariate BRC).⁶ Underlying stocks are characterized with either high or low stock price volatility. All BRCs share identical characteristics with respect to the maturity, the barrier, the interest coupon, and the currency. The BRCs differ only in terms of the number of underlying stocks (one or three) and the price volatility of the underlying stocks (high- or low-volatility). We present five BRCs to the participants in sequential order and ask them to assess each BRC for the probability of full repayment (i.e., the desired outcome for investors). Two of the five BRCs we present to the participants are univariate BRCs based on either a low-volatility or a high-volatility stock. The other three BRCs are multivariate BRCs based on one of the following: (i) three low-volatility stocks, (ii) three high-volatility stocks, or (iii) one high-volatility and two low-volatility stocks. We designed the experimental material such that the multivariate BRCs include at least one of the two stocks that underlie the univariate BRCs. As a consequence, the risk of a BRC *increases* by design when the pool of underlying assets is extended. However, in contrast to normative predictions but in accordance with the dieter's paradox, we find that the loss risk that retail investors associate with BRCs *decreases*

² The margin between the (higher) selling price and the (lower) theoretical value of structured financial products tends to increase with the products' complexity, see, e.g., Stoimenov and Wilkens (2005), Benet et al. (2006), Szymanowska et al. (2009), Henderson and Pearson (2011), Wallmeier and Diethelm (2009), Wallmeier and Diethelm (2012), Deng et al. (2015). Entrop et al. (2016) provide evidence of weak performance of individual investors in structured financial products. The pricing of BRCs with multiple assets is studied in Marena et al. (2015), Wallmeier and Diethelm (2009, 2012).

³ Rieger (2012) reports that Swiss participants rated the probability of a barrier event for a BRC based on the three market indices SMI, S&P 500 and DAX as significantly lower than the corresponding probability for a BRC based on the DJIA. Rieger (2012, p. 115) notes that the "conjunction fallacy typically occurs when one of the conjoint events seems most 'natural' to happen. [Given that] ... it seems most natural to Swiss investors that the 'solid and safe' SMI will not hit the barrier... they fall prey of the conjunction fallacy and overestimate the safety of the three index basket".

⁴ On an operational level, our study differs from Rieger (2012) in two important aspects. Investors in Rieger (2012) assess BRCs that are based on entirely *different* assets (i.e., no asset underlies two distinct BRCs). In addition, participants' risk perception of the individual assets that underlie the BRCs are neither elicited nor manipulated. We control for participants' risk perception of the individual assets that underlie the BRCs by classifying assets as high- or low-volatility stocks. Moreover, to control for the incremental risk of multivariate BRCs above and beyond the univariate BRC, we use BRCs based on systematic combinations of individual stocks to ensure that the *same* stock that underlies a univariate BRC is also included in at least one multivariate BRC (we explain the experimental design in more detail in Section 3.1).

⁵ Due to the different psychological mechanisms, the two constructs can produce conflicting predictions for investors' assessments of BRC loss probabilities. We discuss this in more detail in Section 5, footnote 13.

⁶ See Section 3.1 for a detailed description of the experimental design.

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