A satisficing approach to eliciting risk preferences

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ABSTRACT

A new approach is proposed to eliciting risk preferences by framing choice over risky payoff distributions as a satisficing task. We demonstrate novel links between the information elicited from the satisficing task—which allows subjects to consider accepting a *worse* worst-case outcome in favor of a *better* best-case outcome—and portfolio choice using expected utility theory (EUT). The key tradeoff in our satisficing task can also be stated in reverse: to consider accepting less attractive potential upside gains in order to improve worst-case outcomes. Risk preferences are elicited by asking subjects to choose an acceptable worst-case portfolio outcome from a continuum of binary gambles, each with its own support and unique minimum. The *worst-case aspiration* represents the smallest low-state payoff in the binary gamble that the subject is willing to accept. We show analytically and empirically that choosing a most preferred worst-case aspiration maps into a logically equivalent—but psychologically distinct—process of expected utility maximization (i.e., allocating one's savings over a binary risky asset and risk-free bond using the EUT framework with a unique risk-acceptance parameter under CARA or CRRA risk preferences).

1. Introduction

This paper proposes a new approach to measuring risk preferences. Our approach elicits risk preferences using a satisficing task that asks subjects to consider how potential upside gains must be traded off to improve the (portfolio's) worst-case outcome. The satisficing task is an algebraic re-description of the simplest two-asset portfolio choice task of allocating investable funds between a risk-free asset and a binary risky asset with high and low states. We focus on how much gain must be sacrificed in the upside realization to achieve the subject's desired worst-case outcome (which we refer to as the *worst-case aspiration*). This re-description of the portfolio choice problem evokes new reasoning about tradeoffs in portfolio choice—in terms of the best best-case outcome given the subject's worst-case aspiration, as opposed to orthodox maximization of expected utility based on mean-variance preferences.

Our approach is grounded in Simon's (1959) notion of satisficing where decision makers use threshold-based rules. We apply satisficing of worst-case aspirations (i.e., choosing a "good enough" worst-case portfolio outcome) in the context of choosing a portfolio from a small menu of random payoff distributions. We propose a simple technique for measuring risk preferences and making interpersonal comparisons of risk attitudes using intuitive units of measure that are algebraically equivalent to expected return and standard deviation combinations.

The expected utility framework (Von Neumann & Morgenstern, 1944) is often used to estimate risk preferences.[1] Deviations from expected utility theory may arise as the result of limits on the decision maker's capacity to compute, to know, and/or to remember outcomes and probabilities (Simon, 1955, 1982).[2] Tversky and Kahneman (1974) refer to such violations of axiomatic consistency as behavioral biases, which have inspired models of bounded rationality conceived of as

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  [1] In the EU framework, the preferences are assumed to be well-defined and satisfy the Savage axioms guaranteeing that risk preferences are representable as if they are solutions to an expected utility maximization objective.
  [2] Abundant empirical evidence in economics, psychology and neighboring disciplines of decision science demonstrates that real-world choice data commonly violate EU theory, implying that those data cannot be rationalized as if it arose from a mental process of expected utility maximization (Allais, 1953; Camerer, 1992; Conlisk, 1989; Ellsberg, 1961; Rabin, 2000; Starmer, 2000).

optimization subject to cognitive constraints (e.g., Conlisk, 1996; Day & Pingle, 1991; Simon, 1955, 1978).[3] Selten (1998) focuses on the setting of aspirations, fixed or adjusted, in satisficing processes. Selten hypothesizes that aspiration setting can provide a more descriptive and empirically relevant characterization of actual decision makers' search and stopping rules.

Our approach to measuring risk preferences takes as its point of departure the observation that people make economic decisions over risky payoff distributions without any need for translating outcomes and probabilities into the language of expected utility and symmetric measures of risk. Instead, people frequently set aspirations and then choose an alternative from their choice sets that meets aspiration levels (i.e., satisficing). People apply various techniques of simplification as adaptive responses to the demands of complex decision tasks, such as retirement savings and portfolio choice.[4] Small-scale farms, for example, often target a minimum acceptable level of revenue, which is achieved by cultivating "safe" crops that generate relatively stable returns from one portion of their land, while allocating the remainder of their land to "risky" crops with superior upside (Lopes, 1987). Herb Kelleher, founder and former CEO of Southwest Airlines, talks frequently about his focus on hedging fuel costs, which can be interpreted as locking in a worst-case aspiration for earnings, similar to the decision variable used in our elicitation technique. Adopting simplicity as a guiding principle, Kelleher attributes his company's success, in part, to its focus on targeting a maximum acceptable fuel cost while eschewing complex, multi-year planning, which he believes caused other airlines to struggle: "We have been successful because we've had a simple strategy. The lowest costs in the industry—that can't hurt you. . ." (Lucier, 2004).

We use satisficing decision rules as a means of eliciting subjects' rankings of lotteries because they are intuitive. Asking subjects to consider tradeoffs between best-case and worst-case payoffs is easier for subjects without probability and statistics training than asking them to express tradeoffs between standard deviation and expected value of lotteries. We show that information about subjects' choices over risky lotteries elicited using our satisficing elicitation tool can be transformed into conventional measures of risk aversion based on expected utility theory.

Our elicitation technique asks subjects to invest in a two-asset portfolio consisting of a risk-free bond (with guaranteed return) and a binary risky asset with high and low rates of annual return that, for simplicity, are assumed to occur with equal probability. This structure is similar to the ones used in utility assessment methods (see Farquhar, 1984 for a review) such as certainty equivalence and probability equivalence but the satisficing approach is easier for subjects being natural and intuitive (Brown & Sim, 2009). The resulting satisficing decisions, which trade off larger potential losses (in the portfolio's worst-case outcome) for greater possible gains (or upside potential), are analytically related to the orthodox EU approach to risk-aversion. To our knowledge, our demonstration of this simple analytic relationship between elicited satisficing preferences and EU risk aversion is novel. Our two-asset portfolio decision with *satisficing* follows the design presented in Güth (2007) and further used in studies of satisficing and portfolio choice (Fellner, Güth, & Maciejovsky, 2009). A related satisficing decision procedure is Brandstätter, Gigerenzer, and Hertwig's (2006) *priority heuristic*. They argue that worst-case outcomes are typically more important than the probability of that worst-case outcome occurring. Minimum outcomes play a similarly important role in regret

theory (Loomes & Sugden, 1982), disappointment theory (Bell, 1985), and failure avoidance (Heckhausen, 1991).

The satisficing elicitation technique gives focal importance to the choice of a worst-case payoff in levels (in our case, in Indian rupees, INR). At the outset, we elicit an initial amount (in INR) to be invested in a portfolio of assets. The portfolio allocation across risky equities and zero-risk bonds is to be decided next. The subject must then decide how to allocate the initial investment between a risk-free bond returning 10% and a binary risky gamble with equiprobable returns of + 32% and − 10% returns. The subject is free to change the initial investment after viewing the reward structure before finalizing the decision. All elicited amounts are in currency level (of INR) rather than as percentages (i.e., we do not elicit the portfolio by asking for any non-negative percentage-point increments summing to unity, as in the presentation of canonical portfolio choice problems in finance textbooks). Therefore, the portfolio choice decision is made in units of INR, with pre-testing and redundant cross-checking that alternate between percentage and level expressions used to describe investment returns. Finally, we elicit a *worst-case aspiration*, defined as the minimum acceptable portfolio outcome.

In the satisficing framing, tradeoffs presented to subjects between best-case and worst-case payoffs are constrained such that the subject's worst-case aspiration is respected.[5] We show that the tradeoff between more favorable worst-case aspirations and best-case portfolio gains represents an alternative elicitation scheme that is algebraically equivalent to risk aversion under the assumption of EU maximization. Viewing the portfolio chosen by satisficing from an expected utility perspective, one easily sees that choosing greater (i.e., more favorable) worst-case aspirations can be interpreted as a revealed preference for portfolios with the benefit of lower standard deviation traded off against lower expected value. The elicited worst-case aspiration and implied upper bound on the high-state portfolio return, jointly, produce an "optimal" portfolio (i.e., greatest best-case aspiration given the subject's choice of worst-case aspiration).[6]

The paper is organized as follows. Section 2 details the simple and stylized portfolio choice task used for the purpose of elicitation and measurement of interpersonal variation in risk preferences. Section 3 describes the experimental design and descriptive statistics. Section 4 reports detailed descriptive information about subjects' risk preferences based on the aspiration data that demonstrates links between satisficing and the EU maximization approach; Section 5 provides further discussion and contextualization of our aspiration setting task within the bounded rationality literature. Section 6 concludes.

2. Aspirations and risk

Consider an individual who faces the task of allocating an amount e between the risk-free bond earning constant gross return r (e.g., $r = 1.10$) and the risky investment X with low-state and high-state gross returns denoted l and h, respectively, and corresponding probabilities p and $1 − p$ (e.g., $l = 0.90$ with probability 0.50 and $h = 1.32$ with probability 0.50). If the entire amount e (i.e., the desired investment value (chosen by subjects in INR) is invested in the bond r, then the portfolio's terminal value is simply the product er. Similarly, if the entire amount is invested in the risky asset, then portfolio's terminal

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[3] A subset of this bounded rationality literature relies on satisficing as a good-enough adaptive strategy across different kinds of environments with profound uncertainty (Simon, 1972).

[4] Environments with unknown action spaces and uncertain mappings from actions into payoff distributions provide further motivation for satisficing as a potentially adaptive response (Gigerenzer, Todd, & The ABC Research Group, 1999; Payne, Bettman, & Johnson, 1993).

[5] The possibility of unwanted demand effects on subjects when asked to evaluate lotteries using our satisficing elicitation tool leads to within-subject testing (reported below in Section 3) of risky choice with and without using the satisficing elicitation tool. Subjects make allocation decisions based on both approaches, and a substantial proportion prefers the allocation made using the satisficing elicitation technique.

[6] Subsequent analysis demonstrates links between satisficing and risk aversion in the orthodox expected utility approach. The notion of optimal best-case aspirations given subject's choice of worst-case aspiration is therefore equivalent to the well-known characterizations of optimality: greatest expected return given the subject's choice of standard deviation or, equivalently, the smallest standard deviation given subject's choice of expected return.