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Probability weighting and loss aversion in futures hedging

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Abstract

We analyze how the introduction of probability weighting and loss aversion in a futures hedging model affects decision making. Analytical findings indicate that probability weighting alone always affects optimal hedge ratios, while loss and risk aversion only have an impact when probability weighting exists. In the presence of probability weighting, simulation results for a relevant range of parameter values suggest that probability weighting is dominant; changes in probability weighting affect hedge ratios relatively more than changes in loss and risk aversion. When decisions are made independently, loss aversion has a relatively small impact on hedge ratios for all parameter values, and risk aversion becomes important for only a narrow range of risk coefficients which produce implausible speculative behavior. When prior losses and gains affect behavior, hedging is influenced most by prior outcomes that influence risk attitudes, but this effect is still somewhat less than the consequences of changes in probability weighting.

JEL classification: D01; D81; G11; Q13

Keywords: Probability weighting; Loss aversion; Futures markets; Hedging

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Experimental evidence has demonstrated that the assumptions of the standard expected utility theory are often violated when people make decisions under risk. Schoemaker (1982) and Starmer (2000) discuss problems encountered by expected utility theory and new developments in the field of decision making. De Bondt and Thaler (1995), Hirshleifer (2001) and Barberis and Thaler (2003) provide empirical evidence critical of expected utility theory in financial decision making. As a consequence, researchers have developed alternative theories to explain choice, often based on observed laboratory or experimental evidence. In financial applications, prospect theory developed by Kahneman and Tversky (1979) and Tversky and Kahneman (1992) appears to offer the most promising non-expected utility theory for explaining decision making under risk (Barberis and Thaler, 2003). Prospect theory differs from the expected utility paradigm in that choice is influenced by loss aversion and probability weighting. Loss aversion posits that decisions are made in terms of gains and losses rather than final wealth, and individuals react differently to gains and losses. Probability weighting reflects the notion that decision makers use transformed probabilities rather than objective probabilities in making their choices. The choice model under prospect theory has two fundamental components: a value function that incorporates loss aversion, and a weighting function that reflects a non-linear transformation of probability.

Although extensive research on these dimensions exists, Barberis and Thaler (2003) assert that most work in behavioral finance is narrow as "models typically capture something about investors' beliefs, or their preferences, or the limits to arbitrage, but not all three" (p. 1112). Empirical research in behavioral finance has been dominated by the investigation of loss aversion. Applied work has focused primarily on either loss aversion and reference points to re-examine unexplained phenomena, or analytically incorporated loss aversion and reference points in investment allocation problems (e.g. Benartzi and Thaler, 1995; Barberis Huang, and Santos, 2001). The work investigating the combined effects of the value and probability functions in financial decision making is only now emerging. Strikingly the research findings show that substantive changes can arise when multiple dimensions of the behavioral literature are considered (Blavatskyy and Pogrebna, 2005; Davies and Satchell, 2005; Langer and Weber, 2005), but the complexity of the phenomena suggests that additional work is needed. Further, most recent research has focused primarily on asset price models for equity and bond markets, with little analysis on the role of behavioral theory in futures markets and the hedging decision. To date, only two papers have investigated hedging decisions in the presence of loss aversion (Albuquerque, 1999; Lien, 2001); neither considered probability weighting. The extension to hedging models may be particularly informative because previous research has suggested that loss aversion has no effect on hedging decisions in the presence of unbiased markets (Lien, 2001). Introduction of probability weights, which may deviate from market or objective probabilities, with loss aversion in an integrated framework may provide a more comprehensive understanding of behavioral dimensions of hedging decisions.

The purpose of this paper is to incorporate loss aversion and probability weighting into a futures hedging context. To identify the effects of these factors, a theoretical model is developed and the importance of loss aversion and probability weighting is discussed. In our empirical study we examine the effect of loss aversion and probability weighting for a soybean producer who hedges his crop using a futures market. Distributions for soybean cash and futures price changes are developed to simulate the producer's operational hedging decision for a relevant range of parameter values. Calculated hedge ratios are used