Regret Minimizers and Convergence to Price-Taking

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ABSTRACT

This paper investigates the relationship between how a trader decides to behave in a market and whether or not he grows to act as a price taker as the market increases in size. Specifically, we consider the robustness of price-taking behavior in the private value k-double auction under Knightian uncertainty. A decision problem involves Knightian uncertainty if the agent knows the outcome in each possible state of the world for all available actions, but does not know each state's probability. In our model, traders face Knightian uncertainty regarding other traders' strategies, and possibly the distribution of their redemption values as well.

One of the decision rules available to a decision-maker facing Knightian uncertainty is minimax regret. Unlike expected utility maximizers, who adopt a subjective prior in the face of Knightian uncertainty, minimax regret traders eschew all priors. We find that minimax regret traders will not converge to price-taking behavior even as the number of traders in the market increases. This is a direct consequence of minimax regret's freedom from priors: traders do not take into account that increasing the size of the market decreases the likelihood of a bid or ask being "pivotal" and dramatically affecting the trading price. Since minimax regret traders will not converge to price-taking, the outcome in a double auction market populated by such agents will not converge to efficiency as the size of the market grows, contrary to standard economic intuition.

However, not all regret-based decision rules fail to respond to market size, as minimax regret does. Introducing priors over some part of the decision problem to minimize expected maximum regret, or multiple priors to minimize maximum expected regret, will have different consequences.

A trader may minimize *expected* maximum regret if he has a prior over the distribution of other traders' valuations and costs but maintains Knightian uncertainty regarding other traders' strategies. Such traders will not converge to price-taking behavior as the market grows. In fact, they will shade their bids or asks more as the size of the market increases, approaching the pure minimax regret strategies.

A trader that minimizes maximum expected regret uses a convex set of priors in his decisions. Such traders may converge to price-taking behavior as the market grows. This holds even though they may not evaluate the possible bids according to a single prior, as an expected utility maximizer would. We find sufficient conditions on the set of priors for convergence to price-taking behavior by agents that minimize maximum expected regret. The results suggest the power of "pathological" priors to wreak havoc on a trader's convergence to price-taking behavior and hence on a market's convergence to efficient outcomes.

This exploration of regret-minimizing traders' behavior in k-double auctions illuminates the role of individuals' beliefs in ensuring market outcomes that are consistent with standard economic intuition. Decision rules that abandon all priors over rivals' strategies, as the proposed minimax regret and minimizing expected maximum regret traders do, give counterintuitive results with large numbers of participants. These decision rules may be well-suited to the bilateral bargaining scenario for which they were originally proposed by Linhart and Radner (1989), but applying them to large markets is problematic. Fortunately, avoiding these problems does not require that we take the other extreme of endowing each trader in our model with a single prior. Agents that consult a set of priors and minimize maximum expected regret may still converge to price-taking behavior. The robustness of this market mechanism is limited by the need to avoid "pathological" priors that destroy traders' incentive to truthfully reveal their true redemption values.

Categories and Subject Descriptors

J.4 [**Social and Behavioral Sciences**]: Economics

General Terms

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double auctions, regret minimization, Knightian uncertainty