Stochastic Choice and Noisy Beliefs in Games: an Experiment^{*}

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Abstract

We study an equilibrium model in which players make stochastic choices given their beliefs *and* there is noise in the beliefs themselves. The model primitives are an actionmap, which determines a distribution of actions given beliefs, and a belief-map, which determines a distribution of beliefs given opponents' behavior. These are restricted to satisfy axioms that are stochastic generalizations of "best response" and "correct beliefs", respectively. In our laboratory experiment, we collect actions data and elicit beliefs for a family of asymmetric 2-player games with systematically varied payoffs, allowing us to "trace out" both of these mappings. We find that, while both "noise in actions" and "noise in beliefs" are important in explaining observed behaviors, there are systematic violations of the axioms. In particular, although all subjects observe and play the same games, subjects in different roles have qualitatively different belief biases. The data (actions and beliefs jointly) are well described by a modified version of cognitive hierarchy plus risk aversion. Structural estimates suggest that the player role itself induces a higher degree of strategic sophistication in the player with more asymmetric payoffs.

Keywords: beliefs; quantal response equilibrium; noisy belief equilibrium **JEL Classification:** C72, C92, D84

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Stochastic Equilibria: Noise in Actions or Beliefs?*

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Abstract

Much is known about the empirical content of quantal response equilibrium (QRE) which relaxes the rationality requirement of Nash equilibrium by allowing for "noise in actions" while maintaining that beliefs are correct. By contrast, little is understood of the testable restrictions of equilibrium models which allow for "noise in beliefs" while maintaining best response. We introduce noisy belief equilibrium (NBE) for normal form games in which axioms restrict belief distributions to be *unbiased with respect* to and responsive to changes in the opponents' behavior. The axioms impose testable restrictions both within and across games, and we compare these restrictions to those of regular QRE (*Goeree et al. 2005*) in which axioms are placed on the quantal response function as the primitive. We show that NBE generates similar predictions as QRE such as the "own payoff effect", and yet is more consistent with the empirically documented effects of changes in payoff magnitude.

Keywords: beliefs; quantal response equilibrium; discrete choice models

JEL Classification: C72, C92, D84

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