

Book Reviews

Perea, A.: *Rationality in Extensive Form Games*. 242 pp. Kluwer, Dordrecht, 2001. Hardcover € 110.00.

A decision-maker chooses rationally if his choice is weakly preferred to all of his alternatives. In a game, each decision-maker is a *player*, the alternatives consist of plans of action (or *strategies*), while the player's preferences over strategies depend on *both* the utility (or *payoff*) derived from different outcomes *and* his conjecture concerning opponent behavior. In an extensive form game, a player must also form beliefs about what his opponents will do in parts of the game that will not be reached if the opponents play according to their rationally chosen strategies. Hence, in game-theoretic analysis of extensive form games, a player's beliefs about what an opponent will do must be specified in greater detail than the opponent's own strategy. This observation – which has been pointed out by, e.g., Rubinstein (1991) – motivates a game-theoretic analysis of extensive form games in terms of *what players believe their opponents will rationally do*, rather than in terms of their own rational behavior. It is precisely such an analysis that Andrés Perea presents in his book.

Perea, who is affiliated with the University of Maastricht, starts in chap. 2 by presenting a decision-theoretic framework for extensive form games as well as introducing the concept of a *behavioral conjecture*. A behavioral conjecture specifies beliefs about how a player will act at each of his information sets. The author emphasizes that a behavioral conjecture is “in the mind of the player's opponents” instead of being “in the player's own mind”. Given that a player has behavioral conjectures about his opponents, one can determine what constitutes rational behavior at each of his information sets. The assumption that underlies the analysis of this book is that a player should assign positive probability only to opponent behavior that is rational given the behavioral conjectures held by the opponents.

In chaps. 3–6 it is assumed that a player's behavioral conjectures about his opponents are stochastically independent, and that two players have the same behavioral conjecture about a common opponent. It is also implicitly assumed that each player is informed about the behavioral conjecture held

by his opponents about himself. These are equilibrium assumptions. In line with the underlying philosophy, equilibria are defined in terms of profiles of behavioral conjectures rather than profiles of strategies; i.e., equilibria specify what players believe about each other's behavior rather than what they do themselves. With the formal apparatus in place, Perea offers in chaps. 3 and 4 a well-structured presentation of extensive form equilibrium concepts like *perfect equilibrium*, *quasi-perfect equilibrium*, *sequential equilibrium*, *weak sequential equilibrium*, and *subgame-perfect equilibrium*, and he explains their connection to *backward induction* and normal form equilibrium concepts like *proper equilibrium*, *normal form perfect equilibrium*, and *Nash equilibrium*.

In the equilibrium concepts of chaps. 3 and 4 that support backward induction, players believe that their opponents will choose rationally in the remainder of the game, while past actions may if necessary be considered "mistakes". However, there are examples (like the *battle-of-the-sexes-withoutside-option game*) where observed past actions may – if considered rational – be useful for predicting future behavior. Such *forward induction* can be captured by various concepts and procedures (like *iterated weak dominance*, *stable sets of equilibria*, *forward induction equilibrium*, *justifiable sequential equilibrium*, and *stable sets of beliefs*). These are all presented in chap. 5, while chap. 6 considers various transformations of extensive form games and studies whether equilibrium concepts are invariant to such transformations.

The last chap. 7 differs from the others by dropping the assumption that each player is informed about the behavioral conjectures held by the other players about their opponents. Since each player is concerned about what strategies are best responses for his opponents given their beliefs, what beliefs each opponent holds about the best responses for *her* opponents given their beliefs, and so on, this kind of non-equilibrium analysis requires that hierarchies of beliefs are explicitly modelled. Following Mertens and Zamir (1985) and others, Perea shows how such hierarchies of beliefs can be captured by a model where each player is uncertain about *what* opponents *do* and *who* the opponents *are*. Here the "identity" of an opponent corresponds to a hierarchy of beliefs and is referred to as an epistemic *type*. The author goes on to present non-equilibrium concepts like *rationalizability*, *permissibility*, *weak sequential rationalizability*, and *extensive form rationalizability*.

Although not touching upon some interesting issues relating to extensive games – like communication, evolutionary stability, learning, and bounded rationality – the delimitation of the topics that *are* treated is very natural. The book considers concepts where players believe that their opponents choose

rationally. More importantly, the analysis is presented in a surprisingly self-contained manner: Perea has made a considerable effort by reconstructing proofs for almost all the results that are reported. This makes the book quite valuable for reference.

By presenting concepts in terms of what players believe opponents will do, the book builds on a slightly unconventional – albeit very natural – framework. Even though it contains very few unnecessary idiosyncracies relating to terminology and notation, and the author's own contributions (Perea, 2002; Perea et al., 1997; 2000) are well integrated into the text, this alternative framework makes the monograph perhaps less suitable for textbook use. In addition, there are no exercises and problems that can help readers familiarize themselves with the subject matter. However, as a comprehensive presentation of equilibrium and rationalizability concepts for extensive form games, the book is highly recommended for economists with an interest in game theory. In particular, the emphasis on formally establishing all the results that are reported may help the reader obtain a deeper understanding of familiar game-theoretic concepts.

References

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Easterly, W.: *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics*. XIII, 342 pp. MIT Press, Cambridge, Mass., 2001. Hardcover £ 20.50.

Reading Easterly's unconventional book is both a source of great pleasure as well as growing pain. The pleasure comes from the refreshingly unorthodox approach and the witty style. The pain stems from the fact that we still do not