行政院國家科學委員會補助專題研究計畫成果報告

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計畫主持人：羅曉
共同主持人：無

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行政院國家科學委員會專題研究計畫成果報告

在複雜交互中理性行爲與理性推理過程之研究 (1/2)

Rational Behavior and Rational Reasoning Processes in Complex Interactions (1/2)

計畫編號：NSC 89−2415−H−002−062−

執行期限：89 年 10 月 01 日至 90 年 7 月 31 日

主持人：羅曉　國立臺灣大學經濟學系

一、　中文摘要

本項研究計畫(NSC: 89−2415−H−002 −062−)爲正在進行中的「在複雜交互中理性行爲與理性推理過程之研究」的第一部分。本項計畫之主要目的是調查在複雜互動中之理性行爲，特別是集中在探討動態情形下推理過程及其隱含，因此該項計畫將提供對策略交互中人類行爲，社會規範和制度的進一步了解。更具體地，該項研究計畫描述了一類理性推理過程，并且在此基礎上觀察到一個重要結論： 所有理性推理過程導致相同的“結果”。

關鍵詞：非合作賽局，理性推理過程，認知基礎

Abstract

This research project (NSC: 89-2415-H-002- 062-) is the first part of the on-going research plan, entitled “Rational Behavior and Rational Reasoning Processes in Complex Interactions.” This project aims at exploring rational behavior and rational reasoning processes in “dynamic” games, emphasizing particularly the process of reasoning in dynamic settings; hence, it provides in-depth analysis of behavioral and epistemic assumptions behind human behavior, social norms, and institutions in complex interactions. More specifically, this research project has characterized a family of rational reasoning processes and, moreover, it is observed that every rational reasoning process yields the same “outcome” in terms of the path of play. *JEL* Classification Number: C72.

Keywords: Noncooperative game, rational reasoning processes, epistemic foundation

二、緣由與目的

The normative and positive work of game theory has been motivated, in the main, by an interest in the rigorous understanding of human behavior in strategic contexts. The importance of the subject arises from from the pervasiveness of the assumption of rational behavior in all the human sciences, including behavioral science, economics, social science, political science, mathematics, statistics and so on.

While Nash equilibrium is without doubt the game-theoretic solution concept that is most often applied in economics, the notion assumes that each player is perfectly informed about the others' strategy behavior (thus all the players arrive at the “commonality of beliefs”) --- a condition rarely met in practice. The rationale of Nash equilibrium has been and continues to be the subject of much discussion and debate in the literature (see, e.g., Kreps, 1990; Morris, 1995). Indeed, equilibrium program extremely simplifies the problem of choice in the context of strategic interactions: a rational player will simply choose a best response to the opponents' using strategies.

In any strategic situation, a player *i*'s decision about what to do will depend upon its beliefs about how the opponents would respond to what the player might do and, moreover, the decision will depend upon how the player thinks the opponents' response to what *i* will do compares with what the opponents' response *would* be to other things that *i could* do. The rationality of choices in a game depends not only on what players believe, but also on their reasoning processes for forming their beliefs.

The problem of strategy choice in dynamic settings could become even more complicated. Some of the things that player *i* could do would probably surprise the opponents in the course of a game, and so in considering the consequences of possible choices, *i* has to consider how the opponents would form their beliefs in the face of surprising information. Exploring rational behavior, as well as reasoning processes, (especially in dynamic games) is an important, profound, and interesting subject in game theory and economic theory.

The rationalizability approach *a la* Bernheim (1984) and Pearce (1984), provides an alternative way to study rational behavior in strategic contexts. The notion of rationalizability relies only on the fundamental assumption of common knowledge of rationality. The basic tenet behind this notion is that rational behavior must be justified by rational beliefs and conversely, that rational beliefs must be based on rational behavior. Particularly, the understanding of the rationality of belief is crucial in the understanding of the rationality of behavior.

Since much of the recent interest in the economic applications of game theory has been in situations with a dynamic structure, such as entry and entry deterrence in industrial organization and "time-consistency" problem in macroeconomics, where players move sequentially, this research project purports to focus on extensive games. D. Pearce first offered the notion of extensive form rationalizability (*EFR*), which successfully incorporates backward induction and forward induction (see, e.g., Battigalli, 1997; Battigalli and M. Siniscalchi, 1999; Dekel and Gul, 1997; Gul, 1996; Shimoji and Watson, 1997 for recent developments).

Despite its great potential, *EFR* implicitly requires that all the players endow *a prior* common reasoning process. Consequently, this requirement suffers from the same sort of criticism on the "commonality of beliefs" for Nash equilibrium. Indeed, as iterated dominance may depend upon the way in which the process of iterated elimination proceeds, there may be many "sensible" reasoning processes.

三、研究計畫之內容

In the spirit of Pearce's *EFR*, a reasoning process in extensive games is formally defined a sequence of collections of information sets, strategy profiles, and conditional beliefs. What distinguishes one process from another is the particular collection of information sets considered at each step *k*. Given information sets, strategy profiles, and conditional beliefs, the (*k+1*)-strategies are those *k*-strategies that are best relies to some *k*-conditional beliefs at all *k*-information sets; the (*k+1*)-conditional beliefs are updated via (*k+1*)-strategies whenever possible.

A reasoning process is "rational" if it satisfies an "efficient condition" that essentially captures the idea of common knowledge of rationality (c.k.r.). The family of rational reasoning processes includes: Zermelo's "rollback" procedure and Pearce's *EFR* as two concrete examples. Somewhat surprisingly, all rational reasoning processes yield the same realization in terms of the paths of play. (Cf. the following a four-period version of the centipede game. Two "sensible" reasoning processes yield the same realization, i.e. player 1 stops at the first node.)

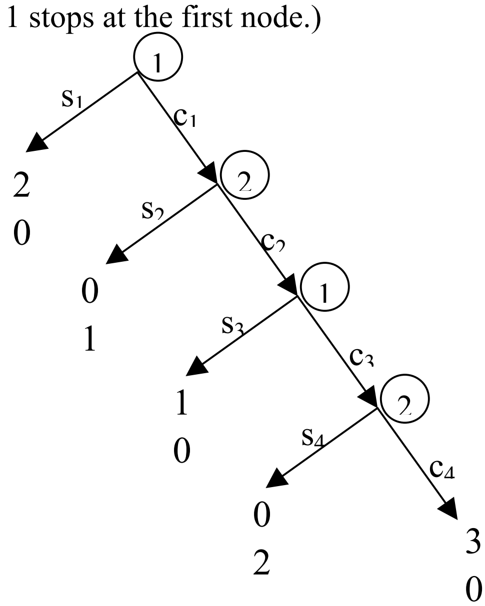

Figure. A 4-period version of the centipede game.

	Zermelo's "rollback" procedure
Round 0	$(s_1, s_3),(c_1, s_3),(s_1, c_3),(c_1, c_3)$; $(s_2, s_4),(c_2, s_4),(s_2, c_4),(c_2, c_4)$
Round 1	$(s_1, s_3),(c_1, s_3),(s_1, c_3),(c_1, c_3)$; $(s_2, s_4),(c_2, s_4)$
Round 2	$(s_1, s_3),(c_1, s_3)$; $(s_2, s_4),(c_2, s_4)$
Round 3	$(s_1, s_3),(c_1, s_3)$; (s_2, s_4)
Round 4	(s_1, s_3); (s_2, s_4)

Table a. Two "sensible" reasoning processes.

	Pearce's *EFR*
Round 0	$(s_1, s_3),(c_1, s_3),(s_1, c_3),(c_1, c_3)$; $(s_2, s_4),(c_2, s_4),(s_2, c_4),(c_2, c_4)$
Round 1	$(s_1, s_3),(s_1, c_3),(c_1, c_3)$; $(s_2, s_4),(c_2, s_4),(s_2, c_4)$
Round 2	$(s_1, s_3),(s_1, c_3)$; (s_2, c_4)

Table b. Two "sensible" reasoning processes.

四、結語

This research project is greatly helpful in broadening my scientific horizons as well as in establishing a solid base at my academic career. This project also provides our students with meaningful research training which is complementary to their academic training. In addition, I believe that this project would make a significant contribution to the rigorous research on economic behavior. Finally, I gratefully acknowledge the generous financial support from National Sciences Council of Taiwan.

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