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RECIPROCAL ALTRUISM AS A FELONY: ANTITRUST AND THE PRISONER'S DILEMMA†

John Shepard Wiley Jr. *

I. INTRODUCTION

The idea of cooperation sounds heartening. Cooperation is the milk of human kindness, the Good Samaritan, and "hope for the future of our species."¹ The lawyers who practice and write in the field of antitrust, however, take a different view. For them, cooperation is a crime.²

This essay is about the idea of cooperation in antitrust law. At the outset, I clarify my terminology. Biologists often refer to *reciprocal altruism*.³ "Reciprocal altruism" in the antitrust context has an odd semantic ring. There is nothing altruistic or self-sacrificing about the cooperation that antitrust rules outlaw: cartel price fixing. Firms do it strictly for the money. I prefer the term *reciprocity* to describe a firm's strategy to pursue behavior that will profit it only if competing firms engage in similar behavior. This usage can create confusion in

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1. R. AXELROD, *THE EVOLUTION OF COOPERATION* (1984) (comments of Lewis Thomas on book jacket). It is no accident that a leading scholarly journal in the field is titled the *Journal of Conflict Resolution*.

2. See also Lowenstein, *For God, for Country, or for Me?* (Book Review), 74 CALIF. L. REV. 1479 (1986). He states:

Bribes, whatever else they may be, are a form of mutually beneficial exchange, or reciprocity. Reciprocity is normally desirable, a cornerstone of human relations in economic, social, political, and personal matters. . . . Having a concept of bribery, then, means identifying as immoral or criminal a subset of transactions and relationships within a set that, generally speaking, is fundamentally beneficial to mankind, both functionally and intrinsically.

Id. at 1480-81. Cf. D. LUCE & H. RAIFFA, *GAMES AND DECISIONS* 101 (1957) ("[I]n some contexts, if the two players are frustrated [in their attempt to cooperate], it may be beneficial to society.").

3. Biologists are intensely interested in the scientific basis for this praised virtue. I presented a version of this paper at a UCLA-sponsored workshop on reciprocal altruism. Most of the workshop participants were behavioral biologists, interested in the problems of altruism in an evolutionary setting. The papers presented at the workshop, including a version of this Article, appear in 9 *ETHOLOGY AND SOCIOBIOLOGY* 241 (1988).

"Reciprocal altruism" also seems inapt in the biological context; biologists themselves seem to refer to the term without any necessary invocation of the common-sense implication of *benevolence*.

the present context, however, because reciprocity is also an antitrust term of art that refers to one firm's decision to sell to another only if the second agrees in turn to buy from the first.⁴ In this Article I use reciprocity in the former sense rather than in its latter, antitrust sense.

Antitrust is a well established field, as American law goes. It has been an active one since 1890, when Congress passed the landmark Sherman Act,⁵ a delphic congressional pronouncement whose brevity forced judges to take the lead in formulating specific antitrust policy. Some of the earliest Sherman Act decisions clarified that the Act's ban on contracts in restraint of trade included cartel agreements.⁶ Just as Saudi Arabia, Iran, and Iraq continually strive to overcome their differences in pursuit of high OPEC oil prices, so did Adam Smith say business people too seldom gather, even for merriment and diversion, without their talk soon turning to some contrivance or conspiracy against the public.⁷ In market economies founded on competition among economic producers, producer cooperation in raising price (or restricting output) hurts consumers. Judges thus have interpreted the Sherman Act to contain a "per se" rule against price fixing agreements: if two or more competitors meet and expressly agree to sell their product only above some specified price, antitrust law metes out harsh penalties.⁸ Antitrust thereby aims to root out and destroy this simple and undesirable type of producer reciprocity.

Antitrust judges have attacked producer cooperation beyond flatly outlawing express cartel agreements. For fear that competitors will *tacitly* cooperate, antitrust law has outlawed activity that has both a potential for social benefit and that does not involve express cartelization — but that *might* increase the chance of successful reciprocity.⁹ The judges who have authored this law plainly believe that firms might engage in reciprocal altruism (or "tacit collusion" or "conscious parallelism"), and that that risk to competition is great enough to justify prophylactic losses in business efficiency. But their views stem solely from casual intuitions about the likelihood that reciprocal or tacitly "collusive" arrangements in fact will succeed in supplanting competition.

In the last twenty years, however, skeptical commentators have

4. See, e.g., *Federal Trade Commn. v. Consolidated Foods Corp.*, 380 U.S. 592 (1965).

5. Sherman Act, ch. 647, §§ 1-8, 26 Stat. 209, 210 (1890) (current version at 15 U.S.C. §§ 1-7 (1982)).

6. E.g., *United States v. Addyston Pipe & Steel Co.*, 85 F. 271 (6th Cir. 1898), *aff'd*, 175 U.S. 211 (1899).

7. A. SMITH, *THE WEALTH OF NATIONS* (1796).

8. E.g., *United States v. Socony-Vacuum Oil Co.*, 310 U.S. 150 (1940).

9. E.g., *United States v. Container Corp. of Am.*, 393 U.S. 333 (1969).

attacked the law these judges have made.¹⁰ Essentially atheoretical legal doctrine thus has proved vulnerable to shifting attitudes of a fundamentally political nature. Recent game theory research, most prominently by Robert Axelrod, offers the hope of filling this theoretical void and providing antitrust doctrine with a more stable foundation.¹¹ Yet Axelrod's work, while of great potential interest to the antitrust world, contains limitations that block any direct transfer of his results to the Sherman Act. These limitations suggest an agenda for future game theory research and its application to antitrust doctrine.

II. TWO SCHOOLS OF ANTITRUST THOUGHT: FAITH AND SKEPTICISM ABOUT THE EVOLUTION OF COOPERATION

Antitrust law makes crucial — and vulnerable — assumptions about the likelihood of reciprocity that causes harmful consequences to consumers. In this section, I first describe antitrust doctrines that demonstrate robust faith that firms indeed will tacitly cooperate to reduce pricing rivalry. I focus on two different antitrust doctrines that embody assumptions about the likelihood and harms of reciprocity: the law governing data exchanges among competitors, and the law governing mergers. Then I will recount the extent to which recent criticism of those doctrines has caused a revision in antitrust policy. This brief survey demonstrates that antitrust law inevitably incorporates some theory about reciprocity, but that no such theory has had a very strong or enduring intellectual foundation.

A. *Data Exchanges*

Competing firms can wish to communicate with one another to discover current market prices and conditions. Often these industry communications take place within a trade association. Since the early days of antitrust enforcement, "trustbusters" have viewed the activities of trade associations with suspicion: suspicion of reciprocity. In light of later game theory scholarship, the strength of — and lack of support for — this suspicion has been remarkable.

A landmark decision, *American Column & Lumber Co. v. United States*,¹² illustrates this point. The case concerned hardwood lumber mills that participated in the "Open Competition Plan" of the American Hardwood Manufacturers' Association (AHMA). The associa-

10. See notes 32-41 *infra* and accompanying text.

11. See Part III.C *infra* and note 65 *infra*.

12. 257 U.S. 377 (1921).

tion developed a plan that required mills to submit to it daily reports of sales quantities, prices, and customer identities, as well as monthly reports of production and stocks. The association then provided members with weekly reports of industry sales and shipments, and monthly reports of production, inventory, prices, and market conditions. The association also inspected members' stocks and grading practices and held periodic meetings to discuss past and future production.

These practices *might* have facilitated collusive pricing, especially because there was an indication that industry officials sometimes used meetings to harangue firms about the need to restrain their output. In particular, the chairman at one such meeting said, "If there is no increase in production, particularly in oak, there is going to be good business. No man is safe in increasing his production. If he does, he will be in bad shape, as the demand won't come."¹³ But there was no direct evidence that the AHMA *actually* had promoted reciprocity, either by setting minimum prices or by punishing price cutters. The Court did claim that there was evidence that the AHMA's plan had "contributed greatly" to an increase in hardwood prices.¹⁴ Still, the Court did not isolate the cause of this price increase, and it is plain from the face of the opinion "that [the relevant year] was a year of high and increasing prices generally and that wet weather may have restricted [hardwood] production to some extent."¹⁵ Inflation, booming demand, and decreased supply thus might have accounted fully for the hardwood price increase, leaving no support for the Court's inference that the AHMA's action indeed had replaced price-competition with price-reciprocity. Instead, the Court's decision rested heavily upon a belief that dangerously successful reciprocity was highly probable.

It was not costless for the Court to outlaw the private data dissemination at issue in the *American Column* case. All else being equal, uncertainty usually is economically undesirable. Firms' ability to plan and act efficiently is improved when uncertainty about present and future market conditions is reduced, a point that Justice Holmes' dissent pressed forcefully.¹⁶ The majority opinion did not try to argue that disseminating data about market conditions was a worthless activity. Rather, the Court responded by stating a theory that reciproc-

13. 257 U.S. at 402 (emphasis omitted).

14. 257 U.S. at 409.

15. 257 U.S. at 409.

16. 257 U.S. at 412 (Holmes, J., dissenting) ("I should have supposed that the Sherman Act did not set itself against knowledge . . . I should have thought that the ideal of commerce was an intelligent interchange made with full knowledge of the facts as a basis for a forecast of the future on both sides.").

ity *inevitably* posed a live threat to competition. The Court said this point was proved:

by the disposition of men to follow their most intelligent competitors, especially when powerful; by the inherent disposition to make all the money possible, joined with the steady cultivation of the value of "harmony" of action; and by the system of reports, which makes the discovery of price reductions inevitable and immediate. The sanctions of the plan obviously are, financial interest, intimate personal contact, and business honor, all operating under the restraint of exposure of what would be deemed bad faith and of trade punishment by powerful rivals.

...
 . . . Men in general are so easily persuaded to do that which will obviously prove profitable that [the] reiterated opinion from the analyst of their association, with all obtainable data before him, that higher prices were justified and could easily be obtained, *must, inevitably have resulted*, as it did result, *in concert of action* in demanding them.¹⁷

Particularly significant was the large number of firms involved in the case. The majority opinion mentioned — but did not stress — that some 365 firms participated in the "Open Competition Plan."¹⁸ These firms, moreover, produced a total of only one-third of United States hardwood output.¹⁹ The majority's empirical guess about reciprocity was thus that noncompetitive behavior was virtually inevitable under the circumstances, despite hundreds of participants within the AHMA and hundreds more outside it. The Court theorized that business firms in this situation would find it easy to collude on setting high prices. A similar attitude is evident in later data dissemination cases, although the number of participants involved was smaller.²⁰ Antitrust law in these decisions has incorporated the suspicions of Adam Smith.²¹

B. *Merger Law*

Past merger doctrine also reveals a similar theory about reciprocity. If trustbusters have been suspicious of the collusive implications of data exchanges, they have been downright fearful of the similar implications of mergers. Unlike the Court in *American Column*, antitrust judges in merger cases generally have focused explicitly on the question of market share: the percentage of market sales or assets that each competitor controls. Merger law specifies under what conditions

17. 257 U.S. at 399, 407 (quotations omitted and emphasis added).

18. 257 U.S. at 391.

19. 257 U.S. at 391.

20. See, e.g., *United States v. Container Corp. of Am.*, 393 U.S. 333 (1969).

21. See text accompanying note 7 *supra*.

antitrust courts will permit two existing companies to unite into one larger unit. (Here I am concerned only with so-called "horizontal" mergers, or mergers between direct competitors. If we assume that soft drinks compete directly with each other, then Coke's attempted purchase of Dr. Pepper, and Pepsi's attempted purchase of 7-Up, are examples of attempted horizontal mergers.) Companies may merge for reasons as diverse as the managers who run them, but two explanations typically predominate: first, mergers can yield efficiencies in production that improve a company's competitive position and can benefit consumers; second, mergers can place independent competitors under a single control, thereby eliminating competition, creating market power, and enforcing producer cooperation.

On general principles, one might oppose large mergers because they increase economic concentration, which some hold to be intrinsically objectionable. With increased international competition, this view is not as popular in the 1980s as it was in the 1950s and 1960s, and this Article will pursue it no further. Instead, I will assume (in keeping with currently prevalent but certainly not indisputable views) that the objective in merger law is to permit those mergers that create efficiencies but to block those that create offsetting market power.²² Thus conceived, merger law asks how many competitors must remain in a market to forestall harmful pricing reciprocity among them. Under this theory, mergers that leave at least this number should be legal, while those crossing this critical threshold should not.

With the 1950 Celler-Kefauver amendments to the Clayton Act,²³ merger regulation in the United States gained teeth. In 1968, the Department of Justice published Merger Guidelines²⁴ setting forth quantitative levels that would trigger agency opposition to a proposed merger. As a self-conscious policy summary by an elite federal agency, these Guidelines were notable and influential. In general terms, the Department committed itself to oppose all mergers in which the two companies each had five percent or more of the market before the merger.²⁵ This administrative guideline disclosed a belief that (if all firms are of equal size) pricing reciprocity — the implicit harm to be avoided — will occur if fewer than twenty market participants ex-

22. The fundamental article on this now highly elaborated approach is Williamson, *Economies as an Antitrust Defense: The Welfare Tradeoffs*, 58 AM. ECON. REV. 18 (1968).

23. Celler-Kefauver Act, ch. 1184, 64 Stat. 1125 (1950) (codified as amended at 15 U.S.C. §§ 18, 21 (1982 & Supp. III 1985)).

24. U.S. Dept. of Justice Merger Guidelines — 1968, *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,101 (1988).

25. *Id.* at p. 20,523.

ist, but is difficult to the point of impossibility when more firms occupy the market.

The judicial merger decisions of the 1960s, when Chief Justice Earl Warren presided over the Supreme Court, reveal a similar but even stronger suspicion of reciprocity. In 1966, the Court invalidated a merger of the Von's Grocery and the Shopping Bag supermarket chains in Los Angeles.²⁶ In 1958, two years before the merger, Von's operated twenty-seven stores in the area and Shopping Bag operated thirty-four.²⁷ The largest chain accounted for but 8% of area grocery sales; Von's was third with 4.7%; and Shopping Bag was sixth with 4.2%.²⁸ The merged Von's/Shopping Bag company thus would have accounted for about 8 percent of a market in which there were over 3000 single-store firms and over 100 chains of two or more stores.²⁹ As the dissent pungently noted, "Three thousand five hundred and ninety single-store firms is a lot of grocery stores."³⁰ Nonetheless, the majority said that this merger's slight increase in firm size and reduction in the number of competitors was excessive.³¹ Once again, it is plain that antitrust decisionmakers believed that rivalry could easily evolve into cartelization.

C. *Reciprocity: Skepticism and Scorn*

Influential critics have attacked this antitrust policy, and in a subtle but definite way they have succeeded in modifying it. Two significant conclusions follow. First, the critics' subtle success shows the weakness of the foundation for earlier beliefs. Second, the critics' attack has embodied a different theory of reciprocity, one more skeptical about the likelihood of successful cooperation.

I cannot document change in the relevant antitrust doctrine by the usual and most positive method of citing later cases that overrule earlier ones. The Burger and Rehnquist Courts of the 1970s and 1980s have decided neither directly relevant merger cases nor any data dissemination cases at all. Case law thus does not directly show changing attitudes about the likelihood of business pricing reciprocity.

Notwithstanding this lack of direct evidence of change, it is quite unlikely that the Court would decide cases like *Von's Grocery* the same way today. Academic commentators, convinced of the hardness of

26. *United States v. Von's Grocery Co.*, 384 U.S. 270 (1966).

27. 384 U.S. at 272.

28. 384 U.S. at 281 (White, J., concurring).

29. 384 U.S. at 273.

30. 384 U.S. at 300 (Stewart, J., dissenting).

31. 384 U.S. at 277.

competition and the fragility of cooperation, have fiercely criticized the Warren Court's strict treatment of mergers. Among the most prominent has been Robert Bork, President Reagan's rejected nominee to the Supreme Court. While a professor, Bork developed a theme of Stigler's to ridicule the Warren Court's merger doctrine.³² He instead proposed that courts permit mergers "up to 60 or 70 percent of the market," a "guess" that he was willing to weaken "[p]artly as a tactical concession to current oligopoly phobia and partly in recognition of [a later statutory amendment's] intended function of tightening [earlier merger rules]."³³ Bork's final recommendation therefore was to permit mergers up to a market share "that would allow for other mergers of similar size in the industry and still leave three significant companies."³⁴ Elsewhere in his work, Bork describes his difficulty with

the uncertainty of the premise that tacit collusion is an important phenomenon, or even that it is a real phenomenon. . . . The difficulty of maintaining small-number cartels based upon detailed communication and agreement should . . . make us dubious that concerted action without explicit collusion is likely to be at all common or successful.³⁵

Criticism like that by Professor Bork affected the merger policy of the Reagan administration in the 1980s. Under President Reagan, the Department of Justice revised the Department's 1968 Merger Guidelines. This revision, completed in 1984, adopted a complex quantitative rule to specify when the Department now will attack or permit mergers.³⁶ For simplicity of explanation, assume all firms within a market are the same size before a merger. In that situation the 1984 Guidelines permit two firms to merge into one if a total of eleven competitors remains afterwards — but not if a total of only ten remains.³⁷ Recall that the 1968 Guidelines promised much stricter opposition to mergers, to the point of challenging mergers that left as many as nineteen firms.³⁸ By lowering the critical threshold from nineteen to ten, the 1984 revision showed a marked increase in official tolerance of market concentration — stemming from a marked increase in official skepticism about the likelihood of pricing reciprocity. The Supreme

32. R. BORK, *THE ANTITRUST PARADOX* 178-224 (1978). See Stigler, *A Theory of Oligopoly*, 72 J. POL. ECON. 44 (1964).

33. R. BORK, *supra* note 32, at 221.

34. *Id.* at 222.

35. *Id.* at 175. See also *id.* at 179-91.

36. U.S. Department of Justice Merger Guidelines — 1984, 49 Fed. Reg. 26,823, 26,831 (1984).

37. *Id.*

38. See text at notes 24-25 *supra*. I continue to analyze both Guidelines under the unlikely but simplifying assumption that all firms in the market are of equal size before the merger.

Court has echoed a similar sentiment in recent dicta.³⁹

III. MARKET COMPETITION AS THE PRISONER'S DILEMMA

Critics like Bork attacked prevailing antitrust assumptions about reciprocity on essentially negative grounds. Older theory had suggested that added market concentration enlarged the prospect of reciprocity — without contributing much to those markets' productive efficiency. The critics savaged this conventional economic learning about oligopolies as vague, illogical, and essentially empty.⁴⁰ The critics' case concentrated more on refuting the claims of the existing literature than on building affirmative, formal, and decisive theoretical support for the thesis that reciprocity indeed was unlikely. A typical style of reasoning, for instance, was that "[i]f explicit collusion is difficult to arrange and hard to enforce if arranged, tacit collusion must be next to impossible."⁴¹

This scholarly attack of the 1960s and 1970s long has been familiar news to the legal antitrust community.⁴² The critics who authored this attack worked largely independently of contemporaneous game theory research that strongly supported their skepticism about market reciprocity. The research concerned the most extensively canvassed problem in game theory: the prisoner's dilemma. In this section, I first describe the prisoner's dilemma and connect its literature with the scholarly attack of the 1960s and 1970s. I do so not to assert the correctness of the critics' attack, but rather because later analysis of the prisoner's dilemma implies *error* in that attack. Game theory, while apparently supportive of the Bork critique, thus may prove ultimately most damaging of that critique. As I complete my survey of these most recent developments and evaluate their significance for antitrust policy, however, it becomes clear that we need research into three specific questions before this game theory can resolutely inform antitrust policy.

39. *Business Electronics Corp. v. Sharp Electronics Corp.*, 108 S. Ct. 1515, 1521 (1988) ("Cartels are neither easy to form nor easy to maintain.").

40. *E.g.*, R. BORK, *supra* note 32; J. MCGEE, IN *DEFENSE OF INDUSTRIAL CONCENTRATION* (1971); Demsetz, *Two Systems of Belief About Monopoly*, in *INDUSTRIAL CONCENTRATION: THE NEW LEARNING* 164 (H. Goldschmid, H. Mann & J. Weston eds. 1974); Demsetz, *Why Regulate Utilities?* 11 J.L. & ECON. 55 (1968).

41. Y. BROZEN, *CONCENTRATION, MERGERS, AND PUBLIC POLICY* 135 (1982).

42. For example, a volume containing a number of key studies was co-edited by a leading antitrust law casebook author and is still published by a legal press. *See* *INDUSTRIAL CONCENTRATION: THE NEW LEARNING* (H. Goldschmid, H. Mann & J. Weston eds. 1974).

A. The Prisoner's Dilemma

The prisoner's dilemma is a stock game theory problem⁴³ named after the following fable. The police nab a pair suspected of a crime, separate them, and present each with the following proposition. If one confesses and supplies evidence that can convict the other who refuses to talk, the authorities will release the confessor and throw the book at the silent one. If both prisoners remain silent, the authorities have evidence to convict both only on minor charges. If both prisoners confess, both are in big trouble. Without communicating, each prisoner must choose either to remain silent or to confess.

A prisoner who remains silent "cooperates" with the partner. Abbreviate this prisoner's strategy as *C*. Convention correspondingly holds that one who confesses "defects" (abbreviated *D*), or "cheats," or, most colorfully, "finks." Because each prisoner has two options (play *C* or play *D*), a two-by-two matrix can display this game's four possible outcomes. Each of the matrix's four cells summarizes one outcome by listing pairs of numbers (or "payoffs," which here represent a bad rather than a good). The first number in the pair is the resulting jail time for the first player, ROW, and the second is the jail time for the second player, COLUMN.⁴⁴

43. Shubik attributes the prisoner's dilemma game to a 1950 Stanford University mimeograph by A.W. Tucker. M. SHUBIK, *GAME THEORY IN THE SOCIAL SCIENCES* 254 (1982).

44. The values in this matrix are conventional but arbitrary. Generally and formally, a set of inequalities defines the prisoner's dilemma. Label the four possible payoffs with four letters: R (Reward); S (Sucker's payoff); T (Temptation); and P (Punishment). Define these payoffs as follows:

		COLUMN PLAYER	
		cooperate	defect
ROW PLAYER	cooperate	(R,R)	(S,T)
	defect	(T,S)	(P,P)

Assume that the bigger the payoff the better. (Obviously the situation is reversed if numbers represent a bad, as in the jail time example in text.) The game is a prisoner's dilemma if $T > R > P > S$. Most analysts add the condition that $R > (T + S)/2$, and some add that $P > (T + S)/2$. See, e.g., Boyd & Richerson, *The Evolution of Reciprocity in Sizable Groups*, 132 J. THEORETICAL BIOLOGY 337 (1988).

		COLUMN PLAYER	
		cooperate: silence	defect: confess
R O W P L A Y E R	cooperate: silence	(1,1)	(5,0)
	defect: confess	(0,5)	(3,3)

Parentheses: (jail time for ROW, jail time for COLUMN)

The prisoner’s dilemma is a generally interesting model for two reasons. First, it represents a common situation: the conflict that arises when individual actions benefit a group but are costly to individual members. Second, it leads to stark paradox. No matter what the partner does, each individual will do better by cheating. (Check this logic yourself on the matrix. First assume that your partner remains silent. Then assume your partner confesses. You will see that, *in either event*, you minimize your own jail time by confessing.) Even though the group of two prisoners would benefit if each prisoner cooperated by remaining silent, rational and informed self-interest leads both prisoners to their worst outcomes: each receives a heavy penalty for failing to cooperate with the other. This context for group cooperation thus frustrates individual aims, a result that occurs even if players repeatedly encounter the situation.⁴⁵

B. Prisoner’s Dilemma and Skepticism About Reciprocity

The prisoner’s dilemma is directly relevant to antitrust policy. Consider a market in which there exists only two producers — a “duopoly.” For illustration, suppose the market again is for soft drinks, and that one firm makes Coke (and Dr. Pepper) and the other makes Pepsi (and 7-Up). If consumers think soft drinks are pretty much the same and so buy mainly on the basis of price, then Coke and Pepsi each face the same problem: What price should I charge?

The duopolists face a prisoner’s dilemma — a fact that the anti-trust literature has neglected but that game theorists and some economists have appreciated for at least thirty years.⁴⁶ Both firms prefer the high price that a monopolist would select if a single firm controlled the entire soft drink market, yet each distrusts the other’s willingness to

45. See text at note 49 *infra*.
46. D. LUCE & H. RAIFFA, GAMES AND DECISIONS 97 (1957); P. SAMUELSON, ECONOMICS 480-83 (8th ed. 1970).

cooperate by maintaining that high price. If the two firms could cooperate in pricing at this high level, then they could divide the monopoly profit that this market offers them. Assume that the alternative to this high cooperative monopoly price is a lower price — like that produced by competition. Competition is costly for the duopolists; its dollar cost is measured precisely by monopoly profits the two forgo.

Because the Sherman Act outlaws contractual price cooperation between firms, the two must decide in every time period what price level to choose. If this pricing game occurs only once (for instance, a sealed bid for a huge one-time Pentagon soft drink supply contract) then the classical logic of the one-time prisoner's dilemma game governs: both Coke and Pepsi, if rational, will opt for the low noncooperative price. Even though both would benefit from high cooperative prices, the reward for noncooperative behavior (together with mutual fear that the other firm will selfishly exploit any cooperative overtures) dooms attractive producer cooperation and assures consumers of the benefits of low competitive prices. In the one-shot game, noncooperation (or competitive pricing, in the cartel context) is a *dominant* strategy — a strong conclusion denoting that picking the low price is the best strategy *no matter what* the other player does. If the prisoner's dilemma is repeated a finite number of times, noncooperation is not a dominant strategy — but neither is anything else. We thus must employ other and less robust solution concepts to define the game's "result." The conventional alternative is the Nash equilibrium, which defines a set of strategies such that no one player, regarding others as committed to their choices, can improve its fortunes.⁴⁷ A Nash (or any other) equilibrium is said to be *perfect* if the players' threats that support it are credible.⁴⁸ In the finitely repeated prisoner's dilemma, the unique perfect Nash equilibrium is the noncooperative strategy of "cheating" or "finking" on each move.⁴⁹ This analysis thus suggests that, over time, both firms will repeat the one-shot result of charging low prices.

This result is striking for antitrust analysts. Even for the most concentrated oligopoly conceivable, this conclusion directly contra-

47. Nash, *Non-cooperative Games*, 54 ANNALS OF MATHEMATICS 286 (1951).

48. Selten, *Reexamination of the Perfectness Concept for Equilibrium Points in Extensive Games*, 4 INTL. J. GAME THEORY 25 (1975).

49. E. RASMUSEN, GAMES AND INFORMATION (forthcoming).

My discussion deals only with theoretical analysis of the Prisoner's Dilemma. The empirical work on the topic is vast, highly suggestive, and beyond my present focus. An extremely helpful survey can be found in Roth, *Laboratory Experimentation in Economics: A Methodological Overview*, ECON. J. (forthcoming, Dec. 1988); see also Caporael, Dawes, Orbell, & Van de Kragt, *Selfishness Examined: Cooperation in the Absence of Egoistic Incentives*, (manuscript on file at Michigan Law Review).

dicts the Court's unrestrained confidence in *American Column* that data exchanges ought to be illegal because it is so *easy* to persuade competitors — even in large numbers — to do “that which will obviously prove profitable.”⁵⁰ The dilemma of the situation is that cooperation can elude even those who are desperately aware of its allure. The implications for merger law are equally subversive. This game theory suggests that law could permit firms to merge until only two remained in the market. As long as contracts to fix prices remained unenforceable, the game's logic suggests that even this highly concentrated duopoly would encounter the same inability to achieve high cooperative prices. This implication suggests that when the Department of Justice rejected earlier law in 1984, its revisionism did not go far enough.

I certainly do not claim that, without the prisoner's dilemma, industrial organization scholars had no clue that cartel efforts were prone to a cheating incentive. Unlike antitrust judges, economists' skepticism about cooperation has been long-standing and widespread. For instance, a recent economic analysis of OPEC concluded that OPEC is exactly what it appears to be: a cartel that has lasted quite a while.⁵¹ This news would scarcely be noteworthy were it not for the prevalent belief among economists that successful and prolonged cooperation is virtually impossible.⁵² Indeed, this disbelief in the threat of successful cooperation sometimes waxes so confident as to prompt calls from economic scholars to repeal the Sherman Act altogether.⁵³ None of these attitudes hangs or falls on the outcome of research on the prisoner's dilemma. The most I can assert is that analysis of the prisoner's dilemma has supported — not caused — skepticism about the harmful consequences of reciprocity.

Yet, analysis of the finitely repeated prisoner's dilemma concisely and compellingly formulates criticism of antitrust doctrine's confidence that “tacit collusion is likely”: it is a *non sequitur* to reason that individuals within a group necessarily will do what is in their group's self-interest. Indeed, the finitely repeated prisoner's dilemma puts the shoe on the other foot. It suggests that tacit group cooperation may be the exception, not the rule, even in the smallest of groups.

50. *American Column & Lumber Co. v. United States*, 257 U.S. 377, 407 (1921). See note 17 *supra* and accompanying text.

51. Griffin, *OPEC Behavior: A Test of Alternative Hypotheses*, 75 AM. ECON. REV. 954 (1985).

52. See, e.g., Hotelling, *Stability in Competition*, 39 ECON. J. 41, 48 (1929) (“understandings between competitors are notoriously fragile”).

53. D. ARMENTANO, *ANTITRUST POLICY: THE CASE FOR REPEAL* (1986); Smith, *Why Not Abolish Antitrust?*, REG., Jan.-Feb. 1983, at 23.

It is ironic, however, that the game theorists who had used the prisoner's dilemma to establish the logical case against cooperation were not delighted with their result. For instance, Shubik described the noncooperative equilibrium of a finitely repeated prisoner's dilemma as "logical and silly,"⁵⁴ while Selten accepted the "logical validity" of this noncooperative equilibrium but rejected it "as a guide to practical behavior."⁵⁵ Theorists continued to labor on a "solution" to the prisoner's dilemma — thus suggesting that they thought have reciprocity was more likely in the real world than their model has implied.

These theorists have succeeded in specifying a variety of game conditions that *might* support cooperation as an equilibrium strategy to the repeated prisoner's dilemma: infinite repetition of the game without too much discounting;⁵⁶ potentially infinite repetition with an exogenous and known probability that the repetition will terminate after any given round;⁵⁷ finite repetition in which the players do not know how many rounds remain;⁵⁸ finite repetition between players who have a small but positive likelihood of being "crazy" or irrationally cooperative;⁵⁹ and construction of a metagame in which players choose conditional strategies that can depend upon the choices made by the other player.⁶⁰ These efforts showed that the logic of noncooperation was not ineluctable.

These analyses failed, however, to marshal a case that cooperation is *more* likely than competition. I summarize the objections seriatim. All approaches relying upon infinite repetition are vulnerable to the indeterminacy of the Folk Theorem, which specifies that eternal cooperation is a perfect Nash outcome — but so is a great variety of other

54. Shubik, *Game Theory, Behavior, and the Paradox of the Prisoner's Dilemma: Three Solutions*, 14 J. CONFLICT RESOLUTION 181, 184 (1970).

55. Selten, *The Chain Store Paradox*, 9 THEORY & DECISION 127, 133 (1978). See also D. LUCE & H. RAIFFA, *supra* note 46, at 101. (The non-cooperative equilibrium "is not reasonable in the sense that we predict most intelligent people would not play accordingly. . . . We feel that in most cases an unarticulated collusion between the players will develop, much in the same way as a mature economic market often exhibits a marked degree of collusion without any communication among the participants.")

This theoretical disquiet turns out to have some empirical basis. See cases cited in note 49 *supra*.

56. Rubinstein, *Strong Perfect Equilibrium in Supergames*, 9 INTL. J. GAME THEORY 1 (1980). See also D. LUCE & H. RAIFFA, *supra* note 46, at 102 (infinite solution is "[i]ntuitively . . . plausible").

57. *Id.*

58. *Id.*

59. Kreps, Milgrom, Roberts & Wilson, *Rational Cooperation in the Finitely Repeated Prisoners' Dilemma*, 27 J. ECON. THEORY 245 (1982).

60. N. HOWARD, PARADOXES OF RATIONALITY: THEORY OF METAGAMES AND POLITICAL BEHAVIOR (1971); Howard, *The Theory of Meta-games*, 12 GEN. SYS. 167 (1966).

patterns of action, including competition.⁶¹ The assumption that, with some probability, the prisoner's dilemma will end in any given round, presents the same difficulty. A different version of the Folk Theorem establishes that models using "crazy" players can generate an array of equilibria simply by varying assumptions about the type of irrational behavior.⁶² Finally, the metagame approach does not fill the gap; some criticize its general utility,⁶³ while even its supporters concede that it "still needs to be translated in a social context."⁶⁴

For the antitrust context, then, this research implicitly acknowledged the *possibility* of tacit cartel collusion but was — at very best — agnostic about the extent of its threat. Then came Axelrod.

C. *Axelrod's Analysis of the Evolution of Cooperation: The Success of Tit-for-Tat*

In the last decade, Axelrod's works have been hugely influential because they make a stronger prediction: that cooperation is *likely* to evolve between self-interested players in a repeated prisoner's dilemma.⁶⁵ Axelrod based this prediction on the striking success of a particular strategy for the repeated prisoner's dilemma: Tit-for-Tat. This strategy plays the prisoner's dilemma game by cooperating on the game's first move, and then, on following turns, playing the same move as its opponent played on the just-finished round. This strategy is cooperative in three senses: it is "nice"⁶⁶ (because it initially tries to cooperate); it is "retaliatory"⁶⁷ (because it quickly punishes opponents who cheat by lowering price); and it is "forgiving"⁶⁸ (because it quickly returns to cooperation after the other player renews efforts to cooperate). Tit-for-Tat independently formalized a notion of cooperation enforcement that economists outside game theory long have described as "detecting significant deviations from the agreed-upon

61. E. Rasmusen, A New Version of the Folk Theorem: (June 28, 1988) (Anderson Graduate School of Management UCLA, Business Economics Working Paper No. 87-6).

62. Fudenberg & Maskin, *The Folk Theorem in Repeated Games with Discounting or with Incomplete Information*, 54 *ECONOMETRICA* 533 (1986).

63. M. SHUBIK, *supra* note 43, at 328-31; Shubik, *supra* note 54, at 190.

64. Rapoport, *Escape from Paradox*, 217 *SCI. AM.* 50, 56 (1967).

65. R. AXELROD, *supra* note 1; Axelrod, *An Evolutionary Approach to Norms*, 80 *AM. POL. SCI. REV.* 1095 (1986) [hereinafter Axelrod, *Evolutionary Approach*]; Axelrod, *The Emergence of Cooperation Among Egoists*, 75 *AM. POL. SCI. REV.* 306 (1981); Axelrod, *More Effective Choice in the Prisoner's Dilemma*, 24 *J. CONFLICT RESOLUTION* 379 (1980); Axelrod & Hamilton, *The Evolution of Cooperation*, 211 *SCI.* 1390 (1981); *see also* Axelrod, *Effective Choice in the Prisoner's Dilemma*, 24 *J. CONFLICT RESOLUTION* 3 (1980). Axelrod and Dion's *Annotated Bibliography on The Evolution of Cooperation* (unpublished manuscript Sept. 1987) contained 236 references.

66. R. AXELROD, *supra* note 1, at 33.

67. *Id.* at 44.

68. *Id.* at 36.

prices [that] . . . will be matched by fellow conspirators if they are not withdrawn.”⁶⁹

Axelrod had the brilliant idea of analyzing the repeated prisoner’s dilemma game by experimenting in a tournament format, with real people submitting different candidate strategies that Axelrod then paired off against each other. The tournament idea, like many great ones, seems simple in retrospect. Here is how it worked. Consider the following prisoner’s dilemma matrix, which Axelrod used and which is similar to the one discussed above⁷⁰ (except that numbers are switched from representing an undesirable quantity, like jail time, to representing desirable goods, like dollars or winning points).

		COLUMN PLAYER	
		cooperate	defect
ROW PLAYER	cooperate	(3,3)	(0,5)
	defect	(5,0)	(1,1)

Parentheses: (points for ROW, points for COLUMN)

Had you responded to Axelrod’s invitation to play in his first tournament (an invitation that fifteen game theory types in fact accepted), you would have submitted your pick of a strategy for playing the repeated prisoner’s dilemma. For example, one such strategy is “always cooperate.” The tit-for-tat submission was “cooperate in the first round, and thereafter copy the opponent’s last move.” The variety of conceivable strategies is infinite. Axelrod pitted each of the fifteen strategies submitted against every other for 200 rounds. (For instance, the match of “always cooperate” against “always defect” simply adds up the scores in the northeast cell 200 times. “Always cooperate” thus scores 0 and “always defect” scores 1000 for this match.) Axelrod then totaled the points that each strategy won in *every* match and compared the overall results.

Axelrod conducted three variations of this basic tournament. In the second tournament, he publicized his results, enlisted 63 instead of 15 players, and ran each match for a probabilistic number of rounds with a mean of 151 (rather than the determinant 200 rounds). In a third type of test, Axelrod altered the proportions of representative strategies in six different ways and reran the second tournament six

69. Stigler, *supra* note 32, at 46.
70. See matrix at text following note 44 *supra*.

times to determine how robust winning strategies were. Fourth, Axelrod ran the strategies from the second tournament in an "ecological" environment: after playing each strategy against every other strategy *one* time, for the next round Axelrod changed a strategy's representation in the total population to reflect that strategy's average score in the previous round. Axelrod continued this process for 1000 "generations."

Tit-for-Tat was spectacularly successful. Its total score beat all other strategies' total scores in the first two tournaments. In the third tournament — the set of six tests — Tit-for-Tat placed first in all but one test, where it placed second. And in the fourth "ecological" test, Tit-for-Tat's total score was highest in the first round. Thereafter Tit-for-Tat never relinquished this lead and by the 1000th generation was the most successful and fastest-growing rule.

These results seem sensational for antitrust. Axelrod's tournaments seemed to offer, for the first time, a precise account of whether — and why — the threat of producer reciprocity among profit maximizers is grave. Skeptics had scoffed that retaliation was unlikely to lead to reciprocity between competitors because retaliation would decrease profits and hence would be "as irrational and as unlikely as predatory pricing."⁷¹ The key implication of Axelrod's work responded that short-run and long-run rationality differed radically — with cooperation supplanting the logic of competition in the long run. The reaction in legal literature was predictable: a commentator announced that Axelrod's analysis suggested that "the inevitability of competition within oligopolies and contract-rigging consortiums may be only myths."⁷² It seemed as though Axelrod's work had vindicated turn-of-the-century judges against those judges' modern critics.

As the commentator recognized, however, scholarly analysis of reciprocity is still in its infancy. Axelrod was willing to extend his conclusion to situations — Congress, war, and international relations — that imply his results are widely applicable. Yet Axelrod's analysis differs in many respects from the market problem that is the concern of antitrust.

71. Y. BROZEN, *supra* note 41, at 136 (footnote omitted). See generally notes 32-41 *supra* and accompanying text.

72. Huber, *Competition, Conglomerates, and the Evolution of Cooperation* (Book Review), 93 YALE L.J. 1147, 1157 (1984) (reviewing R. AXELROD, *THE EVOLUTION OF COOPERATION* (1984)).

D. *Three Limits on Axelrod's Antitrust Relevance*

The promise of Axelrod's work for antitrust law has yet to be realized. Like any model, Axelrod's tournament research abstracts a great deal from reality. These abstractions are points of practical frailty. The binary character of choice in the prisoner's dilemma, for instance, is a great simplification of real market environments. Firms normally face an infinite array of competitive choices, on quality as well as price attributes — and for a line of products, not just one. They can, in other words, cheat on a cooperative arrangement a lot, a little, or not at all — and in many different ways. But the binary limitation of Axelrod's tournaments is not necessarily a simplification that is misleading. Preliminary work by Bendor suggests that replacing a binary choice with a prisoner's dilemma game offering continuous (but bounded) choices produces results analogous to the binary game.⁷³

In a similar vein, Axelrod also employs an equilibrium concept of collective stability. Boyd and Lorberbaum show that this solution concept need not imply evolutionary stability.⁷⁴ Although any model aimed at antitrust relevance would have to make explicit and defend its choice of equilibrium concept, this point does not *necessarily* cast doubt on the general character of Axelrod's results.

Three other general factors, however, do qualify heavily the present applicability of Axelrod's work to antitrust law. My point here, of course, is not to scold Axelrod for shortsightedness. His pathbreaking effort had a far more general aim than investigation of proper policy for the Sherman Act. Rather my concern is to sketch the further work that is needed before Axelrod's insights can be transferred to the market context with confidence.

1. *Number and Size of Players*

Axelrod's tournaments involve many competing strategies that interact with others, one at a time. A model of repeated encounters between *pairs* makes sense for many applications, for instance, a wolf and a bear competing for caribou carcasses. In the market context, however, competition between pairs occurs only in rare cases of duopoly. Usually more than two firms populate a market. Observations by scholars outside the field of antitrust,⁷⁵ as well as more recent com-

73. Bendor, *In Good Times and Bad: Reciprocity in an Uncertain World*, 31 AM. J. POL. SCI. 531 (1987).

74. Boyd & Lorberbaum, *No Pure Strategy Is Evolutionarily Stable in the Repeated Prisoner's Dilemma Game*, 327 NATURE 58 (1987).

75. R. HARDIN, *COLLECTIVE ACTION* 43 (1982); M. OLSON, *THE RISE AND DECLINE OF*

ments by Axelrod,⁷⁶ suggest that coordination becomes more difficult as the number of players increases.

In fact, it has been a long-standing theme of the industrial organization literature that cartelizing grows more difficult as the number of firms in the market increases.⁷⁷ Indeed, this notion forms the very premise of our merger law, which makes measures of industrial concentration the key determinant of merger legality. Axelrod's tournament approach thus does not model antitrust's crucial question about reciprocity: *How many* firms does it take to make the prospect of cooperative pricing unlikely?

Recent analysis in Axelrod's tradition by Boyd and Richerson stresses the importance of studying the likelihood of reciprocity in sizable groups. These authors show that the likelihood that Tit-for-Tat will become common at a stable equilibrium diminishes rapidly as the number of players increases.⁷⁸ Boyd and Richerson make no effort to adapt their model to a market context. But their preliminary and qualitative findings are consistent with economists' standard intuition that collusion is difficult in a crowd. These insights suggest that an Axelrodian fear of collusion may be limited to duopolies and similarly extreme — and highly unusual — levels of market concentration.

The general idea that collusion is harder in sizable groups suggests a related point. Conventional antitrust wisdom holds that successful collusion produces supercompetitive returns, attracts entry, and thus exacerbates the coordination problem. At the same time, the new entry diminishes all players' relative returns from cooperating rather than cheating. Axelrod's analysis does not model these entry effects. Because entry is the nemesis of long-run cartel success, this omission may be an additional reason why future work in the spirit of Axelrod may fail to support the prospect of viable long-run producer reciprocity.

Finally, Axelrod uses a payoff matrix that presumes that players have an equal ability to injure each other. Axelrod used a prisoner's dilemma with a temptation of 5, reward for mutual cooperation of 3, and a sucker's payoff of 0.⁷⁹ These values were the same for both players. In the market context, we might interpret this feature as an as-

NATIONS 29-34 (1982); M. OLSON, *THE LOGIC OF COLLECTIVE ACTION* 36 (1971); M. TAYLOR, *COMMUNITY, ANARCHY AND LIBERTY* 53 (1982).

76. See Axelrod, *Evolutionary Approach*, *supra* note 65, at 1100.

77. E.g., F. SCHERER, *INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE* 199 (2d ed. 1980).

78. Boyd & Richerson, *supra* note 44.

79. R. AXELROD, *supra* note 1, at 8. See note 44 and text at note 70 *supra*.

sumption that all players are of equal size, or that relative size is irrelevant to the game's outcome. Yet conventional antitrust wisdom asserts that the relative size of firms *does* matter. If Pepsi and Coke merge to leave only tiny Shasta Cola, for instance, the standard attitude is that cooperation is more likely than if Coke has one half of the market and Pepsi the other. Axelrod's analysis cannot inform us if this conventional analysis is correct, backwards, or completely irrelevant, because his tournaments took no account of varying player size.

2. Certainty

Axelrod's tournaments assumed that pairs of players understand each others' moves perfectly. Firms, however, can err in interpreting each others' market responses. A firm would commit a Type I error by believing incorrectly that a rival had cut prices, and a Type II error by failing to detect a rival's price cutting.⁸⁰ Examples of Type I errors would arise if a cartel member believes a customer's lie (motivated by the customer's effort to induce price cutting) that another cartel firm cheated by cutting prices. Or suppose Saudi Arabia intends to limit its output to quota levels, but simply makes an accounting error that yields a larger output in some period. Or imagine Venezuela wants to follow OPEC's price, but inadvertently provides a customer with an added service that other OPEC players interpret to be quality competition. Type II errors, on the other hand, follow from the fact that "[t]he detection of secret price-cutting will of course be as difficult as interested people can make it."⁸¹

Axelrod's tournaments cannot say whether "noisy" communication is a serious barrier to cooperation, because they implicitly assumed that one player could identify the other's move with perfect certainty. Omitting treatment of uncertainty is a particularly significant weakness for antitrust law governing data exchanges and mergers. In these contexts, uncertainty about others' actions is highly likely. Firms in these situations typically are anxious to conceal or disguise noncooperative cheating, thus prompting Type II errors. Conversely firms wish to correct others' Type I misperceptions, but antitrust law's per se rule against price fixing makes this type of communicating extremely hazardous.

Several recent papers suggest that players' uncertainty about other players' moves can alter dramatically the prospects for Tit-for-Tat's success. Hirshleifer and Martinez Coll use a very simple model to an-

80. McKinnon, *Stigler's Theory of Oligopoly: A Comment*, 74 J. POL. ECON. 281, 281 (1966).

81. Stigler, *supra* note 32, at 47.

alyze Tit-for-Tat's stability under conditions of uncertainty. The possibility that players might misinterpret the other's moves, these authors find, can lead *either* to a cooperative or to a competitive equilibrium — depending on initial mix of strategies in the population.⁸²

Similarly, Bendor concludes that small levels of uncertainty cause Tit-for-Tat to behave quite differently than it did in Axelrod's tournaments.⁸³ Bendor finds that two Tit-for-Tat players cannot sustain a high level of cooperation when playing under such conditions. In the generational or "ecological" setting, Tit-for-Tat's instability creates an opportunity for strategies with longer memories, which in turn can attract exploiting competitive strategies. Bendor and Mookherjee also find that very small errors of perception or external uncertainty can alter dramatically the successful cooperation that can occur in a decentralized reciprocal relationship operating under complete certainty.⁸⁴ These works suggest that imperfect communication can make successful cooperation far less of an antitrust threat than Axelrod's tournament results might imply.

3. *The Market Interpretation of a Tournament: How Do Firms Learn?*

It is difficult to interpret the first three of Axelrod's tournaments in an antitrust context. Most literally, the analogy suggests an economy that contains as many competing firms as Axelrod's tournaments contained competing strategies: 15 or 63. Each firm competes with all others, but only one at a time — presumably by entering one product or geographical market for 150-200 pricing periods, withdrawing, entering another product or geographical market, and so on. When the rounds are completed, the firms total their profits and the richest one "wins." This tournament model is poorly adapted to the antitrust context. We never see firms engage in dilettantism of such widespread and short-lived proportions.

Axelrod suggests that his fourth test — the generational or "ecological" tournament — is better tailored to a market analogy: "a rule which was not scoring well might be less likely to appear in the future for several different reasons. One possibility is . . . a person using a rule sees that other strategies are more successful and therefore

82. Hirshleifer & Martinez Coll, *What Strategies Can Support the Evolutionary Emergence of Cooperation?*, J. CONFLICT RESOLUTION (forthcoming).

83. Bendor, *supra* note 73, at 544-45.

84. Bendor & Mookherjee, *Institutional Structure and the Logic of Ongoing Collective Action*, 81 AM. POL. SCI. REV. 129 (1987). See also Milgrom, *Axelrod's The Evolution of Cooperation*, 15 RAND J. ECON. 305, 308 (1984) ("The possibility of misinterpretation has significant effects on the desirability of a TIT-FOR-TAT strategy.").

switches to one of those strategies.”⁸⁵ By conceiving of managers who learn from others' experience in distant markets, Axelrod can avoid the implausible need for an individual firm itself to enter and exit a large number of markets.

Models of cultural transmission, however, depend crucially on the details.⁸⁶ Axelrod's model assumes that, from one period to another, strategies gather adherents among managers or firms in proportion to each strategy's "success." But Axelrod defines success in a particular and important way: the size of the *total* points won from interacting with *all* players.⁸⁷ Put otherwise, Axelrod defines the most successful strategy to be the one with the largest *average* point score. Tit-for-Tat never defeats a rival in any one particular match. It cannot. But it does well *overall* because it stimulates high-scoring cooperation with a wide range of partners.

It is quite possible to define "success" differently. UCLA fans might say a football season that includes a victory in the USC game is more successful than a season that produces a higher-scoring point *average* against *all* rivals but includes a loss to USC. Similarly, the management philosophy of Avis might focus more on outselling Hertz than on producing a high level of profit compared to the Fortune 500. Similarly, Avis might consider its showing against Hertz to be a more significant and reliable performance indicator than comparisons with dissimilar firms in unrelated markets, where factors besides management skill complicate the comparison.

In terms of game theory, there is a dramatic difference between setting a goal of victory or one of high payoff.⁸⁸ Stated in a second and equivalent way, defining "success" in relative local terms can lead to far different results than defining success in absolute or global average terms.⁸⁹ Tit-for-Tat performs well under conditions that stress absolute payoff success but does very poorly when success and propagation depend rather upon relative victories. Stated in yet a third way, Axelrod finds that a *round-robin tournament* favors cooperation — but cooperation is either stymied or eliminated altogether if the tournament

85. R. AXELROD, *supra* note 1, at 50.

86. R. BOYD & P. RICHESON, *CULTURE AND THE EVOLUTIONARY PROCESS passim* (1985). Cf. Milgrom, *supra* note 84, at 308 ("[T]here is still the problem of identifying who the players in the game are. . . . Whenever anyone plays a game as part of a family, a firm, or any other organization, there are always the questions of who the players are and to whom reputations attach.").

87. R. AXELROD, *supra* note 1.

88. Behr, *Nice Guys Finish Last — Sometimes*, 25 J. CONFLICT RESOLUTION 289 (1981).

89. See Boyd, *Density-Dependent Mortality and the Evolution of Social Interactions*, 30 ANIMAL BEHAV. 972 (1982).

is an *elimination bout* in which the winning player survives and the loser disappears.⁹⁰

Once again, Axelrod's results will require heavy qualification before they can be applied to the antitrust context. One economic tradition prefers to model firm managers as relentless profit maximizers who work to maximize shareholders' wealth, without regard to personal managerial goals like prestige, total corporate size, or machismo. This tradition suggests that firm managers in fact might survey the interactions of firms throughout the economy and adopt for themselves the strategy that produces the highest profit, on average, thus supporting Axelrod's round-robin assumption and its cooperative result. But another tradition stresses that optimization may result primarily because efficient firms avoid competitive elimination.⁹¹ If that is the case, then the best model of strategy transmission may concentrate on a model of elimination bouts — thus suggesting that cooperation is highly unlikely to arise and that competition should flourish. Once again, Axelrod's tournament results would imply results opposite to those most relevant for antitrust law.

IV. CONCLUSION

The two doctrines I have examined are important antitrust policy. The law of data exchanges governs every market in the country, establishing what communication among competitors is permitted and what is forbidden. Mergers today often involve millions, if not billions, of dollars. Yet over time the law that governs these everyday economic transactions has made widely differing assumptions about the vulnerability of competition to successful producer reciprocity. These assumptions have been rooted in the merest conjecture about the viability of harmful producer reciprocity. As thus should be expected, they have proven vulnerable to substantial revision with shifting political tides. There has been recent progress on a stouter theory of reciprocity, but that progress should impress antitrust with its potential for — not its current offering of — useful insight. Until that theory can give judges helpful generalizations about when cooperation is more likely than competition, antitrust will continue to be based only on the current fashion in guesswork.

90. Hirshleifer & Martinez Coll, *supra* note 82. See also R. SUGDEN, THE ECONOMICS OF RIGHTS, CO-OPERATION AND WELFARE 121 (1986).

91. See Alchian, *Uncertainty, Evolution, and Economic Theory*, 58 J. POL. ECON. 211 (1950).