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PUBLIC-SECTOR COLLECTIVE BARGAINING: LESSONS FROM GAME THEORY

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ABSTRACT

Negotiations between management of a company or agency and unions representing its workers recur at more or less regular intervals over time. In each of the negotiations, each party has the incentive to cooperate with the other for mutual benefit, and simultaneously, the incentive to seek gain at the other's expense. The authors analyze these incentives in the context of a repeating series of Prisoner's Dilemma games. The conclusion drawn is that cooperative bargaining relations are most easily maintained when threats made are credible and, yet, when there is sufficient restraint exercised by the parties that trust between them is maintained.

To those involved in public sector labor negotiations, the outcomes have direct impact on the lives and well-being of a wide range of individuals, be they employees, administrators, or taxpayers. If one looks beyond the immediacy of the bargaining session, however, there are lessons to be drawn from Game Theory regarding the incentives of each party to the negotiation and their subsequent interaction. The insights gained from the analysis then might serve to temper the thinking and demands of both labor and management.

PRISONER'S DILEMMA

One of the simplest games applicable to labor negotiations is named "Prisoner's Dilemma." Prisoner's Dilemma is characterized as a cooperative game in the sense

Table 1. Management's Payoff Matrix

	Labor	
Management	Aggressive	Cooperative
Aggressive	–5	+10
Cooperative	–10	+5

that there are mutual gains to be had if players cooperate with one another. The game also points out that such cooperation is not easily achieved because the rational incentive of each player is not to cooperate, but instead to seek gain at the expense of the other(s). The following hypothetical example illustrates these incentives.

We will assume that there are two parties ("labor" and "management") to this negotiation. Each party has a choice of two strategies (aggressive or cooperative) toward the other. The payoffs in the game to each party depend critically on, not only the strategy that it pursues, but on the strategy of the other. Consider, first, the payoffs facing management illustrated in Table 1.[1]

If both labor and management are aggressive in their bargaining, strife and possible work actions result. There is a negative payoff of –5 to management from the discord. The only worse outcome from management's viewpoint (i.e., a payoff of –10) is if it is cooperative while labor adopts an aggressive stance. In that case, management may be forced to make concessions it can ill afford, placing itself in even greater jeopardy with voters or taxpayers because it is perceived as not "bargaining hard." On the other hand, if it is aggressive and "bargains hard" and labor is cooperative, management may win concessions that will enhance its own prerogatives and save money for the public at large. From management's standpoint, this is the best of possible outcomes (with a payoff of +10). Finally, if both parties are cooperative, both will have to make concessions, but agreement is possible. Work actions are avoided, and each party gets some of what it wants. The settlement of the negotiations on a reasonable (but not entirely advantageous) basis has a payoff of +5 to management.

Consider, next, labor's payoffs, represented in Table 2. Here, if both parties are aggressive, labor strife results, which leads to stress and expense for union members. Such an outcome has a payoff of –5 for labor. If both parties are cooperative, agreement may be reached, with labor making concessions, yielding

[1] The payoffs selected in this game are to some degree arbitrary, but were chosen to illustrate common circumstances.

Table 2. Labor's Payoff Matrix

	Labor	
Management	Aggressive	Cooperative
Aggressive	–5	–10
Cooperative	+10	+5

a payoff of +5 to it. From labor's standpoint, the worst outcome occurs when management is aggressive and labor is not. Labor is then forced to make concessions that union members might deem well beyond reasonable, giving it a payoff of –10. Labor's best outcome occurs when it is aggressive but management is not. Labor reaps the benefit of added concessions at the expense of management, giving labor a payoff of +10.

Given these incentives, if each party behaves rationally, each party will be aggressive and no agreement will be reached. Consider management's alternatives in Table 1. If labor is aggressive, it receives a higher payoff by being aggressive also. By doing so, it would receive a payoff of –5, rather than –10 if it were cooperative. If labor is cooperative, management can receive a payoff of +10 by being aggressive rather than a payoff of +5 by being cooperative. Regardless of the strategy labor pursues, management is better off by being aggressive. Similarly, labor (in Table 2) is better off being aggressive if management is (a payoff for labor of –5 as opposed to –10) and it is better off being aggressive if management is cooperative (a payoff of +10 instead of +5). Thus, labor will also be aggressive.

The curious result of this game is that, even though each party is trying to rationally pursue its own self interest, the outcome is far from desirable for *either* party. To make the point clearly, one need only represent the payoffs in the game as ordered pairs in a single table. The first element of each ordered pair is the payoff to management if a cell of the game matrix is reached, and the second element of the ordered pair is the payoff to labor if that cell is reached. Table 3 represents the game in this way. Because each party has the incentive to be aggressive, the likely outcome will be that each party will receive a payoff of –5. The results are not desirable from either party's point of view.[2] In particular, if both parties were cooperative, each party would benefit, receiving a payoff of +5 (rather than the –5 when each party is aggressive).

[2] In fact, if one could simply add the payoff for management to the payoff for labor to find the joint outcome, the solution reached is the worst outcome of all the possible cells.

Table 3. Combined Payoff Matrix

	Labor	
Management	Aggressive	Cooperative
Aggressive	(–5, –5)	(+10, –10)
Cooperative	(–10, +10)	(+5, +5)

The point of Prisoner's Dilemma is that each side has an incentive to cooperate with the other side for mutual benefit. In this context, if management and labor agreed to cooperate (and if the agreement were maintained), the possibility of an agreement advantageous to both parties exists. That said, however, neither party has an initial incentive to pursue such an agreement. Each, behaving rationally, will choose to be aggressive in its bargaining. Even if somehow the parties agreed to each be cooperative, the agreement would be unstable. Once management knew that labor had agreed to be cooperative, it would still have an incentive to be aggressive (for a payoff of +10 instead of +5). Labor would have the same incentive once it believed management would be cooperative. Thus, while an agreement for both parties to be cooperative is possible and would benefit each, neither party would have an incentive to observe its terms.

STRATEGY IN REPEATING PRISONER'S DILEMMA GAMES

Although the perverse incentives inherent in Prisoner's Dilemma are indeed present in most labor negotiations, the negotiations generally take place in a broader context. In particular, the fact that labor contracts do not last forever forces labor and management to confront each other repeatedly. Moreover, the parties to the negotiations rarely change, and the game repeats with no clear end point (i.e., indefinitely). Each party then must be concerned not only with the optimal strategy to pursue in current negotiations to obtain maximum gain, but also how the strategy pursued now will affect future negotiations. An aggressive (noncooperative) bargaining position by one player in a given round of negotiations conveys information to the other player that will influence its behavior in future rounds. Simply, labor negotiations do not start *de novo* in each round. Rather, each party is well aware of the bargaining history of both parties and takes that history into account in formulating its own bargaining position.

While at any point in time individual players still have the incentive to pursue a noncooperative strategy, that strategy maintained consistently over time will lead to less than optimal results for the player pursuing it (and for his/her opponent).

Aggressive bargaining in the current negotiations may lead to a gain now if one's opponent is cooperative, but a history of noncooperation will leave that opponent with little choice but to be aggressive and bargain noncooperatively. That is, if one player knows or believes that the other will always bargain aggressively, then to protect him/herself from his/her worst outcome (in which s/he makes concessions, but the other player is aggressive), s/he has an incentive to pursue an aggressive stance in the negotiations. In this case, the joint noncooperative solution of the Prisoner's Dilemma game will persist over time.

Although aggressive bargaining on one side breeds aggressive bargaining on the other—leading an inferior solution for both parties—the converse proposition that cooperative bargaining on one side promotes cooperative bargaining on the other will not generally hold true. The crux of Prisoner's Dilemma is that if one player knows the other will be cooperative and conciliatory, his/her incentive is to be aggressive to reap maximum benefit. Of course, this noncooperative behavior victimizes the cooperative player, leaving him/her to contemplate his/her folly. The point here is that for cooperative behavior to persist, it must be mutually beneficial.

If constant aggression is an undesirable solution for either party, and if blind cooperation leads only to self-victimization, the question is whether an optimal strategy exists when Prisoner's Dilemma is repeated indefinitely. Although there is no best strategy that can be postulated *a priori* to answer the question, one strategy has emerged that performed well in experiments and possesses a number of desirable characteristics. That strategy has come to be called tit-for-tat. It is a mechanical, contingent strategy in which the initial move (the first-round move) is to cooperate. The strategy requires that in subsequent rounds, a player simply mimics his/her opponent's move in the previous round. That is, if in the prior round one's opponent is cooperative, then a player should be cooperative in the current round of play. If the opponent was noncooperative, then one should be noncooperative in the current round.

The intuitive appeal of this strategy is that it rewards an opponent's cooperation with cooperation in the next round. Likewise, it meets aggressive, noncooperative behavior with the same. A party playing a tit-for-tat strategy then is signaling his/her willingness to reach a (joint) cooperative solution contingent on the other party's cooperation. On the other hand, the first party will also punish non-cooperative behavior, signaling that party's unwillingness to be taken advantage of repeatedly by its opponents.

There are several other aspects of tit-for-tat that make it a desirable strategy. In their review of the work of Robert Axelrod, Dixit and Nalebuff wrote:

> Axelrod argues that tit-for-tat embodies four principles that should be evident in any effective strategy: clarity, niceness, provocability, and forgivingness. Tit-for-tat is as clear and as simple as you can get. It is nice in that it never initiates cheating (*i.e., non-cooperation*). It is provocable, that is, it never lets cheating go unpunished. And, it is forgiving, because it

> does not hold a grudge for too long and is willing to restore cooperation [1, pp. 106-107, citing 2, p. 110].

Dixit and Nalebuff described an experiment conducted by Axelrod [1, p. 107]. Axelrod constructed a two-person game that was to be repeated 150 times. Next, he solicited strategies from other game theorists that were submitted in the form of computer programs. In a simulation, the programs "competed" against one another pairwise. Each entry then faced each of other entries in head-to-head competition. The score from each contest was summed to determine the winner. Although tit-for-tat could beat no other strategy head-to-head (because at best it will tie them), overall it was the winner because compared to the other strategies it achieved the best balance between encouraging cooperation and discouraging exploitation. Axelrod's work makes a strong case for tit-for-tat as the optimal strategy from an individual player's perspective. Further, because its certain, proportional response to cheating encourages cooperation, it is desirable in a wider context because it tends to maximize the joint payoff of the players [1].

Although tit-for-tat is a strategy that has both intuitive appeal as a variation of the Biblical maxim "an eye for an eye and a tooth for a tooth" and empirical support as evidenced in Axelrod's study, Dixit and Nalebuff contended that the strategy is flawed in practice [1, pp. 109-113]. In particular, they demonstrated that if there is a danger of one party misperceiving another's move (a danger not present in Axelrod's computer simulation), then a chain reaction of mutual recriminations (noncooperative behavior) may result. If party A misperceives party B's cooperative move as being uncooperative, then in the next round of negotiations A will be uncooperative. In the round following that, B will retaliate against A's uncooperative move in the round before. What can result, then, is a pattern of alternating, aggressive moves that repeat indefinitely.[3] Dixit and Nalebuff used the feud between the Hatfields and McCoys as an example of this alternating pattern of aggression [1], but one could easily look at the current disputes between the Israelis and the Palestinians in the same light.

Before closing this section, two extensions of the discussion are worth mentioning. Because of the possibility of the cycle of aggressive moves caused by misperception, Dixit and Nalebuff argued that a player's optimal strategy should be somewhat more forgiving of perceived noncooperative moves than would be dictated by tit-for-tat. That is, a player should not immediately react to an aggressive move by his/her counterpart, but should remember it and react only when the actual intent of one's counterpart becomes clearer. At the same time, however, the authors pointed out that the higher the probability of misperception of moves in the game, the lower the probability that a mutually advantageous, cooperative solution will be reached. A contingent strategy, such as tit-for-tat or

[3] If there is no outside intervention, Dixit and Nalebuff point out that the cycle of aggression will end only if and when one party misperceives the other's aggressive move as cooperative [1].

any of its variations, is based on an ability to react to one's opponent's moves. If one cannot read those moves clearly, then mutual advantage based on trust is hard to establish and to maintain [1, pp. 111-115].

IMPLICATIONS FOR COLLECTIVE BARGAINING

The argument made earlier was that because labor negotiations in the public sector occur on an ongoing, periodic basis, the analogy between these negotiations and the repeated Prisoner's Dilemma game is close. In the course of bargaining, however, the rationale given by one party to justify its position is rarely taken at face value by the other party. The intent of the moves by one side can be unclear and subject to (mis)interpretation by the other. For example, if management contends it cannot meet union wage demands because it lacks the ability to pay, such a claim is most frequently greeted with skepticism by the union. When a claim of inability to pay is made, the United States Supreme Court has ruled in *NRLB v. Truitt Manufacturing Company* that good-faith bargaining requires management to offer proof to substantiate the claim [3, pp. 161-162]. Not surprisingly, the union will subject the claim and the proof offered to intense scrutiny. Only rarely will a claim of inability to pay be accepted at face value, without considerable dispute.

The success of any bargaining strategy and of the negotiations as a whole often turns not only on the positions taken by a party, but also on the credibility of those positions. Because the parties do not change in the public sector and negotiations continue on a repeated basis, a party develops a reputation based on past bargaining history. Moves made in the past by one party that are viewed by the other party as both aggressive and lacking credibility are not likely to elicit cooperative behavior from the second party in succeeding negotiations. One need only consider labor relations in major league baseball. In the rancorous negotiations of 1994-1995, which resulted in a lengthy strike, team owners asserted that most of the teams in the league were losing money and, thus, they required substantial salary concessions from the players. To say that the player's union did not find the underlying assertion of unprofitability convincing is an understatement. The union's chief negotiator, Donald Fehr, accused the owners of false and opportunistic accounting. Not only did the owners' disputed claim poison the 1994-1995 negotiations, but also those for the contract negotiated at a later time. Because of a perceived lack of good faith in the prior negotiations on the part of each party, bargaining positions hardened.

If reaching cooperative bargaining outcomes depends on the credibility and reputations of the parties, what characteristics of the parties determine the probability of a mutually acceptable agreement? Two seem essential. First is openness and transparency. If one party makes claims that might appear self-serving, then they should be prepared to substantiate those claims *willingly.* Moreover, the veracity of the claims made should be evident to the other party (or, at least, to

disinterested, unbiased third parties). One of the difficulties in the 1994-1995 baseball negotiations was that the owners only reluctantly opened their books to demonstrate the losses they said were suffered by the majority of clubs. Even when the books were opened, the evidence was far from clear on the matter. It is little wonder that the players' union did not find the claims credible [4].

On the other hand, Rubin and Rubin cited the example of the election of a new mayor (Stephen Goldsmith) in Indianapolis, Indiana, in 1992. In his election campaign, Goldsmith contended that municipal services were being delivered inefficiently. He proposed privatizing those services. While the unions campaigned vociferously against him, the election of Goldsmith created a threat that no municipal union could ignore. He had a mandate to deliver city services more effectively. Precisely because the threat was both transparent and credible, the municipal union (American Federation of State, County, and Municipal Employees) was forced to make concessions, theretofore resisted, to improve the efficiency of their services [5].

The second characteristic of a bargaining party that tends to promote cooperative bargaining with the other is restraint. That is, if each party believes the other will not seek to act opportunistically to victimize it, cooperative bargaining is more likely. Rubin and Rubin pointed out that before union jobs were lost, the union was given the opportunity to bargain for changes in work rules and to suggest needed changes in work rules to improve efficiency. To demonstrate the administration's commitment to efficiency, a number of (nonunion) supervisory positions were eliminated when it became clear that the positions were redundant. Because these positions were filled largely by political appointees, the cutback came at significant cost to the mayor's own party. Nevertheless, these actions taken together demonstrated both the restraint and the responsiveness that breeds the trust required for cooperative solutions. Although the bargaining process has not been without pitfalls, a minimum of union jobs were lost, the contracting out of work has declined and management-union relations have improved since the mayor's election [5].

In an article in which he describes the evolution of a "collaborative" bargaining relationship in a school district, Kelleher illustrated the restraint on the school administration's side:

> . . . The school committee lawyer and assistant superintendent might have taken advantage of the conflict within the teachers association to secure a better contract, from the school committee's perspective. But instead they emulated the same professionalism of the BTA (*the teachers association*) negotiating team. The superintendent and school committee lawyer focused on preserving their long term bargaining relationship with the association, since they might have "won the battle but lost the war," as the assistant superintendent described it, if they succeeded in the 1996-97 contract, but had damaged their relationship for subsequent negotiations [6].

What Kelleher described is the administration's restraint, which it hopes will build trust in furtherance of a long-term, cooperative relationship. One should note, however, that the administration's restraint is entirely consistent with Dixit and Nalebuff s suggestion that cooperation in repeated Prisoner's Dilemma games is best promoted where not every possibility for short-term gain is exploited (and not every deviation from cooperative behavior punished).

CONCLUSIONS

The implications of this inquiry for public-sector bargaining are straightforward. Cooperative bargaining relations are facilitated when, if aggressive moves by labor or management must be made, their rationale is clear enough to establish their credibility, and paradoxically, when there is sufficient restraint on each side to enable the trust required to maintain long-term cooperation.

REFERENCES

1. A. Dixit and B. Nalebuff, *Thinking Strategically,* W. W. Norton and Company, New York, 1991.
2. See also R. Axelrod, *The Evolution of Cooperation,* Basic Books, New York, 1984.
3. See D. A. Dilts and C. R. Deitsch, *Labor Relations,* Macmillan Publishing Company, New York, 1983.
4. See for example, Mike Fish, Business as Usual: Baseball Owners, Players Fan Flames of Distrust, *CNN Sports Illustrated Online,* February 1, 2002, http://sportsillustrated.cnn.com/inside_game/mike_fish/news/2002/02/01/fish_viewpoint/
5. B. Rubin and R. Rubin, Municipal Service Delivery, Collective Bargaining, and Labor Management Partnerships, *Journal of Collective Negotiations in the Public Sector, 30*:2, pp. 91-112, 2003.
6. J. Kelleher, Understandings of Collaboration in Teacher Contract Negotiation and Implementation, *Journal of Collective Negotiations in the Public Sector, 30*:1, pp. 23-46, 2003.

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