

Strike two: labor-management negotiations in major league baseball

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This article considers a simple variable-threat model of bargaining intended to explain the unusual discontinuous strike threatened by the Major League Players Association in labor negotiations in the Spring of 1980. The model shows that, because the difference between owners' income and players' salaries varies over time, a strike of this sort can arise as an optimal threat on the part of the players. We also consider optimal lockout threats on the part of the owners. The model shows that, when no strike insurance is available, the unique Nash equilibrium of the resulting game involves both a threatened strike and a threatened lockout. However, when strike insurance is available, and in situations in which it is profitable for the owners to purchase it, the unique equilibrium involves a (possibly discontinuous) threatened strike but no threatened lockout.

1. Introduction

I won't even attempt to understand the hyphenated strike, the one week off, the six weeks on and the indefinite off again. . . . [Phil Niekro] said he thought it was "a helluva move." He didn't say why. He could have enlightened me a great deal if he had.

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■ The above statement, made by a sportswriter in a well-known sports publication, refers to the 1980 labor problems which confronted major league baseball (*The Sporting News*, April 19, 1980).¹ On December 31, 1979, the Basic Agreement, the general contract between the team owners and the major league players, expired. Through three months of bargaining, no progress was made on the several issues involved. The players voted on April 1 to strike

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¹ In the same issue, Tom Seaver, veteran pitcher for the Cincinnati Reds, was quoted concerning the strike as follows: "I don't understand. . . . It doesn't make sense, but I guess there must be reasons."

the remaining games of the exhibition schedule, but to return to work for the first six weeks of the regular season and to again go on strike May 23 if negotiations were still deadlocked. At 5 A.M. on Friday May 23 the owners acquiesced and an agreement was reached, thereby averting the second part of the players' strike in literally the final hours.²

The threat of discontinuous strikes appears to be highly unusual in labor-management negotiations. Clearly there was confusion on the part of many people closely connected with the game of baseball; the above quotation indicates that a highly respected baseball writer was unable to see what, if any, logic lies behind the type of strike threatened.

This article attempts to explain how such a strike threat could, in fact, be an optimal strategy on the part of the players. We examine a simple variable-threat bargaining model in the context of the salient institutions of baseball. Both parties will choose a threat; these threats will be carried out in the event that no agreement is reached. Obviously, both parties will choose the threat which offers them the most advantageous bargaining position. The fact that the owners' revenues vary over time can lead the players to threaten optimally a discontinuous strike during the periods of maximum difference between owners' income and players' salaries. Consideration of some of the more prominent, and unique, characteristics of professional baseball will aid in understanding why we do not observe such discontinuous strikes in other industries. We also examine the conditions under which the optimal response by the owners is to threaten a lockout, and when it is more profitable for them to forego this option and to purchase strike insurance instead.

Section 2 outlines the relevant institutional facts. The third section presents the bargaining game. The model is simple; it is intended to show that under the special characteristics present in the baseball industry, a bargaining model can point to an interrupted strike as the dominant threat strategy on the part of the baseball players. The last section concludes with some observations and speculations relevant to the complex issues involved in the baseball contractual problems and the general phenomenon of a discontinuous strike threat.

2. The issues in conflict

■ The Basic Agreement is the general contract between the owners of the team franchises and the players; it is a general contract form which must be adhered to in each individual players' contract. Renegotiation of the Basic Agreement takes place every four years.

By far the single most important issue in the 1980 contract negotiations was the compensation for "free agents." Until 1977 the Basic Agreement contained a section called the Reserve Clause which granted owners monopsony power over players under contract to their individual team; players either *accepted the terms offered by their present owner or left baseball entirely*. Legal cases prior to the negotiation of the 1976 Basic Agreement forced the owners to allow players the ability to become "free agents" and have their

² *New York Times* sportswriter Red Smith, in the Sunday, May 25, 1980, edition, wrote: "After an edifying exercise in brinksmanship, the powers, principalities and archangels of the baseball hierarchy averted a strike by bowing in sweet surrender. In the dark hours before deadline, the owners gave in and accepted the settlement that the players had proposed and they had rejected a week earlier."

services bid for in a reentry draft. In the 1980 negotiations, the owners wanted to restrict partially the freedom of players in the free-agent market; the players obviously were opposed to such a contract, as it would transfer economic rents from the players to the owners.

While there were several issues in contention, the issue of free agency was clearly the central problem.³ Both sides displayed considerable resistance to any compromise of their basic demands. As a result of this deadlock, the players voted to strike the last week of Spring training exhibition games and then play the regular season games until midnight May 22, whereupon they would go on indefinite strike until a new Basic Agreement was finalized.⁴

The first part of the discontinuous strike in the 1980 confrontation cost the owners the revenue from 92 exhibition games; the players lost no salary as their salary does not begin until the start of the regular season.⁵ The timing of the second segment of the strike was just prior to the Memorial Day weekend, traditionally the start of the large attendance gains baseball experiences as Summer begins. Additionally, nationally televised games increase around this time.

The owners were not without any recompense. It is known that they have strike insurance, although information as to the exact details of the strike insurance policy is not available.⁶ However, it was reported that the insurance benefits are an estimated one million dollars per day to the owners as a group, after a two-week deductible period (*The Sporting News*, April 19, 1980, p. 7).

In the next section, we present a simple bargaining model which permits analysis of the effects of the special institutions of the baseball industry. These key aspects are threefold: (1) the players' salary is constant over time, (2) the owners' revenue is variable over time, and (3) the owners have strike insurance. We show, under a reasonable set of assumptions, that these facts can lead to a discontinuous strike threat by the players and the absence of a counterthreat by the owners.

3. A simple bargaining model

■ The two parties in the negotiations, the Major League Players Association (the players) and the owners will each be modeled as risk-neutral individuals

³ While the list of issues is too numerous to mention, a few are enlightening, if only as a benchmark to show the intensity of the free-agent issue. Briefly, the other main points of contention were the minimum salary that can be paid to any major league player, the owners' contributions to the players' pension fund, and the qualifications necessary to allow a player to take his individual contract problems to binding arbitration.

⁴ There had only been one previous strike in modern baseball history; in 1972, two days before the opening of the regular season, the players voted to strike. The issue was the distribution of a surplus from the pension fund, which the players wanted distributed as benefits. The strike lasted 13 days and 86 games were never played in that shortened season. The compromise agreement involved giving equal shares of the surplus of the two parties.

⁵ As an example of the cost to the owners, the lucrative Crosstown series between the L.A. Dodgers and the California Angels was cancelled; this series alone was expected to earn revenues of close to \$500,000 for the two teams.

⁶ The authors met with considerable (and most likely quite reasonable) resistance in their inquiries as to the details of the strike insurance. Indeed, the *N.Y. Times* revealed that the owners' negotiator, Ray Grebey, had set up a fine for disclosing pertinent information about the negotiations. Dubbed the "Grebey Discipline Code," the maximum fine was purported to be \$500,000. Even the usually obliging owner of the Chicago White Sox, Bill Veeck, was understandably noncommittal in our phone conversation. ADDED IN PROOF: In 1981 it was revealed that the insurance policy paid maximum benefits of \$50,000,000.

(i.e., expected income maximizers) involved in a two-stage variable-threat bargaining game. In the first stage of such a game each party chooses a *threat*, to be carried out if the subsequent negotiations fail to produce an agreement. The threats chosen by the two parties in the first stage of the game thus determine the outcome of the game in the event that no agreement is reached in the second stage.

The second stage of the game can then be modeled as a fixed-threat bargaining game, consisting of a pair (T, d) , where T is a subset of the plane representing the set of feasible expected payoffs to the parties, and $d = (d_1, d_2)$ represents the payoff which each party will receive in the event of a disagreement, in which case the threats made in the first stage will be carried out. That is, the rules governing the second stage of the game are that the two parties may agree to any payoff vector $x = (x_1, x_2)$ contained in the feasible set T (in which case the players and owners receive expected income x_1 and x_2 , respectively). If, on the other hand, the two parties fail to reach an agreement, their threats from the first stage are carried out and result in expected incomes d_1 and d_2 .

Thus it is the second stage of the game which determines the final outcome, and the payoffs to the two parties. The goal of each party in the threat stage of the game is to choose the threat which he anticipates will influence the outcome of negotiations in the bargaining stage as favorably as possible.

In what follows, we shall model the expected outcome of a fixed-threat bargaining game (T, d) by a function $f = (f_1, f_2)$ called a *solution*, which can be interpreted as telling us each party's expected utility for playing the game (T, d) . That is, if $f(T, d) = (z_1, z_2)$, then $z_1 = f_1(T, d)$ is the players' expected utility and $z_2 = f_2(T, d)$ is the owners' expected utility for playing the game (T, d) in the negotiation stage.

To be able to model explicitly the problem facing the two parties at the threat stage, we shall take the solution f to be equal to Nash's (1950, 1953) solution F , such that $F(T, d) = z$ is the point (z_1, z_2) in T which maximizes the geometric average of the gains available to the players.⁷ The problem facing the players will be to decide on what kind of strike (if any) to threaten, while the problem facing the owners is what kind of lockout (if any) to threaten. For ease of exposition, we shall attack the problem in two parts. In Model A, we shall derive the optimal strike threat of the players for the restricted game in which the owners cannot threaten a lockout in response; in Model B we shall derive the equilibrium conditions for determining optimal strike threats and optimal lockout threats when both are possible.

□ **Model A: absence of a lockout threat.** Let R denote the total economic rent generated by the scarce resource of player talent over the life of the contract under negotiation (the rent distribution for the current season is excluded as the players' salaries have been previously determined). Let α be the share of this rent which accrues to the players where $0 \leq \alpha \leq 1$. It is this total free-agent rent (R) whose distribution (α) is at issue. Let $N = \{0, 1, \dots, n\}$ denote

⁷ Any of a variety of bargaining solutions would serve our purposes equally well. However, it can be shown that Nash's solution can be interpreted as the expected utility of a certain kind of risk-neutral player for playing a fixed-threat bargaining game (cf. Roth, 1979).

the $n + 1$ periods to be considered. Specifically, let each period represent one week; thus period zero represents the last week of the exhibition game schedule and the first week of the players' threat horizon.⁸

In the event of an agreement α , player income is

$$I_P(\alpha) = \sum_{i=0}^n \sigma_i + \alpha R, \tag{1}$$

where σ_i is the players' salary in period i . We can rewrite (1) as

$$I_P(\alpha) = n\sigma + \alpha R,$$

since the salary during the last week of spring training, σ_0 , is zero, and the salary in any given week of the regular season is a constant: $\sigma_i = \sigma$ for $i = 1, \dots, n$. Likewise, we can write owner income for an agreement α as

$$I_O(\alpha) = \sum_{i=0}^n a_i + (1 - \alpha)R, \tag{2}$$

where a_i is the owners' profit in period i including their share of the previously determined distribution of rents for this season.

In the event of no agreement by the end of the season, we shall assume that α is determined by a random variable \hat{A} , with known mean α_0 . The assumption that α is determined by a random variable is meant to capture the (subjective) uncertainty of the bargainers regarding the ultimate resolution of the conflict if a state of disagreement persists. The assumption that the mean of this (subjective) random variable is known and is shared by both bargainers is a convenient simplification adopted to avoid the additional complexity which would result if we made the more realistic assumption that neither bargainer knew for certain how the other bargainer evaluated persistent disagreement. If, instead, we had modeled it as a game of incomplete information, the cause of *discontinuous* strike threats would be no different from that in the simpler model we consider here. The difference between the two models would show up in the predictions they make about how often (and why) such threats might be carried out.⁹ Additionally, we consider the existence of an insurance policy which pays a benefit to the owners in the event of a strike.

The players may choose a strike S , of the form

$$S = \{s_1, s_2, \dots, s_k\} \subset \{0, 1, \dots, n\},$$

where $s_i \in S$ indicates that the threatened strike includes period s_i . The players' strategy set SS_P is thus of the form

$$SS_P = \{S = \{s_1, s_2, \dots, s_k\} \subset \{0, 1, \dots, n\}\}.$$

Since we are assuming for the moment that the owners cannot threaten a lockout, they have no strategic choices. Their strategy set SS_O has a single element,

$$SS_O = \{L = \{\phi\}\}.$$

⁸ Recall the players' met to vote on the strike threat on April 1, 1980, which was just before the last week of exhibition games.

⁹ The reader is referred to related comments in the conclusion.

If there is a strike during periods $S = \{s_1, \dots, s_k\}$, the players' expected income¹⁰ is

$$I_P(S) = \sum_{i \notin S} \sigma_i + \alpha_0 R = n\sigma - \sum_{i \in S} \sigma_i + \alpha_0 R \tag{1a}$$

or

$$I_P(S) = \begin{cases} (n - k)\sigma + \alpha_0 R & \text{if } 0 \notin S \\ (n - k + 1)\sigma + \alpha_0 R & \text{if } 0 \in S. \end{cases}$$

The players earn their constant salary, σ , over all periods (except Spring training) in which they are not on strike. The owners earn income a_i in any period i not in S and collect insurance benefits h in each period after the first δ deductible periods of a strike. That is, the owners' income in the event of a strike during the periods in S , is

$$I_0(S) = \sum_{i \notin S} a_i + [k - \delta]^+ h + (1 - \alpha_0)R, \tag{2a}$$

where we define

$$[k - \delta]^+ \equiv \max \{0, k - \delta\}.$$

Note that a_i , where $i \notin S$, is assumed for simplicity to be independent of S . That is, we ignore any possible effect of a strike in period j on a_{j+1} .¹¹

The set T of feasible payoff vectors is:

$$T = \{x = (x_1, x_2) \mid (0, 0) \leq (x_1, x_2) \leq (I_P(\alpha), I_0(\alpha)), 0 \leq \alpha \leq 1\}. \tag{3}$$

If the players choose $S = \{s_1, \dots, s_k\}$ and no agreement is reached,¹² the outcome is defined as the disagreement payoff $d(S)$, where

$$d(S) = (d_1, d_2) = (I_P(S), I_0(S)). \tag{4}$$

The payoff function in this threat game can now be defined as

$$\pi(S, \phi) = (\pi_1(S), \pi_2(S)) = F(T, d(S)). \tag{5}$$

¹⁰ This is the players' expected income at the time they must decide to carry out the strike threat; i.e., before they know how the issue will ultimately be resolved. Their expectations at this point are the relevant ones because, as the deadline for the strike to begin approaches, these are the expectations which they use in their decision to accept any offer which has been made, or to go on strike. The same applies to the owners' income in equation (2a).

¹¹ The discontinuous strikes which we are studying would arise even if we relaxed this assumption, as long as there is *some* variable effect of time periods on the owners' income. Thus, even if strikes hurt income in subsequent periods, discontinuous strikes can arise as long as strikes in different periods reduce the owners' income by different amounts.

¹² The parties have incentive to reach agreement in such a bargaining game as long as there is some payoff vector, $x \in T$, which is superior to the disagreement payoff vector d . More formally, a bargaining game (T, d) resulting from a strike threat S is said to be *nondegenerate* if $d < x$ for some x in T . For instance, it would be sufficient to choose S so that $d = d(S) < x(\alpha_0) = (I_P(\alpha_0), I_0(\alpha_0))$. This holds for every $S = \{s_1, s_2, \dots, s_k\}$ such that

$$S \cap \{1, \dots, n\} \neq \{\phi\} \tag{i}$$

and

$$\sum_{i \in S} a_i - [k - \delta]^+ h > 0. \tag{ii}$$

Equation (i) says that the threatened strike is costly to the players ($I_P(S) < I_P(\alpha_0)$). Equation (ii) says the strike is also costly to the owners; the insurance benefits do not fully offset the lost revenue ($I_0(S) < I_0(\alpha_0)$). In what follows, we assume the strike is chosen so that $(T, d(S))$ is nondegenerate.

The Nash solution to this game can be written:

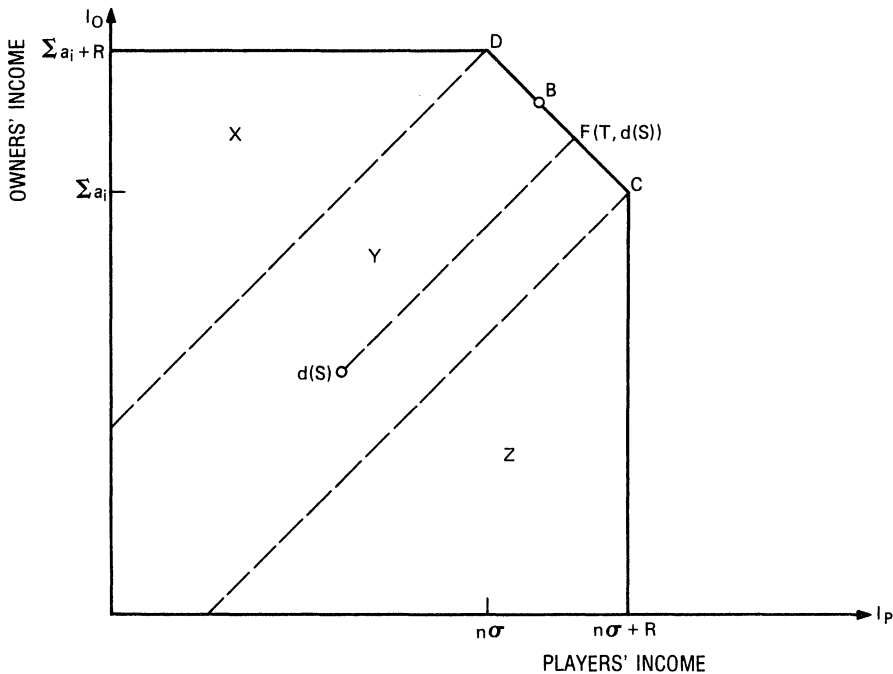
$$F(T, d) = \begin{cases} (n\sigma + R, \sum_{i=0}^n a_i) & \text{if } d_1 - d_2 \geq n\sigma + R - \sum_{i=0}^n a_i \\ \left(\frac{W + d_1 - d_2}{2}, \frac{W - d_1 + d_2}{2} \right) & \\ \text{if } n\sigma + R - \sum_{i=0}^n a_i \geq d_1 - d_2 \geq n\sigma - \sum_{i=0}^n a_i - R & \\ (n\sigma, \sum_{i=0}^n a_i + R) & \text{if } d_1 - d_2 \leq n\sigma - \sum_{i=0}^n a_i - R, \end{cases} \quad (6)$$

where W is defined as the total wealth available to both parties; i.e.,

$$W \equiv \sum_{i=0}^n a_i + n\sigma + R.$$

Figure 1 shows the set of feasible payoffs, T . Equation (6) states that if the disagreement point, $d(S)$, lies in the region X , the Nash solution is the expected payoff $(n\sigma, \sum a_i + R)$ at point D . If $d(S)$ lies in the region Z , the Nash solution is the expected payoff $(n\sigma + R, \sum a_i)$ at point C . If the disagreement point is in region Y , the solution is where the 45° line from $d(S)$ meets the frontier along segment DC . If no strike is threatened, but disagreement occurs, the rent will be distributed according to the random variable \hat{A} , with mean α_0 ; this results in point B . If the players establish a threat S in this model, and if no agreement is reached, the disagreement point $d(S)$

FIGURE 1
THE PAYOFF FRONTIER



will result. Equation (6) indicates the anticipated agreement once the two parties have established their threats and results in *expected* payoff point $F(T, d(S))$ in Figure 1.

Note from (6) that the players' payoff $F_1(T, d(S))$ is an increasing function of $d_1 - d_2$.¹³ Thus, the players' dominant strategy is to choose S so as to maximize $d_1 - d_2$. (This has the effect of moving $d(S)$ toward the region Z in Figure 1.) Now,

$$(d_1 - d_2) = I_P(S) - I_O(S) = \sum_{i \notin S} \sigma_i + \alpha_0 R - \left(\sum_{i \in S} a_i + [k - \delta]^+ h + (1 - \alpha_0) R \right).$$

So

$$d_1 - d_2 = I_P(S) - I_O(S) = \left[\sum_{i \in S} (\sigma_i - a_i) - [k - \delta]^+ h \right] + (2\alpha_0 - 1)R. \quad (7)$$

Note that only the term in brackets in (7) depends on $S = \{s_1, s_2, \dots, s_k\}$.

Since the strike threat should be chosen to maximize $d_1 - d_2$, equation (7) states that the relative efficacy of striking is greatest in those periods i with the largest value for $a_i - \sigma_i$. For convenience in notation, we shall consider the set $N^* = \{1, \dots, n+1\}$ to be a reordering of the periods in order of decreasing $a_i - \sigma_i$; that is, N^* is a reordering of periods such that $(a_1 - \sigma_1) \geq (a_2 - \sigma_2) \geq \dots \geq (a_{n+1} - \sigma_{n+1})$. We use this ordering with equation (7) to establish the following theorem.

Theorem 1: The players' optimal threat strategy $\hat{S}(h)$ is to strike during the first k periods of N^* , where k is defined by

$$\begin{array}{ll} k \geq 1 & \text{iff } a_1 - \sigma_1 \geq 0 \\ \vdots & \vdots \\ k \geq \delta & \text{iff } a_\delta - \sigma_\delta \geq 0 \\ k \geq \delta + 1 & \text{iff } a_{\delta+1} - \sigma_{\delta+1} \geq h \\ \vdots & \vdots \\ k \geq n + 1 & \text{iff } a_{n+1} - \sigma_{n+1} \geq h. \end{array} \quad (8)$$

Proof: If the strike \hat{S} is drawn only from the first δ periods of N^* , then the owners will receive no insurance compensation. Equation (7) implies that extending a strike from period $(i - 1)$ to period i in N^* contributes to raising $d_1 - d_2$ only if $a_i - \sigma_i > 0$.¹⁴ If the strike contains more than δ periods, each additional period brings an insurance payment h to the owners; thus, including an additional period $i > \delta$ of N^* in the threatened strike \hat{S} contributes to raising $d_1 - d_2$ only if $a_i - \sigma_i > h$. Thus, $\hat{S}(h)$ maximizes $I_P(S) - I_O(S)$ for all $0 \leq k \leq n + 1$, which suffices to prove the theorem.

This model, without any threat options available to the owners, has described an optimal threat strategy on the part of the players. For the case

¹³ Note that the players' payoff is *strictly* increasing only until $d(S)$ enters region Z of Figure 1. Once this occurs, the players achieve their maximum payoff $(n\sigma + R)$ for any disagreement point in the region Z .

¹⁴ Note that once the disagreement point enters the region Z , different threats will produce the same payoff: $(n\sigma + R, \sum a_i)$. Thus, more than one optimal threat may exist. However, in or out of the region Z , the particular threat considered here is optimal.

where $k \geq \delta$ their dominant strategy is to threaten the strike $\hat{S} = \{1, 2, \dots, k\}$ such that $a_i - \sigma_i - h \geq 0$ for all $i \in \hat{S}$ and $a_i - \sigma_i - h < 0$ for all $i \notin \hat{S}$.

In the 1980 baseball negotiations, the players chose to strike the last week of the exhibition schedule and then play baseball until May 23, whereupon they would again go out on strike. Model A explains this hyphenated strike under the following conditions:

- (i) $a_e - h > 0$ for the exhibition game period, e ;
- (ii) $a_i - \sigma - h < 0$ for all periods i on or before May 22, 1980;
- (iii) $a_j - \sigma - h \geq 0$ for all periods j after May 22, 1980.

Condition (i) requires the owners' income in the last week of Spring training games to be greater than the insurance benefits.¹⁵ Conditions (ii) and (iii) require that for all regular season periods before May 23 the strike benefits are adequate to compensate the owners for their loss in revenue, while after that date the insurance is insufficient to provide full compensation.¹⁶ In light of early season weather conditions as well as the fact that television revenues jump at the end of May, it is reasonable to conclude that the players understood the optimal threat strategy.¹⁷

□ **Model B: possibility of an owner lockout.** Now consider the case when the owners may threaten a lockout. The set of feasible payoffs is still given by equation (3), and the payoffs to the parties in the event of an agreement are still given by equations (1) and (2). Additionally, the players' strategy set is still

$$SS_p = \{S \subset \{0, 1, \dots, n\}\}.$$

¹⁵ In fact, even if $a_e - h < 0$, we may still have $0 \in \hat{S}$. Such a case occurs if period zero belongs to the first δ member subset of N^* .

¹⁶ While there are no available records to indicate whether all periods before May 23 meet condition (ii), while those after meet condition (iii), several pieces of evidence indicate the probability of such ordering. First, the players' negotiator, Marvin Miller, has been quoted (*The Sporting News*, April 19, 1980, p. 6) as follows:

If the players have to strike during the regular season, they prefer to do it when the crowds and interest are mounting, with the approach of the Memorial Day weekend. Naturally, the owners would prefer a strike at the start of the season, when their losses would be minimal because of rainouts, open dates, and cold weather.

Secondly, examination of attendance figures shows that only one-fifth of the season's attendance occurs in the first quarter of the schedule. Thirdly, television revenues from ABC begin at the end of May.

¹⁷ Clearly, the owners' income is not in perfect sequential ordering. In this case, the optimal strike may be $\hat{S} = \{1, \dots, k\}$, where 1 through k are a series of disjoint periods of duration less than the measure we use, the week. Evidence suggests that this pattern was considered by the players in their threat decision. Mike Marshall, a relief pitcher for the Minnesota Twins of the American League, was quoted (*The Sporting News*, April 12, 1980; p. 17) as follows:

There has been some thought of selectively striking T.V. games and games where large attendances are expected.

It seems clear that at least the decisionmakers representing the players understood the optimal strategy defined by Theorem 1. Certain implementation costs and negative fan reactions which for simplicity are not built into the model may explain why such selective-date striking was not chosen.

Now, however, the owners' strategy set includes the possibility of a lockout in certain periods. We denote the strategy set of the owners as:

$$SS_0 = \{L = \{l_1, l_2, \dots, l_m\} \subset \{0, 1, \dots, n\}\}.$$

In the event that no agreement is reached, the disagreement payoffs, $d(S, L)$, corresponding to threats (S, L) are

$$I_p(S, L) = \sum_{i \notin SUL} \sigma_i + \alpha_0 R \tag{1b}$$

and

$$I_o(S, L) = \begin{cases} \sum_{i \notin SUL} a_i + [k - \delta]^+ h + (1 - \alpha_0)R & \text{if } L = \{\phi\} \\ \sum_{i \notin SUL} a_i + (1 - \alpha_0)R & \text{if } L \neq \{\phi\}. \end{cases} \tag{2b}$$

Equations (1b) and (2b) state that neither the players nor the owners receive any income during periods in which either a strike or a lockout occurs. Additionally, (2b) states that the owners receive no payments from their strike insurance if they engage in a lockout.

After threats S and L have been chosen, the payoff to the two parties (in the negotiation stage) is given by

$$\pi(S, L) = (\pi_1(S, L), \pi_2(S, L)) = F(T, d(S, L)), \tag{5a}$$

where $d(S, L) = (I_p(S, L), I_o(S, L))$, and F is given by equation (6).

Examination of (2b) indicates that if $L = \{\phi\}$, then both

$$d_1(S, L) = d_1(S, \phi) = I_p(S, \phi), \quad \text{and} \quad d_2(S, L) = d_2(S, \phi) = I_o(S, \phi)$$

are given by equations (1a) and (2a). Thus the players' best response to the choice $L = \{\phi\}$ is the strike $\hat{S}(h)$ derived earlier in Theorem 1.

If the owners threaten a lockout $L = \{l_1, \dots, l_m\} \neq \{\phi\}$, then they receive no insurance payments. By equation (6), the players still want to choose a strike threat as to maximize $d_1(S, L) - d_2(S, L)$, which is equal to

$$d_1(S, L) - d_2(S, L) = I_p(S, L) - I_o(S, L) = \left[\sum_{i \notin SUL} (\sigma_i - a_i) \right] + (2\alpha_0 - 1)R. \tag{9}$$

An argument precisely similar to that of Theorem 1 shows that the optimal strike threat in this case is $\hat{S}(0)$; i.e., to strike in every period i such that $a_i - \sigma_i \geq 0$.

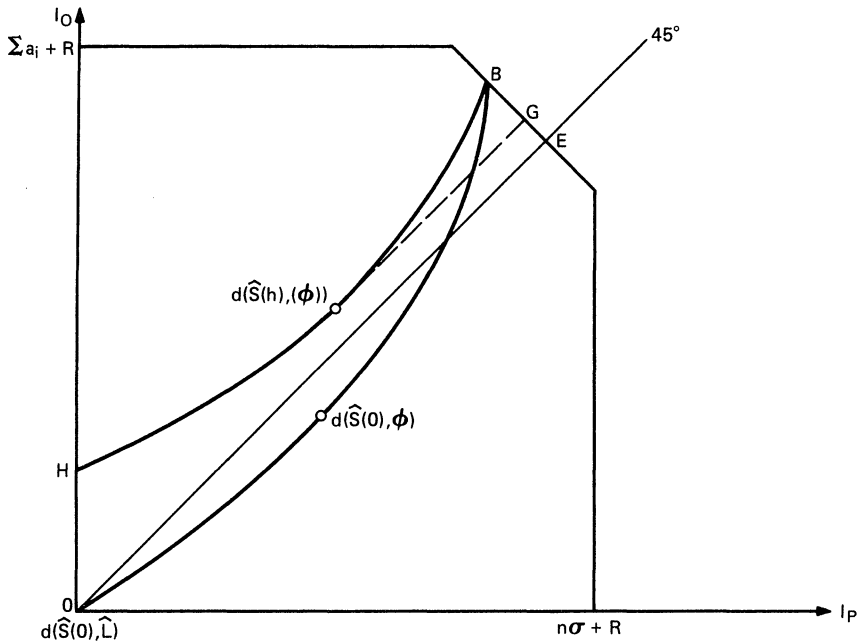
The owners, in turn, must choose among all possible lockouts to find the best threat. From Theorem 1 it is clear that the owners want to choose L so as to minimize the players' advantage, $d_1 - d_2$, as given by equation (9). Among the set of nonempty lockouts ($L \neq \{\phi\}$), an argument analogous to that given in Theorem 1 yields the following result.

Lemma 1: The strategy $\hat{L} = \{l_1, \dots, l_m\}$ defined by $i \in \hat{L}$ if and only if $a_i - \sigma_i < 0$ dominates all other strategies L such that $L \neq \{\phi\}$.

The owners are left to consider only two choices—the "optimal" lockout, $L = \hat{L}$, or no lockout at all, $L = \{\phi\}$. If they choose \hat{L} , the resulting equilibrium of the game is $(\hat{S}(0), \hat{L})$, in which a disagreement would result in all games' being cancelled by either a strike or a lockout.¹⁸ In this case, the disagreement

¹⁸ In the 1973 negotiations, the owners threatened a lockout and the players threatened a strike. As should be expected, an agreement was reached before implementation of either threat.

FIGURE 2
THE PAYOFF FRONTIER



payoffs are $d(\hat{S}(0), \hat{L}) = (I_P(\hat{S}(0), \hat{L}), I_0(\hat{S}(0), \hat{L})) = (0, 0)$ and the payoffs in the negotiation stage are $\pi(\hat{S}(0), \hat{L}) = (F_1(T, (0, 0)), F_2(T, (0, 0)))$.

If the owners choose $L = \{\phi\}$, then they receive per period insurance payments of h in the event of a disagreement: the resulting equilibrium is $(\hat{S}(h), \phi)$, with disagreement payoffs and final payoffs as calculated in Model A.

Thus the owners will choose to threaten a lockout only if $F_2(\hat{S}(0), \hat{L}) \geq F_2(\hat{S}(h), \phi)$. Conversely they will only choose to buy strike insurance if $F_2(\hat{S}(h), \phi) > F_2(\hat{S}(0), \hat{L})$, as only in this case will they be able to derive any benefits from insurance. The fact that the owners have purchased insurance can be taken as evidence that $F_2(\hat{S}(h), \phi) > F_2(\hat{S}(0), \hat{L})$. The optimal decision by the owners in the threat stage of the game is not to threaten a lockout, but to plan to collect insurance in the event of a strike.¹⁹

The analysis and results presented above can be heuristically explained by examining Figure 2. As discussed earlier, point B represents the outcome if neither side threatens any action but disagreement occurs; the rent will be distributed according to the random variable \hat{A} , with mean α_0 . Theorem 1 indicates that as the players add appropriate periods to their strike, the disagreement point moves in a southwesterly direction; if insurance benefits are zero, the disagreement point moves along the path shown as $B0$.²⁰ The players choose the strike threat which produces the disagreement point

¹⁹ It is interesting to note that in recent years the owners have threatened a lockout on at least three occasions. In none of these cases (1969, 1973, 1976) did the owners have the strike insurance protection they presently have.

²⁰ The path $B0$ represents the path of disagreement points as successive periods of N^* are added to the strike threat, regardless of optimality. Therefore, $B0$ is convex by the ordering of periods in N^* in descending order of the difference $a_i - \sigma_i$.

$d(\hat{S}(0), \phi)$. By (6) we know that the anticipated agreement gives the parties equal gains from this disagreement point. That is, the expected payoff from $d(\hat{S}(0), \phi)$ can be found by moving along a 45° line to the frontier.²¹ The owners would respond by threatening a lockout of the remaining periods, as discussed in Lemma 1. Graphically, such a lockout moves the disagreement point from $d(\hat{S}(0), \phi)$ to $d(\hat{S}(0), \hat{L})$, the origin. This moves the expected agreement solution point in a northwesterly direction along the frontier, a move that is obviously beneficial to the owners.

When we include the observed insurance benefits $h > 0$, the path of disagreement points is altered as the effectiveness of each period in the strike is diminished. BH is drawn with h so large that the disagreement path never intersects the 45° line, $0E$, and has a vertical intercept $H = (n + 1 - \delta)h$. The optimal disagreement point from the players' perspective is now $d(\hat{S}(h), \phi)$, as this results in expected payoff point G . If the owners choose a lockout strategy other than $\hat{L} = \{\phi\}$, they will waive all insurance benefits. That is, the disagreement point would return to the origin, corresponding to $d(\hat{S}(0), \hat{L})$, a position less advantageous to the owners than point $d(\hat{S}(h), \phi)$; the agreement solution at point G is more attractive than the lockout solution E with respect to owner well-being.

From the players' threat strategy, it is still clear that a threatened discontinuous strike is optimal; an $h > 0$ merely cuts down the number of periods in the strike \hat{S} as determined by Theorem 1. As shown in the first model, the observed threat of a discontinuous strike is still explained. Additionally, the owners' choice of $\hat{L} = \{\phi\}$ implies h was large enough to force the disagreement path, and therefore the point $d(\hat{S}(h), \phi)$, above the 45° line, $0E$, in Figure 2. The owners would not buy an insurance policy which pays a benefit so small that they waive such benefits in favor of a lockout. The existence of the insurance policy explains why $d(\hat{S}(h), \phi)$ was the observed threat point.

4. Concluding remarks

■ This article has offered a simple variable threat bargaining model which explains the hyphenated strike threatened in the 1980 major league baseball season. It was shown that, given the special characteristics of the industry, the optimal threat on the part of the Major League Baseball Players Association may indeed have been to strike in discontinuous periods. The existence of a strike insurance policy was sufficient to guarantee that the optimal response on the part of the owners was not to threaten a lockout. Thus, under a set of reasonable assumptions, threats similar to those observed are optimal.²² We used Nash's solution to the game; we could have used many others and have

²¹ In the absence of any owner threat, addition of an extra period to the optimal strike threat $\hat{S}(0)$ would move the disagreement point in an unattractive direction from the players' point of view. This results because the 45° line from the point $d(\hat{S}(0), \phi)$ intersects the frontier as far right as possible given the path $B0$. We consider here the case where the disagreement point is in the region Y ; if the curve $B0$ enters the region Z , the players receive their maximum payoff ($n\sigma + R$) at any point in Z .

²² The second part of our model says we should observe agreement after the threats have been established. We did not quite see agreement before implementation of the players' threat; they did strike the last week of exhibition games. The immediacy of this first segment of the strike may have made any negotiated agreement to avert the strike unfeasible. Additionally, see the following comments in the conclusion regarding the possible reasons for such early skirmishing.

found similar results. We have offered a model which gives qualitative results quite similar to the observed phenomenon. To consider the circumstances in which equilibrium strategies might result in an actual strike before agreement was reached, we would have to look to more complicated models. For example, in games of incomplete information (such as might arise if the bargainers did not know some relevant variable like the size of their opponents' "war chest"), bargainers in the early stages of the game might seek to convey their "toughness" through some preliminary skirmishing. However, the choice of the periods in which to strike would continue to respond to the fact that strikes hurt the owners (but not the players) in some periods more than in others.

The approach set out in this article may be used to explain partial strikes of all sorts. In the baseball industry, the systematic variation in revenue to management combined with the constant salary of labor puts extreme importance on the choice of appropriate strike dates. To find such strikes elsewhere, we may have to look at a dimension other than time. In certain industries, a "discontinuous" strike may involve a strike by only selective segments of the work force. For example, workers for a vertically integrated manufacturing concern may find it attractive to use strike threats at only the more capital-intensive segments of the vertical chain. The significance of such occurrences and the relevance of the present approach in explaining them is an area for more research.

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