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INTRANSIGENCE IN NEGOTIATIONS: THE DYNAMICS OF DISAGREEMENT

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Intransigence in Negotiations: The Dynamics of Disagreement*

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Abstract

Three-party negotiations are analyzed in which the players are able not only to rank alternatives but also have a preference for impasse. In a dynamic model, players progressively invoke fallback positions to try to prevent inferior outcomes from being implemented in a game of incomplete information.

A player's intransigence, or unwillingness to retreat to fallback positions, generally works to its advantage. Greater size—or, equivalently, an enhanced ability to effect preferred outcomes—also helps, but intransigence is a potent force by itself.

Recent world trade negotiations are analyzed as a game among the United States, the European Community, and Japan. The positions of these players on the critical issues in these negotiations—agricultural supports and market access—indicates why an agreement supported by all three players has been difficult to achieve.

The game-theoretic analysis illuminates the rational basis of disagreement and why it develops in the manner it does. Extensions of the dynamic model are discussed, including making the preferences of the players for impasse endogeneous.

Intransigence in Negotiations: The Dynamics of Disagreement

1. Introduction

It is often alleged that being tough at the bargaining table pays dividends to a negotiator if there is an agreement. At the same time, toughness on the part of all parties—an unwillingness to compromise—may sabotage the possibility of any agreement, which may hurt everybody.

Trade-offs between holding out, on the one hand, and giving up too much, on the other, have been extensively analyzed in 2-person negotiation games (Brams, 1990; Raiffa, 1982). Much less is known, however, about the effects of intransigence (or the lack thereof) in n-person games (but see Sebenius, 1984), which is the main question we explore in this paper.

We restrict the subsequent analysis to *3*-person conflicts, but we allow for the possibility that the players may have different weights and, therefore, different effects on the outcome. Because the weightier players may encompass several individual players who decide to coordinate their actions or form a coalition, the analysis is also applicable to larger games, in which the players may be thought of as factions of possibly different size.

Our model is one of incomplete information. Specifically, we posit that *the only information players have about each others' preferences is that which is revealed in the course of play.*

Players start out at a point of disagreement, each preferring a different alternative and choosing different strategies to try to implement it. Then, as the game progresses, they acquire new information, which may or may not lead them to agreement in the end.

Players base their choices at each stage on the current state of information they have about the game. They then continually update this information as the negotiations proceed.[1] Eventually, a consensus is reached, which may be either agreement on an alternative or impasse (i.e., an agreement to disagree).

To determine the kind of consensus that is achieved, we assume a particular voting rule. This need not be fixed but can be modified to fit the situation being modeled. (For example, consensus may based on unanimity rather than majority rule, which we postulate here but will change later in the empirical case.)

To motivate the analysis, we discuss an example in section 2 with a tie-breaker in which the players progressively invoke fallback positions to try to prevent their worst states from becoming the outcome. They aim, instead, at achieving at least a next-best outcome in a game of incomplete information.

In section 3 we introduce and illustrate the rules of play without a tie-breaker. These rules allow for the possibility of impasse, which some players may prefer to certain alternatives. We discuss the effects of impasse, and interpret the rules with more examples, in section 4.

The intransigence of players, or their unwillingness to retreat to fallback positions, generally works to their advantage in effecting

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[1]But we do not assume that the updating is based on Bayesian calculations, as is usual in the literature on noncooperative games of incomplete information (Rasumsen, 1989; Myerson, 1991; Fudenberg and Tirole, 1991; Binmore, 1992). Such calculations require more information than is assumed here—in particular, probabilistic information on states, and cardinal utilities rather than ordinal payoffs for the players—which Skyrms (1990), among others, assumes in his "dynamics of rational deliberation." For another game-theoretic model for analyzing the transformation of conflict into cooperation, see Brams (1992).

preferred outcomes, as shown in section 5. Although greater size also helps a player, intransigence is a potent force by itself, given that all preference orders are equally likely. In practice this assumption is surely not accurate, so the value of intransigence needs to be considered in a specific context.

Toward this end, we analyze recent negotiations on world trade in section 6, focusing on the *3*-person game being played among the United States, the European Community (EC), and Japan under the auspices of GATT (General Agreement on Tariffs and Trade). We consider each player's position on two major issues and postulate preferences, based on the players' presumed primary and secondary goals. The analysis indicates that the key to a settlement (as of this writing in July 1992) will be how unacceptable each of the players considers the present deadlock.

Emphatically, the negotiation model developed here does not assume that all players are interested in "getting to yes" (Fisher and Ury, 1983). On the contrary, it allows for deadlock if fallback positions, beyond a certain point, are less desirable than accepting an impasse. Such behavior, as we demonstrate, may be eminently rational, which is not always recognized by those who deplore the lack of agreement in multilateral negotiations like those of the GATT.

2. A Negotiation Game with a Tie-Breaker

We begin by illustrating a model of sequential negotiation, based on incomplete information, and then indicate its relationship to a model of "sophisticated voting," based on complete information.[2] Although the assumption of incomplete information sometimes complicates matters, in this case it facilitates the calculations of players in a plausible manner.

Common to both the complete-information and incomplete-information models is a player who can break a tie if there is an impasse. Hence, there can never be an indeterminate outcome. The possibility of indeterminacy will be incorporated into the more general analysis of sequential negotiation games later, in which a deadlock can arise and not necessarily be broken.

Assume three players, A, B, and C, are trying to negotiate an agreement. They have the following preferences for alternatives a, b, and c:

A: abc (a preferred to b, b preferred to c)

B: bca

C: cab

These preferences result in a *paradox of voting*: $a > b > c > a$, where ">" indicates "is preferred by a majority to."[3]

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[2]This section is based in part on Brams (1991). *Sophisticated voting* involves the successive elimination of dominated strategies in a game of complete information, given that other voters do likewise (Farquharson, 1971).

[3]Thus, a is preferred to b by A and C, b is preferred to c by A and B, and c is preferred to a by B and C. The fact that every alternative can be defeated by some other alternative creates *cyclical majorities*, or a cycle of social preferences such that no alternative is the social choice because a majority prefers it to another alternative. Although the lack of any social consensus is particularly acute when there is a paradox of voting, the other "genuine conflicts" we shall analyze later minimally involve a disagreement among the three players over first choices.

Assume that each of the players knows only its own preferences but does not the other two players' preferences (except as they are revealed in the course of play). The negotiation process unfolds as follows:

1. The players begin by announcing their first choices. This is not an unreasonable assumption; not knowing the other players' preferences, each has nothing to lose by revealing its own most preferred alternative. In Figure 1, we show this revelation at stage 1 by placing a vertical bar

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Figure 1 about here

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between the players' first and second choices, indicating that each supports only its first choice (to the left of the line).

In the event of a three-way tie among *a*, *b*, and *c* (each alternative receives, in effect, one vote), assume A is the "chair"; its first choice, *a*, will prevail by virtue of A's having a tie-breaking vote. This assumption of a tie-breaking vote—or, equivalently, an edge in negotiations should an impasse develop—precludes an indeterminate outcome. Thus, each alternative obtains one vote in stage 1, but A's tie-breaking vote makes *a* the winner.

2. We call this (temporary) winning outcome a *state* and assume that it induces B—for whom *a* is its worst choice—to fall back on its second choice, supporting *c* as well as *b*. Alternative *c* will then have a majority of two out of three supporters (players B and C), which we assume is sufficient to win, so we indicate *c* as the winning state at stage 2.

3. But now, because *c* is A's last choice, it is A who must worry that its worst alternative will be chosen. Consequently, it is reasonable to

Figure 1

Sequential Negotiation Model with Tie-Breaking Vote*

Player	Preference	Stage 1	Stage 2	Stage 3	Stage 4
A	*abc*	*a* I *bc*	*a* I *bc*	*ab* I *c*	*ab* I *c*
B	*bca*	*b* I *ca*	*bc* I *a*	*bc* I *a*	*bc* I *a*
C	*cab*	*c* I *ab*	*c* I *ab*	*c* I *ab*	*ca* I *b*
State		*a*	*c*	*b*	*a*

*A is assumed to have a tie-breaking vote, so in the event of a two-way or three-way tie, the tied alternative that A supports will win (*a* in stage 1, b in stage 3, and *a* in stage 4).

suppose that it will be A, next, that will expand its support to include *b*. The resulting two-way tie (two votes each) between *b* and *c* at stage 3 will be broken in favor of *b* because A, the tie-breaker, supports *b* over *c*. Hence, *c* becomes the winning state at stage 3.

4. Now, however, it will be C's turn to throw its support to *a* (as well as *c*), lest *b* win at stage 3. At stage 4, then, *a* will win because of A's tie-breaking vote, and there is now nothing either B or C can do to alter this outcome. It is in equilibrium, particularly to the chagrin of B, for whom *a* is its worst choice. Even if B withdraws its support from *c*, however, *a* will still prevail.

The simple logic of this model seems quite compelling in negotiations: Each player is motivated, in turn, to expand its support from first to second choices at different stages to try to prevent its worst state from becoming the outcome. By stage 4, all players have revealed their top two choices and, therefore, a complete preference ordering over the three alternatives. As one would expect, the alternative that wins is the tie-breaker's first choice.

This game of incomplete information that we have informally described (rules will be specified later) has a counterpart as a game of complete information, in which each player knows everybody's complete preference ordering from the start. It takes much more complicated and less plausible calculations in the complete-information case to show that the outcome is exactly the same when sophisticated voters use "approval voting" (Brams, Felsenthal, and Maoz, 1988).[4] That is, *a* wins, with each voter voting for its top two alternatives.

But in a game of complete information, the plausibility of the sophisticated-voting model is severely stretched. To determine that *a* wins under this model, players must first ascertain that B has a dominant strategy of voting for both *b* and *c* in a *3*-person game of complete information. Knowing that B will never vote for *b* alone (i.e., because this strategy is dominated), they next must determine that A has a dominant strategy of voting for both *a* and *b* in the reduced game (with B's dominated strategy eliminated). Knowing in turn that A's strategy of voting for *a* alone is dominated—reducing the game still further—they then must determine that C has a dominant strategy of voting for both *c* and *a*. Thereby, the successive elimination of dominated strategies by the players gives a as the sophisticated outcome; the detailed calculations are given in Brams, Felsenthal, and Maoz (1988).

Unlike the sophisticated-voting model, the negotiation model does not assume major information-processing and calculational abilities on the part of the players but, rather, successive movement by the players to their fallback positions (i.e., second choices in our example) as the possibility of ending up with their worst choices looms. It seems to mimic how players might actually think as they negotiate over alternatives, illustrating that an

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[4]Under *approval voting*, voters can vote for as many alternatives as they like (Brams and Fishburn, 1983), mirroring the ability of players in negotiations to take fallback as well as most-preferred positions. Under *plurality voting*, by comparison, voters can vote for only a single alternative, which in negotiations would not permit them to support a fallback position as well as a first choice.

n-person game-theoretic model of negotiations need not be overly complex or esoteric to capture real-life considerations.

3. The Tie-Breaker Removed

In going from stage 1 to stage 4, the players' progressive expansion of their support for alternatives is fueled by the fact that, at each stage prior to stage 4, there is a (temporary) winner that is the worst state of one of the players. Moreover, this player, by giving its support to a lower-ranked alternative, can induce a preferred state.

By stage 4, however, B, who ranks the stage 4 winner (i.e., *a*) last, is helpless to induce a better outcome. The only alternative that B does not support is *a*, its worst choice, which wins at stage 4 without B's support.

Now assume that no player has a tie-breaking vote, making the game a symmetrical one for the players. Thus, at stage 1, there would be a three-way tie among *a*, *b*, and *c*, with the players next moving directly to stage 4 in Figure 1, in which each supports its two best alternatives. We call the lack of a majority consensus for a single alternative *impasse* (*i*).

Assume that a player not only is able to rank the alternatives *a*, *b*, and *c* but also has a preference for *i*. Thus, each player inserts *i* as an alternative in its preference order. For example, if A prefers *a* to *b*, *b* to *i*, and *i* to *c*, its ranking is *abic*.

Now consider the earlier example, in which *i* is the winner at stage 4 if A does not have a tie-breaking vote. The fact that A's preference order is *abic* means that it would "choose" *i* rather than support *c* and thereby help to make *c* the winner.

Assume that every player has a preference for *i* as well as three "regular" alternatives, *a*, *b*, and *c*. Assume also that a player's support for these alternatives and *i* unfolds according to the following rules of play:

1. Each player supports its *first* choice, which is assumed not to be *i*, at the start of the game (stage 1 earlier).
2. If the resulting state, which may be *i* (if there is a tie), is the same or less preferred than the player's *second* choice, then the player supports its second choice.
3. At any subsequent stage, if the resulting state is the same or less preferred than the player's *next-lower* choice, then the player supports this choice.
4. Play terminates when the state for all players is *not* worse than their next-lower choice (if there is one), which then becomes the outcome.

In the earlier example, if all players ranked *i* just above their worst alternative, they would begin by supporting their first choices, which would create a three-way tie and therefore lead to *i* (stage 1 earlier). Because *i* is worse than their second choices, they would next support these choices as well, which would create another three-way tie and again lead to *i* (stage 4 earlier). Because this state in which *i* wins is the same as the players' next-lower choice (i.e., *i*), the players would all support *i* and play would terminate, making *i* the outcome.

Interestingly enough, if A ranked *i* second, making its ranking *aibc*, whereas the rankings of B and C remained *bcia* and *caib*, the outcome would be the same. As before, it would be *i* at the end of the first stage; in the second stage, B and C would lower their support to *c* and *b*, respectively—creating a tie between these two alternatives that gives *i*—and A would also support *i*. In the third stage, B and C would lower their support once again (to *i*), at which point play would terminate, making *i* the outcome. On the other hand, if A ranked *i* last, making its ranking *abci*, and B and C were as before, the outcome would be *c*, because A would give its support to *c* (before *i*) in the final stage, making *c* the winner (it would have support from all three players).

With these examples in mind, we next examine more systematically how the placement of *i* affects outcomes under the four rules of play. For the paradox-of-voting preference scales of the players in the earlier example (we shall include other possible preference scales in the later analysis), there are several different ways in which *i* can be incorporated into the players' preference scales to yield the same outcome. We list these below and indicate whether the player(s) who rank *i* higher (i.e., are more intransigent) do better than those who rank *i* lower:[5]

1. A, B, and C rank *i* the same. Whether the players all put *i* in second, third, or fourth place, there will always be a three-way tie among *a*, *b*, and *c* at the point at which the players cease their support of lower-ranked alternatives. The outcome is therefore *i*, and the effect of different rankings of *i* is *moot* because they are the same for all players.

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[5]If the names of players A, B, and C are changed in the listing below, appropriate changes must be made in the outcomes. (In case 4, for example, if A rather than C is the player who ranks *i* second, *a* rather than *c* is the outcome.) Only case 5 gives qualitatively different outcomes if the names are changed—*i* wins in 5a, but *a* wins in 5b—which is why we distinguish these two cases.

2. A and B rank *i* the same (e.g., fourth); C ranks *i* one rank higher (e.g. third). *a* and *c* tie for the most support (e.g., from three players), and *b* receives less (e.g., from two). The outcome is therefore *i*, so C's higher ranking of *i* does *not* help *c*.

3. A and B rank *i* the same (e.g., third); C ranks *i* one rank lower (e.g., fourth). *b* receives more support (e.g., from three players) than does *a* or *c* (e.g., from two players). The outcome is therefore *b*, so A's and B's higher ranking of *i may* help one player (B in this case).

4. A and B rank *i* fourth; C ranks *i* second. *c* receives support from three players and *a* and *b* from two players each. The outcome is therefore *c*, so C's higher ranking of *i does* help *c*.

5a. A ranks i second; B ranks i third; C ranks i fourth. Each of *a*, *b*, and *c* receives support from two players, creating a three-way tie. The outcome is therefore *i*, so A's and B's higher ranking of *i* does *not* help *a* or *b*.

5b. A ranks *i* second; C ranks *i* third; B ranks *i* fourth. *a* receives support from three players, *c* from two players, and *b* from one player. The outcome is therefore *a*, so A's higher ranking of *i does* help *a*.

6. A and B rank *i* second; C ranks *i* fourth. Each of *a*, *b*, and *c* receives support from two players, creating a three-way tie. The outcome is therefore *i*, so A's and B's higher ranking of *i* does *not* help *a* or *b*.

7. A and B rank *i* second; C ranks *i* third. Each of *a* and *c* receives support from two players and *b* from one player, creating a two-way tie. The outcome is therefore *i*, so A's and B's higher ranking of *i* does *not* help *a* or *b*.

To summarize, in the seven of eight cases in which players rank *i* differently (the rankings are the same in case 1), a player who ranks *i* higher

- is *not* helped in four cases (2, 5a, 6, and 7)—*i* is the outcome in each
- *may* be helped in one case (3)
- *is* helped in two cases (4 and 5b).

We hasten to add that this breakdown of cases does not presume that each case will occur with the same relative frequency. Consider cases 2 and 4, but now assume that it does not matter *which* player ranks *i* in a certain way—it could be any of the three players. Thus in case 2, there are three ways in which two players can rank *i* fourth and the remaining player ranks *i* third, and three ways in which two players can rank *i* third and the remaining player ranks *i* second, making for a total of six ways. By comparison, there are only three ways in which case 4 can occur.

Yet, this is not to say that case 2 will occur twice as frequently as case 4. Empirically, the opposite might be the case if there tends to be one player who is much more intransigent than the others (by ranking *i* two, rather than one, level higher than the other two players). What the incorporation of *i* into the players' preferences establishes is that being less accommodating than other players *sometimes* helps a player achieve a preferred outcome.

Intransigence *never* hurts a player. Even when a player's higher ranking of *i* does not help it, as in cases 2, 5a, 6, and 7, the intransigent player may still benefit. The reason is that its greater favorableness toward *i* over supporting lower alternatives implies that it has a higher preference for *i* than player(s) who rank *i* lower. Hence, even if it does not win with its most preferred "regular" alternative, the intransigent player is comparatively better off in realizing its aims when *i* is the outcome.

4. Interpretation of the Rules

So far we have shown that when the players have paradox-of-voting preferences, the more intransigent player(s) generally benefit by ranking i higher than the other player(s). But these preferences represent only one set of rankings that players may have. In section 5, we shall systematically analyze the effects of intransigence as well as player size for all possible rankings by three players, but next consider how rules 1–4 apply when the preferences of the players are not necessarily paradoxical.

We confine the analysis here and later to *genuine conflicts*, in which the three players all have different first choices: A most prefers *a*, B most prefers *b*, and C most prefers *c*. Thus, there is disagreement at the start of negotiations—or, based on rule 1, there is impasse initially.

Rule 2 is next invoked, with each player supporting its second choice. This second choice may be one of the two remaining alternatives (e.g., either *b* or *c* if A is the player) or *i*. Because there are $3! = 6$ ways of ordering these three lower-ranked options for each of the three players, there are $6^3 = 216$ possible orderings of them for all three players.

Applying rules 2–4 to the selection of an outcome, we first ascertain in how many of these orderings there is impasse. As an illustration of such an outcome (last state to the right), consider the following orderings of A, B, and C:

A:	*a* | *ibc*	*ai* | *bc*	*ai* | *bc*
B:	*b* | *aic*	*ba* | *ic*	*bai* | *c*
C:	*c* | *bia*	*cb* | *ia*	*cbi* | *a*
State:	*i*	*i*	*i*

As in the earlier example, the vertical lines in the orderings just to the right of A, B, and C indicate that the players start off by supporting only their first choices (rule 1). Because, by assumption, the first preferences of the three players differ at this stage, *i* is the initial state.

In the second stage, each player supports its second choice as well (rule 2). At this stage, both *a* and *b* are supported by two players (*c* is supported by only one player), so *i* is the second state because of a two-way tie. (A's support of *i* at this stage simply reinforces this choice.) In the third stage, B and C support their third choices (rule 3), giving unanimous support to *i*,[6] which terminates play since this state is not worse than the next-lower choices of each player (*b*, *c*, and *a* of A, B, and C, respectively) and therefore becomes the outcome.

But note that *b* is the so-called *Condorcet alternative* in the example: majorities prefer it not only to *i* but also to *a* and *c*. Nevertheless, *i* is the social choice in the negotiation model, illustrating that, as in elections, the Condorcet alternative does not always win (Brams, 1985).

To determine whether *i* is the outcome, however, we do not compare player support for it with that for *a*, *b*, and *c*. The following example illustrates this point:

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[6]Although *i* has more support than any regular alternative at this stage, this is not why it wins, as the next example illustrates.

A:	*a* | *ibc*	*ai* | *bc*	*aib* | *c*
B:	*b* | *ica*	*bi* | *ca*	*bi* | *ca*
C:	*c* | *bia*	*cb* | *ia*	*cb* | *ia*
State:	*i*	*b*	*b*

At the second stage, both *b* and *i* are supported by two players, but *b* nevertheless is the state because it is the only regular alternative with majority support. (This becomes unanimous support at stage 3 and makes *b* the outcome.) Recall that *i* is the state only if there is no *single* regular alternative with the most support (i.e., because of a tie).

If there is unanimous support for a regular alternative at any stage, as there is in the next example, this alternative defeats one supported by a simple majority:

A:	*a* | *bci*	*ab* | *ci*
B:	*b* | *cai*	*bc* | *ai*
C:	*c* | *bia*	*cb* | *ia*
State:	*i*	*b*

At stage 2, *b* is the alternative supported by all three players, whereas *c* is supported by two players and *a* by only one player.

None of the examples so far illustrates the situation in which it is rational for a player to give its support to alternatives it ranks *below i*. Yet rules 1–4 allow for this possibility, as the following example illustrates:

A:	*a* | *ibc*	*ai* | *bc*	*ai* | *bc*	*ai* | *bc*	*ai* | *bc*
B:	*b* | *ica*	*bi* | *ca*	*bic* | *a*	*bic* | *a*	*bic* | *a*
C:	*c* | *abi*	*ca* | *bi*	*ca* | *bi*	*cab* | *i*	*cabi* |
State:	*i*	*a*	*i*	*i*	*i*

Because B ranks *c* higher than *a* (the state at the second stage), at the third stage it will lower its support to include *c*. However, its support of *c* creates a two-way tie between *a* and *c*, resulting in impasse at the third stage, which B actually prefers to *c*. But now C, which prefers *b* to *i*, will lower its support to *b* at the fourth stage; at the fifth stage, C will also support *i* because it is the state at the previous stage. Play terminates at the fifth stage because *i* is not worse than each player's next-lower alternative (if there is one).[7]

But note that both A and C prefer *a* to *i*. However, because there is a paradox of voting—a majority (B and C) prefers *c* to *a*, a majority (A and B) prefers *b* to *c*, and a majority (A and C) prefers *a* to *b*—one cannot single out one alternative as socially preferred.

Observe that alternative *a* (rather than *i*) would win if C misrepresented its preference to be *acbi* rather than *cabi*, because *a* would have a majority at the first stage. But this misrepresentation violates rule 1 of the model. Moreover, if players have no information about the preferences of the other players until they are revealed, they have no basis for devising an "optimal" deception strategy.[8]

5. Intransigence Versus Size: Which Is More Helpful?

Now consider, for the 216 different ways in which three players may order the three options below their first choices, in how many they

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[7]It is worth noting that the players' preferences for the three regular alternatives in this example give a paradox of voting, which illustrates case 6 earlier, in which *i* is the outcome for voters with paradoxical preferences.

[8]For different game-theoretic models of deception, see Brams (1978) and Brams and Zagare (1977, 1981).

encounter impasse and in how many one of *a*, *b*, or *c* wins. We have done this analysis for four different *weight configurations*, whereby A, B, and C may have different effects on the outcomes because of their different sizes.

These configurations are defined by weighted votes that we assign to the players. In all configurations, a simple majority of votes is assumed to be sufficient for an alternative to win—provided that it does not tie with another, in which case there is impasse:

1. **All players equal** (A, B, and C have 1 vote each): *a*, *b*, and *c* win in 44 combinations each (total: 132); *i* wins in 84.

2. **One large player and two small players** (A has 2 votes, B and C have 1 each, giving A a veto[9]): *a* wins in 76 combinations, *b* and *c* in 41 each (total: 158); i wins in 58.

3. **Two large players and one small player** (A and B have 2 votes each, C has 1 vote): *a* and *b* win in 72 combinations each, *c* in 34 (total: 178); *i* wins in 38.

4. **One large, one medium, and one small player** (A has 3 votes, B has 2 votes, and C has 1 vote, giving A a veto): A wins in 98 combinations, B in 60, and C in 34 (total: 192); *i* wins in 24.

Even though A has a veto in both configurations 2 and 4, ties—and therefore outcome *i*—are less common in configuration 4 because of the three different weights of the players. For example, if A supports *a* and *c*, B supports *a* and *b*, and C supports *b* and *c*, there is a tie between *a* and *c* in

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[9]By *veto* we mean the ability to block the action of a coalition of the other two players by creating a tie. Put another way, without the vetoer's votes, a coalition of the other players would not have a majority, so the vetoer's votes are necessary, though not sufficient, for a coalition to win.

configuration 2 (with 3 votes each; *b* has 2 votes), whereas *a* wins in configuration 4 (with 5 votes; *c* has 4 votes and *b* has 3 votes).

Define the *determinacy ratio* of configuration *j* as the following quotient:

DR_j = (total no. of wins of *a*, *b*, and *c*)/216,

or the ratio of the number of wins of regular alternatives to total number of wins of regular alternatives plus impasse in all preference orderings. For each of the four configurations, $DR_1 = .61$, $DR_2 = .73$, $DR_3 = .82$, and $DR_4 = .89$. Clearly, impasse is less likely as players of different size, who can affect the outcome differently, negotiate according to the model.

Define the *power ratio* of a configuration *j* as the following quotient:

PR_j = (no. of wins of large player)/(no. of wins of small player),

or the ratio of the number of wins of a large player to wins of a small player. For each of the four configurations, $PR_1 = 1$, $PR_2 = 1.85$, $PR_3 = 2.12$, and $PR_4 = 2.88$, which demonstrates the greater relative ability of the large player to achieve its most preferred outcome going from configuration 1 (no large player) to configuration 4.

In configuration 4, the ratio of the wins of the large player to the wins of the medium player is 1.63, showing that the large player has a win advantage over the medium player greater than their weight ratio of 1.5. However, the 2.0 weight ratio of the medium player to the small player is not matched by the win advantage of 1.76 that the medium player enjoys over the small player.

We conclude that weight—or, equivalently, the ability of larger players more often to win than smaller players—matters. It translates into a player's being able to implement more preferred outcomes *roughly* in proportion to its weight.

Consider next the effect of a player's *intransigence*, measured by how high in its preference order it ranks *i*. The results for each configuration are given in Figure 2, where each triple (i_2, i_3, i_4) indicates the number of

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Figure 2 about here

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wins of each player when it ranks *i* second, third, or fourth in its preference order. We have also given the proportions of wins for each ranking to facilitate comparisons within and between configurations.[10]

The large player does spectacularly better in configuration 2 when it ranks *i* second rather than third, winning almost five times as often (56/12 = 4.67). It wins almost three times as often in configuration 4 (58/20 = 2.90), and twice as often in configuration 3 (36/18 = 2.00), when it is similarly intransigent. Surprisingly, it makes no difference, on the average, if the large player ranks *i* third or fourth in configurations 3 or 4—it does equally badly—whereas in configurations 1 and 2 ranking *i* third is more helpful than ranking *i* fourth. In sum, intransigence never hurts and often benefits players.

It is worth noting that small players who are not intransigent can win on occasion, as the following example illustrates. If A is the large player

[10]The values of i_3 and i_4 for the small players in configurations 2 and 4 are averages. (In configuration 2, 10 is an average of 12 and 8; in configuration 4, 10 is an average of 9 and 11.) These averages iron out the (small) differences between the wins B versus C enjoys when A—instead of B or C—is the large player.

Figure 2

Values (i_2, i_3, i_4) and Proportions for Each Weight Configuration

Configuration	Player Type	Total Wins	Values (i_2, i_3, i_4)	Proportions
1. All players equal	Same	44	(26, 10, 8)	(.59, .23, .18)
2. One large and two small	Large	76	(56, 12, 8)	(.74., .16, .11)
	Small	41	(19, 12, 10)	(.46, .29, .24)
3. Two large and one small	Large	72	(36, 18, 18)	(.50, .25, .25)
	Small	34	(18, 8, 8)	(.53, .24, .24)
4. Large, medium, and small	Large	98	(58, 20, 20)	(.59, .20, .20)
	Med.	60	(28, 16, 16)	(.47, .27, .27)
	Small	34	(14, 10, 10)	(.41, .29, .29)

and B and C are the small players in configuration 2, B wins when it ranks *i* fourth:

A:	*a* | *bic*	*ab* | *ic*
B:	*b* | *cai*	*bc* | *ai*
C:	*c* | *bia*	*cb* | *ia*
State:	*i*	*b*

At the second stage, *b* is supported by all three players (4 votes), whereas *a* has support only from the large player (2 votes) and *c* has support only from the two small players (2 votes).

Thus, even the small, least intransigent player can sometimes win—provided its preferences are sufficiently coincidental with those of other players—but this is the exception rather than the rule. Greater size helps, as we showed earlier with PR_j, and so does intransigence, especially for large players.

Yet even in configuration l, in which size is irrelevant because there are no large or small players, ranking *i* second instead of third increases a player's wins by 160 percent (from 10 to 26). By contrast, raising *i* from fourth to third place increases a player's wins by only 25 percent (from 8 to 10), underscoring the importance of being *maximally* intransigent.

To get an overall picture of the effects of intransigence, sum the (i_2, i_3, i_4) values across all configurations, which gives (255, 106, 98), or proportions (.56, .23, .21). Ranking *i* third or fourth makes little difference. But being maximally intransigent by putting *i* in second place gives a player 141 percent more wins than putting *i* in third place.

Summing wins across the different configurations, however, ignores the fact that impasse is more likely in some configurations than others, as we showed with the DR_j index earlier. But as we showed with the PR_j index, intransigence offers substantial benefits to players, large or small, in all four configurations.

A cleaner comparison—involving only large and small players in configurations 2 and 3—is between (1) the total wins a large versus a small player obtains and (2) the total wins a player who ranks *i* second versus third obtains in these two configurations. The large–vs.–small distinction gives a win ratio of 148/75 = 1.97 in favor of the larger player, which is approximately the ratio of the player weights, as noted earlier. The rank distinction gives a ratio of 129/50 = 2.58 in favor of the more intransigent player, which shows that being intransigent may be even more advantageous.

Although there is no obvious standard of comparison between size and intransigence (is being twice as large comparable to ranking *i* second rather than third?), intransigence, unquestionably, is a powerful weapon in negotiations. On the other hand, the analysis assumes that all rankings below a player's most preferred alternative are equally likely, which may well be violated in practice. For example, intransigence on the part of one player may be associated with intransigence on the part of others, which may only succeed in encouraging impasse, not implementing preferred alternatives.[11] We shall consider this and other issues in the concluding section, but first we turn to a real-life application of the model.

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[11]Socially preferred alternatives may not always be implemented either, as we showed with the first example in section 2 in which the Condorcet alternative was not selected. Of the 216 orderings for each configuration, a Condorcet alternative loses in 36 orderings of configuration 1, 17 of configuration 2, 70 of configuration 3, and 30 of configuration 4.

6. Negotiations on World Trade

Founded in Geneva in October 1947 by 23 countries, the General Agreement on Tariffs and Trade (GATT) is now an organization with 108 countries that has sponsored eight rounds of negotiations.[12] These multilateral talks have dramatically influenced international economic relations since World War II, primarily through liberalizing international trade by lowering tariff barriers.

The latest negotiations have been dubbed the "Uruguay Round" because they began in Punta del Este in September 1986. Scheduled to last four years, they collapsed in Brussels in December 1990.

As of this writing (July 1992), the full reinstatement and successful conclusion of the Uruguay Round faces formidable obstacles. The increase in bilateral trade negotiations, the rise of regional trading blocs, and a new debate about free versus fair trade all may undermine an already shaky international trading regime riddled with protectionist proclivities. But the most immediate obstacle is the conflicting interests of the three major players in the current trading round—the United States (US), the European Community (EC), and Japan (JA)—which Oxley (1990, p. 88) calls the "Big Three."

Of course, there are other influential players, most notably the so-called Cairns Group (Higgott and Fenton, 1989), which is an association of fourteen developed and developing agriculture-exporting countries that has pushed for lower agricultural barriers. Newly industrializing countries (NICs), like South Korea and Taiwan, and developing countries like Brazil,

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[12]This section is adapted from Brams, Doherty, and Weidner (1992), which includes additional empirical material.

India, and the ASEAN states, also have played important roles in the Uruguay Round.

The current impasse, however, is due primarily to differences among the Big Three on agriculture, which Winham and Kizer (1990, p. 43) characterize as "the pivotal issue" and Sjöstedt (1990, p. 3) calls "the most important" unsolved problem. While less consequential to the outcome of the Uruguay Round, the issue of market access also pervades discussions of trade liberalization. Hence, we include the positions of the Big Three on this issue as well as the agricultural issue:

1. Support of agriculture through price supports or export subsidies (favored by EC, opposed by US and JA)
2. Barriers to foreign-market entry (favored by JA, opposed by US and EC).

The "barriers" in (2) do not necessarily apply to intraregional trade, such as between the United States and neighbors like Canada and Mexico. In fact, (2) more and more may be interpreted as the issue of supporting regional pacts—by limiting outside access to internal markets (as EC has done), which may undermine the universality of GATT and which we shall say more about later. Issue (2), of course, is not unrelated to issue (1) if agriculture is the sector being restricted.

JA, at least for its national market, is more restrictive than either US or EC. It therefore seems fair to say that JA "favors" barriers, whereas US and, to a less extent, EC, oppose them. That the nature of JA restrictions is sometimes heavily governed by culture and practice—not comparative advantage in resources or even wages—is illustrated by the case of automobiles:

> Even if U.S. and Japanese automakers attained the same quality and production costs, U.S. producers would likely lose out. Why? Because it takes dealers to sell cars. Establishing a national dealer network from scratch in a country the size of the United States is an expensive and time-consuming task—as it is in Japan because of stratospheric real estate prices. But Japanese automakers selling in the United States don't have to build from scratch. They can piggyback onto existing, GM, Ford, and Chrysler dealers because U.S. antitrust laws stipulate that producers must allow dealers to carry other lines. In contrast, by custom and because the Japanese do not enforce antitrust laws, outside firms find it extremely difficult to hook up with dealers in Japan (Prestowitz, 1991, p. 28).

In the face of such barriers, US and EC have become increasingly less content to be unilateral free traders. For example, US and EC have used import quotas and anti-dumping provisions—sometimes in retaliation against restrictions of JA and other countries (or each other)—or they have negotiated export restraints that evade GATT rules.

At the same time, JA has not been totally recalcitrant and seems to be improving (Sanger, 1991). It has, under pressure, lifted restrictions in certain areas, like its beef market (Oxley, p. 68) and semiconductor-chip trade (Prestowitz, 1991, p. 26) with the United States; the latter agreement from 1986 to 1991 was recently extended for three years (Bradsher, 1991). Currently, however, not only does Japan have a blanket prohibition on rice imports (Farnsworth, 1990), but its rice farmers also benefit from subsidies and have, consequently, become "the most protected farmers in the world" (Passel, 1990).

Call the *positions* on issues (1) and (2)

- A (for agricultural supports) and $\overline{A}$ (against supports)
- B (for barriers) and $\overline{B}$ (against barriers).

Positions on both these issues define four possible *platforms*: AB, A$\overline{B}$, $\overline{A}$B, and $\overline{AB}$. We assume that the players can order these platforms from best to worst, based on primary and secondary goals.

A player's (1) *primary* goal distinguishes its two best from its two worst platforms, whereas a (2) *secondary* goal distinguishes between its two best platforms and between its two worst platforms. Thus, if (1) were $\overline{A}$ and (2) were $\overline{B}$, the player would order the platforms, from best to worst, as follows: ($\overline{AB}$, $\overline{A}$B, A$\overline{B}$, AB).[13]

We assume this ordering to be the preferences of US. We summarize below the primary and secondary goals, and the preferences they imply, of the other players as well:

US: (l) $\overline{A}$ and (2) $\overline{B}$ ⇒ ($\overline{AB}$, $\overline{A}$B, A$\overline{B}$, AB)
EC: (l) A and (2) $\overline{B}$ ⇒ (A$\overline{B}$, AB, $\overline{AB}$, $\overline{A}$B)
JA: (l) $\overline{A}$ and (2) B ⇒ ($\overline{A}$B, $\overline{AB}$, AB, A$\overline{B}$).

Because of its pivotalness in the Uruguay Round, we make the issue of agricultural supports primary for all players.

It is certainly possible that the players' positions on the market-entry issue—and regional versus worldwide pacts, like GATT, which this issue raises—will assume greater importance in the future. Indeed, the ultimate failure of the Uruguay Round may lead to trade agreements by continental

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[13]See Hillinger (1971) and Kadane (1972) for an analysis of the effects of combining different positions into platforms. In the interest of clarity, we include commas between the platforms and put the platforms in parentheses.

blocs, such as the Americas, Europe, and Asia (Passel, 1991), which some analysts view with alarm (Silk, 1991), others consider salutary (Prestowitz, 1991), but which may actually be strategic: "By preparing the ground for a series of bilateral trade deals with every country in Latin America," the United States and its potential partners may be "quietly hedging their bets" ("Hedging," 1990). Conceivably, however, the "minilateralism" of such blocs may evolve into the multilateralism of GATT, facilitating rather than undermining world trade (Yarbrough and Yarbrough, 1992), though this point is hotly contested (Uchitelle, 1991).

Observe that each of the three players has a different first, second, third, and last preference, suggesting a lack of social consensus. Nevertheless, by comparing, for each pair of platforms, which is *socially* preferred (i.e., by a majority of two of the three players), one obtains the social preference ordering shown in Figure 3. (Later we shall indicate that

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Figure 3 about here

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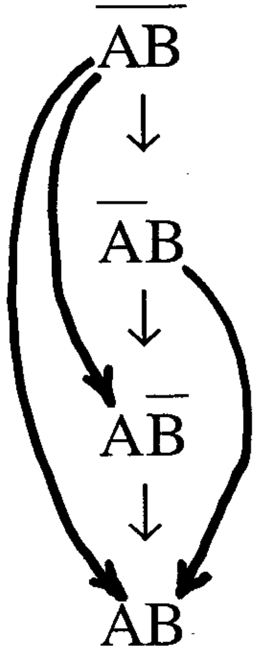
social preferences based on majority rule may not be descriptive of how negotiation outcomes on world trade are determined.)

Notice that two of the three players, indicated by the three arrows emanating from $\overline{AB}$, prefer $\overline{AB}$ to each of the other three platforms. The fact that these other platforms can also be ordered so that all social preference relations flow "downward" from $\overline{AB}$ to $\bar{A}B$ to $A\bar{B}$ to AB establishes the existence of a *social hierarchy* of platforms (so there is no paradox of voting), with $\overline{AB}$ the Condorcet alternative because it defeats the other three alternatives in separate pairwise contests.

Figure 3

Social Hierarchy of Majority Preferences for Platforms*



*Arrows emanating from a higher platform to a lower platform indicate that the former is *socially* preferred (i.e., by a majority of two out of three players) to the latter.

Even $\overline{AB}$, however, if pitted against each of the other platforms, would be opposed by one of the three players. Thus, if each of the players is able to veto the social choice of a platform, the fact that there exists a social hierarchy based on majority preferences does not establish that a social consensus will develop around $\overline{AB}$ at the top of the hierarchy: in a contest with every other platform, there will be one player who will prefer that other platform. Hence, if unanimous consent if required (as is probably the case among the Big Three in the Uruguay Round), it will not be achieved.

Before applying the negotiation model to the preferences of each player, some assumptions must be made about where in the orderings of the players impasse falls (which we capitalize in this section as "I"). Assume EC is adamant in its position on (1); unalterably opposed to $\bar{A}$, it insists on agricultural supports and so puts I in third place.

Assume US puts I in fourth place: it will not give up on both its primary and secondary goals. Then the only way that unanimous consent can be achieved is if JA puts I in fifth place. If this is the case, support of the various alternatives will evolve to the following (we do not show the earlier stages):

US: ($\overline{AB}$, $\bar{A}B$, $A\bar{B}$, I | AB)
EC: ($A\bar{B}$, AB, I | $\overline{AB}$, $\bar{A}B$)
JA: ($\bar{A}B$, $\overline{AB}$, AB, $A\bar{B}$ | I).

By the time the players have lowered their support to the points indicated by the vertical bars, there will be unanimous support for $A\bar{B}$.

Yet both $\overline{A}\overline{B}$ and $\overline{A}B$ beat $A\overline{B}$ in the hierarchy! The former platforms "lose," once I is inserted in the preference rankings, because of EC's hypothesized intransigence—it will not lower its support below I, because, by so doing, it cannot effect a better outcome at any stage. The somewhat diminished intransigence hypothesized for US—and still less for JA—ensures that $A\overline{B}$ rather than AB will be the outcome (the reverse would be the case if JA ranked I fourth and US ranked it fifth). In this manner, a player's higher placement of I induces the choice of a preferred platform, even though this platform may fall lower in the social hierarchy, based on majority-rule voting, than others.

Time will tell, if this hypothetical attribution of platform preferences is correct and the unanimity rule is operative, whether EC ranks I higher than US and JA. The latter players' rankings of I also matter, as we have just shown, and also may not be as hypothesized. Indeed, the fact that the Big Three have disagreed for almost two years suggests that one or more of these players ranks I higher than hypothesized.

The hypothesized preferences of the Big Three (for I as well as for the different platforms), the unanimity decision rule, and negotiations that unfold in the manner of the model certainly do not capture all the nuances of any endgame that may be played out in the Uruguay Round and later. Other preferences and rules, and even new players, might be incorporated into the analysis if it is believed that they offer a more realistic portrayal of the current trade-negotiation game.

It is the *methodology* that we have introduced for analyzing negotiation processes that we think is most important. We believe it offers an enlightening way of viewing the unfolding of positions, and possible changes in support patterns, as players compromise by progressively supporting lower-ranked platforms if it is rational, according to rules 1–4, to do so.[14] A model in which players respond to each other over time is needed, we believe, to explicate the dynamics of multilateral negotiations.

7. Conclusions

Intransigence is a powerful but dangerous card for a negotiator to play in multilateral negotiations. If other parties are also likely to hold out by not retreating to fallback positions, then impasse can be expected.

To be sure, there is nothing irrational about this outcome if players prefer it to other alternatives. Furthermore, it may be effective in inducing other parties to be more forthcoming. On the other hand, if one player's intransigence fosters intransigence on the part of others, such recalcitrant behavior can lead to a disaster for all.

Although one player's intransigence does not depend on another's in the negotiation model, in principle it can be made endogeneous, although the direction of the dependence might vary from situation to situation. Thus, a player might conceivably react to others' intransigence either by turning recalcitrant itself or becoming more accommodating. A player's reputation from prior play also may affect the choices of others, which also is not included in our model.

What is included is a preference for impasse as well as for the regular alternatives. Noncooperative game-theoretic models do not generally

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[14]We are hampered, however, in having insufficient information to test whether support patterns on world trade issues evolved in the manner predicted by the model. In fact, we are not even sure what the "true" preferences of the players are, which is why we claim only to have illustrated a framework, not rigorously tested a model.

postulate such a preference, though cooperative models often include a "disagreement point."

The main theoretical finding is that the more acceptable that impasse is to a player, the more it will achieve its preferred outcome on the average, usually by a factor of two or more when it raises i from third to second place. Overall, intransigence may be a more potent force than size—at least as measured by a player's ability to affect the outcome of negotiations—but the two factors are not directly comparable.

Although intransigence works best in combination with size, small players can sometimes achieve their best outcome if their preferences coincide sufficiently with those of others. Thus, the actual game being played is crucial in determining whether intransigence is helpful or not.

Multilateral negotiations often can be reduced to bilateral negotiations, or a series of bilateral negotiations, but sometimes they resist such a simplification. This seems to be the case in world trade negotiations, in which there are at least three major players and a reduction to *2*-person games would do violence to the reality being modeled.

We developed a dynamic model, and analyzed a *3*-person game among the Big Three, in part because their positions on agriculture, the most contentious issue in the Uruguay round, have been divergent. But the issue of market access also is salient, even if it is less relevant to the Uruguay Round but instead part of a larger game.[15] The latter issue, should it become paramount, may be instrumental in restructuring the

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[15]Clearly, the identity of the players, and what games are being played, is sometimes a mystery that may take empirical investigation to unravel.

players into regional blocs and altering the fundamental nature of the international trading game.

Our analysis of the game among the Big Three, reflecting their positions on both agriculture and market access, indicates that not only do their preferences differ but also demonstrates that one or more will have to make significant compromises to reach a consensus. If not, failure will result because an agreement, at least in the eyes of some players, will be worse than no agreement. This analysis, we believe, illuminates why this is the case and thereby clarifies the rational foundations of disagreement in negotiations.

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