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Disagreement and Authority*

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Abstract

Can two negotiators fail to agree when both the size of the surplus and the rationality of the negotiators are common knowledge? We show that the answer is affirmative. When the negotiators can make irrevocable commitments at a low but positive cost, the unique symmetric equilibrium entails disagreement with high probability. In the unique pair of pure strategy equilibria, one party gets all the surplus. Even though we impose no constraints on side-payments, efficient compromises are unattainable. A strongly asymmetric authority relationship is thus the only viable alternative to costly conflict.

KEYWORDS: Authority, Bargaining, Commitment, Disagreement, Transaction Costs

JEL CODES: C72, C78

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1 Introduction

If negotiators can write binding contracts, why is there ever costly disagreement in bilateral bargaining? Existing formal theory offers two main possibilities. Disagreement arises because of incomplete information or because of irrational negotiators. In his seminal paper, Thomas Schelling (1956) proposed a third reason. Rational negotiators may attempt to increase their share of the available surplus by committing themselves to an aggressive bargaining stance. When both parties engage in sufficiently aggressive bargaining tactics, commitments are incompatible and there is wasteful disagreement.

Schelling's approach to disagreement initially had a substantial impact on political science. It also remains a cornerstone of transaction cost economics, where haggling costs and the danger of disagreement provide the reasons for hierarchical organization; see Williamson (1971, and 1975, page 26-27). Despite its intuitive appeal, large influence, and apparent simplicity, Schelling's verbal theory of disagreement has never won acceptance among game theorists. The strategic value of commitment is widely acknowledged, but theorists have generally opposed the notion that stalemate due to conflicting commitments arise in plausible equilibria of complete information bargaining games. Their argument is simple. If a negotiator believes that the opponent will be committed, it is better to budge and get something than to commit and get nothing. Accordingly, formal models of wars have come to disregard the conflicting commitments argument, except when compromise solutions are infeasible (due to side payment restrictions) or not enforceable in the long run; see for example Fearon (1995) and Powell (2006).

We shall argue that the problem of conflicting commitments has been discarded prematurely. Building on the work of Crawford (1982), we provide weak assumptions under which Schelling's original argument is vindicated.

Crawford studies a two-stage bargaining game in which players first attempt to make observable commitments and then negotiate subject to these commitments. One of his main findings is the following: If commitment attempts are likely to fail, in the sense of leaving the negotiator unconstrained, the only equilibrium outcome entails commitment attempts by both negotiators. The idea is that the opponent is likely to be unconstrained, so if the own attempt succeeds, the expected gain is positive. However, this finding does not help to explain impasse if negotiators have access to commitment technologies that are likely to succeed, because rational negotiators prefer effective commitments to ineffective ones. In particular, Crawford's analysis does not justify stalemate between two rational negotiators with access to fail-safe commitment technologies. We focus on precisely this latter case.

Crawford implicitly assumes that negotiators do not have to incur any costs in order to make commitments. Our discovery is that a minor alteration of Crawford's model, moving from zero to positive commitment costs, dramatically affects the set of equilibrium outcomes. With zero commitment costs, there is a phletora of equilibrium outcomes, many of which are efficient. With small positive commitment costs - which seems to us the more realistic case - the set of (subgame perfect) equilibrium outcomes of the game shrinks dramatically:

1. In the unique symmetric equilibrium, a negotiator randomizes between remaining flexible and making a commitment to take all the surplus. As the commitment cost approaches zero, the probability of disagreement tends to one.

2. In the unique pair of asymmetric equilibria, one negotiator claims the whole surplus and the other negotiator remains flexible.

The intuition for our result rests on the insight that at least one negotiator will always remain flexible with positive probability in any equilibrium. Flexibility allows a best response to any commitment strategy. Being cheaper than the commitment strategies, the flexible option thus precludes any equilibrium in which both negotiators are committed with probability one. Since the best response to flexibility is a commitment to take (virtually) the whole surplus, the positive probability of meeting a flexible negotiator invites aggressive commitment.

If negotiators have the same status, and if there is no history that will help them break the symmetry of their positions, the symmetric equilibrium is the only reasonable outcome.[1] Indeed, we believe that the symmetric equilibrium is the most reasonable outcome also in many cases where symmetry-breaking devices are available. The reason is that one negotiator earns zero payoff in the asymmetric equilibrium. If the negotiator ascribes even a small probability to the event that she has misunderstood the roles, and if commitment costs are small, she may prefer to make an aggressive commitment herself. That is, the asymmetric equilibria become unstable as commitment costs fall. In order to avoid disagreement when commitment costs are low, it seems necessary to establish a firm common understanding concerning which negotiator will be claiming the whole surplus. A justification for strongly asymmetric authority thus arises as a by-product of our analysis.

To our knowledge, this is the first formal model of disagreement in which fully rational negotiators bargain over a convex set of feasible outcomes, have complete information, and can write binding contracts.

The model can also be seen as a theory of why there is authority. By assigning all the authority to one party, it becomes clear who is supposed to be committed

[1] See Crawford and Haller (1990) for a careful discussion of this point.

in future negotiations, and the pair avoids excessive bargaining costs (duplication of c) as well as costly bargaining impasse.[2] Indeed, the model provides a parsimonious formalization of the central argument given by Williamson (1975) for the existence of firms. Williamson argues that independent contractors in a bilateral monopoly – or more generally in a small numbers environment – have an incentive to engage in costly bargaining tactics, entailing "haggling costs" and "maladaptation." By letting one contractor employ the other, and giving the employer the "right to manage," haggling is eliminated. The hierarchical structure of the firm makes sure that authority rests with one party only. The firm is a "quasijudicial" conflict resolution mechanism.

2 Model

There are two negotiators, henceforth called players. Players are indexed $i = 1, 2$ and bargain over a surplus of size 1. The size of the surplus and the rationality of the players are common knowledge.

In the first stage, each player i chooses, simultaneously with the other, either to commit to some demand $s_i \in [0, 1]$ or to wait and remain uncommitted. Let w denote the waiting strategy. Committing entails a commitment cost c, whereas waiting entails a flexibility cost f. In the second stage, two uncommitted players engage in bargaining. Let β_i be player i's share if both players are uncommitted in the second stage. We assume that two flexible players are able to coordinate on an efficient outcome, so that $\beta_1 + \beta_2 = 1$. Since many explicit models of non-cooperative bargaining under perfect information result in such an interior solution, this can be taken as a reduced form of an (unmodelled)

[2] There may even be a biological mechanism supporting this outcome. It is well known that increases in status bring about increases in testosterone levels, at least for males. High testosterone levels in turn causes more competitive behavior. For references, see Goldstein (2001, Chapter 3).

ensuing bargaining game.[3] Without loss of generality, let $\beta_1 \geq \beta_2$.

In the second stage, a committed player cannot revoke her demand. An uncommitted opponent thus observes the opponent's first stage choice and best responds by demanding the residual share $1 - s_i$. A committed player receives the share of the surplus that she demanded if the demands are compatible. (The reader may object that there is no reason for any surplus to be left on the table in this case. Below, we shall demonstrate that our argument holds equally well if, for example, any residual is shared equally.) If players are committed to incompatible positions, they fail to agree and the whole surplus is left on the table. This happens if $s_i + s_j > 1$.

We see that the two–stage game can essentially be described in terms of its first stage strategies.[4] In the first stage, each player has the set of pure strategies $S = [0, 1] \cup \{w\}$. The payoff of player i is

$$u_i(s_i, s_j) = \begin{cases} s_i - c & \text{if } s_i + s_j \leq 1 \text{ or if } s_j = w; \\ 0 - c & \text{if } s_i + s_j > 1; \\ 1 - s_j - f & \text{if } s_i = w \text{ and } s_j \in [0, 1]; \\ \beta_i - f & \text{if } s_i = w \; = s_j. \end{cases}$$

The set of mixed strategies is the set of probability distributions on S. We write a mixed strategy of player i as σ_i. Let $p_i(s)$ denote the associated probability that player i plays the pure strategy s. In the sequel, we analyze this normal form game.

The following lemma is the key to our main result. It says that if commit-

[3] Rubinstein (1982) identified a unique subgame perfect solution to the infinite horizon alternating offer bargaining game. The solution outcome β is efficient and satisfies $\beta_i \in (0, 1)$. The strength of the result is preserved even with weaker solution concepts: it is also the unique efficient iteratively conditionally undominated outcome (Fudenberg and Tirole; 1991, p. 129).

[4] The bargaining game is essentially a Nash demand game (Nash, 1953) played out over two stages. At stage 1, each player i chooses either to commit to some demand $x_i \in [0, 1]$ or to wait and remain uncommitted. At stage 2, a committed player executes the demand x_i. An uncommitted player observes the opponent's first stage choice before choosing her own demand. Two uncommitted players coordinate on an efficient equilibrium with demands β_i.

ment is more costly than flexibility, then nothing but a greedy demand of 1 and waiting, w, is iteratively strictly undominated and thus played with a positive probability in any (subgame perfect) Nash equilibrium. The logic of the result is straightforward. Observe first that some commitment strategies are strictly dominated. Since commitment is more costly than waiting, player 1 strictly prefers w to any $s_1 \in [0, \beta_1]$, and player 2 strictly prefers w to any $s_2 \in [0, 1-\beta_1]$. After these strategies are eliminated, player 1 strategies $s_1 \in (\beta_i, 1)$ are strictly dominated by the mixed strategy $\sigma_1 = (p_1(1) = s_1, p_1(w) = 1 - s_1)$. If player 2 plays w, player 1's expected shares of the surplus are the same for s_1 and σ_1; if player 2 plays $s_2 \in (1 - \beta_1, 1]$, the expected share of the surplus to the mixed strategy is greater. Since the cost of the mixed strategy is only $cs_1 < c$, strict dominance is established. Likewise, player 2 strategies $s_2 \in (1-\beta_1, 1)$ are dominated by the mixed strategy $(p_2(1) = s_2, p_2(w) = 1 - s_2)$. Thus, only waiting and committing to the whole pie are iteratively undominated.[5]

Lemma 1 *Suppose $c > f$. Then, only 1 and w are iteratively strictly undominated.*

The iterative elimination of strictly dominated strategies leads to simple game of chicken[6]: Neither $(1, 1)$ nor (w, w) can constitute an equilibrium. If $c < \beta_i$, $s_i = 1$ is the unique best response to $s_j = w$, and $s_i = w$ is the unique best response to $s_j = 1$. Therefore, there is no symmetric pure strategy equilibrium. There may be a symmetric equilibrium in mixed strategies, however. In a mixed

[5] As promised, let us show that the argument also holds if two committed players with $s_1 + s_2 < 1$ share the residual pie in equal shares. Confine attention to the case $\beta_1 = \beta_2 = 1/2$. Committing to s_i when the opponent commits to $s_j = 0$ gives $s_i + (1 - s_i)/2 - c$. Waiting gives $\beta_i - f$. Thus, waiting strictly dominates commitments to

$$s_i < 2(c - f).$$

Once these commitment strategies are ruled out, any remaining commitment strategy s_i can at most yield $s_i + (1 - s_i - 2(c - f))/2 - c$, and thus the waiting strategy iteratively strictly dominates any $s_i < 6(c - f)$. We can continue the iteration until we reach the bound $s_i \leq 1/2$ and no interatively undominated commitment strategies leave any pie on the table. From here on the argument is as in the main text.

[6] In section 4 of his paper Crawford (1982) shows that, in his model with a minor relaxation of rationality, iterative elimination of strictly dominated commitment strategies leads to a prisoner's dilemma where a unique commitment strategy dominates the waiting strategy. In our model players are fully rational.

strategy equilibrium, the expected payoff from $s_i = 1$, which is $1-p_j(1)-c$, must equal the expected payoff from waiting, which is $(1-p_j(1))\beta_i - f$. Thus, for given β_1 and β_2 there is a unique mixed strategy equilibrium. There is also a unique pair of asymmetric pure strategy equilibria. In these equilibria one player commits to demanding all the surplus and the other player waits.

Proposition 1 *Suppose $c \in (f, \beta_2)$. (i) For any pair (β_1, β_2), there is a first stage mixed strategy equilibrium, $p_i(1) = (1-\beta_j - c + f)/(1-\beta_j)$ and $p_i(w) = (c-f)/(1-\beta_j)$. (ii) In the unique pair of first stage pure strategy equilibria, either $p_1(1) = 1$ and $p_2(w) = 1$ or $p_2(1) = 1$ and $p_1(w) = 1$.*

It remains to select between the equilibria. At first sight, the mixed strategy equilibrium is more plausible. If players have identical roles, then there is no reason why they should be able to coordinate at anything but a symmetric equilibrium at stage 2 in case they both wait. Then, $\beta_1 = \beta_2 = 1/2$, and the mixed strategy equilibrium depicted in Proposition 1 is symmetric too. If the two players have no device that allows them to take asymmetric roles at stage 1, the principle of insufficient reason would thus lead them to the symmetric equilibrium[7]. On the other hand, the symmetric equilibrium is not strict. Strictness speaks in favor of the pure strategy equilibria.[8] However, as Young (1993) indicates, strictness is a questionable criterion in the presence of noise. As c approaches f, slight uncertainty about player roles suffices to destabilize an asymmetric equilibrium. The player who is supposed to settle for nothing is tempted to commit aggressively just in case the opponent has not done so. It thus takes a strong prior convention to select any of the asymmetric pure strategy equilibria over the symmetric mixed strategy equilibrium.

[7] See Crawford and Haller (1990).

[8] Formally, the asymmetric equilibria are not strict either, because a player who waits and expects the opponent to play 1 is indifferent between all stage 2 strategies. However, if we discretize the strategy space, there are typically strict equilibria in which one player claims *almost* all the surplus.

As c approaches f from above, the mixed strategy probability of aggressive commitment increases monotonically towards 1. Small positive commitment costs in combination with unclear roles is thus the worst possible state of affairs.

Our analysis hinges crucially on the assumption that $c > f$. Crawford (1982) realized that the case $c = f$ gives rise to a vast multiplicity of equilibria. Proposition 1 of Ellingsen (1997) uses evolutionary tools to show that only the equal split is symmetric and stable. When $0 = c < f$, Proposition 3 in Ellingsen (1997) demonstrates that in all stable symmetric equilibria bargainers commit to approximately half of the pie. Thus if commitment is weakly cheaper than flexibility, the equal split is the only stable symmetric equilibrium outcome. The intuition is that the possibility of waiting eliminates all other symmetric equilibria, but that waiting cannot be part of any equilibrium. As it turns out, this parameter configuration also admits many asymmetric equilibria; any efficient division is supportable as an equilibrium. When commitment is cheaper than flexibility, the model therefore predicts neither disagreement nor extreme authority.

3 Final remarks

When commitment is cheap, but more costly than flexibility, we conclude that efficient outcomes are only attainable if negotiators share a mutual understanding that one of them, say player i, is entitled to the whole surplus. Otherwise, conflict is almost certain. To us, this is remarkable. For example, our model has no equilibrium in which each player is entitled to half the surplus. Efficiency requires extreme asymmetry.

With the benefit of hindsight, our disagreement equilibrium can be seen as a cousin of Proposition 2 in Ellingsen (1997). Ellingsen also studies the tradeoff between commitment and flexibility in the Nash Demand game, albeit in a single-population evolutionary model with observable strategies and zero commitment costs. His Proposition 2 considers a case in which the size of the pie is uncertain, and commitments are nominal. In that case, a bilateral commitment to " fair" demand, such as half the normal surplus, will entail conflict whenever the surplus is smaller than normal. The flexible strategy then does better than the committed fair strategy, and ends up coexisting with the aggressive committed strategy. Ellingsen's result hinges crucially on the assumption that the size of the surplus is uncertain when the commitment is made, and that it is impossible to commit to a relative share of the surplus. We make neither of these assumptions. In another closely related paper on the Nash Demand game, Güth, Ritzberger and van Damme (2004) assume that there is some small uncertainty as to the actual size of the surplus and let negotiators choose their demands either before or after the uncertainty resolves. They show that there are only two strict Nash equilibria. In each of these equilibria, one negotiator demands almost all of the surplus before the uncertainty is resolved. The other waits until the size of the pie is known and demands the remainder. In their model, as in Ellingsen's, commitment is costly because of the inability to adapt the demand perfectly to the size of the surplus. However, by allowing asymmetric equilibria, they predict an efficient outcome. It is worth pointing out that the asymmetric equilibria are strict only because of the uncertain size of the surplus. With full certainty of the surplus size, we are back to the vast multiplicity of equilibria.

Let us also briefly comment on some more distantly related work, confining attention to generic models of disagreement[9]. Roughly speaking, the prevailing view is that, if parties can write enforceable contracts and monetary transfers

[9] Muthoo (1996) deals with commitment, like us, but is concerned with efficient outcomes. He addresses incomplete information as the primary source of inefficiencies (1996, section 5.1).

are unrestricted, disagreement can result either from bounded rationality, incomplete information, or from non–standard preferences. Crawford (1982, Sections 4 and 5) demonstrates that expectational errors may suffice to generate stalemate due to conflicting commitments even when commitment technologies are quite effective.

It is widely accepted that conflict may arise as a consequence of incomplete information. Myerson and Satterthwaite (1983) show quite generally that disagreement is bound to arise with positive probability when negotiators are uncertain about the opponent's private valuation. Abreu and Gul (2000), Compte and Jehiel (2002) and Kambe (1999) consider dynamic bargaining models in which players may be irrational and where uncertainty about the opponent's rationality can be a source of inefficient delay (but not ultimate disagreement). In their models, as in that of Myerson and Satterthwaite, inefficiencies disappear as the amount of private information tends to zero, except in non–generic cases; see Abreu and Gul (2000, Proposition 6).[10]

In bilateral perfect information bargaining over a single trade, it is known that delay may occur if the negotiation is subject to a deadline (Ma and Manove, 1993). This is easiest to see when players take turns to make offers, but may delay their moves. If the discount factor is large, the first mover may then wait to make the offer until just before the deadline.[11] If the negotiators have imperfect control over the timing of their offers, for example due to imperfect communication channels, Ma and Manove show that deadlines may induce not only delays, but also offers that are rejected with positive probability and disagreements. In a sense, this model introduces asymmetric information about valuations through the random delay; when making an offer, the proposer does not know what the

[10] Another difference between their approach and ours is that it is endogenously more costly to build more extreme reputations, so it can be optimal to have intermediate commitments.

[11] Ma and Manove (1993) credit Martin Hellwig with making this point.

responder's valuation will be when the offer arrives. Reference-dependent preferences may also entail disagreement. If negotiators are unwilling to accept any offer that they have previously turned down, Fershtman and Seidman (1993) show that this can delay agreement if there is a deadline. Li (2007) strengthens the result: if players are unwilling to accept offers that do not improve on rejected offers in net present value terms, then delay is unavoidable even without a deadline. The logic is closely related to that in Compte and Jehiel (2004) who show that if opponent's outside option depends endogenously on offers that are made, delays may occur.

Asymmetric information models of disagreement can only explain impasse when there is a positive probability that the disagreement outcome is efficient. Thus, in the case of large quasi-rents, there should not be any danger of disagreement. For transaction cost economics, with its focus on haggling over quasi-rents, our model provides a better justification.

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