# Simulating the Bargaining Model of War

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**Abstract**

This paper outlines a classroom simulation for teaching the bargaining model of war. The bargaining model has become one of the most important theories of international conflict, but the technical notation often used to illustrate it is troublesome for some students. Below, I describe a simple card game that can be integrated into a broader strategy for conveying the bargaining model's core insights. I also highlight ways in which the game can be modified to focus on different aspects of the model's logic.

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James Fearon's seminal work on the "bargaining model" of war set in motion a research agenda highlighting the important effects of informational asymmetries on international conflict (Fearon 1995). The basic claim that uncertainty, misrepresentation, and mutual optimism can significantly increase the likelihood of conflict has gained significant traction in the the field. Indeed, it is reasonable to claim that the bargaining model should constitute an important piece of an undergraduate IR curriculum. But despite the model's elegance and intuitive logic, much of bargaining literature contains highly technical, game-theoretic notation that is simply unsuited for most undergraduates.[1] Even basic treatments in widely used introductory textbooks use some basic mathematical notation that might be problematic for certain students (Frieden, Lake and Schultz 2012).

Below, I describe a simple card game that clearly illustrates the core logic of Fearon's bargaining model. The game carefully simulates informational asymmetries and costly conflict while providing students with "incentives to misrepresent" their bargaining strength as Fearon's model indicates. The game is highly flexible, and the parameters can be easily adjusted to highlight different components of the bargaining logic.

Research has shown that classroom simulations can be a highly effective pedagogical tool (Frederking 2005; Shellman and Turan 2006). As such, the lack of simulations for teaching this important theory is highly problematic. The simulation I describe below is somewhat atypical in that it is divorced from real-world political scenarios (Wheeler 2006; Raymond and Sorensen 2008; Brynen 2010). I do not present a "role-playing" or hypothetical crisis situation. Rather, I describe a game that focuses entirely on the abstract logic of information, bargaining, and conflict. Instructors can then integrate this game with additional simulations that encourage students to apply the bargaining logic to real-world scenarios (Asal 2005; Raymond and Sorensen 2008; Brynen 2010). For instance, instructors might follow this game with an in-depth historical case study of the Korean War, or a crisis simulation centered the India-Pakistan dispute over Kashmir. Integrating this game into a broader lesson plan can help instructors incorporate the bargaining model into even introductory IR courses.

[1] For a useful exception, see Reiter (2003).

# 1 Describing the Bargaining Model

Fearon's argument centers on the idea that war is costly, and if rational states were completely informed regarding the capabilities and resolve of their adversaries, they should typically settle disputes without resorting to war. The costs of conflict create a "bargaining range" of outcomes that *both* parties should prefer to war. The theory highlights three distinct dynamics that cause rational states resort to war despite its high costs.

First, due to "informational asymmetries" and uncertainty regarding an adversary's strength and resolve, states might overestimate their ability to achieve a favorable outcome through war. Essentially, states cannot fully know their adversary's capabilities and commitment. Furthermore, states have a strong "incentive to misrepresent" and exaggerate their power in order to secure a better deal. Uncertain states thus might overestimate their own capabilities and stumble into a costly war based on a rational "mutual optimism" (Slantchev and Tarar 2011).

Second, even if states were fully informed of one another's power and resolve, they could still end up in conflict if power is shifting exogenously, or if the good in dispute is itself a source of power. Under this "commitment problem" logic, perfectly informed states can agree to a deal under current conditions, should they remain static (Powell 2006). But when relative power is in flux, the declining state cannot trust its adversary to continue abiding by the agreement into the future. Power shifts thus compel declining states to fight now rather than risk fighting later under more dangerous conditions.

Finally, Fearon shows that a mutually agreeable negotiated solution might not be possible if the good in dispute is "indivisible" such that it cannot be continuously divided without diminishing its value. When bargaining over sacred territory or strategically valuable terrain that loses its value if split with another actor, there may not be a practicable way of dividing that good that still falls within the bargaining range. Thus, issue indivisibilities can prevent a negotiated outcome even if states are fully informed and power levels are stable.

### 1.1 Key Insights of the Bargaining Model

The logic described above yields at least four key substantive claims. First, greater levels of uncertainty and incentives for states to misrepresent their capabilities increase the probability of conflict. Conversely, greater transparency and increased availability of information should be a force for peace. Second, shifting levels of relative power increase the probability of war. Third, greater flexibility in dividing a disputed good should help states avoid war. And fourth, as war becomes more costly states should be more eager to avoid it, increasing the range of outcomes that both prefer to conflict and decreasing the frequency of war.

Although the simulation described below focuses on the effect of uncertainty, the game can be easily modified to highlight each of these theoretical claims. The simulation is designed to enable students to effectively describe, explain, and apply the bargaining model's central claims regarding uncertainty and conflict.

## 2 Describing the Game

The game involves pairs of students using a deck of playing cards to "gamble" over pennies. The instructor distributes one deck of shuffled cards and one roll of pennies to each pair of students. For simplicity, I typically remove face cards from each deck, leaving only cards with a face value of two through nine (32 cards in total). Students then divide the pennies in half, giving an equal share to each player.

In the first round of the game each student is dealt two cards, both *face down*. Each student also must "ante up" and put one penny into the pot at the start of each hand. After both players look at their own cards, Player 1 (P1) must decide whether to make a demand for the pot, or to concede it to Player 2 (P2). If P1 opts to concede, P2 takes the pot, the cards are discarded, and another hand is dealt. If P1 makes a demand, however, P2 must decide whether to "resist" the demand and fight over the pot. If P2 resists, both players turn over their cards and the player with the highest card total (i.e. the summed face values of the player's two cards) wins the pot and collects the two pennies. But crucially, because the players could not agree to a negotiated solution, they both suffer "costs of war" equal to one penny each. The pennies representing the

costs of war are removed from the game and kept to the side. Neither player can ever recoup these losses. The players are not allowed to "split" the pot.[2] If, however, the players turn over their cards and have equal hands, a "stalemate" results. The pot is then split evenly between the two players, but because they each suffer the costs of war, the one penny that each player takes from the pot is removed from the game.

There are five potential outcomes. If P1 concedes, she loses the penny she bet at the outset of the hand, and P2 wins that penny. P1's payoff is $-1$ and P2's payoff is $+1$. Alternatively, if P1 makes a demand and P2 concedes, P1 takes the pot and gets $+1$ while P2 gets $-1$. If P1 issues a demand, P2 resists, and P1 has the better hand, then P1 takes the pot (i.e. $+1$) but must also pay the costs of conflict such that her net payoff is zero. P2 loses the pot *and* pays the costs of conflict, netting a payoff of $-2$. Conversely, if P1 makes a demand, P2 resists, and P2 has the stronger hand, P2 receives zero and P1 receives $-2$. Finally, if the players turn over their cards and have equal hands, they split the pot while also suffering the costs of conflict. Each player's net payoff is then $-1$. The instructor establishes the number of hands in each round. The players take turns acting first, alternating roles as P1 and P2.

At the end of each round of hands, the instructor asks each pairing for the "score" of their game, or the number of pennies with which each player finished. The pennies are unlikely to be a strong motivator for students, so the instructor may need to offer extra credit to the "winner" of each game. But importantly, this competitive score keeping is largely a form of misdirection. We want to know *not* who won each round, but how many "wars" occurred or how many pennies were removed from the game. Fortunately, this can be easily deduced by subtracting the sum of P1 and P2's scores from the total number of pennies distributed.

## 2.1 Subsequent Rounds

After students complete the first round of hands and the instructor compiles the scores, a new round begins. The cards are reshuffled and the pennies redistributed to the players in equal shares. Game play remains the same in the second round with one important exception – the cards are now dealt with one card face down, and the other face up. Half of each player's

[2] As I describe below, this rule can be relaxed to simulate greater "divisibility," which should make conflict less likely.

bargaining strength is now common knowledge. This, of course, simulates the greater availability of information regarding relative power in a bargaining interaction. The students play the same number of hands as the first round, according to the same rules.

Even though players still have incomplete information regarding their opponent's hand, there are many scenarios in which a player knows her own hand to be so weak that backing down is a dominant strategy. Suppose P1 was dealt a four face up, and a three face down. She thus has a score of seven. If P2's face up card is a nine, P1 knows that irrespective of the value of P2's other card, P2 has the superior hand. If P2 acts first and makes a demand, P1 should always concede. The greater availability of information should thus allow the players to avoid conflict more frequently.

After completing the second round and tabulating the scores, the pennies are redistributed and cards are shuffled. The third round is identical to the first two rounds, except now *both* cards are dealt face up. Both players are thus perfectly aware of the balance of power between them in the bargaining interaction. Conflict should be easily avoidable, with one important exception. If the players are dealt equal hands – say, P1 is dealt a six and five, while P2 is dealt a nine and two – war may be possible. If P1 makes a demand, P2 is indifferent between conceding and resisting. Likewise, even if P1 knows that P2 will resist her demands, she is indifferent between making a demand and conceding. Rational players might thus end up in conflict *even in the complete information game*, but only if the players are dealt even hands and they are prohibited from agreeing to split the pot.[3]

## 3 Modifications

The baseline version of the game described above emphasizes informational asymmetries and misrepresentation as causes of conflict. But the game's parameters can be manipulated to offer an even more fine-grained picture of the importance of information, or to highlight other components of the bargaining model's core logic.

First, the instructor can create a more fine-grained picture of information's effect on conflict

[3] As described below, this is an excellent opportunity to highlight "issue indivisibility" as a cause of war. If the players were allowed to agree on a 50/50 split, war should *never* occur, even with equal hands.

by simply having the students deal extra cards in each hand. If each hand consists of four cards per player, there is greater uncertainty regarding an opponent's strength, as the range of possible values their hand could take is wider. Subsequent rounds can then be adapted to reveal smaller increments of information. In a four-card game, the second round of play would have one card face up and three cards face down (i.e. 25% information). The third round would have two cards face up and two cards face down (50% information), and so on. Each round would thus allow smaller additions of information, potentially resulting in more subtle shifts in the frequency of conflict.

Second, the instructor can adjust the parameters to simulate more costly conflict and observe how this affects the frequency of war. Subsequent iterations could impose higher costs (e.g. two pennies each) or *asymmetrical* costs of war where one player suffers a greater penalty as the result of conflict. In this case, the instructor should take special note of the players' scores when counting pennies at the end of the round to determine how asymmetrical war costs affect relative bargaining power.

Third, the instructor can simulate greater "divisibility" by allowing the players to agree to "split the pot." This can be extended by increasing the size of the pot and allowing players to split it in a greater variety of ways. Theoretically, this should significantly reduce the frequency of conflict. In the complete information game, allowing a negotiated split pot should completely eradicate conflict.

Capturing the effect of power shifts and commitment problems is the most difficult aspect of this simulation. The game must simulate a shifting balance of bargaining power, while also providing the declining actor with the means to avert this power shift through initiating costly conflict. For example, the instructor might inform the players at the outset that there will be two rounds of play, and the players will keep the pennies they win from the first round when they transition into the second round. But importantly, when the cards are dealt for the second round, P1 must give her four highest cards to P2, while P2 will give his four lowest cards to P1. P1 will thus be severely disadvantaged in the second round. However, if P1 wins the first round and secures more pennies than her opponent, she may reduce her vulnerability in round 2. If P1 won the first round by one penny, she only has to give up her three best cards. If she wins the first round by two pennies, she only gives up her two best cards, and so on. If P1 wins the first round by four or more pennies, she does not have to give up any of her cards, and round 2 will be played

on even terms. This set-up provides P1 with an incentive to bargain very aggressively in round 1. The short term costs of conflict may be worth risking for P1 if they offer her a better chance of averting a diminished bargaining position in the second round.

Alternatively, the instructor could simulate short-term commitment problems by simply altering the rules such that the winner of a hand benefits from some predetermined bump to their score in the subsequent hand. If P1 wins the first hand, for example, she then adds two points to her hand in the next round. This simulates a situation where power is shifting endogenously, and the good in dispute is itself a source of power for future conflicts. Both players face incentives to take an aggressive bargaining stance, and conflict should become more likely.

## 4 Presenting Results

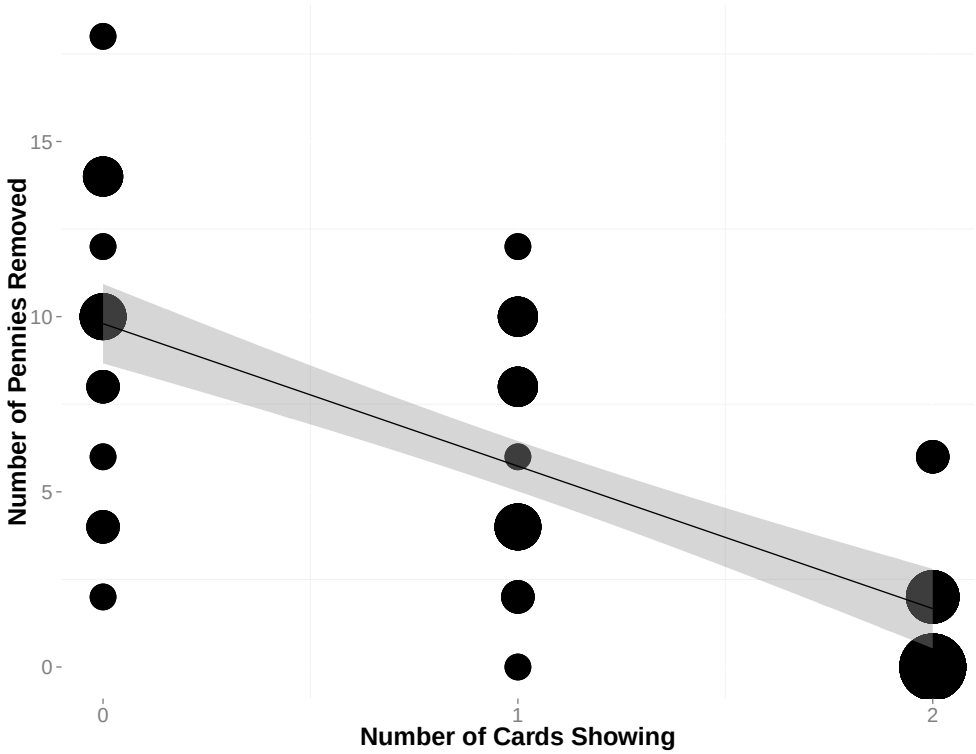
According to the logic of the bargaining model, the frequency of conflict should be monotonically decreasing as more cards are revealed. The instructor should calculate the average number of "wars" that occurred in each round.[4] The instructor can then show the students how their own behavior tracks with the bargaining model's expectations, and whether conflict was less common as information become more available. Additionally, maintaining a running spreadsheet of game results over time and across classes can allow instructors to have informative visual representations of aggregate data ready for immediate presentation. For example, Figure 1 presents a frequency-weighted scatter plot (i.e. "bubble plot") showing the number of revealed cards on the x-axis and the frequency of conflict on the y-axis. The fitted bivariate regression line clearly illustrates the pacifying effect of greater information.[5] Instructors can compare individual class results to the broader trends that emerge from prior iterations of the game in past courses.

The exact nature of presentation will obviously depend on how the instructor manipulates the parameters across the various rounds. Figure 1 shows how the results might be presented for the baseline simulation described above. But simple adjustments in presentation could capture the effects of, for example, increasing costs of war or greater divisibility.

[4] This can be done very quickly. I often tabulate the results from Round 1 while the students are playing Round 2, and tabulate Round 2 while Round 3 is played. I tabulate Round 3 as the students "clean up" after the game.

[5] See supplemental files for instructions on how to produce similar figures using Excel, STATA, and R.

**Figure 1: Effect of Information on Frequency of Conflict**




# 5 Teaching Points

Upon completing the game, instructors should discuss the logic of the simulation and ask for insight on why students played as they did. This section describes some questions and prompts instructors might use to draw out important concepts.[6]

First, the instructor might ask students in a highly conflict-prone pairing to explain why they were so often unable to come to an agreement. Players frequently indicate that they were simply bluffing about the strength of their own hand, hoping to win the pot despite a weak hand. This directly captures the "incentives to misrepresent" that Fearon highlights as a key cause of war. The instructor can then highlight how bluffing became less effective, and thus less common, as more information was revealed.

Second, the instructor might ask students if they ever resisted their opponent's demand despite having a weak hand. Students often claim that they would rather "go down fighting" than abjectly concede. This dynamic can prompt a discussion of how states might actually derive a

[6]The supplementary materials include slides that instructors can build upon in presenting the results.

*positive* utility from fighting, as their leaders can project an image of toughness to domestic constituents. Instructors might also ask whether such behavior was intended to project a reputation for firmness to their opponent.

Next, as discussed above, conflict is indeed possible even in the complete information game where the players know one another's hands. In my experience, there are often a couple of cases where players fight simply out of spite, or because they are dealt even hands and it is actually arguably rational to do so. In the former case, instructors can use the motivation of spite to highlight the psychological and non-rational components of interstate bargaining. This is an excellent opportunity to illustrate the limitations of the bargaining model.

Conversely, if players fought in the complete information game because they were dealt even hands, the instructor should note that this was not necessarily the result of irrational behavior. Rather, it resulted from the inability of the players to divide the pot. A quick description of each player's payoffs will reveal that conflict is perfectly rational when the pot is indivisible, but completely irrational and avoidable if the players are allowed to divide the good.

Again, specific teaching points will depend in large part on how the instructor chooses to manipulate the game's parameters. If the game is designed such that changes in the costs of conflict are implemented across rounds, while cards dealt face down throughout, the subsequent discussion will obviously focus on how variations in the costs of war affect the probability of conflict. But for each variation of the game, changing the game's parameters provides instructors with valuable opportunities to highlight different aspects of the bargaining logic.

## 6 Conclusion

This paper describes a simple card game that can help clarify the core logic of the bargaining model of war. The game carefully simulates incomplete information and costly conflict, and its flexibility allows instructors to highlight different aspects of the bargaining model's core logic. The bargaining framework is now widely used in the field of international relations, and it is becoming increasingly important to teach this material to undergraduates. Simplifying and illustrating the model's core logic with minimal notation can thus be immensely beneficial for students.

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