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FERNANDO DE LIMA LOPES

NEGOTIATION AND CONFLICT WITH MUTUAL OPTIMISM

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Dissertação apresentada à Escola de Economia de São Paulo como pré-requisito à obtenção de título de mestre em Economia de Empresas.

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Resumo

Uma das principais explicações para a ocorrência de conflitos custosos é otimismo mútuo: duas partes que barganham a divisão de um ativo podem decidir entrar em um conflito ineficiente *ex-post* se ambos estiverem otimistas a respeito de suas chances de vencer o conflito. O presente artigo investiga se otimismo mútuo ainda é capaz de gerar conflitos quando permitimos que haja um componente dinâmico no processo de negociação entre as partes conflitantes na forma de múltiplos *rounds* de barganha—a maioria dos modelos de conflito é estática. Nosso principal resultado é que, por si só, otimismo mútuo não é suficiente para iniciar um conflito. O conflito só surge quando as formas alternativas de resolução da disputa são insatisfatórias para uma das partes envolvidas.

Palavras-chave: barganha, informação assimétrica, conflitos, otimismo mútuo, jogos dinâmicos.

Abstract

A leading explanation for the occurrence of costly conflicts is mutual optimism: two parties bargaining over the division of an asset might decide to engage in an ex-post inefficient conflict if both are optimistic about their chances of winning the conflict. This paper investigates whether mutual optimism can still generate conflicts when we allow for a dynamic component in the negotiation process among conflicting parties in the form of multiple bargaining rounds—most models of conflict are static. Our main finding is that by itself, mutual optimism is not sufficient to lead to conflict. Conflict only arises when alternative means of dispute resolution are unsatisfactory to one of the parties involved.

Keywords: bargaining, asymmetric information, conflicts, mutual optimism, dynamic games.

Contents

1 Introduction

Conflicts are costly and, nonetheless, they occur. Situations in which two parties engage in some form of deleterious confrontation in which only one of them can emerge victorious are not rare. One could think of wars (which destroys capital and labor) or litigation (which requires legal fees, such as attorney's compensation). However, because of these very costs that are intrinsic to conflicts, gains from avoiding them exist and one can always find a mutually beneficial agreement that avoids conflict. But if such agreements exist, why are they not agreed upon?

Among the explanations for conflicts in the literature, rationalist explanations play a prominent role. These explanations consider agents that are capable of taking into account all of the costs and benefits associated with conflicts and still decide to engage in one rationally. Mutual optimism—when both parties believe rationally that they have favorable odds of winning the conflict—is one of the most widely accepted explanations for conflicts among the broader literature on asymmetric information and conflicts.[1]

This paper investigates whether mutual optimism can still generate conflicts when we allow for a dynamic component in the negotiation process among conflicting parties in the form of multiple bargaining rounds—most models of conflict are static. We aim to explore if, and how, mutual optimism arises in equilibrium when agents have the option of engaging in additional rounds of bargaining, carrying information from their interaction in the previous rounds. Our main finding is that by itself, mutual optimism is not sufficient to lead to conflict. Conflict only arises when alternative means of dispute resolution are unsatisfactory to one of the parties involved.

We consider the following discrete-time infinite-horizon bargaining model. Two agents, an aggressor and a defender, bargain over the division of an infinitely divisible asset with a known value.[2] In every period, the aggressor proposes a division of the asset, which the defender either accepts or rejects. Unlike in static models of conflict, a rejection does not automatically imply that the bargaining parties engage in a conflict. Instead, they must actively do so. However, once an agent starts a conflict, the other cannot prevent it.

[1] See, e.g., Brito and Intriligator (1985), Blainey (1988), Fearon (1995), and Johnson (2009).

[2] Alternatively, one can think that the asset is indivisible, but monetary transfers between the agents are possible.

Conflict is a costly winner-takes-all lottery. We introduce a scope for mutual optimism by assuming that the defender is privately informed about the likelihood that they can win the conflict—the defender is either weak, with a low probability of winning, or strong, with a high probability of winning. In our setting, conflict never happens in equilibrium in the absence of asymmetric information.

We show that if only the aggressor can initiate a conflict, then the aggressor never exercises this option in equilibrium.[3] It is only when the defender can initiate a conflict, that mutual optimism can lead to conflicts in equilibrium. However, in this latter case the scope for conflict is reduced (and can even disappear) if there are alternative means of conflict resolution. We model those as an exogenous division of the asset that can happen in every period with a positive probability.

The remainder of the text is organized as follows. We discuss the related literature in the remainder of this chapter. Chapter 2 sets up the baseline model and discusses some assumptions. Chapter 3 analyzes the infinite-horizon bargaining game. Chapter 4 extends the model to allow for exogenous conflict resolution. Chapter 5 concludes.

1.1 Related Literature

Mutual optimism as an explanation for conflicts was initially proposed by Fearon (1995), his seminal paper that compiles rationalist explanations for war.[4] In Fearon's setup, an uninformed party proposes a division of some asset and an informed party, who might be strong or weak, defined by their probability of victory in conflict, accepts or rejects the offer. A rejection implies a conflict breaks out. A conflict only happens when the informed party is strong but the uninformed party assigns a high enough probability to the event that the informed party is weak.

Fey and Ramsay (2007) criticize mutual optimism as motive for conflicts by employing an argument similar to that of a no-trade theorem: when a party initiates a conflict, it reveals information about itself and causes the opponent to reconsider its chances of winning. Slantchev and Tarar (2011) argue that the reason conflict is not an equilibrium phenomenon in Fey and Ramsay (2007) is not related with the logic of the no-trade theorem, but some of the modelling assumptions in the paper, namely, that the

[3] This result is reminiscent of Diamond's paradox.

[4] Fearon's contribution can be seen as a rationalist reinterpretation of an earlier, irrationalist, explanation by Blainey (1988), in which agents disagree about their relative power prior to conflict.

parties can always engage in actions that prevent conflict from starting. In our model, once a party starts a conflict, the other cannot prevent it.

Our model is also related to the literature on bargaining with common value uncertainty.[5] There are some peculiarities that set our model apart, though. First, we focus on an alternative form of resolution to bargaining, conflict. We wish to understand why and how often this form of settlement happens and how it shapes bargaining. Second, common-value uncertainty usually refers to some form of uncertainty embedded in the payoff or quality of the good being bargained. When the uninformed player agrees to the terms of the bargain, they are buying a lottery in which the random variable is the payoff the good provides. In our model, war is the lottery and the aggressor only agrees to it when they agree to engage in war. At the start of the game, the aggressor is not aware of the lottery they are buying if they initiate a conflict. As it turns out, we do not see an optimistic aggressor concede along the way in equilibrium, which is a typical feature of models of bargaining with common-value uncertainty.

[5] See, e.g., Evans (1989), Vincent (1989), and Deneckere and Liang (2006).

2 Baseline Environment

Time is discrete and the horizon is infinite. There are two agents, an aggressor (A) and a defender (D), bargaining over the division of an asset of value 1. Agents' payoffs are equal to the share of the asset they receive minus costs, if any.[1] Agents have a common discount factor $\delta \in (0, 1)$.

Bargaining takes place as follows. Agent A makes take-it-or-leave-it offers and D decides whether to accept it of reject it. An offer is the share x of the asset agent A is willing to give to agent D in order to resolve the issue without confrontation. Both agents may have an opportunity to start a conflict (more on that below). War is a winner-takes-all scenario requiring resource expenditure. The winner receives the whole asset, but both agents pay a cost $c > 0$. So, the winner's payoff is $1 - c$, while the loser's payoff is $-c$.

We assume war has large unforeseen circumstances that may swing the outcome in favor of any side of the conflict. This means that both agents can win. We work with two possible types for the defender: high type (H) or low type (L), indicating the level of threat the defender represents to the aggressor in case of war. The probability of victory in a war for the defender of type $j \in \{L, H\}$ is p_j, with $1 > p_H > c > p_L > 0$ (that is, war is costly for the low type defender). The defender's type is private information.

Note that the defender of type j strictly prefers any offer $x > p_j - c$ to war. Similarly, the aggressor prefers any offer $x < p_j + c$ to war when facing a defender of type j, as the aggressor's payoff would be $1 - x > 1 - p_j - c$. So, without asymmetry of information, any offer in the interval $[p_j - c, p_j + c]$ would generate a peaceful agreement, preventing conflict in equilibrium.

The generalized version of our model considers a pair of random variables $\xi_t^j \in \{0, 1\}$, $j \in \{A, D\}$, that determines when each players has the opportunity to engage in war. When $\xi_t^j = 1$, that means that player j has the option of declaring a war in case an offer is rejected at time t. Variable ξ_t^j assumes value 1 probability λ^j and value 0 with probability $1 - \lambda^j$. The realization of each of these random variables is private information to the

[1] Another possible interpretation is that these two agents have preferences over an issue that can be resolved over an interval $[0, 1]$, with A preferring resolutions closer to 0 and D preferring resolutions closer to 1.

agent to which they pertain.[2]

The timing is as follows. At the beginning of each period t, the aggressor chooses an offer $x_t \in [0,1]$ to make to the defender. Then D chooses to accept or reject that offer. If D accepts, the asset is divided according to x_t. However, if D rejects, then Nature chooses the realization of ξ_t^D and ξ_t^A. The agents with the opportunity to do so, choose whether to engage in war or not. If no agent chooses war, then another negotiation round commences, with A again choosing an offer.

Define $x^t := (x_1, \dots, x_{t-1})$ as a public history, that is, the history of $t-1$ rejected offers. Define $h^{j,t} := (\xi_1^j, \dots, \xi_{t-1}^j)$ as a private history for agent j, that is, the history $t-1$ realizations of ξ_t^j. Since each player has two moves inside a period, strategies will be comprised of two functions, one that captures the bargaining dimension and the other that captures the conflict dimension of the game. A pure strategy for A is a sequence $\sigma^A = (\sigma_{t,1}^A, \sigma_{t,2}^A)_{t\in\mathbb{N}}$ such that $\sigma_{t,1}^A(x^t, h^{A,t}) \in [0,1]$ is A's offer after history $(x^t, h^{A,t})$ and

$$\sigma_{t,2}^A(x^{t+1}, h^{A,t}, \xi_t^A) \in \begin{cases} \{N\}, & \text{if} \quad \xi_t^A = 0 \\ \{N, W\}, & \text{if} \quad \xi_t^A = 1 \end{cases}$$

is A's decision regarding conflict, where W means declaring war and N means not declaring war.

A pure strategy for D is a sequence $\sigma^D = (\sigma_{t,1}^D, \sigma_{t,2}^D)_{t\in\mathbb{N}}$ such that $\sigma_{t,1}^D(x^t, x_t, h^{D,t}) \in \{a, r\}$ is D's decision after history $(x^t, x_t, h^{D,t})$, where a means accepting and offer and r means rejecting it, and

$$\sigma_{t,2}^D(x^{t+1}, h^{D,t}, \xi_t^D) \in \begin{cases} \{N\}, & \text{if} \quad \xi_t^D = 0 \\ \{N, W\}, & \text{if} \quad \xi_t^D = 1 \end{cases}$$

is D's decision regarding conflict.

For each $t \in \mathbb{N}$, define $q_t(x^t, h^{A,t}) \in [0,1]$ as the aggressor's posterior belief that defender is high type after $(x^t, h^{A,t})$. Since ξ_t^A is orthogonal to ξ_t^D, we have that $q_t(x^t, h^{A,t}) = q_t(x^t)$, for all $h^{A,t}$ and all t. A belief system is a sequence $q = (q_t)_{t\in\mathbb{N}}$. We look for Perfect Bayesian Equilibria (PBE).

A strategy profile $\sigma = \left(\sigma^A, \sigma^D\right)$ and a belief system q is a PBE if:

[2] We discuss the implications of this assumption later in the text.

(i) σ is sequentially rational given q;

(ii) beliefs of all players are consistent with Bayes' rule and equilibrium strategies.

3 Benchmark Model

We first analyze the one-period model, analogous to the model in Fearon (1995), and then analyze the infinite-horizon model.

3.1 Bargaining for One Period

Consider first the model with one round of bargaining. In this version, a rejection implies a war breaks out. Call q the prior belief the aggressor holds that the defender is a high type.

Define the offer that leaves the high type indifferent:

$$x_H := p_H - c$$

Note that any $x > x_H$, if offered, must be accepted by both types, since it exceeds their expected value in case of war (and a rejection implies a war breaks out for the second period). Then, any $x > x_H$ is sub-optimal, because it is strictly dominated by $(x_H + x)/2$. Observe also that any $x \in (0, x_H)$ has the same outcome, that is, a defender type H rejects the offer and a defender type L accepts the offer, resulting in payoff $q(1 - p_H - c) + (1 - q)(1 - x)$, which is strictly decreasing in the offer x. Then, any $x \in (0, x_H)$ is strictly dominated by $x/2$. War, which has expected payoff $q(1 - p_H) + (1 - q)(1 - p_L) - c$ is strictly dominated by offering zero, since the aggressor saves the cost c with probability $1 - q$.

Then, the aggressor either offers 0 or x_H in equilibrium. Notice that an offer of x_H must be accepted with probability one by both types of defender, for otherwise the aggressor could profitably deviate by offering $x_H + \varepsilon$ with $\varepsilon \approx 0$. Likewise, an offer 0 must be accepted with probability one by a low-type defender. The aggressor strictly prefers to offer x_H when

$$1 - x_H > q(1 - p_H - c) + (1 - q) \Leftrightarrow q > \frac{p_H - c}{p_H + c} =: q^*$$

The equilibrium is then characterized by a threshold belief that separates two regions. For values of q smaller than q^*, the aggressor is sufficiently optimistic and makes a low offer (zero) that is only accepted by the low type (and thus, we have war with the high type defender with probability q). For q larger than q^*, the aggressor is sufficiently pessimistic and concedes, making an offer that is accepted by both types of defender (x_H), resulting in peace with probability one. The proposition below makes explicit the mechanism of mutual optimism in the one-period game.

Proposition 3.1. *In every equilibrium, the following happens:*

(i) if $q_1 > q^* := (p_H - c)/(p_H + c)$, then A offers $x_H := p_H - c$ and the defender accepts for sure;

(ii) if $q_1 \leqslant q^*$, then A offers zero, L accepts and H rejects.

This proposition is analogous to the results of the canonical model in Fearon (1995). The aggressor agrees to engaging in war *ex ante* with probability q, even knowing that they can lose the conflict, precisely because they are optimistic about their chances of dealing with a low type defender. The high type defender, on the other hand, knows their probability of winning in conflict is high and, therefore, accepts to engage in war if the offer does not meet the value of their outside option. This is the mutual optimism mechanism at play enabling war even when gains of reaching an agreement are present.

3.2 Infinite Horizon Model

First, we examine the infinite horizon bargaining game with option of engaging in war in the hands of the defender exclusively (that is, $\lambda^D = 1$ and $\lambda^A = 0$). After a rejection, the defender chooses whether to start a conflict or not. If they do, the game ends and the winner is chosen according to the strength of the defender. If they do not, another bargaining round starts and the aggressor has another opportunity of making an offer. We show that, when the defender has the option of engaging in war, the equilibrium is very similar to the one-period bargaining games, as the defender is eager to exercise their power as soon as possible and collect a larger surplus.

Proposition 3.2. *Suppose $\lambda^D = 1$ and $\lambda^A = 0$. In every equilibrium, the following happens:*

(i) if $q_1 > q^* := (p_H - c)/(p_H + c)$, then A offers x_H in $t = 1$ and defender accepts for sure;

(ii) if $q_1 \leqslant q^*$, then A offers zero in $t = 1$, L accepts, H rejects and initiates conflict.

Proof. See Appendix.

The equilibrium in this case is very similar to what we have seen in the one-period game. The same threshold separates when the aggressor makes a concessive or an aggressive offer and there is war with the high type defender provided that the aggressor is optimistic enough.

Here, the mutual optimism device still surfaces as a cause for war because a rejection by the high type defender implies a war breaks out (this feature was forced in the one-period game by an assumption). The high type defender does so because their best (and only) way of extracting any surplus from the negotiation is by forcing their way out of it in the first period. There is no use to waiting, since the aggressor will never make an offer as good as what the defender can take through war.

Thus, when making an offer, the aggressor is confronted with the possibility of war if they make a low offer and are dealing with a high type defender. The aggressor may be willing to take on those odds if they believe that the defender is a low type with high enough probability and that is where mutual optimism comes into play again.

However, as we will show in the next chapter, this is an artificial way of introducing a dynamic component in this model. Because we left the defender with no other device but to fight, it is obvious that they will start a war if the offer is not to their satisfaction. In the next chapter we consider the opposite scenario, in which the aggressor has the option of starting wars exclusively. This analysis helps us understand how limiting the assumption that a rejection implies war can be.

3.3 Infinite Horizon with Aggressor Choosing War

Now, after a rejection, the aggressor always has the option of engaging in war (thus ending the game) or making an additional offer (that is, $\lambda^D = 0$ and $\lambda^A = 1$). We show with the proposition below that, when the aggressor has the option of engaging in war or making an additional offer after a rejection, the only PBE involves an offer of zero in the first period that is accepted by both types of defender.

Proposition 3.3. *Suppose $\lambda^D = 0$ and $\lambda^A = 1$. In equilibrium, A offers zero in $t = 1$ and the defender accepts for sure.*

In the infinite horizon model with aggressor choosing war, the scope of conflict disappears. This happens through an increase in the concession region, that is, the region in which the aggressor makes an offer that is accepted by both types, a phenomenon not unlike Diamond's Paradox. Now, for any prior belief, the game ends in immediate agreement with probability one and there is no longer room for conflict.[1]

Another interesting feature is that the size of the concessive offer shrinks to zero. Thus, the share of the pie that is appropriated by the aggressor is larger. Differently from most models of bargaining with common value uncertainty, the high type defender does not have any way to exercise their power unless the aggressor chooses to engage in war. Since the aggressor never does, neither type of defender have an outside option that could give them positive payoff. The concessive offer can then be as small as the aggressor wishes it to be.

Also unlike what we see in the related literature of bargaining with common value uncertainty, there is no delay in resolution. In environments such as Evans (1989) or Vincent (1989), it is common that the equilibrium is characterized by an increasing sequence of offers (like what we see in our model) that ends in a high enough offer that is accepted by all types of players. It is as if, after some time experimenting with low offers, the uninformed player is finally "convinced" that they are dealing with a strong counter-part and concedes. The analogous in our model would be a sequence of offers ending in x_H, which never happens.

This behavior is due to the fact that the incremental value of being a high type relative to a low type shrinks to zero as bargaining stretches to infinity (since the high type cannot freely exercise their power), differently from the literature on bargaining with

[1] Note that asymmetric information becomes irrelevant when the aggressor has the option to start a war. The outside options of both players become the same, there is a single offer made in equilibrium and there is no learning.

common value uncertainty. Thus, this version of the model does not display any delay, a feature often seen in models of bargaining with common value uncertainty.

We consider the more general version of the model, with $\lambda^D, \lambda^A \in (0,1)$, below. Define $V_H = \lambda^D x_H / \left[1-(1-\lambda^D)\delta\right]$ the expected value of waiting to engage in war for the high type defender.

Proposition 3.4. *Suppose $\lambda^D \in (0,1)$ and $\lambda^A \in (0,1)$. There exists an equilibrium with threshold $\tilde{q} = (1-\delta)V_H / \left[1-\delta-\lambda^D(1-p_H-c-\delta(1-V_H))\right]$ such that the following happens:*

(i) if $q_1 > \tilde{q}$, then A offers V_H in $t=1$ and defender accepts for sure;

(ii) if $q_1 \leqslant \tilde{q}$, then A offers δV_H in $t=1$, L accepts and H rejects. H declares war if he has the chance. Otherwise, A offers V_H in $t=2$ and H accepts.

In this version, four things happen. First, the offer that enables immediate agreement is an intermediate offer, between those of Propositions 2 and 3. This is natural, since the high type defender gets the chance of exercising their power only with probability λ^D.

Second, the low offer that is made when the aggressor is optimistic is larger different than zero. This happens because a rejection in this version of the model implies that the aggressor learns has no way of learning the type of the defender. In other words, if an offer is rejected, thinks they are dealing with a high type defender that did not have the chance of engaging in war. Therefore, if the aggressor would offer anything less than δV_H, the low defender must reject that offer with positive probability. Otherwise, they could successfully fool the aggressor into thinking they are dealing with a high type defender. This informational advantage is why the low type defender is able to extract a larger share of the surplus.[2]

[2] If the realization of ξ_t^D were observable, this informational advantage would still exist, but the low type defender would have less room for extracting surplus. This happens because the aggressor learns for certain that they are dealing with a low type defender after a rejection if the defender is called to decide whether to engage in war or not and chooses not to do so (which happens with probability λ^D). Therefore, if the aggressor would offer anything less than $(1-\lambda^D)\delta V_H$, the low defender could successfully fool the aggressor into thinking they are dealing with a high type with frequency $1-\lambda^D$. Thus, the size of the offer that is accepted in equilibrium by the low type defender is equal to $(1-\lambda^D)\delta V_H$.

Third, we can see how equilibrium payoffs for both types of defender behave as a function of λ^D. We see that for every value of λ^D, high type defender's payoff is weakly larger than the low type defender's and it increases continuously from zero to x_H as λ goes from zero to one. The low type defender's payoff however, increases continuously only for the interval $\lambda^D \in [0, 1)$. When $\lambda^D = 1$, low type's payoff falls discontinuously to zero.[3]

This means that if there is a probability that the defender may not be able to declare a war, as small as it may be, a weak adversary may use this as a device to emulate a strong opponent. We also see that, because the low type defender's payoff is equal to zero both when $\lambda^D = 0$ and $\lambda^D = 1$, the low type defender prefers scenarios in which there are some level of uncertainty regarding the opportunity to perform an attack. The high type defender, on the other hand, prefers to exercise their power with certainty.

Finally, the region that enables conflict (which is bounded by $\tilde{q}$) exhibits an interesting behavior as a function of λ^D. When the probability that the defender may start a war increases, we have two opposite effects at play: a risk effect and a wedge effect. The risk effect is the threat that a rejection now implies a war with higher probability, reducing the expected payoff of making a low offer and, thus, reducing the value of $\tilde{q}$. The wedge effect happens because, when λ^D is larger, the difference between V_H and δV_H is larger, making the lower offer more attractive and thus, increasing the value of $\tilde{q}$. Which effect will dominate (and, therefore, if the belief region that enables conflict will shrink or grow) depends on the values of parameters p_H, p_L, c and δ.

[3] This discontinuity is not present when ξ_t^D is observable. Instead, the low type defender's payoff, which is equal to $(1 - \lambda^D)\delta V_H$ initially rises, then falls continuously as a function of λ^D. It is still, however, equal to zero when $\lambda^D = 0$ and $\lambda^D = 1$.

4 Exogenous Probability of Resolution

For the following chapter, we consider the case in which there is a probability $\theta \in (0,1)$ that the negotiation is exogenously settled and the defender receives a share $\overline{x} \in (p_H - c, p_H + c)$ of the asset being bargained. Note that this resolution is strictly preferred to war by both agents.

One could think of this exogenous resolution as an international organization stepping into the conflict and settling it through diplomacy or sanctions. However, since international interference in local issues often times must be discussed and approved by the international community, this intervention is delayed every period with probability $1-\theta$. For the remainder of this chapter, define $V_R := \theta\overline{x}/\left[1-(1-\theta)\delta\right]$ to be the *ex ante* expected value of the intervention for the defender.

We re-examine the case in which the defender is the one who has the option of engaging in war below ($\lambda^D = 1$ and $\lambda^A = 0$). Now, with exogenous resolution of negotiation, we show that the scope for conflict is reduced as it may be more beneficial for the defender to wait for international intervention instead of attacking their opponent. This is shown in the proposition below, for which we consider the case where $x_H \geq V_R$.[1]

Proposition 4.1. *Suppose $\lambda^D = 1$ and $\lambda^A = 0$. In every equilibrium, the following happens:*

(i) if $q_1 > q_R^* := (p_H - c - V_R)/(p_H + c - V_R)$, then A offers x_H in $t = 1$ and defender accepts for sure;

(ii) if $q_1 \leqslant q_R^*$, then A offers V_R in $t = 1$, L accepts, H rejects and declares war.

Note that the scope for war is reduced in two different ways. If the benefit from the exogenous resolution is large enough, we have essentially the same result as in the model where the aggressor chooses war: equilibrium offers are always equal to the reservation value V_R and there is immediate agreement, leaving no room for conflict or mutual optimism.

[1] For the case with $x_H < V_R$, since the outside option of both players is equal and neither of them is interested in engaging in war, we can just apply the same argument as Proposition 6 below and get that the only equilibrium offer is $x_1 = V_R$ and it is accepted by both types.

If the benefit from exogenous resolution is small, then there is still a possibility for conflict when the aggressor is sufficiently optimistic. However, note that $q^*_R < q^*$ always, which means that the parameter interval that enables war has shrunk while the range of beliefs that result in immediate agreement has increased. This happens because the probability of exogenous resolution increases the outside option of the low type defender, thus reducing the expected payoff of making a low offer and risking war with the high type defender for the aggressor. Since the payoff from making a low offer is smaller, the optimism required for the aggressor to make this offer is larger (one could interpret this as the aggressor becoming more risk averse).

We once again look at the case with $\lambda^D = 0$ and $\lambda^A = 1$. In the proposition below, we show that the exogenous probability of resolution does not increase the probability of war in this version of the model. It does, however, promote a more equitable split of the asset.

Proposition 4.2. *Suppose $\lambda^D = 0$ and $\lambda^A = 1$. In equilibrium, A offers V_R in $t = 1$ and the defender accepts for sure.*

Therefore, introducing a new way of conflict resolution does not alter our initial result and mutual optimism again plays no role in equilibrium. The aggressor always makes the minimum offer necessary for the defender to accept and there is immediate agreement for every initial belief. The larger equilibrium offer is expected, since now the defender may always reject an offer and wait for the intervention, which bounds his payoff away from zero.

We also provide a result for this model when $\lambda^D, \lambda^A \in (0, 1)$ in the Appendix. Qualitatively, the results are the same as what we have seen above. If the value of the exogenous resolution is not too large, there is still scope for conflict as a result of mutual optimism. However, if the exogenous resolution is too attractive (or too likely), the parameter region that enables conflict in equilibrium becomes negligible.

Essentially, what we see in this version of the model is that mutual optimism is only relevant when the player wielding the threat of war has no other option to extract surplus from the negotiation. Mutual optimism is still relevant in shaping conflicts in the infinite horizon game, but only when the defender is left no other instruments but their military strength. Thus, our results point in the direction that mutual optimism, although an important ingredient in enabling conflicts, is not sufficient to promote wars when the bargaining horizon extends to infinity.

5 Concluding Remarks

We show that by itself, mutual optimism cannot generate conflicts once bargaining can take place for indefinitely many periods. The static models of conflict rely on the strong defender being able to exert their power over the other party immediately. Otherwise, the cost of carrying this impasse over time might be too large and their confidence in their ability to win the conflict no longer guarantees them a large piece of the pie. Thus, mutual optimism no longer matters in the long run.

When we allow the defender to exercise their power through war, mutual optimism becomes relevant again, but only when coupled with a lack of alternatives on the part of the defender. If given the opportunity to wait for a peaceful resolution, the defender may take that opportunity and the possibility of war due to optimistic beliefs may once again nullified.

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Appendix

Proof of Proposition 3.2 First, note that defender type H rejects any offer $x_t < x_H$, since he can always guarantee payoff $p_H - c$ for himself through war. Also, the aggressor will never offer anything larger than x_H. Then, after a rejection, H always chooses to engage in war right away (otherwise, the largest payoff they would receive would be δx_H). This means that $q_t(x^t) = 0$ for any history x^t with $t > 1$. Thus, $x_t = 0$ for any $t > 1$. Knowing this, type L must accept any offer weakly larger than zero in period $t = 1$ (if not, L may engage in war, which results in payoff $p_L - c < 0$, or wait for the next round and receive zero).

Then, any offer $x_1 > x_H$ has the same outcome as $x_1 = x_H$ (immediate agreement) and any offer $0 < x_1 < x_H$ has the same outcome as $x_1 = 0$ (L accepts and H rejects and proposes war). Thus, A offers either x_H or zero in period $t = 1$. The belief threshold that separates when each offer is more profitable is defined by:

$$1 - x_H > q_1(1 - p_H - c) + (1 - q_1) \Leftrightarrow q_1 > \frac{p_H - c}{p_H + c} =: q^*$$

Thus, A offers $x_1 = x_H$ if $q_1 > q^*$ and $x_1 = 0$ if $q_1 \leqslant q^*$. □

Proof of Proposition 3.3 Define $V_j(x^t)$ the continuation payoff of defender type $j \in \{H, L\}$ in history x^t. Define $V_j^* := \sup_{x^t} V_j(x^t) \leq 1$ and $V^* := \max_j V_j^*$. Assume by way of contradiction that $V^* > 0$. Thus, any offer δV^* must be accepted by both types of defender in any history. Then, for all x^t and j, $V_j(x^t) \leq \delta V^* \Rightarrow V_j^* \leq \delta V^*$. However, for some j_0, $V_{j_0}^* = V^*$, which implies that $V_{j_0}^* \leq \delta V_{j_0}^*$. This is only possible if $V_{j_0}^* = V^* = 0$, a contradiction. Therefore, the aggressor offers zero in the first period and both types of defender accept the offer. □

Proof of Proposition 3.4 The proof follows from guessing and verifying a set of equilibrium strategies and beliefs that enable the outcome described in the proposition. As a guess, we pose the following equilibrium strategy for the aggressor: if there exists an $x_\tau \in x^t$ such that $x_\tau \geqslant \delta V_H$, then the aggressor offers V_H; if all $x_\tau \in x^t$ are smaller than $\delta^2 V_H$, then the aggressor offers V_H if $q_t > \tilde{q}$ and δV_H if $q_t \leqslant \tilde{q}$; and if no x_τ is larger than δV_H and there exists an $x_\tau \in x^t$ larger than $\delta^2 V_H$, then the aggressor offers V_H if $q_t > \tilde{q}$, δV_H if $q_t < \tilde{q}$ and randomizes between the two if $q_t = \tilde{q}$. The aggressor never declares war.

For the high type defender, we propose that he accepts any offer larger than V_H, rejects anything smaller than V_H and declares war whenever possible. For the low type defender, we pose the following equilibrium strategy: he accepts any offer larger than δV_H

and rejects any offer smaller than $\delta^2 V_H$ for any history; if there exists an $x_\tau \in x^t$ such that $x_\tau \geqslant \delta V_H$, then he rejects any offer smaller than δV_H; if every $x_\tau \in x^t$ is smaller than δV_H, then he randomizes when offered anything between $\delta^2 V_H$ and δV_H. The low type defender never declares war.

Now, we only need to specify a belief system. We pose that $q_t(x^t) = 1$ if there exists any $x_\tau \in x^t$ larger than δV_H; and if every $x_\tau \in x^t$ is smaller than δV_H, then $q_t(x^t)$ is computed by Bayes' rule.

Now we check that this is indeed an equilibrium by showing that there are no profitable deviations for any player. Note that H always chooses war after rejection (if they have the opportunity), since x_H is larger than any offer the aggressor makes in equilibrium. Also, H has the option of rejecting every offer and waiting to engage in war, which yields payoff $\lambda^D x_H / \left[1 - (1 - \lambda^D)\delta\right] = V_H$. Thus, H rejects any offer lower than V_H. We argue that H must accept V_H in equilibrium. Suppose they do not. By the equilibrium structure we posed, the largest offer H will receive in the next period is V_H. But then, H's continuation payoff must be (weakly) smaller than $\lambda^D x_H + (1 - \lambda^D)\delta V_H = V_H$. Thus, H would be rejecting an offer that is larger than their continuation payoff, a contradiction.

Consider a history such that there exists $x_\tau \in x^t$ such that $x_\tau \geqslant \delta V_H$. Since $q_t(x^t) = 1$, the aggressor has no incentive to offer anything less than V_H (which is the offer that is accepted in equilibrium by H). Knowing that he can get continuation payoff V_H for sure, L will accept anything larger than δV_H and reject anything smaller than δV_H.

Now fix a history in which all $x_\tau \in x^t$ are smaller than δV_H. H's strategy still holds. Since H rejects any offer smaller than V_H, L cannot accept anything less than δV_H. If they did, then there would exist a profitable deviation: reject the offer and get δV_H. This happens because the aggressor does not observe the realization of ξ_t^D. Suppose then L accepts an offer smaller than δV_H. If the aggressor observes a rejection and the game reaches period $t + 1$, he thinks he is dealing with high type defender that did not have the chance to declare war. Thus, $q_{t+1}(x^{t+1}) = 1$, $x_{t+1} = V_H$ and L would have a profitable deviation.

We now argue that the aggressor does not have any profitable deviation and must offer either V_H or δV_H. Clearly, he cannot offer any $x_t \in (\delta V_H, V_H)$, as it yields the same outcome as offering δV_H, but with a lesser payoff. He cannot offer any $x_t \leq \delta^2 V_H$ either: L will reject this offer (since they can obtain at least δV_H in the next period). The aggressor is delaying the game for sure, since this offer is rejected by both types of defender, and is dominated by offering δV_H.

Suppose now the aggressor deviates by offering $\delta V_H - \varepsilon$ such that $\delta^2 V_H < \delta V_H - \varepsilon < \delta V_H$. First, note that L cannot accept $\delta V_H - \varepsilon$ for sure, otherwise, this would be a profitable deviation for the aggressor. L cannot reject $\delta V_H - \varepsilon$ either, because the maximum payoff they would get is $\delta^2 V_H$. Thus, L must accept $\delta V_H - \varepsilon$ with some probability $\alpha_t \in (0,1)$. This means that L is indifferent between accepting and rejecting, which means that the aggressor is randomizing next period's offer.

Suppose the aggressor offers V_H with probability $\beta_{t+1} \in (0,1)$ and δV_H with probability $1 - \beta_{t+1}$ in $t+1$. We can compute β_{t+1} as a function of ε:

$$\delta V_H - \varepsilon = \delta(\beta_{t+1} V_H + (1 - \beta_{t+1})\delta V_H)$$

$$\beta_{t+1} = \frac{\delta(1-\delta)V_H - \varepsilon}{\delta(1-\delta)V_H}$$

But then, the aggressor must also be indifferent between offering δV_H and V_H, which means $q_{t+1}(x^{t+1}) = \tilde{q}$. Then, we can calculate the probability of acceptance by L:

$$\tilde{q} = \frac{q_t(1-\lambda^D)}{q_t(1-\lambda^D) + (1-q_t)(1-\alpha_t)}$$

$$\alpha_t = \frac{\tilde{q} - q_t\left[1 - \lambda^D(1-\tilde{q})\right]}{\tilde{q}(1-q_t)}$$

We can now compute the payoff of offering $\delta V_H - \varepsilon$, which we call $\Pi(\varepsilon)$:

$$\begin{aligned}\Pi(\varepsilon) =& (1-q_t)\alpha_t(1 - \delta V_H + \varepsilon) + q_t\lambda^D(1 - p_H - c) + \\ & \left[q_t(1-\lambda^D) + (1-q_t)(1-\alpha_t)\right]\delta\beta_{t+1}(1 - V_H) + \\ & q_t(1-\lambda^D)\delta(1-\beta_{t+1})\left[\lambda^D(1-p_H-c) + (1-\lambda^D)\delta(1-V_H)\right]\end{aligned}$$

After some tedious algebra, we get that if $q_t \leqslant \tilde{q}$, then $\Pi(\varepsilon) < \Pi(0)$, for all $0 < \varepsilon < \delta(1-\delta)V_H$; and if $q_t > \tilde{q}$, then $\Pi(\varepsilon) < 1 - V_H$, for all $0 < \varepsilon < \delta(1-\delta)V_H$.

Now, we only need to verify that the threshold is indeed $\tilde{q}$. The aggressor prefers to offer V_H rather than δV_H when:

$$1 - V_H > q_t \left[\lambda^D(1 - p_H - c) + (1 - \lambda^D)\delta(1 - V_H)\right] + (1 - q_t)(1 - \delta V_H)$$

$$q_t > \frac{(1-\delta)V_H}{1 - \delta - \lambda^D\left[1 - p_H - c - \delta(1 - V_H)\right]} =: \tilde{q}$$

Therefore, A offers $x_t = V_H$ if $q_t > \tilde{q}$ and $x_t = \delta V_H$ if $q_t \leqslant \tilde{q}$. □

Proof of Proposition 4.1 By the same logic of Proposition 2, H rejects any offer $x_t < x_H$ and proposes war right away. Thus, $q_t(x^t) = 0$ for any $t > 1$ once again. However, now L has minimum continuation payoff V_R, since they can always reject any offer and rely on the exogenous resolution of conflict. Then, L must accept any offer weakly larger than V_R in period $t = 1$ (otherwise, L would have the option of engaging in war, getting payoff $p_L - c < 0$, or waiting for the next round and getting $\theta\overline{x} + (1-\theta)\delta V_R = V_R$).

Then, any offer $x_1 > x_H$ has the same outcome as $x_1 = x_H$ (immediate agreement) and any offer $V_R < x_1 < x_H$ has the same outcome as $x_1 = V_R$ (L accepts and H rejects and proposes war). Thus, A offers either x_H or V_R in period $t = 1$. The belief threshold that separates when each offer is more profitable is defined by:

$$1 - x_H > q_1(1 - p_H - c) + (1 - q_1)(1 - V_R) \Leftrightarrow q_1 > \frac{p_H - c - V_R}{p_H + c - V_R} =: q_R^*$$

Thus, A offers $x_1 = x_H$ if $q_1 > q_R^*$ and $x_1 = V_R$ if $q_1 \leq q_R^*$. □

Proof of Proposition 4.2 Define again $V_j(x^t)$ the continuation payoff of defender type $j \in \{H, L\}$ in history x^t. First, we argue that $V_j(x^t) \geq \theta\overline{x}/\left[1 - (1-\theta)\delta\right]$ for all j and x^t. Note that any defender can always reject every offer and get payoff

$$\frac{\theta\overline{x}}{1 - (1-\theta)\delta}$$

Thus, $V_R = \theta\overline{x}/\left[1 - (1-\theta)\delta\right]$ represents a lower bound for the continuation payoff for the defender in any history x^t.

We now argue that V_R is also the maximum continuation payoff for both types of defender in any history. Define again $V_j^* := \sup_{x^t} V_j(x^t) \leq 1$ and $V^* := \max_j V_j^*$. Assume by way of contradiction that $V^* > V_R$. Thus, any offer $\theta\overline{x} + (1-\theta)\delta V^*$ must be accepted by both types of defender in any history. Then, for all x^t and j, $V_j(x^t) \leq \theta\overline{x} + (1-\theta)\delta V^* \Rightarrow V_j^* \leq \theta\overline{x} + (1-\theta)\delta V^*$. However, for some j_0, $V_{j_0}^* = V^*$, which implies that $V_{j_0}^* \leq \theta\overline{x} + (1-\theta)\delta V_{j_0}^*$. This implies that $V_{j_0}^* = V^* \leq \theta\overline{x}/\left[1-(1-\theta)\delta\right] = V_R$, a contradiction. Therefore, the aggressor offers $x_1 = V_R$ in the first period and both types of defender accept the offer. □

Define $\hat{V}_H := \left[\theta\overline{x} + (1-\theta)\lambda^D x_H\right] / \left[1-(1-\theta)(1-\lambda^D)\delta\right]$.

Proposition .1. *Suppose $\lambda^D \in (0,1)$ and $\lambda^A \in (0,1)$. There exists an equilibrium with a threshold given by*

$$\tilde{q}_R = \frac{(1-(1-\theta)\delta)\hat{V}_H - \theta\overline{x}}{1-\delta-\theta(1-\delta)-\lambda^D\left[1-p_H-c-(1-\theta)\delta\hat{V}_H-\delta(1-\theta)-\theta+\theta\overline{x}\right]}$$

such that the following happens:

(i) if $q_1 > \tilde{q}_R$, then A offers $\hat{V}_H$ in $t=1$ and defender accepts for sure;

(ii) if $q_1 \leqslant \tilde{q}_R$, then A offers $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$ in $t=1$, L accepts and H rejects. H declares war if he has the chance. Otherwise, A offers $\hat{V}_H$ in $t=2$ and H accepts.

Proof. The proof follows very closely to what we did for Proposition 4. The equilibrium strategies we guess, however, are as follows:

For the aggressor, if there exists an $x_\tau \in x^t$ such that $x_\tau \geqslant \theta\overline{x}+(1-\theta)\delta\hat{V}_H$, then the aggressor offers $\hat{V}_H$; if all $x_\tau \in x^t$ are smaller than $\theta\overline{x}\left(1-(1-\theta)\delta\right)+(1-\theta)^2\delta^2\hat{V}_H$, then the aggressor offers $\hat{V}_H$ if $q_t > \tilde{q}_R$ and $\theta\overline{x}+(1-\theta)\delta\hat{V}_H$ if $q_t \leqslant \tilde{q}_R$; and if no $x_\tau \in x^t$ is larger than $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$ and there exists an $x_\tau \in x^t$ larger than $\theta\overline{x}\left(1-(1-\theta)\delta\right) + (1-\theta)^2\delta^2\hat{V}_H$, then the aggressor offers $\hat{V}_H$ if $q_t > \tilde{q}_R$, $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$ if $q_t < \tilde{q}_R$ and randomizes between the two if $q_t = \tilde{q}_R$. The aggressor never declares war.

For the high type defender, we propose that he accepts any offer larger than $\hat{V}_H$, rejects anything smaller than $\hat{V}_H$ and declares war whenever possible. For the low type defender, we pose the following equilibrium strategy: he accepts any offer larger than $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$ and rejects any offer smaller than $\theta\overline{x}\,(1-(1-\theta)\delta) + (1-\theta)^2\delta^2\hat{V}_H$ for any history; if there exists an $x_\tau \in x^t$ such that $x_\tau \geqslant \theta\overline{x} + (1-\theta)\delta\hat{V}_H$, then he rejects any offer smaller than $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$; if every $x_\tau \in x^t$ is smaller than $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$, then he randomizes when offered anything between $\theta\overline{x}\,(1-(1-\theta)\delta) + (1-\theta)^2\delta^2\hat{V}_H$ and $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$. The low type defender never declares war.

For the belief system, we pose that $q_t(x^t) = 1$ if there exists any $x_\tau \in x^t$ larger than $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$; and if every $x_\tau \in x^t$ is smaller than $\theta\overline{x} + (1-\theta)\delta\hat{V}_H$, then $q_t(x^t)$ is computed by Bayes' rule.

Now, we only need to proceed as we did for Proposition 4 to establish the result. □