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SOLVING INTERSTATE TERRITORIAL DISPUTES: AUTONOMOUS SOLUTION OR INTERNATIONAL ORGANIZATIONS' INTERVENTION?

DARIO MAIMONE ANSALDO PATTI E PIETRO NAVARRA

Solving Interstate Territorial Disputes: Autonomous Solution or International Organizations'Intervention?

Dario Maimone Ansaldo Patti[*] Pietro Navarra[†]

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Abstract

In international relations literature it is controversial whether international organizations can play an effective role in settling disputes among countries. In this paper, we develop a theoretical model to assess this issue. The main result of this paper is that international organizations cannot impose a better agreement than the one which countries can reach by themselves to settle their disputes. Instead, in a majority of cases, the solution proposed by the international organization in an arbitration process makes one country dissatisfied, this preventing the acceptance of that solution.

1 Introduction

During the last fifty years, the number of international organizations (IOs hereafter) grew dramatically. Across this period, they dealt with several episodes of international politics, some of which also highly dramatic as conflicts involving two or more countries. Whenever an episode involves two or more countries, IOs intervene. However, it is also

[*]Department of Economics, University of Essex.

[†]CPNSS, London School of Economics.

true that several times they have been passed over, since the actors involved in the crisis have some concerns about IOs' effectiveness. Moreover, in some cases countries took decision in contrast with the opinions expressed by IOs.

Therefore, it may seem controversial whether the IOs may play an effective role in preventing international crises and dealing with them. For instance, Abbott and Snidal (1998) point out that the international relations literature does not present a unified view about the reasons of the existence of such organizations and, consequently, about their effectiveness.

On the one hand, several contributions stress the crucial role of IOs. For instance, Angell (1913) consider them useful since they decrease countries' tendency to go to war. Also Abbott and Snidal (1998) evaluate positively the role of IOs in preventing war, since according to the authors they own two foundamental characteristics. The first one is their ability of "centralizing" a crisis in a common framework, conveying the collective activities and offering a stable institutional structure where several issues can be discussed. The second characteristic refers to their independence from a single country or a group of countries and this gives the IOs the necessary credibility to deal with international crisis. Other contributions, such as Keohane (1984) and Chayes and Chayes (1998), share the same view about IOs' ability of "centralizing" a crisis. More recently, using several case studies, Lindley (2007) highlights the fact that IOs introduce transparency in international relations, reducing the cases of miscalculations and misunderstandings. From a different point of view, but always in support of the role of IOs, Gartzke, Li and Boehmer (2001) note that such organizations increase the opportunity costs of going to war.

On the other hand, there is a large literature, mainly empirical, which underlines the fact that the IOs have a limited, and possibly an ineffective, role in preventing and managing a crisis. For instance Jervis (1982) and Schweller (2001) argue that IOs are not really effective in influencing countries' attitude toward the war. Moreover, Regan (2002) shows that outside intervention has the consequence of enlarging the duration of interstate conflicts, and Hafner-Burton and Montgomery (2006) provide evidence that membership to IOs significantly alters the distribution of social power among countries and this leads to shape the conflicts among them.

Finally, Boehmer, Gartzke and Nordstrom (2004) offers an intermediate answer to the question about the effectiveness of IOs, claiming that they may raise hostilities among countries in some circumstances, lowering them in others.

As we have noted, the international relations literature displays an ambiguous position regarding the effectiveness of IOs. That ambiguity represents the starting point of this paper, since we are going to develop a theoretical model, which allows us to assess whether outside interventions, carried out by IOs, are effective in managing countries' crises or not.

The effect of mediation on the bargaining outcome has been analysed extensively in the economic literature. For instance, Compte and Jehiel (1995) and Manzini and Mariotti (2001) focus on the role of mediation as an outside option to the bargaining process. Jarque et al. (2003) characterize the mediator as an information filter in an asymmetric environment.

The main contribution of this paper is the model itself. We propose a theoretical model, which sheds light on the ability of IOs to manage international crises. As we reported previously, a large part of the international relations literature evaluates this point from an empirical point of view, whereas we provide a theoretical framework on this issue.

We first develop a war scenario, in which two countries fight over the control of the fertile land. That model, which would be analyzed both in a symmetric and in an asymmetric setup, represents the banchmark in order to evaluate whether and under which circumstances countries may be better off finding a peaceful agreement.

We propose and compare two alternative solutions.

The first one focuses on the possibility that countries find an agreement by themselves. We model this alternative in two ways. In the first case, we apply the standard Nash bargaining problem to derive a sharing rule to divide the fertile land. In the second one, we apply a modified version of the Nash problem, namely the Nash variable threat model. Operationally, the difference between those two models consists of reverting the timing of the game. In the first case, countries defines the sharing rule and, if their negotiation are unsuccessful, they move to a war choosing how to allocate their resources between production and war. Clearly the equilibrium, which emerges in this case, is the one derived in the war scenario. In the second case, countries first decide about how much to allocate to the war and then bargain over the sharing rule. In the second case countries commit themselves to a specific distribution of resources, which must be implemented independently from the result of the negotiation. However, beyond the technical details, choosing one specification or the other has important practical consequences, as we will explain. The solution with a commitment appears to be more consistent with the reality, since it implies that, when seating at the negotiation table, each country shows its strength and exploits it during the bargaining. This does not happen when we apply the standard Nash bargaining problem since any allocation is decided after only the bargaining has been unsuccessful. When the solution with commitment is chosen, the distribution of the resources between production and war enters directly into the bargaining problem as a deterrence tool to force the bargaining outcome in favor of one country or the other.

The second solution, which we propose, consists of calling an IO as an arbitrator in the dispute. It should be remarked that the arbitrator sets an agreement, which countries may either accept or reject. Its role is different from the one, which a mediator may play, since the latter intervenes strategically in the dispute offering several possible solutions until all the parties accept one.[1]

It may be argued whether it is realistic to call an arbitrator in a dispute, since in this case countries give up their bargaining power, which is entirely held by the arbitrator. An example, which may be consistent with our model, is the following. Let

[1] See Muthoo (1999) for an explanation about the difference between arbitrator and mediator. Mediation in a strict sense implies a process of offers and counter-offers, mediated by a third party until both countries agree on a solution. Binmore, Rubinstein and Wolinsky (1986) and, more recently, Wilson (2001) show that under some circumstances the solution to the offers and counter-offers process converges to the Nash bargaining solution. In our paper the latter is the solution to the attempt of countries to reach an agreement without the intervention of a third party. Therefore, the solution reached by a mediator is quantitatively not different from the one reachable by parties, the only difference being possibly the waste of time embodied in the offers/counter-offers process.

us consider two poor countries, whose relations are deteriorating. Let us also assume that an IO is willing to offer some economic aid which may improve significantly their conditions. The economic aid offer is subject to the acceptance of a peaceful settlement of their dispute, which the IO imposes to them. Under those circumstances, the IO holds the necessary power to impose an agreement, which is meant to be in the interest of both countries, whereas countries need to give up their bargaining power if they want to improve their conditions. Clearly, they still have the chance of rejecting the agreement. However this option can be risky due to the loss of the economic aid.[2]

We compare the agreement, which countries reach by themselves, with the one imposed by the arbitrator. As we will make clear in the following analysis, the intervention of an IO is not always necessary. Instead, countries may find a suitable agreement by themselves, which makes them both satisfied, whereas the agreement imposed by the arbitrator generally leaves at least one country dissatisfied. Only under some specific circumstances and given some values of the parameters of the model, the two solution may be identical.

The paper is organized as follows. In the next section, we highlight the main feature of the model, while in section 3.3 we discuss the implications, which stems from the decision of solving the territorial dispute moving to war. We analysis the implication of the war both in a symmetric and in an asymmetric context, assuming that countries differ in their skills. Since the war is the default way to settle the dispute, we will use it as a benchmark in order to evaluate the alternative solutions, which we propose. In section 3.4, they are analysed. We consider the case in which countries find an agreement by themselves. In section 3.5 we study the consequences of an outside intervention, which takes the form of arbitration. In section 3.6 we compare the two different solutions to avoid the fight and in section 3.7 we conclude.

[2]It should be noted that in our analysis we focus on the peacekeeping activity of the IO and not on the peacemaking one, i.e. on the activity which prevents a conflict. For a better distinction between those two activities see Camina and Porteiro (2007).

2 Model Framework

Let us consider two countries, 1 and 2. They produce a consumption good, y, using a production input taken from an initial endowment, normalized to unity, and some fertile land under their control. More specifically:

$$y_i = \alpha_i r_i K_i \tag{1}$$

where α_i is a positive parameter, which measures the state of the productive technology of country i, r_i is the production input, taken from an initial endowment which is normalized to unity, and K_i is the extension of available fertile land. In the simplified world, which we consider in this model, the amount of consumption good can be thought as also being the wealth of each state.

The distribution of K is different. Country 1 owns less fertile land than its opponent. More specifically:

$$K_1 < K_2 \tag{2}$$

We assume that a territorial dispute arises between countries and, as recalled in the previous section, the default method to solve it is to go to war. Bearing in mind this perspective, countries divide their initial endowment between two alternative uses. A share of it is mobilized for the production of the consumption good, while the remaining part is allocated for the conflict. Therefore, we have:

$$1 \geq r_i + f_i \tag{3}$$

where f_i represents the share of endowment, allocated for the fight.

The possibility of war makes the possess of land insecure. The availability for each country, in fact, depends on their military efforts. When countries settle the territorial dispute by fighting, country i would obtain the following amount of land:[3]

$$\left[K_i - \left(p_j^A - p_i^D\right) K_i + \left(p_i^A - p_j^D\right) K_j - c\right] \tag{4}$$

[3] In determining the amount of land available to country i, I use a partially modified version of the specification contained in Gartzke and Rohner (2006).

where p_i^A, p_i^D, p_j^A and p_j^D $\forall i, j = 1, 2$, ranging between 0 and 1, measure the effectiveness of country i and j in attacking and defending, $\left(p_i^A - p_j^D\right)$ indicates the probability that country i is successful in the appropriation activity and c is a fixed amount of land, which becomes unproductive after the war. To keep things simple, each country faces the same cost of war in terms of land destruction. Therefore, c does not vary. According to this fact, it follows that, after the war, the total amount of land, which can be employed in the production of the consumption good, is equal to $K_1 + K_2 - 2c$. In order to make sure that there exists always some positive amounts of fertile land available after the war, we make the following assumption on the parameter c:

$$c \leq \frac{K_1 + K_2}{3} \tag{5}$$

which implies that the war does not destroy all the fertile land.

In general terms, equation (4) has the following interpretation. At the end of the war, country i's amount of land is equal to K_i diminished by the portion of land lost in the war, $\left(p_j^A - p_i^D\right) K_i$, but augmented by the amount of land taken from its opponent, $\left(p_i^A - p_j^D\right) K_j$. As recalled, a fixed portion of territory, c, cannot be used since the war made it unproductive.[4]

The probability of successful appropriation is calculated as the difference between the attacking capability of country i and the defensive skills of its opponent. In order to keep things meaningful, we introduce the following condition:

$$p_i^A \geq p_j^D \tag{6}$$

Two reasons justify the previous assumption. The first one consists of ruling out the event of a negative probability, which is clearly meaningless. The second justification refers to the opportunity of making war an appealing option. As a matter of fact Assumption (6) is well-consistent with the scenario of a war. As Quester (1977), Jervis (1978) and Van Evera (1998) point out the offensive advantage makes the war more likely as well as the international system less peaceful. On the other hand, as Jarvis

[4]This assumption, which is fairly standard in conflict theory literature, remarks the cost of the war. In our model choosing to go to war has two negative effects. First, it reduces the amount of resources allocated to the production. Second, it makes unproductive a portion of land.

(1978) stresses, "...when the defense has the advantage, it is easier to protect and to hold than it is to move forward, destroy and take" (p. 187). In this case the war would be less appealing. Moreover, another important issue embodied in our model is the clear distinction between attacking and defensive phase. As a consequence of this fact, if attacked, a country may only defend its territory, but it cannot counterattack at the same time.[5]

We model explicitly the attacking and defensive skills of a country as a linear function of the resources mobilized for the war. Moreover, even if a country allocates all its resources for its military scopes, it does not mean that its attacks and/or defense are, in fact, effective. Instead, this depends also on its ability of attacking and defending. Taking all those issues into consideration, we have:

$$p_i^A = \beta_i f_i \tag{7}$$

$$p_i^D = \gamma_i f_i \tag{8}$$

where $0 < \beta_i \leq 1$ and $0 < \gamma_i \leq 1$ capture country i's attacking and defending skills. It can be noted that a full effectiveness in attacking and defending can be reached if and only if a country allocates all its endowment for the war *and* it has the highest attacking/defending skills.

It is also important to underline that country i's probability of being successful in the appropriation of the opponent's territory, $\left(p_i^A - p_j^D\right)$ is increasing in the amount of resources, which it allocates for the war, and decreasing in the allocation of country j.

Through the paper, we make use of the following assumption about the technologies owned by countries:

$\beta_1 > \beta_2 > \gamma_1 > \gamma_2$, $(\beta_1 - \gamma_2) > (\beta_2 - \gamma_1)$ and $\left(\beta_i - \gamma_j\right) \leq \frac{1}{2} \forall i, j = 1, 2$ and $i \neq j$.

Previous assumption puts some restrictions on military skills of countries. The first inequality highlights that in general the attacking abilities are more effective than the defensive ones. However, as the second inequality clarifies, country 1 has a larger chance of being effective than its opponent's, when it attacks. Finally the third inequality in

[5] This assumption simplifies our model but, at the same time, it is consistent with the conflict theory literature. For instance Grossman (2004) makes a clear distinction between attack and defense.

the assumption avoids the possibility that one country's attacking skills are so much better than the result of any attack is easily predictable.

Moreover Assumption 3.1 sheds light on the reason why a war can be considered a likely event. As Powell (1999) points out, it is a consequence of the dis-alignment between the distribution of the benefits - the fertile land in this case - and the underlying distribution of the power. While country 1 is dissatisfied with the current situation, country 2 is not. However, since the former is more powerful than the latter, the war becomes an almost inevitable event.

In the next section, we characterize the equilibrium, when countries go to war. As we clarified earlier, we use that result as a benchmark for the following analysis, in which we consider some alternative options in order to avoid war. In particular, we focus on the possibility that countries find an appropriate agreement by themselves and also on the case in which they call for the intervention of a third party in the dispute. However, as we pointed out in the introduction, there is not an unambiguous view in international relations literature about the effectiveness of the intervention of a third party, which usually is an IO. The formal model, which we develop in the following sections, should shed lights on this issue.

For sake of clarity, we must point out that in the following analysis we make the assumption that countries share a perfect information about the main parameters of the model.

3 Modelling the war

When countries go to war to settle their territorial dispute, they play a simultaneous move game, in which they choose the optimal allocation of their initial endowment between two alternative uses. It is important to stress the trade-off embodied in this choice. If a country mobilizes too many resources for the war, its chance of being successful in the appropriation activity and defending its territory would increase. Nonetheless this choice reduces the disposal of production input, which, in turn, decreases the amount of (expected) wealth. In other words, countries are asked to balance between the two different uses in order to maximize their (expected) amount of consumption good. This problem is very frequent in international relations. Allocating more resources for the production brings a *direct* effect for each country, while using more resources for the war has an *indirect* effect on their wealth. On the other hand, if a country prefers to put more effort in the production of the commodity good, it will be more insecure and exposed to an external threat. Solving this dilemma is the focus of each country in the real world, as Powell (1993) points out.

4 The symmetric setup

We start our analysis by modelling a scenario in which countries have the same skills. In other words, we do relax the assumptions which we have described in the previous section. This implies, for instance, that the defensive and the attacking abilities of each country depend only on the allocation of the initial endowments to the war. In this way, we can characterize a benchmark model, which can be useful in our following analysis.

Substituting equations (3.7) and (3.8) into the production function, taking in consideration symmetry between countries and rearranging, the objective function of each country can be specified as follows:

$$y_i = \alpha r_i \left\{ \left[1 - (f_j - f_i)\right] K_i + (f_i - f_j) K_j - c \right\}$$

As clarified earlier, the probability of being successful in the fight depends on each country's allocation to the war. Using the endowment constraint, we can derive the following pair of reaction functions:

$$\begin{aligned} BR_1(f_2) &= \frac{1}{2} - \frac{K_1 - c}{2(K_2 + K_1)} + \frac{1}{2} f_2 \\ BR_2(f_1) &= \frac{1}{2} - \frac{K_2 - c}{2(K_2 + K_1)} + \frac{1}{2} f_1 \end{aligned}$$

Solving the previous pair of equations yields countries' allocations to the war:[6]

$$f_1^{SYM} = \frac{K_1 + 2K_2 + 3c}{3(K_1 + K_2)}$$
$$f_2^{SYM} = \frac{2K_1 + K_2 + 3c}{3(K_1 + K_2)}$$

It is interesting to note that the allocation of resources to the war depends on the extension of the fertile land available to each country. More specifically, if we accept the assumption (3.2), namely that $K_2 > K_1$, then country 1 would allocate more resources to the war than country 2. This is due to the fact that who owns the larger portion of fertile land finds more efficient to allocate resources to the production, since the opportunity cost of the alternative use is high.

If we relax also that assumption and assume a full symmetry, countries allocate the same amount of resources to the war. This case is very peculiar: If $f_1^{SYM} = f_2^{SYM}$, then each country obtains the same amount of expected consumption good. However, most importantly, if they allocate the same amount of resources to the war, we have:

$$y_i^{SYM} = \alpha r_i^{SYM} (K_i - c) \quad \forall i = 1, 2$$

In other words in equilibrium the war has the only consequence of reducing for each country the amount of fertile land and, possibly, the war becomes a less likely outcome, since a country cannot expect to defeat the opponent. In terms of the balance of power theory of war, when two countries have the same strength, then a peaceful but armed outcome may prevail.

5 The asymmetric setup

5.1 The consequences of asymmetric attacking skills

In this subsection, we describe the characterization of our model considering the case in which countries differ in their attacking skills, using the assumption that $\beta_1 > \beta_2$. Rearranging the objective function accordingly, we have for country i:

$$y_i = \alpha r_i \left\{ \left[1 - \left(\beta_f f_j - f_i\right)\right] K_i + \left(\beta_i f_i - f_j\right) K_j - c \right\}$$

[6] We use the superscript "SYM" to distinguish the equilibrium in a symmetric environment.

Using the endowment constraint, maximization of the objective function yields:

$$BR_1(f_2) = \frac{[\beta_1 K_2 + (K_2 + \beta_2 K_1) f_2 + c]}{2(K_1 + \beta_1 K_2)}$$
$$BR_2(f_1) = \frac{[\beta_2 K_1 + (K_1 + \beta_1 K_2) f_1 + c]}{2(K_2 + \beta_2 K_1)}$$

From the previous pair of equations, we may obtain the equilibrium values in this (partially) asymmetric setup, i.e.:[7]

$$f_1^{PASY} = \frac{2\beta_1 K_2 + \beta_2 K_1 + 3c}{3(K_1 + \beta_1 K_2)}$$
$$f_2^{PASY} = \frac{2\beta_2 K_1 + \beta_1 K_2 + 3c}{3(K_2 + \beta_2 K_1)}$$

Clearly, the main difference between the symmetric equilibrium and the one derived in this subsection relies on the role played by the coefficients referring to the attacking skills. As it can be easily noted, the more effective are the attacking skills of a country, the more its opponent prefers to allocate a larger share of resources to the war. More specifically, allowing for asymmetry between countries may introduce a certain degree of instability in their relations. While in the previous symmetric scenario, the war becomes less likely since, in expected terms, countries share the same probability of success, in this case one country has a higher chance of success. In other words, breaking the equilibrium alters the balance of power between countries and if there exists a dis-alignment between the distribution of the power and the distribution of the wealth, the war becomes a more likely outcome.

The asymmetric distribution of the resources between production and war gives rise to a different probability of success and consequently to a different expected amount of consumption good.

5.2 The equilibrium in a fully asymmetric setup

In this subsection we develop a fully asymmetric model in which countries differ both in their attacking and defensive skills. This fact introduces a further difference, which

[7] We use the superscript "$PASY$" to define the equilibrium, which we have obtained, in such an asymmetric environment. We speak of a partially asymmetric equilibrium since it we are considering only a difference in the attacking skills.

is important to evaluate the allocation decisions of each country. As a matter of fact, in this case allocating more resources to the war may not be effective, since the defensive skills may make any attacking decision ineffective. Therefore, in this subsection we resume all the assumptions of the model, specified in the previous sections and characterize the equilibrium, which we are going to use in our following analysis.

Substituting equations (7) and (8) into the production function and rearranging, we obtain the objective function of each country if they move to the war:

$$y_i = \alpha_i r_i \left\{ \left[1 - \left(\beta_j f_j - \gamma_i f_i\right)\right] K_i + \left(\beta_i f_i - \gamma_j f_j\right) K_j - c \right\} \tag{9}$$

Using the constraint (3) into the previous equation for r_i, we can derive countries' reaction functions in terms of the the optimal choice of the opponent:

$$BR_1\left(f_2\right) = \frac{1}{2} - \frac{K_1 - c}{2\left(\beta_1 K_2 + \gamma_1 K_1\right)} + \frac{\left(K_1 \beta_2 + \gamma_2 K_2\right)}{2\left(\beta_1 K_2 + \gamma_1 K_1\right)} f_2 \tag{10}$$

$$BR_2\left(f_1\right) = \frac{1}{2} - \frac{K_2 - c}{2\left(\beta_2 K_1 + \gamma_2 K_2\right)} + \frac{\left(K_2 \beta_1 + \gamma_1 K_1\right)}{2\left(\beta_2 K_1 + \gamma_2 K_2\right)} f_1 \tag{11}$$

It is straightforward to note that country i's reaction function is upward-sloping with respect to the allocation of its opponent. This implies that the more resources it allocates for the war, the more country j will do. This fact can give rise to an arms race, which can be harmful for the welfare of the involved countries. The choice of enlarging the amount of resources allocated for the war following the opponent's choice is frequent in the real world. For instance, the behavior of US and USSR during the Cold War are a clear example of it. More recently, the same situation characterized the relations between India and Pakistan and their nuclear race.

Substituting equation (11) into (10) and using the constraint (3), we can characterize the equilibrium allocation of the resources between production and war when countries fight for the control over the fertile land:

Proposition 1 *The unique Nash equilibrium of the war game is given by the following* *allocations for country* 1 *and* 2 *respectively:*

$$f_1^* = \frac{2}{3} - \frac{K_1(2-\beta_2) + K_2(1-\gamma_2) - 3c}{3(\beta_1 K_2 + \gamma_1 K_1)} \tag{12}$$

$$r_1^* = \frac{1}{3} + \frac{K_1(2-\beta_2) + K_2(1-\gamma_2) - 3c}{3(\beta_1 K_2 + \gamma_1 K_1)} \tag{13}$$

$$f_2^* = \frac{2}{3} - \frac{K_2(2-\beta_1) + K_1(1-\gamma_1) - 3c}{3(\beta_2 K_1 + \gamma_2 K_2)} \tag{14}$$

$$r_2^* = \frac{1}{3} + \frac{K_2(2-\beta_1) + K_1(1-\gamma_1) - 3c}{3(\beta_2 K_1 + \gamma_2 K_2)} \tag{15}$$

Differently from the previous subsections, it is not trivial to evaluate the relations between the equilibrium values and the main parameters of the model, since we need to take into consideration both the attacking and the defensive abilities of each country. Let us consider how the allocation choice of country 1 changes when its military skills and the extension of its amount of fertile land vary. First we evaluate the impact of a change in the attacking and defensive skills. Differentiation yields:

$$\begin{array}{l} \frac{\partial f_1^*}{\partial \beta_1} = \frac{K_2[K_1(2-\beta_2)+K_2(1-\gamma_2)-3c]}{3(\beta_1 K_2+\gamma_2 K_1)^2} \lesseqgtr 0 \\ \frac{\partial f_1^*}{\partial \gamma_1} = \frac{K_1[K_1(2-\beta_2)+K_2(1-\gamma_2)-3c]}{3(\beta_1 K_2+\gamma_2 K_1)^2} \lesseqgtr 0 \end{array} \tag{16}$$

It can be easily noted that if the cost of the war was equal to 0, country 1 would increase the percentage of the endowment employed for the war, as its military skills improve. However, as we specified earlier, the war is costly. It can be shown that in this case country 1's optimal allocation for the war increases if and only if the defensive capabilities of its opponent are sufficiently low, namely $\gamma_2 < \bar{\gamma}_2$, where the latter indicates a threshold value.

On the contrary if $\gamma_2 > \bar{\gamma}_2$, country 1 prefers to reduce its efforts for the fight, since it is more convenient to employ more resources for the production of the commodity good, since attacking may not be so effective. It is worthwhile to stress again that this decision is undertaken since the war represents an inefficient option given the high cost in terms of unproductive land, which it generates, and the sufficiently high defensive skills of the other contestant.

Instead, if the amount of the initial fertile land is larger, unambiguously country 1 prefers to allocate more resources for the production as the following derivative witnesses:

$$\frac{\partial f_1^*}{\partial K_1} = -\frac{K_2\left[\beta_1\left(2-\beta_2\right)-\gamma_1\left(1-\gamma_2\right)\right]+3\gamma_1 c}{3\left(\beta_1 K_2+\gamma_1 K_1\right)^2} < 0 \tag{17}$$

Clearly, similar results hold, if we consider the relations between f_2^* and β_2, γ_2 and K_2. Therefore, putting together equations (16) and (17) we can derive the following result:

Proposition 2 *If the war is sufficiently costly and a country increases its military abilities, it allocates more (less) resources for the war if its opponent has sufficiently low (high) defensive skills. Instead, if the amount of fertile land available enlarges, it prefers to allocate more resources for the production.*

Proof. In the appendix. ■

Some other interesting issues emerges from the analysis of the relations between f_1^* and the military attitudes of its opponent. It straightforward and not surprising the fact that an increase in β_2 and γ_2 brings to a larger allocation of resources for the war as the following derivatives clarify:

$$\frac{\partial f_1^*}{\partial \beta_2} = \frac{K_1}{3\left(\beta_1 K_2+\gamma_1 K_1\right)} > 0 \tag{18}$$

$$\frac{\partial f_1^*}{\partial \gamma_2} = \frac{K_2}{3\left(\beta_1 K_2+\gamma_1 K_1\right)} > 0 \tag{19}$$

Instead it is more interesting to note how country 1 reacts to a change in K_2. The following derivative sheds light on this point:

$$\frac{\partial f_1^*}{\partial K_2} = \frac{K_1\left[\beta_1\left(2-\beta_2\right)-\gamma_1\left(1-\gamma_2\right)\right]-3c\beta_1}{3\left(\beta_1 K_2+\gamma_1 K_1\right)^2} \tag{20}$$

It can be noted again that if the cost of the war is equal to 0, any enlargement in the amount of the fertile land owned by country 2 would increase the optimal value of f_1^*.

On the contrary, if the cost of the war is the highest possible, the derivative is negative. It follows that for sufficiently high values of c, country 1 prefers to reduce the amount of resources allocated for the war in order to increase the production of the commodity good.

It should be noted that this choice is perfectly consistent with the decision that country 2 takes if K_2 becomes bigger and with the upward-sloping relation between countries' reaction functions. We note from Proposition 3.2 that country 2 reacts to an increase in its amount of fertile land by reducing the share of the endowment mobilized for the war. Therefore, in the light of the action taken by its opponent and the characteristics of the reaction functions, it is understandable why country 1 decreases the amount of f_1^*. Other things being constant, this fact may not affect the probability of winning the war, but according to the changes in f_1^* and f_2^*, determined by an enlargement in K_2, country 1's probability of success may even increase. The positive consequence of that new allocation of the endowments is that country 1 may make more resources available for the production of the commodity.

Using together equations (18) to (20), we can state the following result:

Proposition 3 *If the military skills of a country become more effective, its opponent allocates more resources for the war. Instead if the cost of the war is sufficiently high and the fertile land controlled by a country becomes larger, its opponent reduces the share of the endowment employed in the fight.*

Proof. In the appendix. ■

It may be remarked that some of the previous results hold, other things being constant. For instance, we noted that a change in K_1 leads to a reallocation of the endowment in favor of the production. However this result is reverted if the change in the land is followed by an increase in β_2. In this case, we have:

$$\frac{\partial f_1^*}{\partial K_1 \partial \beta_2} = \frac{\beta_1 K_2}{3\left(\beta_1 K_2 + \gamma_1 K_1\right)^2} > 0 \tag{21}$$

On the other hand, if country 2 becomes more effective in defending than attacking, then, again, a change both in K_1 and in γ_2, has the effect of reducing the share of resources allocated for the war:

$$\frac{\partial f_1^*}{\partial K_1 \partial \gamma_2} = -\frac{\gamma_1 K_2}{3\left(\beta_1 K_2 + \gamma_1 K_1\right)^2} < 0 \tag{22}$$

In the first case, equation (21), the allocation of more resources for the war is necessary to defend the territory from the opponent's more vigorous attacks. Instead, in the second case, equation (22), the increase in γ_2 makes it less convenient to allocate more resources to the war. Therefore, the result in (17) is confirmed and further supported.

Substituting equations (12) to (15) into the production functions, we derive the amounts of consumption good that each country is expected to obtain after the conflict, i.e.

$$y_1^* = \frac{\alpha_1 \left[K_1 \left(2-\beta_2+\gamma_1\right)+K_2 \left(1+\beta_1-\gamma_2\right)-3c\right]^2}{9\left(\beta_1 K_2+\gamma_1 K_1\right)} \quad (23)$$

$$y_2^* = \frac{\alpha_2 \left[K_2 \left(2-\beta_1+\gamma_2\right)+K_1 \left(1+\beta_2-\gamma_1\right)-3c\right]^2}{9\left(\beta_2 K_1+\gamma_2 K_2\right)} \quad (24)$$

Proposition 4 *After the war, when country* 1 *is sufficiently strong compared to its opponent, it owns the largest amount of fertile land. Also the consumption good, which it enjoys, is bigger than the one obtained by country* 2*.*

Proof. See the appendix. ■

Proposition 3.4 focuses on the main issue of the problem under analysis and gives a justification to the war. As recalled earlier, the war is the natural consequence of the inconsistency between the distribution of the power and the underlying benefit. As international relations theory highlights,[8] the dissatisfied country prefers to go to war in order to obtain the realignment between power and benefits. This is particularly true, when, as in our case, the dissatisfied country is also the most powerful. In the light of the characterization of the war game in this section, it is interesting to evaluate how the relation between a superpower and a rising one may develop. The equilibrium derived earlier lets us to infer how their relations may deteriorate.

[8] Referring to satisfied and dissatisfied countries is quite common in international relation, as Schweller (1996) points out. However, authors sometimes qualify countries differently.

6 A peaceful settlement of the dispute: the autonomous solution

Proposition 3.4 confirms that a war is appealing for the dissatisfied country. Therefore, given the lack of any specific constraint on its choices,[9] country 1 may decide to attack to modify the status-quo. Nonetheless, the war has the side effect of making a portion of the territory unproductive, which, in turn, implies a reduction of the global amount of y.

Hence, it is interesting to investigate an alternative to the war, such that countries may find an agreement in order to avoid it. However, finding such an agreement is not trivial, since it should satisfy both countries at the same time.

As a matter of fact, the agreement must make the dissatisfied country not interested anymore in the war, but at the same time it should not impose on country 2 to give up more land than it would do after the war. Any larger concession lowers country 2's interest in a peaceful settlement of the dispute.

Figure 3.1 allows us to evaluate and clarify the point under discussion. Point x represents the status quo. Country 1 controls the territory to the left of x, which corresponds to the initial amount of fertile land, K_1, while the remaining part to the right of the status quo is under country 2's control.

After the war, as Proposition 3.4 clarifies, the distribution of the land has been completely reverted. The partition is indicated by the point x^*. Country 1 now controls a share of territory, which is equal to $K_1^* \equiv (1-\pi_2^*)\,K_1 + \pi_1^* K_2$, where $\pi_1^* \equiv (\beta_1 f_1^* - \gamma_2 f_2^*)$ and $\pi_2^* \equiv (\beta_2 f_2^* - \gamma_1 f_1^*)$. The remaining part of the land to the right of x^* is at country 2's disposal. The dashed portions at the extremes of the line $K_1 + K_2$ indicates the fraction of land, which is still under the control of both countries but it is unproductive after the war.[10]

[9] This is due to the fact that, as Oye (1985) points out, international relations are a valid approximation of the state of nature.

[10] The points indicated in the picture and, consequently, the partition of the fertile land do not rely on some specific values of the parameters of the model. Instead, they represent a graphical interpretation of the intuition contained in Proposition 4.

If countries want to find an agreement and to avoid the conflict, the agreement should assign to country 1 at least the same amount of territory that it obtains after the war. Any other partition would make at least one country dissatisfied and the war unavoidable.

In this section we derive and analyze the conditions, which allow countries to strike such an agreement. We characterize an *autonomous* solution, which is reached without the intervention of a third party. Moreover, we consider two alternative ways to reach such an agreement and discuss which of them is more suitable.

In the next section we introduce a third party, namely an IO, which is assigned the task of finding an appropriate solution to solve the territorial dispute.

It should be remarked that the analysis focuses only on actions, which aims at preventing a conflict. While some other contributions, such as Camina and Porteiro (2007), take into account also the role of mediation within a conflict (*peacemaking*), we deal with *peacekeeping* only, namely, with actions, which take place before the conflict in order to prevent it.

6.1 The autonomous solution with commitment

If struck, the agreement gives country 1 a share τ of all fertile land, $K_1 + K_2$, while the remaining is assigned to its opponent. Therefore, their production functions are, respectively:

$$
\begin{aligned}
y_1 &= \alpha_1 r_1 \tau \left(K_1 + K_2\right) \\
y_2 &= \alpha_2 r_2 \left(1 - \tau\right) \left(K_1 + K_2\right)
\end{aligned}
$$

It is important to stress that within this framework countries are allocating resources to both the production of the consumption good and the war. As a matter of fact, we suppose that at the beginning of the negotiation process, countries *commit themselves* to a specific distribution of their endowments between production and war. Moreover, that distribution cannot be changed in the future.

In other words, given the production functions and the availability of fertile land after the agreement, countries commit themselves to a distribution of resources between

r_i and f_i in order to maximize their production functions. After that commitment, they bargain to define the sharing rule to divide the fertile land.

Therefore, the timing of the can be described as follows:

1: Countries commit to a distribution of resources, in order to maximize the amount of consumption good given a potential share of fertile land;

2: They determine the sharing rule to divide the fertile land.

Second Stage

The game is solved starting from the determination of the optimal sharing rule. In order to derive it, we set the following Nash bargaining problem (NBP, hereafter):

$$\max_{\tau} \{\alpha_1 r_1 \tau (K_1 + K_2) - \alpha_1 r_1 [(1 - \pi_2) K_1 + \pi_1 K_2 - c]\} \times \\ \{\alpha_2 r_2 (1 - \tau)(K_1 + K_2) - \alpha_2 r_2 [(1 - \pi_1) K_2 + \pi_2 K_1 - c]\} \tag{25}$$

where $\alpha_i r_i [(1 - \pi_j) K_i + \pi_i K_j - c]$ $\forall i, j = 1, 2$ and $i \neq j$ characterize the set of the disagreement points, indicating the amounts of consumption good, which are obtained by countries if they do not reach an agreement.

The structure of the game, which we are analyzing, is slightly different from a standard NBP. In the latter case, the set of disagreement points is fixed and in the context under analysis it would be the outcome of the war game, characterized in the previous section. Instead in the problem set above the disagreement points represent *variable threats*. This difference is a direct consequence of countries' commitment at the beginning of the negotiation.

When the set of the disagreement points is not fixed but varies according to players' strategic choices, the NBP changes into a Nash variable threat (NVT, hereafter) model. Nash (1953) extends the standard NBP, in order to encompass the possibility that players may affect the outcome in the case in which an agreement is not reached. As Osborne and Rubinstein (1990) clarify, the important implication of the NVT is that when countries commit themselves to a specific distribution of the resources, the pair of threats, which come from that choice, must be carried out, even though they are not necessarily a Nash equilibrium of the war game. Moreover, the threat points are now determined in such a way, that each country chooses its own, taking into account the optimal choice of its opponent.

There are two important consequences embodied in the use of a NVT. The first has been highlighted above and refers to the fact that $r_i < 1$, even though countries do not necessarily go to war. The second consequence relies on the observation that when committing themselves to a specific allocation of the endowment, they should take carefully into account two trade-offs, which make their choices complex. One one hand, more resources for the war can be a valid threat against the opponent, when countries bargain to find the most appropriate sharing rule. However, too many resources for the fight can be effective to gain a larger portion of fertile land, but inefficient for the future production of the commodity good. On the other hand, when committing themselves to a specific allocation, countries need to take into consideration a second and similar trade-off between production and fight, which occurs in the event of a future war.

Rearranging equation (25), we can write the NVT in a more compact way:

$$\begin{aligned} \max_{\tau} NTV \equiv \; & \alpha_1 r_1 \left\{ K_2 \left[\tau - \pi_1 \right] - K_1 \left[(1-\tau) - \pi_2 \right] + c \right\} \times \\ & \alpha_2 r_2 \left\{ K_1 \left[(1-\tau) - \pi_2 \right] - K_2 \left[\tau - \pi_1 \right] + c \right\} \end{aligned} \tag{26}$$

Maximization yields:

$$\begin{aligned} & \alpha_1 r_1 \left(K_1 + K_2 \right) \alpha_2 r_2 \left\{ K_1 \left[(1-\tau) - \pi_2 \right] - K_2 \left[\tau - \pi_1 \right] + c \right\} \\ = \; & \alpha_1 r_1 \left\{ K_2 \left[\tau - \pi_1 \right] - K_1 \left[(1-\tau) - \pi_2 \right] + c \right\} \alpha_2 r_2 \left(K_1 + K_2 \right) \end{aligned}$$

Rearranging we obtain the shares that each country enjoys in the case of an agreement, i.e.:

$$\tau = \frac{K_1}{K_1 + K_2} + \frac{\pi_1 K_2 - \pi_2 K_1}{K_1 + K_2} \tag{27}$$

$$(1-\tau) = \frac{K_2}{K_1 + K_2} + \frac{\pi_2 K_1 - \pi_1 K_2}{K_1 + K_2} \tag{28}$$

The interpretation of equations (27) and (28) is straightforward: each country receives a share of the total fertile land, which is equal to the one it originally controls, augmented/diminished by a fraction, directly dependent on how successful each of them is in the conflict.

First Stage

We can now turn back to the first stage of the game in order to derive the optimal allocation of resources between production and war. Substituting the corresponding values for τ and $(1-\tau)$ in the production functions, we obtain:

$$y_1 = \alpha_1 (1-f_1) \{[1-(\beta_2 f_2 - \gamma_1 f_1)] K_1 + (\beta_1 f_1 - \gamma_2 f_2) K_2\} \tag{29}$$
$$y_2 = \alpha_2 (1-f_2) \{(\beta_2 f_2 - \gamma_1 f_1) K_1 + [1-(\beta_1 f_1 - \gamma_2 f_2)] K_2\} \tag{30}$$

It is interesting to note that equations (29) and (30) are identical to the one derived in the war game, with the exception of the parameter c, which measures how much land is made unproductive after the war. Maximization yields the following equilibrium allocations of resources:[11]

$$f_1^{**} = \frac{2}{3} - \frac{K_1 (2-\beta_2) + K_2 (1-\gamma_2)}{3 (\beta_1 K_2 + \gamma_1 K_1)} \tag{31}$$
$$r_1^{**} = \frac{1}{3} + \frac{K_1 (2-\beta_2) + K_2 (1-\gamma_2)}{3 (\beta_1 K_2 + \gamma_1 K_1)} \tag{32}$$
$$f_2^{**} = \frac{2}{3} - \frac{K_2 (2-\beta_1) + K_1 (1-\gamma_1)}{3 (\beta_2 K_1 + \gamma_2 K_2)} \tag{33}$$
$$r_2^{**} = \frac{1}{3} + \frac{K_2 (2-\beta_1) + K_1 (1-\gamma_1)}{3 (\beta_2 K_1 + \gamma_2 K_2)} \tag{34}$$

Differently from the equilibrium in the war game, countries are now allocating more resources for the production than for the war. This translates into a larger amount of consumption good. As a matter of fact, in equilibrium countries obtain, respectively:

$$y_1^{**} = \frac{\alpha_1 [K_1 (2-\beta_2+\gamma_1) + K_2 (1+\beta_1-\gamma_2)]^2}{9 (\beta_1 K_2 + \gamma_1 K_1)} \tag{35}$$
$$y_2^{**} = \frac{\alpha_2 [K_2 (2-\beta_1+\gamma_2) + K_1 (1+\beta_2-\gamma_1)]^2}{9 (\beta_2 K_1 + \gamma_2 K_2)} \tag{36}$$

Previous results lead to the following proposition:

Proposition 5 *An agreement with commitment assigns to country* 1 *and* 2 *the follow-*

[11] I make use of the symbol "**" to denote the equilibrium values when countries reach an agreement without the intervention of a third party and in the context of a a NVT model.

ing share of fertile land, respectively:

$$\tau^{**} = \frac{K_1(2-\beta_2+\gamma_1)+K_2(1+\beta_1-\gamma_2)}{3(K_1+K_2)}$$
$$(1-\tau^{**}) = \frac{K_1(1+\beta_2-\gamma_1)+K_2(2-\beta_1+\gamma_2)}{3(K_1+K_2)}$$

It follows that $K_1^{**} > K_2^{**}$*. Moreover, the allocation of the initial endowment is such that* $f_i^{**} < f_i^*$ *and* $r_i^{**} > r_i^*$ $\forall i = 1, 2$*. As a consequence, both countries enjoys a larger amount of consumption good than after the war.*

Proposition 3.5 draws attention to two points. The first one is that both countries can take advantage of finding an agreement, since the amounts of consumption good, which they enjoy, increase. The second interesting issue consists of the fact that the bargaining process assign to countries the same portion of land, which they obtain after the fight. In this way, country 1 lose any interest in the war, while its opponent is not forced to give up more than it may lose after a fight.

The latter point is specified in Figure 3.2. The new distribution of the fertile land is denoted by the point x^{**} and it corresponds precisely to the distribution, which countries obtain after the war, indicated by the point x^*. Moreover, differently from the war, countries can now use for the production of the consumption good all the land under their direct control.

6.2 The autonomous solution without commitment

Differently from the case of a negotiation with commitment, countries may decide not to commit themselves to any specific distribution of the endowment. This fact has two consequences. The first one is that they now allocate all their endowment for producing the commodity good. Therefore, their production functions become, respectively:

$$y_1 = \alpha_1 \tau (K_1 + K_2)$$
$$y_2 = \alpha_2 (1-\tau)(K_1 + K_2)$$

The amounts of consumption good now depend only on the production technology and the share of the fertile land, obtained through negotiation.

The second consequence of choosing an agreement without commitment is that the set of disagreement points is given by the equilibrium values of the war games.

Formally, the timing of the game is the following:

1: Countries negotiate the sharing rule to divide the fertile land;

2a: Production takes place if the agreement has been reached at the first stage;

2b: If negotiation is not successful they go to the war, choosing how to allocate their endowment between production and fight.

The game is solved backward.

Second Stage

The two possible developments at the second stage are clearly alternative. The amounts of commodity good produced by countries at the second stage are easily derived and correspond to the set of equation provided above.

First Stage

In order to derive the value of the sharing rule, we employ the traditional NBP, keeping fixed the disagreement points as determined in the war game. Formally we have:

$$\max_{\tau} NBP \equiv \left[\alpha_1 \tau \left(K_1 + K_2\right) - y_1^*\right] \left[\alpha_2 \left(1 - \tau\right) \left(K_1 + K_2\right) - y_2^*\right] \tag{37}$$

Maximization yields the following result, characterizing the first stage of the game:[12]

$$\hat{\tau} = \frac{1}{2} + \frac{\alpha_2 y_1^* - \alpha_1 y_2^*}{2\alpha_1 \alpha_2 \left(K_1 + K_2\right)} \tag{38}$$

Using the equilibrium value for $\hat{t}$ in the production functions derived in the second stage, we obtain the equilibrium amount of consumption good enjoyed by both countries, namely:

$$\hat{y}_1 = \frac{\alpha_1 \left(\Phi + \Omega_1 - \Omega_2\right)}{18 \left(\beta_1 K_2 + \gamma_1 K_1\right) \left(\beta_2 K_1 + \gamma_2 K_2\right)} \tag{39}$$

$$\hat{y}_2 = \frac{\alpha_2 \left(\Phi - \Omega_1 + \Omega_2\right)}{18 \left(\beta_1 K_2 + \gamma_1 K_1\right) \left(\beta_2 K_1 + \gamma_2 K_2\right)} \tag{40}$$

[12] In the following analysis we use the symbol "ˆ" to denote the equilibrium values, derived in the context of an autonomous solution without commitment.

where

$$\Phi = 9(K_1+K_2)(\beta_1 K_2+\gamma_1 K_1)(\beta_2 K_1+\gamma_2 K_2)$$
$$\Omega_1 = (\beta_2 K_1+\gamma_2 K_2)\left[K_1(2-\beta_2+\gamma_1)+K_2(1+\beta_1-\gamma_2)-3c\right]^2$$
$$\Omega_2 = (\beta_1 K_2+\gamma_1 K_1)\left[K_2(2-\beta_1+\gamma_2)+K_1(1+\beta_2-\gamma_1)-3c\right]^2$$

The main results contained in this subsection can be summarized in the following Proposition:

Proposition 6 *An agreement without commitment assigns to country* 1 *and* 2 *the following share of fertile land, respectively:*

$$\hat{\tau} = \frac{1}{2}+\frac{\alpha_2 y_1^* - \alpha_1 y_2^*}{2\alpha_1\alpha_2(K_1+K_2)}$$
$$(1-\hat{\tau}) = \frac{1}{2}-\frac{\alpha_2 y_1^* - \alpha_1 y_2^*}{2\alpha_1\alpha_2(K_1+K_2)}$$

It follows that $\hat{K}_1 > \hat{K}_2$, while countries allocate all their endowment for the production of the commodity good.

6.3 Comparison between commitment and no commitment solution

Clearly, the two solutions derived in the previous sections are alternative, since countries may decide to bargain with or without commitment on the distribution of the endowment in the event that an agreement is not reached. It becomes interesting to evaluate which of them is in fact chosen by countries.

It is quite cumbersome to compare the values for τ derived under the two different scenarios. However, it should be noted that according to some specific values of the parameters of the model, consistent with assumption 3.1, the sharing rule reached within an agreement with commitment assigns to one country more than the one stuck without commitment. For instance it can be noted that if we set the following values $\beta_1 = \frac{3}{4}$, $\beta_2 = \frac{1}{2}$, $\gamma_1 = \frac{1}{3}$ and $\gamma_2 = \frac{1}{4}$, we have:

$$\tau^{**} - \hat{\tau} = \frac{1}{81}\frac{297K_1K_2^2 + 681K_1^2K_2 + 215K_1^3 + 27K_2^3}{(4K_1+9K_2)(2K_1+K_2)(K_1+K_2)} > 0$$

In all the cases such as the previous one, country 1 prefers an agreement with commitment, since the share of the land at its disposal is larger than in the other case. The reason for that difference relies on the fact that in the former case, country 1 can exploit its strength and drive the result of the negotiation to its favor.

The difference between the two types of agreements regarding the distribution of the land can be fully understood in Figure 3.3.

Clearly, one type of agreement would be supported by one country, while the other would be suggested by its opponent.

Although we cannot establish unambiguously whether countries choose an agreement with commitment or a solution without commitment, we can consider some arguments, which can shed light on which solution countries may choose.

The first one has been highlighted before and refers to the fact that the distribution of the benefit should be consistent with the underlying distribution of the power. As Powell (1999) clarifies, if countries reach an agreement, the latter must have such characteristics that the dissatisfied country obtains at least as much as it would get from a war. At the same time, the country, which originally benefited of the large part of fertile land, is willing to give up only the sufficient portion of its territory, which makes its opponent not interested in the war anymore. Any other kind of agreement, which imposes different concessions, leaves one of the contestants not satisfied. A rational choice for both countries is to strike an agreement, which is not different from the allocation, obtainable after the war. If we follow this view, the agreement with commitment is a valid candidate with respect to the other type of negotiation.

The second reason in favor of the agreement with commitment is that this option is more consistent with what happens in the real world. If two countries are facing a period of crisis and are trying to settle their dispute through a negotiation, it is quite likely that they want to make use of their military capabilities as a deterrence tool.

If they commit themselves to a specific allocation of the endowment at the beginning of the negotiation, their choices give rise to a serious and credible threat if an agreement is not reached. In terms of the classic logic of war, the commitment plays the role of a deterrence tool. According to Powell (1990), the latter is a form of coercion. In the framework of negotiation, it "... deters an adversary from doing something like...[not putting too much effort for reaching an agreement]...by convincing it that the cost of doing so would be grater than the potential gain" (Powell, 1990, p. 7).

Both the arguments, reported above, support the idea that countries prefer to bargain having committed themselves to a specific allocation of their endowment if they cannot find an agreement. Moreover, as recalled, this alternative is more realistic looking at the way in which international relations develops in the real world. Therefore, in the remaining part of the paper, we assume that countries choose to negotiate an agreement with a commitment and contrast it with the solution, which emerges when a third party intervenes.

7 Calling for an arbitrator

What happens if countries are not able to find an agreement by themselves? In the international relations it is very common that countries call for a third party in order to settle their dispute. Nonetheless, as we recalled in the introduction, there exist ambiguous opinions about the effectiveness of the role that a third party can have in such a case. This is particularly true if it is an IO instead of a single state.

In this section, we allow for a third party's intervention for ending the territorial dispute, assuming that the third party is in fact an IO. Our choice is justified by the two functional characteristics which IOs own, as indicated by Abbott and Snidal (1998), namely the centralization and, more importantly, the independence of such organizations. If the third party is another country, it may not act impartially given the possibility of being interested in favouring one country instead of the other. This is particularly true, if we assume that the third party takes the role of an arbitrator. As recalled above, the latter proposes a solution, which it thinks to be better for the contestants. Moreover, its proposal is not negotiable, but can be either accepted or refused. If countries reject the proposal, they go to war.

Therefore in this section we evaluate the action of an IO as a third party. So the two terms can be considered interchangeable.

The objective of the arbitrator is to find a suitable agreement for the division of the fertile land, such that the difference in the amounts of consumption goods, enjoyed by players is the smallest possible. Moreover, how much country 1 obtains from that division depends on how successful it would be in the event of a war. Therefore, the share τ assigned by the arbitrator is a linear function of country 1's chance of success:

$$\tau = (\beta_1 f_1 - \gamma_2 f_2) \tag{41}$$

Following this characterization of the sharing rule, the arbitrator needs to impose a redistribution of the endowments in such a way to minimize the differences in the amount of consumption goods. Put differently, the agreement should impose a balance in the distribution of the resources between production and war. This, in turn, put a limit to the allocation of resources to military purposes.[13] The choice of minimizing the difference in the amount of good can be evaluated as motivated by fairness decision in order to bring balance in the distribution of benefits, which is consistent with the military attitudes of countries.

In a more formal way, the objective of the arbitrator can be written as follows:

$$\min_{r_1, r_2 f_1, f_2} \left\{ \alpha_2 r_2 (1-\tau)(K_1+K_2) - \alpha_1 r_1 \tau (K_1+K_2) \right\} \tag{42}$$

Using the endowment constraint and eq. (41), we can rewrite (42) as follows:

$$\min_{f_1, f_2} (K_1+K_2) \left\{ \alpha_2 (1-f_2) \left[1 - (\beta_1 f_1 - \gamma_2 f_2)\right] - \alpha_1 (1-f_1)(\beta_1 f_1 - \gamma_2 f_2) \right\}$$

[13] The attitute of such an agreement in favor of peace relies exactly on the fact that now countries cannot mobilize as much resources as they want for the war. Imposing some constraints on countries' allocation choice is not unusual in international relations. For instance, after the Second World War, the peace treaties stated that Germany and Japan could not allocate more than a small fraction of their GDP to the military expenditures.

Minimization yields:[14]

$$
\begin{aligned}
f_1^A &= \frac{\beta_2 (\alpha_1 + \alpha_2) (\alpha_2 \beta_1 + \alpha_1 \gamma_2)}{Z_1} && (43) \\
r_1^A &= \frac{\beta_1 [\beta_2 (2\alpha_1 - \alpha_2) - \gamma_1 \alpha_2 (\beta_2 + \gamma_1)]}{Z_1} && (44) \\
f_2^A &= \frac{\beta_1 (\alpha_1 + \alpha_2) (\alpha_1 \beta_2 + \alpha_2 \gamma_1)}{Z_2} && (45) \\
r_2^A &= \frac{\beta_2 [\beta_1 (2\alpha_2 - \alpha_1) - \gamma_2 \alpha_1 (\beta_1 + \gamma_2)]}{Z_2} && (46)
\end{aligned}
$$

where

$$
\begin{aligned}
Z_1 &= \alpha_2 \beta_1 (3\alpha_1 \beta_2 - \alpha_2 \gamma_1) + \alpha_1 \gamma_2 (\alpha_1 \beta_2 - \alpha_2 \gamma_1) \\
Z_2 &= \alpha_1 \beta_2 (3\alpha_2 \beta_1 - \alpha_1 \gamma_2) + \alpha_2 \gamma_1 (\alpha_2 \beta_1 - \alpha_1 \gamma_2)
\end{aligned}
$$

The most interesting difference between the equilibrium values derived in the previous sections and the ones imposed by the arbitrator is that they do not depend on the amounts of K_1 and K_2. Instead, when the arbitrator imposes its optimal allocations of the endowment between the two alternative uses, it focuses on the productive and military characteristics of countries. This is perfectly consistent with the fact that it wants to minimize the difference between the amount of consumption goods and, at the same time, it has to derive a sharing rule for the land. Therefore, it becomes more relevant for instance how productive countries are than how large is the fertile land, which they actually own.

Substituting the equilibrium values for f_1 and f_2 into eq. (41) yields the following result:

Proposition 7 *The agreement imposed by the arbitrator assigns to country* 1 *and* 2 *the following share of fertile land, respectively:*

$$
\begin{aligned}
\tau^A &= \frac{(\alpha_1 + \alpha_2) (H - V)}{Z_1 Z_2} && (47) \\
\left(1 - \tau^A\right) &= \frac{Z_1 Z_2 - (\alpha_1 + \alpha_2) (H - V)}{Z_1 Z_2} && (48)
\end{aligned}
$$

[14]In the following analysis, I use the superscript "A" to indicates the equilibrium solutions, which are derived when an arbitrator intervenes.

where

$$
\begin{aligned}
H &= \beta_1\alpha_2\left\{\beta_2^3\alpha_1\left(3\alpha_2\beta_1+2\alpha_1\gamma_2\right)+\alpha_2\gamma_1\left[\beta_1\beta_2^2\alpha_2+\gamma_2\gamma_1\alpha_1\left(\alpha_1\gamma_2+\alpha_2\beta_1\right)\right]\right\} \\
V &= \beta_2\gamma_2\alpha_1\left\{\beta_2\gamma_2\alpha_1^2\left(\beta_1+\beta_2\right)+\alpha_2\left[\beta_1^2\left(3\beta_2\alpha_1+2\gamma_1\alpha_2\right)+\beta_2\gamma_1\gamma_2\alpha_1\right]\right\}
\end{aligned}
$$

Given that the extension of fertile land is not relevant in the allocation of the endowments, so it is not for the determination of the sharing rule.

Instead, it becomes interesting to observe whether the choice operated by the arbitrator is efficient or not. More specifically, assuming that countries have different productive skills, is the third party's choice affected negatively by the different military attitudes of countries? If this is the case, the decision taken by the IO may support the country which does not own the more efficient productive technology.

Clearly, it is not straightforward to evaluate analytically the relation between τ^A and the two parameters, which refers to countries' productivity. Nonetheless, we can carry out some numerical examples, which may shed light about the point under discussion.

In all the following cases, we set $\beta_1 = \frac{3}{4}$, $\beta_2 = \frac{1}{2}$, $\gamma_1 = \frac{1}{3}$ and $\gamma_2 = \frac{1}{4}$, consistently with assumption 3.1. Moreover, we assume that $\alpha_2 = 1$ an country 1's productivity cannot be larger.

Numerical simulation yields the following result:

$$
\tau^A = \begin{cases} 0.8654 & \text{if } \alpha_1 = \frac{1}{2} \\ 0.5730 & \text{if } \alpha_1 = \frac{2}{3} \\ 0.3653 & \text{if } \alpha_1 = 1 \end{cases}
$$

It can be noted that the larger is the difference in the productivity between countries, the more is the share of land assigned to country 1. On one hand, this is consistent with the third party's attempt of reducing the gap between the amount of consumption good enjoyed by countries, this leading to the allocation of more land to the less productive contestant. On the other, that choice is not efficient. This implies that the trade-off between equity and efficiency is solved in favor of the former. Surely, this choice is determined by the differences in the military skills of countries. The more skillful is a contestant and the less productive, the larger share of fertile land it obtains.

This is due to the fact that the third party, at the same time, tries to minimize the risk of a conflict between countries.

The previous analysis can be summarized in the following corollary to Proposition 3.7:

Corollary 8 *The most powerful contestant obtains a larger share of fertile land, the less productive it is.*

The obvious consequence of this fact is that the third party's attempt of imposing a fair sharing rule translates in a reduction of the total welfare.

8 The agreement with commitment vs the arbitrator solution

So far we have provided two possible solutions for settling the territorial dispute peacefully. In the set of the autonomous solutions, we selected the agreement with commitment as the most likely type. It becomes interesting to evaluate whether the arbitrator solution is more effective than the agreement with commitment or if the opposite holds. Effectiveness is meant to refer to the possibility that the solution imposed by the arbitrator is more appropriate for settling the territorial dispute, although we already know that arbitrator's solution is inefficient, given certain values of the parameters.

Comparing the τ^A and τ^{**} gives the following result:

$$\left(\tau^A - \tau^{**}\right) = \frac{K_1 G_1 + K_2 G_2}{3\left(K_1 + K_2\right) Z_1 Z_2}$$

where

$$\begin{aligned} G_1 &= \left[3\left(H_1 - V_1\right)\left(\alpha_1 + \alpha_2\right) - Z_1 Z_2 \left(2 - \beta_2 + \gamma_1\right)\right] \\ G_2 &= \left[3\left(H_1 - V_1\right)\left(\alpha_1 + \alpha_2\right) - Z_1 Z_2 \left(1 + \beta_1 - \gamma_2\right)\right] \end{aligned}$$

It is not easy to unambiguously determine whether the solution imposed by the arbitrator is in fact better or worse than the one reached by countries or identical to it. The following result may shed light on this point:

Proposition 9 *The agreement with commitment may give country* 1 *a larger, smaller or equal share of fertile land than the division imposed by the arbitrator. Therefore:*

$$\left(\tau^A - \tau^{**}\right) \begin{cases} > 0 \\ = 0 \\ < 0 \end{cases}$$

The above difference is equal to zero if and only if there exists a set of parameters values such that $\alpha_i = \alpha_i^A$*,* $\beta_i = \beta_i^A$ *and* $\gamma_i = \gamma_i^A$ $\forall i = 1, 2$.

We cannot establish unambiguously the sign of $\left(\tau^A - \tau^{**}\right)$. However we can make some arguments about the effectiveness of IO's intervention.

The most important point, which we want to highlight, is that, given continuity in the parameters of the model, there may exist a combination of them, which we denoted by using the A-superscript, such that $\tau^A = \tau^{**}$. Otherwise, either $\tau^A > \tau^{**}$ or $\tau^A < \tau^{**}$. The consequence of this fact clearly appears from a look to Figure 3.4.

When $\tau^A = \tau^{**}$, the distribution of the fertile land, indicated by the point x^A along the $(K_1 + K_2)$ line, is equal to the one, which would be obtained after the war and under the agreement with commitment. Instead, the point $'x^A$ indicates a distribution of the land such that $\tau^A > \tau^{**}$. In this case country 1 receives more than after the war and when an agreement with commitment is struck. Clearly, this possibility advantages it with respect to its opponent. On the other hand, the point $''x^A$ is drawn under the hypothesis that $\tau^A < \tau^{**}$. Differently from the previous cases, this solution benefits country 2, which obtains more than under the two previous circumstances.

Therefore, if $\tau^A > \tau^{**}$, country 2 needs to give up more than under the agreement with commitment. Hence, it is quite unlikely that it accept this solution. However, if $\tau^A < \tau^{**}$, it would be country 1 to refuse the arbitrator's proposal, since it becomes more convenient to fight a war, which would give him a larger portion of land.

Clearly, there is only one case in which the solution proposed by the arbitrator would be accepted. Namely, when $\tau^A = \tau^{**}$. However, as we make clear in the last proposition, this possibility requires a specific combination of the parameters, which may not be so likely, given that the range of military parameters is constrained by Assumption 3.1.

This analysis allows us to evaluate how likely is that an IO, taking the role of the arbitrator can be effective in settling the territorial dispute between countries. It appears that arbitrator's proposal can be effective only in a limited number of cases, according to whether the parameters take specific values.

Generally speaking, the intervention of an IO as arbiter in the territorial dispute under analysis is not necessary. As a matter of fact, the most the third party can do is to indicate the same agreement, which countries can reach by themselves, but it cannot impose a more efficient solution. On the other hand, in the majority of cases, its arbitration is ineffective, since it leaves at least one country dissatisfied.

9 Concluding remarks

In this work, we modeled the interaction between two countries having a dispute about the distribution of the fertile land. The possibility of war between them depends on the fact that the distribution of the power is not consistent with the benefits enjoyed by them.

We characterized and evaluated the equilibrium of the war game played by countries and we allowed for the possibility that an agreement is reached. More specifically, such an agreement can be struck without the intervention of a third party or by calling an arbitrator in the dispute. We referred to the first one as the autonomous solution, which can be reached under a commitment about the distribution of the initial endowment between war and production or without such a commitment. Relying on the way in which real facts in international relations evolve, we argued in favor of an agreement with commitment.

If a third party is called into the dispute, we assumed that it plays the role of an arbitrator, which imposes an agreement, which balances between the power and the benefits and it can be acknowledged as being fair.

The results, which we obtained, seem to argument in favor of the autonomous solution for at least one but important reason. The agreement imposed by the third party cannot be more efficient than the one reached by the countries on their own.

Moreover in several cases, depending on the range of the parameters of the model, the arbitrator proposes a distribution of the land, which is unsatisfactory for at least one of them. This reduces greatly the possibility that the agreement proposed by the arbitrator is accepted by both contestants.

In this paper, we assumed that the arbitrator is in fact an IO, motivating our choice with the observation that, differently from a single country, an IO should own the necessary independence to carry out its task. Therefore, the terms IO, arbitrator and third party could be read interchangeable in this paper.

Our conclusions can be considered as provocative since they seem to support the view that IOs are not necessary to solve interstates disputes. It should be noted that our results are obtained under the hypothesis of common knowledge between countries. While we do not focus on this issue in our work, it would be interesting to evaluate whether IOs can play in fact the role of conveying information between countries, when the hypothesis of common knowledge is relaxed, given their capability of "centralizing" the discussion on a crisis. This is precisely the view offered by Lindely (2007), who argues that IOs can reduce the risk of a war, increasing transparency and avoiding miscalculations.

Moreover, while we use a static framework, it would be interesting to evaluate whether the same results are supported in a dynamic contest. A possibility is that the role of the IOs may reduce the length of negotiations, speeding up the peace process.

We would like to conclude this work, providing some information about crises management occurred in the past. We present some data taken from the database on International Crisis Management compiled by Brecher and Wilkenfeld (2007). It offers information about the characteristics of international crises occurred between 1918 and 2004.

In this time span, 443 episodes of international crises arose with different features, ranging from simply economic threat to threat to the very existence of a country. We present some data referring to the activity of some UN's offices, which were involved in 223 crises. The choice of focusing on this organization relies on the fact that it can be considered as the natural location for addressing issues related to crises, which may have a general impact on international stability.

It is interesting to observe that in 6 cases the UN involvement exacerbated the conflict, while in 164 cases it had no effect or simply a marginal one. The intervention was effective only in 53 crisis. Moreover only in 56 cases all the parties involved in the crisis, where the UN intervened, were satisfied by the outcome of the crisis. More importantly, in 102 of these cases (almost 46%), crisis recurred within 5 years.

The data which we reported above show only a correlation between the involvement of the UN and the outcome of a crisis. They do not pretend to infer causality, but simply introduce some numbers which can draw attention to the real effectiveness of IOs and, especially, of the UN. Instead, this simple statistics may represent a starting point to disentangle the effectiveness of IOs' actions as the UN on the management of a crisis from the effect of the intervention of a third country. This would create a link between theory and real world, providing empirical support to the result reached in this work.

Appendix

Proof of Proposition 3.2

In order to prove the first part of proposition, we note that the sign of the derivatives (3.16) is either positive or negative depending on the numerator:

$$[K_1 (2 - \beta_2) + K_2 (1 - \gamma_2) - 3c] \lesseqgtr 0$$

Previous inequality implies:

$$K_1 (2 - \beta_2) + K_2 (1 - \gamma_2) \lesseqgtr 3c$$

According to equation (3.5), c cannot be greater than $\frac{K_1+K_2}{3}$. Therefore, we substitute this value in previous inequality for c and rearrange it. We obtain:

$$K_1 (1 - \beta_2) \lesseqgtr \gamma_2 K_2$$

A further step leads to the following inequality:

$$\frac{K_1}{K_2} \lesseqgtr \frac{\gamma_2}{1 - \beta_2} \tag{A4}$$

It can be noted that for sufficiently small (high) values of γ_2 the lhs is larger (smaller) than the rhs. Therefore, given continuity in γ_2 and a sufficiently large value of the cost of the war, there must exists a value, $\bar{\gamma}_2$, such that the sign of the derivative is positive or negative according to whether $\gamma_2 \lesseqgtr \bar{\gamma}_2$.

As far as the last part of the proposition concerns, we need to show that the following inequality holds:

$$[\beta_1 (2 - \beta_2) - \gamma_1 (1 - \gamma_2)] \geq 0$$

After rearranging, we obtain:

$$\frac{\beta_1}{\gamma_1} \geq \frac{(1 - \gamma_2)}{(2 - \beta_2)} \tag{A5}$$

The latter inequality is always satisfied, since by Assumption 3.1, the lhs is always larger than 1, while the rhs is always smaller than 1.

Proof of Proposition 3.3

In order to prove the second part of this proposition, first we show that the sign of the derivative is negative when the cost of the war is the highest possible. Clearly, the sign is determined by the numerator. Substituting the value for c in equation (20) and rearranging, we obtain:

$$K_1 \left[\beta_1 \left(1-\beta_2\right) - \gamma_1 \left(1-\gamma_2\right)\right] - \beta_1 K_2 < 0 \tag{A6}$$

It can be noted that (A6) is always satisfied, because by (2), the following inequality is always satisfied:

$$K_1 \left(1-\beta_2\right) < K_2$$

Therefore, given that the derivative is positive if $c = 0$, there must exists a value of c sufficiently large such that the derivative (20) is negative.

Proof of Proposition 3.4

As far as the first part of proposition concerns, the amounts of fertile land, which countries own after the war, are:

$$\begin{aligned} K_1^* &\equiv \left[1-\left(\beta_2 f_2^* - \gamma_1 f_1^*\right)\right] K_1 + \left(\beta_1 f_1^* - \gamma_2 f_2^*\right) K_2 - c \\ K_2^* &\equiv \left(\beta_2 f_2^* - \gamma_1 f_1^*\right) K_1 + \left[1-\left(\beta_1 f_1^* - \gamma_2 f_2^*\right)\right] K_2 - c \end{aligned}$$

Substituting the equilibrium values in the above equations and rearranging yields:

$$K_1 \left[1-2\left(\beta_2-\gamma_1\right)\right] > K_2 \left[1-2\left(\beta_1-\gamma_2\right)\right] \tag{A7}$$

It can be noted that if $(\beta_1 - \gamma_2) \gg (\beta_2 - \gamma_1)$, the above inequality is satisfied.

In a similar manner, we can show that $y_1^* > y_2^*$. Contrasting the two values we obtain:

$$\begin{aligned} & \frac{\alpha_1 \left[K_1 \left(2-\beta_2+\gamma_1\right) + K_2 \left(1+\beta_1-\gamma_2\right) - 3c\right]^2}{\left(\beta_1 K_2 + \gamma_1 K_1\right)} \\ > \quad & \frac{\alpha_2 \left[K_2 \left(2-\beta_1+\gamma_2\right) + K_1 \left(1+\beta_2-\gamma_1\right) - 3c\right]^2}{\left(\beta_2 K_1 + \gamma_2 K_2\right)} \end{aligned}$$

Assuming that α_1 is sufficiently large, such that $\frac{\alpha_1}{(\beta_1 K_2+\gamma_1 K_1)} \geq \frac{\alpha_2}{(\beta_2 K_1+\gamma_2 K_2)}$, we need to prove the following inequality:

$$\begin{aligned} & \left[K_1\left(2-\beta_2+\gamma_1\right)+K_2\left(1+\beta_1-\gamma_2\right)-3c\right]^2 \\ > & \left[K_2\left(2-\beta_1+\gamma_2\right)+K_1\left(1+\beta_2-\gamma_1\right)-3c\right]^2 \end{aligned}$$

After rearranging, the latter can be rewritten as:

$$K_1\left[1-2\left(\beta_2-\gamma_1\right)\right]>K_2\left[1-2\left(\beta_1-\gamma_2\right)\right] \tag{A8}$$

As before, if $K_1\left[1-2\left(\beta_2-\gamma_1\right)\right]>K_2\left[1-2\left(\beta_1-\gamma_2\right)\right]$, (A8) is satisfied and $y_1^* > y_2^*$.

Checking convexity of arbitrator's objective function

Let us indicate with z the objective function of the arbitrator. In order to check convexity, we need to show that the following set of derivatives is satisfied:

$$\begin{aligned} z_{f_1 f_1} & > 0 \\ z_{f_2 f_2} & > 0 \\ z_{f_1 f_1} z_{f_2 f_2} & > \left(z_{f_1 f_2}\right)^2 \end{aligned}$$

where the subscripts denote the variable with respect to which the objective function is differentiated.

It is straightforward to note check that

$$\begin{aligned} z_{f_1 f_1} & = 2\alpha_1\beta_1>0 \\ z_{f_2 f_2} & = 2\alpha_2\gamma_2>0 \end{aligned}$$

As far as the last inequality concerns, we have:

$$4\alpha_1\beta_1\alpha_2\gamma_2>\left(\alpha_2\beta_1-\alpha_1\gamma_2\right)^2$$

The latter inequality implies:

$$6\alpha_1\beta_1\alpha_2\gamma_2>\left(\alpha_2\beta_1\right)^2+\left(\alpha_1\gamma_2\right)^2$$

It can be noted that for sufficiently and positive values of the parameters, the latter inequality is satisfied.

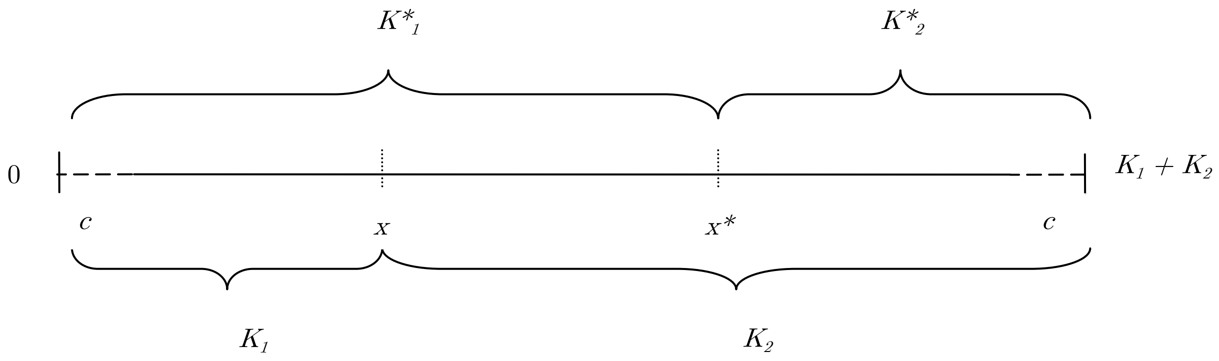

FIGURE 3.1 – THE DISTRIBUTION OF FERTILE LAND BEFORE AND AFTER THE WAR

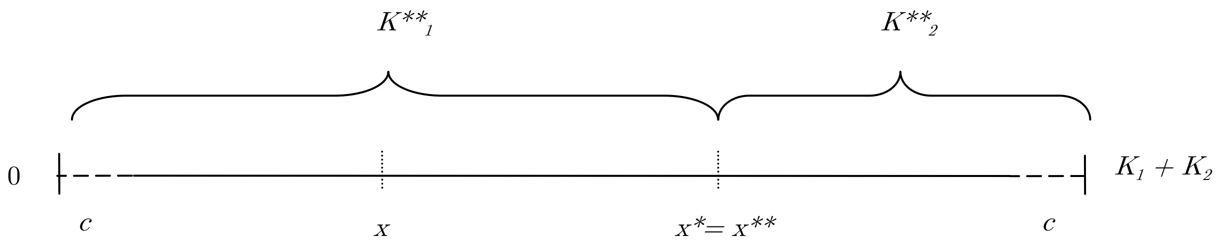

FIGURE 3.2 – THE DISTRIBUTION OF THE FERTILE LAND AFTER THE AGREEMENT WITH COMMITMENT

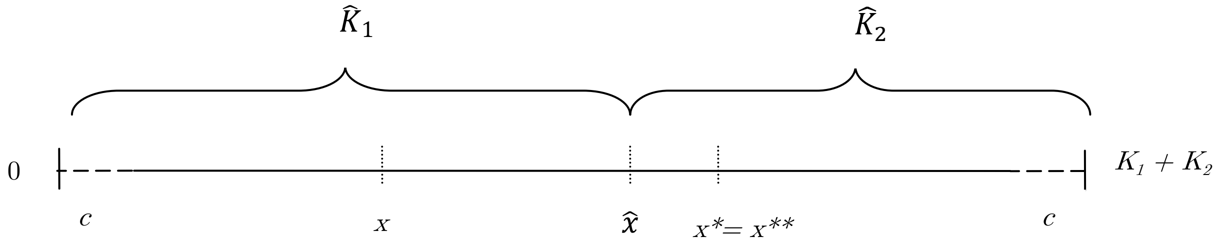

Figure 3.3 – THE DISTRIBUTION OF THE FERTILE LAND AFTER THE AGREEMENT WITHOUT COMMITMENT

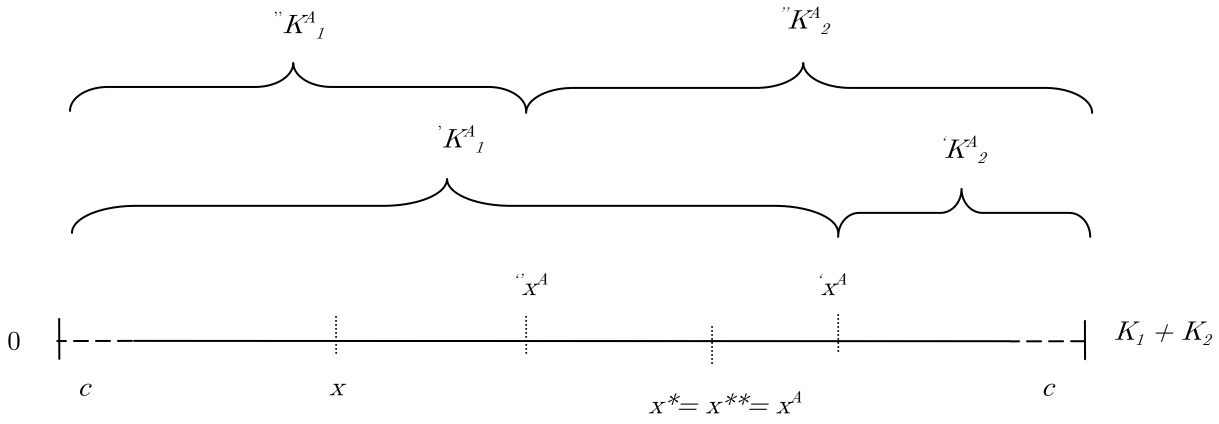

Figure 3.4 – The Autonomous Solution vs the Arbitrator Agreement