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Reviewed work(s):

Source: *The American Political Science Review*, Vol. 85, No. 4 (Dec., 1991), pp. 1303-1320

Published by: [American Political Science Association](#)

Stable URL: <http://www.jstor.org/stable/1963947>

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ABSOLUTE AND RELATIVE GAINS IN INTERNATIONAL RELATIONS THEORY

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The problem of absolute and relative gains divides neoliberal institutionalism and structural realism. The former assumes states focus primarily on their absolute gains and emphasizes the prospects for cooperation. The latter supposes states are largely concerned with relative gains and emphasizes the prospects for conflict. Existing work in international relations theory generally traces the differences between these two theories to different assumptions about states' preferences. Using a simple game-theoretic model, this essay offers a reformulation of the problem of absolute and relative gains that links changes in the states' behavior, the feasibility of cooperation, and especially the states' concern for relative versus absolute gains explicitly to changes in the constraints facing the states. Many of the differences between neoliberal institutionalism and structural realism appear as special cases of the model.

The problem of absolute and relative gains divides two of the most influential approaches to international relations theory. Neoliberal institutionalism assumes that states focus primarily on their individual absolute gains and are indifferent to the gains of others. Whether cooperation results in a relative gain or loss is not very important to a state in neoliberal institutionalism so long as it brings an absolute gain. In terms of preferences, this focus on absolute gains is usually taken to mean that a state's utility is solely a function of its absolute gain. In contrast, neorealism, or structural realism assumes that states are largely concerned with relative rather than absolute gains. In the anarchy of international politics, "relative gain is more important than absolute gain" (Waltz 1959, 198). A state's utility in structural realism is at least partly a function of some relative measure like power.¹ These differing assumptions

about states' preferences lead to different expectations about the prospects for international conflict and cooperation. The more states care about relative gains, the more a gain for one state will tend to be seen as a loss by another and the more difficult, it seems, cooperation will be.²

However, tracing different expectations about the likelihood of conflict and cooperation to different assumptions about states' preferences poses an important theoretical difficulty for international relations theory.³ Jervis (1988), Keohane (1984), Lipson (1984), Stein (1983, 1984), and the contributors to the volume edited by Oye (1986) have recently called for trying to bring at least some aspects of the study of international political economy, which is usually taken to be the province of neoliberal institutionalism, and the study of security affairs, which is usually taken to be the province of structural realism, within a single analytic frame-

work. But if neoliberal institutionalism and structural realism really do make fundamentally different assumptions about states' preferences, then efforts to unify these approaches with a third-image explanation cannot succeed.

To use Waltz's analogy (1979, 89-91) between political structures and economic market structures, it will be impossible to explain the differences between neoliberal institutionalism and structural realism over, say, the prospects for international cooperation in the same way that economists explain the differences between outcomes in a perfectly competitive market and a monopoly. In that explanation, economists assume that the goals or preferences of the unit, in this case the firm, are the same in both a perfectly competitive market and in a monopoly: a firm seeks to maximize its profits. What varies in moving from one market structure to the other are the constraints under which a firm attempts to maximize its profits. Thus, changes in the market constraints and not in the units' preferences account for the variation in a firm's behavior in the two different market structures. If, however, neoliberal institutionalism and structural realism are actually based on fundamentally different assumptions about states' preferences, then moving from a neoliberal institutional to a structural realist setting would see a change in the attributes of states, that is, their preferences. In this sense, neoliberal institutionalism and structural realism would be about essentially different types of units, one primarily concerned with absolute gains, the other with relative gains. Consequently, the locus of the differences between neoliberal institutional and structural realist explanations of international behavior would be in the first or second images. A third-image unification of these approaches, which would explain changes in states' behavior in terms of changes in the constraints facing the states and not in terms of changes in

the type or nature of states' preferences, would be impossible.

I offer a reformulation of the problem of absolute and relative gains and take a step toward bringing the study of international conflict and cooperation within a single analytic framework.⁴ I show that many important aspects of neoliberal institutionalism and structural realism may be seen as special cases of a very simple model of the international system in which changes in the states' behavior, the feasibility of cooperation, and especially the states' concern for relative versus absolute gains are explicitly linked not to different assumptions about the states' preferences but to changes in the constraints facing the states. The model thus shifts the focus of analysis away from preferences to constraints.⁵

In the model, states are assumed to be trying to maximize their absolute gains. That is, a state's utility depends solely on the absolute level of economic welfare it attains. This is in keeping with neoliberal institutionalism. But the states are trying to maximize their economic welfare within the constraints imposed by an anarchic international system in which the use of force, in keeping with structural realism, may be at issue. When the cost of using force is sufficiently low that the use of force actually is at issue, cooperative outcomes that offer unequal absolute gains cannot be supported as part of an equilibrium even though the states' preferences are defined only over their absolute level of economic welfare. This inability to cooperate is in accord with the expectations of structural realism, though the assumption that states are maximizing their absolute gains is not in keeping with its usual formulations. If the use of force is not at issue because fighting is too costly, then the results are more in accord with neoliberal institutionalism. For example, cooperative outcomes that could not be sustained when the use of force was at issue now become feasible.

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Thus, many aspects of neoliberal institutionalism and structural realism appear as special cases of the model.

The model developed below is extremely simple. It aims primarily at conceptual clarification, not empirical application. To this end, it has been deliberately designed to show, in the simplest possible well-defined game-theoretic model, that many of the differences between neoliberal institutionalism and structural realism can be traced explicitly to the constraints facing states, rather than to their preferences. The extreme simplicity of the model clarifies the relation between constraints and the problem of absolute and relative gains that although present in more complicated models, would be more difficult to discern there. The development of more complicated and less contrived models awaits future work.⁶ But despite the model's simplicity, its analysis makes three new points that are relevant to international relations theory. Most narrowly, it suggests that cooperation in some circumstances may be even more difficult to achieve than has been previously appreciated. Some agreements that offer equal absolute gains—and therefore no relative gain—cannot be sustained in equilibrium. The reason is that cheating on the agreement would bring large relative gains.

The second and third points address two other broader issues in international relations theory. The model offers a simple formal example showing that Waltz's notion of political structure is unable to account for important changes in the feasibility of international cooperation. The political structure as Waltz defines it (1979, 79–101) remains constant throughout the analysis; but the feasibility of cooperation varies. Thus, variations in what Waltz takes to be the structure of the political system cannot explain the variation in the feasibility of cooperation in the model.

The second issue is the relation between

anarchy and cooperation. Structural realism generally associates anarchy with a concern for relative gains and a lack of cooperation (Waltz 1979, 105). Neoliberal institutionalism, however, argues that anarchy in the sense of a "lack of a common government" (Axelrod and Keohane 1986, 226; Keohane 1984, 7) does not imply a lack of cooperation (Keohane 1984, 65–84). The present analysis helps to elucidate the sources of this difference. The ability or inability to enforce rules of behavior is relevant only if the physical environment defined by the system's constraints is such that one of the possible behaviors is to use one's relative gain to one's advantage and to the disadvantage of others. If there are no such opportunities, then the inability to commit oneself to a promise not to use a relative gain to one's advantage is moot. Thus, the concern for relative gains arises from both anarchy and the constraints that define the range of possible behavior. Although such a system is clearly implicit in structural realism, neither neoliberal institutionalism nor structural realism fully appreciates the significance of the system's constraints in the origins of the concern for relative gains.

One consequence of the failure of both structural realism and neoliberal institutionalism to appreciate the role of the system's constraints in the problem of absolute and relative gains is the use of repeated games in both of these approaches to model the international system implicit in structural realism (e.g., Jervis 1978, 171; Keohane 1984; Oye 1986). As will be shown, relative gains in repeated games, including the repeated prisoner's dilemma, cannot be used to one's advantage. Thus, even if states are unable to make binding agreements in these models, relative gains in repeated games do not matter. This renders any analysis of structural realism's understanding of the relation between anarchy, relative gains, and cooperation based on

these models problematic.

Finally, a more complete understanding of the relation between the system's constraints and the origins of the concern for relative gains also shows there is nothing theoretically special about the possible use of force. If the nature of military technology is such that one state can turn a relative gain to its advantage and the disadvantage of others, then these constraints will induce a concern for relative gains and this may impede cooperation absent any superior authority to ensure that these gains not be used in this way. But if, for example, the nature of an oligopolistic market is such that a firm can use a relative gain in market share to increase its long-run profits at the expense of other firms, then this system will also induce a concern for relative gains that may make cooperation difficult. The concern for relative gains may characterize many domains, and a more refined understanding of the origins of this concern helps to identify them.⁷

I will examine a very simple neoliberal institutional model of the problem of cooperation. The examination shows that the repeated games offer poor models of the problem of conflict and cooperation in structural realism. I will then modify the model so that the constraints of the modified model create opportunities for a state to turn relative gains to its advantage, which in turn, induces a concern for relative gains. I then use this model to study how changes in these constraints affect the feasibility of cooperation.

A Simple Neoliberal Institutional Model

The essence of the neoliberal institutional analysis of the problem of cooperation is that the shadow of the future may lead the egoistic states hypothesized in structural realism to cooperate. Repeated interaction gives each actor the ability

to punish uncooperative behavior today with future sanctions. If the shadow of the future looms sufficiently large, then the future costs to uncooperative behavior will outweigh the immediate gains; and, weighing costs against benefits, even egoistic states will cooperate. This logic is, in turn, formalized in the neoliberal institutional analysis with a repeated prisoner's dilemma in which mutual cooperation can be sustained as an equilibrium outcome with a strategy of punishing defection should it occur.⁸

First, I will present a simple neoliberal institutional model of the problem of conflict and cooperation. The model has been explicitly designed to capture the essence of the neoliberal institutional analysis in the simplest possible formal setting and to be as similar to a repeated prisoner's dilemma as possible. This similarity helps to clarify the relation between the formalization used here and that employed in other work on neoliberal institutionalism. Second, I will demonstrate that the model actually does capture the essence of the neoliberal analysis problem of cooperation. Finally, repeated games are shown to be poor models of the problem of absolute and relative gains and cooperation in structural realism.

The simple neoliberal institutional model is a three-by-three game that is played twice. The states, in keeping with neoliberal institutionalism, will try to maximize the absolute sum of their first- and second-period payoffs. The second play of the game casts a shadow of the future onto the first play of the game. But because the game is only played twice, there is no shadow of the future to affect the prospects of cooperation in the second period. Thus, the problem of cooperation reduces to seeing if the shadow of the future makes cooperation possible in the first period. In this way, the two-period repeated game provides a formal setting for studying the problem of conflict and cooperation that is simpler than the in-

finitely repeated prisoner's dilemma.⁹

The three-by-three game, which will be played twice, will be called \mathcal{E} and is derived from the prisoner's dilemma by adding a third strategy to the two-by-two prisoner's dilemma. There are two states, S_1 and S_2 , in this game; and each has three strategies: F , T , and C . Figure 1 shows the payoffs to the various possible outcomes. The four cells at the upper left form a simple prisoner's dilemma in which each state strictly prefers playing T to F regardless of whether the other state is playing T or F . But if both states play T , they are worse off than if both had played F . The outcome (T, T) is Pareto-inferior to (F, F) . If one state plays C , then that state's payoffs are zero regardless of what the other state does—while the other state obtains 0, $-1/2$, or -1 if it plays C , T , or F , respectively.

It is important to emphasize that the game composed of two plays of \mathcal{E} is an extreme theoretical simplification. \mathcal{E} has been explicitly designed so that it captures the essence of an infinitely repeated prisoner's dilemma and the neoliberal institutional analysis of the problem of cooperation in the simpler formal setting of a two-period repeated game. At this level of abstraction, \mathcal{E} serves as a substantive model of the international system or of the international economy only in the very general ways that the repeated prisoner's dilemma does in neoliberal institutional or structural realist analyses of the problem of cooperation. Nevertheless, \mathcal{E} may be given a more concrete interpretation that is roughly based on an optimal tariff model, and describing this interpretation may help to make the analysis clearer. Building on Johnson's (1953) seminal work on optimal tariffs, the strategies F , T , C may denote free and open trading policies, imposition of the optimal tariff, and closure of the economy by trade prohibition, respectively. By assumption, there are only two states;

Figure 1. A Neoliberal Institutional Model

		S_2		
		F	T	C
S_1	F	3,3	1,4	-1,0
	T	4,1	2,2	-1/2,0
	C	0,-1	0,-1/2	0,0

consequently, the option of closing the economy is equivalent to imposing an embargo.¹⁰ The game \mathcal{E} then, represents the case in which a state gains if it is the only state to impose a tariff but both states lose if they both impose tariffs; that is, the outcome in which both states impose tariffs (T, T) leaves both states worse off than the free trade outcome, (F, F) . If both states close their economies and effectively embargo each other by playing C , there will be no trade. The payoffs in this case are less than the payoffs obtained if both states had imposed an optimal tariff.¹¹ If only one of the states closes its economy, there will still be no trade regardless of what the other state does; and the state that closed its economy receives the same payoff regardless of what the other state does. But the state that had expected to trade, either freely or with tariffs, suffers a loss due to a misallocation of its productive resources. Accordingly, each state prefers to close its economy if the other does. For

the sake of clarification, the neoliberal institutional model composed of playing \mathcal{E} may be loosely interpreted as a very rudimentary model of strategic trade.¹²

The formal aspects of the neoliberal institutional critique of structural realism's analysis of the problem of cooperation are based on a repeated prisoner's dilemma in which the shadow of the future is large enough to induce cooperation. In order to relate the present formalization to that employed in the neoliberal institutional critique, the payoffs of the model developed here have been constructed so that the shadow of the future does induce cooperation in the model. More formally, the neoliberal institutional model has been explicitly designed so that (F, F) is a first-period equilibrium outcome.¹³

To show that (F, F) can be a first-period equilibrium outcome, the equilibria of the neoliberal institutional model will be determined. In equilibrium, the outcome on the last play of a repeated game must be an equilibrium of the stage game that is being repeated.¹⁴ In particular, the second-period outcome of the game composed of two plays of the stage game \mathcal{E} must be an equilibrium of \mathcal{E} . \mathcal{E} , in turn, has two pure-strategy equilibria.¹⁵ In the first equilibrium, each state imposes the optimal tariff and receives a payoff of 2. In the second equilibrium, each state embargos the other by closing its economy to trade. This yields the payoffs $(0, 0)$. Thus, in the game in which \mathcal{E} is played twice, the only second-period outcomes that can be part of an equilibrium are (T, T) and (C, C) .¹⁶

Playing \mathcal{E} twice does, however, affect the first-period outcomes that can be sustained in equilibrium. Indeed, the free trade outcome (F, F) as well as the outcomes in which one state imposes a tariff, (T, F) and (F, T) , can occur in equilibrium. For example, the equilibrium strategies that lead to (F, F) in the first period are for S_1 to play F in the first period and

T in the second period if (F, F) is the first-period outcome and C if not and, similarly, for S_2 to play F in the first period and T in the second period if (F, F) is the first-period outcome and C if not. In essence, the state that remained faithful to free trade during the first period by playing F is punishing the defector in the second period by imposing an embargo. Clearly, (F, F) is the first-period outcome if both states follow these strategies. These strategies also constitute an equilibrium if neither state can improve its payoff by deviating from its strategy, given that the other player is following its strategy. If both states follow these strategies, each receives three in the first period and two in the second for a total payoff of five. If, however, a state deviates in the first period by playing T , it will do better in that period by realizing a payoff of four. But given the other state's strategy of imposing an embargo in the second period by playing C if (F, F) was not the first-period outcome, the most that a defector can attain is a second-period payoff of zero. This yields a total payoff of four; that is, the future cost of defection, which is to obtain zero rather than two in the second period, outweighs the immediate gain to defecting, which is four rather than three in the first period. No player has any incentive to deviate from the strategies just described, so these strategies constitute an equilibrium whose first-period outcome is (F, F) .¹⁷ Thus, threats to punish can be used to sustain cooperation in this model. Similar strategies will also support (F, T) and (T, F) as equilibrium outcomes.¹⁸

As in the neoliberal institutional critique of structural realism, anarchy does not imply a lack of cooperation. The equilibria of this model are consistent with the lack of a common government in the sense that they are subgame perfect.¹⁹ This means that carrying out the threatened punishment of imposing an embargo in equilibrium is in the threatener's own

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self-interest. Neither state can improve its payoff by backing down and not following through on its threat, given the other state's strategy.²⁰ Because implementing the threat to punish deviation is in the threatening state's own interest, the equilibria supporting (F, F) , (T, F) , or (F, T) do not implicitly require that some external authority exists to enforce threats or promises that are in a state's interest to make but not necessarily to implement should the time come to do so. In this sense, these equilibria are in keeping with the notion of international anarchy as the absence of a central authority. Cooperation, even in anarchy, is possible.²¹

In sum, the repeated prisoner's dilemma has been widely used to provide the formal underpinnings of the neoliberal institutional analysis of the problem of international conflict and cooperation. The repeated game composed of twice playing \mathcal{E} formalizes much of the essence of the neoliberal institutional critique of structural realism in a simpler setting. The shadow of the future makes cooperation possible even in an anarchic system in which each state judges "its grievances and ambitions according to the dictates of its own reason" (Waltz 1959, 157) because there is no authority that is superior to the states. In particular, the cooperative outcome in which both states maintain open economies and receive equal absolute gains can be supported in equilibrium. This equilibrium offers each state a payoff of five in the repeated game. The absolute gains are equal, so there are no relative losses. There are, however, also equilibrium outcomes in which the states' absolute gains are unequal and, therefore, one of the states suffers a relative loss. For example, in the equilibrium in which (F, T) is the outcome in the first period, S_1 receives four in the first period and two in the second for a total of six. S_2 receives one in the first period and two in the second for a total of three. Because these are equilibrium

payoffs, the state suffering a relative loss, while certainly preferring a higher payoff, cannot improve its payoff by altering its strategy. In this sense, this state is unconcerned by its relative loss.

Although the repeated prisoner's dilemma provides the formal foundations for the neoliberal institutional critique of structural realism's pessimistic assessment of the prospects for cooperation in anarchic systems, repeated games, including the repeated prisoner's dilemma and the simple neoliberal institutional model developed here, formalize structural realism's understanding of the international system and, especially the role of force in that system very badly. This, in turn, significantly weakens any analysis of the problem of relative gains and the feasibility of cooperation based on this type of formalization. Repeated games are poor models for two reasons.

The first is more readily apparent but less directly related to the problem of absolute and relative gains and the effects of the concern for relative gains on the problem of cooperation. Structural realism, as well as realism,²² focuses on a system in which states have the option of using force if that seems to them to be in their best interest and in which the use of force may transform the system. For Aron, international relations "present one original feature which distinguishes them from all other social relations: they take place within the shadow of war" (Aron 1966, 6). For Waltz, force in international relations "serves, not only as the ultima ratio, but indeed as the first and constant one. . . . The constant possibility that force will be used limits manipulations, moderates demands, and serves as an incentive for the settlement of disputes" (1979, 113). And for Gilpin, hegemonic war is a principle means of systemic change (1981, 42-49).

Given the central role that the possible use of force plays in structural realism, it would seem that any model of the inter-

national system envisioned in structural realism would have to satisfy two requirements: (1) the option of using force should be represented in the model; and (2) the model should allow for the possibility that the use of force might, whether intentionally or not, change the system. For a repeated-game model, the first requirement means that one of the options in the stage game that is being repeated should correspond to the option of using force. If, for example, the system is being formalized with a repeated prisoner's dilemma, then defecting should be taken to represent the option of attacking. Repeated games can satisfy this requirement.

But repeated games cannot satisfy the second requirement, and this renders them poor models of the international system implicit in structural realism. If the international system is modeled as a repeated game, then the state of the system (i.e., the actors, the options available to the actors in each period, and the payoffs to the various possible combinations of actions) remains constant. Every period looks like every other period in a repeated game. Nothing the actors do can change the state of the system. Fighting a hegemonic war in one period does not affect the constraints facing the actors in the next period. If, for example, both states defect in any round of a repeated prisoner's dilemma and this is interpreted as fighting a hegemonic war, then a hegemonic war can never change the system; for immediately after the war, the same states simply play the prisoner's dilemma again and the game continues on as if nothing had happened. Put another way, using a repeated game to model the international system is to say that the system in 1939 was formally equivalent to the system that emerged in 1945. Because force can never change the system if this system is formalized as a repeated game, formalizing the international system inherent in structural realism in this way is quite problematic.

The second reason that repeated games formalize structural realism's conception of the international system poorly is more subtle but also more directly related to the problem of absolute and relative gains and the feasibility of cooperation. The concern for the relative gains in structural realism arises because a state's relative loss to another state may be turned against it as that other state pursues its own ends: "If an expected gain is to be divided, say, in the ratio of two to one, one state may use its disproportionate gain to implement a policy intended to damage or destroy the other" (Waltz 1979, 105). If, therefore, a model is to provide a good formalization of structural realism's conceptualization of the problem of relative and absolute gains, there should be some way for a state in that model to use a relative gain to its advantage and to the detriment of the other state. Unless such an option exists in the model, there is no reason for a state to be troubled by a relative loss, and the model is not capturing what structural realism sees as the essence of the problem of relative gains and cooperation. But no such option exists in repeated games; consequently, they assume away what structural realism takes to be the essence of the problem of relative gains and cooperation.

That there is no way for a state's relative loss to be turned against it in a repeated game is easiest to see by considering how actors sustain cooperation in repeated games and then showing that a state's ability to induce the other state to cooperate is unaffected by any relative losses. To sustain cooperation in any two-actor game, each actor must be able to make the long-run costs of defection for the other actor outweigh the immediate gains. The future costs that each actor can impose on the other determine whether or not the actors can sustain cooperation. But in a repeated game, an actor's ability to make the future costs of defection higher than the immediate gain does not

depend on how well that actor has done in the past relative to the potential defector. If, for example, a sanction must be imposed for five periods in a repeated game to make the cost of defection exceed the gain, then it will always take five periods to do this regardless of how well the actors have done in relation to each other before the sanction is imposed. Because the ability to impose future costs does not depend on how well the states have done relative to each other, achieving a relative gain or suffering a relative loss does not affect a state's ability to induce cooperation with threats of future punishment. A state that has suffered a series of relative losses can threaten to impose just as much future punishment on the other state as it would have been able to threaten had it not suffered these relative losses. Relative losses do not impede a state's ability to enforce cooperation in a repeated game. There is, therefore, no reason to be concerned with relative gains or losses. Thus, the formalism of a repeated game omits what structural realism sees as the very essence of the problem of absolute and relative gains. For this reason, repeated games formalize the international system implicit in structural realism very badly.²³

A more satisfying analysis of the problem of relative gains and the feasibility of cooperation requires a model in which the option of using force is represented explicitly and in which a state's relative loss may be turned against it. Using the neoliberal institutional model analyzed here as a point of departure, I next develop a model that satisfies these two requirements. In that model, each state's ability to use force successfully to achieve its ends will depend on how well it has previously done relative to the other state.

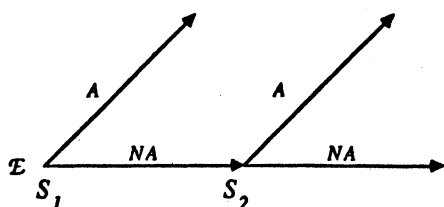
A Structural Model of the Problem of Absolute and Relative Gains

I develop a very simple and highly stylized formalization of the problem of absolute and relative gains. States will now have the explicit option of using force if that seems to them to be in their best interest. More importantly, the model has been explicitly designed so that relative gains and losses matter because they affect a state's ability to use force successfully to further its interests. As will be seen, these constraints actually do induce a concern for relative gains. For this reason, this model offers a better formalization of the structural realism's understanding of the problem of absolute and relative gains.

Because the constraints in the model formally induce a concern for relative gains, the model may be used to examine how changes in these constraints affect the states' relative concern for absolute and relative gains and the feasibility of cooperation. This examination shows that many important aspects of neoliberal institutionalism and structural realism emerge as special cases of the model. If the use of force is at issue because the cost of fighting is sufficiently low, cooperation collapses in the model. This is in keeping with the expectations of structural realism. But if the use of force is no longer at issue, cooperation again becomes feasible. This is more in accord with neoliberal institutionalism. The model thus offers a synthesis of the apparently conflicting perspectives of neoliberal institutionalism and structural realism on the problem for relative gains and the feasibility of cooperation by explaining variations in the relative concern of relative gains and in the corresponding feasibility of cooperation in terms of changes in the constraints facing the states and not in terms of the attributes of the states.

The model also addresses two other

Figure 2. The Option of Fighting



issues in international relations theory. First, the structure of the international system as Waltz defines it will be shown to remain constant throughout the analysis. Yet the feasibility of cooperation varies. This means that Waltz's notion of structure is unable to account for these changes in the feasibility of cooperation. Second, the model clarifies the relation between anarchy and cooperation by helping to explain why anarchy does not imply a lack of cooperation in some systems but does impede cooperation in others as neoliberal institutionalism has shown.

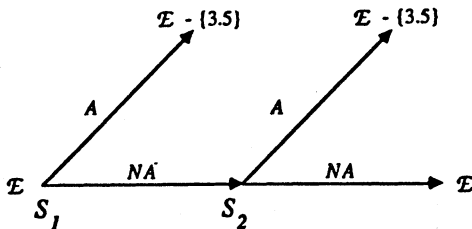
The specter of war is introduced into the model by assuming that each state must decide whether or not to attack between the two plays of \mathcal{E} . As illustrated in Figure 2, after the first play of \mathcal{E} S_1 chooses between attacking, A , or not attacking, NA . If S_1 attacks, there is war. If S_1 does not attack, then S_2 must decide between attacking or not. If S_2 attacks, there will also be war. If S_2 does not attack, then there is no war and the game ends with the second play of \mathcal{E} .

To complete the specification of the modified game, the payoffs to attacking must be defined. This specification depends, in turn, on making a fundamental assumption about the nature or technology of warfare; and it is at this point that relative gains formally enter the analysis. The very simple, highly stylized assumption about the nature of warfare

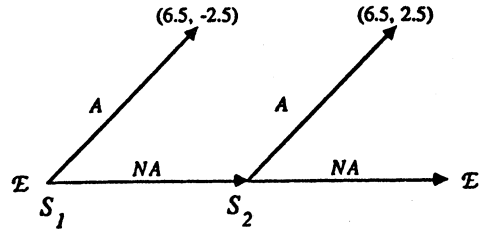
underlying this analysis is that the stronger a state is economically, the more likely it is to prevail in war. Thus, relative gains matter because they affect how the states are likely to fare in the event of war and thus affect the states' future expected payoff. It is important to emphasize, however, that relative gains are significant not because a state's utility is a function of them—the states are still trying to maximize their absolute gains—but because the constraints imposed by the underlying technology of war makes it possible for a state to use its relative gains to its advantage and to the disadvantage of the other state.²⁴

To formalize a stylized technology of warfare in which relative gains and losses affect a state's ability to prevail in the event of war, the payoffs to attacking will be taken to depend on what happened on the first play of \mathcal{E} . The states are assumed to be roughly equal before the game begins, so that the states will fight to a stalemate if there is war and if the difference between the first-period payoffs is too small to give one state a significant military advantage. More specifically, if one state attacks and the difference between the first-period payoffs is less than 3, then both states will fight to a draw, paying a fighting cost of 3.5, and then play \mathcal{E} for a second time. These payoffs are shown in Figure 3, where $\mathcal{E} - \{3.5\}$ is the payoff matrix obtained by subtracting 3.5 from each payoff in \mathcal{E} . If the difference between the first-period payoffs is at least 3, then the state with the higher payoff will be assumed to be sufficiently strong economically that it will prevail if there is war. If a state prevails, then its payoff to the entire game is what it received on the first play of \mathcal{E} , which must have been 4 (for otherwise the difference between its payoff and the other state's payoff would have been less than 3) less the cost of fighting, 3.5, plus the payoff to victory, which will be taken to be 6. In sum, the total payoff to prevailing is 6.5. Defeat

**Figure 3. The Payoffs
If Fighting Brings Stalemate**



**Figure 4. The Payoffs if
 S_1 Will Prevail**



means a loss of 3.5 due to the cost of fighting plus 0, which will be taken as the payoff to defeat. Thus, the total payoff if a state is defeated is the first-period payoff, which must have been 1 if the difference between the states' first-period payoffs was at least 3, less the cost of fighting, 3.5, for a net of -2.5 . These payoffs are depicted in Figure 4.

The prospect of war renders cooperation in the first play of \mathcal{G} impossible. Clearly, the outcome (T, F) cannot be sustained as a first-period equilibrium outcome. If S_1 imposes a tariff and S_2 maintains an open economy, then S_1 is sure to attack and defeat S_2 because this maximizes S_1 's payoff. The game would end with payoffs $(6.5, -2.5)$. S_2 , however, can do better than this by playing T in the first period. This will give S_2 a first period payoff of 2; and, because war would mean stalemate, neither state will attack. S_2 will therefore end the game with at least two. Thus, S_2 has an incentive to deviate from F in the first period in order to deprive S_1 of its relative gain; and this means that (T, F) cannot be part of an equilibrium. A similar argument shows that (F, T) cannot be an equilibrium outcome.

The effects of the specter of war on the outcome in which both states maintain open economies (F, F) illustrate a point that suggests cooperation may even be

more difficult than has been previously appreciated. Because (F, F) offers both states equal absolute gains and consequently no relative gains, it might seem that it would be possible to sustain this outcome in equilibrium. This, however, is not the case. Although this outcome offers no relative gain, deviating from it does; and this means that it cannot be an equilibrium outcome. If one state plays F and the other cheats with T , then the latter will secure a large relative gain and then attack and prevail. Each state, therefore, has an incentive to deviate from F if the other player is playing F , so (F, F) cannot be an equilibrium outcome. Anarchy and the possible use of force may even prevent the realization of agreements that provide equal absolute gains if deviating from the agreement would yield large relative gains.

These results are in keeping with the expectations of structural realism. Although each state in the model is trying to maximize its absolute level of economic welfare, it is doing so within an anarchical structure whose underlying technology of warfare means that the relative gains of another can be turned against it so as to reduce its future level of economic welfare. These constraints force the states to be concerned about relative gains in the sense that outcomes that offer unequal absolute gains or the prospect of unequal

absolute gains should one state cheat on an agreement cannot be sustained in equilibrium. The only first-period equilibrium outcomes in the model are those in which both states impose tariffs (T, T) or close their economies (C, C).

But if the constraints facing the states change, the conclusions are more in accord with the expectations of neoliberal institutionalism. In particular, cooperation reemerges once the use of force is not at issue. To formalize this, suppose that the cost of fighting rises from 3.5 to 7. Then the payoff to victory is $4 - 7 + 6 = -1$, to defeat, $1 - 7 + 0 = -6$. In these circumstances, a state prefers not to attack even if it has secured a relative gain on the first play of \mathcal{C} . Even if sure of prevailing, no state will resort to force; and cooperation again becomes feasible in the model. To sustain (F, F), for example, the state's equilibrium strategies would be to play F in the first play of \mathcal{C} , not attack, and then play T in the second period if both states played F in the first period. If a state deviated from F in the first period or if a state attacked and the war ended in a stalemate, then the states would sanction each other during the second period by playing C . To see that these are, in fact, equilibrium strategies that do support (F, F) in the first period, note that if both states follow them, then each receives 3 in the first period, does not attack, and then obtains 2 in the second period for a total of 5. If S_1 deviates from F by playing T , it will receive 4 in the first round and then must decide whether or not to go to war. If it does, it will prevail, but its total payoff will be the first-period payoff of 4, less the cost of war, 7, plus the payoff to victory, 6. The overall payoff of deviating in this way is 3. This, however, is less than S_1 would have obtained had it followed the original strategy. S_1 , therefore, has no incentive to deviate by playing T and then attacking. S_1 also has no incentive to deviate by playing T in the first period and then not attacking, for S_2 will be playing

C in the second period because of S_1 's deviation from F . In this case, S_1 's payoff will be $4 + 0 = 4$. S_1 , therefore, has no incentive to deviate from the strategy specified; nor, by a symmetric argument, has S_2 . These strategies thus constitute an equilibrium that leads to the cooperative first-period equilibrium outcomes.

In brief, cooperation collapses in the model when the use of force is at issue. This is in keeping with structural realism. But if the cost of war is sufficiently high that the use of force is no longer at issue, then cooperation again becomes possible; and this is in accord with neoliberal institutionalism. Thus, the simple model developed here integrates much of structural realism and neoliberal institutionalism within a common analytic framework, in that many aspects of these two approaches appear as special cases of the present model.

The structural model illuminates two other issues in international relations theory. First, it formally shows that Waltz's notion of a political structure (1979, 79–101) cannot explain the variation in the feasibility of cooperation considered here. The political structure, as Waltz defines it, remains constant and unchanged throughout the analysis. Consequently, structural changes as Waltz conceives of them cannot account for the variations in the likelihood of cooperation. Explaining the range of cooperative behavior examined here requires a more detailed examination of the system's constraints than Waltz's definition of structure permits.

To see that the three characteristics that define a political structure for Waltz, i.e., the distribution of capabilities, the functional differentiation or nondifferentiation of the units, and the ordering principle, remain constant, note that the game is completely symmetric. There are only two states, and the only difference between them is that one is labeled S_1 and the other is labeled S_2 . Thus, as the cost of

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fighting varies, there is no change in the distribution of capabilities or in the functional differentiation of the states. The ordering principle also remains that of anarchy, in that the games are always analyzed in terms of subgame perfect equilibria. The political structure, therefore, remains constant, although the feasibility of cooperation varies.

The second issue in international relations theory is the relation between anarchy and cooperation. Cooperation collapses when the use of force is at issue. But anarchy in the sense of a "lack of common government" to enforce agreements is not in and of itself the cause of this collapse. No such authority exists in the neoliberal institutional model in which *ℰ* was simply repeated twice or in the structural model. Yet, cooperation was an equilibrium outcome in the former and in the latter when the use of force was sufficiently costly. Anarchy, as neoliberal institutionalism argues, does not logically imply a lack of cooperation (Keohane 1984, 65–84).

What accounts for the lack of cooperation is not anarchy for this is present in all of the models. Rather, the explanation lies in the different sets of constraints that define what the states can do in anarchy. In the structural model when the use of force is at issue, as it is in the international system envisioned in structural realism, relative gains matter. In these circumstances, the constraints in the structural model formally create an opportunity for each state to exploit its relative gain to its own advantage and to the detriment of the other state. Such constraints will then induce a concern for relative gains unless there is a central authority that can ensure that no state will exploit the opportunity afforded by these constraints. Cooperation, therefore, collapses for two reasons. The constraints create opportunities for a state to exploit its relative gains to its advantage and to the disadvantage of the other state; and there is no common

government to ensure that states do not exploit these opportunities. In contrast with the structural model, anarchy does not imply a lack of cooperation in the neoliberal institutional model, because relative gains do not matter in that model. As I have shown, each state's ability to deter defection with the threat of future punishment does not depend on how well that state has done relative to the other in a repeated game. The constraints in the neoliberal institutional model do not offer the states a way to exploit a relative gain. Consequently, there is no need for a common government to ensure that the states do not exploit opportunities to turn a relative gain to their advantage, because there are no such opportunities in the model.

In sum, two factors combine to induce a concern for relative gains and make cooperation difficult. The first factor, which heretofore has only been implicit in structural realism's description of the international system, is that the constraints defining the system create opportunities for one state to turn relative gains to its advantage and to the disadvantage of other states. The second factor, on which both structural realist and neoliberal institutional analyses of the problem of relative gains and cooperation have focused, is anarchy.²⁵ If opportunities to exploit relative gains exist, then the absence of a common government to ensure that the states do not exploit these opportunities may impede cooperation.

By emphasizing that structural realism implicitly assumes that the nature of military conflict means that the potential use of force creates a set of constraints in which states can exploit their relative gains, I may have obscured a more general point. The general problem confronting a state in this system is one of constrained optimization in which the units are trying to maximize their absolute level of economic welfare subject to a set of constraints in which a unit's current rela-

tive gain may be translated into a future absolute gain for that unit and a future absolute loss for the other units. If this more general description also applies to other systems, then the present analysis may also help to explain why cooperation may be difficult to achieve in those systems even though the units in those systems are attempting to maximize their absolute gains and the possible use of military force is not a relevant part of the problem. If, for example, long-run profit maximization within an oligopolistic market structure depends on relative gains in terms of, say, market share, then this analysis would suggest that it may be very difficult to achieve international cooperation and collaboration even if national security concerns are not at issue.²⁶ Describing the problem faced by states in the international system in the more abstract terms of the optimization problem confronting them may suggest previously unappreciated parallels between this and other problems where the possible use of force is not the source of the concern for relative gains.

Conclusions

The problem of absolute and relative gains divides neoliberal institutionalism and structural realism. The former assumes that states are primarily concerned with absolute gains while the latter assumes that states are primarily concerned with relative gains. What to assume about states' preferences is a theoretical question, not an empirical one. States as rational unitary actors do not exist. They are a theoretical construct. Thus, the question of whether states maximize absolute gains or are concerned about relative gains is empirically meaningless. The real question is, Which assumption about state preferences is more useful? Which in the context of a broader theory gives rise to better

insights? Any firm judgment about this must await further work. As a first step toward this judgment, I have begun to describe some of the insights that follow from examining a simple model in which states are assumed to be attempting to maximize their absolute level of economic welfare in an anarchic international system in which an absolute gain but relative loss today can become an absolute loss tomorrow.

This simple model takes a step toward bringing neoliberal institutionalism and structural realism within a single analytic framework by showing that many aspects of these two approaches can be seen as special cases of the model. In keeping with the expectations of structural realism, states are concerned about relative gains when the possible use of force is at issue. Cooperative outcomes that offer unequal absolute gains cannot be an equilibrium in this system. Indeed, even some agreements that offer equal absolute gains, and therefore, no relative gain cannot be sustained in equilibrium, because one state can achieve a relative gain by defecting from the agreement. The prospects for cooperation are, however, sensitive to the costs of fighting. If the use of force is no longer at issue, then a state's relative loss will not be turned against that state. Relative gains no longer matter, and cooperation now becomes feasible. This is in keeping with the expectations of neoliberal institutionalism.

The model also furthers the analysis of two other issues in international relations theory. First, it provides a simple formal example showing that Waltz's characterization of a system's political structure in terms of its ordering principle, the functional differentiation of its units, and the distribution of capabilities across the units cannot account for the variations in the feasibility of cooperation examined here. Changes in the cost of war do not affect the system's structure in Waltz's formulation but do affect the potential for coop-

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eration in the model. Second, the model helps to clarify the relation between anarchy and cooperation. Anarchy, as neoliberal institutionalism has shown, does not imply a lack of cooperation. Rather, two factors combine to make cooperation difficult. The first is anarchy, defined as a lack of a common government that can enforce commitments. The second factor (crucial to structural realism but only implicit in it) is that the system be characterized by a set of constraints that present the states with opportunities in which they can use relative gains to their advantage and to the disadvantage of others. Absent such opportunities, relative gains cannot be exploited, and there is no need for a central authority to ensure that these nonexistent opportunities are not exploited.

Notes

I thank David Collier, Michael Desch, James Fearon, Jeff Frieden, Avery Goldstein, Joanne Gowa, Joseph Grieco, Keisuke Iida, Ethan Kapstein, Robert Keohane, James Morrow, Ronald Mitchell, Kamal Shehadi, R. Harrison Wagner, and Celeste Wallander for helpful comments and criticisms.

1. For discussions of neoliberal institutionalism's emphasis on absolute gains and realism's or structural realism's emphasis on relative gains, see Gilpin 1981, 18–25; Gowa 1986, 172–79; Grieco 1988a, 1988b, 1990; Hoffmann 1973, 6–12; Jervis 1988, 334–36; Keohane 1984; Keohane and Nye 1977, 23–37; Keohane and Nye 1987, 728–33; Krasner 1983, 356; Lipson 1984, 12–18; Mearsheimer 1990, 11, 44–45; Morgenthau 1967; Rosecrance 1981, 705–7; Rosecrance 1986, 44–63; Snidal 1981, 3–6; Stein 1983, 134; Stein 1984, 383–86; Viner 1948, 1–29; Waltz 1959, 34–36, 196–98, 219–21; Waltz 1979, 102–28; and Wolfers 1962, 67–115.

2. Discussions of absolute and relative gains and the problem of cooperation include Gowa 1986; Grieco 1988a, 1988b, 1990; Lipson 1984; and Snidal 1991.

3. For specific examples characterizing the concern about relative gains in terms of preferences, see Gilpin 1981, 18–21; Grieco 1988a, 1988b, 1990; Jervis 1988, 335; Keohane 1984, 66; Lipson 1984, 15; Mearsheimer 1990, 11, 44–45; Snidal 1991; and Stein 1983, 134; Stein 1984, 382. Keohane also claims that many aspects of neoliberal institutionalism can be

based on the same set of assumptions about states' preferences that structural realism employs (1984, 67). However, Gowa (1986) in general and Grieco (1988a) in particular argue that the repeated prisoner's dilemma on which Keohane bases much of his analysis (1984, 65–84) is not consistent with structural realism.

4. For other attempts to integrate the analysis of conflict and cooperation, see Lipson 1984, Oye 1986, and Stein 1984.

5. Explaining states' concern for relative gains in terms of constraints rather than preferences is incidentally more in keeping with the original notions of structural realism. Indeed, what makes structural realism structural and distinguishes structural realism from realism is that the concern for relative gains is induced by the system's structural constraints (Waltz 1959, 34–36).

6. See Powell (1991) for an effort in this direction.

7. For Waltz, the concern for relative gains also extends beyond the international system to other self-help systems (1979, 91). But it is difficult to define self-help precisely.

8. For examples using the repeated prisoner's dilemma to formalize the problem of cooperation see Axelrod 1984, Keohane 1984, and Oye 1986.

9. As is well known, if the prisoner's dilemma is repeated a known finite number of times and there is complete information, there is no cooperation in equilibrium. There must be infinitely many repetitions for there to be cooperation in equilibrium. If, therefore, one is to study the problem of cooperation formally in the context of a repeated prisoner's dilemma, one must focus on an infinitely repeated prisoner's dilemma. The present formulation permits the formal study of cooperation in the simpler setting of a two-period repeated game.

10. One of the weaknesses of this interpretation is that the states in \mathcal{E} are choosing their policies simultaneously and must endure significant losses before they can change their policies in the second period. A better substantive model would not entail simultaneous decisions or would allow the states to change their policies before suffering significant losses.

11. Johnson (1953) shows that if both states impose optimal tariffs, then, depending on the elasticities of demand, one or both states will suffer compared to the free trade outcome. Optimal tariffs cannot make both states better off. (In this analysis, optimal tariffs are assumed to leave both states worse off relative to the free trade outcomes. Consequently, the payoffs to (F, F) are larger than those to (T, T) in \mathcal{E} .) He also establishes that there will be a positive volume of trade even if both states have imposed an optimal tariff. This implies that the states obtain higher payoffs even with mutual tariffs than they would if there were no trade. Thus,

payoffs to (T, T) are higher than the payoffs to an outcome in which at least one of the states plays C .

12. For an introduction to, and survey of, some of the recent work on strategic trade, see Cohen 1990, Krugman 1986, Richardson 1990, Stegemann 1989, and Stern 1987.

13. Recall that the problem of cooperation reduces to what can happen in the first period because \mathcal{E} is only played twice, which implies that there is no shadow of the future in the second period.

14. If the equilibrium of a repeated game did not require the states to play an equilibrium of the stage game in the last period, then one of the states would have an incentive to deviate from the purported equilibrium strategy in the last period of the game. This implies that the purported equilibrium strategies cannot actually be equilibrium strategies because no actor can ever have any positive incentive to deviate from an equilibrium strategy.

15. I will focus exclusively on pure-strategy equilibria and disregard mixed strategies.

16. The combination of strategies (T, T) is an equilibrium of \mathcal{E} because no state has any incentive to deviate from its strategy, given the other state's strategy. If S_1 plays T , then playing T offers S_2 its highest payoff. Conversely, if S_1 plays β , then S_2 also offers S_2 its highest payoff. Similarly, (C, C) is an equilibrium even though it is Pareto-dominated by (T, T) because no state has any incentive to deviate from its strategy, given the other state's strategy. If S_1 plays C , then playing C offers S_2 its highest payoff; conversely, if S_1 plays C , then C also offers S_2 its highest payoff.

17. The reason that cooperation can arise in equilibrium in the game composed of a finite number of repetitions of \mathcal{E} but not in a finite number of repetitions of the prisoner's dilemma has to do with a very peculiar characteristic of the prisoner's dilemma, which is that the minmax payoff equals the equilibrium payoff. This is true of very few other games; and when the minmax payoff does not equal the equilibrium payoff, cooperative outcomes, as well as any other individually rational outcome, can be supported in equilibrium in a finitely repeated game if the number of repetitions is sufficiently large and the actors do not discount the future too much. Indeed, the technical reason for adding the strategy C to the prisoner's dilemma formed by the strategies F and T is to make the minmax payoff unequal to the equilibrium payoff. This makes it possible to sustain cooperation in the first period and thus to capture the essence of the infinitely repeated prisoner's dilemma in a simpler setting. For further discussion of the equilibria of repeated games, see Benoit and Krishna 1985, Fudenberg and Maskin 1986, and Kreps et al. 1982.

18. The problem of multiple equilibria frequently plagues repeated games. Indeed, almost any outcome can be supported in equilibrium. More formally, any individually rational payoffs can be approxi-

mated in the limit if the game is repeated sufficiently often and the actors do not discount the future too much (Benoit and Krishna 1985; Fudenberg and Maskin 1986).

The existence of multiple equilibria suggests that one purpose of institutions and regimes may be to focus expectations on a particular equilibrium. This is certainly in keeping with the notion that regimes are "sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations" (Krasner 1983, 2). Although suggestive, this is formally rather ad hoc. Ideally, one would like to formalize the institution within the model with the result that the model has a unique equilibrium. For an important effort along these lines see Morrow 1990.

19. See Rasmusen 1989, 83–89 for a discussion of subgame perfection.

20. To see that the equilibrium supporting the (F, F) is subgame perfect, let S_1 's strategy be to play F in the first period and T in the second period if (F, F) is the first-period outcome and C if not. Similarly, S_2 's strategy is to play F in the first period and T in the second period if (F, F) is the first-period outcome and C if not. As shown above, neither state has any incentive to deviate from its strategy, given the other state's strategy, so this combination of strategies constitutes a Nash equilibrium in which (F, F) is the first-period outcome. To establish subgame perfection, it must also be shown that neither state has any incentive to deviate from carrying out the threatened embargo, given the other state's strategy and that (F, F) was not the first-period outcome. Suppose that S_1 played T , rather than F , in the first period. Given S_1 's strategy of playing C in the second period if, as is assumed, (F, F) was not the first-period outcome, then S_2 has no incentive to deviate from its strategy of embargoing S_1 ; that is, S_2 cannot improve its payoff by playing something other than C , given S_1 's strategy of playing C . Similarly, given S_2 's strategy of playing C in the second period if (F, F) was not the first-period outcome, then S_1 has no incentive to change its strategy by playing something other than C , given that S_2 is playing C . Neither state has any incentive not to carry out its threat, given the other's strategy; and the equilibrium is subgame perfect.

21. Although the equilibria of the neoliberal institutional model are subgame perfect, the desire to conduct this analysis in the simplest formal setting possible creates some difficulties. These equilibria are not renegotiation-proof (Farrell and Maskin 1989). Surmounting this would require moving to a more complicated formal setting that would tend to obscure the basic points the model is intended to illustrate.

22. See n. 5.

23. Gowa (1986) and Grieco (1988a, 1988b, 1990) have also criticized the use of the repeated prisoner's

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dilemma to model structural realism's conception of the problem of cooperation. Their criticisms, however, focus on the states' preferences and the assumption that states are trying to maximize their absolute gain.

24. The phrase "technology of warfare" is used here because the nature of military technology in this formalization constrains the states in the international system in much the same way that the technology of production constrains firms in an oligopolistic market.

25. For examples of this focus, see Oye 1986.

26. Indeed, Grieco (1990) studies the problem of relative gains in the context of negotiations between the European Community and the United States over nontariff barriers, a context in which it is difficult to attribute any concern for relative gains to the effects that a relative loss may have on the probability of survival. This analysis helps explain why this concern may nevertheless still be present at least at the level of firms and why they may try to induce the government to reflect these concerns.

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