Title: Cooperation, Conflict, and the Costs of Anarchy

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Abstract:

I consider a model in which two states choose how much to arm and whether to attack in successive periods. Arms are useful not only for deterrence or taking territory, but also because they influence the resolution of a set of disputed issues. It is shown that states can cooperate on the issues by limiting military competition, but only as far as a "war constraint" allows. Factors determining the tightness of the war constraint imply hypotheses about the international determinants of military effort and thus the costs of anarchy. The strategic logic of the model differs from standard security dilemma arguments, in which the costs of anarchy are associated with conflict between status quo states that are uncertain about others' territorial revisionism. Here, inefficiency arises because arming to deter lowers a state's value for living with the status quo, which creates a security externality and a feedback loop. The model both synthesizes and revises a diverse range of theoretical arguments about the determinants of interstate cooperation and conflict.

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In *Theory of International Politics*, Kenneth Waltz famously analogized states in international relations to firms in a oligopolistic industry.[1] Firms choose prices (or quantities) in an effort to maximize profits, but in the limiting case of perfect competition they earn no profit at all due to a strategic incentive to undercut each other. Given their preferences, anti-trust law, and "the structure of the situation," the firms face what amounts to a Prisoners' Dilemma. Waltz saw this model as exactly parallel to the idea that international anarchy leads states to choose policies – arming, allying, and attacking, in particular – that can make them worse off than they could be if they could instead commit themselves to cooperate. For Waltz, the microeconomic analogy was a way of developing and putting on solid ground the traditional Realist intuition that there is something fundamentally different about interstate relations, something that makes them inevitably tragic in a way that domestic politics need not be.

Theory of International Politics was written before developments in game theory reworked the field of industrial organization, and in particular before elaboration of the idea that repeated interactions could allow firms to construct self-enforcing agreements that would sustain higher prices and profits.[2] Robert Axelrod and Robert Keohane applied this idea to international relations, suggesting that it undermined the claim that they must necessarily be conflictual and tragic.[3] Joseph Grieco argued in response that if states have an intrinsic preference for "relative gains," it could be impossible to sustain a cooperative interstate agreement by implicit threats of ceasing cooperation if the other cheats.[4] Robert Powell argued that the right Realist counter should not be to make a different assumption about state preferences, but to understand that in anarchy the use

[1] Waltz 1979.

[2] In game theory, the core idea of the "folk theorems" dates to the 1950s, but extensive development with application to oligopoly theory occurred in the 1980s. In his first book, Waltz 1959, 191-92, considered but largely discounted the possibility of getting interstate cooperation from implicit threats of a trade war in his discussion of anarchy and international trade.

[3] Axelrod 1984; Keohane 1984.

[4] Grieco 1988. Grieco suggested that states' intrinsic preference for relative gains makes their interactions more

of force can enable states to convert relative advantage into absolute gains.[5] Depending on military technology and costs for fighting, this possibility might prevent states from cooperating despite a "shadow of the future" (i.e., repeated interactions). Tragedy restored, but with qualifications.

Running parallel to this neoliberal-neorealist exchange and continuing today, a debate among (mainly) self-described Realists has centered on a different objection to the idea that anarchy implies a great deal of tragedy. Robert Jervis argued that tragic outcomes were due to "the security dilemma," and that the severity of the dilemma varies with the degree to which military technology and geography favor offense or defense in interstate war. Jervis' core arguments, developed further by a number of scholars taking a similar approach, picture state leaders as uncertain about whether other states are satisfied with the territorial status quo or have expansionist preferences. When defense is favored in the "offense-defense balance," arms levels can safely be lower and cooperation is less risky if another state is in fact expansionist. Using this theoretical basis, "defensive realists" maintain that because offense is disadvantaged due to balancing behavior and because nuclear weapons effectively favor defenders, international anarchy needn't or shouldn't be the source of large costs.[6] "Offensive realists" disagree due to reservations about the offense-defense balance concept and because they think that even a small probability of facing an expansionist type is enough to make major powers expansionist or defensively aggressive in turn.[7]

Routinely taught in graduate International Relations seminars, the arguments referenced above are interesting and important. They conflict in some places but seem to overlap in others.[8] It is

"zero sum" than they otherwise would be, thus reducing the scope for cooperation. But if Realism is identified with the claim that international politics are zero-sum between states, then a Realist can't also argue that international politics are rendered tragic by anarchy. In a zero sum game you can make one party worse off to the benefit of the other, but you can't make both worse off than they ideally could be.

[5]Powell 1991.

[6]Jervis 1976, 1978; Glaser 1992, 2010; Kydd 1997, 2005; Van Evera 2001.

[7]Brooks 1997; Mearsheimer 2001.

[8]In his constructivist take on the anarchy question, Wendt 1992 pointed out that if states did not understand

not clear whether or exactly how they might emerge and survive as implications of a common set of premises.[9]

This paper develops a two-state model built on Realist premises. The states in the model (1) interact in the absence of a third-party that can reliably guarantee agreements between them (anarchy); (2) can gain from coordinating their interactions but have some degree of conflicting preferences over issues of mutual concern, which may include territory; (3) have the ability to generate and use armed force against each other; and (4) find both the provision and use of arms costly, at least to some extent. The goal is a baseline model that succinctly characterizes central strategic problems faced by states interacting in international anarchy, and that yields clear implications on what determines variation in the costs of anarchy over time and across states.

To outline the model, two states choose arms levels and whether to attack in successive periods. If there is no war, relative military strength determines the resolution of a set of issues through an unspecified bargaining process. If there is a war, territory is put into play, so that the winner gets not only control of the issues but also the loser's territory. I show that repeated interactions can be used to enable mutually beneficial cooperation between the states on the issues, but subject to a *war constraint*: arms levels cannot be so low that a state would prefer to "break out" by rapidly mobilizing and going to war. Thus, as "neoliberal institutionalists" like Keohane and Axelrod argued, there can be considerable scope for cooperation despite anarchy due to the possibility of self-enforcing agreements that rely on repeated interactions. However, in line with the traditional Realist intuition, this mechanism cannot in general support the first-best outcome of no war and no costly armament (or other competitive effort). *Some costs of anarchy are avoidable without supranational government, some are not.* At least for the two-state case, the model shows just what

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themselves to have conflicting preferences, they could not be troubled by Prisoners' Dilemma-type problems, and suggested further that repeated cooperation might incline states' leaders to feel bad about acting in ways that disadvantaged their partners. Realists disputed the relevance of both points.

[9] Wagner 2010, chap. 1.

follows from a set of standard premises – that is, states that have the capacity to use force, some conflict of interest, but also a common interest in avoiding wasteful and dangerous competition.

The baseline model yields a set of natural propositions on the size of the unavoidable costs of anarchy. In line with Jervis although due to a different logic, the war constraint is less severe, and thus the potential depth of interstate cooperation greater, the more geography and military technology favor defense relative to offense. The war constraint is also less tight the less intrinsic value the states put on controlling the other's territory, which can be an effect of industrialization, democracy, or nationalism when agreement on homelands and borders exists. Greater "gains from trade" – meaning more potential value to be divided up that is separate from homeland territory – may either increase or decrease the war constraint due to offsetting effects. Protectionism, or any factor that lowers the efficiency of exploitation of gains from trade between independent states, tightens the war constraint, raising the arms level necessary for a stable peace. In dyads where one state has greater military potential than the other, the smaller state is predicted to have a higher arms burden, but the model reveals offsetting forces that push in the direction of military burdens being only weakly related to state size.

Although not normally stated in terms of arms levels as a measure of international cooperation, some of these implications will seem familiar to IR theory adepts. In particular, some results that emerge from the baseline model look like a synthesis of positions argued by "defensive realism," "neoclassical realism" and "neoliberal institutionalism," with additional implications on conflict and trade reminiscent of ideas from, for example, Cordell Hull and Richard Rosecrance.[10] Other positions, such as several associated with offensive realism, are not supported.

What is new then? First, theoretical synthesis. These and other implications emerge in a connected and transparent way from a single strategic model. This is in contrast to the standard presentation of arguments given above as competing schools of thought that are based on or stress different assumptions or issue domains.

[10]On Hull, see Schatz 1970, 89; Rosecrance 1987.

Second, the baseline model represents an alternative theoretical foundation, since the logic that generates the implications differs markedly from standard arguments. The closest thing to a clear baseline model in the existing literature – and also the theory undergirding defensive realism – is Jervis' treatment of the security dilemma and subsequent developments of it.[11] In this model, great power politics are driven primarily by states' uncertainty about other states' preferences for territorial expansion. By contrast, while it could be added in principle, this model has no uncertainty about types at all. We still get, however, standard security-dilemma-like results concerning the offense-defense balance. Indeed, the model suggests a novel way of formalizing the somewhat mysterious idea of the security dilemma: Even without any uncertainty about states' preferences, in the model greater offensive advantage leads to greater equilibrium arms levels, which lower states' values for living with the status quo and so make the gamble of war more attractive. More broadly, an important feature of the baseline model is that it puts the guns-butter tradeoff at the heart of the theory, a political economy dimension entirely missing from the "anarchy arguments" glossed above.[12]

[11] Jervis 1978; Glaser 1992, 2010; Kydd 1997, 2005.

[12] There is no consensus formalization of the security dilemma and informal versions vary in their logics. The standard brief definition, that it refers to the fact that "many of the means by which a state tries to increase its security decrease the security of others" (Jervis, 1978, 169), is by itself a statement of a tradeoff at best, not a social dilemma. The next step is usually to suggest that the tradeoff plus uncertainty about other states' types leads to unwanted, dangerous mutual escalation. But it is not clear why arming due to mutual fears of expansionist types should increase fears further (a "spiral") unless we assume a particular form of irrationality or suppose that states are also uncertain about others' beliefs about their own types (Kydd, 1997). Even in the latter case, escalation correctly signals a higher chance that the other side is expansionist, and status quo states can have an incentive to signal their type by restraint (Kydd, 2005). Finally, in the Jervis model tragic outcomes can occur only when both states are in truth status quo oriented; in the baseline model presented here, inefficient outcomes arise when one or both states have some revisionist preferences and this is commonly known. As noted below, this may be a better fit for some

Third, some implications of the model are new – such as the results on state size and arms burdens – or significantly revise important existing theories. For example, all existing conceptualizations of the offense-defense balance define it in terms of the prospects or costs of successful attack versus defense, taking force levels as exogenously given. But as becomes clear in the model, forces levels are chosen endogenously in light of military technology and geography in part to affect prospects for successful offense or defense. This point undermines or even inverts standard offense-defense hypotheses about the how military technology and geography matter. For instance, relative offensive advantage in technology or geography causes states to arm to higher levels, and at these levels the odds of successful attack can actually be lower than if defensive advantages were greater. Thus, railroads massively increased rapid mobilization capacity in late 19th century Europe, which drove increases in equilibrium armament levels, which in turn made the status quo less desirable but conquest less easy than it would have been at lower arms levels.

Fourth, compared to existing theory, the baseline model yields more determinate and testable implications for a relatively measurable proxy for the costs of anarchy – military burdens and force sizes. For lack of space I only briefly consider broad patterns in military spending and force size among the major powers over the last 150 years in light of the model's implications, leaving an assessment based on panel data to other work.[13]

Regarding the model itself, the closest papers in the literature are due to Powell and Matthew Jackson and Massimo Morelli.[14] Powell's underappreciated article was the first to explicitly model state choices about how much to arm and whether to attack in a dynamic setting. He identified

important empirical settings, such as current US relations with China, Iran, or North Korea, for example.

[13]For a panel data analysis see the draft version of this paper, Fearon 2015.

[14]Powell 1993; Jackson and Morelli 2009; see also Morrow 1997. Also related are contest models of armed conflict, such as Skaperdas 1992, Hirshleifer 1995, and Garfinkel and Skaperdas 2007, in which decisions about arms or predation effort translate directly into resource allocations. As here, bargaining conditional on arms levels is assumed to be efficient, but there is no possibility of "arming up" and attacking. The model below can be seen as a repeated contest model with the added possibility of attack, which implies a war constraint on minimum arms levels. Note also

the core tradeoff that lies behind the war constraint in the model below: higher peacetime arms levels reduce the ability to "break out" and attack, but they also reduce the states' values for living with the status quo by reducing consumption. The costs of deterrence can make war to eliminate or lessen the need for deterrence a more attractive, if tragically inefficient, option.[15]

Whereas in Powell's model the only issue at stake is control of one's own or the other state's territory, the model developed below adds an international issue over which the states have conflicting preferences. This could be anything, for example, the terms of a trade deal, the division of Poland or spheres of influence, support for rebels in a third country, or the value of getting one's way on *all* disputed issues apart from control of homeland territory. This addition allows the model to speak to the IR debate on cooperation and conflict as it developed after Waltz. Arming in the model is not just about attack or deterrence, but also about gaining bargaining leverage on

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that the fact that arms do not accumulate across periods in any of these models (including here) means that they cannot easily be interpreted as models of arms *races*. When dynamic, they are instead about repeated decisions on military spending rather than military stocks. The tradition of Richardson arms race models focused on accumulation of arms stocks but did not model any decisions, including attack; see Isard and Anderton 1985 for a review. Another literature analogized arms races to repeated Prisoners' Dilemmas, representing neither accumulation nor decisions to attack; see for examples Axelrod 1984; Downs and Rocke 1990. Fearon 2010 analyses a game-theoretic arming model with both accumulation and explicit attack decisions. Slantchev 2011 studies arming in crises as a signaling strategy, and, in a model with one round of arming, Kydd 2000 considers bargaining in the shadow of a possible arms race where there is uncertainty about one side's capacity.

[15]See Coe 2012 on "costly peace" arguments for conflict more generally, and Kydd 2015, chap. 7, who argues for the term "costly deterrence." The core mechanism was characterized by Kant in *Perpetual Peace*: "For they [states with standing armies] constantly threaten other states with war by the very fact that they are always prepared for it. They spur on the states to outdo one another in arming unlimited numbers of soldiers, and since the resultant costs eventually make peace more oppressive than war, the armies are themselves the cause of wars of aggression, which set out to end burdensome military expenditure."

contested issues. The states have an incentive to arm for bargaining leverage, but also wish to avoid wasted effort. In effect they face a classic "repeated PD" problem with respect to the contested issues, but this problem is embedded in a larger context where the use of force puts sovereignty at risk.

Jackson and Morelli examine models similar to Powell's but their states choose arms levels simultaneously rather than sequentially. The minor timing difference proves to have oddly large consequences. With simultaneous arming there is no pure strategy equilibrium because at arms levels high enough that neither wants to break out and attack, a state could do better by temporarily lowering arms spending before the other has a chance to react. This may seem like a technical artifact, but it raises a good substantive question: If arms levels are just about deterrence, why aren't states constantly trying to save on spending by short-run cuts not large enough to draw an attack? The model below suggests one possible resolution. Arms are valuable not only for deterring but also for bargaining leverage on other issues. Cuts that would not lead to an all-out attack by a rival would nonetheless disadvantage the state in issue bargaining. The model has simultaneous arming decisions, but stable arms levels when peace is supportable.[16]

The literature on "the bargaining model of war" focuses on frictions that might explain costly armed conflict, such as private information and incentives to misrepresent, and commitment problems occasioned by power shifts.[17] While war can be an equilibrium outcome in the model presented below (arising from "costly deterrence," a commitment problem) its focus is not on explaining specific wars but instead is about the quality of interstate relations more generally. The main choice of interest is arms levels (or military effort), which emerge as a natural and theoretically defensible

[16]Meirowitz and Sartori 2008 and Debs and Monteiro 2014 show that when arming decisions are not observable, pure strategy equilibria may disappear and war may occur even when arms are useful for bargaining advantage.

[17]For examples, Fearon 1995; Reiter 2003; Powell 2006. Models in this literature assume, realistically, that there is some known conflict of interest between the parties, similar to the model analyzed here and distinct from standard security dilemma arguments.

measure of the degree of cooperation and conflict in an interstate system that might be attributed to, or blamed on, the condition of anarchy. The model highlights how arms levels feed back on states' values for living with a peaceful status quo and thus affect their willingness to run risks of war. But specific paths to war are not the focus (as indicated, for example, by the assumption of efficient issue bargaining).

The next two sections define the model and give the main equilibrium results. I then present comparative statics on what determines maximum feasible interstate cooperation, compare the logic to existing IR theory, and provide a brief assessment of how the comparative statics square with broad temporal and cross-sectional empirical patterns. The fifth section summarizes results for a variant in which states can differ in relative resources, and briefly discusses arguments about multipolarity.

Model

Two states, 1 and 2, interact in successive periods $t = 0, 1, 2, \ldots$. They each get resources normalized to size 1 each period. Resources can either be consumed or converted, one-for-one, into arms. For simplicity and clarity, in this section the two states are identical in terms of resources and other parameters, such as value for taking territory. Section 5 presents a variant with asymmetric states that can differ by resources or value for taking new territory.

In each period, the states simultaneously choose arms levels $a_i^t \in [0, 1]$, next observe $a^t = (a_1^t, a_2^t)$, and then simultaneously choose whether to attack the other. (When there is no need to be explicit about the period, I will use (a_1, a_2) for arms levels.) If either attacks, war occurs, one side wins, taking all the resources or territory, and the strategic interaction ends. If neither attacks they move to the next period. Payoffs are discounted by the common factor $\delta \in [0, 1)$ each period.

In every period t, there is an international issue worth $\gamma > 0$ that can be divided up between them. This could stand for a different issue in every period (the "issue of the moment"), or it could be the same issue, always potentially subject to renegotiation. The most natural interpretation is that γ stands for many issues, summarizing their total value to the two states. In the discussion of

empirical implications in section 4 below, I will refer to γ as the gains from trade. Conceptually, the distinction between γ and the resources that each state controls is that the states are "sovereign" over the latter, but cannot unilaterally decide the allocation of γ.

Since the focus here is not on possible inefficiencies in bargaining over γ, I assume that if war does not occur, the states divide up γ in each period as a function of relative military strength. Suppose that if force levels are (a_1, a_2) and there is no war, then state 1's payoff is $1-a_1+\gamma q(a_1, a_2)$ while state 2 gets $1 - a_2 + \gamma(1 - q(a_1, a_2))$. This says that a state's payoff if war does not occur is what it doesn't spend on arms plus its value for the issue resolution. A number between zero and one, $q(a_1, a_2)$ is state 1's share of the division of the issues γ.

$q(a_1, a_2)$ has the usual properties of a "contest success function."[18] It is symmetric, which implies an equal split when $a_1 = a_2$, and $q(a_1, a_2)$ is increasing in a_1 and decreasing in a_2. Thus a state can gain a larger share of what it wants on the issues by increasing its arms. $q(a_1, a_2)$ can be interpreted as the probability that state 1 wins the (limited) military conflict over γ that would occur if bargaining failed, and thus a component of the "disagreement point" that determines the bargaining outcome.

If state $i \in \{1, 2\}$ chooses to attack j in a period (and j stays on defense), then we will assume that i wins the all-out war that occurs with probability $p^i(a_i, a_j; m)$, where $m \geq 0$ is an exogenous parameter that indexes offensive advantage. A factor will be said to increase offensive advantage if for any given positive force levels at the time of attack, its presence improves an attacker's odds.[19]

[18] Hirshleifer 1989.

[19] Formally, $m' > m$ implies $p^i(a_1, a_2; m') > p^i(a_1, a_2; m)$ for all $(a_1, a_2) > 0$. See the online appendix for further technical conditions on p^i used in some propositions below. A second type of "offensive advantage" pertains to factors that increase the mobilization increment an attacker can get before counter-mobilization by the defender. Formally, we could set $\Delta > 0$ as the largest amount a state can add to its forces in a single period (if it has the resources). For simplicity I will allow states to arm all the way to $a_i = 1$ in any period. Results for the model with Δ as a constraint representing this aspect of offensive advantage are the same as for m.

To give a specific example, consider

$$p^i(a_i, a_j) = \frac{a_i}{a_i + a_j/m}. \tag{1}$$

Thus for values of m less than 1, the defending state j gets an advantage against the attacking state i, for (say) equal force sizes. In the specific case of (1), m can also be interpreted as a measure of "the offense-defense balance" in that $1/m$ is the ratio of attacker to defender forces that gives an attacker a 50-50 chance of victory.

Finally, state i's expected payoff from period t forward if it attacks defender j in period t is

$$1 - a_i + p^i(a_i, a_j)\frac{\gamma - c + \delta(1+\mu)}{1-\delta}.$$

For simplicity war is treated as a costly lottery. The loser is eliminated, getting a payoff of zero henceforth. The winner gets full control of the issues in the present and all future periods, and gets control of the loser's territory and resources starting in the next period.[20] We assume that each state values the other side's territory at $\mu \in [0, 1]$, which allows us to vary how "greedy" they are.[21] Small μ means that they don't get as much value out of ruling the other state's territory as they do their own (which is worth 1). This could be for several reasons, including costs of ruling hostile foreigners, lack of interest in territory not considered to be historic homeland, or democratic values that support self-determination or political equality. The parameter $c \geq 0$ is broken out to represent additional or other costs of fighting, such as destructive impact.[22]

[20] Alternatively we could assume that the victor replaces the loser's regime with a new government that has different territorial or issue preferences; this model does not address this post-war choice. See Bueno de Mesquita, Morrow, Siverson et al. 2003, chap. 9.

[21] Glaser 2010.

[22] There are a number of ways that war costs can be introduced. They could be paid by both sides (here only winner pays, while loser is just eliminated), or we could reduce all values of the winner by a factor less than one. In the symmetric case it doesn't matter which we choose, excepting part (3) of Proposition 3 below. The assumption

I focus on conditions under which it is possible to support undominated pure-strategy subgame perfect equilibria with no war, and conditions under which war is the only equilibrium outcome.[23]

By assuming that the most a state can arm in a period is 1, we have also assumed that whatever value the states derive from the issue dimension, it cannot be converted into military capability. This is not necessary. We could have $a_i^t \in [0, 1+\gamma q(a_i^{t-1}, a_j^{t-1})]$, so that last period's total resources can be used for this period's arms. Allowing γ to be usable for military capability may or may not tighten the war constraint in the analysis that follows, but does not change qualitative results.

For simplicity and generality the bargaining over the issues represented by γ is treated in a reduced-form way. As discussed in the online appendix, several common bargaining protocols can give rise to a function $q(a_1, a_2)$ as described. These include a game in which in each period each state has an equal chance of finding itself in a position to change the status quo on the issue and the other can then choose whether to use force to try to reverse a fait accompli; and a game where we simply select the Nash bargaining solution over division of γ, with disagreement being a costly conflict lottery over γ. The key assumption, which is entirely consistent with the Realist tradition, is that relative military power translates into more favorable issue outcomes on average. This is not true for all issues all the time; for example, if both sides must agree to change the status quo, then a challenger's threats to use force may be hard to make credible. The assumption here is that it is true often enough that states in the model expect that reducing military strength could disadvantage them in issue bargaining in the future.

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that costs are effectively paid forever is for convenience. Below we do the analysis taking the discount factor to 1, which means that any cost paid in a finite number of periods effectively vanishes. Assuming damage is permanent is simple way to keep a cost term in the easier-to-present model with $\delta \to 1$.

[23]Because the states simultaneously choose whether to attack in each period, there are always SGPNE equilibria in which both attack because they expect the other to attack, even though it may be that both prefer no war and neither attacking is also an SGPNE.

Results

How much "cooperation under anarchy" is possible in this two-state model? Note that if peace can be sustained (no attacks in equilibrium), then cooperation can be identified with the equilibrium level of arms. More arms, less cooperation. This is because arms spending is just wasteful. If the states are spending positive amounts (a_1, a_2) and dividing γ in shares $q(a_1, a_2)$ and $1 - q(a_1, a_2)$, they could always be better off spending at lower levels that yield the same division. The most efficient outcome, or maximum cooperation, would be a peaceful equilibrium in which neither spends anything on arms and the issue is divided equally in every period, yielding per period payoffs of $1 + \gamma/2$.

Two temptations work against feasibility of the first best. The first is the *war constraint*: if one state has no arms then the other may prefer to build and attack, so as to gain control of the issues and more territory (if it values the latter). The second temptation is that independent of the incentive to arm and attack, arming would confer bargaining leverage and yield more favorable issue resolutions.

Cooperating on international issues

It is useful to begin by forgetting the war constraint and considering the problem of cooperation over the issues. A state can get more favorable issue resolutions by increasing military strength, but if the other replies in kind both are worse off than if they had not armed up. If they fail to construct what would amount to an arms control agreement, a spheres of influence agreement, an agreement to demarcate or demilitarize a border, or the like, then the non-cooperative "one-shot" outcome is the pair of arms levels such that neither wants to spend more given what the other is spending. This is the level a^{NE} ("NE" for Nash equilibrium in the stage game) such that the marginal issue benefits of spending more equal the marginal arms cost of 1 when both choose it (assuming an interior solution):

$$\gamma q_1(a^{NE}, a^{NE}) = 1.$$

If, as is natural, we assume that the bargaining returns to arming are lower at higher levels of arms, then it is easy to show that the more the states care about the issue conflict (larger γ), the more effort they waste on the competition (larger a^{NE}).[24]

However, as Axelrod, Keohane, and others argued, the states can use "the shadow of the future" to construct deals to support more cooperative and efficient outcomes. They agree to spend or compete less and to compromise on the issues, with the understanding that if either reneges they will return to costly competition. Consider an arms level $\hat{a} < a^{NE}$. Using a trigger strategy as the implicit punishment threat, the states prefer to stick with cooperating at $\hat{a}$ provided that

$$\frac{1 - \hat{a} + \gamma/2}{1 - \delta} \geq \max_{a} 1 - a + \gamma q(a, \hat{a}) + \delta \frac{1 - a^{NE} + \gamma/2}{1 - \delta}.$$

The left-hand side is the payoff for sticking with the deal. The right-hand side is the best a state can do by arming up in a period, which will then be followed by a return to costly competition. Multiplying through by $1 - \delta$ and considering what happens as δ approaches 1 – that is, as states put more weight on their welfare in future periods, or as the time it takes to perceive and respond to arms changes by the other side lessens – we get the following result.

Proposition 1. *If military power can be used to influence issue resolutions beyond state borders but not for conquest of the other state's territory, then for large enough δ the states in the model can support cooperation on any $\hat{a} < a^{NE}$, including maximum cooperation at $\hat{a} = 0$ in all periods, as an equilibrium outcome.*

So far, so neoliberal. If the "if" condition in the proposition held universally, the fact of anarchy would in principle pose *little or no problem* for states in international politics, and there would be no grounds for viewing international relations as a necessarily tragic realm.

[24]The assumption on q is that $q_1(a, a)$ is decreasing in a. See the online Appendix for details. Subscripts on functions indicate derivatives ($q_i(a_i, a_j) = \partial q / \partial a_i$).

But that condition need not hold. If state j has no military, state i might prefer to arm and attack to take territory. To keep things simple, suppose that $p^i(a_i, a_j)$ is such that when $a_j = 0$ state i can win for sure at minimal cost in arms.[25] Then i prefers to arm a little and take over j if

$$\frac{1+\gamma/2}{1-\delta} < 1 + \frac{\gamma - c + \delta(1+\mu)}{1-\delta},$$

which is the case if

$$c < \delta\mu + \gamma/2. \tag{2}$$

This condition means that if the costs of fighting do not outweigh the value the states put on acquiring new territory and full determination of the issues, the first-best outcome of maximal cooperation (no arms spending) and no war is not possible, because each would be tempted to arm up and invade.

The war constraint

From the analysis above it is evident that given (2), stable peace requires that both states arm enough that neither would want to "break out," arming rapidly and attacking, as Hitler did in the 1930s. Putting the incentive to compete on the issues to the side for the moment, suppose both states are choosing arms level $\hat{a} > 0$. For this to be an equilibrium each must prefer peace at $\hat{a}$ to mobilizing and attacking:

$$\frac{1-\hat{a}+\gamma/2}{1-\delta} \geq \max_a 1 - a + p^i(a, \hat{a})\frac{\gamma - c + \delta(1+\mu)}{1-\delta}. \tag{3}$$

This is the war constraint, the condition on arms that must be satisfied for states not to want to mobilize and attack. Multiplying through by $1-\delta$, we have

$$1 - \hat{a} + \gamma/2 \geq \max_a (1-a)(1-\delta) + p^i(a, \hat{a})(\gamma - c + \delta(1+\mu)). \tag{4}$$

[25] That is, assume $p^i(a_i, 0) = 1$ for $a^i > 0$. This isn't strictly necessary; we could have that i may still require some positive arms level to take over a j with no formal army.

Although not necessary for the results that follow, we can simplify and get a clearer understanding of the strategic dilemma by considering the problem for discount factors arbitrarily close to one. If the "shadow of the future" is long enough, a state maximizes the value of the break-out option by spending all available resources on arms in a period (i.e., $a = 1$) in order to maximize the chance of victory in war.[26] So the war constraint simplifies to

$$1 - \hat{a} + \gamma/2 \geq p^i(1, \hat{a})(\gamma - c + 1 + \mu). \tag{5}$$

Figure 1 graphically depicts the war constraint in two possible cases. In the first, there are values of $\hat{a}$ that satisfy the constraint and there is a minimum value a^* that satisfies it with equality. In the second, there is no arms level that is high enough that neither side prefers to mobilize and attack but low enough that a peaceful status quo is preferable to trying war in hopes of getting rid of the need for costly deterrence.[27] In this second case, war is inevitable; in fact, it must occur in the first period in equilibrium. The cause can be attributed to anarchy (and condition 2), in that the states would prefer it if they could commit to zero arms and no attacks. Note also that the "shadow of the future" is as long as it can be here. For preferences and a military technology such that the war constraint cannot be met, the states' capacity to attack and possibly eliminate the other undermines the possibility of cooperation based on repeated interactions.[28]

[26]The marginal cost of arming on the right-hand side of (4) is $1-\delta$, which gets arbitrarily small as δ goes to one. So as long as p^i is increasing in its first argument, the a that solves the RHS of (4) must be $a = 1$. A better formulation – which I don't use here for simplicity and because the effects are the same as for m – would be that the states can add no more than a fixed amount $\Delta > 0$ in one period (before the other can effectively counter), in which case Δ measures a second form of "offensive advantage." This form is referred to below in the discussion of railroads and other technological aids to mass mobilization in the late 19th century.

[27]This is the central trade off that Powell 1993 identified. Due to the timing difference (simultaneous arming rather than sequential) and the issue conflict, satisfying (4) is not a sufficient condition for equilibrium here, though it is in Powell's model; see below.

[28]Powell 1993.

Suppose parameters are such that the war constraint can be satisfied. This is necessary for a peaceful equilibrium to exist, but not quite sufficient: It must also be that neither state would want to *decrease* its arms level enough in one period to save on costs but not so much as to draw an attack. As the following main result details, neither wants to do this if reducing arms spending would hurt the state enough in bargaining over disputed issues.

Proposition 2. *If there is a smallest a^* that solves the war constraint (4) with equality, and $a^* \leq a^{NE}$, then for large enough δ the game has peaceful equilibria in which, on the path of play, the states choose $\hat{a} \in [a^*, \bar{a}]$ in every period, where $\bar{a} \leq a^{NE}$ is determined by specific parameters. Thus in the most cooperative equilibrium the states choose a^* in all periods on the path. Further, if defensive advantage is sufficiently large (that is, m is small enough), such an a^* definitely exists and $a^* < a^{NE}$.*

Using standard assumptions about states' preferences and capabilities, Proposition 2 provides an answer to the question of how much cooperation under anarchy is possible. As neoliberal institutionalists argued, states can use repeated interactions and the shadow of the future to construct regimes or tacit deals that make them better off than they would be without such formal or informal institutions. (By "institutions" I mean simply coordination on more efficient outcomes that requires acting against short-run interests; in practice this is often facilitated by international organizations whose roles are not modeled here.) Without institutions, states in the model engage in costly competition at the myopic Nash outcome of a^{NE}.

However even with institutions – coordination on an $a^* < a^{NE}$ – there are still unavoidable costs of anarchy. The depth of cooperation is constrained by the inability to commit not to go to war if the other state's military effort is low enough.

Before moving to what determines how deep interstate cooperation can be, a comment on the strategic role played by issue competition. If there are no disagreements over international issues ($\gamma = 0$), then the cooperative equilibria just described do not exist. The reason is that $\gamma = 0$ implies that the states have no reason to arm for bargaining leverage ($a^{NE} = 0$), and then there

is no penalty for a short-run cut in arms spending not large enough to undermine deterrence of invasion. For small enough γ but enough "greed" about territory that condition (2) still holds, the model becomes close to that of Jackson and Morelli: the states need positive arms levels to deter attack but have an incentive to undercut each other in arms spending.[29] From any symmetric force level that satisfies the war constraint, each would want to deviate *down* just enough that the other side would not be tempted to attack. Mixed strategy equilibria result, with a positive probability of attack and war. Empirically, however, we do not see states constantly and arbitrarily varying their military spending.[30]

Introducing issue competition provides one empirically plausible way to resolve the puzzle. When $a^* < a^{NE}$, undercutting on military strength leads to less favorable outcomes on international issues the state cares about. In other words, arming or other costly competitive effort is valuable not only for deterrence of invasion but also for helping to get one's way in the random and diverse disputes that make up international affairs. "Diplomacy without arms is like music without instruments," as Frederick the Great put it.[31]

In this deliberately spare, "pure IR" model, the only reasons states have for wanting arms and a military have to do with foreign policy. They are used to deter or attack another state and to gain influence in international bargaining. But of course rulers want armies for domestic political reasons as well. They need guns and soldiers to deter or put down organized rebellions. For many countries, this domestic demand for arms could be the explanation for why they don't have an

[29]Jackson and Morelli 2009.

[30]Kydd 2015, 121, makes this same point.

[31]If $a^* > a^{NE}$ the game does not have a pure strategy equilibrium and I will not attempt to characterize the complex mixed strategy equilibrium that results; see Jackson and Morelli 2009 for an analysis of a simplified version with three arms levels. Another approach to resolving this mixed-strategy puzzle is to introduce uncertainty about state types, so that if a state deviates down it increases the probability that the other will be a type that would then want to attack. See Kydd 2015, 120-124.

incentive to undercut to save money, getting into the unstable dynamic discussed by Jackson and Morelli. Let a^D be the army size or spending level the state's leadership would choose if there were no international threats or bargaining considerations whatsoever. If $a^* < a^D$, then the same argument as given above would apply, although in this instance international cooperation would be of no use for reducing arms levels to the minimum that satisfies the war constraint. To the contrary, such a domestically insecure state's demand for a larger-than-necessary military might aggravate international conflict by increasing neighbors' military burdens.

As discussed further in Section 5, in the post-Cold War world many small states' borders are de facto protected by the expectation that the U.S., the European Union, and perhaps the U.N. would impose sanctions or worse if they were openly invaded by a neighbor. (In this two-state model, this amounts to aggressors having higher costs to attack due to expected reactions of more powerful states.) These states' arms levels may be entirely determined by domestic political considerations and not at all by considerations of deterrence or competition on interstate issues.

How deep can interstate cooperation be?

Because he was focused on the claim that anarchy made international politics inevitably conflictual, Waltz had little to say about what explains variation in international cooperation. His main variable was the number of major powers (more on which below). In arguments that greatly influenced Realists, he suggested that "unit level" factors – characteristics of states other than relative power, like regime type or preference for territorial acquisition – should not be part of a "systemic" IR theory and also are not likely to have large and consistent effects on levels of international conflict and cooperation.

Writing at about the same time, Jervis famously argued that variation in the extent of international conflict and cooperation depends on factors influencing states' ability to arm up and invade for given initial arms levels, and also to distinguish offensive from defensive forces. For example, states separated by distance and water should find it easier to cooperate, as should nuclear weapons states with secure second-strike forces, because these make invasion and conquest nearly impossible.

Jervis' logic relied on the idea that states are always uncertain about whether their counterparts might be aggressive types. When offense is advantaged, it is more dangerous to cooperate (e.g., to lower your arms levels) because you are in deeper trouble if the other side turns out to be an aggressive type.[32]

The main variables determining the feasibility of international cooperation for neoliberal institutionalists were the "shadow of the future" (state leaders' discount rates) and a somewhat generic notion of degree of conflict of interest.[33] Whether because the shadow of the future is difficult to measure or because leader discount rates don't explain much variation in international cooperation, the cooperation-under-anarchy program has been more successful at explaining the basis for much international cooperation and many international institutions than at explaining variation over time or across states.

What determines maximum feasible cooperation in the model presented above?

Proposition 3. *Maximum feasible international cooperation (smaller a^*) is (1) decreasing in the value the states derive from controlling the other's territory (μ); (2) increasing in defensive advantage (smaller m) and war costs (larger c); and (3) may increase or decrease with the value of the international issues in dispute (or the gains from trade) between the two states, γ.*

Value for territory

The less "greedy" the states are about additional territory, the less they need to arm for deterrence (or otherwise compete) and in turn the greater the scope for cooperation on other issues. This is an intuitive implication of this fundamentally Realist model, and it is consistent with the

[32] Jervis 1976, 1978. The "uncertainty about other adversary's intentions" version of this argument has been developed most extensively by Kydd 1997, 2005, Glaser 1992, 2010, and Baliga and Sjöström 2004, 2011. Jervis' arguments can also be interpreted in terms of the equilibrium selection principle of "risk dominance"; see for example Padró i Miquel and Chassang 2007, 2010, who get to risk dominant equilibria via a "global games" approach.

[33] Oye 1986.

claims of neoclassical realists who argue that most international conflict stems from states with revisionist preferences rather than "tragic" conflict between fearful, uncertain security-seekers.[34] In the model, however, it is precisely revisionist preferences that make for tragedy, in the sense of inefficient arming that makes war more attractive and that could be avoided but for interstate anarchy. Here, more "greed" makes for *more* inefficiency, not less. (Note that standard security dilemma arguments conceptualize inefficient outcomes only in terms of conflict between security seekers.)

The mechanism is not simply that more value for additional territory makes conquest more valuable, but instead involves a feedback loop. Suppose a new leadership comes to power in state A that puts greater intrinsic value on controlling territory beyond its current borders (an increase in μ_A in an asymmetric version of the model). At prior arms levels, state A would want to arm up and attack. Understanding this, state B arms to a higher level to deter A. But this makes a peaceful status quo less valuable for state B since it now has to spend on an on-going policy of "containment." So in turn A needs to arm more to deter attack by state B, *even if* state B is a pure status quo type that has zero intrinsic value for controlling more territory ($\mu_B = 0$). In turn, A's need to deter B from attacking to get rid of the threat arising from A's revisionist preference lowers A's value for a peaceful status quo relative to war, feeding back again on B's need for arms (and so on up to equilibrium levels, if a peaceful equilibrium exists).

Two points follow on this example. First, it shows how the model captures the Waltzian insight that "systemic forces" can override the influence of particular "unit level" state desires or characteristics. A state with no intrinsic value for acquiring more territory or deposing another regime might be driven to do so by a neighbor's greed along with system effects of its own response. The idea of "liberal imperialism" or "making the world safe for democracy" follows this logic.[35] Second, it nonetheless does not follow that the intrinsic value states put on territory has no bearing

[34]Schweller 1996, 1998; see also Kydd 2005.

[35]A developed example is Coe's account of the reasons for the U.S. invasion of Iraq in 2003. He argues that the Bush administration judged (poorly, it would seem) the costs of continued containment of Saddam Hussein's regime

on the level of international cooperation, or that all states are driven by anarchy to be expansionist, as "offensive Realists" like Mearsheimer maintain.[36] As the model and main results show, this state-level characteristic is a natural component of a Realist, structural model, and its variation has an important influence on outcomes.

There has been little analysis in IR of the determinants of states' intrinsic value for controlling additional territory, whether by critics of Realism or by Realist critics of Waltz's and offensive realists' skepticism. And perhaps due to lack of theory linking revisionist territorial preferences to the costs of anarchy, we have not seen extensive efforts to measure variation in territorial preferences to check whether this might explain significant variation in the costs of anarchy.[37] The baseline model suggests how the international effects of plausibly important state-level factors – such as democracy, nationalism, and industrialization – can be incorporated in a structural model and analyzed for their impact on the costs of anarchy, via their effect on states' values for territorial conquest. I provide a very partial sketch in the rest of this subsection.

What determines a state's value for ruling new territory? In *ancien regime* days it might have been the productivity of the peasants and towns that a ruling noble could tax. Nowadays it can still have to do with the material value of land. For instance, high arms levels around the Persian Gulf are plausibly related to the presence of valuable oil reserves. But probably more often it has to do with nationalist ideologies and attachments. Where there is agreement that borders correctly divide national territories, values for adding more are lower than where there is disagreement, other things equal. Empirically, arms levels tend to be much higher while cooperation and international institutions are less evident where there are dissatified nationalisms. Consider Israel and its neighbors, North and South Korea, Eritrea and Ethiopia, Armenia and Azerbaijan,

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to be greater than the costs of deposing him. The costs of containment stemmed from the same sort of commitment problem as in the model above. See Coe 2012.

[36] Mearsheimer 2001.

[37] There is not much in the IR literature besides Kaysen 1990 and Rosecrance 1987, 1999.

or India and Pakistan (who disagree about Kashmir).

Table 1 lists the top and bottom 15 states on two measures of military effort – military spending as a share of GDP and armed forces per 1,000 population – for both the Cold War years and the period 1991-2010.[38] The first superscript on the country name indicates the number of territorial rivalries the state was involved in according to the rivalry codings of William Thompson and David Dreyer. These are cases where Thompson and Dreyer judge that two states view each other as "threatening competitors" and where they "contest the exclusive control of territory." Most often these territorial rivalries are linked to competing nationalist ideologies concerning what land properly belongs to the nation, or in the case of the two Koreas (which Thompson and Dreyer do not code as a territorial rivalry) which regime should rule the territory that belongs to the Korean nation. Territorial rivalries are clearly much more common among the highly armed states than among the low-military-effort states. Further, note that high military effort states are often the smaller state in a dyad with an intense nationalist conflict – for instance, Eritrea, Armenia, Israel (versus its several larger neighbors), Kuwait, Greece, Taiwan, and North Korea.[39]

Regarding variation over time, there are good reasons to think that industrialization, the spread of democracy, and the sorting of people and boundaries according to nationalist ideologies have –

[38]Military burden is the Correlates of War (COW) estimate of military spending divided by total GDP (World Bank), both in current U.S. dollars. I extend the series for 2008-2010 using SIPRI estimates; the coverage is 1960-2010. Soldiers per 1000 comes from COW and is available for 1945-2007. Military burden is missing for a number of countries including some that are probably high spenders, like North Korea. Finally, the list is based on countries that had a population greater than 500,000 in 1990 (or first year of independence if later), so 15 is approximately a decile.

[39]Thompson and Dreyer 2012, 21. By saying that a territorial conflict is nationalist I do not rule out that there may be major material motivations as well, as in the case Iraq's claim on Kuwait. Of course, the bivariate relationship between rivalry and arms spending is very strong. Post-1945 arms levels are analyzed using the model to guide the empirical specifications in Fearon 2015.

on average and over the last 200 years – reduced states' intrinsic value for acquiring new territory. Concerning industrialization, when income comes mainly from human capital and manufactured tradables rather than land, it is arguably harder to profit from military conquest, and less necessary since trade can provide a cheaper alternative.[40] Next, democracies have less economic rationale for military conquest than a narrowly held autocracy if the rents from military conquest must be shared more broadly, or if a strong norm of political equality (which might have an instrumental basis) implies that people in conquered territory would have to be treated as citizens on equal terms.[41] Concerning nationalism, the aftermath of two world wars, decolonization, and the break up of the Soviet Union all contributed to greater congruence between interstate borders and conceptions of common nationality, albeit with a number of important exceptions that continue to stimulate conflict and arming, as noted above.

Figure 2 shows striking declines over the last 190 years in the number of territorial rivalries per independent state, again using Thompson and Dreyer's codings. The change is particularly large for the militarily strongest states in the international system, which saw a steep and persistent drop in territorial rivalries in the years around World War II. To be sure, this is not a perfect measure of average values for μ, for reasons discussed below. But since territorial rivalries involve public claims on a neighbor's territory sufficient to cause perception of serious threat, their decline is at least consistent with the proposition that on average states' value for acquiring new territory has declined. Further, the cases behind the large drop for major powers from 1939 to 1945 are consistent with the idea that democratization and more nationalism-congruent borders have contributed to the long-run reduction. These include the end of three disputes associated with Italy's switch from

[40]On the impact of industrialization on the value of military conquest, see especially Kaysen 1990, Gat 2005, Gartzke 2007, Coe 2015, and Liberman 1998 for a critique based on Nazi Germany's success in extracting rents from occupied Europe. In work on democratization Boix 2003 and Acemoglu and Robinson 2006 make a similar argument that industrialization increases the exit options for wealth producers which in turn constrains predatory states.

[41]Bueno de Mesquita, Morrow, Siverson et al., 2003, 419; Fearon, 2012; Jackson and Morelli, 2007; Zacher, 2001.

fascism to democracy; four territorial rivalries associated with the end of imperial Japan; and two rivalries associated with end of Nazi Germany and the redrawing of borders (and possibly the ethnic cleansing of German speakers) in Eastern Europe.

The offense-defense balance

In the model, deeper cooperation is possible in equilibrium when the odds of successful attack are lower for any given force levels, which is how greater defensive advantage is defined here. Since Jervis the canonical justification for this claim has been that states are uncertain about others' preferences over territory or issues (μ and γ in the model), and guessing wrong is more dangerous when offense is relatively advantaged. Extensions of the core idea hold that offensive advantage makes "spirals of hostility" and preemptive war more likely between what are in fact security seeking states.[42]

A weakness in these arguments is that it is not clear why genuinely security seeking states that have no territorial or issue conflicts would be unable to credibly signal this to each other over time.[43] Another issue is that it is not empirically plausible that any state has ever been a pure security seeker. Surely all states have things about the political world they would like to change if they faced no external constraints. Perhaps this is simply a matter of degree, so that the Jervis-Glaser-Kydd "two type" model is still a good approximation for some cases, such as U.S. policymakers' thinking about the Soviet Union during the Cold War. But there are many other cases where one or both states correctly understand that the other has significant revisionist preferences and these are at the root of the conflict. As noted above, standard security dilemma arguments either rule out or have no way of conceptualizing tragic outcomes (inefficient arming, conflict) in these settings.[44]

[42]Jervis 1978; Glaser 1997, 2010; Kydd 1997; Van Evera 1984; Posen 1993.

[43]Kydd 2005.

[44]It is also not clear if the standard arguments go through if "status quo states" are in fact a little greedy when it comes to issues (if not necessarily territory). For example, defense dominance – such as a "nuclear shield" – might make it safer for a slightly revisionist state to pursue aggressive policies abroad.

In the baseline model the states have no uncertainty at all about each other's preferences and neither is a pure security seeker (if $\mu > 0$ or $\gamma > 0$). Thus the standard security dilemma arguments do not apply. Instead, relative advantage for offense increases arming and lowers cooperation because more arms are needed to deter break out, and deterrence is needed because the states have some revisionist preferences. Worse, offensive advantage has a perverse multiplier effect: The more arms a state needs to deter attack by a potential adversary, the less desirable living with the status quo becomes for that state. This makes war relatively more attractive, which means that the other state has to spend more, which makes the status quo less good for it, and so on. As Powell showed and as seen in Figure 1, the net result can be that there is no arms level high enough to deter break out but low enough to make the status quo preferable to fighting.

Literally interpreted, the "no peaceful equilibrium" case in Figure 1 may be quite rare, but it is plausible that a state's value for living with the territorial status quo – and thus its willingness to risk war – depends in part on how much it has to spend to maintain it. The baseline model clarifies how states' value for (living with) the status quo is endogenous to the strategic dilemma posed by anarchy, with the political economy tradeoff between guns and butter playing a central role.[45]

What determines variation in the offense-defense balance and are these things related to observed levels and patterns of international cooperation and conflict? Answering this question requires, first, additional interpretation of "offensive/defensive advantage," a difficult concept that is the source of much debate. In almost all cases, scholars define offense-defense advantage or "balance" in terms of the ease or cost of offensive operations, either given a defender's forces or without

[45]To be clear, whenever μ or γ is greater than zero, states in the model are greedy types in the sense of security dilemma theory; they put positive value on acquiring more territory or changing issue outcomes for their own sake. The parameters μ and γ index how "greedy" they are in that sense. But their "value for the status quo" in the sense of the payoff stream from a peaceful status quo versus the gamble of war is endogenous and can vary, because it depends on how much consumption they can get in peace (which depends on military spending).

specifying the force levels at which cost is to be evaluated. In the most detailed analysis, Glaser and Kaufmann define the balance as "the ratio of the cost of the forces the attacker requires to take territory to the cost of the forces the defender has deployed."[46]

But defenders choose forces in light of what they think is needed to deter, and defender force size strongly affects the costs or ability of an adversary to arm up to a force ratio favorable for attack. So, for example, if a technological change renders existing force sizes too small for comfortable deterrence – say, railroads make the movement and supply of mass armies more feasible – then states may arm to higher peacetime levels so as to offset what would have been good odds for an attacker "breaking out" from the old force levels. The cost or ease of offense from the new equilibrium force levels thus need not be any different from what it was before the technological change that favored offense. Put differently, the underlying technological influences on offensive prospects (summarized by the exogenous parameter m in the model) have a direct, positive effect on the odds of successful attack for any *given* force levels. But this direct effect can be undone by the indirect effect a larger m has via increased equilibrium arms levels.

Indeed, the baseline model yields the following general implication, which is surprising and interesting in light of the existing literature.

Proposition 4. *Consider the model with any contest success function $p^i(a_i, a_j; m)$, where m indexes offensive advantage in the sense that p^i is increasing in m for positive arms levels. In a peaceful equilibrium with arms levels a^*, the probability that a break-out attack would succeed is* decreasing *in offensive advantage.*

So greater offensive advantage implies higher equilibrium force levels (from Proposition 3), but

[46] Glaser and Kaufmann 1998, 50. Glaser and Kaufmann list a number of other definitions, most of which take the same approach though without being clear about force levels. Representative would be Van Evera 2001, 118, who says "In this book, 'offense dominant' means that conquest is fairly easy, 'defense dominant' means that conquest is very difficult." See Davis, Finel, Goddard et al. 1998-1999 and Lieber 2000 for debate on the measuring the offense-defense balance and additional references.

a smaller chance that an offensive would succeed at those force levels! The intuition is straightforward: Higher arms levels make the status quo less appealing. Thus for peace to continue to be feasible with greater m, mobilizing and going to war must become less attractive, which means that its odds of success must decline. The effect of the endogenous increase in arms levels must more than offset the direct impact of an offense-favoring technological change.[47]

To illustrate, consider two examples, the first hypothetical. Two kingdoms are separated by a broad river, and given this river each requires a standing army of only, say, 1,000 soldiers to deter "arming up" and invading with the maximum capacity of (say) 5,000 soldiers. A massive earthquake upstream causes the river to run dry. Now 1,000 is not enough to deter break out and invasion because a defender no longer has the advantage provided by the river. So both sides arm to a new equilibrium level at, say, 3,000 soldiers, which is much costlier to maintain. Because war is now more attractive than before in terms of the long-run cost savings from defeating the other kingdom, arms levels have to be high enough that break out and attack is even less likely to succeed than before in order to maintain deterrence. This is so despite the fact that for any *given* force levels, the elimination of the river unambiguously favors offense.

Second, consider that many have argued that Europe on the eve of World War I was characterized by a high level of defense dominance, in fact if not in the perceptions of military and civilian leaders. The evidence comes from the war itself, which showed that greatly improved firepower (better rifles and machines guns) had rendered taking defended terrain extremely difficult. At the same time, however, railroads and better roads had made it possible for the continental powers to mobilize vastly larger numbers of soldiers and deliver them to a front much more quickly than before the 1860s. This meant that *at low initial force levels*, a break out – mobilization and rapid

[47]To prove Proposition 4, write (5) as an identity using $a^*(m)$ for $\hat{a}$, and let $p(m) \equiv p(1, a^*(m); m)$. Differentiating both sides in m, $p'(m)$ must be negative since from Proposition 3, $da^*(m)/dm$ is positive. Note also that this result does not depend on the assumption that "break out" entails spending all resources on arms; it also obtains in the variant of the model wherein states are limited in the amount they can arm up before the other state can respond.

delivery of a mass army to the front – could give a state a good chance of victory by a crushing blow, even despite some machine guns on the other side. To deter such an attack, states thus needed to arm up to peace-time levels high enough that break out would not be sufficiently attractive.

Thus the conventional IR wisdom about this famous case may have it backwards. A situation of increased *offensive* advantage may have caused states to try to arm up to levels high enough that break out would not be so promising as to make attack appealing. There could have been increased offensive advantage even though at equilibrium force levels driven by this technological condition, offense was not highly likely to succeed.[48] The confusing thing is that arms levels determine the likelihood that an attack will succeed, but at the same time the likelihood that attack will succeed determines arms levels. At equilibrium force levels, it may appear that "defense dominance" prevails, because many machine guns and sophisticated use of railroads by a defender could probably stop an attack. But the need for many machine guns and many quickly mobilizable troops in peacetime is driven by an offensive advantage (the ability to generate a massive, mobile army quickly). Further, high levels of costly arms and military preparedness, or the anticipation of ruinous arms racing, makes a peaceful status quo less appealing.[49]

To summarize, offense is more advantaged the greater the odds that an attacker wins for any given force levels, and the more forces mobilization can add before an adversary can effectively

[48] Although some recent work by historians casts doubt on this view (see Lieber 2007), it could be that a "cult of the offensive" meant that leaders had radically incorrect beliefs about the prospects for offensives given force levels and military technology in 1914 (Snyder 1984; Van Evera 1984). I am stylizing the example (by assuming no cult of the offensive) to help make the point that offensive advantage in technology, geography, and so on, and the odds that an attack succeeds at equilibrium arms levels are different things.

[49] Drawing on recent work by historians, McDonald 2011 makes a compelling case that in the five years prior to July 1914 "the arms race on land had thus pushed Germany to its financial limits and threatened the government's capacity to sustain it," inclining its leaders towards a preventive war with Russia, which was arming up at a rapid clip and was not so financially constrained.

counter. Greater offensive advantage in these two senses imply higher equilibrium arms levels and other forms of costly competition (less international cooperation); probably greater odds of large-scale war[50]; but not greater odds that attackers will actually win their wars.

With the offense-defense balance so understood, in a conventional world any technological or doctrinal innovations that enable states to mobilize and deploy troops more quickly favor offense and so should make for higher arms levels and less international cooperation. By contrast, because the threat to use nuclear weapons becomes increasingly credible as a nuclear-armed state loses homeland territory in conventional war, nuclear weapons make old-style territorial conquest difficult to imagine. As Jervis and others argued, this technological development implies a major shift in the direction of defense dominance among nuclear states, and probably even among states that could acquire nuclear weapons on short notice. With secure second-strike forces, a break-out attack to overwhelm an adversary becomes suicidal for any disparity in conventional arms.

The empirical expectation, then, is that prior to the nuclear era the major powers should have seen increasing arms levels and decreasing international cooperation after Prussia's demonstration of how railroads, good roads, and organization could be used to rapidly mobilize and deploy mass armies in the Austro-Prussian and Franco-Prussian wars of 1866 and 1871. Onorato, Scheve, and Stasavage document that the share of major power populations mobilized *during* interstate wars increased enormously in the period from 1859 to 1970 (or 1954), compared to wars in previous and subsequent years.[51] They argue that this was largely due to the railroad. This is direct evidence for a large increase in offensive advantage in a sense specified above – that is, railroads and other

[50]In this complete-information model war either occurs or does not occur for given parameter values, and higher m makes it more likely that no peaceful equilibrium exists. Empirically it is more plausible that greater offensive advantage increases war risk not by eliminating peaceful equilibria, but rather by making states willing to bargain more aggressively because they find the status quo less appealing. See Fearon 2012 for a version of this model with incomplete information bargaining that illustrates this mechanism.

[51]Onorato, Scheve, and Stasavage 2014.

technological and organizational innovations caused a substantial increase in capacity to mobilize and deploy large numbers of troops rapidly. Thus the results from the baseline model imply that we should see, for the major powers, a general tendency for *peacetime* force levels to be increasing, until the impact of nuclear weapons begins to be felt, after which there should be declines.[52]

The solid black lines in Figure 3 display armed forces per 1000 population for nine major powers for 1816 to 2007, during years when the state was not engaged in an interstate war. The lines have wide dashes for years of interstate war. The small-dashed line is a smooth of the solid black line, thus showing the trend for peacetime armed forces in the state (wartime force levels are not included in the smooth).[53]

The patterns – mainly "inverse U" shaped – are largely though not entirely consistent with the expectations based on the broad system-level variations in the offense-defense balance described above. First, all of these states see declines (and mainly very large declines) in armed forces from the mid-1950s to the present. Although in a few cases the decline occurs mostly after the end of the Cold War, for most it is taking place throughout. This is consistent with the major powers adjusting gradually to a new world in which, in contrast to the period from (at least) 1900 to 1950, they do not need to worry about being able to quickly raise a mass army to defeat a possible attack by another major power in a total war. Of course, other factors may contribute to more cooperation and less competition among the major powers since World War II. More are democracies and there are fewer nationalist disagreements about which nations should own what land in Europe or Northeast Asia since the post-war settlements. As argued above, both factors

[52]Onorato, Scheve, and Stasavage link the decline of wartime force sizes to the development of precision-guided munitions and cruise missiles in particular. Few of the several post-1971 interstate wars were fought between adversaries fielding such weapons, however.

[53]To make the graph more readable I have coded the U.S. Civil War as "interstate" here. Otherwise, all data is from the Correlates of War's list of interstate wars and the National Military Capabilities data set, version 4.0; Singer 1987.

make for lower values for annexing territory, which in the baseline model implies lower arms levels. But the pattern is nonetheless also consistent with the large increase in defensive advantage due to the advent of nuclear weapons.[54]

On the other side of 1945, in various degrees France, Britain, Germany, the U.S., Japan, and Turkey (Ottoman Empire) all see increasing force levels in the years leading up to World War I, consistent with the implications of increased offensive advantage in the second part of the 19th century. Russia, Italy, and China do not, however, with these data. Russia may be explained by the fact that its absolute army sizes were growing rapidly due to its large population and moderate population growth (see the next section for results on relative size and arms levels).[55] Note also that after 1860 almost all European powers moved to conscription and shorter periods of service, in order to increase reserve forces and the number of young men trained to fight. By contrast, in the nuclear era the major powers have moved back to smaller professional armies with long service

[54]If nuclear weapons amount to nearly infinite defense dominance, why didn't U.S. and Soviet forces fall faster after the mid-1960s, and why haven't more major powers acquired them? First, as argued above, states can want militaries for bargaining leverage and capabilities for disputes short of conquest or defense against conquest, and also for domestic purposes. Second, U.S. Cold War strategy deliberately chose to maintain large conventional forces stationed in Europe and Asia, along with extended "security umbrellas," rather than promote nuclear proliferation by major power allies like West Germany, Japan, and South Korea; see Trachtenberg 1999; Gavin 2012. That policy choice was the basis for large conventional forces in Europe during the Cold War, and, since 1991, what is called "unipolarity" (Wohlforth, 1999). Third, it has taken time for the major powers to adapt and have some confidence in a nuclear world (as concerns major power relations).

[55]The U.K. is demobilizing after the Crimean War and Boer Wars, but appears to be on an upward trend even so. In this era the U.S. and the U.K. had much smaller standing forces than the continental powers, which is naturally explained in terms of the defensive advantage they get for being protected by oceans. Japan similarly has relatively small peacetime forces as a share of population at all times. China does as well, though in this case a small population share translates to a very large army.

periods, and smaller reserve forces.[56] Historians have often stressed increasing military competition and arms racing in the decades leading up to World War I.[57]

For the interwar period, the German army abided by the force size limitations of the Versailles Treaty until 1933 when Hitler began his rearmament drive. Faced with a major power regime that appeared to have greater value for territorial expansion than before, the other European powers and the U.S. followed quickly, though not quickly enough. Joseph Maiolo details the politics of the European and Asian arms races of the 1930s. Military and civilian leaders in all the major powers had concluded from the Great War that "a modern war is a war of nations rather than armies," so that peacetime forces and industrial mobilization capacity had to be capable of rapid and massive expansion.[58] He argues that the strain of mobilizing to get to higher peacetime arms levels in the midst of the Depression was an important factor driving Europe to war. The much larger mobilization capacity of a hostile Soviet Union meant that deterrence would require high and possibly unsustainable levels of peacetime armament in Germany. Similarly, Dale Copeland shows how concern about the inability to match Soviet military might in the long run motivated both Hitler and his generals to plan for preventive war from 1933 on.[59]

Value for issues other than territory

The term γ in the model represents the states' value for issues in dispute other than control of homeland territory, and which cannot be determined unilaterally by either state. The larger γ, the greater the potential for cooperation in the neoliberal institutionalist sense of agreements to share gains from mutual restraint on competitive policies and behaviors. The empirical example of greatest interest, given an extensive literature and debate, concerns gains from international trade. Clearly, greater potential gains from trade imply greater potential for international cooperation, as

[56] Sheehan 2008.

[57] See McDonald 2011 and references therein.

[58] Maiolo 2010, 107.

[59] Copeland 2000, chap. 5.

might occur if trade costs decline (due to, for instance, steam power or containerized shipping or between contiguous as opposed to distant countries). But how do greater gains from trade affect the costs of anarchy, here measured by a^*, the smallest arms level consistent with a stable peace?

In contrast to value for territory or war costs, increasing the gains from trade has competing effects. On the one hand, greater gains from trade increase the value of a peaceful status quo in which these are shared, but on the other hand, *there is more value to be captured from a successful all-out war*. The first effect favors lower arms levels, the second higher. It is worth stressing that virtually the entire literature on interdependence and war neglects the second effect. The standard argument is that more trade between two states increases the opportunity cost of war, a claim that does not consider what happens to trade after one side wins a war. If the winner takes over or sets the policies of the loser, it can capture all gains from trade for itself.[60]

In the model with risk-neutral (linear) preferences over territory and issues, the marginal impact of increasing γ on a peaceful status quo is one half (gains are divided equally), while the marginal impact on value for war is $p^i(1, a^*)$, the chance that an attack would succeed at equilibrium arms levels. So if $p^i(1, a^*) > 1/2$ then in this case increasing γ increases a^*. But $p^i(1, a^*)$ need not be greater than one half (due to defensive advantage), and if states have declining value for gains then the "bird in the hand" of an international agreement to divide them becomes more attractive relative to the war gamble for "two in the bush."

These results on γ also depend on how we envision domestic politics affecting the distribution of gains from successful war. For an autocrat or a democracy willing to economically oppress the people in a defeated country, successful war might double the "gains from trade" via the increased tax base that results from conquest. But to the extent that the winning state would not disproportionately tax people in the defeated territory, then increased gains from trade simply increase the

[60]The most developed version of the opportunity-cost argument is Martin, Mayer, and Thoenig 2008. It is perhaps more relevant for conflicts that do not put sovereignty at issue (which is true of most MIDs, for example). See Copeland 2015, chap. 1, for a review of work on economic interdependence and war.

value of a neoliberal deal between independent states, so reducing international competition (a^*).[61]

Finally, note that increasing the gains from trade in the model is *not* the same thing as reducing protectionism. The above analysis assumed that gains from trade are fully exploited in a neoliberal deal between states – γ is divided equally and fully. To model protectionism or other barriers to full efficiency when the states are sovereign, let the gains available in peace be $\gamma^p < \gamma$, p for "protectionism." Now it is immediate that greater protectionism implies a tighter war constraint and greater a^*, since there is now a greater economic efficiency motivation for war.[62]

Protectionist and colonial trade blocs in the 1930s were thought to have favored war, by increasing the returns to acquiring territory where a major power could guarantee a flow of resources and benefit from trade based on comparative advantage. Rosecrance and others have argued that free trade favors peace because it provides states with a cheaper means of obtaining benefits that, in a world with less free trade, might require conquest to obtain.[63] The model formalizes and extends this argument. Free trade here favors international cooperation and lower costs of anarchy not because it is a benefit foregone while fighting, but because it reduces the relative economic appeal of successful conquest. Thus freer trade should allow states to maintain lower equilibrium arms levels. Lower costs of anarchy in turn make a peaceful status quo more beneficial and so more robust against temptations for war.[64]

[61]This is the same argument made above about democracies having less value for conquering additional territory (μ), but applied here to one form of γ (gains from trade).

[62]This can be seen directly from Figure 1; decreasing γ^p shifts the line giving the payoff for peace down but has no effect on the value for war if, post-war, the winner can collect the full gains from trade γ.

[63]Rosecrance 1987.

[64]Copeland's "trade expectations" theory and analysis of historical evidence stresses the idea that a trading state that anticipates increased (extreme) protectionism may go to war to avoid loss of gains from trade. This is a dynamic version of the model's logic just described; Copeland 2015.

Differences in relative power and greed, and multipolarity

For clarity the baseline model assumed two states with equal resources, the same preferences over territory, and the same war costs. In this section I consider a variant that allows for asymmetries, and briefly discuss the restriction to two states.

Relative power and arms levels

Existing IR theory makes *no* predictions about how the military burdens of two adversaries should be expected to vary with relative resources.[65] If state A grows larger than state B, how should we expect force sizes or military spending as a share of GDP to change in both states? Empirically, as suggested by examples from Table 1, there seems to be a tendency for the smaller state in a rivalrous dyad to make a larger military effort, relative to resource base. Perhaps this makes intuitive sense – the smaller state needs to spend a larger fraction of income to match the arms levels produced by an even smaller fraction spent by the larger state.

Analysis of a more general version of the baseline model largely supports this intuition, but with qualifications. In the online appendix I consider a version in which the states have resources r_1 and r_2 that they can spend on arms, where $R = r_1/r_2$ indexes state 1's "relative power." The analysis identifies offsetting strategic dynamics. First, greater relative resources for state 1 means that it can get a bigger advantage from mobilizing and attacking, which implies that a smaller state 2 needs a larger peacetime military burden to maintain deterrence. However, greater relative resources for state 1 also means that state 2 has more to gain from successful conquest, a motivation that presses the larger state to spend more to deter. The second strategic logic is referenced by Douglas MacArthur's comment that "Wars are caused by undefended wealth," which suggests that rich countries need to spend more to deter invasion.[66]

Nonetheless, further analysis shows that under a plausible assumption about how war costs

[65] By contrast, following Olson and Zeckhauser 1966 a large literature examines the distribution of defense spending within alliances. For a review see Murdoch 1995.

[66] The offsetting dynamics could help to explain why most states spend approximately the same share of national

vary with relative size – namely, that the smaller state faces higher costs – the smaller state in a rivalry will tend to have the larger peacetime military burden. Let i's costs for war with j be $c_i r_j$. In the case of the ratio-form military technology, a closed-form solution for the lowest feasible equilibrium military burdens, $b_i^* = a_i^*/r_i$, can be derived.[67] Figure 4 shows how state 1's military burden varies as we vary the ratio of its total resources to state 2's (that is, $R = r_1/r_2$), for two levels of offensive advantage and two levels of "greed."[68]

The smaller state has the larger equilibrium military burden, and its burden increases as the power disparity grows.[69] The size of these effects are increasing in greed and offensive advantage, and decreasing in war costs. Note also that except in the case of high greed and high offensive advantage, military burdens are quite insensitive to relative power ratios. This is due to the offsetting strategic forces described above.[70]

Asymmetric "greed" or war costs

States can differ not only in relative size but also in the value they put on acquiring new territory or costs of fighting relative to value for new territory. To extend possible asymmetries to

income on the military and have similar shares of population in the army, without a strong tendency for military burdens to vary with aggregate income.

[67]See online Appendix. The closed-form solution is for the "Powell model" with $\gamma = 0$, so technically we need to assume a sequential move extensive form. The same qualitative results hold for the model with $\gamma > 0$ in numerical examples like those of Figure 4, but general results are harder to obtain and no closed form is possible.

[68]The parameters used for the figure are m equals .1 or .2 (offensive advantage), and $\mu - c$ equals .2 or .4 (greed net of war costs).

[69]The appendix shows that for the ratio form the smaller state's military burden always increases as it gets smaller in the case of symmetry in other parameters, for any m.

[70]With sufficient greed, at very high levels of resource asymmetry the bigger state prefers to simply take over the small state rather than pay the costs to deter invasion. This is why, for extreme imbalance, there is no peaceful deterrent equilibrium in the high offensive advantage/high greed case in the figure.

these factors, let $\mu_i \in [0,1]$ be the weight state i puts on control of j's territory, and c_i be i's costs for war. We then have

Proposition 5. *Let $w_i(r_i, r_j, \mu_i, c_i)$ be state i's value for winning a war, and suppose that w_i is increasing in μ_i and decreasing in c_i. Then for any military technology, increasing the value state i puts on control of state j's territory, or reducing i's costs for fighting state j, implies greater equilibrium military burdens for* both *states.*

Greater greed in state j forces i to arm more to maintain deterrence, which leads state j to arm more because state i is now less happy with the status quo and so more willing to risk conflict. In an extreme case, a sufficiently greedy state could lead a status quo state – one with *zero* intrinsic value for additional territory – to prefer war to eliminate the greedy regime and so reduce the need for costly deterrence and competition. U.S. entry into World War II, and arguably the Iraq War of 2003, were partly motivated by this logic, which accords more generally with the idea behind Wilson's notion of war "to make the world safe for democracy."

More than two states

Waltz proposed to explain variation in the risk of major power war by the number of major powers. He argued that more than two major powers ("multipolarity") implied higher risk due to a greater chance of miscalculation about who would fight with whom, due to complexity and to incentives for "buck-passing." But he also argued that in anarchical systems states tend to balance by allying with the weaker side against a stronger aggressor. This tendency should create expectations of coalition balancing against aggressors under multipolarity, thus some effect in the opposite direction of the first argument.[71]

Dynamic balance of power models with more than two states and in which coalitions can form are extremely complex. They are sensitive to what seem like fairly arbitrary assumptions and

[71] See Van Evera 1990, 36, for a good discussion.

appear to support few general results.[72] In addition, to date theoretical formulations abstract from features such as geography that have been critical influences on what coalitions are likely to form in, say, European great power politics.[73] These are reasons why it makes sense for a baseline model to begin with relations between just two states. But it also means that some important strategic dynamics cannot be addressed by the model, such as the U.S. or Britain entering continental wars out of fear that victory by France or Germany would harm them in the future.

Nonetheless, for an empirically common case of multipolar politics we can get an immediate and natural implication from the baseline model. Namely, if there is a "balancer" state that would intervene on behalf of state j when state i attacks j, this amounts to defense dominance in the model: Either the war costs of the attacker are increased, or the odds of victory are decreased (smaller m). By results summarized in Propositions 3 and 5, in both instances the war constraint is relaxed and greater cooperation becomes feasible between i and j.

The U.N. order and decolonization after World War II created a system with many small, poor, formally independent countries, mainly in Africa and Asia. Invasions in the developing world with the goal of conquest or annexation of territory have been extremely rare since 1945, in some part because of developing states' "recognition that they will probably meet strong Western opposition if they embark on territorial aggression."[74] The implication of the baseline model is then that these states can afford to have smaller militaries than they otherwise might. Indeed, for small, low-income countries that do not have a significant nationalist land dispute with any neighbors, the size of their military probably does not reflect interstate deterrence at all, and is instead purely a matter of

[72]Wagner 1986, 1993; Niou, Ordeshook, and Rose 1989; Powell 1999; Krainin 2014.

[73]Models typically assume that any state can equally well attack any other state (conditional on relative resources), whereas in reality spatial arrangements matter a great deal.

[74]Zacher 2001, 242. See also Fazal 2007 and Jackson and Rosberg 1982, who argue that African "juridical" states coordinated expectations of joint opposition to territorial aggression (balancing) among themselves, so lowering the need for larger military capabilities.

domestic demand (a^D as discussed above). In other words, for large parts of the world, there is no binding war constraint on arms levels and international cooperation. The costs of interstate anarchy are low for these states as a result of major power policies.

Conclusion

The model of interstate politics analyzed above may be summarized as follows. States can use military effort to change the world beyond their borders in directions they like and also to invade other states or defend against invasion. But because military effort is costly (there is a guns-butter tradeoff), they face a strategic problem akin to repeated Prisoners' Dilemma (PD). Threats or use of force can gain short-run advantage on various issues, but if other states do the same they end up spending more for no gain in the long-run. Thus agreements to limit costly competition by using strategies of conditional cooperation (e.g., Tit for Tat), often facilitated by international institutions, make sense, even for "greedy" states.

However, because the strategic problem states face in anarchy is *not* a standard repeated PD, this "neoliberal institutionalist" mechanism cannot necessarily be used to reduce the costs of anarchy to zero. Unlike in repeated PD, a cooperating state can be eliminated or permanently disadvantaged (made unable to retaliate effectively) if the other state "defects." As seen in the baseline model, the extent of international cooperation is limited by states' need to maintain enough arms to deter mobilization and attack by potential adversaries. This "war constraint" sets a lower bound on the costs of anarchy. In the model, the lower bound is determined primarily by the offense-defense balance, the intrinsic value *both* states put on controlling additional territory, and the extent of gains from cooperation on issues beyond homeland territory.

The model shows how diverse and apparently conflicting theoretical arguments can be synthesized in the sense of being derived in a clear, connected fashion from a small set of Realist premises. Some of its main implications are similar to those of the closest thing to a baseline model in the literature, the two-type security dilemma theory posed by Jervis and developed by Glaser, Kydd,

and others.[75] However, its core strategic logic is different. In this way it suggests an alternative theoretical foundation.

In the model, the costs due ultimately to anarchy arise not from states' uncertainty about others' territorial aims, but instead from a strategic dynamic rooted in political economy. For instance, state A's territorial revisionism forces state B to spend more to deter, which lowers B's value for the status quo, forcing A to spend more to deter B, which lowers A's value for the status quo further, and so on. Greater equilibrium military competition makes states more willing to risk war in crises or try preventive war to avoid oppressive defense burdens in the future.[76] Greater offensive advantage in geography or military technology means that states have to arm more to get the same degree of deterrence, thus endogenously lowering states' values for living with the status quo and exacerbating a "security dilemma" as this theory would understand it.

The standard two-type model has no way to understand tragic inefficiency between states with some revisionist preferences.[77] Here, by contrast, revisionist preferences plus anarchy can cause tragedy for any set of states not all known to be pure security seekers, due to security externalities of costly competition in arms or other military effort.[78]

Extensions to the complete-information model might introduce incomplete information about

[75] Jervis 1976, 1978; Glaser 2010; Kydd 2005.

[76] For empirical examples from the lead ups to the World Wars, see McDonald 2011, Ferguson 1994, Herrmann 1996, 228, Maiolo 2010, and Copeland 2000.

[77] Recall that Jervis 1976 distinguished between "real" and "illusory incompatibility" and saw only the latter as inefficient, a tradition carried on in the way that standard security dilemma arguments are presented.

[78] Some constructivists hold that anarchy need not be costly because one can imagine a world in which states do not understand themselves to have any serious conflicts (such as revisionist territorial or conflicting preferences on specific issues). No disagreements implies no commitment problems. As noted, most Realists and neoliberals might agree but question the relevance of the observation. Still, this is not to say that changes in the realm of ideas and discourse can't affect conceptions of self-interest and conflict of interest – certainly they can. For example, the germ theory of disease was an intellectual innovation that led, correctly, to increased perception of common interest across

states' preferences for territory (μ). Its absence is not intended to suggest that uncertainty about motivations is unimportant for some major power interactions. Jervis' and much work following him demonstrate otherwise.[79] Starting with a complete-information baseline is useful for multiple reasons, including clarifying the sources of the costs of anarchy and allowing us to understand just what incomplete information about motivation would add.

Moreover, not all major power security competitions are driven primarily by mutual uncertainty about the extent of the other side's intrinsic preferences for territorial expansion. For instance, it seems plausible that Chinese and U.S. leaders understand perfectly well that the former would like to revise the "territorial" status quo in the East and South China seas, and that the U.S. would prefer that they did not. Likewise, the leaders of North Korea and Iran correctly view U.S. administrations as having revisionist preferences concerning their regime type, so that the U.S. can't easily commit not to support avowedly democratic challengers in these states in the event of domestic uprisings (as in Libya, for example). This known U.S. revisionism can then add to the incentive to develop nuclear arms.[80] Such interactions may not be best analyzed in terms of status quo types' uncertainty about whether the other is revisionist, and yet – by the strategic logic developed above – they can still be very costly and inefficient as a result of anarchy.

Even though the costs of anarchy have been at the center of arguments in International Relations for years, there have been almost no efforts to measure them empirically in a systematic way, beyond studies of patterns and amounts of interstate war. The analysis here suggests that arms levels provide a theoretically defensible measure, because failures of interstate cooperation in areas where repeated interactions could in principle support deals should not necessarily be blamed on anarchy. Moreover, arms levels are a convenient measure both for gauging welfare consequences of

states in some areas (Cooper, 1989). Smithian and Ricardian theories of international trade are another important example (e.g., Morrison, 2012).

[79] Jervis 1976, 1989.

[80] See Fearon 2011 for more on these examples.

anarchy across time and space and for assessing whether and how much a "third image" logic influences these costs. Regarding the former, arguably a couple percent of GDP for most countries these days – the median was about 1.5% in 2012 – is not that much tragedy, especially if one considers that for many or even most countries, some large fraction of this is wholly about domestic stability or military politics rather than interstate competition. An important point – consistent with "defensive realism" and critics who stress domestic determinants of territorial preferences – is that very low costs of anarchy in a nuclear world with many industrialized, free trading, nationalism-satisfied major-power democracies is implied by a Realist baseline model.[81]

If antitrust law permitted it, profit-seeking firms in an oligopolistic market would merge to form a single monopoly. Likewise, the two states in the model could in principle completely eliminate the costs of anarchy by merging or federating into a single state, after which they could end military efforts directed at external defense. The condition of anarchy among states is not a natural given but instead an endogenous choice made by state leaders. States do not merge for the same two main reasons that combatants in civil wars find it so difficult to agree on powersharing arrangements. First, it is risky to trust that a new government's paper constitution will be able to protect one from attack and expropriation after one has disarmed or ceded control to a powerful higher-level military force. Second, in the modern period when nationalist sentiment can be very strong, a leader and his or her constituents may simply have a large "consumption value" for formal independence, so that the costs of anarchy are a price of nationalist satisfaction. The higher the price, the stronger the incentive for small states to merge and for major powers to try to construct stronger institutions at the international or regional levels. But strong international institutions will be harder to build due to the underlying conditions that create the need for costly deterrence. When the costs of anarchy are low (for example, at present, for the reasons suggested above), genuine pooling of sovereignty might be more feasible but there is also less call for it, and more scope for international institutions

[81]Note that low military burdens in recent years are something to be explained. In earlier periods governments spent almost all of what they could raise through taxes on the military.

and conditional cooperation between independent states.[82]

[82]I consider the issues that arise when we make anarchy an endogenous choice in work in progress.

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Table 1: Top and bottom 15 states on two measures of arms levels

Top 15, military burden		Top 15, armed forces/1000	
Cold War	post-Cold War	Cold War	post-Cold War
USSR^{2,3}	Kuwait^{1,0}	Israel^{3,2}	North Korea^{0,1}
Oman^{1,0}	Eritrea^{2,1}	Taiwan^{1,0}	Eritrea^{2,1}
Angola^{0,2}	Russia^{0,1}	Jordan^{3,1}	Israel^{3,2}
Israel^{3,2}	Oman^{0,0}	North Korea^{0,1}	Jordan^{2,0}
China^{5,1}	Saudi Arabia^{1,2}	UAE^{0,0}	Syria^{4,1}
Vietnam^{2,2}	Armenia^{1,0}	Albania^{0,1}	UAE^{0,0}
Egypt^{1,7}	Syria^{4,1}	Bulgaria^{3,0}	Greece^{1,1}
Bulgaria^{3,0}	Bosnia^{2,0}	Mongolia^{0,0}	Oman^{0,0}
Iraq^{2,4}	Liberia^{0,0}	Greece^{3,1}	Iraq^{1,4}
Jordan^{3,1}	Angola^{0,1}	Iraq^{2,4}	Taiwan^{1,0}
Saudi Arabia^{3,4}	Israel^{3,2}	Laos^{0,0}	Lebanon^{0,0}
Syria^{4,3}	Jordan^{2,0}	Syria^{4,3}	Singapore^{1,0}
Hungary^{1,0}	Tajikistan^{0,0}	South Korea^{0,1}	Libya^{1,1}
Mongolia^{0,0}	Yemen^{1,0}	Turkey^{3,0}	South Korea^{0,1}
Djibouti^{0,0}	Uzbekistan^{1,0}	USSR^{2,3}	Armenia^{1,0}

Bottom 15, military burden		Bottom 15, armed forces/1000	
Cold War	post-Cold War	Cold War	post-Cold War
Haiti^{0,0}	Costa Rica^{0,0}	Gambia^{0,0}	Haiti^{0,0}
Mauritius^{0,0}	Jamaica^{0,0}	Niger^{0,0}	Ghana^{1,0}
Gambia^{0,0}	Mexico^{0,0}	Mauritius^{0,0}	Niger^{0,0}
Mexico^{0,0}	Mauritius^{0,0}	Burkina Faso^{1,0}	Malawi^{1,0}
Costa Rica^{0,1}	Dominican Republic^{0,0}	Lesotho^{0,0}	Nigeria^{1,0}
Niger^{0,0}	East Timor^{0,0}	Malawi^{2,0}	Kenya^{1,1}
Trinidad^{0,0}	Trinidad^{0,0}	Rwanda^{0,1}	Burkina Faso^{0,0}
Jamaica^{0,0}	Ireland^{0,0}	Sri Lanka^{0,0}	Mauritius^{0,0}
Sierra Leone^{0,0}	Guatemala^{1,0}	Kenya^{2,1}	Papua New Guinea^{0,0}
Panama^{0,0}	Austria^{0,0}	Benin^{0,0}	Gambia^{0,0}
Fiji^{0,0}	Japan^{1,0}	Papua New Guinea^{0,0}	Mali^{0,0}
DRC^{0,1}	Malawi^{1,0}	Ivory Coast^{1,0}	Bangladesh^{0,0}
Japan^{0,0}	Papua New Guinea^{0,0}	Jamaica^{0,0}	Ivory Coast^{0,0}
Nepal^{0,0}	Ghana^{1,0}	Mali^{1,0}	East Timor^{0,0}
Bangladesh^{0,0}	Gambia^{0,0}	Bangladesh^{0,0}	Cen. Afr. Rep.^{0,0}

Notes: First superscript is # of territorial rivalries in period; second is # states with a "positional," "ideological," or "interventional" rivalries (Thompson and Dreyer 2012). Some high-spending states like North Korea are missing data on military burden and so do not appear in the military burden lists. Post-Cold War is after 1990.

Figure 1: Equilibria with and without stable deterrence

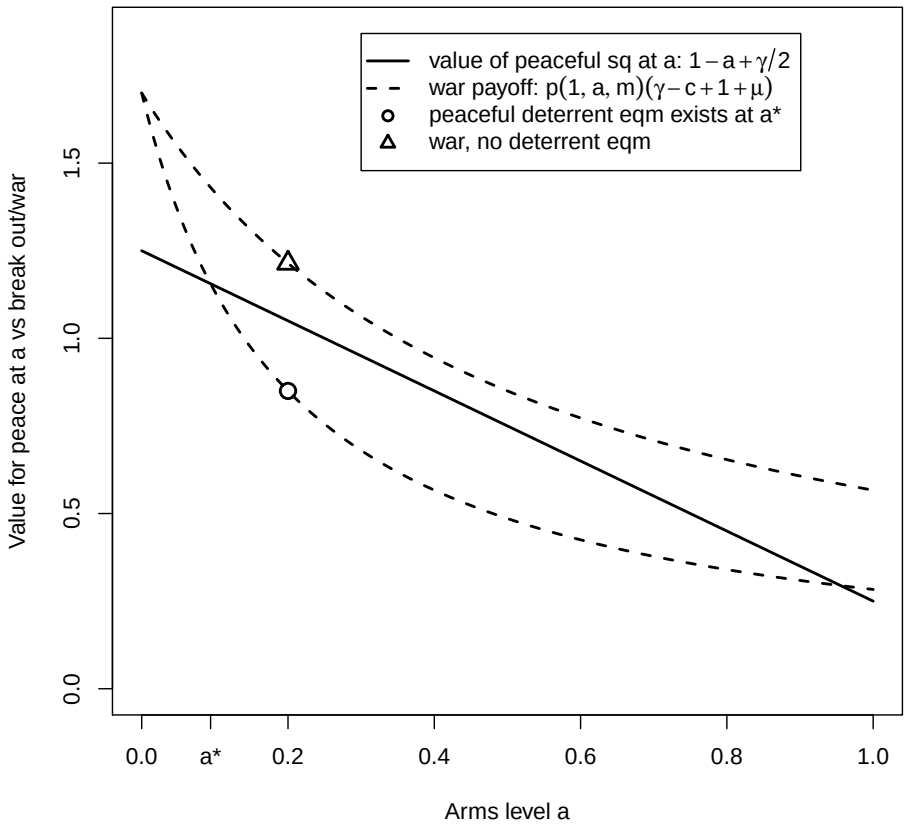

Figure 2: Territorial rivalry over time

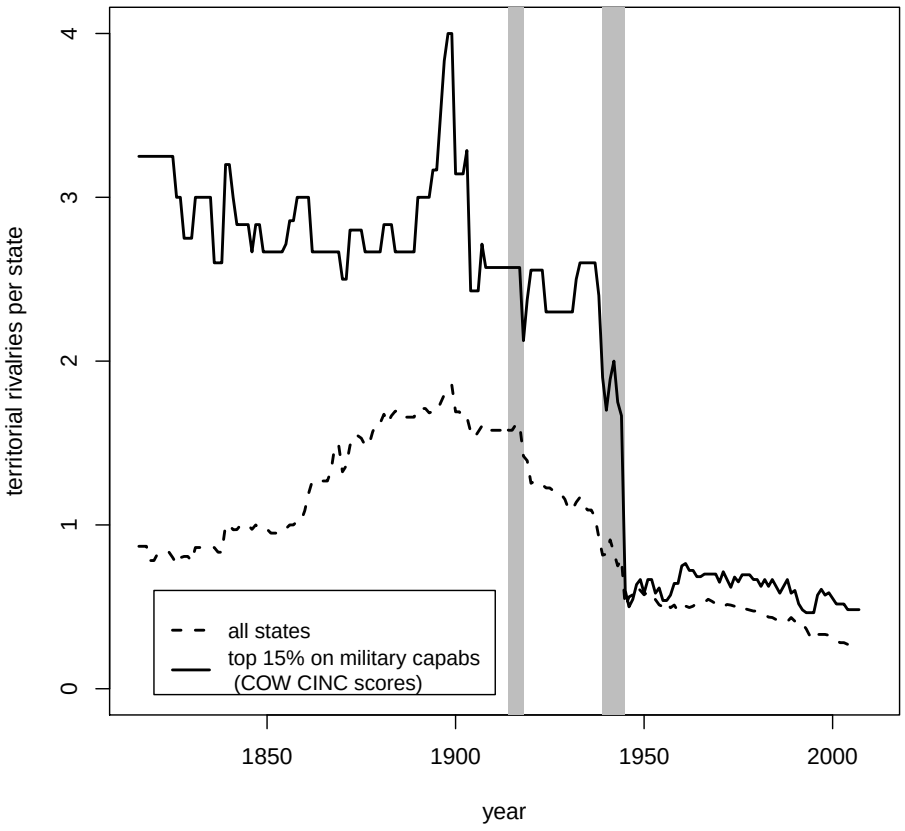

Figure 3: Peacetime armed forces per 1000 population

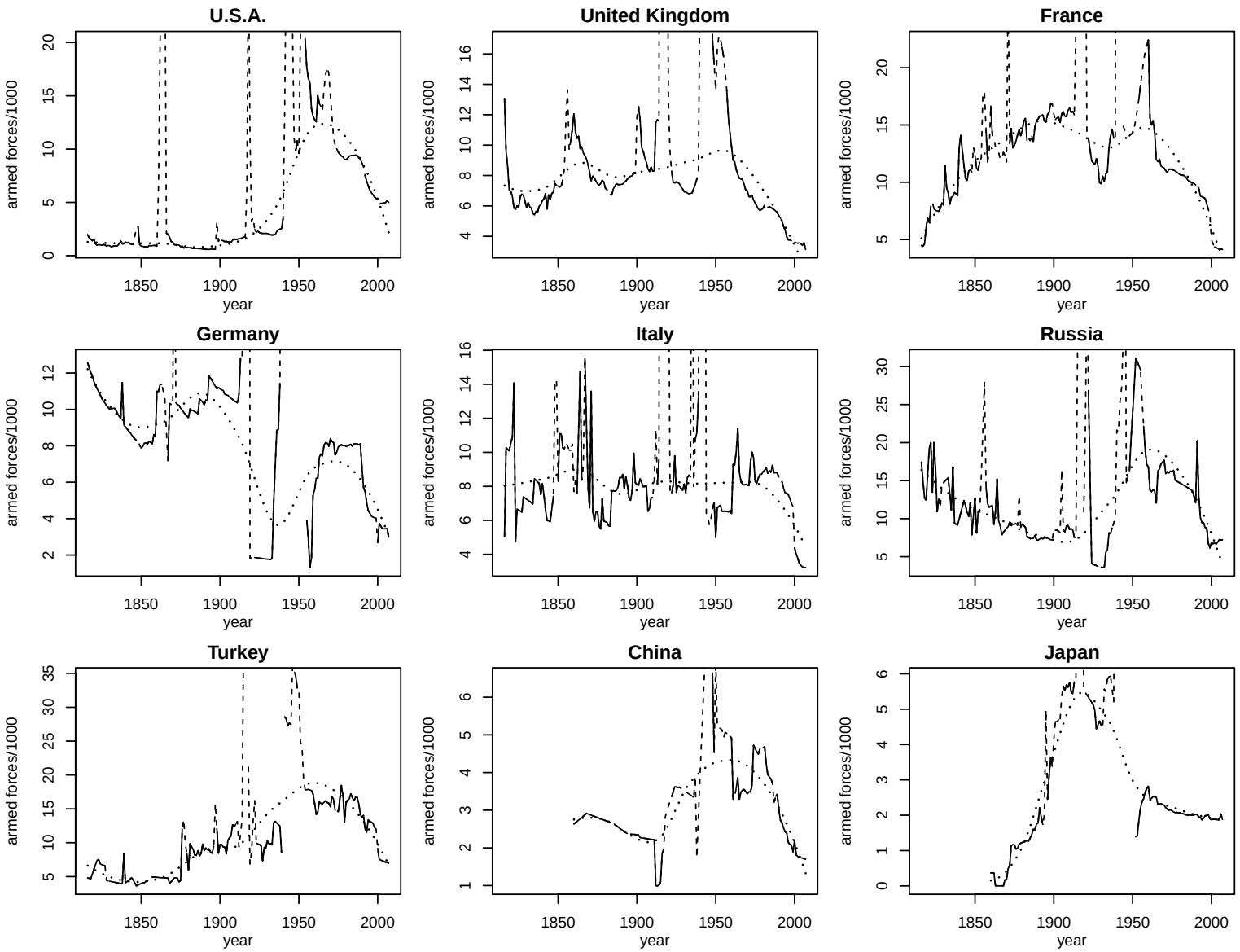

Figure 4: Relative power and military burdens