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**ALLIANCES VERSUS FEDERATIONS: AN ANALYSIS WITH MILITARY AND
ECONOMIC CAPABILITIES DISTINGUISHED**

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Abstract

This essay explores the distinction between federations and alliances and asks the question: When will states choose to federate rather than ally? William Riker (1964) argues that a necessary condition for a federal state's formation is that those offering the federal bargain must seek to "expand their territorial control, usually either to meet an external military or diplomatic threat or to prepare for military or diplomatic aggression and aggrandizement." This argument, though, fails to ask why states sometimes respond to threats by forming federations and at other times by forming alliances. Here, after assuming that states have initial endowments of military and economic resources, where economic resources enter utility functions directly and are what states maximize and where military capability influences preference only insofar as it determines a state's ability to counter threats, we offer a multi-stage game-theoretic model in which states may be compelled to divert economic resources to military spending. Alliances, in turn, are self-enforcing coalitions designed to augment a state's offensive or defensive capabilities. Federations, which serve the same ends as alliances, are coalitions that need to be enforced by the "higher authority" established when the federation is formed. Our operating assumption is that states seek to form a federation in lieu of an alliance if and only if (1) a stable alliance partition does not exist or, if one exists, it is dominated by an unstable partition and (2) if the cost of the loss of sovereignty to each state in the federation is offset by the gains from joining it, relative to what that state secures as its security value.

pan of the necessary conditions for the formation of a federation; namely that "cooperation [arises] from a desire to improve relations within the cooperating group [which can be] ... independent of threats from outside groups" (Wolfers 1962: 27). Nevertheless, Riker's analysis fails to exclude the possibility that circumstances lead sometimes to the formation of a federation and at other times to something else. Hence, to frame an hypothesis about sufficiency or to speculate about what that "something else" might be, we must go beyond that analysis to the things that differentiate federations from other cooperative arrangements, notably alliances.

Riker's analysis, though, does do more than give us cause to differentiate between federations and alliances. It also brings into question the usual assumption in formal models that the constellation of states is fixed or that it changes only through aggression, and, because the incentives to ally or confederate operate directly on decision makers within states, it places the analysis of international politics at the heart of the study of domestic politics and vice versa. This fact, in turn, leads to the issue of state goals. Specifically, when theorizing about the choice between forming a federation versus an alliance, we are especially interested in learning when the costs of a loss of sovereignty associated with joining a federation might be offset by a decreased need to spend economic resources on military capability so as to allow a state greater opportunity to enjoy the fruits of its economy than when only the option of forming an alliance is available.

We hasten to add here that we do not here want to enter into the debate over state goals. Our analysis is in keeping with Waltz's (1979: 105, 126) view, in making the analogy between international systems and oligopolistic markets, that "to maximize profits tomorrow as well as today, firms first have to survive" and that "power is a means not an end" and with Viner's (1948:11) oft-quoted summary of the relationship between power and wealth, namely:

(1) wealth is an absolutely essential means to power, whether for security or for aggression; (2) power is essential or valuable as a means to the acquisition or retention of wealth; (3) wealth and power are each proper ultimate ends of national policy; (4) there is long-run harmony between these ends, although in particular circumstances it may be necessary for a time to make economic sacrifices in the interest of military security and therefore also of long-run prosperity.

To transform this argument into a more formally stated hypothesis that allows us to model the opportunities states confront for augmenting their power through alliances or federations we offer an analysis in which states maximize social welfare, where the importance of "power" (military capability) is endogenously determined by the interplay of this objective and the opportunities to form alliances or federations. More specifically, we assume that states have initial endowments of military and economic resources, where economic resources enter utility functions directly and are what states maximize and where military capability influences preference only insofar as it determines a state's ability to expropriate economic resources from others and to counter threats against itself.

Economic resources are convertible into military capability, but once converted they are not part of the accounting of a state's welfare. A state may be compelled to divert economic resources to military spending, but such spending is only a means for defense or for expropriating new economic resources from other states. Alliances, in turn, are self-enforcing coalitions -- states adhere to the agreements that describe them only to the extent that it is in their individual self-interest to do so -- designed to augment a state's offensive or defensive capabilities as mediated by each state's ultimate goal of maximizing its economic base. In contrast, federations, which can serve the same ends as alliances, are coalitions that need to be enforced exogenously -- by the "higher authority" that is established when the federation is formed.

Insofar as goals and the tradeoff between economic and military capability is concerned, then, our perspective parallels Powell's (1991, 1993) analysis, where the weight given to absolute versus relative resources is endogenous. In fact, the structure of the model, including our accommodating potential asymmetries between offensive and defensive capabilities, is identical to the one Powell formulates. But because we are concerned primarily with alliances and federations, here we focus on the interplay of economic and military resources in an n -country context in which the ultimate configuration goals -- a state's "taste" for power versus wealth -- is determined by the opportunity to form coalitions of different types.

Briefly, Section 1 offers elementary notation about economic and military resources, about the efficacy of military power, and about the game we assume states play after making their decisions about alliance formation and confederation. Section 2 considers the different equilibria that can prevail when the possibility of defensive alliances and confederation are excluded and when states are modeled as taking a myopic view of strategic possibilities. Section 3, in contrast, assesses the advantages of different coalitions when states make a comprehensive assessment of consequences, and Section 4 applies this analysis to the choice between alliance and confederation.

1. Basic Structure

To understanding why federations as opposed to alliances form, or why states ally in any form, we need to understand the inter-relationship of primary and instrumental goals as part of some general equilibrium processes (Niou and Ordeshook 1994b). Thus, after letting $N = \{1, 2, \dots, n\}$ denote the set of relevant countries, we assume that the status quo of an international system is described by three vectors. The first, $m = (m_1, m_2, \dots, m_n)$, describes the military capabilities of each state. A second vector, $d = (d_1, d_2, \dots, d_n)$, describes the defensive capabilities of each state -- the advantage of the defense over the offense with the idea that it takes Xd units of offense, with $d \geq 1$, to overcome X units of defense. Finally, the third vector, $e = (e_1, e_2, \dots, e_n)$ describes what it is that each state maximizes, its economic resources.

Of course, m , d , and e are merely notation, and we do not want to argue that any of these vectors has anything more than an imprecise empirical referent. It is best to think of these vectors as summarizing qualitative concepts

that we know can be operationalized only in ad hoc ways. Nevertheless, characterizing the status quo by the triple $S = (m,d,e)$ allows us to accommodate the following things:

1. *Separability of military and economic capabilities and resources:* Ignoring the possibility of a military-industrial complex that values m_i for its own sake, as in Powell (1993), military capability is valued only to the extent that it is instrumental for securing or defending economic resources. Thus, only a state's economic resources, e_i , measures its welfare or can be consumed. Hence, we assume that each state i maximizes e_i and is concerned with m_i only to the extent that it influences i 's ability to defend e_i or to secure by way of expropriating it from other states.
2. *Productivity (or absence thereof) of military capability:* States can spend economic resources to purchase military capability (for simplicity, in the ratio of 1 to 1). But once a share of economic resources is "spent," the resulting military capability cannot be consumed or put to any productive use other than to defend the state against aggression or to commit aggression against other states. That is, increased military capability does not generate externalities that add to a society's overall productivity or wealth.
3. *Asymmetry of defensive and offensive capability:* It is generally assumed that the defense holds the advantage in military adventures (for a discussion of the relevant literature see Levy 1984). The vector d allows military power to be asymmetric with respect to offensive and defensive capability -- i can overcome j only if $m_i > m_j d_j$. Ideally, we would want d to be a matrix, where d_{ji} is j 's defensive advantage with respect to i , since doing so admits of considerations of geography to the extent that j may need fewer resources to defend against i than against another state k . In effect, then, our analysis assumes that $d_{ji} = d_{jk} = d_j$ and ignores geographic asymmetries.
4. *The spoils of war:* Rather than suppose that the military capability of a defeated country accrues to the victors, differentiating between m and e allows us to suppose that it is only a country's economic base that is transferred to and of value to such a winner. If, for instance, i eliminates j , then i 's military capability remains at m_i whereas its economic base increases to $e_i + e_j$.

To this structure we now want to add one additional assumption about preferences. Specifically, although each country wants only to maximize its economic resources, we assume that it (or at least the regime that rules it) also wants to survive. Hence, we differentiate between elimination and merely spending e_i to zero. That is, if given a choice between elimination from the game and surviving but with no disposable economic base, we assume that every country would choose survival.

2. A World of Cynics and Pessimists

Our ultimate objective is to distinguish between alliances and federations as responses to the security dilemmas states confront. But first we want to consider the strategies states should choose if they individually operate under the assumption that defensive alliances are inherently unstable and that a state is secure if and only if it can defend its own interests without assistance from anyone else. Thus, without distinguishing between alliances, federations, and coalitions, we offer the following result:

Result 1: *If coalitions of any form are prohibited or are otherwise deemed unreliable, then $S = (m,d,e)$ is stable if and only if, whenever for any i in N ,*

$$(m_i + e_i)d_i \leq \sum_{j \in N - \{i\}} m_j, \text{ then } e_i = 0.$$

Otherwise, if

$$e_i < \sum_{j \in N - \{i\}} e_j, \text{ then } m_i d_i - \sum_{j \in N - \{i\}} m_j = e_i$$

but if

$$e_i \geq \sum_{j \in N - \{i\}} e_j, \text{ then } m_i d_i - \sum_{j \in N - \{i\}} m_j = \sum_{j \in N - \{i\}} e_j.$$

The first expression states that if i 's military and economic endowment is less than the aggregate military endowment of the other states, taking into account i 's defensive advantage, then i must spend to 0. The second and third expressions concern states with relatively greater military and economic capability. The second expression excludes the possibility that it is worthwhile for the other states in the system to spend the additional resources necessary to capture i 's economic resources. And the third condition is, in effect, an efficiency criterion and requires that no state spend more than necessary given the military capabilities of the other states.

Example 1: Consider the 2-country system $S' = [(100,100),(1,1),(150,50)]$. Suppose country 2 reasons thus: "if I spend 25, then country 1 must spend 25 to overcome me. But if I am left with only 25 economic units, it is not worth it to 1 to spend additional resources to absorb me." So suppose the system first moves to $[(100,125),(1,1),(150,25)]$. But now 2 can overcome 1 and so 1 must invest at least 25 to defend itself, thereby producing the outcome $[(125,125),(1,1),(125,25)]$. Now 2's earlier reasoning no longer applies -- once having spent 25, 1 might as well spend an additional unit to eliminate 2 and secure 2's economic resources. In anticipation of this, 2 should spend all of its resources initially, rather than only 25 units. And in anticipation of this move by 2, 1 spends 50 units to defend itself. Hence, the final stable outcome is $S = [(150,150),(1,1),(100,0)]$.

Notice that in this example, one country (2 in this instance) spends all of its economic resources. This fact can be generalized thus for 2-country systems:

Remark 1.1: *If $n = 2$, and if $d_1 = d_2 = 1$, then S is stable only if $e_i = 0$ for one or both countries.*

This remark, though, depends critically on the assumption that no state enjoys a defensive advantage. To see this, consider another 2-country example.

Example 2: Suppose $S' = [(100,100),(2,1),(100,100)]$, so that countries 1 and 2 are wholly symmetric except for their defensive capabilities. This asymmetry is reflected in the final, uniquely stable outcome, $S = [(100,150),(2,1),(100,50)]$. Owing to 1's defensive advantage, 2 cannot successfully attack 1. Moreover, although 1 can defeat 2 by converting slightly more than fifty units of economic resources to military capability, 1 can only hope to win fifty units of economic resources in the process. So S is stable.

This last example occasions two questions. First, beginning at some status quo, $S' = (m', d', e')$, is there an attainable stable S ? By attainable we mean a system that can be achieved by way of some "reasonable" individual adjustments in military capabilities. Second, if such an S exists, is it unique -- is there any path dependence here? In fact, the answer to both questions is straightforward once we notice that by focusing on the security values of individual countries and by supposing that each state seeks merely to maximize its security value, we have effectively decoupled individual decisions so as to assure the validity of the following result:

Remark 1.2: *For every status quo there exists a unique stable S .*

Note that one implication of this remark is that if two states are identical with respect to the status quo values of m , d , and e , then they are necessarily treated identically in equilibrium. Also, as a generalization of Remark 1.1,

Remark 1.3: *If there is no asymmetry between offensive and defensive capability (if $d_i = 1$ for all i in N), and if no country can make itself militarily predominant, then the uniquely stable S has every country converting all of its economic resources to military capability.*

Proofs are offered in the appendix, but the logic of these remarks can be illustrated by two 3-country examples, one with symmetric defensive values and the other with asymmetric ones.

Example 3: Suppose $S' = \{(100,100,100),(1,1,1),(150,100,50)\}$. Remarks 1.2 and 1.3 imply that the uniquely stable system here is $S = \{(250,200,150),(1,1,1), (0,0,0)\}$. Starting at S' , 1 looks safe if it increases its military capacity to 225, since this leaves it with 25 economic units and since 2 and 3 must spend 25 to overcome 1. So suppose the system first moves to $\{(225,100,100),(1,1,1),(25,100,50)\}$. But now 2 (3) must transform all of its economic resources to ensure its survival against the combined initial capabilities of 1 and 3 (1 and 2). Thus, everyone can anticipate $\{(225,200,150),(1,1,1),(25,0,0)\}$. But then 2 and 3 can overcome 1 if 1 does not increase its military capacity further. Indeed, 1 must spend its remaining 25 economic units to ensure survival, which yields the asserted equilibrium.

Example 4: If we now increase 1's defensive capability so as to generate the status quo $S' = \{(100,100,100),(2,1,1),(150,100,50)\}$, then the unique equilibrium becomes $S = \{(175,200,150),(2,1,1),(75,0,0)\}$. Countries 2 and 3 must spend all of their economic resources to ensure their survival. But 1 can take advantage of its relative defensive invulnerability and spend only half its economic resources on military capability.

3. Toward a Less Myopic View

The preceding analysis gives us some insight into the strategic imperatives felt by a state when it bases its actions on the presumption that only coalitions directed against it can be sustained and, when calculating its security value and corresponding response, that other states may even act irrationally. It is against this background that states evaluate the utility of alliances and federations. So suppose that countries act less myopically and assume full rationality on everyone's part. Specifically, suppose events unfold according to the following sequence:

- Stage 1:** Countries form coalitions, alliances, federations, etc.
- Stage 2:** Assuming that the agreements from Step 1 are binding, countries decide how much additional military capability to purchase
- Stage 3:** States are allowed to defect from their agreements, and, if they choose, can attack others so as to eliminate them from the game.

Finally, with the new status quo that is established in Stage 3, the system returns to stage 1 and the process repeats itself.

To convert this three-stage scenario into a tractable model requires a clearer conceptualization of what we mean by an alliance. Briefly, then, if we interpret an alliance as a limited collective security agreement in which alliance members agree not to threaten each other and to defend each other from threats originating outside of the alliance (see Niou and Ordeshook 1994a, and Morrow 1994 for an elaboration of this definition), then

Definition: A *stable alliance* is a coalition formed in Stage 1 such that no one has an incentive to defect to some other coalition. If the *coalition structure* P , which corresponds to the collective security agreements reached in Stage 1, partitions the set of countries, N , into exhaustive and disjoint subsets, then P is stable if, after adjustments are made in Stage 2 as described, no subset of countries will subsequently defect in Stage 3 to generate a different coalition structure.

Rather than proceed to unnecessary formalism, we can illustrate the essential meaning of this definition as well as the three-stage process just outlined by returning to Examples 3 and 4.

Example 3 (continued): Earlier, on the basis of Remark 1.3, we argue that if $d_i = 1$ for $i = 1, 2, 3$, then the unique equilibrium has all three countries spending everything on military capability. But this conclusion assumes that two countries will eliminate the third if it is both possible and profitable to do so. Suppose, though, that at Stage 1, countries agree not to attack each other, thereby forming the coalition of the whole, $\{1,2,3\}$. In accordance with this agreement, no one spends anything at Stage 2 on additional military capability. Now consider the incentives of, say, 1 and 2 to defect from the agreement at Stage 3 by eliminating 3 and somehow dividing its economic resources among themselves. But if 3 is eliminated, Remark 1.1 applies, and 1 or 2 will have to reduce its economic resources to zero. That is, either 1 or 2 (or both) will not gain from 3's elimination. Since this argument applies to $\{1,3\}$ and $\{2,3\}$, S is stable: no country will be eliminated or will be forced to reduce its economic resources to zero.²

Example 4 (continued): Suppose $\{1,2,3\}$ forms, and assume, as before, that no one spends to procure additional military capability. But suppose 1 and 3 defect in Stage 3 in order to eliminate 2, divide 2's economic resources 30-70, and thereby generate the new status quo, $[(100,-,100),(2,-,1),(180,-,120)]$. At this point 1 and 3 must readjust their military capabilities. But Remark 1.1 no longer applies since d_1 equals 2, not 1. In fact, the unique stable system is $[(110,-,165),(2,-,1),(170,-,55)]$. Thus, both 1 and 3 gain from 2's elimination. The threat against 2 is viable, and thus neither $\{1,2,3\}$ nor $S = [(100,100,100),(2,1,1),(150,100,50)]$ are stable.

² If, though we distinguish system- from resource-stability, S may not be *resource stable* to the extent that subgames of threats and counter-threats may compel states to buy each other off in the event that threats short of doomsday proposals are viable. For a discussion of such threats as well as a formalization of the distinction between resource-stability and system-stability see Niou, Ordeshook, and Rose (1989).

Notice that such examples allow us to assess assertions about the influence of changes in defensive capability on international stability. For example, consider Jervis's (1978:199) argument that "The advantage of the defense can only ameliorate the security dilemma;" Levy's (1984:) assertion that "If weapons and policies that protect the state do not provide the capability for attack, then the basic postulate of the security dilemma no longer applies;" Quester's (1977:208) argument that "Offenses produce war and/or empire; defenses support independence and peace;" and Hart's (1932: 72) contention that "any strengthening of the defensive at the expense of the offensive is a discouragement to aggression." But Examples 3 and 4 differ only in that 1's defensive capability in Example 4 is greater than in 3, and in Example 3, no economic resources are spent on military capability, whereas in Example 4, $\{1,2,3\}$ is no longer stable and one or more countries must procure additional military capability. Thus, although the intuition offered by Jervis, *et al* may apply to 2-country systems, we see here that the ideas and intuition gained from focusing on bipolar systems does not always extended to larger systems.

Returning now to Example 4, let us determine the stable systems that can prevail when all strategic possibilities are considered.

Example 4 (Continued): Consider in turn each of the three coalitions structures ($\{1,2\},\{3\}$), ($\{1,3\},\{2\}$), and ($\{2,3\},\{1\}$). First, if ($\{1,2\},\{3\}$) is agreed to in Stage 1, then-stage 2 should produce the system [(100,100,150),(2,1,1),(150,100,0)]. But now 1 has an incentive to defect to 3, eliminate 2, and, after making suitable adjustments in military capabilities, achieve the stable outcome [(110,-,165),(2,-,1),(170,-,55)]. Hence, the coalition structure ($\{1,2\},\{3\}$) cannot be stable. Similarly, if ($\{1,3\},\{2\}$) is the agreement reached in Stage 1, then Stage 2 produces the system [(100,200,100),(2,1,1),(150,0,50)], whereupon 1 has an incentive to defect to 2 and to generate a stable outcome such as [(110,200,-),(2,1,-),(170,20,-)]. Hence, the coalition structure ($\{1,3\},\{2\}$) cannot be stable. Finally, consider ($\{2,3\},\{1\}$). Unlike our previous two cases, following the formation of this structure in Stage 1, the Stage 2 economic-military adjustments yield a stable outcome in which everyone retains some economic benefit. Specifically, $S = [(167,130,120),(2,1,1),(83,70,30)]$ prevails. Notice, in particular, that if 1 attacks 2 and thereby threatens to generate the outcome [(167,-,125),(2,-,1),(158,-,25)], then 3 should aid 2: otherwise, 3 must subsequently convert all of its economic resources to military capability and realize a final payoff of 0.

What remains before we can assert that S is stable in this example is to show that neither 2 nor 3 will defect from $\{2,3\}$ subsequently to attack the other. But if, for instance, 2 announces a unilateral defection, then 3 spends so as to set e_3 equal to 0, 2 does the same in order to defend against an attack by 1 and 3, and 3 increases military capabilities to 175 to defend against 2 and 3.

4. Alliances versus Federations

Example 4 shows that stable alliances - stable collective security arrangements - need not encompass all countries, and that, as in some balance of power scenarios, it need not be the case that two countries necessarily eliminate the third. At the same time, we have also seen that not all "profitable" coalitions are stable alliances, and it is this fact that we use as leverage to study federations. Turning first to the differences between alliances and federations, and building on the treatments of these types of coalitions offered by Riker (1964), Wolfers (1962) and others, we see that there is little disagreement that alliances and federations differ in at least the following qualitative and admittedly imprecisely formulated ways:

1. In accord with Riker's definition that a state is federal "if two levels of government rule the same territory" (1964:11), the formation of a federation generally involves a more significant abrogation of sovereignty than does the formation of an alliance. We can appreciate that federations admit the principle of secession (e.g., the USSR, the Arab League), whereas members of some alliances have been punished for attempting to secede (Hungary and Czechoslovakia from the Warsaw Pact). Nevertheless, unlike an alliance, the formation of a federation is generally associated with the creation of a central government with a constitutional grant of supremacy and the authority to coerce subunits to its will through the use of military force if necessary.
2. The policy domain of a federation is greater than that of an alliance. An alliance, although it might offer significant economic benefits to its members, is traditionally conceptualized (and as distinct from "regimes") and concerning military matters primarily, and, commonly, a specific shared threat. The issues relevant to a federation, in contrast, encompass the full range of military-economic-political matters.
3. Citizens, at least in democratic federations, have a "say" in the politics of all federal subjects via national elections or via a national legislature whose laws have supremacy over federal subject law. In an alliance, the domain of democratic governance is restricted to the political subunits that constitute the alliance.

Because forming a federation is more costly to the political units involved in terms of the loss of sovereignty, it must be that they produce something of value over an alliance. That something, we believe, can be described thus:

- A. The loss of sovereignty is essential to achieve the offensive or defensive benefits of the federation. Specifically, were the federation an alliance - were the federation to be a coalition enforced solely by the self-interest of its constituent parts without regard to the coercive authority of a central government ~ then that alliance would be unstable.
- B. For each state in the federation, the gains from federation are "sufficiently great" relative to the alternatives. Specifically, if there are stable alliance partitions that might serve as an alternative to the federation, then those partitions must be less profitable than the federation for all federation members. And if there is no

stable alliance partition, then the federation must be more profitable for all members than some "reasonable" lottery over the set of feasible alliance partitions.

Admittedly, items A and B are inferences we draw not from any formal theory or comprehensive survey of federations, but rather from our general intuitive understanding of how and why federations form. For example, under the Articles of Confederation, the U.S. was largely an alliance -- at least to the extent that the central government had no authority, barring a unanimous vote in the Congress -- to tax, raise an army, regulate interstate commerce, or do much of anything else. That the alliance was deemed unstable is clear. Washington and others expressed the fear, for instance, that the Mississippi territories, especially Kentucky, might ally with Spain and that the Northeastern states would choose to "go it alone" or seek reconciliation with England. And as Hamilton expressed his concern, "Considering our distance from Europe, it would be more natural for these confederacies [regions of the U.S. Confederation] to apprehend danger from one another than from distant nations, and therefore that each of them should be more desirous to guard against the others by the aid of foreign alliances, than to guard against foreign dangers by alliances between themselves" (Alexander Hamilton, *Federalist Papers*, no. 6). Thus, there was a general concern that unless strengthened, the U.S. "alliance" was inherently unstable and required uncommon measures to ensure its viability.

To convert these ideas into something we can use in the context of our analysis, we offer the following definition:

Definition: The partition P is a federation partition and $F \in P$ a *potential federation* if P is an unstable alliance partition, and if

1. for any stable alliance partition, P' , P dominates P' in the sense that $u_i(P) > u_i(P')$ for all countries $i \in F$; or
2. if there is no stable alliance partition, then P is preferred by all countries in F to the uniquely stable outcome implied by Result 1 and Remark 1.2.

We call F a *potential federation* for three reasons. First, there may exist more than one partition that satisfies the preceding definition and thus more than one coalition that might try to form as a federation. Indeed, as we show later in Example 6, this is generally true whenever there are no stable alliance partitions, since then every state must "overspend" in order to ensure its continued existence. Second, insofar as there is a loss of sovereignty, we must still contend with the fact that forming a federation is costly to the political elites in each confederating unit. The analysis of this cost lies outside the scope of this essay, and thus we cannot say whether the gains of federation exceed this cost and thus, even if unique, we cannot say whether a potential federation will in fact form (for progress on this question see Altfeld 1984, Lalman and Newman 1991, and Morrow 1991, 1993). Finally, since F is, by

definition, an unstable alliance, its realizability depends on the feasibility of constructing a central government that can maintain a belief among its constituent units that it can and will sanction defectors (d'Encausse 1993), on the relative magnitude of the economies of scale that derive from the federation and the creation of a common market within it, and on the skill with which federation members create institutions that render the federation's maintenance in the self-interest of political elites. Because the analysis of these things also lies outside the scope of our analysis, we can only speak of potential federations.

With the understanding that we cannot model here the costs associated with a loss of sovereignty, we can nevertheless extend Riker's analysis of federalism to state a necessary and sufficient condition for states to pursue establishing the governmental structures of a federation:

States will seek to form a federation in lieu of an alliance if and only if (1) a stable alliance partition does not exist or, if one exists, it is dominated by an unstable partition and (2) if the cost of the loss of sovereignty to each state in the federation is offset by the gains from joining it, relative to what that state secures as its security value.

Suppose now that F is sustainable if it is profitable, and that the costs of the loss of sovereignty are not so great as to render the possibility of forming a federation out of the question. There are now three possibilities with respect to any status quo S :

- there are one or more stable alliance partitions that are undominated by any federation partition;
- there are one or more stable alliance partitions, all of which are dominated by one or more federation partitions;
- there are no stable alliance partitions, but there is at least one federation partition that dominates any "reasonable" lottery over the feasible alliance partitions.

Our central result here is that none of these possibilities can be ruled out. Alliances and federations exist as potential cooperative arrangements under a variety of circumstances, and, as our examples show, it is unlikely that we can classify the circumstances under which one cooperative arrangement prevails rather than another in any simple parsimonious way. We begin by reconsidering Example 3.

Example 3 (continued): Recall that the coalition of the whole (1,2,3) is the uniquely stable alliance partition. Suppose countries 1 and 2 form a federation so to effectively change the status quo to [(200,100),(1,1),(200,100)] in order to eliminate 3. But now Remark 1.1 applies, and the uniquely stable outcome is [(200,200),(1,1),(2(X),0)] - country 3, preferring to survive, converts all of its resources to

military capability. Thus, 1 and 2 gain nothing by federating, and since the same argument holds for $\{1,3\}$ and $\{2,3\}$, we see that in this example the only viable alliance is $\{1,2,3\}$, which is to say that the system is equivalent to a collective security arrangement in which no one threatens anyone else.

This example, though, raises the question as to whether there are circumstances in which smaller alliances might form without the possibility of a federation. To that end, consider Example 5.

Example 5: Suppose $S = [(100,150,150),(2,1,1),(100,50,50)]$. As with the preceding example there are three cases.

Case 1: Consider the alliance partition $\{1,2,3\}$, and suppose $\{1,3\}$ defects to eliminate 2. Then if $[(100,-,150),(2,-,1),(130,-,70)]$ illustrates how 1 and 3 divide 2's economic resources, the eventual equilibrium is $S' = [(110,-,165), (2,-,1), (130,-,55)]$. Since both 1 and 3 prefer S' to S , $\{1,2,3\}$ is unstable.

Case 2: If $\{1,3\}$ forms initially, then 2 must protect itself by converting all of its economic resources to military capability, so as to yield $[(100,200,150),(2,1,1),(100,0,50)]$. But now if 1 and 2 ally to eliminate 3 and divide 3's resources so as to yield $[(100,200,-),(2,1,-),(130,20,-)]$, then the eventual equilibrium is $S' = [(110,200,-),(2,1,-),(130,20,-)]$, which 1 and 2 prefer to the initial outcome. Hence $\{1,3\}$ is unstable (as is $\{1,2\}$).

Case 3: If $\{2,3\}$ forms, then initial adjustments yield $S' = f(167,150,150),(2,1,1),(33,50,50)$. Now suppose that 3 defects to form $\{1,3\}$ and to eliminate 2. If 1 and 3 distribute 2's resources so as to generate the initial outcome $[(167,-,150),(2,-,1),(58,-,75)]$, then the final outcomes after adjustments by 1 and 3 so that neither can threaten the other is $[(167,-,196),(2,-,1),(58,-,29)]$, which 3 likes less than what it gets from $(2,3)$. Since this fact holds regardless of how 1 and 3 divide 2's economic resources (or how 1 and 2 divide 3's), $\{2,3\}$ is a stable alliance.

The importance of this example is seen by noticing that the $\{2,3\}$ alliance gives 2 and 3 what they would get from any 2-country federation. If such a federation or any other forms, the excluded country must set its economic resources to zero so as not to be eliminated. Thus, no 2-person federation can expropriate resources from the excluded country, in which case neither 2 nor 3 has any incentive to abrogate its sovereignty.

Examples 3 and 5, then, establish that federations need not appear even if there are no costs to federation. Now reconsider example 4.

Example 4 (continued): Earlier we concluded for this example that the uniquely stable alliance partition is $P' = (\{2,3\}, \{1\})$, in which case the payoff vector $e = (83,75,25)$ prevails. But if, say, the coalition $\{1,2\}$ forms and is exogenously maintained, then both 1 and 2 are better off. With P' they get 83 and 75

respectively, whereas with a coalition $\{1,2\}$ that cannot be disrupted, they sustain the status quo payoffs of 150 and 100 respectively. Hence $\{1,2\}$ is a federation, as is $\{1,3\}$ for the same reasons. Thus, rather than predict the formation of the stable alliance $\{2,3\}$, if the difference in payoffs between forming an alliance and forming a federation is great enough for countries 1 and 2 or 1 and 3, then either 1 and 2 or 1 and 3 will form a federation.

Thus, Example 4 illustrates a circumstance in which a federation partition holds an advantage over even a stable alliance partition. For the final possibility with respect to illustrating the circumstances under which a federation might form, consider Example 6.

Example 6: Let $S = [(100,150,150),(2,1,1),(50,50,50)]$. Then there are three cases. *Case 1:* If the alliance partition $\{1,2,3\}$ is stable, then $S' = S = [(100,150,150),(2,1,1),(50,50,50)]$ prevails. But if $\{1,3\}$ defect to eliminate 2, they can divide 2's resources to produce $[(100,-,150),(2,-,1),(80,-,70)]$. At this point, 1 and 3 would adjust to reach $S'' = [(110,-,165),(2,-,1),(70,-,55)]$. But S'' is stable and strictly preferred by 1 and 3 to S . Hence, $\{1,2,3\}$ is not stable.

Case 2: With the alliance partition $(\{1,3\},\{2\})$ -- or equivalently, $(\{1,2\},\{3\})$ - the countries adjust to $S' = [(100,200,150),(2,1,1),(50,0,50)]$. But now if 1 defects to form $\{1,2\}$ and eliminate 3, we get $[(100,200,-),(2,1,-),(80,20,-)]$, at which point, the countries adjust to the stable outcome $S'' = [(110,200,-),(2,1,-),(70,20,-)]$, which is strictly preferred S' . So $(\{1,3\},\{2\})$ -- and $(\{1,2\},\{3\})$ - is unstable.

Case 3: With the alliance partition $(\{1\},\{2,3\})$, the countries adjust to $S' = [(150,150,150),(2,1,1),(0,50,50)]$. But if 3 defects to produce $\{1,3\}$ and eliminate 2, then the intermediate outcome $[(150,-,150),(2,-,1),(20,-,80)]$ results, at which point the countries adjust to $S'' = [(150,-,170),(2,-,1),(20,-,60)]$, which 1 and 3 unanimously prefer to S' . So $(\{1\},\{2,3\})$ is unstable.

Thus, all alliance partitions are unstable, and, in fact, if countries 2 and 3 proceed under a different assumption, one or the other will be eliminated. In this instance, each state should proceed in accordance with our analysis of myopic play (Section 2), in which case the uniquely stable outcome corresponding to the one identified by Result 1 and Remark 1.2 is $[(150,200,200),(2,1,1),(0,0,0)]$. Thus, any federation of two countries is profitable.

Although it is not part of our formal analysis, countries 2 and 3 are in a somewhat different position than 1; namely, if they ally but one of them defects, the other is eliminated. Perhaps more than any of our preceding examples, then, this last one corresponds best to what Riker (1964) has in mind in his analysis of federalism. Here if state 2 and 3 choose to ally, they must do so in the strengthened way implied by the definition of a federation since only in this way can alliance preclude elimination.

5. Conclusions

The instabilities associated with breakdowns of balances of power generally concern armed conflict among sovereign states or losses of sovereignty by one state to the benefit of some other state. Conversely, the processes of stable systems in which a balance is interpreted as operating effectively, are more gradual and "evolutionary ... [whereby] continual adjustments are made to accommodate the shifting interests and power relations of groups of states" (Gilpin 1981:45). One part of this adjustment process is the formation of alliances that, for instance, seek to "maintain a continuous conviction in every state that if it attempted aggression, it would encounter an invincible combination of the others" (Wright 1942:254). Both processes — the absorption of one state by another and the formation of an alliance - entail the loss of sovereignty (if alliances have any value as a deterrent, then participants must believe that they entail an abrogation of some degree of sovereignty, usually the right to decide fully whether or not to commit to the defense of an ally), so it is possible to argue that such events differ only by degree.

There is, however, another feature of international politics that entails something other than armed conflict and the absorption of one state by another but that involves a loss of sovereignty to a degree greater than that implied by alliance formation — the confederation of several states so as to form a new state. We have in mind those confederations that emerge not because one state emerges victorious over others through military conquest (e.g., the unification of Greek city-states under Phillip II, of China's warring states under Ch'in in 221 B.C., or the development of the Soviet Empire beginning in Tsarist times), but rather those confederations in which two or more states abrogate their sovereignty in favor of a new entity in a seemingly more peaceful and consensual way, as occurred in 1787 with the U.S. Constitution, in 1871 with Bismarck's ascendancy in Germany, and perhaps even today with the incremental unification of Western Europe.

Historians might argue, of course, that there is only a fine line between Ch'in and Bismarck or even whether particular confederations differs sharply from the closely formed alliance between Germany and Austria immediately preceding World War I. However, China's unification was a wholly endogenous event in the sense that the Warring States Period ended with victorious military conquests under terms dictated by a single state, and the Austro-German alliance allowed both Austria and Germany considerable latitude in their foreign policies. In contrast, those unifications that Germany and America illustrate were more voluntary in nature, driven largely by common fears of civil unrest and the exogenous threats of other states (Riker 1964), and in which the authority to conduct foreign policy was ceded to newly created central authorities. Realists, in discussing international instability and systems "out of balance," have few qualms about discussing China's unification, and certainly the Austro-German alliance is viewed as driven by balance of power considerations, but aside from occasional discussions (Wolfers 1964), the unification of Germany or the formation of the American republic are rarely treated as examples of breakdowns in balance of power politics or as examples of the stabilizing processes of such politics.

We find this treatment of confederation curious since, in a loose way, we can treat federations as an intermediate point on a scale defined at one extreme by one state's involuntary absorption of others and defined at the other end by alliances and coalitions designed to take advantage or defend against those excluded from them. Of course, any

attempt to conceptualize macro-political processes unidimensionally entails a great many ambiguities. Nevertheless, we should always be alert to the possibility of establishing a parsimonious and general theory. Hence, we have tried in this essay to examine whether the theoretical tools we use to model alliance formation in a balance of power context can be applied equally well to the analysis of federations and whether the forces dictating the formation of one alliance as against another can account for the formation of federations as well. Given the assumption that a federation corresponds, in its membership, to an unstable alliance that must compete against alliances that are stable but less profitable for its members, we believe that we have largely succeeded in this objective.

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Appendix 1

Proof, Result 1: Given the military capability distribution of the other countries, $m_{-i} = (m_1, m_2, \dots, m_{i-1}, m_{i+1}, \dots, m_n)$, first, if country i 's initial military and economic endowment is less than the aggregate of the other countries' military capability,

$$(m_i + e_i)d_i \leq \sum_{j \in S-(i)} m_j,$$

then i needs to convert all its economic resources to military to ensure that other countries will not have incentives to attack i . Second, if

$$(m_i + e_i)d_i > \sum_{j \in S-(i)} m_j,$$

then $S-(i)$ will not have incentives to attack i if $m_i d_i - \sum_{j \in S-(i)} m_j = e_i$ because i 's military capability is sufficiently large such that $S-(i)$ has to convert more of their economic resources to military to overcome i than what they can expect to gain. Finally, if

$$m_i d_i - \sum_{j \in S-(i)} m_j = e_i \geq \sum_{j \in S-(i)} e_j,$$

then i can reduce its military investment to the level such that

$$m_i d_i - \sum_{j \in S-(i)} m_j = \sum_{j \in S-(i)} e_j$$

because $S-(i)$ only has $\sum_{j \in S-(i)} e_j$ to invest in military to overtake i .

We also need to show that no subset of the countries, say C , has an incentive to attack $S-C$. For a coalition C to gain by spending some of its economic resources on military to defeat $S-C$, it requires that

$$\sum_{j \in C} m_j + \alpha \sum_{j \in C} c_j > \sum_{i \in S-C} m_i d_i$$

and

$$\alpha \sum_{j \in C} c_j < \sum_{i \in S-C} c_i,$$

$0 < \alpha \leq 1$. But since for any i that $e_i > 0$, either

$$m_i d_i - \sum_{j \in S-(i)} m_j = e_i,$$

or

$$m_i d_i - \sum_{j \in S-(i)} m_j = \sum_{j \in S-(i)} e_j \text{ if } e_i \geq \sum_{j \in S-(i)} e_j.$$

This implies that

$$\sum_{i \in S-C} m_i d_i \geq \sum_{i \in S-C} (\sum_{j \in S-(i)} m_j + \sum_{j \in S-(i)} e_j) > \sum_{j \in C} m_j + \alpha \sum_{j \in C} c_j,$$

which shows that it is impossible for a coalition C to gain by converting its economic resources on military to defeat $S-C$.

If a country's investment does not satisfy the condition specified in Result 1, then the system is not stable because either country i will be eliminated or i can reduce its military expenditure to a lower level.

Proof, Remark 1.1: Since $d_1 = d_2 = 1$, if $e_1, e_2 > 0$, then if $m_1 \neq m_2$, the stronger country can acquire the other country's economic resources by defeating it; if $m_1 = m_2$, one of the countries can convert some of its economic resources to military capability and defeat the other.

Proof, Remark 1.2: We can compute the stable outcome using the following algorithm: With respect to the status quo, let all countries that satisfy the first expression in Result 1 set their economic resources to zero. The second equation requiring that

$$m_i d_i - \sum_{j \in S-\{i\}} m_j = e_i$$

now defines a system of simultaneous equations that may or may not have a solution (where a solution requires that all military and economic capabilities be non-negative, and that no state's economic capability exceed its status quo endowment). Suppose it does not solve. Then it must be the case that some additional countries must set their economic resources to zero, owing to those countries that have "spent" their initial economic endowment. After doing so, resolve the set of "second" equations for the countries that remain. Continue with this process, which must eventually solve or have all countries spend all their economic resources. If it does solve, then it must be a unique solution since the equations are linear.

Proof, Remark 1.3: Suppose the contrary is true, $e_i > 0$ for some $i \in S$. Now if

$$\sum_{j \neq i} m_j < m_i' + e_i' - e_i,$$

by assumption,

$$m_i' + e_i' \leq \sum_{j \neq i} m_j' + e_j',$$

then countries in $S-\{i\}$ are not investing enough in military. They should at least invest to level such that

$$\sum_{j \neq i} m_j = m_i' + e_i' - e_i,$$

otherwise they would be defeated by i . But then $S-\{i\}$ can defeat $\{i\}$ by converting some economic resources to military capability. Thus, to prevent from being eliminated, i has to convert all its economic resources to military.

Finally, if

$$\sum_{j \neq i} m_j > m_i' + e_i' - e_i,$$

then i has to convert more economic resources to military capability to ensure its survival. This shows that if $e_i > 0$ for some i , then e_i will eventually be driven down to zero by $S-\{i\}$.

Proof, Remark 1.4: In a stable two-country system, first, if $m_1 d_1 - m_2 = e_1$ and $e_1 < e_2$, then an increase in 1's defensive advantage from d_1 to d_1' will allow 1 to invest less in military and retain more economic resources because in the new system 1 can secure its survival if $m_1' d_1' - m_2 = e_1'$. Country 1's readjustment in turn might allow country 2 to cut back its military expenses due to a less external threat. Second, if $m_1 d_1 - m_2 = e_2$ and $e_1 \geq e_2$, then the same reasoning shows that at least country 1 can spend less on military. Finally, if $(m_1 + e_1) d_1 \leq m_2$, then an increase in 1's defense advantage will give 1 the opportunity to retain some of its economic resources if d_1' is large enough so $(m_1 + e_1) d_1' > m_2$.

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