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Property Distribution and Configurations of Sovereign States
A Rational Economic Model

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ABSTRACT

A nation's wealth is both an object of conquest to covetous aggressors and a resource to its owners for self defense. To maintain autonomy every country must mount a defense which either makes its capture (1) more expensive than any aggressor can afford, or (2) more expensive than it is worth to aggressors. Whether this condition can be satisfied for all countries simultaneously depends as shown in this paper on relative efficacy of military offense versus defense, the aggregate of wealth among nations and its distribution, and the benefits a conqueror may obtain from conquest, including the duration of these benefits. The paper shows how these factors fit together to determine the sustainability and stability of the international distribution of property as embodied in the configuration of sovereign states.

Property Distributions and the Configuration of Sovereign States:

Why at any given time are there a particular number of sovereign countries? At the moment, we have about 200, the number having increased fairly rapidly since the end of the Cold War and resurrection of boundary issues virtually throughout the globe. On average over this period countries have grown much richer, which means they present more lucrative objects of conquest than earlier. But simultaneously they have become more capable guardians of their own integrity. Also the dispersion of wealth among countries has increased.

How do these factors influence the processes whereby states merge or fragment and therefore ultimately their numbers? This question of the economics of state formation has evoked a growing literature, not always necessarily couched in the language of (inter)national merger and fragmentation, not even always concerned with conflict, appropriation, and wealth or prosperity although this is the most common context.[1]

An early and especially trenchant approach was suggested by economist Earl Thompson (1974, 1979). In the first of his papers Thompson proposed:

> [When] the distribution of capital between countries is an equilibrium distribution...each... has rationally decided...which property to claim and defend...and...the decisions are mutually consistent given the world's aggregate stocks of capital... In equilibrium, the country possessing a unit of capital in a given period is the country that has made a prior commitment to impose on any other country attempting to acquire the capital, damages which are at least as great as the value of the capital to that [aggressor] country. [*Journal of Political Economy*, 1974,

[1] (Examples include Alesina and Spolaore (1997, 2000a, 2000b), Alesina, Spolaore, and Wacziarg 2000), Friedman (1977), Garfinkel (1990), Garfinkel and Skaperdas (2000), Grossman (1998) Grossman and Mendoza (2001), Hirshleifer (1988, 2000), Konrad and Skaperdas (2001), Neary (1997), Sandler (2000), Skaperdas (1992), Wittman (1991, 2000), and many others. Some of this work just takes states as local public good jurisdictions and asks the optimal number, public good provision, and population composition. Other work ignores public good effects altogether and takes trade vs size as the sources of private economic benefit. Some combines this with scale economies in military power and/or conflict success functions originated in the rent seeking literature to examine the incentives to produce versus fight over distribution. Production technology, political transaction costs, and military coercion technology, are prominent in some explanations while the geography of state borders, and the administrative costs of tax collection are determinative factors in others. Still other variations include the style of governance, whether democratic or autocratic as influential.

p. 758].[2]

This paper builds a simple comparative static model to capture Thompson's idea (further elaborated in the second of his two articles) and illuminate how equilibrium depends on the aggregate magnitude and distribution of property. In doing this we uncover an important part of the puzzle missing from Thompson. Specifically we identify two primitive economic mechanisms which produce such security/equilibrium in the distribution of property under international anarchy. I call these: "Security by Denial of Benefits from Conquest" and "Security by Making Conquest Unaffordable." They relate closely to military concerns about an enemy's intentions vs. capabilities, and to strategic concepts of deterrence and defense (McGuire 1967), (Snyder 1961), (Schelling 1960, 1967), (Wohlstetter 1959). This exposition, which I hope will capture a unifying thread through the literature mentioned, reflects a rational conflict approach to the sources of equilibrium in the international system. Irrational-extortionist and chicken-type commitment games as sources balance are left unexplored.

INCENTIVES FOR PROPERTY REALIGNMENTS

Alloyed in Thompson's analysis and most others mentioned above are three material factors crucial to one nation's gain from merger or separation from another.

1. *Strategic Advantage/Survival effects of merger or separation*: When does merger/conquest improve countries' military capabilities, offensive or defensive? Because of economies of scale and scope in defense or offense both countries in a merger may gain *strategically*.[3] There may simply be technical military advantages from merging as where interior borders need not be defended (Sandler, 1977; Sandler and Hartley, 2001). Or the advantages may be more conventionally economic, as where costs

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[2] In the second article Thompson repeated. "Each 'nation' or given subgroup of individuals, must defend its assets in order to own them ... For any distribution of property between nations, there is a set of minimal national defense efforts required to prevent one nation from taking the property of another... When property is distributed so that rationally chosen defense efforts reach these levels, there is an equilibrium distribution of property across the various nations." [*Journal of Political Economy*, 1979 pp. 2-3.].

[3] The benefits labeled "strategic" are in truth economic benefits as well. The term "strategic" is simply meant to distinguish benefits and costs connected with interactions between military forces which have traditionally been the purview of political and military strategists. Due to Tullock (1974) and Hirshleifer (1991), economists have come to call the mathematical formulae that express these reciprocal relations "conflict success functions."

of defense are fixed, independent of size of population or wealth.

This first incentive derives from the reciprocal relation between economic size/strength and national power and survival. It depends crucially on how technology, geography, and scale influence the relative power of attack vs. defense. (Hirshleifer 1988, 1989), (Levy, 1984), Read (1964), (Skaperdas, 1992, 1996).

2. *Production, Investment, Consumption effects of merger of states:* When do countries gain commercially from a merger? Because of mutual gains in production or consumption stemming from economies of scope, of scale, or transaction costs (in provision of private goods and especially of public goods) some or all countries may benefit from aggregation. Merger may permit greater specialization of labor, investment and trade, and thus greater output or better allocation of risk than even that afforded by perfect free trade. (The related, inverse, question of when countries benefit from division will not be explicitly addressed.)

This second factor implies that increased production/consumption opportunities can lead nations to a recognition of the higher opportunity costs of conflict and, therefore, to replacement of border/sovereignty battles by competition and cooperation in production-investment-trade, (Anderton 1992, 2000a,b), (Garfinkel and Skaperdas, 2000), (Genicot and Skaperdas, 2002) (McGuire 1990), (Polachek 1980), (Seiglie 2001), and (Skaperdas and Syropolous, 2002). Thus some of the costs of aggression may show up not merely as resource costs of military action, but also as opportunity costs of trade or other amicable interactions among states which war/conquest precludes.

3. *Property Right and Wealth Distribution effects of merger or separation*: When does one country gain from conquest and exploitation of another? As we argue, because of a surplus of wealth over subsistence needs, a country may gain a *redistributive transfer* of this surplus by means of conquest-theft.

This last factor elevates the modern concern for the allocative and distributive implications of property right assignment to an international level. The idea is central to Thompson. See also Anderton (1999), Findlay (1996), Hirshleifer (1988,1991), Grossman (1998), and Tullock (1974, 1980).

These three effects may be interdependent or nested. For example, the strategic gains from merger may arise because of the economic gains (e.g. if it is the economic enrichment caused by merger that makes some sorts of military capability affordable). Or the possibilities for enrichment from redistributive conquest may only derive from economic efficiencies due to greater scale of the merged states.

This paper will combine these three effects in a simple comparative static analysis (see Garfinkel 1990 for dynamic analysis going beyond Thompson's) to show how benefit and cost calculations support a country's independence, or failing that, its conquest or capitulation. Such benefit-cost calculations in turn provide the foundation for equilibria in the numbers, sizes, and compositions of countries. Our benefit cost account of nation state structure takes individual states or governments as monolithic decision units, and abstracts from all singularities stemming from geography and history. The model contains no elements of mass action or mob psychology to explain political upheavals. The equilibria we seek to describe will be limited to equilibria arising from pairwise competition or challenge among states; alliances or other forms of coalitions whether for defensive purposes of survival or acquisitive purposes of conquest will be only briefly considered later in this paper.[4]

I am aware of the limits, pitfalls, dead ends, and possible false leads of a static approach to such a grand problem. Costs, benefits, plans and decisions to attack, resist, submit etc. may be spread out over many years, subject to postponement, revision, modification, and reversal. Clever and successful strategies may hinge on such dynamic effects and exploit them. Rather than the discreet, zero-one model presented here, decisions by states may be smooth and optimal especially when risk/prospect can be smoothly varied. Reasonable choice may be conditioned by asymmetric information, credibility, and past established reputation; nor are all choices always "reasonable." Despite these many caveats and shortcomings, the model developed here has the compensating advantage of simplicity. We cannot incorporate all these realistic effects with the many branches leading off of each; equally we cannot plausibly argue for still further simplification beyond this model. With a noteworthy parsimony of assumptions we identify important sources of stability and instability in the distribution of property among states, and of equal import the sources of such outcomes.

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[4] Todd Sandler reminds me of the potential for and desirability of incorporating three-plus country contests and, therefore, alliances and clubs in the bare bones model presented herein. As the results derived later show, such analysis will yield such surprises as alliance formations among smaller states which generate instabilities in a larger arena.

DEFENSE ALLOCATION REQUIRED TO PRESERVE INDEPENDENCE

To define the crucial concept of the required allocation to defense which a nation might need to secure its property, wealth, boundaries, and sovereignty we focus first on only one victim-nation in a world of (potentially) infinitely wealthy other nation-predators. The context is single period and comparative static. Therefore, consider an initial distribution of property between two nations. This distribution will persist if each nation's benefit-cost analysis of the gains from conquest and the costs of national survival sustain that distribution. We call such enduring distributions, "equilibria," noting that there may be many such enduring equilibria distributions. Equilibrium thus is assumed to depend on

- the initial total and distribution or wealth among nations.
- the cost, technology, and resources available for conquest or defense, including ability to borrow resources from others (although our treatment of borrowing will be quite limited).
- the survival needs of both conquered and dominant societies.
- the destructiveness of war, the resistance of subjugated societies to exploitation, and efficiency of rulers in extracting tribute from their colonies as measured by necessary allocations to ongoing subjugation (although we take only a few steps toward including the destructiveness of war).

Initially we ignore possibilities for international borrowing and explicit analysis of the destructiveness of war itself, to be introduced later in our graphical analysis. We will not concern ourselves explicitly with the population per se of victim nor conqueror, instead only with aggregate wealth, consumption, survival needs, etc. of societies.[5]

[5] Later, we will briefly recognize how the destructiveness of war itself may influence these calculations, and how a country's ability to borrow to defend itself or to conquer others can influence these outcomes.

Table I: Notation:

t	Time/date index; $t = 0$ represents the present when conquest occurs or independence is maintained; $t = 1 \ldots 4$, are future years when benefits from conquest or continued independence are enjoyed.
V	Index for potential victim nation at risk of being conquered by an attacker "A."
A	Index for potential attacker or predator nation, potential conqueror of "V."
R_V	Country V's current period ($t = 0$) resources; R_V is assumed to be constant throughout $t = 0 \ldots 4$. This assumption is simpler than Thompson's which involves savings decisions over many time periods, and thus an endogenously growing R_V.
R_A	Current period resources for A.
S_V	Country V's current period ($t = 0$) population subsistence needs, S_V, also assumed to be constant throughout $t = 0 \ldots 4$.
S_A	A's population subsistence.
$U_V = R_V - S_V$	Country V's surplus over survival needs. This surplus is available for military (offensive or defensive) allocations, or for ongoing resistance against occupation/subjugation, or for tribute to conquerors, or for consumption enjoyment. The comparable concept or variable in Thompson's analysis is called the "coveted capital stock." The same idea and notation will apply to A with subscripts changed.
$U_A = R_A - S_A$	Country A's surplus over survival needs.
$B_A[R_V - S_V]$	*Present value* as valued by A, the potential conqueror, of country V's net resources beginning from next period $t = 1 \ldots 4$, net of V's survival needs, and net of A's ongoing costs of colonization/exploitation. This might be the same for all potential conquerors or different among them. The function B_A may also incorporate economic production advantages of merger between the two countries as well as the redistributive/ transfer benefits to A; but the emphasis here is on redistribution. This future surplus presumably excludes M_V since once conquered, country V's military forces are disbanded. Because B_A includes *all future flows* of conquered surplus --- properly discounted --- the graph of B_A versus U_V will lie above the 45^O only provided the discount rate is less than 100%. Effects of increases in discount rate will be to lower this graph but never below 45^O.
M_V	Country V's military expenditure, assumed to serve simultaneously as defense against attack, and as offensive expenditure potentially of use for conquering other nations. Military outlays are thus assumed to have a dual use, "public good," characteristics of providing defensive and offensive capabilities simultaneously. (McGuire 1965 pp. 141-2).Our initial assumption is that M_V must be paid out of current surplus.

M_A	Country A's military expenditure, which must also be paid for from current surplus. The same caveats apply here as for M_V. A more dynamic multi-temporal treatment of savings and investment would allow that some or all of M_V or M_A to be stockpiled from past savings, or enhanced by borrowing, but this is modeled only later.
$C_A = H_V^A(M_V)$	Necessary military expenditure by attacking/predator country required to conquer V; this is the same as the amount of military expenditure by A required to make V capitulate. Thus, C_A embodies the comparative effectiveness of attack versus defense. Conquest, if it happens, will occur during the current period. As mentioned above, included in this cost may be a portion of the opportunity loss of foregone trade and other friendly interactions which a conquering state may have to give up if it pursues conquest. Anderton (2000) Successful conquest of V by A brings A the present value gross benefit of $B_A = B_A[R_V - S_V] = B_A[U_V]$. If conquest involves future ongoing costs (which seems likely) we include those as a negative implicit factor in the benefit function $B_A[C]$.
$G_A = B_A[U_V] - C_A$	Net present value gain to A from conquering V. Other than C_A, at this stage we ignore the destructiveness of war itself.

Note however, that the costs of war or costs of conquest as given in the table above i.e. $C_A = H_V^A(M_V)$ may not satisfactorily reflect an *opportunity cost* factor of especially great importance for describing how equilibrium configurations change as countries grow richer. No doubt a major cost of conflict can be the opportunity cost caused by economic disruption at home, and loss of gains from specialization, investment, risk spreading and trade with other countries. And the richer the prospective attacker, the greater should be this cost.[6] Thus a more realistic characterization of costs of conquest might well be $C_A = F_V^A(R_A, M_V)$. This could easily imply a correlation between total world wealth and peace; and it could imply that distributions of smaller more numerous states coexist in equilibrium at greater levels of aggregate wealth. Including this feature in the analysis is entirely feasible but doing so now makes it too complicated too soon, and I save this effect for a later exercise.

6 This observation underlay comment before and after WWI and after the Cold War (McGuire, 1990), as well as the large body of literature on the relationships between trade and conflict initiated by Polachek (1980).

BENEFIT COST CALCULUS OF DEFENSE

Now to analyze equilibrium configurations of property aggregate and distribution we assume:

1. Confrontations whether actual wars or demonstrations which lead to capitulation occur in a single period.

2. No international borrowing to finance attack or defense expenses is allowed to begin with, and past saving or stockpiling to build up a stock of military weapons is ignored also. (We briefly explore the effects of both these below). Therefore, one equilibrium condition is that during each period:

$$M_V \# R_V - S_V;$$

and

$$M_A \# R_A - S_A.$$

(As elaborated in footnote 9, We could incorporate past saving and present borrowing in the constraint as $M\#R- S+\varsigma +\$$ where $\$$ stands for borrowing and ς stands for past military stockpiles accumulated at t = 0.)

3. Full information with no uncertainty; therefore it can be rational for a country to spend as much as its entire current resource surplus over survival needs on M, if this allows it to conquer a rich enough country, or deters another from conquest. See also Garfinkel and Skaperdas (2000)[7]. If, to settle disputes short of war, it is possible or necessary to leave some of the surplus "on the table" either for attacker or defender, then M_V or M_A will be less than these amounts, as this effect reduces the maximum extraction from a conquered population as well as a the maximum possible effort (available from current resource flows) to be directed toward conquest.

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[7] This paper demonstrates how it can be rational for all in an international system to spend on arms today more than the expenditure needed to settle today's disputes peacefully. This can happen if settlement by conquest/conflict rather than by negotiation today save a country a future, ongoing, repeated arms drain. The relationships modeled in this paper could be extended to multi-period decision with the consequent issues of intertemporal foresight, consistency, and optimization.

4. Countries rationally compare the costs and benefits of aggressions/conquest. If benefits exceed costs they allocate sufficient resources to M to conquer/colonize; otherwise their military expenditures are restricted to defensive. To repeat, these decisions all occur in period 0. See equation (5) below. This assumption of rational calculation of benefits and costs ignores the entirely reasonable advantages a country may find in promising or committing to irrational action.[8]

5. If country V were conquered its future consumption stream would be forever reduced to its minimal survival needs, S_V. Therefore, V will be willing to devote its entire surplus U_V to defense if necessary to prevent conquest.

6. Country A accurately measures a present value benefit of $B_A[U_V]$ if it conquerors V. The cost to A of conquering V depends on V's defensive effort, but if A can overcome those defenses in the present period, it will enjoy the benefit forever, a durability which is captured in the function B_A. However, A may find that the benefit of conquest is not worth the cost.

7. Moreover, with no current borrowing and no inherited stockpiles, we also assume initially that the resources required by A to successfully conquer V must be available to A out of its current surplus. Similarly, resources required by V to maintain independence must be available from current surplus. (As we later recognize both of these stocks may be augmentable by previous stockpiling or by borrowing)

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[8] The calculus of conquest and survival may be different when sequences of moves and commitments are allowed for the players. If conquest or submission is a gigantic game of international "chicken," then the capacity *credibly* to offer another the choice between annihilation and submission may not be adequately represented by force duel or conflict success function (CSF). The place of CSF's in making symmetric commitments as in Mutual Assured Destruction (MAD) may be a lot more complicated. But CSF's (as in our linear case) are still crucial to outcomes determined by "naively rational extortion," when a not only will power but also a demonstrated capability to conqueror (not requiring actual application of force) may be necessary to evoke capitulation.

In equilibrium country V either will persist as an independent state or it will be absorbed by a conqueror. (If absorption occurs, V may eventually become an integrated equal partner with its conqueror, but that is not our present concern). Once all conquests/absorptions have been effected, an equilibrium will exist in the entire international system since no nation both is capable of and would benefit from conquest of another.

For example suppose that a once conquered a country offers little resistance to exploitation; that is assume that the ongoing costs to the conqueror of maintaining colonialism are low. Suppose in addition that the conquering power is patient, and therefore discounts future benefits rather little. Then quite possibly because a victim country's defense is limited to its surplus over survival needs in any single year while the temptation it offers to conquerors is high, it may not be able to secure its property/independence. This conclusion however will depend crucially on the technology of defense versus offense, measured as the rate at which offensive and defensive expenditures neutralize each other --- as defined by the function $H_V^A(M_V)$. More generally, we desire to explore how this outcome depends on the values of S, R, U, of M and C, and of the functions $B_A(\bullet)$ and $H(\bullet)$, and to construct a set of tools to facilitate such analysis.

TWO CATEGORIES OF AUTONOMY PRESERVING ALLOCATION TO DEFENSE

First we identify the maximum defense effort required to secure property or preserve national independence. There are two distinct possibilities. First is the amount of M_V which makes conquest more expensive than it's worth to the conqueror. Second is the amount of M_V which makes conquest more expensive than the conqueror can afford. (Borrowing and stockpiling will influence the relative importance of these two impediments to conquest.)

The value of M_V which raises the cost of conquest above its benefit to A is defined implicitly by:

$$B_A[R_V - S_V] - H_V^A(M_V) = 0 \qquad : \; H_V^{A\prime} > 0 \tag{1}$$

or

$$M_V = C_A^{-1}[B_A(U_V)] = g[U_V] \qquad : \; g' > 0 \tag{2}$$

where C_A^{-1} represents the inverse function of $H_V^A(M_V)$. We denote this value of as M_{VND} ("ND" for "not desirable").

The value of M_V which raises the cost of conquest above A's resources is defined implicitly by:

$$R_A - S_A - H_V^A(M_V) = 0 \tag{3}$$

or

$$M_V = C_A^{-1}[U_A] = h[U_A] \tag{4}$$

We denote this value of M_V as M_V^{NF} ("NF" for "not feasible").

These two distinct ways in which one country can prevent being conquered by another have differential effects on the nature of equilibrium. Because we assume here that countries cannot borrow internationally to finance defense outlays and have not stockpiled arms in the past, the amounts M_V and M_A cannot exceed the surplus over subsistence available in the respective home country.[9] The rule proposed here for V's equilibrium allocation to "defensive" or independence sustaining military effort is:

$$z_V = \mathrm{Min}\,[g(U_V), h(U_A)] = \mathrm{Min}\,[M_V^{ND}, M_V^{NF}] \tag{5}$$

Because every country is potentially a "victim" country, V stands for every country in the international anarchic system. Then

$$z_V > U_V \quad \mathrm{o} \quad M_V^* = 0: \qquad \text{V loses its independence} \tag{6}$$

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[9] So long as conquest is worth the cost and perfect international financial markets exist, an attacking country may be able to make up its resource shortfall by borrowing today and repaying out of the conquered surplus (if the attacker) in the future. Similarly a defending country should be able to borrow the entire present value of its surplus over survival needs to defend itself against takeover and pay back loans from that surplus in the future. Total borrowings and past savings then would add to offense and defense capabilities.

Adding these factors first alters the resources constraints. We incorporate past saving and present borrowing in the constraint as $M_j \# R_j - S_j + \mathcal{S}_j + \$_j$ and $\$_j \# \$_j(R_j - S_j)$ where $\$_j$ stands for borrowing which is limited by some present value function of future surpluses, $\$_j(R_j - S_j)$ which can be used to repay debts, and $\mathcal{S}$ stands for past military stockpiles accumulated at $t = 0$. These constraints apply to both attacker and defender, $j = (A,V)$.

Next the equilibrium conditions change: now for eqs. (1,2) there is no change for M_V^{ND}, but for M_V^{NF} eq (3) now becomes $\mathcal{S}_A + \$_A + R_A - S_A - H_V^A(M_V) = 0$, with a corresponding adjustment in eq. (4).

With perfect information in international markets, both attacker and defender could not simultaneously borrow these maxima, as the market might anticipate that only one of the loans would be repaid. This effect could be incorporated in the present value borrowing constraints $\$_j(R_j - S_j)$.

$$z_V \# U_V \quad o \quad M_V^* = z_V: \qquad \text{V maintains its independence} \qquad (7)$$

This rule assumes that all countries know all others' military allocations/capabilities and all other aspects of full information. Each country calculates (a) the required defense which is just enough to make conquest more costly than it is worth, and (b) the required defense which is just enough to make the limited resources of any adversary insufficient to win a war of conquest. Every country then allocates the lesser of the above two amounts to defense in order to maintain its independence. Or if it cannot successfully defend itself, it allocates nothing to defense and is absorbed by a conquering state. Again note that eqs. (6) and (7) imply that V will if necessary and efficacious allocate up to its entire surplus over survival needs to defense; this is because if conquered or obliged to capitulate we assume it will have to turn over that entire surplus to the conqueror. Country A, however, might allow V to keep some of this surplus in a negotiated merger. This provides V with a third choice, not analyzed here, between capitulate and fight. (Grossman and Mendoza 2001).

DEFENSE ALLOCATIONS ILLUSTRATED

These rules for allocation to defense are pictured easily as in Figure 1. There the origin of the resource endowment for A and V has been displaced by the amount of survival need, so that each axis represents R - S = U for V and A. This allows us to use the x-axis simultaneously to depict the enticement of V's resources to A as an object of capture, and the security they represent to V as a support for defense. Because A's and V's surpluses can be used for offensive or defensive forces, the x-axis can represent M_V and the y-axis can also represent C_A. Thus, given our simplifying assumptions and absent borrowing or stockpiling, for any value of [R - S], M or C can be less than or equal that value but not exceed it. To further simplify the illustration, both benefits B_A and costs C_A are assumed to be linear functions of $[R_V - S_V]$ and of M_V respectively.[10] (Thus,

[10] It may seem unnatural to assume as the diagram does that the benefits of conquest are independent of M_V, since M_V (or maybe $M_V + M_A$) can be a good proxy for the destructiveness of war itself, and therefore reduce the present value of all future war spoils to the conqueror. This effect can be easily included by adding another quadrant to the diagram to show how the future surplus available to a conqueror ($U_V^{FUTURE} = R_V^{FUTURE} - S_V^{FUTURE}$) may depend on M_V and/or M_A.

the x-axis has a different interpretation regarded as the independent variable which determines benefits B_A versus one which will induce costs C_A.) Increases in costs of colonization or in the discount rate have the obvious implication to shift down the position of and/or reduce the slope of B_A (but not reduce it below 1:1). Also the cost of conquest is assumed to require positive resources from A, even if V posts no defense at all. Accordingly the C_A curve has a positive y-intercept. C_A is drawn to have an average value greater than 1 --- accurate if absolutely technology/cost favors defense. C_A also has a slope greater than 1 reflecting an assumption that defense has an advantage over offense at the margin. If this margin were increasing at greater scales of offense and defense then the slope of curve C_A would increase.

Figure 1

The diagram is to be read as follows. Consider first values of U_V and (absent borrowing or stockpiling) necessarily, therefore, of M_V less than that at the intersection of the B_A-curve with the C_A-curve, that is to the left of that intersection. In this range C_A is above B_A, so if V were to allocate its entire surplus to M_V it could make the cost of conquest to A (C_A) greater than its value (B_A). But V need not allocate its entire surplus to defense. To show V's allocation to defense for any V-surplus, U_V*

$$U_V^* = [R_V^* - S_V^*] \tag{8}$$

read up to B_A to obtain the cost which V must impose on A (this being the amount C_A*) to make conquest uneconomic, i.e. worth less than it costs; a horizontal from that point will intersect curve C_A; from this intersection drop a vertical line to the x-axis to obtain the required level of defense M_V*; this is the requirement for M_V if the attacker's surplus $U_A = [R_A - S_A]$ *equals or exceeds* C_A*; if the attacker's net resources, say U_A^0, are less than C_A^*, then the required M_V is found at the intersection of $U_A^0 = [R_A - S_A]$ with curve C_A and then down to the x-axis.

Now consider values of U_V which exceed the value at which curves B_A and C_A intersect, that is to the right of the intersection; here B_A lies above C_A. Before, to the left that intersection M_V could be less than U_V, but to the right, absent borrowing and stockpiling, because of the constraint M_V cannot exceed U_V.

Therefore, in this range, if for any value of M_V, A's endowment U_A exceeds $C_A(M_V)$ then the defender cannot impose sufficient costs on A to preclude conquest, and A absorbs V. If $U_A < C_A(M_V)$, however A *has inadequate resources* to conquer V. Thus to the right of the intersection and below the curve C_A, A would benefit from conquest of V but cannot afford to win. Arguably in a rational world of perfect foresight, perfect capital markets and unrestricted borrowing, such a configuration might be unsustainable, as it implies an unexploited opportunity for gain. But that jumps to a conclusion possibly to be illustrated or derived later, once savings S and borrowing $ are introduced.

Note that the diagram actually identifies the amount of M_V that V will spend to avoid capitulation to A if capitulation can be avoided, and the C_A curve shows the amount A must spend to induce V to capitulate. On this interpretation, anarchic property distribution results from a success or failure of a sort of "naively rational extortion." Analysis of hot war in which resources are destroyed on both sides is left for a later exercise.[11]

SOME ALTERNATIVE BENEFIT-COST CONFIGURATIONS

We now can analyze how these two conditions imply (for various B and C functions, resources R, and relative effectiveness of attack versus defense functions, H, and ignoring the effects of R_A on C_A) whether a configuration of nation-states is in equilibrium or subject to alteration by forced redistribution, or when a single state is the only outcome. The benefit of this system is that it can be very easily captured and understood with a few simple diagrams.[12] Figures 2a,b,c give several possible configurations of the benefit $B_A[R_V - S_V]$, and cost $C_A = H_V^A(M_V)$ functions for the attacker state. (To save space in Figures 1 and 2 the x-axes and

[11] For more on the distinction between conquest with and without war, see Grossman and Mendoza (2001). Garfinkel and Skaperdas (2000) tell us that hot war requires wither incomplete information or an intertemporal strategy, neither of which are present in this paper.

[12] As pointed out to me by referees, others have presented diagrammatic approaches to the conflict-merger-independence question with some features in common to that given here. These include Powell (1993, 1999) and Blainey (1991).

y-axes are not drawn to equal scale so that 45^{O} shows up as a slope less that 1:1). Considering the entire space (entire quadrant) these functions and their diagrams indicate <u>potential</u> for redistribution by conquest. Concrete possibilities of conquest will depend upon realized values of R_V, R_A, S_V, S_A, etc. and some values of these may never be observed as being out of equilibrium. Still even if one's model of equilibrium configurations of sovereign states depends strongly on ideas about extortion, bribery, or game theoretic chicken to the extent these are influenced by objective factors the potential benefit cost calculation described here is logically prior.

Figures 2a, 2b, 2c

The vertical axis shows U_A , to repeat A's resources R_A net of survival needs S_A; also shown are (1) country A's gross payoff from successful aggression or from "naively rational extortion", that is $B_A[R_V - S_V]$, as well as (2) the maximum (or lesser) cost which V can impose on A, as a necessary price of conquest, assuming V were to allocate up to its entire surplus to defense; this is $C_A = H_V^A(M_V)$. This curve C_A shows that to conquer even a totally defenseless country V, a minimum amount of M_A is required since the curve has a positive y-intercept. Moreover, this curve has a slope greater than 1/1 being steeper than the 45^{O} line. This means that the defense/offense technology pictured favors the defense in the sense that at the margin it requires more than one unit of country A's resources devoted to attack to offset a one unit increase in country V's allocation to defense. Of course the C_A-curve is by no means necessarily linear; an increasingly steep slope would mean that the defense had a greater and increasing marginal advantage at higher levels of military competition.

Figure 2(a,b,c) then shows vertically shaded areas to indicate the combinations of U_A and U_V for which country A <u>is able</u> to conquer country V <u>and will gain</u> from doing so, gain in that its benefits exceed the cost of conquest. Such points, therefore, would never be observed as equilibrium outcomes. The figure also shows horizontally shaded areas where country V can defeat country A's attack, and therefore country V is safe; and lastly the figure shows diagonally shaded areas with resource combinations such that country A could always defeat country V, but country V can make the costs of such aggression exceed the benefits of conquest to country A. Because in Fig 2a the cost of conquest curve C_A rises less rapidly than the benefit curve B_A it illustrates a case in which *as a country gets richer the prize that its capture offers a potential conqueror grows faster and greater than the cost it can impose upon such a conqueror*. Thus after the crossover between C_A and B_A, as shown by the widening wedge between these two functions, for greater U_V country V becomes more and more vulnerable *ceteris paribus*[13] to the possibility of takeover by A. This structure, therefore, implies that a country may have an "incentive to remain poor." This effect of "the benefits of impoverishment" is another among the paradoxes of conflict first noticed by Hirshleifer (1991).[14]

Figure 2b is a modification of 2a which produces a different conclusion as to the resource distributions which are safe from aggression/conquest of V by A. There, for low values Fig 2a and 2b are about the same, but at higher expenditure levels scale economies favor the defense with sufficient strength, such that then a new region of stability emerges where the defense can forestall attackers by making conquest more expensive than it is worth beyond a second crossover point. Accordingly, comparisons of Figures 2a and 2b call attention to possible wealth effects under alternative assumptions as to interaction between wealth and military (offense vs. defense) technologies.

Figure 2c shows still another case, one in which country V is "naturally invulnerable"; with the configuration shown there is no combination of resources for which conquest is both advantageous and feasible for country A. Clearly more complex and elaborate cases can be constructed; for instance, if the subsistence costs within the conquered country change with total resources or change as a result of conquest --- even though population of V remains constant -- then the curve B_A may be displaced downward and changed in shape. This may alter dramatically the regions of safety and of warfare or conquest. Or again if the cost curve were

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13 *Ceteris paribus* ignoring differential effects for example of borrowing or weapons stockpiling.

14 Charles Anderton noticed this implication of the logic presented here, and pointed it out to me.

irregularly shaped then multiple intersections are entirely possible. A strength of this technique of identifying regions of security is that it is robust to an entire menu of such parametric changes or elaborations in the model. (I will take up some such alternatives presently).

Although the incentive structure underlying observed equilibrium configurations of sovereign states may be as pictured, this need not imply that all the combinations pictured would actually ever be observed. For example, depending on the sustainability of configurations in which wealth is coveted but cannot be conquered, some may be non-equilibrium and not observed; or some for configurations near the origin positive allocations to M_A, or to M_V can be unnecessary to sustain independence and, therefore, should not be observed.

EQUILIBRIUM DISTRIBUTIONS OF PROPERTY

This structure can now be used to give a map to relate distribution of wealth or property and the implied stability of the international system. Figure 3 identifies differential regions of mutual non-aggression and of absorption of one state by another. The example of Figure 3 is for a system of two states where both the cost curves C_A^J and the benefit-payoff to conquest curves, B_A^J, (J=1,2) are straight lines. The benefit and cost functions are also assumed to be symmetric.

Figure 3

The diagrams show how, for these particular assumptions, some distributions of resources among states would be stable and others not so. Imagine superimposing the two panels of Figure 3. The diagram would then implies and depict four categories of resource distribution.

C Areas "$_1$ (and "$_2$) show bilateral resource distributions for which country 1 (country 2) cannot and would not want to conquer country 2(1).

C Areas $$_1$ and $$_2$ show bilateral resource allocations for which country 1(2) would be able to conquer country 2(1) but would not want to because the effort-cost exceeds the benefit.

C Areas ($_1$ and ($_2$ show bilateral resource distributions where country 1(2) both can and would want to conquer country 2(1).

C Lastly areas *$_1$ and *$_2$ show resource distributions for which country 1(2) would like to but has insufficient resources to capture country 2(1).

Thus areas " $_1$ and " $_2$ and as well as * $_1$ and * $_2$ represent distributions of wealth such that the potential attacker has *insufficient resources* to effect a successful conquest --- or equivalently such that the victim *does* have sufficient resources to make "conquest" impossible. On the other hand, in the areas $ $_1$ and $ $_2$ a successful "attack"[15] is possible; resources are such that the attacker can overwhelm the defender, but the cost of success would outweigh the benefits.

It follows that all the combinations --- that is the intersections or overlaps of areas --- "$_1$"$_2$, "$_1$*$_2$, "$_2$*$_1$, $$_1$*$_2$, $$_2$*$_1$, and *$_1$*$_2$, all represent stable distribution of property configurations. On the other hand, the overlapping areas *$_1$($_2$, and ($_1$*$_2$ are unstable. In these last two areas country V cannot allocate sufficient resources to its own defense to cause the value which it constitutes for potential conqueror, A, to fall short of the resources required for a successful conquest --- i.e. V cannot make it irrational for A to attack. Nor for these unstable distributions of property or wealth --- that is for *$_1$($_2$, and ($_1$*$_2$ --- can V allocate so much to defense that A is unable successfully to attack. Consequently resource combinations in these unstable regions should lead to mergers by conquest. Here I neglect several interesting variations which would arise if the cost and benefit curves C_A^J and B_A^J, (J=1,2) are not straight lines, or are not symmetric. Left for later exercises are cases in which overlaps arise between areas ($_1$, and ($_2$, where both countries have the incentive and the means to conquer the other.

Distributions of wealth --- according to Figure 3 --- tend to be stable if they are very unequal, for then although large rich countries can conquer small poor ones, *the natural advantage of the defense makes this more costly than it is worth.* These are regions of stability due to insufficient benefits from conquest or "Security by Denial of Benefit." At the same time, roughly equal distributions of resources among states make all invulnerable to conquest because none is physically/financially capable of conquering others even

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15 I put "attack" and "conquest" in quotes because actual hot war is not necessary here, distribution may be resolved by confrontation alone, by bribery or buy-out, where in the endowed configurations, CSF's etc. may simply establish initial bargaining points.

though it would pay to do so if it were affordable. These are regions of stability due to insufficiency of resources,[16] "Security by Making Conquest Unaffordable." These conclusions may change, of course, if the benefit and cost functions are no longer symmetric; and indeed, asymmetry should be the rule for reasons of geography, culture, technical evolution and style and so on, all calling for adjustments in the depiction or realization of the model. To infer at this stage, therefore, that historically raw equality is to be expected in the data would be unjustified.

EFFECTS OF PAST WEAPONS STOCKPILING, CURRENT BORROWING FROM ABROAD AND OF THE DESTRUCTIVENESS OF WAR.

We have taken a complex problem and boiled it down to its essentials, believing that the gains from simplification are worth the insight gained. The diagrams show more than outcomes, or equilibrium values; they give the entire field of incentives which the opportunity for gainful war may reflect. Moreover, as we now shall see they lend themselves very effectively to showing how such important extra features such as ability to stockpile weapons etc. change the incentives.

Stockpiled Weapons

Consider first the possibility that a country has stockpiled weapons in past time periods. With such costs sunk, the prospective costs of war are reduced. We can show that directly as in Figure 4 just by shifting downward the C_A curve. We might assume that the downward shift is a simple summation of past weapons accumulated, or if past weapons are less effective this accumulation might shift the curve down less or warp it in some way. In any case if war is waged with inherited weapons, some of its cost is sunk, and it will seem more attractive. This is exactly what Figures 4a and 4b show, particularly if C_A^1 shifts down and C_A^2 shifts to the left, while curves B_A^1 and B_A^2 are unchanged.

Ed: Figure 4 about here

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16 With more than two countries, this simple classification will be inadequate, since any one country may fall into different categories when compared with several other countries.

C Areas " $_1$ (and " $)_2$ decrease in size/importance. These are areas of bilateral resource distributions for which country 1 (country 2) cannot and would not want to conquer country 2(1).

C Areas \$ $_1$ and \$ $_2$ may increase or decrease in size. These show bilateral resource allocations for which country 1(2) would be able to conquer country 2(1) but would not want to because the effort-cost exceeds the benefit.

C Areas ($_1$ and ($_2$ increase in size. These show bilateral resource distributions where country 1(2) both can and would want to conquer country 2(1).

C Lastly areas * $_1$ and * $_2$ may increase or decrease depending on the slope and position of B_A^1 and B_A^2 . These show resource distributions for which country 1(2) would like to but has insufficient resources to capture country 2(1).

Borrowing for War

Next consider effects of an ability to borrow (assuming no stockpiling for simplicity). First borrowing, *ceteris paribus*, reduces the cost *out of present resources* of overcoming any given sized enemy forces; thus the first effect of borrowing is to lower present cost; C_A^1 shifts down and C_A^2 shifts leftward. This is pictured in Figure 5. But, of course debt must be paid off. This is shown as a downward shift for B_A^1 and a leftward shift for B_A^2. Will the present value of the future debt payoff equal present borrowings? If so then C_A^1 (C_A^2) shifts the same amount as does B_A^1 (B_A^2). If the present value of debt payments exceeds the amount borrowed (which seems probable) then C_A shifts down(left) less than B_A. For illustration suppose that C_A and B_A shift down by the same amounts. Then we summarize their combined effects:

Fig 5

C Areas " $_1$ (and " $_2$) will decrease in size/importance. These are areas of bilateral resource distributions for which country 1 (country 2) cannot and would not want to conquer country 2(1). If the downward shift in B_A^1 is sufficiently greater than that of and C_A^1 then " $_1$ may increase in size.

C Areas $\$_1$ and $\$_2$ increase in size. These show bilateral resource allocations for which country 1(2) would be able to conquer country 2(1) but would not want to because the effort-cost exceeds the benefit.

C Areas $(_1$ and $(_2$ increase in size. These show bilateral resource distributions where country 1(2) both can and would want to conquer country 2(1). Introduction of borrowing increases the proportion of resource distributions for which greed could provide incentives for war and even introduce reciprocal incentives which would not exist without borrowing.

C Lastly areas $*_1$ and $*_2$ may decrease. These show resource distributions for which country 1(2) would like to but has insufficient resources to capture country 2(1).

Opportunity Cost of War

It was pointed out in the context of Table I that an important factor influencing incentives to merge can be the opportunity cost of conflict, going beyond or in addition to the costs of battle. If so, costs could be written $C_A = F^A_V(R_A, M_V)$, or if additive $C_A = F^A_V(M_V) + G_V(^A R_A)$. This difference could be included into the diagrams fairly easily, and the auxiliary relationship showing opportunity cost added with a supplemental diagram. The net outcome of such opportunity cost effect is to raise or rotate the $C_A = F^A_V(M_V)$ cut-off curve of the diagrams progressively for higher values of C_A. (Above the cut-off curve further effects of opportunity cost are irrelevant for rational calculation). The opportunity costs of war might also extend to future periods, both deflating future home surplus, and reducing the surplus value obtainable through battle or extortion. This effect can be built into the present value benefit curves in an analogous fashion, however, and does not present any new issues at this level of generality. The opportunity cost effect, therefore, produces the following changes:

C Areas " $_1$ and " $_2$ decrease in size/importance. These are areas of bilateral resource distribution for which country 1 (2) cannot and would not want to conquer country 2(1).

C Areas $ $_1$ and $ $_2$ may increase or decrease in size. These show bilateral resource allocations for which country 1(2) would be able to conquer country 2(1) but would not want to because the effort-cost exceeds the benefit.

C Areas ($_1$ and ($_2$ increase in size. These show bilateral resource distributions where country 1(2) both can and would want to conquer country 2(1).

C Lastly areas * $_1$ and * $_2$ may increase or decrease. These show resource distributions for which country 1(2) would like to but has insufficient resources to capture country 2(1).

Destructiveness of War

Finally we can modify our diagrams to show the effects of war's destruction. Without addressing the question of why it would be fought if knowledge is perfect, we assume that this destructiveness is simply known in advance and included in each party's calculus. If war is destructive, this increases the cost of conquest *and* the cost of self defense over and above that already pictured *and these tend to offset each other in their influence on the curve* C_A. The destructiveness of war also *reduces the benefit* of winning, and it, therefore, involves some downward (leftward)movement of the benefit curves B_A^1 (B_A^2).

On what does this destructiveness depend? If this cost due to the destructiveness of war were just a fixed amount, then the B_A curves should be moved downward or leftward a fixed amount. Or the destructiveness of war might depend on, say, total military conflict that is on the sum, $M_A + M_V$. Then an algebraic or geometric construction could show B_A^1 would rotate downward. Or suppose the destructiveness of war as perceived from one country depended on that country's wealth, then this effect could be folded into the analysis along the lines of the previous section. Consider then as a first order estimate the effects of a simple downward (leftward) shift in the benefit curve B_A. This cost of war effect, therefore, produces the following changes:

C Areas "$_1$ (and "$_2$) may increase or decrease in size/importance depending on the specifics of B_A and C_A. To repeat, these are areas of bilateral resource distributions for which country 1 (country 2) cannot and would not want to conquer country 2(1).

C Areas $$_1$ and $$_2$ decrease in size. These show bilateral resource allocations for which country 1(2) would be able to conquer country 2(1) but would not want to because the effort-cost exceeds the benefit.

C Areas ($_1$ and ($_2$ decrease in size at least within realistic range of the crossover point between B_A and C_A. These show bilateral resource distributions where country 1(2) both can and would want to conquer country 2(1).

C Lastly areas *$_1$ and *$_2$ decrease. These show resource distributions for which country 1(2) would like to but has insufficient resources to capture country 2(1). These changes in the benefits of conquest generally increase the range over which avoidance of war depends on making it not worth to potential combatants, while the range over which avoidance of war based on insufficient resources decreases.

CONCLUSIONS

This paper builds on the view of a country's wealth as providing an enticement to others to seize it through war or extortion, and simultaneously as a military resource for protecting its owner. Adding a conflict technology of offense versus defense together with systematic evaluation of the benefits of theft then implies how, for some combinations of wealth, rational calculating countries should wage or threaten to wage wars conquest, while for other combinations rational calculation supports peace. Our approach thus distills Thompson's analysis to its barest essentials, to examine how these incentives vary with the shape and location of the pay-off function B_A^J (J=1,2) and with the relative effectiveness of defense versus aggression $C_A = H_V^A(M_V)$. We show that rational calculation may exclude war for two distinct reasons. (a) First for given offense-defense technologies no country may have sufficient resources to defeat and capture another. In this case every country can mount a defense which physically or fiscally precludes its capture. We call this "Security by Making Conquest Unaffordable or Infeasible." (b) But second even though affordable, conquest may be undesirable, in that it costs more than it is worth. Countries may mount sufficient defense to make the costs to a victor exceed the benefits which capture will yield. We call this "Security by Denial of Benefits."

A principal empirical implication of this analysis concerns equilibrium distributions of property. First the model defines a niche for small/poor countries with natural defenses; these are areas $\$_1$ and $\$_2$, and this seems to accord well with historical fact. Second the model implies that equal distributions as exemplified by areas * and (may or may not represent peaceful equilibrium configurations, depending on the specifics of C and B curves, abilities to borrow, and to stockpile for wars, and specifics of surpluses available for theft or conquest. With this approach we can identify some unexpected interdependencies between resource distributions, technologies, and conflict, as well as confirm previously held intuitions. For example this set-up will identify cases in which a given distribution of income among countries tends to be unsustainable because one country is able to and would benefit from conquering another. Sometimes from such unstable distributions stability can be generated by transferring income "peacefully" among existing "competitor" states, without increasing the total (not an unexpected result). On the other hand cases in which the cost curves C_A^J overlap would indicate a state of distribution in which both countries would benefit from conquering the other and are capable of successful conquest. This could require striking asymmetry in the cost curves, or an pronounced comparative advantage for offensive forces, but it could indicate a "pocket of indeterminacy" (terminology suggested by Charles Anderton), where objective incentives to fight (or to capitulate) exist for both of two (or all) rivals. An unsuspected configuration such as this may be more likely be a prelude to negotiated merger.

Again unexpectedly the analysis suggests that (given symmetry in cost and present value benefit functions and linearity as in our diagrams) for more or less equal distributions of wealth countries can put up defenses which an attacker cannot afford to defeat and capture. These are areas $"_1"_2$, $"_1*_2$, $*_1"_2$ and $*_1*_2$ in Figure 3. Under such "equal" distributions, if all countries are "poor", with resources (to the left or below the intersections of C_A and B_A) conquest would not be worth it even if possible so there it is the non desirable constraint which binds. But for higher aggregate of world wealth more or less equally distributed, (north and east of the intersections of C_A and B_A) the unaffordability constraint is binding. The analysis also confirms and illustrates ones intuition that an ability to borrow and/or to stockpile weapons narrows down the set of distributions of world aggregate wealth for which war cannot be afforded. This shows in the diagrams as curves C_A and/or B_A shift downward and to the left narrowing down the areas $"_1"_2$, $"_1*_2$, $*_1"_2$ and $*_1*_2$. One's expectation should be that if any capture or predation is worthwhile in the sense that it is worth more than its cost, then prospective conquerors should be able to find the resources on world markets to conduct their wars and share (via debt repayments) their loot. In terms of Figure 3 borrowing and past weapons accumulation should reduce the relevance of areas $*_1$ and $*_2$, and in particular overlap between them. (Of course abandoning an assumption of symmetry can produce a great range of variation such as where conquest favors one country at low income levels but the other country at higher levels.)

This setup also permits ready analysis of the effects of changes in war fighting technology --- for example changes which favor offense or defense. Similarly the effects of changes in a society's benefit calculus including discount rate and costs of occupation are readily pictured as alterations in the position or shape of the benefit functions B_A^J. Note that both shifts in the C-curves and B-curves re-position the crossover point between B and C, and therefore the regions where security by non-affordability of conquest, versus non-desirability obtain. On the other hand, because the analysis is comparative static, it cannot do full justice to the intertemporal multi-period nature of the phenomenon, nor to questions of dynamic consistency --- disadvantages to be set off against the economy of expression of this approach.

Moreover the analysis is suggestive as to how economic growth --- which moves the wealth distribution point in Figure 3 outward --- may alter the incentives for merger, or precede resource alignments conducive to fragmentation. Similarly, Figure 3 suggests that when extended to groups of three or more countries, a merger or division between two may change radically the incentives relating to a third. Evidently, introducing the possibility that benefit and cost curves --- B_A^J, and C_A^J --- can be convex or concave may produce numerous other regions of stability or instability. Other extensions of the analysis should include better integration of borrowing, inclusion of population (in addition to wealth) as an independent variable in the benefit and cost functions, and a focus on the effects of conquest upon productivity of the conquered country.

REFERENCES

Alesina, A. and Spolaore, E. (1997) On the number and size of nations. *Quarterly Journal of Economics* **112**(1), 27-56.

Alesina, A., and Spolaore, E. (2000) Conflict, defense spending, and the number of nations. Mimeo, Department of Economics, Brown University.

Alesina, A., and Spolaore, E. (2000) War peace, and the size of countries. Mimeo, Department of Economics, Brown University.

Alesina, A., Spolaore, E., and Wacziarg, R. (2000) Economic integration and political disintegration. *The American Economic Review* **90**(5), 1276-96.

Anderton, C. H. (1992) Toward a mathematical theory of offensive/defensive balance. *International Studies Quarterly* **36**(1), 75-100.

Anderton, C. H. (1999) Appropriation possibilities in a simple exchange economy. *Economic Letters* **63**(1), 77-83

Anderton, C. H. (2000a) An insecure economy under ratio and logistic conflict technologies. *The Journal of Conflict Resolution* **44**(8), 23-38.

Anderton, C. H. (2000b) Exchange of goods or exchange of blows? new directions in conflict and exchange. *Defense and Peace Economics* **11**(1), 55-71.

Blainey, G. (1991) *The Causes of War*. New York, NY: The Free Press.

Bolton, P., and Roland, G. (1997) The breakup of nations: a political economy analysis. *Quarterly Journal of Economics* **112**(4), 1057-1090.

Buena de Mesquita, B. (1981) *The War Trap*. New Haven, CT: Yale University Press.

Casella, A. (2002) The role of market size in the formation of jurisdictions. *The Review of Economic Studies*. forthcoming.

Findlay, R. (1996) Towards a model of territorial expansion and the limits of empire. *In The Political Economy of Conflict and Appropriation*, edited by M. Garfinkel and S. Skaperdas. Cambridge, UK: Cambridge University Press, 41-56.

Friedman, D. (1977) The size and shape of nations *The Journal of Political Economy* **85(1)**, 59-77.

Garfinkel, M. (1990) Arming as strategic investment in cooperative equilibrium. *The American Economic Review* **80**(1),50-68.

Garfinkel, M., and Skaperdas, S. (2000) Conflict without misperceptions or incomplete information. In *The Journal of Conflict Resolution* **44**(4), edited by T. Sandler. 793-807.

Genicot, G., and Skaperdas, S. (2002) Investing in conflict management. *The Journal of Conflict Resolution*, forthcoming.

Grossman, H. (1998) Producers and predators. *Pacific Economic Review* **3**, 169-87.

Grossman, H., and Mendoza, J. (2001) Annexation or conquest? The economics of empire building. Working Paper 8109, National Bureau of Economic Research Cambridge, MA.

Hirshleifer, J. (1988) The analytics of continuing conflict. *Synthese* 76(2), 201-33.

Hirshleifer, J. (1989) Conflict and rent-seeking success functions: Ratio vs difference models of relative success. *Public Choice* **63**(2), 101-12.

Hirshleifer, J. (1991) The Paradox of power. *Economics and Politics* **3**(3), 177-200.

Hirshleifer, J. (2000) The macrotechnology of conflict. In *The Journal of Conflict Resolution* **44**(4), edited by T. Sandler, 773-92.

Konrad, K., and Skaperdas, S. (2001) The market for protection and the origin of the state. Mimeo, Department of Economics, University of California, Irvine.

Levy, J. (1984) The offensive/defensive balance of military technology: a theoretical and historical analysis. *International Studies Quarterly* **28**(2), 219-38.

McGuire, M.C. (1965) *Secrecy and the Arms Race*. Cambridge, MA: Harvard University Press.

McGuire, M.C. (1967) The structure of choice between deterrence and defense. In *Issues in Defense Economics*, edited by R.N. McKean, New York: National Bureau of Economic Research, 129-149.

McGuire, M. C. (1990) The revolution in international security. *Challenge* **9**, 8-18.

Morrow J. (1997) When do "relative gains" impede trade? *The Journal of Conflict Resolution* **41**(1), 12-33.

Neary, H. M. (1997) Equilibrium structure in an economic model of conflict. *Economic Inquiry* **35**(4), 480-94.

Polachek, S. W. (1980) Conflict and trade. *The Journal of Conflict Resolution* **24**(1), 55-78.

Powell, R. (1993) Guns, butter and anarchy. *The American Political Science Review* **87**(1), 115-32.

Powell, R. (1999) *In the Shadow of Power*. Princeton: Princeton University Press.

Read, T. (1964) The nuclear battlefield in historical perspective. Mimeo, Bell Telephone Laboratories, Murray Hill, NJ.

Sandler, T. (2000) Economic analysis of conflict. In *The Journal of Conflict Resolution* **44**(4), edited by T. Sandler, 723-729.

Sandler, T. (1977) Impurity of defense: an application to the economics of alliances. *Kyklos* **30** (3), 443-460.

Sandler, T. and Hartley, K. (2001) Economics of alliances: the lessons for collective action. **39**(3), 869-896.
Schelling, T.C. (1966) *Arms and Influence*. New Haven, CT: Yale University Press.

Schelling, T.C. (1967) The strategy of inflicting costs. In *Issues in Defense Economics*, edited by R.N. McKean. New York: Columbia University Press, 105-127.

Seiglie, C. (2001) The effects of trade on military spending. Mimeo, Department of Economics, Rutgers University.

Skaperdas, S, (1992) Cooperation, conflict, and power in the absence of property rights. *The American Economic Review* **82**(4), 720-739.

Skaperdas, S. (1996) Contest success functions. *Journal of Economic Theory* **7**(3), 283-90.

Skaperdas, S., and Syropolous, C. (2002) Insecure property and the efficiency of exchange. *The Economic Journal*, forthcoming.

Snyder, G. (1961) *Deterrence and Defense*. Princeton, NJ: Princeton University Press.

Thompson, E. A. (1974) Taxation and national defense. *The Journal of Political Economy* **82**(4), 755-782.

Thompson, E. A. (1979) An economic basis for the "national defense argument" for aiding certain industries. *The Journal of Political Economy*, **87**(1), 1-36.

Tullock, G., 1974, *The Social Dilemma: Economics of War and Revolution*. Charlottesville, VA: Center for Study of Public Choice, University of Virginia.

Tullock, G. (1980) Efficient rent seeking. In *Toward a Theory of the Rent Seeking Society*. Edited by J. M. Buchanan, R. D. Tollison, and G. Tullock. College Station, TX: Texas A&M University Press, 3-15.

Wittman, D. (1991) Nations and states: mergers and acquisitions; dissolutions and divorce. *The American Economic Review Papers and Proceedings* **81**, 126-129.

Wittman, D. (2000) The wealth and size of nations. In *The Journal of Conflict Resolution* 44(4), edited by T. Sandler 868-84.

Wohlstetter, A. (1959) The delicate balance of terror. *Foreign Affairs* **37**(2), 211-34

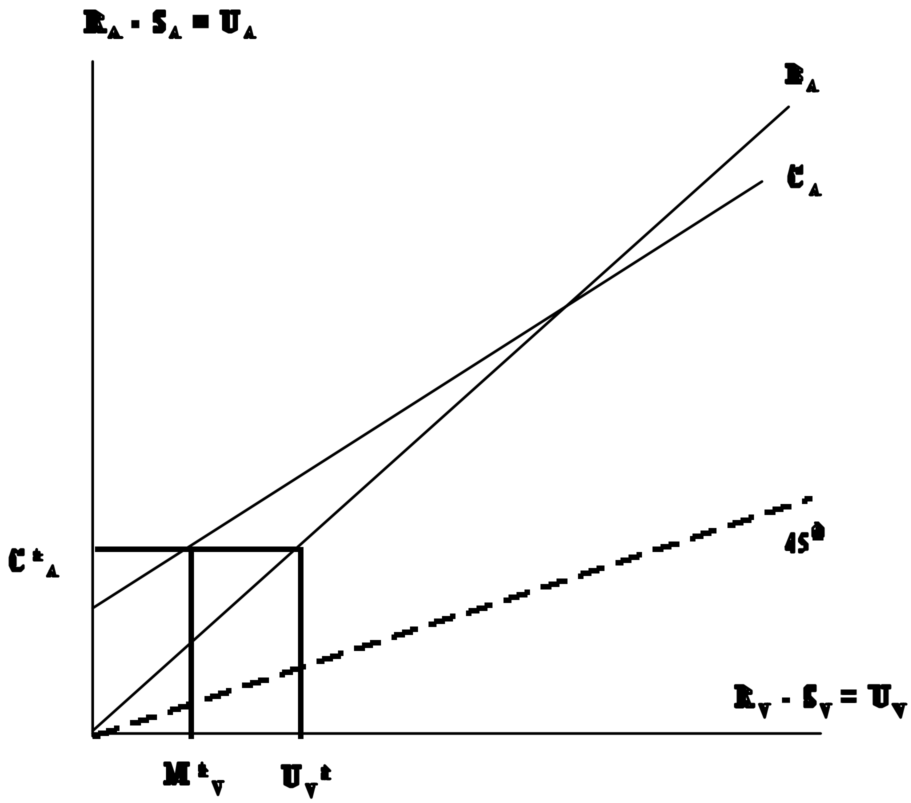


Figure 1

The Present Value Benefits and Costs to A of Conquering V:
V's Wealth as an Object of Theft and a Support of Defense

Figure 2a

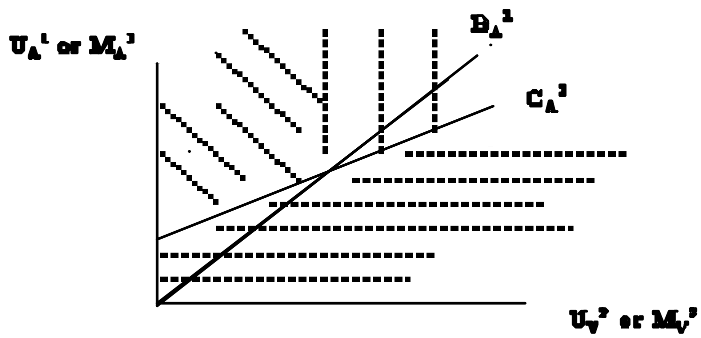


Figure 2b

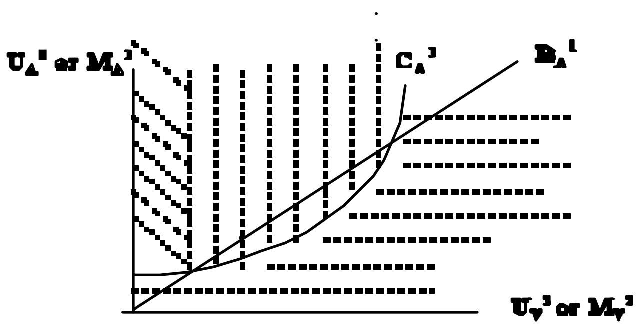


Figure 2c

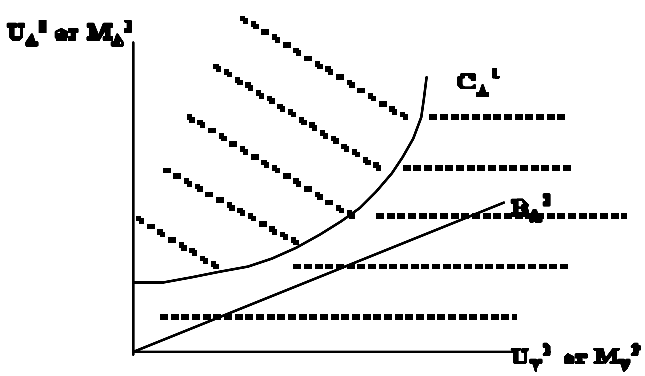


Figure 2

Alternative Present Value Benefit and Cost Configurations
Horizontal Stripes: A Incapable of Conquest
Vertical Stripes: A Capable of and Benefits from Conquest
Diagonal Stripes: A Capable but Conquest not Worth the Cost

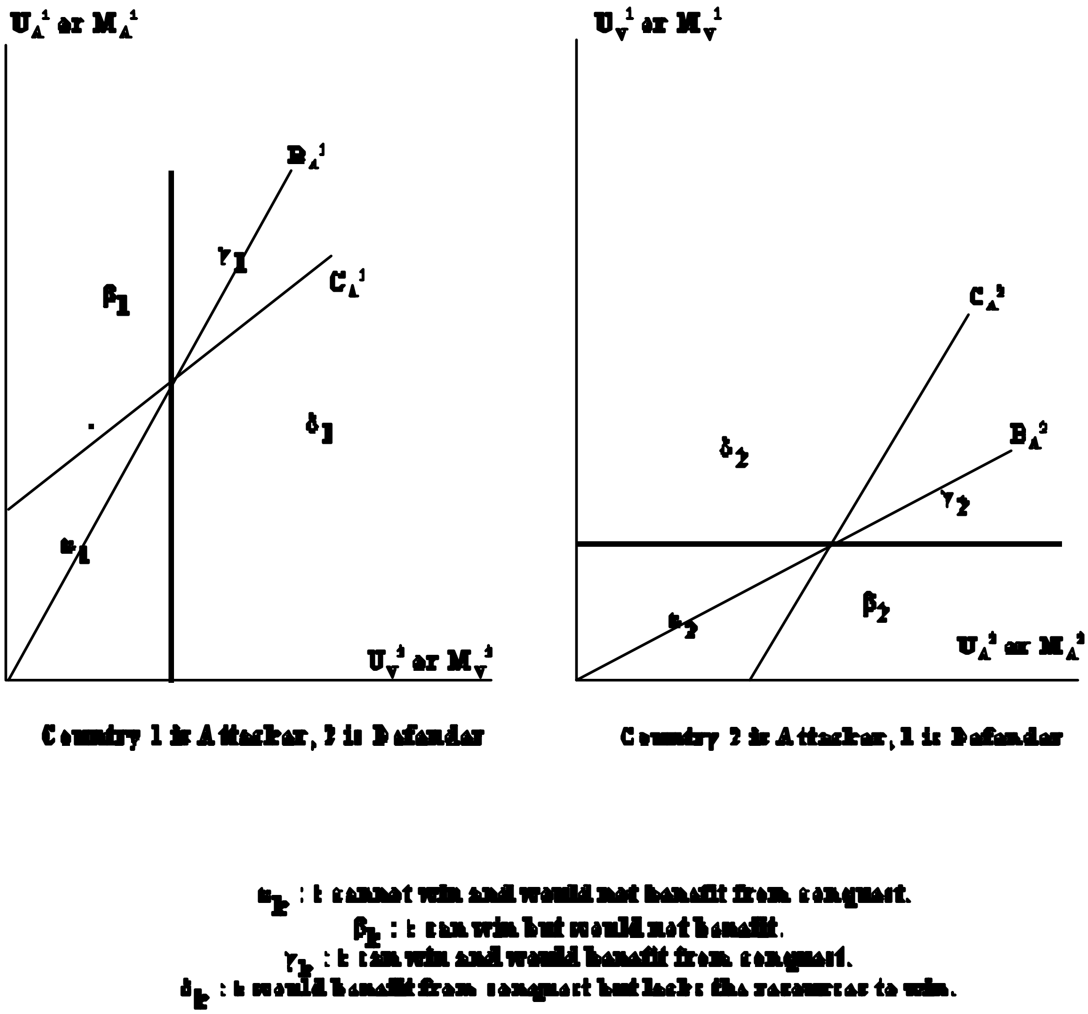
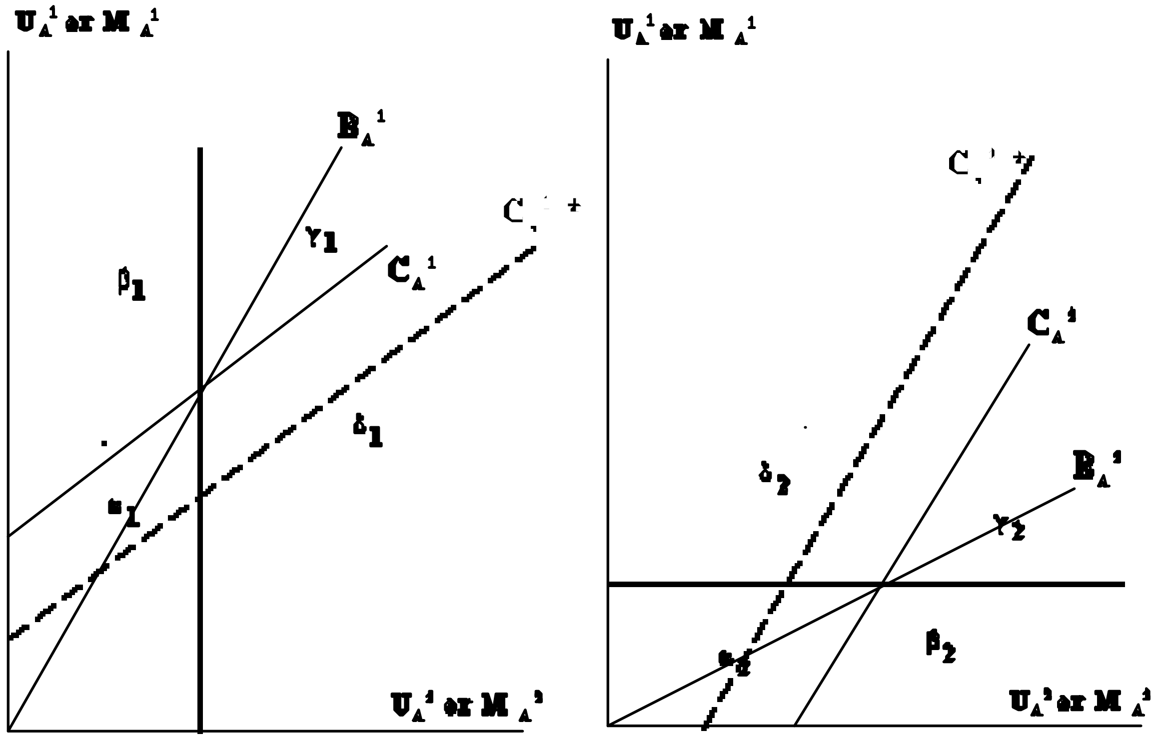


Figure 3

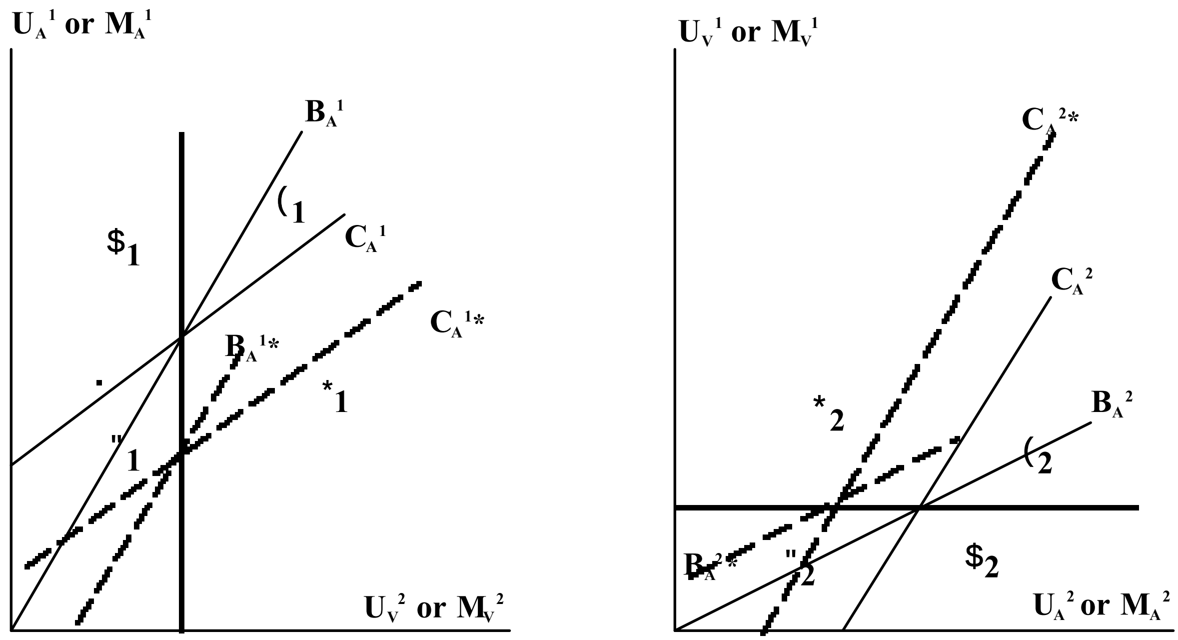
System Wide Safety against or Vulnerability to Attack
Depends on Aggregate World Resources and Their Distribution



Broken C_A^t curves show effects of inheritance of stockpiled weapons from past savings.
Areas α, β etc. change as explained in the text

Figure 4

The Effect of Past Stockpiles of Weapons on System Wide Safety against or Vulnerability to Conquest



Broken C_A and B_A curves (shown as C_A* and B_A*) give the effects of borrowing for war Areas α, β etc. change as explained in the text

Figure 5

The Effects of Borrowing for War on System Wide Safety/Vulnerability